

Quantification of Virtue in Late Medieval Europe

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Fourteenth century Europe saw a growing interest in quantification. This interest has been well studied by historians of physical sciences, but medieval scholars were also interested in the quantification of psychological qualities. In general, the quantification issues addressed by medieval scholars were theoretical, even (by our standards) mathematical, rather than those of practical measurement. There was recognition that the seriousness of a sin and the penance laid down for it should be proportionate. A number of late medieval scholars were interested in the quantification of *caritas*, a Latin word that is translatable as charity or loving benevolence. The scholastic interest linked to the practical issue of how *caritas* might become habitual through the repeated performance of virtuous acts. Gregory of Rimini's treatment of *caritas* in his commentary on Peter Lombard's *Sentences* illustrates how one medieval scholar related the quantification of virtue to the quantification of physical qualities such as temperature and luminescence.

Keywords: quantification, Middle Ages, *caritas*, measurement

In the 14th century, European scholars began to consider that a number of different qualities could be measureable or quantifiable. Much of their focus was on physical qualities such as velocity, heat, and illumination, but the interest of medieval scholars was never restricted to physical qualities. They also considered how psychological and theological qualities could be quantified, and the present article outlines how this “near frenzy to measure everything imaginable” (Murdoch, 1975, p. 287) was applied to such qualities.

The late medieval interest in quantification is quite well known to present-day scholars, and particularly to historians of mathematics and the physical sciences (e.g., Grant, 1996; Maier, 1982; Murdoch & Sylla, 1975; Sylla, 1971, 2010; Tanay, 1993). As is outlined later in the article, some scholars have considered why this interest might have arisen (e.g., Kaye, 1998; Robert, 2013), and others have considered how our current understanding of some physical and mathematical principles developed during the late Middle Ages (Sylla, 2010). However, the quantification of psychological qualities has been the subject of much less modern attention, although the medieval interest in it has been noted from time to time (e.g., Kaye, 1998; Leff, 1961; Maier, 1952; Michell, 2006).

The term *psychological quality* is used broadly in the present articles to cover both feelings and transitory states—for example, those of pain or caring for someone else—and habits, dispositions, or virtues—for example, the slowly developed virtue of caring for other people. As is outlined in the remainder of this article, the quantification of both types of quality was considered in the 14th century, although the latter probably received more

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attention. Increasing people's virtue or simply getting them to behave better was, reasonably enough, an important theological and practical concern.

The remainder of this article is structured as follows. The next section outlines two concepts that are present in Aristotle's *Nicomachean Ethics*, relevant to the present topic, and heavily influential in the Middle Ages. From there, I proceed to consider medieval ideas of sin, penance, and *caritas*, a Latin word that might be translated as charity or loving benevolence, and how these were interrelated in medieval thinking, particularly that of St. Thomas Aquinas (1225–1274), up to about the end of the 13th century. One important aspect of the interrelation is the concept of *proportionality*. The 14th century saw greatly increased interest in quantification, and some aspects of this increased interest are briefly outlined. The next and longest section of the article outlines the thinking of Gregory of Rimini (ca. 1300–1358) on *caritas*, and shows how his thinking on this was interwoven with ideas about the quantification of luminescence and heat. Finally, conclusions are drawn.

Two Concepts From Aristotle's *Nicomachean Ethics*

It is well known that medieval scholarship and learning were very heavily influenced by Aristotle (ca. 384–322 BCE). Works by Aristotle that survived into, or were rediscovered in, the Middle Ages cover such different topics as physics, biology, psychology, sleep, metaphysics, ethics, politics, poetics, and logic, and these works are generally systematic and interlinked (Aristotle, 350 BCE/1931b). Thirteenth-century scholars, such as Albertus Magnus (1193–1280), Thomas Aquinas, and Duns Scotus (1260–1308), attempted a wide coverage of the different topics addressed by Aristotle as well as some reconciliation of these topics with Christian theology. Indeed, the 13th-century approach to knowledge was often synthetic (e.g., Kemp, 1990).

Aristotle's (ca. 350 BCE/1931a) *Nicomachean Ethics* focuses on how people should live, and two of the many concepts in the work have particular importance for the present article. The first of these is the idea of *proportionality*. Virtues such as courage, which is intermediate between cowardice and rashness, can be considered as the mean of arithmetic proportions, just as 6 is intermediate between 2 and 10 (Aristotle, ca. 350 BCE/1931a, 1106a). Justice is a matter of proportion and injustice is a violation of proportion (Aristotle, ca. 350 BCE/1931a, 1131a–1131b). Money, considered by Aristotle to be a measure of human need, is a means of making the demand for different goods commensurate, using proportionate ratios. For example, “Let A be a house, B ten minae, C a bed. A is half of B, if the house is worth five minae or equal to them; the bed, C, is a tenth of B; it is plain, then, how many beds are equal to a house, viz. five” (Aristotle, ca. 350 BCE/1931a, 1131b). Thus, the measure of money enables statements about ratios of value, such as saying that a house has five times the value of a bed.

