University of Groningen

The ontology of determination, from Descartes to Spinoza

Sangiaco, Andrea

Published in:
Science in Context

DOI:
[10.1017/S0269889715000319](https://doi.org/10.1017/S0269889715000319)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2015

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Sangiaco, A. (2015). The ontology of determination, from Descartes to Spinoza. *Science in Context*, 28(4), 515-543. <https://doi.org/10.1017/S0269889715000319>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

The Ontology of Determination: From Descartes to Spinoza

Andrea Sangiacomo

University of Goningen, The Netherlands
E-mail: a.sangiacomo@rug.nl

Argument

This paper argues that Spinoza's notions of "conatus" and "power of acting" are derived by means of generalization from the notions of "force of motion" and "force of determination" that Spinoza discussed in his *Principles of Cartesian Philosophy* to account for interactions among bodies (impacts) on the basis of their degrees of contrariety. I argue that in the *Ethics*, Spinoza's ontology entails that interactions must always be accounted for in terms of degrees of "agreement or disagreement in nature" among interacting things. The notion of "power of acting" is used to express the extent to which a thing's conatus is aided or restrained by external causes on the basis of its degree of agreement or disagreement in nature with them. "Power of acting" generalizes the same approach and method of resolution at the basis of the notion of "force of determination" in order to account for causal interactions not only among the simplest bodies but also among more complex individuals.

Determinatio ad rem juxta suum esse non pertinet:
sed econtra est ejus non esse.
Spinoza to Jelles, 2nd June 1674 (Ep50)

1. Determination and Activity

In the third part of the *Ethics*, Spinoza demonstrates that "each thing, as far as it can by its own power, strives to persevere in its being" (E3p6).¹ This proposition serves as the cornerstone of the so-called "conatus" doctrine, upon which Spinoza bases his theory of affects and his moral philosophy. According to this doctrine, things actively strive to

¹ In quoting Spinoza's works, I use Spinoza 1994 for the *Ethics* and Spinoza 2002 for the other works. Main abbreviations are E = *Ethics*, PCP = *Principles of Cartesian Philosophy*; TTP = *Theological-Political Treatise*; Ax = Axiom, C = corollary, Def = definition, Dem = demonstration, L = Lemma, P = proposition, and S = scholium.

resist external causes and increase their “power of acting” (*potentia agendi*, E3p7dem). In fact, each thing “has the power [*potestas*] of bringing about certain things [*quaedam efficiendi*], which can be understood through the laws of [its] nature alone [*per solas ipsius naturae leges*]” (E4def8). However, Spinoza demonstrated in the first part that “every singular thing . . . can neither exist nor be determined to produce an effect unless it is determined to exist and produce an effect [*ad existendum, et operandum determinetur*] by another cause” (E1p28). Spinoza is surely committed to showing that finite things, unlike God, are never absolutely *free* but rather “compelled” in the sense that they are “determined by another to exist and to produce an effect in a certain and determinate manner” (E1def7). According to E1p28, the thing’s power of acting would be nothing but the power of external causes applied to a barely passive thing.

In this paper, I argue that Spinoza does not conceive of external determinations as a threat to the causal activity of finite things, but rather as what specifies how and to what extent each thing brings about its own effects. From this point of view, the thing’s “power of acting” should be understood as the thing’s *conatus* insofar as external causes increase or decrease its causal efficacy. I contend that Spinoza arrives at this notion of “power of acting” by generalizing the notion of “force of determination” that he introduced in his earlier *Principles of Cartesian Philosophy* (hereafter PCP) to deal with the problem of how the motive force of a body is modified during interactions with other bodies in the case of oblique collisions. By investigating how force of determination provides Spinoza with a model to design the concept of “power of acting,” the paper aims to improve our understanding of both the internal consistency of Spinoza’s ontology of power and how it is rooted in seventeenth-century natural philosophy.

Valtteri Viljanen recently argued that Spinoza’s ontology is based on the idea that things are essentially defined by their causal efficacy. He presents the problem of the compatibility between external determinations and a thing’s own activity in these terms:

Sometimes Spinoza writes as if finite things were exclusively externally determined; but many other passages imply that this is not his complete view. 2p29s expressly states that things are determined internally as well; moreover, . . . were this not so, many aspects of his ethical project would remain incomprehensible. So obviously such propositions as the famous E1p28 consider finite things *insofar as* they are determined externally, from the “common order of nature,” which, however, does not prevent them from being also, at least to some extent, internally determined, that is from existing and acting as determined by one’s own nature alone. (Viljanen 2011, 126; emphasis in the original)

I agree with Viljanen that we need to read E1p28 in a way capable of saving the consistency of Spinoza’s ontology by providing a “compatibilist” account of activity and external determinations. However, E1p28 clearly states that finite things are *always* externally determined since the first moment of their existence and whenever they operate. Should we assume a strict definition of activity by pretending that “acting as determined by one’s own nature *alone*” excludes any intervention of external

determinations, we would not be able to find any respect in which things are properly active. I argue that we can avoid this difficulty by treating Spinoza's account of power of acting as designed to deal with the manner in which external determinations and the thing's activity are composed together in every causal process.

The reading of determination I propose implies a reassessment of Spinoza's debt towards Descartes' physics as well. Over the last decades, scholars have evaluated in contradictory ways the debt of Spinoza's philosophy to early modern science. While in the second half of the twentieth century Spinoza was portrayed as exploiting the achievements of the "scientific revolution" when building his own system, recent literature has put such reading into doubt.² The majority of scholars who have aimed at showing the scientific relevance of Spinoza's thought have attempted to present Spinoza as a critic of Descartes.³ Conversely, scholars who pointed out the shortcomings of Spinoza's ontology often explained them as Spinoza's failed emancipation from Cartesian physics.⁴ Spinoza's *conatus* doctrine is a thorny point in this debate. Descartes' principle of conservation of the state of motion or rest does not seem to imply the same dynamic element embedded in Spinoza's notion of *conatus* (according to which a thing not only preserves its state but also strives to increase its power of acting).⁵ On the one hand, if Spinoza remained a Cartesian, the *conatus* principle would seem at odds with the guidelines of Descartes' physics. On the other hand, if Spinoza departed from Cartesian physics, it would be far from obvious that he was able to propose a fully consistent account of the activity of finite bodies. As Richard Manning summarized the issue: "Spinoza tried to develop an . . . account of bodies that both conformed to the mechanical principles of the Cartesian view and preserved the sense that bodies are centers of real activity; but his entitlement to that sense is hard to square with mechanism" (Manning 2012).

² For instance, Gueroult 1974, 159 and 171–175; *Appendice n° 5*, 555–559 argued that Spinoza derived his theory of individuation from Huygens' works on pendulums, while Klever 1988 and 1993 claimed that Spinoza was more a scientist than a philosopher. However, Parrochia 1984–5 and 1987 and Gabbey 1996 have shown the insufficiencies of Gueroult's thesis, while Moreau 1994, 283–287, has clarified the exaggeration of Klever's claims. According to Gaukroger 2006, 491, Spinoza's attempt to combine elements drawn from a mechanist physics with his *conatus* doctrine is fundamentally flawed from the point of view of seventeenth-century natural philosophy: "no one with an active commitment to natural philosophy could have considered the Spinozean proposal seriously It was simply ignored by natural philosophers, and it lacked any natural-philosophical legitimacy." Schliesser 2014 argues that the conception of Spinoza as actively influenced and involved in the development of the new seventeenth-century mechanical philosophy is misleading. Viljanen 2011, 34, further supports this reading by arguing that "the basic model of causation cannot be, for Spinoza, one adopted from the mechanical sciences." Viljanen actually revives the claim already put forward by Zac 1963, according to which Spinoza would have been more acquainted with the Renaissance predecessors of the scientific revolution than with its supporters. Against this reading, see Messeri 1990.

³ Rivaud 1924 was among the first who used this strategy, followed by (among others) Lachterman 1978; Adler 1996; Peterman 2012.

⁴ See, for instance, Hassing 1980; Gaukroger 2006; Manning 2012.

⁵ See, for instance, Lécivain 1977–78; Lachterman 1978; Klever 1988; Gillot 2004; Viljanen 2011, 105–112.

In the following, I argue that this apparent dilemma can be solved by examining more carefully Spinoza's rethinking of Cartesian physics as advanced by his PCP. Although this work remains Cartesian in its guidelines, I demonstrate how Spinoza's treatment of the concept of determination provides him with a conceptual tool that he will exploit in the *Ethics* to construct the notion of "power of acting." Accordingly, I begin with (§2) an outline of the meaning of Descartes' notion of determination and the problems connected to it in the *Principles*. I present then (§3) how Spinoza attempts to resolve these difficulties in his exposition of Descartes' *Principles* by introducing the concept of "force of determination." I conclude (§4) by discussing how the notion of "power of acting" in the *Ethics* is based on the same main features that characterize the "force of determination."

2. Determination in Cartesian Physics

In order to understand Spinoza's discussion of "force of determination" in his PCP, it is necessary to first outline the problems raised by Descartes' use of the concept of "determination" in his *Principles of Philosophy* (hereafter PP). It is far beyond the limits of this paper to provide a historical reconstruction of the sources of Descartes' use. As Alan Gabbey has shown, prior to Descartes the concept conveyed a variety of meanings connected with some kind of "specification."⁶ Descartes uses "determination" in physics⁷ in an analogous way to express what is measured, specified, or precisely delimited. A thing is "determined" insofar as we can express the actual way in which such thing stands in relation to others in a certain physical environment. In this sense, we can "determine" the distance of a body from others or the way in which it is located or moves among them.⁸

Nonetheless, Descartes uses determination in a more restricted sense to indicate the path (*via*) through which a body moves, that is, the directional aspect of its motion. Gabbey synthesizes this technical meaning by observing that determination is "the directional mode of the motive force" (Gabbey 1980a, 258).⁹ Although the body's

⁶ For instance, Gabbey 1980a, 249, notes that in Aquinas, "*determinatio* is a particular actualization or realisation of some general power, *determinatum* applies to what is specified or settled in some sense."

