



GOD'S DICE: BAYESIAN PROBABILITY AND PROVIDENCE

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The Reverend Thomas Bayes has recently become best known for his mathematical Theorem, but Bayes' vocation, and primary identity, was that of minister. Bayes' writings include a tract on divine benevolence and an essay on the philosophy of calculus as well as what has come to be known as Bayes' Theorem. Two and a half centuries ago, Bayes affirmed both the Providence of God and the probabilistic nature of reality. This essay explores some implications of Bayes' Theorem in light of his theology. The central thesis is that it is fruitful to make the connection between Bayes' mathematical theory of probability, its implications when extended in time, and his view of God as the continuous in-breaking of the good tending to the benefit of all creation. In so doing, Bayes suggests ways to shed light on current theological and philosophical discussions, including theodicy, religion and science, and chance and Providence.

BAYESIAN THINKING

The Reverend Thomas Bayes, FRS (1702-1761) is best known today for his posthumously published *An Essay Towards Solving a Problem in the Doctrine of Chances* (1763), which lends the name to what is now known as Bayes' Theorem. Bayes published two other works, one anonymously, with the ungainly title, *An Introduction to the Doctrine of Fluxions, and a Defence of the Mathematicians Against the Objections of the Author of the Analyst*, so far as they are designed to affect their general *Methods of Reasoning* (1736), that mobilized his mathematical skills and practical reasoning to defend Isaac Newton's calculus, which accurately analyzed and predicted conditions, against Bishop George Berkeley's philosophical objections. Bayes' final work, published post-humously, was

theological, with the even more lumbering title of *Divine Benevolence: Or, An attempt to prove that the principal end of the Divine Providence and Government is the Happiness of his Creatures; being An Answer to a Pamphlet, entitled. Divine Rectitude or An Inquiry concerning the Moral Perfections of the Deity. With A Refutation of the Notions therein advanced concerning Beauty and Order, the Reason of Punishment, and the Necessity of a State of Trial antecedent to perfect Happiness* (1731).

Bayes was a Calvinist, who wrestled with the questions of Divine Providence, chance, and creaturely freedom. His defense of calculus probably got him into the Royal Society, but his mathematical theory gained no particular attention for two centuries. It was extended in application by Pierre-Simon Laplace (Salsburg 2001: 128). Still, Bayes remained on the fringes of probability analysis until the twentieth century, when Markov Chains and Monte Carlo Methods were put to practical use in analyzing and troubleshooting complex systems, including physics and chemistry (Metropolis & Ulam 1949; Metropolis 1953), and computers exploited the full power of his theory. Bayes' Theorem may be written as follows:

$$P(X|Y) = \frac{P(Y|X) \times P(X)}{P(Y)}$$

It describes how the probability of an event X changes related to the presence of another event Y. That change can be in fact, as when vaccinations reduce the probability of getting a disease. It can be in knowledge, as when the outcome of a test for a disease changes the known probability of having a disease. It can be used to test assumed probabilities, like the accuracy of a hypothesis.

Bayes' equation allows for probabilities to be dealt with mathematical precision. Specifically, he explicitly recognized that events in the world do not necessarily take place at random, that is, only dictated by the pure mathematics of degrees of freedom. Bayes allowed for analysis based on preexisting probabilities, the real world of facts and natural regularities as determined by law rather than "chance." Bayes implicitly defined causality probabilistically, not purely deterministically or merely correlatively. Smoking, for example, may cause cancer, but not so that all smokers get cancer and all non-smokers do not. Cause, in this case, means "increases the probability of." Alison Gopnick and Henry Wellman inquire:

What is causation anyway? . . . Traditionally, philosophers have approached this problem in several different ways. David Hume (1739) famously argued that there is no such thing as causation. Instead, there are simply associations between events. "Mechanists" like Kant in philosophy and Michotte in psychology . . . argued that causal relations involve particular spatiotemporal patterns, such as contact and launching. Piaget (1930) grounded causation in the immediate consequences of our intentional actions Recently, however, the philosopher James Woodward has articulated and formalized an alternative interventionist account of causation . . . that if there is a direct causal relation between A and B, then, other things equal, intervening to change the probability of A will change the probability of B. This view of causality is rather different from the associationist, mechanistic, or Piagetian views that underpin earlier work on the development of causal knowledge. But this account dovetails with causal Bayes nets; the models also relate causality to probability and intervention (2012: 1089).

Probabilities change in several ways. They can be changed by learning, as when a hypothesis becomes more accurate as new evidence arises, or by conditions, as when genes spread through a population of bacteria so it becomes antibiotic resistant. There can also be several sources of change for any given event such as wet grass which is dependent on the probability of humidity, rain, and sprinklers. Bayes' insights into how to handle probabilistic functions have been extended mathematically through time by Markov Chains and Monte Carlo Methods, a class of algorithms which predict how probabilities change as a chain of events unfolds.

These models are called random processes, but "random" is not exactly accurate. Each individual change is not so much "random" as weighted toward a particular outcome. The system evolves toward more probable states, and away from less probable ones. Other models of change over time, including changes of gene frequency due to survival pressure through evolutionary time, explicitly take into account how outcomes are shaped by a combination of events and changes in the probable number, kind, or results of those events.