The second concept is that thorough and early training—the formation of good habits or dispositions—is important for the development of good character and virtue (e.g., Aristotle, ca. 350 BCE/1931a, 1105b, 1106a). As Aristotle (1931a, 1180a) puts it, “the man who is to be good must be well trained and habituated, and go on to spend his time in worthy occupations and neither willingly nor unwillingly do bad actions”. Although Aristotle's thinking about habits was well known, he was not the only ancient writer known in the Middle Ages who wrote about these issues. For example, similar views, along with a certain amount of practical advice, can be found in the writings of Galen (129–ca. 200) and Seneca (ca. 4 BCE–65; Galen, ca. 190/1963; Seneca, 45/1928 for an overview of the history of anger control, see Kemp & Strongman, 1995).

As with many of Aristotle's other works, the *Nicomachean Ethics* was widely available in various Latin translations and read in the Middle Ages from the 13th century onward. Hearing lectures on it was often a part of the Bachelor of Arts curriculum in medieval European universities. It was also the subject of commentaries in which medieval scholars

attempted to explain the contents. For example, Thomas Aquinas (1272/1964a) produced a commentary on it.¹ Robert Grosseteste (ca. 1175–1253) translated a number of the earlier Greek commentaries on the *Nicomachean Ethics* into Latin (Mercken, 1991).

Sin, Penance, and Caritas

Sin was a major preoccupation of medieval Christianity, as it has been in Catholicism since the Middle Ages (e.g., Aquinas, ca. 1273/1964b, Part 1.2, Question 88; *Catechism of the Catholic Church*, 2016). Medieval Christian and subsequent Catholic thinking generally followed Aquinas in dividing sins into two types: mortal and venial. Mortal sin was more serious than venial sin. Death in a state of mortal sin—that is, after committing a mortal sin and not properly repenting afterward—earned one’s soul eternal damnation; death in a state of venial (lesser) sin earned one an unpleasant, and perhaps lengthy, spell in purgatory but with the expectation of eventually going to heaven (Aquinas, ca. 1273/1964b, Part 1.2 Question 88). If someone committed a sin, either mortal or venial, it could be forgiven by God, following an act of contrition on the part of the sinner. This forgiveness was thought to be complete, provided that the contrition was genuine. Contrition might occur during confession to a priest who would normally grant absolution from the sin. The priest would also impose a penance, that is, a punishment (Aquinas, ca. 1273/1964b, Part 3, Questions 84–89). The penance could be regarded as a debt to God that should be paid off (Aquinas, ca. 1273/1964b, Part 3, Question 86, Article 4).

Even within the two categories of sin, there were believed to be differences in the seriousness of the sins. More important in the present context, there was a general belief that, other things being equal, more serious sins should receive more serious or harsher penances. Such thinking aligned well with Aristotle’s ideas about justice.

Determining the seriousness of a sin and the corresponding appropriateness of the punishment for it were not easy tasks. In the early Middle Ages, penances for particular sins were, to some extent, codified in manuals (see, e.g., McNeill & Gamer, 1990) that were subsequently known as penitential canons (e.g., Aquinas, ca. 1273/1964b, Supplement, Question 8, Article 7, Objection 3; Tentler, 1977, pp. 321–340). In the later Middle Ages, there was more reliance than previously on the judgment of the confessor, who was supposed to consider a wide range of mitigating factors, for example, whether the penitent was actually capable of enduring the penance or willing to perform it and how contrite the sinner was. There was also a concern for restitution: If someone else suffered in consequence of the sin, the sinner was supposed to compensate the sufferer to the best of his or her ability (e.g., Brandeis, 1900; Tentler, 1977, pp. 301–344). This heavier emphasis on considering individual circumstances also underlined a later medieval tendency for the theology of confession to diverge somewhat from canon or church law (Brundage, 1995, p. 152).

Nonetheless, it remained a general principle throughout medieval times that, other things being equal, more serious sins should attract heavier penances (Tentler, 1977). For example, Aquinas (ca. 1273/1964b, suppl. 8.7) concluded that “in consideration of the debt [owing as a result of sin] . . . the quantity of the punishment corresponds radically to the quantity of the fault.” One reason given for this correspondence is that “man is reduced to the equality of justice by the punishment inflicted on him. But this would not be so if the quantity of the fault and of the punishment did not mutually correspond” (Aquinas, ca. 1273/1964b, suppl. 8.7).

A feature of medieval Christian theology was that sin was thought to be bad not only because of evil done directly but also because it blocked the sinner’s ability to develop

¹ Not all the translations were of the complete work, but Aquinas’s commentary contains reference to all the Aristotle citations in this section.

more positive feelings of love and benevolence. The basic idea was taken from Jesus's restatement of the Commandments in St. Matthew's (Good News Bible 2nd Edn, Matt. 22:37-40) gospel:

"Love the Lord your God with all your heart, with all your soul, and with all your mind." This is the greatest and most important commandment. The second most important commandment is like it: "Love your neighbor as you love yourself." The whole Law of Moses and the teachings of the prophets depend on these two commandments.