⁷ Descartes uses the term "determination" also in his metaphysics to express, for instance, the fact that the intellect determines the will or the will determines itself to act in a certain way (see, e.g., the fourth *Meditation*, CSM2, 40–42). Despite the different context, this use of "determination" seems to overlap with the use of the same term in the physical domain by expressing the way in which the power of the will of affirming or denying is applied to certain ideas. Spinoza stresses the strict analogy between physics and psychology by pointing out that the mind's "decision" is nothing but the mental counterpart of the "determination of the body" (E3p2s).

⁸ Cf. PP2, 13 (translated in Descartes 1983, 45).

⁹ Descartes expressly claims that determination is only modally distinct from motion in his reply to Hobbes *via* Mersenne (21 April 1641, AT III, 355–356) and to Clerselier (17 February 1645, AT IV, 185). On Descartes' account of modal distinction, see PP1, 61 (reproduced by Spinoza in CM2, 5) and the comments provided by Hoffman 2001.

motion must always point in a certain direction, the fact that the body has a certain quantity of motion does not imply that it will move in one direction or in another. Determination is a *mode* in the sense that it specifies the direction in which the body actually moves. Insofar as determination is a mode of motion, and motion is quantifiable, we expect that determination is quantifiable as well. However, here problems begin.

Scholars have often commented on the difficulties of Descartes' treatment of determination as a quantity. As Daniel Garber put the issue, "even though determination is a quantitative notion, Descartes proposes no general *quantitative* law to govern the changes that can occur in determination" (Garber 1992, 192).¹⁰ I would like to suggest that (at least part of) the problem depends on the modal nature of determination. On the one hand, insofar as it is a mode, determination seems accidental to the motive force and can then be treated independently from it. On the other hand, determination must somehow depend on the motive force without which it could not be conceived. For present purposes, I would like to focus on how this tension emerges in the context of Descartes' account of the laws of nature in the second part of the *Principles* (which will be the starting point of Spinoza's own discussion).

According to the first law (L1), each body strives to persevere in its own state, motion or rest, figure, shape, or size. This implies that changes in the body's state arise only from external causes acting upon the body. In this sense, L1 considers the body not only as "simple and undivided" ("quatenus est simplex et indivisa," PP2, 37; AT VIIIa, 62), but also insofar as "it is considered only in itself" ("et in se sola consideratur," PCP2, p14), as Spinoza will point out. Determination does not depend on the body considered in isolation because it expresses the way in which the body moves among other bodies. It follows that L1 does not imply a conservation of determination.

It is the second law of nature (L2) that addresses this aspect by stating:

Every piece of matter, considered in itself, always tends [*tendere*] to continue moving, not in any oblique path but only in a straight line. This is true despite the fact that many particles are often forcibly deflected by the impact of other bodies Clearly whatever is in motion is determined [*determinatum*], at the individual instants which can be specified as long as the motion lasts, to continue moving in a given direction along a straight line, and never in a curve. (PP2, art. 39)

Consider Descartes' example of a stone revolving about the center of a sling. L2 affirms that the stone is determined to continue its motion along the tangent, and it would move that way if the sling let the stone go.¹¹ This rectilinear tendency does not depend

¹⁰ See also Gabbey 1980a, 256–257; Jullien 2011.

¹¹ While Descartes uses the verb "tendere" in PP2, 39, he employs "conari" in PP3, 56. Garber 1992, 219–220, proposes distinguishing between determination and tendency. He conceives of determination as the real actual directional aspect of a motion (or a component of it), while tendency would be only "motion in potentiality." However, the text of PP2, 39, just quoted continues by saying "indeed, our hand can even feel this while we are turning the stone in the sling, <for it pulls and stretches the rope in an attempt to move away from our hand

on the specific quantity of motion that the stone has, and the force with which the sling deflects the stone from its rectilinear path does not affect such tendency. Although, later in the *Principles* (PP3, 55–60),¹² Descartes will attempt to derive the cause of light from this rectilinear tendency, it does not seem to imply (*prima facie* at least) anything more than a merely geometrical or directional aspect of motion.

While L1 deals with the state of a body (size, motion, or rest) but not with determination, L2 deals with determination in a way that seems completely independent of the size and speed of the moving body or the other bodies acting upon it. By presenting L1 and L2 as two distinct laws, Descartes reinforces the impression that the state of a body and its determination are two rather distinct features. Determination would be a mode of motion in the sense that it is accidental to it and can be treated apart from the quantity of motion. However, if determination were a mere directional or geometrical element of motion, it would be hard to see how it could have any physical effect whatsoever. As Peter McLaughlin observed, “if determinations are taken as directions or as *projections* of motions on lines of direction, they could not be part of any causal explanation of anything” (McLaughlin 2000, 93; emphasis in the original).¹³

The third law of nature (L3) suggests a closer relation between the body’s quantity of motion and its determination. It establishes that

When a moving body collides with another, if its power [*vis*] of continuing in a straight line is less than the resistance of the other body, it is deflected so that, while the quantity of motion [*motum*] is retained, the direction is altered [*determinationem amittit*]; but if its power of continuing is greater than the resistance of the other body, it carries that body along with it, and loses a quantity of motion equal to that which it imparts to the other body. (PP2, 40)

The output of impacts among bodies equilibrates their reciprocal contrarieties. As Gabbey notes, Descartes endorses a view that was common at the time whereby “interactions between bodies were seen as contests between opposing forces, the

in a straight line>.” Therefore, the tendency to move along a straight path is not a “motion in potentiality” (in the sense that it is not actualized) because it produces a real effect, such as the stretching of the rope.

¹² Descartes attempts to derive from the tangential tendency prescribed by L2 a tendency along the normal, which is necessary to identify the cause of light with the pressure upon the ethereal matter of the heavens that stars’ revolution produces. Moreover, in PP3, 59 he suggests that the body will strive to recede from the center of revolution in proportion to the speed of the revolution itself. However, these claims raise several worries. Henry More already doubted that any pressure along the normal might be deduced in Descartes’ account (see More to Descartes, 23 July 1649 in AT V, 386). For further discussion of this point, see the commentary by Rodger and Miller in Descartes 1983, 113, note 55; Garber 1992, 223; Shea 1996; Roux 2006.

¹³ Jacques Rohault summarizes Descartes’ use of “determination” by asserting (Rohault 1671, chap. 13, 100): “quand un corps se meut vers quelque costé, cette disposition qu’il a à tendre vers ce costé-là plustost que vers un autre, est ce qu’on nomme sa détermination.” Although the use of the term “disposition” might square with Descartes’ account of the rectilinear tendency stated by L2, Descartes’ use of “determination” applies to bodies actually moving in certain directions and not merely “disposed” to move in that way. As suggested by Damerow et al. [1991] 2004, 131, in Rohault’s presentation, determination “came to mean simply *direction*.”

larger forces being the winners, the smaller forces being the losers” (Gabbey 1980a, 243). According to L3, the stronger body affects the weaker by imposing its own determination as well. This implies that the stronger body has also a greater determination to continue in its own direction. Because bodies are stronger or weaker depending on their “force of motion” (*vis*), Descartes observes the following:

We must be careful to note what it is that constitutes the power [*vis*] of any given body to act on, or resist the action of another body. This power consists simply in the fact that everything tends, so far as it can, to persist in the same state, as laid down in our first law. Thus . . . what is in motion has some power of persisting in its motion, i.e. of continuing to move with the same speed and in the same direction [*eandem partem*]. An estimate of this last power must depend firstly on the size of the body in question and the size of the surface which separates it from other bodies, and secondly on the speed of the motion, and on the various ways in which different bodies collide, and the degree of opposition involved. (PP2, 43)

Descartes presents force of motion as a consequence of L1, that is, of the preservation of the state with which the body maintains its own motion unless acted upon by a stronger body. Descartes claims that force of motion can be quantified in terms of “quantity of motion,” i.e. size times speed. He notes that “what is in motion has some power of persisting in its motion, i.e. of continuing to move with the same speed *and* in the same direction.” This suggests that force of motion also quantifies determination in the sense that a body will maintain or lose its determination depending on whether and to what extent it is stronger or weaker than the impacting body. The seven rules of impact following L3 confirm this claim by stating that whenever a body is stronger it maintains its determination and changes the determination of the other colliding body.

At first glance, this reading does not raise problems insofar as Descartes’ discussion of L3, and the rules of impacts deal with collinear impacts in which the bodies’ determinations are always defined along the same line. Problems arise instead if we try to apply this view to the case of oblique collisions. Although Descartes does not address oblique collisions as such in his *Principles*, he deals with a similar case in the second discourse of the *Dioptrique*. In order to demonstrate the laws of reflection and refraction, Descartes discusses the impact of a body on a certain surface (that can be considered as a larger body at rest) at a certain angle. To deal with this case, Descartes proposes to resolve the motion of the impacting body in its components. In fact, “not only the determination to move in a certain direction but also the motion itself, and in general any sort of quantity, can be divided into all the parts of which we can imagine that it is composed” (Descartes 1983–84, 157). However, should we take these components (according to the parallelogram rule) as expressing the distribution of the body’s quantity of motion along different directions, we would

obviously violate the principle of conservation of the quantity of motion (because the quantity of the components will be greater than the quantity of the resultant). To rephrase the issue in Gabbey's words: "as a directional feature of motion subject to the parallelogram rule, Descartes' *determination* has to be accommodated to his 'non-vectorial' conservation law" (Gabbey 1980a, 254).¹⁴ Nonetheless, it remains problematic how this accommodation can be worked out.