Bayesian probabilities are sometimes called subjective, but that is not necessarily the case. Sometimes the prior probabilities (the known accuracy of a medical test, for instance) are known precisely, and specious subjective correlations, such as the lunar effect or astrological predictions, can be falsified by data. But the math works for calculations based on estimated or assumed

probabilities as well as observed probabilities. Bayesian reasoning has been applied to matters of faith, such as trying to figure out the probability that God exists, given the evidence (Swinburne 2003, 2010; Unwin 2003).

With the advent of computers and their capabilities for continuous recalculations, Bayes' Theorem became capable of doing, for the Cyber Age, what calculus did for the Industrial Age. Bayesian probabilistic models are used in robotics, aeronautics, user-friendly computer programs of all sorts, business and economic decision-making models, optimal ranking, expert systems, diagnostic programs, and spam filtering. Continually updating how a computer handles information or how a robot responds to stimuli creates machines capable of continuous improvement. Bayes' Theorem has proven powerful enough to shed light on the processes of evolution (Shultz 2011) and the nature of human reasoning (Agrawal 2013; Kördling & Wolpert 2004).

For two centuries, Bayes' defense of calculus was a footnote in history, his mathematical theorem infrequently used. His theological publication received even less attention. Long considered a reasonably cogent answer to a no-longer-asked question, Bayes' theological musings went the way of the millions of sermons, essays, and tracts written by thousands of divines through the ages. But the same mind that made the mathematical connections made the theological. It is intriguing to explore the connection between Bayes' mathematical theory and his view of God as the continuous in-breaking of the good tending to the benefit of all creation. In so doing, Bayes might suggest ways to shed light on current theological and philosophical discussions, including theodicy, religion and science, and, especially, chance and Providence.

BAYES' THEOLOGY

Bayes was a contemporary of Newton and a Calvinist who held an Augustinian worldview which strongly differentiated between the fallen world and the redemption to come and emphasized the Providence of God. Newton had provided paradigmatic evidence that God was a supremely rational mathematician, and thought to establish a link from nature to God through clear observation: "This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being" (1825: 388). But Newton unwittingly cleaved Providence from fate, and mind from mechanics, with the theory of gravity. Since a simple

equation was all that was required to explain the motions of the planets, a personal Being was no longer needed to explain the most determinative force in nature. Moreover, the same force that keeps the world providentially circling the sun kills unwary children. Thus, the view of nature as wholly mechanical and impersonal acquired a strong rational appeal. It eliminated the theodicy problem because the predictive power of both calculus and the theory of gravity seemed to accurately describe a universe made up of nothing but matter in motion.

If Bayes' view of God's benevolent, providential action is combined with his mathematical theorem, his worldview could be seen as consistent with both the Newtonian world and traditional theism by introducing a developmental viewpoint which addresses the tension between the real and ideal, the religious promises of blessings and the everyday realities of tedium and suffering, the promise of Providence and the erratic distribution of luck or fortune, the probabilistic--but not certain--relationship between virtue and reward, and between sin and punishment.

Bayes' pamphlet on *Divine Benevolence* is devoted to the idea that, if all of God's actions are seen under the one motivation of producing the greatest happiness for all creation, supposed tensions such as Law and Grace, God's justice with God's love, will be resolved:

If we suppose that God desires the happiness of his creatures, and at the same time the beauty and order of his works, if these two principles of action often clash and interfere, and set bounds to each other; this cannot be to represent him as governed by one uniform principle, tho' his love of order, and his love of his creatures, be both called moral rectitude: but if his moral rectitude be nothing else but a desire or inclination to preserve a constant regard to the general happiness of the universe in all his actions, then he is in this view represented as truly governed by one uniform principle; though we should afterwards find it very convenient to reckon justice, veracity, mercy, patience, &c. as particular species or branches of this rectitude (1731: 16).

It would be misleading to equate "happiness," as Bayes uses the term, with self-centered pleasure. Bayes was using it in the Aristotelian sense of *eudaimonia*, the soul fulfilling its purpose by being actively conformed to virtue. Even if Bayes used it in the Lockian sense of pursuit of the greatest

pleasure, Locke defined the greatest pleasure in terms of a mandate from God: "This is the only true touchstone of *moral rectitude*, and by comparing them to this law, it is that men judge of the most considerable *moral good* or *evil* of their actions; that is, whether as *duties* or *sins*, they are like to procure them happiness or misery from the hands of the Almighty" (1813: 348). In the *U.S. Declaration of Independence* (1776), Jefferson, following Locke, reasoned from the Laws of Nature and of Nature's God to self-evident truths, unalienable rights, and, finally, "Life, Liberty, and the pursuit of Happiness." In addition, Bayes suggested that divine benevolence can be squared with the world as it is if happiness is reframed as virtue increasing experience of, and satisfaction with, life *starting from the station and mission in life where one currently is*:

If we conceive of the goodness of God as an unbounded inclination to create happiness, and consequently suppose he has made the world as happy and as perfect as he possibly could, there are undoubtedly abundance of phenomena, the consistence of which with this supposition we cannot discern, and which we shall find some difficulty to persuade men are not incompatible with it: But if we only conceive of the divine goodness a most kind affection towards his creatures, and as inclining him to confer upon that universe of creatures he has made the greatest happiness of which they are capable, still supposing that their original capacities were fixed by his will and pleasure, we shall find it much easier to satisfy our selves, that there is nothing in any appearances of providence contrary to the most perfect goodness of the divine nature (1731: 71).