In this passage, Christian duty is clearly framed in a positive rather than a negative way, and this was acknowledged by medieval theologians (e.g., Aquinas, ca. 1273/1964b, Part 2.2, Question 44, Articles 1-3).

In medieval Latin, a frequently used word to describe the loving benevolence or caring implied by the passage from St. Matthew's gospel is *caritas*. The natural English translation of this word is "charity," but although a medieval person who had *caritas* would be expected to donate to charitable causes, the meaning extended well beyond the simple giving of alms, which is mostly what is implied by our present-day use of the word "charity." For example, in the *Summa Theologiae*, Aquinas defines *caritas* as a kind of friendship, indispensable for other virtues, and the greatest of the virtues. It applies to both love of God and one's neighbor, and brings with it joy, peace, mercy, and kindness. Someone who possesses *caritas* is less likely to do wrong of any kind (e.g., Aquinas, ca. 1273/1964b, Part 2.2, Questions 23 and 25-32). It is not easy to find a good one- or two-word English translation of *caritas*—loving benevolence might be the closest—so in this article, I leave the term untranslated.

A medieval Christian who wanted to avoid the pains of hell or purgatory and instead reap the benefits of heaven or purgatory would also be concerned to increase his or her *caritas*, and try to become a kinder, more caring, more warm-hearted person. How was this to be accomplished? The usual answer to this question, easily derivable from the *Nicomachean Ethics*, was that you did it by learning to behave differently. In particular, you did it by developing habits (Latin: *habitus*) of kindness and consideration.

Habit, the encouragement of good habits, and the inhibition of bad ones were central concerns of medieval psychology. Aquinas presented the idea of a habit as a kind of intellectual memory that might incline one to act kindly and justly. In his conception, and in the medieval conception generally, such habits are not narrowly linked to particular acts—for example, remembering to greet a particular person politely in the morning—but rather they are generalized to become a disposition to be polite and kind. Thus, they are close to the present-day idea of a psychological trait. The initial performance of an act of kindness—giving alms to a beggar or treating someone gently—might be difficult, but with repetition and continual practice, this slowly becomes a more natural and easier thing to do (Aquinas, ca. 1273/1964b, Part 1.2, Questions 49-53). In the thinking of Duns Scotus, habits are acquired by the repeated exercise of will power. For example, "by its frequently elicited acts, the will can produce a certain correct aptitude inclining it towards similar acts, and that aptitude is what I call a virtue" (Duns Scotus, ca. 1300/1986, p. 326). In William of Ockham's (ca. 1285–1349) theories of cognition, habits became the basis not only of moral actions and inclinations but also of much of how we recall events from the past (Kemp, 1998). Perhaps most importantly, the idea that habits are created in the immortal, intellectual soul provided a basis for Christian beliefs about the afterlife. Someone who has acquired virtuous habits, above all *caritas*, will, at the same time, develop his or her immortal soul to the point at which it is worthy of eternal life in heaven rather than damnation (e.g., Aquinas, ca. 1273/1964b, Part 1.2, Question 67, Article 1).

The medieval concern with developing *caritas* also provided a rationale for the practice of issuing indulgences, by which a sinner could buy his or her way out of either penance or a spell in purgatory, provided that the payments accompanied or were the consequence of genuine contrition. It is not clear when the practice of indulgences began (Swanson,

2007, Chapter 1), but they were in reasonably common use in the 13th century, and Aquinas (ca. 1273/1964b, Supplement, Question 25) defends their use in the *Summa Theologiae*. Their use seems to have increased substantially in the later Middle Ages.

The idea that people could buy their way out of punishment in the afterlife by monetary payments in this one was heavily criticized at the end of the Middle Ages by John Wycliffe (ca. 1325–1384) and Martin Luther (1483–1546) as well as a host of others (Swanson, 2007), but there was a practical point to indulgences. The money that people spent on indulgences was put to such purposes as building churches, maintaining the transportation network, or helping out poor but deserving individuals, and it is easy to argue that such activities were more socially useful than penitential fasting (Schaffern, 2005; Swanson, 2007). Indeed, one could also argue that the development of habits of charitable giving might be more beneficial to the sinner, and so the practice of indulgences was closely tied to the idea of *caritas* (e.g., Swanson, 2007, pp. 225, 522). It is also arguable that the apparent commercialization of salvation is implicit in the idea of penance as a paying off of a debt (Schaffern, 2005). Moreover, the practice is clearly related to the concern in the later Middle Ages—for example, in the late medieval *Jacob's Well*—that true contrition for deeds that wrong others should be followed by appropriate acts of restitution (Brandeis, 1900, pp. 199–216).