In the *Dioptrique* this problem is defused by bracketing the impacting body's quantity of motion (and thus by considering changes in its speed as arbitrary) in order to focus on how the determination is modified in the case of reflection and refraction. Nonetheless, readers were puzzled by this solution and tried to understand whether motion and determination should then be clearly distinguished (as Fermat asserted) or not at all (as Hobbes contended) from motion itself.¹⁵ Descartes disagrees with both approaches. In the first case, we remain with a purely geometrical notion of determination that, as noted above, turns out to be of little or no use in the explanation of physical phenomena. In the second case, we face the difficulty of reconciling directional and arithmetical aspects of determination.

In order to solve this dilemma it is necessary to explain how determination, as a *mode*, can depend on the force of motion without getting ensnared by the above-mentioned difficulties. This is exactly the task Spinoza undertakes by introducing the concept of "force of determination" in his PCP.¹⁶

3. Spinoza's "Force of Determination"

In PCP2, p27 Spinoza presents the third rule of impact, according to which "if A and B are equal in size¹⁷ but B moves a little faster than A, not only will A be reflected in the opposite direction, but also B will transfer to A half the difference of their speeds, and both will proceed to move in the same direction at the same speed." Because A and B have different speeds (and thus different forces),¹⁸ the contrariety between their motions will be eliminated by redistributing the excess of motion in equal parts between them. Because B has a greater quantity or force of motion it will impose its own determination on A. This suggests that the greater the quantity of motion, the greater the force with which the body will impose its own determination over the

¹⁴ On the same point, see also McLaughlin 2000, 90–97.

¹⁵ Concerning Fermat's critiques, see AT I, 357–359; 452; 465–468; AT II, 17–20; concerning Hobbes' critiques, see AT III, 288; 303–307; 320–326. For an overview on these debates, see Sabra 1967, 69–135; Damerow et al. [1991] 2004, 120–127.

¹⁶ Concerning the many others points in which Spinoza attempts to improve or modify the original text of Descartes' *Principles*, see Gabbey 1996, 155–166.

¹⁷ I correct the translation proposed by Spinoza 2002 of the Latin "moles" with "mass." In the context of Cartesian physics, in which bodies are defined through geometric extension, I find "size" more appropriate.

¹⁸ Cf. PCP2, p22: "vis sive motus."

other. In the case of bodies equal in size, this means that “the greater the speed of a body, the more it is determined to move in the same straight line, and conversely, the more slowly it moves, the less its determination” (PCP2, P27c). Although this claim suggests that determination is quantified by force of motion, Spinoza emphasizes that this does not imply that the “force of determination” is always equal to the force of motion.

The scholium of P27 addresses this issue by discussing the case of oblique collisions in which the two forces must be distinguished.¹⁹ The core of Spinoza’s argument goes as follows:

I think it advisable to add a few words wherein the force of determination is explained as distinct from the force of motion. If bodies A and C are conceived as equal and moving in a straight line toward each other at equal speed, these two bodies (Prop. 24 Part 2) will be reflected in opposite directions, each preserving its own motion undiminished. But if body C is at B, and moving at an oblique angle toward A, it is clear that it is now less determined to move along the line BD or CA. So although it possesses motion equal to A’s, yet the force of C’s determination when it moves from directly opposite toward A – a force that is equal to body A’s force of determination – is greater than C’s force of determination when it moves from B toward A; and it is greater in proportion as the line BA is greater than the line CA. For in proportion as BA is greater than CA, so much more time does B require (with B and A moving at the same speed, as is here supposed) to be able to move along the line BD or CA, along which it opposes the determination of body A. (PCP2, p27s)

¹⁹ At the time Spinoza published his PCP, Huygens already worked out his account of the rules of impact in his *De motu corporum ex percussione* (written in 1656), although this work was not published until 1703 and did not address the case of oblique collisions. Huygens’ rules are significantly different from Descartes’ but Spinoza did not seem convinced of their validity even after the publication of the PCP (see Ep30a, dated 1665, and Sangiacomo 2013b, 271–278). Descartes claims in PP2, 53 that his rules of impact apply to bodies that are perfectly “hard” in the sense that they are not at all deformed by the impact (if this condition is not obtained, the bodies will behave differently, see Descartes to Mersenne, 26 April 1643, AT III, 652–653). Spinoza followed Descartes also on this point. However, Descartes’ “hard bodies” behave like they were perfectly “elastic” insofar as Descartes’ third law admits the conservation of the quantity of motion. In reality, however, perfectly elastic collisions would have different outputs from what was prescribed by Descartes’ rules of impacts, as shown by Huygens in his *De motu*. On Huygens’ account of collisions, see Gabbey 1980b and Erlichson 1997.

Spinoza proposes to resolve the motion of the body moving obliquely along BA into two components, BC and BD (equal to CA).²⁰ This resolution shows that the two colliding bodies are opposed only insofar as they both proceed along the direction CA. If we assume that the two bodies are equal in both size and speed, then we must conclude that they have the same force of motion. However, this does not imply that they have the same force of determination as well. The body moving from B, with the same force of motion as the body moving from A, will move more slowly along BD. This is because if the two bodies move with equal speed respectively along AC and BA, the body moving along BA will arrive later than the one moving along AC because “the line BA is greater than the line CA.” In other words, the body moving from B will cover BD or CA in more time, that is, it will move more slowly along CA than the body moving directly from C to A. Accordingly, the force of motion of the body moving from B will be relatively smaller, along the component BD or CA, than the force of motion of the body moving directly from A to C – i.e., it will be relatively weaker in its determination along CA. For this reason, the more that BA is longer than CA, the more the force of determination of the body moving from B is weaker than the force of determination of the body moving straight from C to A. Conversely, to have the *same* force of determination, the body moving from B to A must have a speed greater than that of the other body and greater insofar as BA is longer than CA.

Instead of making determination independent of the quantity of motion (Damerow et al. [1991] 2004, 131), Spinoza’s account implies that the force of determination is equal to the body’s speed (or, more generally, to its force of motion) along the component opposed to the motion of the colliding body. In the case of collinear impacts, bodies are totally opposed to each other, and thus force of motion and force of determination are not distinguishable. However – and this is the point of the whole scholium – these two forces must be distinguished insofar as bodies can be only partially opposed, that is, only along certain components of their motions, as it happens in the case of oblique collisions.

While force of motion expresses an absolute quantity, insofar as it depends on the body’s size and speed alone, the force of determination can be quantified only with respect to the degree of opposition to the motion of another colliding body. In Spinoza’s diagram, different forces of determination can be applied along the same lines BD or CA depending on the speed of the body moving from B. From this point of view, the length of BD or CA does not represent the quantity of the force of determination as such. Nonetheless, the proportion between the lines BA and CA expresses the degree of opposition between the two bodies because “in proportion as BA is greater than CA, so much more time does B require . . . to be able to move along the line BD or CA.” It follows that the proportion between the whole force of motion of a body and its force of determination in a certain direction is the same as the

²⁰ It should be observed that Spinoza’s diagram is very similar to that used by Descartes in the second discourse of the *Dioptrique* to deal with the case of reflection. Cf. AT IV, 93, CSM1, 157.

proportion between the whole trajectory and the component of this trajectory along which the body is opposed to the colliding body.²¹ In other terms, it might be said that $FD_B:FM_B = CA:BA$ (assuming “FD” as “force of determination” and “FM” as “force of motion” of the body moving from B).²² In this way, Spinoza acknowledges a dependency between scalar and directional aspects of motion without merging them, and thus without incurring the difficulty discussed in the previous section.²³

This result is exemplified at the end of PCP2, p27s. Spinoza claims that if the body moving obliquely is stronger, the redistribution of the quantity of motion will be proportional to the extent to which BA is greater than CA. This is an implementation of the third rule of impact stated in P27 in the case of an oblique collision:

If the excess of B over A is more than the excess of the line BA over the line CA, then B will repel A toward A', and will impart to it as much of its motion as will make the ratio of the motions of B to A the same as the ratio of the line BA to the line CA, and losing as much motion as it has transferred to A, it will proceed to move in its original direction. For example, if the line AC is then to the line AB as 1 to 2, and the motion of body A is to that of the body B as 1 to 5, then B will transfer to A one degree of its motion and will repel it in the opposite direction, and B with four remaining degrees of motion will continue to move in its original direction. (PCP2, P27s: 167)

In the case of collinear impacts among bodies equal in size but with different speeds, the third rule prescribes that the stronger body will retain its determination by reversing the determination of the other body and that it will transfer half of the excess of its quantity of motion in order to restore the equilibrium. In the case of oblique collisions, Spinoza's solution implies the same output concerning the determinations of the two bodies after the impact but modifies the way in which we have to calculate the quantity of motion that must be transferred.

According to Spinoza's account, if the excess of B's quantity of motion over A is more than the excess of BA over CA, then the body moving from B is stronger and

²¹ In this way, Spinoza seems to follow a suggestion made by Descartes in a Letter to Mersenne dated 26 April 1643. In the case of a larger body impacting obliquely a smaller body at rest, Descartes claims (without providing further explanation) that the speeds of the impacting bodies after the collision stay in the same proportion as the trajectories along which they move. See AT III, 651–652: “la proportion qui est entre les lignes CF et CE [i.e., in Descartes' diagram, the trajectories of bodies B and C after the collision], est la même qui serait entre la vitesse des boules B et C.” The physical scenario is analogous to that of Rule 5 but implemented in the case of an oblique collision. For a detailed commentary of Descartes' treatment, see Damerow et al. [1991] 2004, 128–130. It should be noted that this letter was published in the second volume of Descartes' correspondence published by Clerselier in 1659, and it was thus available when Spinoza published his PCP in 1663.