The continuous improvement of the world should not be understood simply as continual progress or increasing pleasure. Those ideas are anthropocentric or egocentric, while Bayes' point is theocentric. Scripture teaches that spiritual progress is often at the expense of material progress, involving suffering, grief, yearning, hard work, and rejection (Matt 5:3-11). But suffering for Christ's sake, to the glory of God and the benefit of one's fellow human beings, is fulfilling one's purpose: virtuous, constructive, and redemptive. True happiness, therefore, is found in doing God's will, even if the results, in this world, may vary. Taken together, Bayes' Theorem and theology suggest that even though progress may not be the inevitable result of any given action, or to be expected in a given lifetime (Isa 6: 9-13), it is worthwhile, because of the universally active grace of God, and all free beings are responsible to make proper choices from available options.

In a sort of evolutionary scale, a Great Chain of Being, Bayes prefigured Process Theology by extending the subjects of divine happiness from the "highest possible" beings to "insensible matter." God, Bayes concluded in a passage celebrating diversity, is benevolent by giving each being the highest happiness available to it:

the most happy universe is not one that consists of the greatest possible number of the most happy beings only; but one that consists of that, and the greatest possible number of beings next inferior to the first rank, and so downward, 'till we come to those that approach the nearest to insensible matter. This certainly must be allowed, unless it can be proved that the greatest possible number of the most happy beings having been created, no others can possibly be made. So that a most happy universe is so far from being unbeautifully uniform, that it must be most beautifully various; a most regular and orderly advance of perfection being made from insensible matter, without breaking the scale of beings, quite up to the highest possible rank. Strange therefore it is, that any, because he only sees the lowest part of this scale, should from hence infer a defeat of happiness in the whole (1731: 73).

Howard Van Till's treatment of "creaturely capabilities" is similar to Bayes' formulation:

the being of every creature--that is, every member of the creation, whether animate or inanimate--is defined not only by its "creaturely properties" but also by its characteristic array of "creaturely capabilities" to act and interact in particular ways, often in accordance with patterns--whether deterministic or probabilistic--that are empirically accessible to the natural sciences . . . how could it be that the outcome of [the actions of atoms and molecules] could lead to the vast array of astronomical and biotic forms that now comprise the universe? Only, I believe, as the outcome of God's continuing blessing on those creaturely capabilities (Cunningham 2007: 245-48).

Van Till, like Bayes, believes that God "acts by calling upon the creation to employ its creaturely capabilities to bring about a fruitful outcome" (Pennock 2001: 509). As Bayes put it:

Now, as the desire of some end must be the motive to any action, so 'tis the nature of the end designed, and which the action is proper to effect that renders it good or bad, fit or unfit to be performed. When therefore we

say, that God is in all his actions governed by the reasons and fitness of things, we must, I think, mean, if we would understand ourselves, that he is moved to every action by a regard to some good and valuable end, and always chooses that way of conduct which is most proper to bring about the end designed (1731: 15).

This view pictures God as more intimately involved in the world than a deistic designer; and more ethical than an impersonal force. God has good ends in mind for creation, creatures experience happiness or unhappiness in response to felt needs but, in the ultimate Providence of God, true happiness is fulfilling the creature's God-ordained purpose. Ethically, the difference between teleological and deontological ethics becomes a matter of perspective. Virtue is invariant as to goal, but varies according to proper action depending on one's available options and probable outcomes. Everything gets a chance to advance or contribute to the harmony and good of all. This view is also like a Whiteheadian sort of "alluring God," that echoes John Polkinghorne's refinement of Monod:

Jacques Monod characterized evolution as involving an interplay between the contrasting tendencies of Chance and Necessity. We can accept his analysis, provided we understand the meaning of these words in the right way. Chance is not intrinsically capricious or meaningless, but it simply stands for the contingent particularity of what has actually happened. The richness of created possibility is so great that only a small fraction of what might have happened has actually occurred. Necessity stands for the lawful regularity of the world, to whose specific and finely-tuned character the atheist Monod paid too little attention. Evolutionary process is the shuffling exploration of potentiality, as creation's inherent fruitfulness is brought to birth through creaturely happenstance. The right theological way to think about this was formulated by Charles Kingsley and Frederick Temple in the years following 1859. Each said that, while God could no doubt have produced a ready-made creation, the Creator had chosen to do something cleverer than that in making a world in which "creatures could make themselves" (2009: 169).

Van Till, too, assumes a benevolent, but not magically interventionist, God, Who is strategic in creating and redeeming the universe. Van Till echoes Bayes when he writes: "Some have chosen a perspective that presumes the existence of gaps in the creation's formational economy--gaps to be bridged by occasional episodes of form-imposing divine intervention. My own choice

strongly favors the concept of a creation optimally gifted by the Creator with a robust and gapless formational economy” (Pennock 2001: 510). Bayes’ *Divine Benevolence* is a specialized tract, written in response to another tract. However, even if Bayes assumed a developmental, even a gradualist, view of the usual working of Providence, it does not preclude radical, even catastrophic, God-directed events in history. It is the gradual build-up of force, after all, that produces earthquakes and volcanic eruptions.