Quantification in the 14th Century

The 14th century saw a number of new scholarly developments. William of Ockham (ca. 1285–1349) was often credited with initiating a new approach, a *via moderna*, that contrasted with the *via antiqua* of the preceding century (Oberman, 1987). The best-known element of this new approach was probably nominalism, which (roughly) holds that general ideas or *universals*, for example “cats,” are purely mental concepts, whereas only particular animals that we call cats exist outside of the mind. The idea that universals do not exist outside the mind was very strongly argued in William of Ockham’s *Ordinatio* (William of Ockham, ca. 1318/1967), and succeeding medieval writers produced different variants of the doctrine (see, e.g., Courtenay, 2008, Chapter 1).

Another development in the first part of the 14th century was an enormous increase of interest in how qualities could be quantified. Two important centers of this interest in quantification were the University of Oxford and the University of Paris. Important scholars, sometimes known as calculators, at Merton College in Oxford included Thomas Bradwardine (ca. 1290–1349), Richard Swineshead (active 1340–1354), and William Heytesbury (ca. 1313–1372). Particularly prominent at the University of Paris was Nicole Oresme (ca. 1320–1382).

Many of the 14th-century scholars came up with ideas that foreshadowed later advances in mathematics and physics. Their thinking about these areas is reasonably well known to present-day historians of science, particularly to historians of mathematics and physics (see, e.g., Coleman, 1975; Grant, 1996; Kaye, 1998; Maier, 1982; Murdoch & Sylla, 1975; Sylla, 1971, 2010; Tanay, 1993), so I shall only summarize a little of it in this article. However, in line with the general synthetic tendency of medieval scholarship, ideas developed in one branch of thinking were often used in other branches. In particular, medieval thinking about psychological qualities often used similar concepts and language to those used for thinking about physical qualities, so it is worthwhile to consider some aspects of the latter beforehand (Murdoch, 1975).

In the first place, the interest of the 14th-century scholars in attempting to quantify concepts such as velocity, heat, and illumination was not directed at developing practical ways to measure these qualities. Simply, although medieval Europe possessed reasonable measures of length, weight, and (more approximately) time, they did not have any good way to measure velocity or heat, let alone more psychological qualities (e.g., Maier, 1952,

pp. 259–260). Instead, the usual focus was on exploring some of the theoretical aspects of quantification rather than measurement itself.²

For example, Thomas Bradwardine produced a theory of movement in which velocity varies with the ratio of force to resistance, and one can see this as an early example of describing a physical law by a mathematical function (Maier, 1952). The middle degree theorem, which describes how an average velocity could be calculated, appears to have arisen rather haphazardly among the Oxford calculators (Sylla, 2010). Another, later approach to describing velocity related more to geometry. Nicolas Oresme asked his readers to imagine movement over a period of time. Time is denoted by a horizontal line, and there is a certain velocity at each period of time, which can be expressed by a line of a particular height that is perpendicular to the time line. The longer the vertical line, the greater the velocity. In this way, one can consider *uniform* velocities, in which all the perpendicular lines have the same height (and it is, of course, easy to estimate the distance covered from the area of the rectangle produced), or *difform* velocities, in which velocity is different at different points of time. For example, one can have a velocity that is linearly reduced to zero over the time and is depicted as a triangle (Oresme, ca. 1355/1968, pp. 289–291). There is a great variety of difform velocities. It could be, for example, that the velocity of the moving object is accelerated, perhaps uniformly, perhaps not (Oresme, ca. 1355/1968, pp. 413–425).

Oresme’s geometrical way of thinking about velocity can be used to describe any quality. Generally, he describes the extension of a quality (e.g., the duration of a body’s movement) as a latitude (or longitude). There is also an intensity (or intension) of a quality at different points. The former is represented by a horizontal line and the latter by a succession of vertical lines (Oresme, ca. 1355/1968, pp. 171–173).³ In both Oresme’s and other writing of this period, there is substantial reference to proportions. So, for example, “let A be a quality three times as extensive as quality B, and similarly twice as [uniformly] intense . . . the compound ratio will be a sextuple ratio” (Oresme, ca. 1355/1968, p. 407).

Some theorizing from this period precedes later developments in the mathematics of calculus and real analysis. There is a good deal of writing on infinity and infinitesimals (e.g., Oresme, ca. 1355/1968, pp. 425–435). An example of this was the ongoing debate as to whether a line could be constructed from indivisibles, that is, points that have no dimensions themselves and are indivisible (e.g., Murdoch & Synan, 1966). Medieval scholars lined up on either side of this issue as well as defining intermediate positions. A 14th-century summary of the different positions is given by Adam de Wodeham (1298–1358; 1988, pp. 3–27). Some other issues of this kind are described in the next section, because Gregory of Rimini referred to them.

Fourteenth-century scholars often discussed qualities that we would consider psychological alongside the physical ones. Adam de Wodeham (ca. 1328/1988, p. 33), for example, begins his discussion of indivisibles by asking whether caritas is made up of indivisible forms. Oresme (ca. 1355/1968, p. 387) considers the difform nature of pain and joy as well as that of velocity:

Let A and B be two pains, with A being twice as intensive as B, and half as extensive. Then they will be equally simply . . . although pain A is worse than, or is more to be shunned than, pain B. For it is more tolerable to be in less pain for two days than in great pain for one day.