²² We could express the relation between CA and BA through the cosine of the angle BAC (which is the angle of incidence). In this case, we would obtain that $FD_B = FM_B \cos(BAC)$. This implies that $FD_B = FM_B$ in case of collinear impacts, i.e., when $\cos(BAC) = 0^\circ$.

²³ According to Gabbey 1996, 162, Spinoza's “solution is incorrect and confused” (Manning 2012 reiterates the same judgment). While this might be true from the point of view of post-Cartesian physics, I would like to stress that Spinoza's solution is perfectly understandable from a Cartesian point of view.

has a greater force of determination than the body moving from A. It still follows that the stronger body (B) will maintain its determination while the weaker body (A) will continue in the opposite direction (i.e. toward A'). Nonetheless, the opposition between the forces of determination of the two bodies will be eliminated not through a transfer of half of the excess of the quantity of motion of B over A, but rather by restoring the proportion between their forces of motion and their trajectories. This implies that the equilibrium will be restored as soon as the two colliding bodies acquire the same force of determination. As Spinoza explains in his example, let us assume that $AC:AB = 1:2$ while $FM_A:FM_B = 1:5$. The equilibrium will be restored if the proportion between FM_A and FM_B is the same as the proportion between AC and AB, that is, a proportion of 1 to 2. This can be easily achieved by transferring one degree of speed from B to A with the result that $FM_A:FM_B = 2:4$, which is the same proportion of AC and AB.²⁴

Collinear impacts can be viewed as particular cases of oblique collisions in which the proportion between the trajectories along which the bodies are opposed is the same as the proportion between their quantities of motion. In other words, in collinear impacts the whole quantity or force of motion of a body is opposed to the whole quantity or force of motion of the other. In all the other cases, what must be equilibrated is not the difference between the forces of motion but rather between the forces of determination of the two bodies, insofar as the force of determination expresses the degree of opposition among the colliding bodies. Indeed, in oblique collisions, we need to consider not only the excess in the quantities of motion of the two bodies but also the proportion among the components along which they are opposed. It follows that oblique collisions require a transfer of motion smaller than what would be required in the case of collinear impacts, insofar as the opposition between the bodies in oblique collisions concerns only part of their motion or force. For instance, in the case at stake in PCP2, p27s, rule three would prescribe a transfer of two degrees of speed from B to A, that is half of the excess of 5 over 1, while in case of an oblique collision the transfer is of just one degree of speed from B to A.²⁵

I would like to conclude this analysis of Spinoza's treatment of force of determination by stressing its two main features. First, force of determination expresses a part of the force of motion proportional to the degree of opposition with the colliding body. In this

²⁴ By applying the proportion $FD_B:FM_B = CA:BA$, we can derive that, before the impact, $FD_A = FM_A \cdot (AC:CA) = 1$, while $FD_B = FM_B \cdot (CA:BA) = 5/2$. After the impact $FD_A = 2$, and $FD_B = 4/2 = 2$.

²⁵ This discrepancy in the result of impacts in case of collinear or oblique collisions is justified by the fact that Spinoza demonstrates in PCP2, p23, as an immediate consequence of the principle of conservation of the state (PCP2, p14), the "principle of least modal mutation," introduced by Descartes only in a letter to Clerselier dated 17 February 1645 (AT IV, 183–188). In the case of oblique collisions, Descartes' third rule would imply a change greater than that prescribed by Spinoza's solution. For further discussion concerning PLMM, see (about Descartes' use of it) Gabbey 1980a, 263–270, Garber 1992, 242–248; and (about Spinoza's treatment) Gabbey 1996, 162–164.

sense, force of determination is not defined by the nature of the body alone (as force of motion is), but rather by the degree of contrariety among the motions of the impacting bodies. Force of determination is distinguished from force of motion as a mode of it, in the same way in which, according to Descartes, determination itself is modally distinguished from motion. The modal nature of force of determination is important to understand how it can depend on force of motion without being strictly identical to it. Second, in order to deal with this contrariety we need to resolve the motion of the bodies into their components. The body's force of determination depends on the proportion between the body's trajectory as a whole and the component of its trajectory along which it is opposed to the colliding body. In oblique collisions, bodies are never totally opposed but they oppose each other only along certain components.

4. From the Force of Determination to the Power of Acting

As the previous section shows, Spinoza introduced his notion of "force of determination" in order to explain the way in which determination depends on motion as a *mode*, without stumbling into the difficulties that affected Descartes' position. By developing an account of oblique collisions, Spinoza significantly broadened Descartes' account of impacts and refined a method to deal with interactions among colliding bodies on the basis of the degree of opposition among their components.

In this section, I contend that Spinoza's ontology in the *Ethics* entails that causal interactions must always be understood on the basis of the degree of opposition among the interacting things. Nonetheless, in the *Ethics*, the degree of opposition is rephrased in more general terms as a degree of "agreement or disagreement in nature" among things. On this basis, I argue that Spinoza derives the notions of "conatus" and "power of acting" from those of "force of motion" and "force of determination" by means of generalization, in order to account for causal interactions not only among the simplest bodies but rather among things in general. In so doing, Spinoza imports in the *Ethics* the two main features of his notion of "force of determination" that I outlined at the end of the previous section, namely, the fact that it expresses how a certain causal network modifies a thing's force and the necessity to implement a method of resolution in order to analyze causal interactions.

To support this reading, I first provide (4.1) an outline of how causal interactions must be understood in the *Ethics*. Then (4.2) I describe how conatus and power of acting must be conceived of as generalizations of the notions of force of motion and force of determination before. I explain (4.3) how this reading helps us address the problem raised at the beginning of this paper concerning Spinoza's account of activity and its compatibility with his claim that every thing is always determined by external causes. To conclude (4.4) I highlight the advantages of my proposed reading for our understanding of both the conceptual and historical meaning of Spinoza's account of causal interactions.

4.1. Spinoza's account of causal interactions in the *Ethics*

In order to appreciate how Spinoza reworks his account of “force of determination” in the *Ethics*, it is important to briefly recall the general framework in which interactions among things have to be understood in the context of Spinoza's mature ontology. First, in the *Ethics*, finite things are nothing but modes of God's substance, and they can causally interact only insofar as they are expressed under the same attribute (E3p2). From this point of view, when two things interact with each other, they always share some aspect of their own nature (at least their being modes expressed under the same attribute). Second, finite things are defined by different individual essences, which define various properties and causal powers that individual things have. This entails that insofar as different things are essentially determined to bring about incompatible effects, these things will also be “contrary” in nature. Both these claims have crucial consequences for Spinoza's account of causal interactions.

The claim that interacting things always share at least a common attribute is at the core of Spinoza's account of “common properties” developed in the second part of the *Ethics* (E2p38–39; Gueroult 1974, 345–347), upon which he constructs his account of “common notions” and the definition of reason (E2p40s2). Spinoza later introduces the notion of “agreement in nature” [*natura convenire*]²⁶ in order to quantify the extent to which things can share common properties. The degree of agreement in nature between two things depends on two factors. The first is the essence belonging to each thing: the more similar are the essences of the two interacting things, the greater the number of common properties they will share. The second factor is the way in which the two things are determined to operate: the more two things are determined to bring about compatible effects (i.e. the more they are determined to operate on the basis of their common properties), the more they agree in nature. For instance, from the point of view of their essences, a human being and a stone will have a lower degree of agreement in nature than two human beings, although two human beings can often disagree in nature insofar as they are determined to operate on the basis of different passions (E4p31–34).

Although finite things always share at least *some* minimal degree of agreement in nature, the notion of “contrariety” among their natures is no less important. Spinoza states that “things are of a contrary nature, that is, cannot be in the same subject, insofar as one can destroy the other” (E3p5). This proposition is crucial for Spinoza's demonstration that a thing, insofar as it strives to persevere in its own being, cannot strive to destroy itself, since its own being cannot entail the production of any effect against the thing's own being (E3p6dem). Yet, this notion of contrariety is also critical to understand why *external* causes (i.e. other things) can limit and restrain the thing's

²⁶ In the *Ethics*, Spinoza consistently uses the Latin “convenire” and “convenientia” to express agreement in nature; see e.g. E4p32dem. For the opposite expression, “natura discrepare” or disagreement in nature, see e.g. E4p33.

conatus (E4p3–4) and ultimately lead to its destruction (E3p8dem; E4p20s). Also, in this case two factors determine the degree of contrariety or disagreement in nature among finite things. On the one hand, the more two things are defined by contrary essences (i.e. essences that define causal powers that immediately exclude the existence of the other thing), the less they will be able to agree in nature. On the other hand, the more two things are determined to operate on the basis of what they do *not* share (e.g. different essential properties, or different external causes operating on them), the more they will disagree in nature.