God is said to be, among other characteristics, personal, all-good, omniscient, almighty, and omnipresent. Therefore, consciousness, goodness, truth, beauty, miracles, religious experiences, and design are usually taken as evidence for God. But for Bayes, in classic Calvinist style, nothing is beyond the Providence of God. Commenting on Proverbs 16:4, Bayes notes that: “The meaning of which verse is, I apprehend, very well expressed in bishop Patrick's paraphrase of it. 'The Lord disposes all things throughout the world to serve such ends as he thinks fit to design, which they cannot refuse to comply with. For if any men be so wicked as to oppose his will, he will not lose their service; but when he brings a public calamity on a country, employ them as the executioners of his wrath'" (1731: 38). The real world includes both sides of the evidentiary coin, order and disorder, elegance and awkwardness, beauty and ugliness, benevolence and harm. Polkinghorne proposes that:

Behind all this thinking there lies a kind of natural theology appealing to the order and fruitfulness of the world as signs of the divine Mind and Purpose that undergird its history. Yet an honest theologian must also admit that this is only one half of the story of creation. As well there is its shadow side, the destructiveness and apparent wastefulness of nature that must also be taken into account (2009: 168).

Bayes is more sanguine concerning such dilemmas, suggesting that:

Some particular appearances it may perhaps be hard to reconcile to our ideas of perfect goodness, but we shall ordinarily find that these are the effects of general laws, that in the main are useful and beneficial; and it is not to be expected but that we, who have but very imperfect views of things, should sometimes meet with difficulties that we can't easily account for, though we shall never find any that really overthrow our notion of a perfectly good and benevolent Deity (1731:23-24).

There are many answers to the problem of evil, but they all boil down to variations on one theme: "There is only one broad strategy possible for any theodicy. It is to suggest that the world's suffering is not gratuitous but a necessary contribution to some greater good which could only be realized in this mysterious way. The problem of evil is to be met by setting it within that wider context in which it can dissolve into fulfillment" (Polkinghorne 2005: 73). Fulfillment can be external, in the form of measurable accomplishments, or internal in the form of growth. Viktor Frankl put it this way:

If there is meaning in life at all, then there must be a meaning in suffering. Suffering is an ineradicable part of life, even as fate and death. Without suffering and death, human life cannot be complete. The way in which a man accepts his fate and all the suffering it entails, the way in which he takes up his cross, gives him ample opportunity--even under the most difficult circumstances--to add a deeper meaning to his life Everywhere man is confronted with fate, with the chance of achieving something through his own suffering (2006: 67-68).

In *Divine Benevolence*, Bayes offers his attempt at a solution based on the unmerited grace of God:

A man, for instance, has no more reason to complain of any arbitrary or partial proceeding in the divine being, though with all his boasted merit he should not be able to attain the happiness of angels; than a brute can complain that he is utterly incapable even of that happiness, which men may enjoy in this life. But all that follows from what I have asserted is, that God has other reasons for bestowing happiness upon, and for diversifying the happiness of his creatures, besides a regard to their merit (1731: 63).

Suffering, if it does nothing else, stimulates a search for solutions ameliorating the source of that pain, including the "inner triumph" of choosing the heroic path in the face of circumstance (Frankl 2006: 72).

CHANCE AND PROVIDENCE

Philosophical positivism, including its political-theological child fundamentalism, demands logical but erroneous black-and-white thinking: statements are factual or false, the world is determined or chaotic. But in reality, most statements are more or less accurate, and events more or less probable.

Some words used to deal with the unpredictability of life are luck, blessing, grace, judgment, and law. The word "luck" is generally used when an event is experienced as impersonal. A mechanical failure which results in an accident is impersonal, and bad, hence "bad luck." Winning the lottery is impersonal, and good, therefore "good luck." Blessing, grace, and judgment refer to good or bad undeserved or deserved events. Law refers to predictable regularities observed in nature or moral rules given to guide the exercise of free will.

When events like accidents, diseases, and natural disasters are referred to as happening "by chance," it generally means that they are not chosen or cannot be made sense of by those affected. If two responsible drivers have an accident, it is called a "chance event." If one of the drivers was driving drunk, it would be caused by the drinker. Even though the probability of getting hit by a hurricane is known for most areas, getting hit by a hurricane is referred to as a chance event because hurricanes do not choose where they go. Natural events are called the "judgment of God" if those affected have characteristics which are judged by the person assessing God's action to warrant God's discipline, and "acts of God" by insurance companies to absolve humans of legal responsibility. Using the word "chance" to describe an event may reduce guilt, and is appropriate when people feel bad for events beyond their control.

