Conatus

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1. Synonyms

Endeavor, endeavour, striving.

2. Related Topics

Descartes, Spinoza, Hobbes, Huygens, inertia, motion, projectiles, early modern mechanics, natural philosophy, light theory, animal locomotion, late-scholastic physics,

3. Definition/Introduction

"Conatus" is a Latin word that is often translated as "endeavor", "striving", and, by some authors, taken as a synonym of "tendency". Deriving from a concept discontinuously used within late-scholastic theory of gravitation, the conatus acquired relevance in the thoughts of early modern philosophers such as Descartes, Hobbes, Huygens, Spinoza, and Leibniz, and in fields as diverse as physics, optics, physiology, theories of animal locomotion, metaphysics, and ethics. Though these authors meant quite different things when they wrote about the conatus (such that it is hard to provide a comprehensive definition of it), the concept appears to be connected, in very general terms, to the way early modern philosophers tried to account for the behavioural tendencies of things within a broadly-defined mechanistic horizon, and thus beyond Aristotelian hylomorphism.

4. Conatus: various uses of the concept.

4.1. Conatus in late-scholastic natural philosophy.

In late-scholastic natural philosophy, the conatus is a marginal, though widespread, concept used in the frame of Aristotelian-inspired accounts of gravitation—that is, the perpendicular fall of heavy bodies towards the centre of the earth—and, sometimes, levitation—that is, the apparent tendency of light bodies to move straight upwards. In the framework of Aristotelian-scholastic physics, gravitation was described as a form of natural motion (as opposed to violent motion, that is, the upward or downward but curvilinear motion of projectiles), was ascribed to the form of heaviness (or, in the case of levitation, of lightness) which characterized the gravitating body, and was directed in the most possible immediate way (that is, along a straight line) to what was called the "natural place" of the body (in the case of heavy bodies, the centre of the Earth). In this framework, late-scholastic natural philosophers argued that, when the natural motion of a body was impeded, it would exert a certain force, which they named "conatus," perceivable as an endeavor that the body exerted, in proportion to its weight, to fall downwards and rectilinearly towards the centre of the earth. Understood in such terms, the conatus appears to have been a concept of some relevance and dissemination especially within 16th- and 17th-century authors (Leijenhorst 2002, Garau 2014).,

4.2. Conatus in Descartes' physics and optics.

In the early modern period, the late-Scholastic concept of conatus was taken up, though heavily modified, by a number of authors. Descartes was very likely acquainted with such late-scholastic use of the conatus, which was present in texts—such as the Conimbricenses *Commentaries* to Aristotle's Physics (1602) and Eustachius's *Summa* (1626)—and which he recalled that he had read in a letter to Mersenne (30 Sept. 1640), also expressing his intention to return to them. In his writings (and in particular in *Le Monde ou Traité de la Lumière*, 1630, and in the *Principles of Philosophy*, 1644), Descartes repurposed the scholastic concept above described, adapting it to his "proto-inertial" system of natural philosophy. In general, Descartes' idea is that bodies, when impeded in their rectilinear motion, exert a force that he names "conatus". So while in Scholastic physics a conatus denoted a force deriving from impeded natural (and thus formal and intrinsic) motion, in Cartesian physics it characterized the rectilinear tendency to move (Garau, 2014). This principle must be understood in the more complex frame of Descartes' physics. According to Descartes, from the simplicity of God's action of continuous recreation of nature it follows that bodies would move indefinitely along a straight line with constant speed, or stay indefinitely in a state of rest, were they not interfered with by other bodies. Descartes described this elementary feature of the physical world as a set of three laws that he named "laws of nature," which find their most definitive formulation, along with their proofs, from proposition 36 to 42 of part two of the *Principles*. However, such a condition is merely ideal: as the world is in fact composed of an indefinite, and indeed even potentially infinite, number of bodies of imperceptible dimension (as God can always divided matter further), and no vacuum is given, all bodies are *de facto* prevented from continuing indefinitely in their rectilinear, uniform motion. When such impediment ensues, bodies either change the direction of their rectilinear trajectory, or take up a curvilinear motion. However, while moving curvilinearly by effect of external constraints, bodies maintain, for each instant of their motion, an endeavor to move rectilinearly. In the *Principles of Philosophy* II, 39, Descartes showed this through an experiment. When a stone rotates around a sling, Descartes argued, its motion is not naturally bound to continue along the circle described by its slinging, but according to its tangent. Indeed, by experience we know that, if we release the stone, it continues its trajectory along the tangent (or at least so Descartes believed). According to Descartes, this experiment proved that motion is rectilinear in nature and that circular motion derives from a state of constraint, and consequently at each instant of its curvilinear motion a body has a tendency to move rectilinearly and centrifugally.