It follows that in Spinoza's ontology interactions among things is understood as interactions among finite modes that neither totally disagree in nature nor totally agree in nature. The general problem raised by this view is that of finding a way to deal with these interactions by taking into account different degrees of agreement or disagreement in nature. Consider, however, that finite modes are always expressed also as bodies since every thing is also expressed by the attribute of extension. Translated into physical terms and restricted to the case of the simplest bodies, the problem of causal interactions in the *Ethics* is thus identical to that addressed in PCP2, 27s. In that scholium, Spinoza established that contrariety among impacting bodies is a matter of degree, and in order to calculate the result of an impact (which is the only way in which the simplest bodies can causally interact) it is necessary to assess the extent to which the different components of the bodies' movements are contrary to each other. In the *Ethics*, Spinoza faces the same problem but at a more general level, by addressing the case of interacting bodies that can be defined not just by the components of their motion but also by complex physical structures defined by complex essences (see the definition of individual after E2p13s). As we shall see in the next section, Spinoza's solution consists in generalizing the notions of "force of motion" and "force of determination" in order to apply them to every mode of God's substance.

4.2. *Conatus and power of acting*

After having stated that "each thing, as far as it can by its own power, strives to persevere in its being" (E3p6), Spinoza goes further by demonstrating that "the striving by which each thing strives to persevere in its being is nothing but the actual essence of the thing" (E3p7). The demonstration runs as follows:

From the given essence [*essentia data*] of each thing some things necessarily follow (by IP36), and things are able [to produce] nothing but what follows necessarily from their determinate nature (by IP29). So the power of each thing, *or the striving by which it (either alone or with others) does anything [potentia sive conatus, quo . . . quidquam agit]*, or strives to do anything—that is (by P6), the power, *or striving [potentia, sive conatus]*, by which it strives to persevere in its being, is nothing but the given, *or actual*, essence of the thing itself, q.e.d. (E3p7dem)

In E3p7, Spinoza argues that when the thing's essence is instantiated in existence it exists as a *conatus* to bring about what follows from the causal disposition embedded in it.²⁷ From E3p6 and p7 it follows that the thing's *conatus* depends on the thing considered in itself and "as far as it can by its own power" ("quantum in se est").

In the case of a simplest body, defined by a certain speed and size, the body's *conatus* would consist in its persevering in the same quantity of motion, and this is what is expressed in the context of Cartesian physics by the "force of motion." From the point of view of the *Ethics*, the notion of "*conatus*" has a more general meaning than "force of motion," insofar as the former expresses the fact that each thing (independent of the attribute by which it is expressed) strives to bring about those effects that follow from its own essence (which might be much more complex than that of a simplest body). Nonetheless, the simplest instance of *conatus* in physics is the effort of a simplest body (which is the simplest kind of "thing" admitted by Spinoza's ontology) to persevere in its own quantity of motion (size times speed). Moreover, the thing's *conatus*, as the force of motion, does not depend on external causes and is defined only on the basis of the constitutive features of the thing itself. From this point of view, both force of motion and *conatus* express the fact that a thing is equipped with some intrinsic force through which it is able to persevere in its own being.

In E3p7dem Spinoza also clarifies that the thing's *conatus* implies a "power of acting." He often equates "power of acting" and "*conatus*"²⁸ because the thing's power of acting expresses the thing's ability to produce those effects that follow from its determinate nature. Although the power of acting cannot be conceived of apart from the thing's *conatus*, these two concepts express the thing's activity in two different ways. While the thing's *conatus* expresses what the thing can do "as far as it can by its own power," the "power of acting" expresses the thing's *conatus* insofar as it is determined by external causes that aid or restrain it.

Since in Spinoza's ontology every thing is expressed under the attribute of extension, I shall clarify his account of power of acting by considering how this notion applies to the cases of simplest bodies and individuals. Simplest bodies are the simplest modifications of God's substance expressed under the attribute of extension. According to Spinoza, even the simplest bodies agree in nature to some extent (L2 after E2p13s). Yet, they can change the state of motion or rest of other bodies only insofar as they are determined in contrary ways. As Spinoza explains, "a body in motion moves until it is determined by another body to rest; and that a body at rest also remains at rest until it is determined to motion by another" (L3c after E2p13s). A body in motion cannot

²⁷ Spinoza equates "given essence" and "actual essence." Although the expression "actual essence" (which will appear again only in E4p4dem) might puzzle the reader, Spinoza often uses "actual" in conjunction with "existence" to stress the existence of the body as it exists in duration (see E2p11; 3p11s; 3 General Definition of Affects, expl.; 4p4dem; 4p21Dem, 4p23Dem and S; 5p29 and S). Because the adjective "given" (*data*) has the same meaning, it seems safe to conclude that "actual essence" refers to the way in which a certain essence exists in a given time and place. On the distinction between formal and actual essence, see Viljanen 2014.

²⁸ See E3p37dem; E3p55Cdem; E3 General definition of affects, expl.

be determined to rest by another body insofar as they agree in nature, since insofar as they agree in nature they are defined by the same properties, and from these properties nothing follows that could determine them to change to the contrary (E3p5). Yet, simplest bodies can disagree in nature to some degree (e.g. they can have different kinetic states, different quantities of motion, or different determinations), and it is on the basis of their degree of disagreement that they can affect each other and produce changes in their respective states.

In order to understand to what extent a simplest body can preserve in its own state, it is necessary to consider not only its force of motion or conatus (which depends on the body considered in itself), but also what Spinoza called in the PCP “force of determination,” which expresses the degree of contrariety between the interacting bodies. Since the only actions that a simplest body can bring about are those that have to do with its power to preserve its own quantity of motion and determination, force of determination also expresses the simplest body’s “power of acting,” that is, how the simplest body’s conatus can be successful in its effort to maintain its state given the way in which it is modified by other bodies on the basis of its degree of agreement and disagreement in nature with them.

Individuals are defined as “complex bodies” (see Def after E2p13s) that have internal structures and can be composed of simplest bodies or by other individuals (L7s after E2p13s). Spinoza discusses transformations that individuals can undergo by distinguishing changes that do not alter the “form” or structure of the individual body from those that can destroy it (L4–7 after E2p13s). This entails that in order to understand how individuals interact, it is fundamental to consider the extent to which external bodies compromise the conservation of the individual form or rather help the individual to retain it. Yet, external bodies can change the individual form only insofar as their nature is incompatible with that of the individual, that is, only insofar as the individual and the external bodies acting upon it disagree in nature. On the contrary, external bodies can help the individual to preserve its own form only insofar as their effects are compatible with the conservation of the individual form, that is, insofar as they agree in nature with it.

The efficacy of the individual’s conatus (i.e. the efficacy with which the individual is able to persevere in its own being) depends on the degree of agreement and disagreement in nature between the individual and the external causes acting upon it. This efficacy is expressed by the “power of acting,” which works analogously to the “force of determination” in the case of the simplest bodies insofar as it expresses how the individual’s conatus can be more or less successful in its striving to persevere in its own being depending on the different kinds of external causes with which it interacts. The individual’s power of acting is different from the force of determination of the simplest bodies insofar as an individual body is more complex and thus more able to be modified and modify external bodies in a greater variety of ways. Nonetheless, despite this different degree of complexity that distinguishes the cases of simplest bodies from that of individuals, power of acting expresses the extent to which each individual is

“determined” to preserve its own form or structure in the context of a specific causal interaction, in the same way in which the “force of determination” of a simplest body expresses the extent to which it is determined to preserve the scalar and directional components of its motion depending on its degree of contrariety with the other bodies acting upon it.

This account of “power of acting” can be further generalized in order to deal with interactions among “things” in general, that is, without referring to a particular attribute under which they are expressed. In this general sense, power of acting depends not only on the actual essence of the thing alone, but also on the *mode* in which it is determined by the causal network in which it exists. For instance, in the first postulate of the third part Spinoza states that “the human body can be affected in many ways in which its power of acting is increased or diminished, and also in others which render its power of acting neither greater nor less.”²⁹ In general, Spinoza’s subsequent discussion of the affects is based on the idea that all the affects of joy or sadness always express different kinds of transitions to higher or lower degrees of power of acting (E3 AD2–3).

Spinoza explicitly states that these transitions must be understood as modifications of the thing’s perfection (i.e. of the thing’s ability to exist and bring about its own effects), rather than as transformations of its essence. As a result, they cannot be conceived of, properly speaking, as changes in the thing’s *conatus* (which expresses the way in which the thing’s essence exists in act), but they must be understood as changes in the thing’s power of acting. As he explains in the *Preface* to the fourth part of the *Ethics*: “when I say that someone passes from a lesser to a greater perfection, and the opposite, I do not understand that he is changed from one essence, or form, to another. . . . Rather, we conceive that his power of acting, insofar as it is understood through his nature, is increased or diminished” (E4, Pref).

From this point of view, Spinoza needs to account for how different interactions with external causes can change the thing’s power of acting. This is possible only insofar as external causes agree or disagree in nature with the thing upon which they operate (E4p29–30). Insofar as the thing’s *conatus* and the external causes are determined to produce the same effects (based on their shared common properties), they will compose their forces and external causes will increase the thing’s power of acting, by facilitating its capacity to bring about its own effects. On the contrary, insofar as the thing’s *conatus* and the external causes are determined to bring about contrary effects, the stronger agent will win by decreasing the power acting of the other.

²⁹ I read this postulate as textual evidence against Viljanen’s own definition of power of acting in terms of “an agent’s capacity to bring about effects the nature of which depends on our essence alone” (Viljanen 2011, 82). This reading does not seem to recognize any distinction between power of acting and activity *tout court*. Nonetheless, should power of acting consist in nothing but bringing about what follows from our essence alone, Spinoza would not be entitled to claim that external causes can *increase* our power of acting by determining our nature. From this point of view, in fact, “joyful passions” (i.e. transitions to higher degrees of power of acting that the agent is not able to bring about by itself) would be inconceivable.