Given the probabilistic nature of nature, true violations of natural law are very rare. Bayes notes that "no finite number of returns would be sufficient to produce absolute or physical certainty" (1763: 409). Certainly, no human healings, financial windfalls, or rescues from danger--things often referred to as miracles--qualify as true violations of natural law. But the unexpected, unpredictable nature of events, good and bad, need not disprove a Providential ordering of the universe. Bayes saw Providential order in the world: "With respect, therefore, particularly to the course of events in nature, it appears, that there is demonstrative evidence to prove that order of events which we observe, and not from any of the powers of chance" (1763: 414). In his introduction to Bayes' publication, Richard Price wrote that, "therefore, the frame of the world must be the effect of the wisdom and power of an intelligent cause; and thus to confirm the argument taken from final causes for the existence of the Deity" (1763: 373). Paul Ewart deals with chance this way:

"How can God be sovereign if random events occur?" The answer proposed here, that God can be sovereign only when random events occur,

will involve a revision of what is meant by sovereignty. In this view chance does not exist as an accidental by-product in Creation so that God has to intervene periodically (i.e. very often!) to put things right. On the contrary, God may have intentionally made a world where chance plays a positive and creative role. This would apply not only to the world in general but also to particular events that we experience personally. If we can appreciate that chance fulfills an essential role it may help us live with it in gratitude rather than resentment (2009: 116).

In fact, Polkinghorne observes, a degree of chance is necessary for the universe to function at all:

Science has increasingly come to recognize that the regimes in which it is possible for genuine novelty to emerge are always regimes held "at the edge of chaos." Too far on the orderly side of that frontier, and things are too rigid for there to be any possibility beyond the mere rearrangement of what already exists. Too far on the disorderly side, and things are too haphazard for any novelties that might emerge to be able to persist (2009: 169).

Most events in the world are not random. For example, the mathematical probability that 2 things, designated H and O, taken three at a time will produce H-O-H is one out of 8. But, if the H's are hydrogen (H_2) molecules and the O's are oxygen (O_2), the probability that they will produce H_2O (H-O-H) is over 99 percent when the hydrogen is burned. *Atoms do not combine at random.* There is, in fact, an entire branch of science devoted to discovering the prior probabilities for how atoms combine--chemistry. Not only chemistry, but science itself, is possible because so little in the world occurs "by chance," that is, as simple mathematical possibilities would suggest. There is an *a priori* order to the world, and the natural sciences are sophisticated observational systems by which prior probabilities are cataloged and the effects of changes (under specific conditions) recorded. Probabilities change as conditions change. Bayes saw no blasphemy in such a fundamental idea of God-directed progress:

I know it is usually presumed that all the works of God are most perfect; and thus they undoubtedly are, if by this be meant, that they are exactly agreeable to the highest goodness and wisdom, and have nothing in them that implies want of perfection in their author. But that the universe has such a degree and quantity of perfection, as that no addition can possibly

be made to it even by infinite wisdom and power, seems to me so far from being what we ought to suppose true; that I question whether the notion itself be not perfectly unintelligible (1731: 68-69).

Since the rise of materialism, existentialism, and postmodernism, the idea of chance has been conflated--and habitually equated--with meaninglessness, unconsciousness, and purposelessness. But that need not be the case. In lotteries, for example, people quite purposefully and quite successfully use a pure, Frequentist chance design to raise money. Many human activities such as traffic flow or the stock market operate with large uncertainties, but are neither wholly unpredictable nor meaningless. Scientific experiments are often undertaken repeatedly to discern underlying order where none would be apparent by considering a single case. "Meaningful" or "meaningless" are not properties, they are assessments based on the effects on people and possibilities for the future. John Hall suggests that:

So pervasive is the association of purposelessness with chance that I propose to abandon the term and use "stochastic" to describe what we are considering instead. A stochastic process is one for which there is more than one possible outcome and the outcome that actually occurs cannot be predicted with certainty. For many such processes, the set of possible outcomes is associated with a probability distribution. The question of whether a stochastic process, or the system of which it is a part, has any purpose cannot be prejudged. The answer must be determined by studying the system itself and any purposes claimed for it (2009: 4).

Dennis Polis writes that the universe operates by a generate-and-test means-ends strategy mirrored in artificial intelligence (AI) and the scientific method (2010: 62). Hall concurs that: "On the most minute level, God may act by determining some or all of the seemingly stochastic outcomes of quantum processes. On another level, God may alter the outcomes of chaotic processes through minuscule perturbations" (2009: 10). Paul Carr goes even further, noting the necessity of randomization within a predictable framework, for life, survival, and, perhaps, consciousness itself: "Chance operating within a law-like framework is the basis of the inherent creativity of the natural order in its ability to generate new forms of matter and life" (2004: 937). Polis concludes that: "To judge whether nature is well-designed, one needs to understand that God is not merely 'designing' an optimal eye, knee, or back. He is 'designing' a consistent and harmonious universe capable of evolving organisms able to achieve some sensible purpose" (2010: 61).

CHOICE AND VIRTUE

As a Presbyterian in the eighteenth century, Bayes subscribed to the *Westminster Confession of Faith* as well as the *Westminster Larger and Shorter Catechisms*. The *Larger Catechism*, especially questions 91-153, spells out the duties in great detail that God requires of humans and sins forbidden. The moral law shows God's will to humankind "directing and binding everyone to personal, perfect, and perpetual conformity and obedience there-unto . . . promising life upon the fulfilling, and threatening death upon the breach of it" (2002: 208). The law, therefore, can be viewed as a way to make people happy, that is, virtuous through conformity to the will of God. Bayes muses that:

By the goodness of God we ought, I think, to understand *a disposition to communicate happiness to his creatures in general*; so that the end of goodness is answered by every action that produces more happiness than misery. By justice we are to understand *a disposition to take care of the support of the cause of virtue and righteousness, by the distribution of proper rewards and punishments* (1731: 10).