The conatus comes into play later in *Principles* III, 56-59, in connection with his explanation of the nature of light. Here, Descartes returned to the example of the sling. Here, he claimed that the stone, during its curvilinear motion, tended, or "endeavoured" ("conari"), towards many directions: Descartes distinguished between a tangential conatus – considering only the “force of motion” imparted to the stone—and a centrifugal conatus—considering only the centrifugal tendency of its motion. It is important to note that while Descartes claimed that the conatus is not actual motion, but only tendency to motion, a number of passages from the *Principia* (mainly in III, 58-9) point to the fact that he understood the conatus in dynamic terms. An ant walking its way to the outer extremity of a rotating stick, a ball placed within a rotating cylinder, or the simple experience of the increase in tension of the chord of a sling, brought Descartes to argue that, at each instance, a conatus added its force to that of another conatus occurring a moment before. The increase in tension of the string, in this respect, displays the increase, in Descartes’ words, of the “quantity of force” produced by the adding up of the conatus. While the status of force in Descartes’ physics remains uncertain (as it might be found to contradict its commitment to explain physical phenomena in geometrical terms), such passages evidence that he understood the conatus as a force, and a quantifiable one at that, seemingly proportional to the rotation speed of the object.

The conatus has a crucial application in Descartes’ explanation of the nature of light in the *Optics* (1637), and of the origin of solar light (part III of the *Principles*). Despite his corpuscularian approach to the explanation of natural phenomena, Descartes argued that light is not corpuscularian in nature and does not result from the motion of particles through a medium. Rather, it consists only in a conatus, here understandable as a pressure, that is transmitted through the surrounding environment by the light source, and that affects the eyes in the same way we perceive the texture of the ground through a stick. In Descartes’ vortical model of the universe, each star stands at the centre of a vortex, and is composed by particles of fine nature such as those of fire, which Descartes named “first element”. The vortical motion pushes the more coarse particles to the outer boundaries of the system, so that while space is mainly filled with particles of air, or second element, planets are formed by particles of earth, or third element. In turn, also the particles composing the stars are continuously pushed outwards, but encounter the resistance of other particles of the same kind, and, finally, of those of air. During such vortical motion, they exert centrifugal (and thus radial) and tangential conatus. These tangential and radial conatus, not being motion and therefore not causing mutual impediment, sum up and result in a pressure that exerts itself radially and rectilinearly against the surrounding air particles, and is transmitted instantaneously to the outer parts of the solar system. Reaching the eyes (having often rebounded against opaque bodies), this pressure is perceived as light.

4.3. Conatus in Hobbes’ physics and physiology.

The concept of conatus has a fundamental role also in the physics and physiology of Thomas Hobbes. Hobbes likely developed his concept of conatus (which in the English versions of Hobbes’ writings is translated as “endeavour”) independently from Descartes’ (as it is already present in the *Short Tract* of 1630, which predates his acquaintance with Descartes). Evidence suggests that he was acquainted with the late-scholastic use of the concept (as testified by his critique of Thomas White’s *De mundo* in 1643, see Hobbes 1976 and Lejenhorst 2002). *De corpore* (1655) is the text where Hobbes applies more systematically the conatus to account for kinetic phenomena as well as for the emergence of physical qualities in matter, though the conatus is also employed in other works by Hobbes, such as the *Leviathan* (1651). In *De Corpore* (III, 15), Hobbes defined the conatus as the motion that is given in the space of a geometrical point, which he conceived as been material, and carrying therefore dimensions, though beyond perception and accountability. From a temporal perspective, this corresponds to the motion that is given in an instant of time. Such features bear similarities with Galileo’s notion of *momento* (Brandt 1928; Leijenhorst 2002), . Hobbes claimed that the conatus propagated indefinitely and inextinguishably, thus implicitly accounting for the conservation of the quantity of motion in a physical system. Despite being beyond sensation, the conatus varies however in intensities, which Hobbes understood in mere quantitative terms. In other terms, bodies characterized by different speeds are composed by conatus of different intensities, as much as falling bodies of different materials, Hobbes claimed, have different descending conatus. In *De corpore* (especially III, 22), the conatus has also the function of explaining different physical properties – such as, for instance, resistance, penetrability, fluidity, and restitution – which are generally accounted in terms of the presence of imperceptible conatus in the bodies in question. To provide an example, Hobbes explained elasticity as the presence of a conatus that a bent body possesses towards the restoration of its original shape in its internal parts.