In the context of Cartesian physics, Spinoza introduced the notion of “force of determination” in order to deal with impacts among bodies that were not completely contrary. In fact, the “force of determination” is intended to allow a more careful analysis of the degree of contrariety among interacting bodies and assess the result of the impact on this basis. Analogously, the notion of “power of acting” works in the same way and addresses the same problem of interaction among things that are contrary only to some degree. The notion of “power of acting” is more general in its scope than the notion of “force of determination” since it applies to every kind of thing and not just to impact among simplest bodies. Nonetheless, the variations of the power of acting have to be understood on the basis of the method of resolution that Spinoza implemented in PCP2, 27s in order to distinguish between elements of agreement or disagreement among the interacting things.

In order to assess agreement and disagreement, we have first to recognize that “our power of acting, . . . however it is conceived, can be determined, and hence aided or restrained, by the power of another singular thing which has something in common with us, and not by the power of a thing whose nature is completely different from ours” (E4p29dem). Assuming that a thing is “good” or “evil” insofar as it “increases or diminishes, aids or restrains, our power of acting” (E4p8dem), Spinoza deduces that “no thing can be evil through what it has in common with our nature; but insofar as it is evil for us, it is contrary to us” (E4p30). Indeed, “insofar as a thing agrees with our nature, it is necessarily good” (E4p31). Insofar as things share a common nature, they are determined to produce effects that are similar and thus mutually compatible. In this case, each thing affirms its existence by producing effects similar to those produced by other things to affirm their nature. The result is that each thing’s power of acting is strengthened by the activity of the others. This is the reason why when individuals determine each other, insofar as they are guided by reason (i.e. by common notions), they reciprocally increase their powers of acting and their activity (E4p35 with C and S). Instead, things are contrary to each other insofar as one affirms itself by producing effects that deny the existence of the others. In this case, the thing with the stronger power of acting imposes itself on the others by restraining their powers of acting. Spinoza consistently uses the expression “insofar as” (*quatenus*) to express that agreement or disagreement in nature comes in degrees, and the same thing can agree with another to a certain degree but oppose it to another degree (E4p33).

In that sense, the transitions between different degrees of our power of acting (i.e. affects, E3 AD1–3) cannot be defined by our conatus alone, but only by considering how external causes modify it. As Spinoza demonstrates, “the force and growth of any passion, and its perseverance in existing, are not defined by the power by which we strive to persevere in existing, but by the power of an external cause compared with our own” (E4p5). In order to better understand how Spinoza’s account works, consider for instance how he treats the following case:

Sadness diminishes or restrains a man's power of acting (by P11S), that is (by P7), diminishes or restrains the striving by which a man strives to persevere in his being; so it is contrary to this striving (by P5), and all a man affected by sadness strives for is to remove sadness. But (by the definition of sadness) the greater the sadness, the greater is the part of the man's power of acting to which it is necessarily opposed [*eo majori parti hominis agendi potentiae necesse est opponi*]. Therefore, the greater the sadness, the greater the power of acting with which the man will strive to remove the sadness, that is (by P9S), the greater the desire, *or* appetite, with which he will strive to remove the sadness. (E3p37dem)

Sadness is produced by some external cause able to restrain the thing's conatus. For this reason, sadness expresses a transition to a lower degree of the thing's power of acting (E3AD3expl). Spinoza conceives of sadness as opposed to a certain *part* of the thing's power of acting (*pars agendi potentiae*). This part of the thing's power of acting expresses the degree of disagreement in nature between the thing and the external causes acting upon it. The greater the part of the thing's conatus that it opposes, the greater the sadness. It follows that the greater the decrease of the power of acting produced by sadness, the greater the part of the thing's power of acting that will resist such a decrease and oppose it. This part of the thing's power of acting that will oppose sadness is nothing but a part of the thing's own conatus (i.e. appetite) proportionate to the degree of opposition between the nature of the thing and that of the external causes acting upon it. In this way, Spinoza derives the force that a certain individual's conatus has to oppose sadness from the degree of disagreement between the nature of the external causes and the individual's own nature (i.e. from that degree of disagreement that is the cause of sadness itself).

The same model can be applied to explain how different individuals can establish a social cooperation and join their powers of acting.³⁰ According to Spinoza, human beings agree in nature only insofar as they are determined to act under the guidance of reason, that is, on the basis of shared common properties (E4p35). However, human beings can disagree in nature insofar as they are ruled by passions (E4p32–34). Moreover, Spinoza suggests that should two individuals agree in nature completely, they would form an individual two times more powerful (E4p18s). Let us consider three human beings having equal power. They will share some common properties (E2p39) but they will be also driven by different passions (E4p3–4). Insofar as these individuals are driven by passions, they will disagree in nature and thus they will be contrary to each other and oppose each other. Since (by hypothesis) they will have equal power, they will not be able to destroy each other, but each of them will be able to equally oppose the others and decrease their power of acting by inducing in them affects of sadness (since whatever decreases the individual's power of acting produces a certain kind of sadness, E3p11s). According to E3p37dem, this situation will entail

³⁰ This point is further developed by Sangiacomo 2013a.

that each of these individuals will strive to remove the cause of this sadness and that its desire would be greater in proportion to the cause of its sadness. However, the cause of sadness is the disagreement in nature among the three individuals, that is, the fact that they determine each other on the basis of passions, rather than of common properties. It follows that each individual (insofar as she has the sufficient power of thinking to adequately conceive of the real cause of its sadness) will desire to determine itself on the basis of these common properties that will foster her agreement in nature with the others. As a result, each of these individuals will strive to contrast its passions by acting under the guidance of reason and thus by adapting its own nature to that of the other individuals in such a way to establish a form of cooperation and foster each individual's power of acting (E4p46).

To obtain such a result might be difficult among large groups of individuals since each of them is dominated by different passions and different external causes. For this reason, Spinoza himself suggests that certain passions, when manipulated in the right way by a common political power, might be helpful to foster agreement in nature. As he explains: "everyone refrains from doing harm out of timidity [*timor*] regarding a greater harm. By this law, therefore, society can be maintained" (E4p37s2). In the case of large groups of individuals, the existence of a common passion (e.g. fear of greater harm) able to equally determine everyone and refrain them from harming each other will be an external condition that prompts these individuals to cooperate on the basis of what they share.³¹ Once again, this is possible only by distinguishing between elements of agreement and disagreement in nature among the individuals, whose conatus will strive to resist only those elements that constitute the basis of the disagreement in nature among them. This strategy offers a glaring example of how even "sad" passions, such as fear, can be "useful" in Spinoza's sense, which is ultimately defined by the capacity to foster social cooperation (i.e. causal interaction based on agreement in nature): "things which are of assistance to the common society of men, or which bring it about that men live harmoniously, are useful" (E4p40). From this point of view, external determinations and the passions they produce can be a crucial and sometimes unavoidable resource to bring about social cooperation and ultimately lead to increasing the power of acting of different individuals interacting together.

This discussion shows that Spinoza's notion of "power of acting" is based on the same two main features of his notion of "force of determination" that I emphasized at the end of section three. First, the thing's power of acting expresses the *mode* in which the thing's conatus is modified by external causes on the basis of the thing's degree of

³¹ In TTP16, 7, Spinoza explains: "it is far from being the case that everyone can easily be led by the sole guidance of reason. For everyone is guided by their own pleasure, and the mind is very often so preoccupied with greed, glory, jealousy, anger, etc., that there is no room for reason." This is the reason why "laws should be so drawn up that people are restrained less by fear than hope of something good which they very much desire; for in this way everybody will do his duty willingly" (TTP5, 9). In fact, Moses for instance "took great care to ensure that the people would do its duty willingly and not through fear" (TTP5, 10).

agreement or disagreement in nature with them. Second, in order to analyze causal interactions and the increase or decrease of the thing's power of acting, it is necessary to implement a method of resolution able to distinguish the extent to which a thing agrees or disagrees in nature with the external causes that determine it.

4.3. *Being determined to act*

My reading shows why external determinations do not necessarily represent a threat to the thing's activity. Reconsider E1p28 mentioned at the beginning of this paper:

Every singular thing, or any thing which is finite and has a determinate existence, can neither exist nor be determined to produce an effect unless it is determined to exist and produce an effect by another cause, which is also finite and has a determinate existence; and again, this cause also can neither exist nor be determined to produce an effect unless it is determined to exist and produce an effect by another, which is also finite and has a determinate existence, and so on, to infinity. (E1p28).

The thing's essence has a kind of existence on its own insofar as it is comprehended in God's attributes (E2p8, E5p29s). For this reason, external causes do not determine the thing to exist in the sense that they produce it *ex nihilo*, but rather in the sense that they specify at which point in the causal chain of finite modes the thing's essence will be actually instantiated. Analogously, external causes do not determine the thing to operate in the sense that they are responsible for the causal dispositions embedded in the thing's essence. In fact, because the thing's essence can be conceived of independently of its existence (E1p24), and then of the external causes that determine the thing to exist, the thing's essence can be conceived of independently of these external causes as well. This implies that the thing's essence and the causal dispositions it entails do not depend on these external causes. Rather, insofar as external causes determine the thing to exist in a certain time and place, they determine it to bring about the effects that follow from its essence in that time and place, that is, by interacting in a certain causal network that will affect the thing's causal efficacy.³²

³² E1p28 may be read in a "temporal" sense, according to which each finite thing is determined to exist when it comes to be, but thereafter it acts independently (to an extent) by virtue of the power of existing and acting imbued in it by its first cause. The use of the past tense in the demonstration ("*debut* etiam determinari ab alia," E1p28dem, emphasis added) would support this reading. However, this reading faces two problems. The first is that it would restrict the validity of E1p28 only to the "generative" causes of the thing's existence by demonstrating the unlikely claim that every finite thing is no longer determined by external causes besides and after the act of its generation (which is against E4p3–4). Second, should the thing's essence receive its properties and its definition from an external generative cause, it would be impossible to conceive of that thing's essence without its external generative cause; but insofar as the essence of a thing does not involve its existence (E1p24), the thing's essence *cannot* entail the cause of its existence or depend upon it. It follows that the generative external

External causes determine the thing to exist and operate in the sense that they affect and modify the *way* in which the thing brings about the effects that follow from its own essence. In this sense, E1p28 states that the *mode* in which each thing operates does not depend on the thing alone (as if the thing were free, E1def7), but it will always depend on external causes. Because God (as modified by finite modes) is responsible for the determination of both the existence and operation of finite things, Spinoza concludes that “in nature there is nothing contingent, but all things have been determined from the necessity of the divine nature to exist and produce an effect in a certain way” (E1p29).