A similar rule holds for joy. Moreover, for the experiences of both pain and joy Oresme (ca. 1355/1968, pp. 387–393) thought that exactly how the pains and joys are configured

² Hence the use of the term “quantification” throughout this article rather than the more easily understood “measurement.”

³ Oresme’s hesitation between longitude and latitude for the first quality reflected his dilemma of whether to continue using an older but less exact terminology.

over time played an important part. Incidentally, present-day experiments on the evaluation of pain and pleasure agree with Oresme in indicating that the configuration of pain or joy over time is more important than the duration of the experience (e.g., [Fredrickson & Kahneman, 1993](#); [Redelmeier & Kahneman, 1996](#)).

A question that has concerned present-day historians of science is why this late medieval interest in quantifying came about. For example, [John Murdoch \(1975, p. 287\)](#) asked, “How and why did the near frenzy to measure everything imaginable come about in the fourteenth century?” The question is especially hard to answer because, as already noted, the “near frenzy” did not reflect an increase in anyone’s actual ability to measure velocity or temperature. A number of answers to the question have been suggested.

[Joel Kaye \(1988, 1998\)](#) has put forward the theory that the increase in measurement came about because of the growing wealth and monetization of the 14th-century economy. There is a reasonable amount of evidence for this theory. As we saw earlier, Aristotle thought about money as essentially a measure of proportionate need. Oresme thought a good deal about money and, indeed, wrote a treatise on it (*De moneta*, [Oresme, ca. 1365/1956](#)), which had the main objective of persuading medieval rulers that debasing the currency had nasty consequences, even though it did provide a relatively simple way to increase government revenue in the short term. Thus, as people in the 14th century became more knowledgeable about money, so they would have become more adept at making the kinds of proportional judgments that might be used of any measure, and, as we have seen, were used by some 14th-century scholars.

Other theories have been put forward by present-day scholars, although none seems to be as well developed as Kaye’s. [Collette and Bradbury \(2009\)](#) remarked that civic clocks became more widespread in the 14th century. [Robert \(2013\)](#) pointed out that attempting to rebalance bodily humors with different medicines inevitably leads to the quantification of appropriate dosages. [Murdoch and Sylla \(1975, pp. 341–343\)](#) suggested that quantification might have arisen from a desire to make theology a more exact discipline. One can debate which of these different possibilities describes a cause of interest in quantification, and which an effect, but at least it does seem clear that the interest of 14th-century scholars in quantification accompanied a greater use of different quantity measures in 14th-century society.

Quantifying Caritas in the Sentences of Gregory of Rimini

The standard textbook of Western Christian theology from the early 13th until the 16th century was the *Four Books of Sentences* written by Peter Lombard (ca. 1096–1160; for an English translation, see [Peter Lombard, ca. 1150/2007](#)). Not only was this work studied by medieval theology students—it was also commented on by many medieval scholars. The commentaries covered a vast range of different topics, some clearly connected to theological concerns, some not. Indeed, perhaps on occasion, “the theological point at hand is being used not as a genuine reason, but merely as an excuse, to discuss such and such a philosophical—even natural philosophical or ‘scientific’—problem” ([Murdoch, 1975, p. 328](#)). For example, much of the early part of William of Ockham’s *Ordinatio*, written as a commentary on the first part of the *Sentences*, is concerned with arguing for nominalism ([William of Ockham, ca. 1318/1967](#)).

Gregory of Rimini was probably born toward the end of the 13th century and died in Vienna in 1358, not long after being named as General of a monastic order known as the Augustinian Hermits. Much of his life was spent as a scholar and academic, including teaching theology as a professor at the University of Paris between 1341 and 1351. During this stay, he wrote his own commentary on Peter Lombard’s *Sentences*. Not all of the 14th-century scholars appear to have been very interested in theological issues, but Gregory was, although he combined this interest with considerable knowledge of the work

of the Oxford calculators (for more detail about Gregory's life and theology, see [Leff, 1961](#)).

In Gregory's commentary on the Seventeenth Distinction of the first book of Peter Lombard's *Sentences*, he considers six separate questions, all of them related to the general topic of caritas, which is the main theme of the distinction ([Gregory of Rimini, ca. 1350/1982](#), pp. 215–481). In order of presentation in Gregory's text, the six questions are