In *De corpore* and *De homine* (1658) the conatus has also a crucial role in Hobbes' physiology, providing the foundation of his theory of sensation and of his egoistic understanding of human behaviour. Hobbes describes sensation in terms of motion. Motion coming from the surrounding environment is firstly transmitted to the brain through the sense organs, and from there eventually reaches the heart, where Hobbes (following Aristotle) believes that sensation takes in fact place. Being an elastic organ, the heart reacts producing a conatus. Such reflection can be directed outwardly, that is, to the extremities of the body, or inwardly. In the former case, such lingering motion (which Hobbes names "phantasmata" or ideas) are perceived by the sentient subject as reflecting something in the external world, despite being in fact a product of our perception. It is important to note that Hobbes explains the relation between phantasmata and ideas not in term of a congruence between the external world and our ideas (as in fact qualities do not exist outside our mind), but as a dynamic process of causation (understood in mechanistic terms) that connects changes in our ideation to changes in the outer world.

The conatus is also at the root of Hobbes' explanation of voluntary motion (Garau 2016), which provides the foundation for his egoistic understanding of human psychology, and, in turn, for his political theory. This theory is similar to his understanding of sensation. Following Harvey (but providing a significant revision of his understanding of the heartbeat), Hobbes understood the centrality of heartbeat in causing blood circulation, and, in turn, in supporting life, and named such system "vital motion." When external stimulus, understood in kinetic terms, are transmitted to the heart, they can hinder or favor its motion, provoking the sensations of pain or pleasure and ensuing a counter-conatus to move away, or towards, the stimulus. Such mechanistic understanding of appetite and aversion, deriving from a mechanistic revision of the Aristotelian system, is defined by Hobbes as "voluntary motion."

4.3. Conatus in Spinoza's metaphysics.

The conatus has a fundamental role also in Spinoza's philosophy. In the *Ethics* (1677), Spinoza argued that each thing is characterized by a conatus to persevere in its own being (E3p6), and equated such conatus with the essence of each individual thing (E3p7), stating that it is not definite but indefinite in time (E3p8). This doctrine – which, although with different formulations, can be found in all Spinoza's works with the exception of the *Emendation of the Intellect* (1662)–, was likely inspired by Descartes' laws of nature – and in particular for the first, which states that each thing perseveres in its own state unless interfered with – and concept of conauts (Garber 1992, Carrero 2002). Several terminological and conceptual evidences point in that direction: from Spinoza's very use of the term "conatus," to the fact that, in earlier writings (as for instance in the *Short Treatise*, likely written in 1660, and in the *Theologico-Polical Treatise*, 1670) he also, or exclusively, describes the conatus as a tendency to state-preservation, rather than then to being-preservation. Moreover, while Spinoza surely knew of Hobbes' conatus, its strong anti-dynamicist character cannot be found in Spinoza.

A crucial difference from Descartes' conatus is certainly the fact that Spinoza's use of the concept is not limited to the physical world – that is, to bodies –, but also includes ideas, providing in this way a comprehensive ontological description of individual things – after having dealt with the metaphysics of substance in Ethics, I –, and of their activity. While, analogously to Descartes, Spinoza derives the preservation of beings from the (seemingly) self-evident principle that things cannot destroy themselves (E3p4-5), the metaphysical foundation of the conatus is provided on expressive, immanentistic bases, as individual things are seen as expressions of the power of the immanent substance (E3p6. See Lin 2004, Viljanen 2011, and for another interpretation Bennett 1984). This represents a significant difference from Descartes' metaphysical justification of state-persistence, which relies on the continuous recreation of things, or ordinary concourse, of the transcendental God – what Spinoza elsewhere defines as a "transitive action."

While representing the principle of the activity of things, Spinoza clarifies that a thing maintains its conatus also when acted upon, or, more in general, when lies in a state of passivity. On a psychological level, this means that if the mind has adequate ideas (and therefore is active), or confused ones (and therefore is passive), it always preserves its essence, that is, that of striving to persist into being. On this basis, the conatus provides a description of the psychological fundaments of the human being. When the conatus is referred on the mind alone, Spinoza explain, is called will, while when referred to both mind and body it is called appetite (E3p9). Desire is an appetite conscious of itself, which characterize human beings. From this, Spinoza derives that we do not desire a thing because it seems good to us, but that, vice versa, we consider something as good because we desire it. Deriving from the conatus to persevere into existence, desire appears as the very essence of human behaviour.