Moreover, E1p28, far from denying the thing’s activity, provides a general ontological basis for the fact that external determinations can *increase* the thing’s power of acting, insofar as external determination always arises from causes that share something with the nature of the thing that they determine. This point is exemplified by the case of joyful passions, which consist in an increase of the thing’s power of acting that does not depend on the thing’s own conatus but only on some external cause. In fact, we are passive not just because we are determined by external causes, but rather insofar as we are determined in such a way that we are “considered as a part of Nature which cannot be perceived clearly and distinctly through itself, without the others” (E3p3s; see also E4p2). For instance, in the case of a passion of joy, our power of acting is increased (E3, AD2), but such an increase cannot be understood without taking into consideration the external cause that produces it by determining our conatus. According to Spinoza, the remedy to this passivity arises from “reason” insofar as it is based upon “common notions” that express what “is common to, and peculiar to, the human body and certain external bodies by which the human body is usually affected, and is equally in the part and in the whole of each of them” (E2p39). Clearly, reason does not make us independent of external causes (which is impossible, E4p4), nor does it contradict the fact that our body is a part of Nature. Rather, common notions point to those properties that are shared among our body and the external bodies that determine it. Whatever follows from these shared properties, it will follow in the same way from our own body and from external causes. Insofar as we are determined by what is common (i.e., by reason), we cannot produce anything different from what would follow from our own nature alone or that could not be understood through it.³³ Spinoza demonstrates that “to every action to which we are determined from an affect which is a passion, we can be determined by reason, without that affect” (E4p59). Passions determine us to act, and we are “passive” only insofar as “the man’s power of acting is not increased to the point where he conceives himself and his actions adequately” (E4p59dem).

cause cannot be the cause of the thing’s *essence* and thus it cannot define it. This later point is further developed by Sangiacomo 2013b, 386–407.

³³ This point is extensively discussed by Sévérac 2005.

Eventually, it must be stressed that Spinoza derives from E1p28 the claim that our power of acting can be restrained only by “another singular thing which has something in common with us” (E4p29). Spinoza argues that “the power of each singular thing, and consequently (by IIP10C), man’s power, by which he exists and produces an effect, is not determined except by another singular thing (by IP28), whose nature must be understood (by IIP6) through the same attribute through which human nature is conceived” (E4p29dem). This reference to the thing’s power of acting presupposes that the thing determined by external causes already strives to bring about its own effects through a certain force on its own part. Because things can determine each other only insofar as they are expressed under the same attribute (for E2p10 and E3p2), those external causes that determine the thing’s power of acting always have something in common with the thing that they determine, that is, they share at least the same attribute under which they are conceived. This confirms that there is never *absolute* opposition among interacting things even when external causes significantly decrease the thing’s power of acting. However, insofar as external causes agree in nature with the thing they determine, they do not decrease, but rather increase, its power of acting.³⁴ From this point of view, the external causes that determine a certain thing are always a possible resource and not necessarily a threat to the increase of its power of acting.

To summarize, external determinations specify how the thing’s causal dispositions can be concretely realized. In Spinoza’s ontology, “determination” maintains a meaning analogous to that used in the context of Cartesian physics in the sense that it accounts for the way in which a certain causal process is brought about by considering the way in which things interact. Although every thing always strives to bring about those effects that follow from its own nature, the thing’s capability to actually bring about these effects depends on the way in which external causes determine it. Spinoza introduces the notion of “power of acting” to express how different kinds of interactions with external causes increase or decrease the thing’s ability to bring about its own effects. Although E1p26–29 specifies that the way in which a thing is determined to act and bring about a certain effect is strictly necessary (in this sense, Spinoza’s account of determination does not introduce any form of contingency in the causal process), it also stresses that the *way* in which the thing’s determination is defined crucially relies on its relationship with the causal network in which it operates.

4.4. Conclusions

The reading I have proposed improves both the conceptual and historical understanding of Spinoza’s account of causal interactions. From a conceptual point of view, there is

³⁴ For instance, men can disagree in nature insofar as they are ruled by passions (E4p34), and then they can be “troublesome to one another” (E4p34dem). However, insofar as men are guided by reason, they agree in nature (E4p35) and “man is a God to man” (E4p35s).

a strong tendency in recent scholarship to read Spinoza's conatus doctrine on the basis of a robust form of essentialism. Don Garrett (2002) advanced this reading by claiming that Spinoza's conatus argument in E3p6–7 would be supported by a theory of inherence according to which finite things would approximate the way in which God himself acts by producing its effect without being acted upon by any other thing. Valtteri Viljanen developed this view by considering as the way in which a thing would act without receiving any impediment from external causes to be the state of “perfect essence actualization” (Viljanen 2011, 125–132). Although I subscribe to the fact that Spinoza's conatus doctrine presupposes a robust essentialism, I contend that the way in which Garrett and Viljanen defend this point tends to create a tension between activity and external causes which is at odds with Spinoza's ontology. Both Garrett's and Viljanen's readings suggest that activity is conceived of on the basis of what a thing can do in virtue of its own essence “alone” (i.e. on the model of God's own activity). However, insofar as external causes are conceived of only as a possible threat, at best, for activity, such an activity can find only little or no room in Spinoza's world, since the *Ethics* repeats *ad abundantiam* (e.g. E1p28; E2p13s; E3, Pref; E4p3–4) that in nature no finite thing can ever act *alone*.³⁵ By clarifying the different conceptual labour that the notions of conatus and power of acting are supposed to do in Spinoza's ontology, the reading I propose is in a better position to both accommodate Spinoza's robust essentialism *and* explain how each finite thing always exercises its causal activity within a complex network of determinations arising from external causes. This provides a better account of how the notion of activity applies to the case of *finite* modes and to what extent it differs from the model provided by God's own activity as the only infinite substance. In fact, unlike God (who cannot be determined by anything else), finite modes can act only insofar as they are constantly determined by external causes. These determinations, however, can result in either a decrease *or* an increase of the thing's power of acting depending on the degree of agreement and disagreement in nature between the thing itself and the external causes operating on it.

From a historical point of view, a due appreciation of the way in which the notions of conatus and power of acting derive from “force of motion” and “force of determination” allows a reassessment of the way in which Spinoza's debt toward Cartesian physics is usually conceived. First, my reconstruction of how Spinoza took issue with the notions of force of motion and force of determination in PCP2 demonstrates that the way in which Spinoza rethinks Cartesian physics is in no way a simplistic appropriation of Descartes' concepts. Moreover, although the majority of scholars who dealt with this issue focused on the relationship between E3p6–7 and Descartes' first law of nature, the discussion provided so far shows that Spinoza's great debt to Cartesian physics is better located in his treatment of the problem of determination.

³⁵ Conversely, Spinoza blames “ambition” to be the passion through which human beings are led to strive to impose their own nature and explains how this determines them to increase their disagreement in nature among each other. Cf. E3p31s and E4p37s1.

Second, the main reason why Spinoza's conatus doctrine is seen to be at odds with Descartes' first law is due to the fact that Spinoza's conatus is understood to be oriented to *increase* its own power, rather than merely persevere in its current state. However, a due appreciation of the different roles of conatus and power of acting leads to a reconsideration of this point. A thing's conatus, considered in itself, does not entail any effort to "increase" its power, simply because each thing, considered in itself, strives to persevere in its own being, which is already perfect insofar as it is real (E2def6). Only insofar as a thing interacts with other external causes, its conatus can be restrained or supported, and its power of acting increased or decreased accordingly.

Because every finite thing can exist and operate only insofar as it is determined by external causes (E1p28), the thing's conatus can strive to preserve its own being only by increasing its agreement in nature with external causes; but the more the thing agrees in nature with external causes, the more they will increase its power of acting (by supporting, rather than opposing, its causal efficacy, E4p18s). It follows that the thing's conatus to persevere in its own being (i.e. to increase its agreement in nature with external causes) necessarily leads the thing to strive to increase its own power of acting. This striving to increase the thing's power of acting does not depend on the notion of conatus itself. Rather this is a consequence of the way in which that notion works within the ontological framework that Spinoza provides, which is based on the concept of "agreement in nature" as the fundamental criterion to determine whether, and to what extent, different things can interact without destroying each other, and possibly by composing their own forces together.³⁶

On the one hand, this conclusion reduces the distance between Descartes and Spinoza's views, insofar as we restrict our focus – as I suggest in this paper – to the notions of "force of motion" and "conatus." On the other hand, what explains the thing's effort to increase its own power of acting is the way in which the notion of power of acting operates in Spinoza's account of causal interactions based on the notions of agreement and disagreement in nature. Both this notion of power of acting and the use of agreement and disagreement to assess its variations is something that Spinoza initially developed in PCP2, 27s to explain the modal nature of determination, which remained problematic in Descartes. The major difference between Descartes and Spinoza's accounts is that in the *Ethics* Spinoza considers both the elements of disagreement *and* agreement in nature as having a role in causal interactions, while in the context of Cartesian physics the emphasis was placed mainly on the elements of contrariety among the colliding bodies. Nonetheless, the guidelines of Spinoza's account of interaction are derived from his own rethinking of Cartesian physics, and the method of resolution developed in PCP2, 27s to deal with impacts remains at the core of Spinoza's treatment of causal interactions in the *Ethics*.