Still, the *Westminster Confession* says that humans are not capable, or even desirous, of accomplishing virtue on their own (2002: 128). Bayes seems, therefore, to rely on believers "being quickened and renewed by the Holy Spirit . . . thereby enabled to answer this call, and to embrace the grace offered and conveyed" (2002: 134). In Bayes' view, "it is plain that we are so formed as necessarily to approve of kind and beneficent actions, and to dislike a cruel and barbarous character" (1731: 24). So, the work of the Holy Spirit in humans motivates them to reveal, embody, and glorify God by one's life (2002: 195).

The Bible recognizes that a course of action may be good and right overall, but success and blessings are not certain: "The rain falls on the just and the unjust" (Matt 5:45), and "the race is not always to the swift or the battle to the strong, nor does food automatically come to the wise or wealth to the brilliant or favor to the learned; but time and chance happen to them all" (Ecc 9:11). Still, righteous behavior increases one's probability of happiness and blessings (Ps 1), but does not guarantee them, in much the same way that eating right and exercising regularly increases the probability that one will live a long and healthy life, but does not guarantee it. Therefore, the Bible can

affirm, without contradiction, that blessings follow righteous behavior and that the righteous often suffer. But that does not absolve people from the responsibility to choose to work for the best probable outcome for their actions.

Human beings spend a great deal of their lives anticipating the future, hoping for good outcomes and anxious about bad ones. Discussions of the human predicament regarding the future generally take one of three directions: (1) the future is closed, determined by God or the mechanics of nature, unfolding like a novel; (2) the future is open, free, almost infinite in its possibilities; and (3) the future is a human projection. From a Bayesian perspective, the future is predictable, but not certain, and changeable within limits. The future is determined in that it is limited to a range of possible outcomes, yet undetermined because it is probabilistic within that range. As probability becomes actuality, some possibilities are lost and new possibilities are created. People are, therefore, responsible, not just for their past actions and decisions, but for the future as well.

Morality is inherently temporal as God is active transforming the world through human actions and changes in probabilities which change the givens of life. Polkinghorne recalls that: "Karl Barth says of the Christian God that: 'Without God's complete temporality the content of the Christian message has no shape.' That is because the Christian gospel is an unfolding drama of redemption, not a timeless moment of illumination" (2005: 91). And Bayes says that people are right to judge each other on the basis of works, even though God alone knows the heart:

We indeed can only value persons from their actions, because 'tis by this means only we form a judgment of their internal temper; but he, who immediately discerns the inward dispositions of the mind, can have no reason to wait till these be discovered by external actions, in order to know where his love and esteem should be fixed (1731: 60).

If Bayes had addressed the challenge from his younger contemporary David Hume--that ethical thinkers slide mindlessly from "is" to "ought" without making clear, reasonable connections (1793: 335)--he would have had all the tools to provide an effective answer to Hume's critique. Present actions produce future conditions; actions produce "is's," therefore they are necessarily guided by "oughts." So, even by Hume's own limited definition of

morality as arising from "sentiments," one ought to act in such a way as to produce a more probably pleasant future than an unpleasant one.

CONSCIOUSNESS

In the aftermath of Newton, the materialist worldview came to leave out, not only God, but the most basic empirical evidence of all--human experience, including values, cognition, consciousness, and the very experience of experiencing. Thomas Nagel (2012), writing from an atheistic philosophical perspective, notes that any worldview that solves the problem of consciousness by ignoring it or explaining it away gives up far too much to be considered "scientific" in any reasonable sense of the word.

"Consciousness," Nagel avers, "is the most conspicuous obstacle to a comprehensive naturalism that relies only on the resources of physical science" (2012: 35). As Nagel extrapolates:

I find it puzzling that this view of things should be taken as more or less self-evident, as I believe it commonly is. Everyone acknowledges that there are vast amounts we do not know, and that enormous opportunities for progress in understanding lie before us. But scientific naturalists claim to know what the form of that progress will be, and to know that mentalistic, teleological, or evaluative intelligibility in particular have been left behind for good as fundamental forms of understanding. It is assumed not only that the natural order is intelligible but that its intelligibility has a certain form, being found in the simplest and most unified physical laws, governing the simplest and fewest elements, from which all else follows . . . perhaps part of the appeal of this conception is that if the laws are simple enough, we can come to rest with them and be content to say that this is just how things are (2012: 20).

Furthermore, Nagel continues: "The fundamental elements and laws of physics and chemistry have been inferred to explain the behavior of the inanimate world. Something more is needed to explain how there can be conscious, thinking creatures whose bodies and brains are composed of those elements. If we want to try to understand the world as a whole, we must start with an adequate range of data, and those data must include the evident facts about ourselves" (2012: 20). Oskar Gruenwald concurs that: "One of the great ironies of twentieth-century science is that it conquered and redefined academe and the entire culture by bracketing values, faith and God, only to find itself

confronted with ethical, meta-scientific, and metaphysical questions while lacking the resources for credible answers" (2005: 144).