1. Whether it is possible for someone to delight God by merit if he does not have in himself an infused habit of created caritas⁴ (underlying this question is the generally held idea that habits are to some extent infused through the sacraments; [Gregory of Rimini, ca. 1350/1982](#), p. 215).
2. Whether some bodily form is augmented or made more intense continuously or whether some intensive augmentation of a bodily form is a continuous movement⁵ ([Gregory of Rimini, ca. 1350/1982](#), p. 250).
3. Whether a bodily form becomes more intense through refinement from a contrary and is made less intense through the additive mixture of a contrary⁶ ([Gregory of Rimini, ca. 1350/1982](#), p. 326).
4. Whether a bodily form is made more intense through the acquisition of a new form or part or degree of a form of the same root⁷ ([Gregory of Rimini, ca. 1350/1982](#), p. 365).
5. Whether caritas can be augmented. (Gregory goes on to remark, "After the augmentation of bodily qualities has been considered, consideration moves to the augmentation of spiritual ones, and particularly caritas, which was a principal concern of the master [that is, Peter Lombard]"⁸; [Gregory of Rimini, ca. 1350/1982](#), p. 418).
6. Whether caritas can be augmented or achieve greater intensity to infinity⁹ ([Gregory of Rimini, ca. 1350/1982](#), p. 460).

These questions are all discussed at length. The form of the discussions varies from question to question, and some are further broken down into different questions, but Gregory generally follows a typical medieval scholastic structure. Each question begins with arguments against and for, and usually these arguments are attributed to some previous writer. Some of Gregory's arguments are taken from the Bible or early Christian writers such as St. Augustine, some from Aristotle or his commentator Averroës, and some from other medieval scholastics. Often, Gregory then presents his own view, with arguments for it, and then gives reasons for rejecting each opposing view. Occasionally, other scholars' views are presented and considered in some detail. For example, as part of the fourth question, the different views of Giles of Rome (ca. 1243–1316) and Walter Burley are considered and rejected.

If one takes the critical question in this list to be the psychological or theological fifth one, then it is noteworthy that it is immediately preceded by three questions that mainly have to do with present-day physics or mathematics. The obvious implication, which is

⁴ Utrum sit possibile aliquem meritorie deum diligere non habendo in se habitum caritatis creatae infusum. For the theology of this question, see [Leff \(1961, Chapter 5\)](#).

⁵ Utrum aliqua forma corporalis augeatur seu intendatur continue sive utrum aliqua augmentatio intensive formae corporalis sit motus continue.

⁶ Utrum forma corporalis intendatur per depurationem a contrario et remittitur per admixtionem contrarii.

⁷ Utrum forma corporalis intendatur per acquisitionem novae formae vel partis seu gradis formae eiusdem rationis.

⁸ Utrum caritas possit augeri. . . . Postquam visum est de augmento qualitatum corporalium, videndum est de augmento spiritualium et specialiter caritatis, de qua Magister principaliter agit.

⁹ Utrum caritas possit augeri seu fieri maior intensive in infinitum.

borne out in detail by the cross-referencing in and to the fifth question, is that the intensification of the psychological quality of *caritas* is supposed to operate in a similar way to the intensification of physical qualities.

The principal physical qualities considered in the second to fourth questions are those of luminescence and heat, chosen perhaps because they offer rather different models for how a quality becomes more intense. The luminescence of an object remains constant if no movement occurs but appears to increase continuously if one slowly moves the object closer to the light source. It is also immediate: Consider, for example, the removal of a screen between a light source and an object. On the other hand, an object becomes gradually hotter if it simply remains close to a source of heat (Gregory of Rimini, ca. 1350/1982, pp. 252–255). As in other 14th-century writing, the arguments and examples sometimes deal with issues that we would consider mathematical rather than physical. Under the second question, for example, there is an argument that if some object has a first instant of its existence, then there can be no last instant of its nonexistence (Gregory of Rimini, ca. 1350/1982, pp. 262–265). The issue foreshadows the present-day mathematical concept of a Dedekind cut and was also considered by William Heytesbury (ca. 1335/1984).

A much debated theoretical point in the 14th century (e.g., Shapiro, 1959) concerned how a particular form could be made more intense and how continuous this process could be, and this issue is addressed in the second to fourth questions. So, for example, extra units of the quality—for example, heat—might simply be added to the existing heat of an object. (An acknowledged difficulty with this theory was a variation of the concern with indivisibles. How did one avoid positing a continuum of heat that contains infinitely small units of heat?) Alternatively, the greater intensity might come about through the removal of a contrary quality. So, for example, white might become whiter through the removal of some of the black, or an object might become hotter because cold components were removed. (Medieval theorizing about heat often posited cold as a separate quality rather than simply as an absence of heat.) A difficulty with this theory is that not all qualities—light, for example—were thought to have contraries, as Gregory of Rimini (ca. 1350/1982, p. 328) pointed out. Another possibility, put forward by Walter Burley (ca. 1275–1344) is that each change in quality is actually a new and (perhaps slightly) different quality. A difficulty with this position is that there are phenomena—the gradual increase in light and the withdrawal of shadow as the sun comes up over the horizon, for example—that do seem to be continuous (Gregory of Rimini, ca. 1350/1982, p. 261).

It is the fifth question that comes closest to a present-day psychological one. Gregory divides his discussion of this question into two articles: the first presents four conclusions with reasons for accepting them; the second considers two doubts.