³⁶ This point is further developed by Sangiacomo 2015.

To conclude, Spinoza's account of activity does not require a thing to be independent from external determinations. On the contrary, external determinations specify the conditions in which the thing actualizes its causal dispositions. Depending on how external causes compose their own effects with the effects that the thing strives to bring about, the thing's power of acting is increased or decreased. In this way, Spinoza's ontology elaborates the same distinction he introduced in his commentary on Cartesian physics between force of motion and force of determination. From this point of view, the legacy of Descartes' physics does not appear as a burden that compromises Spinoza's philosophical project but rather as a useful resource that Spinoza further develops in order to "consider human actions and appetites just as if it were a question of lines, planes, and bodies" (E3pref).

Abbreviations

- AT: Descartes, René. 1964–1974. *Oeuvres*. Edited by Charles Ernest Adam and Paul Tannery.
- CSM1: Descartes, René. 1985. *The Philosophical Writings of Descartes* (vol. I). Translated by John Cottingham, Robert Stoothoff, Dugald Murdoch, Anthony Kenny.
- CSM2: Descartes, René. 1984. *The Philosophical Writings of Descartes* (vol. II). Translated by John Cottingham, Robert Stoothoff, Dugald Murdoch, Anthony Kenny.

Acknowledgments

This paper is part of the research project "Naturalism and Teleology in Spinoza's Philosophy," funded by the Fritz Thyssen Stiftung and led by Martin Lenz at the University of Groningen. I would like to thank Martin Lenz and Mogens Laerke for their helpful comments on previous versions of this paper.

References

- Adler, Jacob. 1996. "Spinoza's Physical Philosophy." *Archiv für Geschichte der Philosophie* 78(3):253–276.
- Damerow, Peter, Gideon Freudenthal, Peter McLaughlin, and Jürgen Renn. [1991] 2004. *Exploring the Limits of Preclassical Mechanics: A Study of Conceptual Development in Early Modern Science. Free Fall and Compounded Motion in the Work of Descartes, Galileo, and Beeckman*. New York: Springer.
- Descartes, René. 1964–1974. *Oeuvres*. Edited by Charles Ernest Adam and Paul Tannery, new presentation by Joseph Beaude, Paul Costabel, Alain Gabbey and Bernard Rochot, 11 vols. Paris: Vrin.
- Descartes, René. 1985. *The Philosophical Writings of Descartes*, vol. 1. Translated by John Cottingham, Robert Stoothoff, Dugald Murdoch, Anthony Kenny. Cambridge: Cambridge University Press.
- Descartes, René. 1984. *The Philosophical Writings of Descartes*, vol. 2. Translated by John Cottingham, Robert Stoothoff, Dugald Murdoch, Anthony Kenny. Cambridge: Cambridge University Press.

- Descartes, René. 1983. *Principles of Philosophy*. Translated with explanatory notes by Valentine Rodger Miller and . Reese P Miller, Dordrecht: Reidel (ried. Kluwer).
- Erlichson, Herman. 1997. "The Young Huygens Solves the Problem of Elastic Collisions." *American Journal of Physics* 65(149): <http://dx.doi.org/10.1119/1.18659>.
- Gabbey, Alan. 1980a. "Force and Inertia in the Seventeenth Century: Descartes and Newton." In *Descartes: Philosophy, Mathematics and Physics*, edited by S. Gaukroger, 230–320. Brighton: Harvester Press.
- Gabbey, Alan. 1980b. "Huygens and Mechanics." In *Studies on Christiaan Huygens* (Invited Papers from the Symposium on the Life and Work of Christiaan Huygens, Amsterdam, 22–25 August 1979, vol. II), edited by H. J. M. Bos, 166–199. Lisse: Swets & Zeitlinger Publishers.
- Gabbey, Alan. 1996. "Spinoza's Natural Science and Methodology." In *The Cambridge Companion to Spinoza*, edited by Don Garrett, 142–191. Cambridge: Cambridge University Press.
- Garber, Daniel. 1992. *Descartes' Metaphysical Physics*. Chicago: University of Chicago Press.
- Garrett, Don. 2002. "Spinoza's conatus Argument." In *Spinoza: Metaphysical Themes*, edited by Olli Koistinen and John I. Biro, 127–158. New York: Oxford University Press.
- Gaukroger, Stephan. 2006. *The Emergence of a Scientific Culture: Science and the Shaping of Modernity*. 1210–1685, Oxford: Oxford University Press.
- Gillot, Pascale. 2004. "Le conatus entre principe d'inertie et principe d'individuation: Sur l'origine mécanique d'un concept de l'ontologie spinoziste." *XVIIe siècle* 56(1):51–73.
- Gueroult, Martial. 1974. *Spinoza: L'âme (Ethique 2)*. Paris: Aubier.
- Hassing, Richard F. 1980. "The Use and Non-Use of Physics in Spinoza's Ethics." *Southwestern Journal of Philosophy* 11(2):41–70.
- Hoffman, Paul. 2001. "Descartes' Theory of Distinctions." *Philosophy and Phenomenological Research* 64(1):57–78.
- Jullien, Vincent. 2011. "Relativité, determinatio et parallaxe dans la physique cartésienne." *Philosophiques* 38(2):493–521.
- Klever, William. 1988. "Moles in motu: Principles of Spinoza's Physics." *Studia Spinozana* 4:165–195.
- Klever, William. 1993. "The Motion of a Projectile: Elucidation of Spinoza's Physics." *Studia Spinozana* 9:335–340.
- Lachterman, David R. 1978. "The Physics of Spinoza's Ethics." In *Spinoza: New Perspectives*, edited by Robert W. Shahan and John I. Biro, 71–111. Norman OK: University of Oklahoma Press.
- Lécrivain, André. 1977–1978. "Spinoza et la physique cartésienne." *Cahiers Spinoza* 1:235–265; 2:93–206.
- Manning, Richard. 2012. "Spinoza's Physical Theory." *The Stanford Encyclopedia of Philosophy*. Spring 2012 edition, edited by Edward N. Zalta. <http://plato.stanford.edu/archives/spr2012/entries/spinoza-physics/> (last accessed July 2015).
- McLaughlin, Peter. 2000. "Force, Determination and Impact." In *Descartes' Natural Philosophy*, edited by S. Gaukroger, J. Schuster and J. Sutton, 81–112. London-New York: Routledge.
- Messeri, Marco. 1990. *L'epistemologia di Spinoza: Saggio sui corpi e le menti*. Milano: Il Saggiatore.
- Moreau, Pierre-François. 1994. *Spinoza: L'expérience et l'éternité*. Paris: Puf.
- Parrochia, Daniel. 1984–1985. "Physique pendulaire et modèles dans l'Ethique de Spinoza." *Cahiers Spinoza* 5:711–792.
- Parrochia, Daniel. 1987. "La science de la nature corporelle." *Studia Spinozana* 3:151–173.
- Peterman, Alison. 2012. "Spinoza on the 'Principles of Natural Things-.'" *Leibniz Review* 22:37–66.
- Rivaud, Albert. 1924. "La physique de Spinoza." *Chronicon Spinozanum* 4:24–57.
- Rohault, Jacques. 1671. *Traité de Physique*. Paris: Denys Thierry.
- Roux, Sophie. 2006. "Découvrir le principe d'inertie." *Recherches sur la philosophie et le langage* 24:449–511.
- Sabra, Abdelhamid I. 1967. *Theories of Light from Descartes to Newton*. London: Oldbourne.
- Sangiacomo, Andrea. 2013a. "What Are Human Beings? Essences and Aptitudes in Spinoza's Anthropology." *Journal of Early Modern Studies* 2(2):78–100.
- Sangiacomo, Andrea. 2013b. *L'essenza del corpo: Spinoza e la scienza delle composizioni*. Hildesheim–Zürich–New York: G. Olms.

- Sangiaco, Andrea. 2015. "Teleology and Agreement in Nature." In *Spinoza: Basic Concepts*, edited by A. Santos Campos, forthcoming. Exeter: Imprint Academic.
- Schliesser, Eric. 2014. "Spinoza and the Philosophy of Science: Mathematics, Motion, and Being." In *Oxford Handbook on Spinoza*, edited by M. Della Rocca, 1–26. Oxford: Oxford University Press.
- Sévérac, Pascal. 2005. *Le devenir actif chez Spinoza*. Paris: Honoré Champion.
- Spinoza, Baruch. 1994. *A Spinoza Reader: The Ethics and Other Works*. Edited and translated by E. Curley, Princeton: Princeton University Press.
- Spinoza, Baruch. 2002. *Complete Works*. Translated by Samuel Shirley, edited by Michael L. Morgan. Indianapolis: Hackett.
- Viljanen, Valtteri. 2011. *Spinoza's Geometry of Power*. Cambridge: Cambridge University Press.
- Viljanen, Valtteri. 2014. "Spinoza on Virtue and Eternity." In *Essays on Spinoza's Ethical Theory*, edited by Matthew J. Kisner and Andrew Youpa, 258–272. Oxford: Oxford University Press.
- Zac, Sylvain. 1963. *L'idée de vie dans la philosophie de Spinoza*. Paris: Puf.