Bayes did not address consciousness; he assumed it. Bayes wrote just after René Descartes and John Locke made the first attempts to write about consciousness as understood in modern times. Prior to that time, what we now think of as consciousness was dealt with using concepts like knowing, heart, soul, and the image of God (*imago Dei*). In the *Westminster Confession*, people were created in the image of God with "reasonable and immortal" souls which perceive, suffer, behold, and, presumably, feel joy. Hearts can have God's law "written on them" and be deceitful, humbled, governed, and purified. Bayes subscribed to the *Larger Catechism* notion that people are made in the image of God, which includes knowing, right motivations, and power "yet subject to fall," and "having the seeds of repentance unto life, and all other saving graces, put into their hearts, and those graces so stirred up, increased and strengthened, as that they more and more die unto sin, and rise into newness of life" (2002: 197, 205).

Bayes was almost certainly familiar with both Locke and Descartes and, as a mathematician-theologian, may well have favored Descartes' view that consciousness does not come from unconscious matter. Except that, for Bayes, consciousness would have been breathed into creatures, from the lowest to the highest, by God, for their benefit, rather than attached through a particular point like a gland.

Far from having solved the problem of consciousness, Nagel suggests that the materialistic philosophy that pervades the natural sciences "solves" the problem by ignoring it: "The existence of consciousness is both one of the most familiar and one of the most astounding things about the world. No conception of the natural order that does not reveal it as something to be expected can aspire to the outline of completeness" (2012: 53). Polis puts it more succinctly: "Naturalists reject Mind by projecting the science into a mechanistic conceptual space excluding ends" (2010: 34). And yet, as Polis points out: "For a naturalist, if there is mind at all, there is mind in nature. There is no place else for it to be" (2010: 43).

Worse, Nagel contends, since consciousness is the only way we know anything, and materialism reduces consciousness to an epiphenomenon: "Evolutionary naturalism implies that we shouldn't take any of our convictions

seriously, including the scientific world picture on which evolutionary naturalism itself depends" (2012: 28). Bayes (and Newton, for that matter) would surely agree.

A Bayesian explanation of consciousness goes as follows: If God wills the happiness of His creatures, the probability of flourishing is enhanced by remembering (Klein 2010: 13). Memory, a picture of how things have worked out in the past, is, therefore, inherently future-oriented. It allows the past to connect to the future as the stuff of knowledge, reason, logic, and wisdom. As Thomas Suddendorf and Michael Corballis note, memory has more survival value than perception alone: "Declarative or explicit memories provide greater flexibility because they can also be voluntarily triggered top-down from the frontal lobes, rather than bottom-up through perception They may be regarded as decoupled representations that are no longer directly tied to the perceptual system" (2007: 300).

Vilayanur Ramachandran and William Hirstein suggest that qualia, awareness of being aware, are adaptive and evolved "because of their role in facilitating non-automatic, decision-based action," and that "the single most important principle underlying the mechanisms of perception and conscious experience" is that "they may have evolved exclusively for extracting statistical regularities from the natural world" (1997: 429, 453). Consciousness of facts, "statistical regularities" in the natural world, is one part of wise and ethical action, a good gift of God. Bayes concludes that "a tendency or fitness in things to produce happiness, or to prevent mischief, is that which constitutes the fitness of things; but whatever it be, whether a tendency to promote happiness, or order and beauty, or the like, that renders actions fit to be performed, this must be mentioned in the definition of divine rectitude" (1731: 15).

CONCLUSION

Bayes lived at the time of the invention of calculus, but prior to the extension of his theory by means of computers, Markov Chains, and Monte Carlo Methods, so he never saw the full mathematical power of his theory explored. It is not recorded that Bayes himself ever combined his theology and mathematical theory. But his two ideas, taken together, suggest an intriguing and quite contemporary way to look at the Providence of God, the problem of chance and reliability in the universe, the relation between Christianity and

science, the human need for meaning, and the probabilistic nature of outcomes which influence ethical decision-making.

Bayes' essays, even the one defending calculus, may be seen as compatible with Polkinghorne's view of God acting through the "complex dynamical systems" of the universe (2005: 46), Elizabeth Johnson's "Risk-taking God," and Van Till's "creation generously gifted by God with a robust and gapless formational economy" (Cunningham 2007: 298, 244). Johnson virtually quotes the *Westminster Confession of Faith*, when she writes: "God's providential guidance is accomplished in and through the free working of secondary causes . . . random occurrences themselves are secondary causes with their own integrity" (Cunningham 2007: 297).

Bayes' equation might extend theological inquiry by means of mathematics as well as through evidence-based, historically informed reason, and shed light on how, even in a universe where suffering is present, God can be powerful, just, and reliable, but not magical or capricious. Bayes' God is neither a deistic clock-maker or impersonal force, on the one hand, nor an inscrutable interventionist tinkerer, on the other. As Polkinghorne intimates: "The world in fact discerned by modern science has an openness in its becoming which is consonant, not only with its being a world of which we are actually inhabitants, but also with its being a world which is the creation of the true and living God, continually at work within its process" (2005: 112). Paul Carr sums it up: "Does God play dice? Yes and no. Yes, if one considers the random nature of evolution and fractal statistics. No, if one considers their globally deterministic laws and rules. 'God plays dice with the universe, but they're loaded dice'" (2004: 937).