4.6. Conatus in Huygens' physics.

Likely influenced by Descartes, Christiaan Huygens extensively used the concept of conatus in his attempt to explain the nature of gravitational and centrifugal forces, and to provide a calculation of them. In his *De vi centrifuga* (1659), Huygens makes extensive use of conatus in his descriptions of both the gravitational force ("conatus descendendi"), and the centrifugal one ("conatus a centro recedendi"). Unlike Descartes, Huygens did not aim at identifying the origin –whether formal or divine – of the forces he describes, nor does he provide any definition of conatus in general. However, it seems that he understood it as something comparable to a form of potential energy. If we tie a body to a string and let it fall, Huygens observes, it will exert a conatus to move downwards, also exerting a certain force against the string that restrains it. However, differently from Descartes, the conatus here is not only described as a force exerted by a body when prevented from moving according to its kinetic determination, nor as a generic tendency to continue to move rectilinearly. On the contrary, according to Huygens it entails, potentially, a determined kind of motion – that is, a uniform acceleration. Therefore, a "gravitational" conatus entails this potential motion along with its particular speed, which becomes actual once external constraint is removed.

According to Huygens, the fact that conatus entails a particular motion along with its determined speed means that it can be measured once this potential energy becomes actual. Descartes had observed that the increase in the conatus of a rotating ball was somehow proportional to the increase of the tension of the cord restraining it. But because he believed conatus, by definition, to be a mere force that was produced in absence of motion, its calculation was intrinsically problematic. On the contrary, since conatus for Huygens entailed a certain determined motion along with a certain determined speed, it could be calculated by observing the space covered by a projectile in equal unit of time once released by the constraints which prevent its motion. Huygens applied this model, for instance, to the calculus of gravitational conatus, which he understood to be an example of uniform acceleration. In order to overcome the problem raised by the aberration provoked by the medium, Huygens provided an experiment based on the observation of the motion of the projectile in the fractions of time following its separation from the string. Indeed, he suggested that one should not consider what happens to the body sometimes after separation from the cord, for friction can in fact distort our measurement. On the contrary, we have to consider the behaviour of the projectile in the small instants of time from the outset of motion, if we want to determine the strength of the conatus.

A similar understanding pertains to the calculus of centrifugal conatus. Huygens explicitly compared the "gravitation" conatus to the "centrifugal" one. Referring to the Cartesian observation of the ball rotating around a sling, he claimed that the conatus would be similar to that of the ball suspended on the same string, as they will both tend to recede along the straight lines of their strings with accelerated motion; while however the downward motion would increase in the proportion of 1, 4, 9… in equal instants of time, the centrifugal conatus is seen as proportional to the speed imparted by the rotating agent.

4.6. Conatus in Leibniz's early works.

The young Leibniz was likely influenced by Hobbes' conception of conatus (Garber 2008), even claiming that the conatus was to be considered as the "gate of philosophy" ("porta philosophia." See Antognazza 2009). Starting from the idea – which will characterize also his mature endeavours – that the mechanistic features of bodies cannot explain fully for all natural phenomena, in *Theoria motus abstracti* (1671), Leibniz claimed that only an incorporeal principle could account for the origin of the motion of bodies. Here, he described the "conatus" in a Hobbesian fashion as a motion taking place in an instance of time or a point of space, coinciding with the beginning or the end of motion. Since, differently from Descartes, Leibniz identifies here the essence of bodies with motion, and not extension, and since motion is composed by conatus, the conatus is described as the principle of body's activity, now placed in bodies themselves, with the result that extended things derive from an unextended principle.

4.7 Conclusion.

A relatively secondary concept in late-Scholastic physics, the conatus acquired significance during the early modern period especially in mechanistic and proto-inertial physical frameworks. Here, it was mainly used to describe the nature, or explain the origin, of activity. But while in late-Scholasticism such explanation relied on hylomorphism, early modern conatus was connected to the more general question of replacing Aristotelian forms with other sources of activity. Hobbes' physics confronted such problem by ascribing to microscopic motion – the conatus – the origin of motion itself, and stressing the indefinite conservation and propagation of motion throught matter. In such context, reactive conatus helped him tackling the problem of the origin of animal and voluntary motion. This allowed him to provide a unified picture of the physical, "biological", and psychological spheres, on which he then based his political philosophy. For Descartes, and then for Spinoza, the conatus reveals a more complex entanglement with metaphysics. For them, the origin of activity is ultimately God, understood by the former as a transitive agent that recreates nature continuously, or, by the latter, as a causal power that is immanent to nature itself. Descartes appeared to adapt the Scholastic conatus to the mechanistic framework of his physics, at the same time describing it, somehow contradictorily, as a force exerted by a body when prevented from moving rectilinearly. Likewise, Spinoza appointed self-preservative conatus as the essence of individual things, consisting of an expression of God's power to act. The doctrine then finds systemastic employment in Spinoza's description of passions. Other versions of the conatus – in particular those of Leibniz and Huygens – can be seen as derivative of Hobbes and Descartes respectively.

5. Cross-References

Galileo, Descartes, Hobbes, Spinoza, Leibniz, Huygens, momento, impetus, gravitation, force, motion, inertia, Teleology

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