The first conclusion in Article 1 is that, indeed, *caritas* can be increased, and an important reason for believing this is that St. Paul (Philippians 1: 9; 2 Thessalonians 1: 3) wrote to early Christian congregations praying for and rejoicing in their increase in the quality (Gregory of Rimini, ca. 1350/1982, p. 420). The second conclusion is that increased *caritas* does not always come about through the reduction of a contrary. The reason given for this conclusion is that it is possible for someone to have an increase in *caritas* without previously having sinned at all. This is not a straightforward conclusion because, as St. Augustine pointed out, a desire for worldly goods is opposed to *caritas*, suggesting that the latter does actually have a contrary. Moreover, it is difficult to see that someone who has perfect *caritas* could have any habitual worldly desire at all, although it might be possible for that person to occasionally feel a desire that would not be acted on. (Gregory of Rimini, ca. 1350/1982, pp. 421–423). A further point is that if a pleasure-loving nonbeliever were baptized, he would receive an infusion of *caritas*, but his previous bad habits would remain (Gregory of Rimini, ca. 1350/1982, p. 422). (The strength of both *caritas* and worldly desire are partly a result of the habits and inclinations formed by past actions.)

The third conclusion is that *caritas* is augmented through acquiring a new degree of it (Gregory of Rimini, ca. 1350/1982, p. 423). This leads to the fourth conclusion, which is that if *caritas* is increased, this does not imply that any preexisting *caritas* is destroyed (Gregory of Rimini, ca. 1350/1982, p. 424). Gregory relates this conclusion to the issue of how bodily forms can be increased over time (Gregory of Rimini, ca. 1350/1982, pp. 388–393). If one habit of *caritas* were to succeed another, then the new habit would have to be created instantly. Moreover, if there is a habit in Socrates that is destroyed at the same time as another, stronger habit is created by a new act, and then there must be a point at which the two habits coexist (Gregory of Rimini, ca. 1350/1982, pp. 424–425).

The second, lengthier article considers whether the intensity of *caritas* or some other virtue can be increased in continuous time and whether *caritas* can be diminished¹⁰ (Gregory of Rimini, ca. 1350/1982, p. 427). Gregory's answer to the first question is "yes." A key point here is that, according to both Aristotle and experience, habits are strengthened and augmented through acts that take place over periods of time rather than instantly. Thus, they are not like a light source that produces all of its light intensity immediately. The answer to the second question is also "yes." For example, *caritas* could be diminished by acts that are contrary to it (Gregory of Rimini, ca. 1350/1982, pp. 448–449).

Within the second article are passages in which it is apparent that *caritas* can be thought of in a very quantitative way. I give an example of such a passage, chosen to illustrate the quantitative nature of the discussion rather than because it reflects Gregory's own views (in fact, it suggests conclusions opposite to Gregory's):

If Socrates, who has a habit of gentleness, should elicit inside a certain period of time, for example one hour, many successive acts of gentleness equal in degree, always with some lapse of time between the ending of one act and the generation of the next one, many degrees would be added to that habit, and the habit of gentleness would be greater in him at the end of the hour than at the beginning.¹¹ (Gregory of Rimini, ca. 1350/1982, p. 428)

The fifth question begins with a difficulty that is then returned to at its end. This is the difficulty of reconciling the idea of increasing and decreasing *caritas* with Catholic ideas of mortal and venial sin. Mortal sin condemns the sinner to damnation and can be thought to remove all *caritas*, and so is clearly not an incremental matter. The quantitative issue is resolved by claiming in effect that mortal sin is worse than any acts of merit can be good (Gregory of Rimini, ca. 1350/1982, pp. 418, 453–456). The opposite difficulty occurs with venial sin, because no amount of venial sin can produce eternal damnation. There is no sum of venial sins that can totally diminish *caritas*. Gregory is thus led to reject an argument that someone who has, say, a hundred degrees of *caritas* might lose one degree through each venial sin committed and then, with the hundred and first such sin, find himself damned (Gregory of Rimini, ca. 1350/1982, pp. 418, 449, 456–458).

It is not possible in this space to summarize all of Gregory's arguments about *caritas* fairly and briefly, and I have not attempted to do so.¹² Moreover, as remarked earlier, he is by no means the only medieval scholastic to address these issues. For example, both Walter Chatton (ca. 1285–1343), Adam de Wodeham (probably writing about 20 years before Gregory), and William of Ockham considered *caritas* at length in their own

¹⁰ *Utrum intensio caritatis aut alterius virtute fiat in tempore continue. Secundum, utrum caritas possit minui.*

¹¹ *Si Socrates habens habitum mansuetudinis eliceret infra certam partem temporis, verbi gratia infra unam horam, plures actus mansuetudinis successive aequales in gradu, semper inter corruptionem prioris et generationem sequentis laberetur aliquod tempus, plures gradus essent additi illi habitui et habitus mansuetudinis esset intensior in eo in fine horae quam esset in primo instant horae illius.*