God need not be limited to either playing at dice with the universe or controlling precisely how everything turns out. A Bayesian God redesigns the dice themselves as the outcomes of rolls become apparent. God creates the world, sustains, and sanctifies it (Col 1:11-17). The best course for humans, therefore, is to conform their will to God's will, exercising their true nature in benevolent living (Col 3:1-17), guided and empowered by God to His glory and the benefit of the world.

REFERENCES:

- Agrawal, Anurag. 2013. Living in a Bayesian World: Scientific Deduction Through Induction. *Current Science* 102 (5): 676-77.
- Bayes, Thomas. 1731. *Divine Benevolence*. London: John Noon.
- _____. 1763. An Essay Towards Solving a Problem in the Doctrine of Chances. *Philosophical Transactions of the Royal Society* 53: 370-418.
- Carr, Paul H. 2004. Does God Play Dice? Insights from the Fractal Geometry of Nature. *Zygon* 39 (4): 933-40.
- Cunningham, Mary Kathleen, ed. 2007. *God and Evolution: A Reader*. New York: Routledge.
- Ewart, Paul. 2009. The Necessity of Chance: Randomness, Purpose, and the Sovereignty of God. *Science & Christian Belief* 21 (2): 111-31.
- Frankl, Viktor E. 2006. *Man's Search for Meaning*. Boston, MA: Beacon.
- Gopnick, Allison & Henry M. Wellman. 2012. Reconstructing Constructivism: Causal Models, Bayesian Learning Mechanisms and the Theory Theory. *Psychological Bulletin* 138 (6): 1085-1108.
- Gruenwald, Oskar. 2005. The Third Culture: An Integral Vision of the Human Condition. *Journal of Interdisciplinary Studies* XVII (1/2): 139-60.
- Hall, John W. 2009. Chance for a Purpose. *Perspectives on Science & Christian Faith* 61 (1): 3-11.
- Hume, David. 1739. *A Treatise of Human Nature*. London: John Noon.
- Klein, Stanley B., Theresa E. Robertson & Andrew W. Delton. 2010. Facing the Future: Memory as an Evolved System for Planning Future Acts. *Memory & Cognition* 38 (1): 13-22.
- Kördling, Konrad P. & Daniel M. Wolpert. 2004. Bayesian Integration in Sensorimotor Learning. *Nature* (15 January): 244-47.
- Locke, John. 1813. *An Essay Concerning Human Understanding*. London: Cummings, Hillard & Buckingham.
- Metropolis, Nicholas & Stanislaw Ulam. 1949. The Monte Carlo Method. *Journal of the American Statistical Association* 44 (247): 335-41.
- _____, et al. 1953. Equation of State Calculations by Fast Computing Machines. *Journal of Chemical Physics* 21 (6): 1087-92.
- Nagel, Thomas. 2012. *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature is Almost Certainly False*. Oxford: Oxford University Press.
- Newton, Isaac. 1825. *Newton's Principia: The Mathematical Principles of Natural Philosophy*. Tr. Andrew Motte. New York: Daniel Adee.
- Pennock, Robert T., ed. 2001. *Intelligent Design Creationism and Its Critics*. Cambridge, MA: MIT Press.
- Polis, Dennis. 2010. Evolution: Mind or Randomness? *Journal of Interdisciplinary Studies* XXII (1/2): 32-66.

- Polkinghorne, John C. 2005. *Science and Providence: God's Interaction With the World*. W. Conshohocken, PA: Templeton Foundation Press.
- _____. 2009. Scripture and an Evolving Creation. *Science & Christian Belief* 21 (2): 163-73.
- Salsburg, David. 2001. *The Lady Tasting Tea*. New York: Henry Holt.
- Shultz, Susanne, Christopher Opie & Quentin D. Atkinson. 2011. Stepwise Evolution of Sustainable Sociability in Primates. *Nature* (10 November): 219-22.
- Suddendorf, Thomas & Michael C. Corballis. 2007. The Evolution of Foresight: What is Mental Time Travel, and is it Unique to Humans? *Behavioral and Brain Sciences* 30 (3): 299-313.
- Sun, Eric, et al. 2010. The Contributions of Improved Therapy and Earlier Detection to Cancer Survival Gains, 1988-2000. *Forum for Health Economics & Policy* 13 (2): 1-20.
- Swinburne, Richard. 2003. *The Resurrection of God Incarnate*. New York: Oxford University Press.
- _____. 2010. *The Existence of God*. New York: Oxford University Press.
- Ramachandran, Vilayanur S. & William Hirstein. 1997. Three Laws of Qualia: What Neurology Tells Us About the Biological Functions of Consciousness, Qualia and the Self. *Journal of Consciousness Studies* 4 (5-6): 429-58.
- Unwin, Stephen D. 2003. *The Probability of God: A Simple Calculation That Proves the Ultimate Truth*. New York: Crown Forum.
- Westminster Confession of Faith. 2002. *The Book of Confessions, Constitution of the Presbyterian Church (U.S.A.)*. Part I. Louisville, KY: Office of the General Assembly.

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