¹² For example, it is possible that Gregory's views on *caritas* and 14th-century measurement issues are linked to his views on nominalism, but I do not find obvious links in his discussion of the Seventeenth Distinction. There is also a present-day debate as to Gregory's actual stance on nominalism (Courtenay, 2008, p. 14, 349).

commentaries on the Seventeenth Distinction of the Sentences (Adam de Wodeham, ca. 1325/1990; Chatton, ca. 1323/2002; William of Ockham, ca. 1318/1977). However, these writers posed quite different questions within the distinction. Moreover, neither devotes any questions to physical phenomena, although these phenomena are referred to. However, Richard Fitzralph (ca. 1300–1360) did consider the quantification of caritas in the context of the quantification of physical qualities (Leff, 1963). To summarize, Gregory's approach and conclusions were not completely shared by these or other medieval scholars, although there were some common features. William of Ockham (ca. 1318/1977, p. 479) remarks, for example, that everyone agrees that caritas can be increased, although there is disagreement on how this might happen.

Present-day psychology is not greatly concerned with any particular one of Gregory's conclusions. Nonetheless, three points should be clear from the brief, selective summary just given. First, like other medieval scholars, and following Aristotle, he conceives caritas and other virtues to be developed incrementally as habits by the repetition of the appropriate actions. Second, he considers that the quality of caritas is, in some respects, similar to physical qualities like illumination and heat. Most obviously, quantitative arguments apply to all three. Third, he is prepared to use arguments from a number of different sources—the Bible, prior theorizing, or analogy to physical qualities—to come to conclusions about the nature of caritas and other virtues.

Conclusion

The preceding sections have covered a range of different topics. In this final section, I draw some conclusions from them.

First, reasoning about quantification was applied to psychological qualities as well as to physical ones. Gregory of Rimini changed very easily from writing about one sort of quality to writing about the other whenever he wished to draw an analogy he thought was appropriate. In fact, a case could be made that 14th-century scholars were more willing to accept the quantification of psychological qualities than many scientists in the 20th century. For example, a number of members of the British Ferguson Committee, whose final report was issued in 1940, were unable to accept that sensory dimensions (e.g., the loudness of sound) could actually be quantified at all (Ferguson et al., 1940). Similar doubts have been more recently raised by Joel Michell (1999, 2006) regarding the quantification of psychological scales. Indeed, when Michell (2006) distinguishes extensive and intensive measures, he traces the latter back to the 14th century. Thus, the issue of quantitative measurement of psychological qualities first discussed in the 14th century is still a live one.

Second, as other historians of science have already commented, the medieval approach to quantification was somewhat different to that taken by scientists today. Perhaps most striking is that the qualities discussed, whether velocity, heat, caritas, or gentleness, do not actually get measured. It is reasonable to assume that many of the physical qualities were not measured because there was no reasonable way to do it. However, this is not so clear-cut for the psychological qualities. For example, simple measures of caritas could have been obtained by asking someone's friends, family, or confessor for verbal, or even numerical, ratings. To my knowledge, such measurement was not attempted. On the other hand, some of the more theoretical aspects of medieval quantification do not much concern most present-day psychologists, although they remain part of mathematics.

Third, although the late-medieval interest in quantification could have been brought about by the growing monetarization of society, medical dosages, or the spread of clocks, it is not easy to see a direct connection between these changes and many of the issues that medieval scholars such as Gregory of Rimini actually considered. Increasing one's wealth and accounting for one's expenditure, for example, do not have anything very obvious to do with whether a new level of wealth is different in form or degree to the old level, or

whether knowing the first instant of the new level implies you cannot define a last instant of the old one.

Fourth, despite the lack of reasonable means of measurement and the somewhat rarified nature of much of the discussion of quantification, the medieval interest in quantifying psychological qualities was to some extent practical. Finding the appropriate punishment or penance for a particular crime or sin is a practical issue at least as much as a theoretical one. Similarly, the question of how *caritas* might be increased—and whether it can be increased at all—had obvious social implications in the Middle Ages, just as it does today. Indeed, given the nature of technology and society in the Middle Ages, it may have made more sense to concentrate on the psychological qualities than the physical ones.

Fifth, the medieval quantification of the psychological qualities was not straightforward. The division of sins into mortal and venial is clearly a qualitative one (although classifying them need not be), and reconciling this division with a quantitative view of *caritas*, or, for that matter, an appropriate match of punishments or penances to different wrongdoings was seen as difficult by medieval eyes as well as our own.

Finally, although Gregory of Rimini's use of quantitative thinking in his discussion of *caritas* was a relatively new development, other ingredients of the discussion had been well known in the 13th century. The augmentation of *caritas* by performing virtuous acts had been part of Aquinas's thinking, too, as was the consideration of proportionality that underlay the new quantitative approach. The idea that a Christian should try to increase his or her *caritas* was explicit in St. Matthew's gospel. The new way of thinking built on and incorporated the old.

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