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God, Man, Chaos and Control: How God Might Control the Universe

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Introduction

In 1911 a Belgian Chemist by the name of Ernest Solvay hosted the world's leading scientists for a weekend of discussions and debates in Paris, now referred to as the First Solvay Conference. The youngest invitee was none other than Albert Einstein, at the age of twenty-two. By the Fifth Solvay Conference in 1927, when Albert Einstein was an established member of the scientific community, the main topic on the discussion floor was the newly founded theory of quantum mechanics. A founding principle of quantum mechanics was that one cannot determine both the precise location and momentum of an electron with absolute certainty. This concept is known as the Heisenberg Uncertainty Principle.[1] Because the Uncertainty Principle, discussed at the conference, challenged a basic tenet of physics, claiming that the universe was inherently uncertain, it offended Albert Einstein's sensibilities. His reaction to this aspect of quantum mechanics was "God would not play dice with the universe."

[1] Quantum mechanics was first proposed by Schrödinger and Heisenberg. One of its primary concepts states that at very microscopic sizes—those shorter than Planck's length, $1.616199(77) \times 10^{-35M}$—the location and momentum of an object cannot be determined simultaneously. One can state with a certain probability that an electron or other object would be present at a particular location, but not with certainty, except at the expense of knowing its velocity and motion.

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Einstein believed that the physical principles that operate the universe must be precise and always quantifiable. His dismissal of quantum mechanics, a theory that has since been validated in a variety of experiments, is a widely cited example of an error made by a great genius. However, one could argue that Einstein's reservation about quantum mechanics reflects sensitivity for a deterministic nature of the universe that bridges the gap between science and theology. The acceptance of quantum mechanics as a factor in—and not a rejection of—God's method for affecting our reality opens a "backdoor" for divine intervention to affect physical events without the possibility of human detection.

The possibility that quantum mechanics represents a mechanism for God's control of the universe has been discussed by both physicists and theologians in the last few decades.[2] Most prominently Nicolas Saunders[3] and his critics have focused on whether advances in physics allow what Saunders calls SDA (Special Divine Action) to be part of the current universe as we understand it. Saunders concluded that SDA was not consistent with his understanding of modern physics. However, the discussion centered on an aspect of quantum mechanics that is still poorly understood, namely whether quantum mechanics is "deterministic," in its ability to provide ontological certainty even if there is no epistemological certainty. In other words, the aspect in question is whether the outcome of an immensely complex quantum interaction is predictable if all the variables are known in advance. In the years since Saunders first published, new theories have been developed to push this conversation further than ever before.

The purpose of this article is to review the problem of free will and divine intervention from the prism of Jewish sources, within the context of modern science. Among the many lenses the Jewish tradition provides for us to frame history is the division between times of open miracles and hidden miracles. The Bible is full of open miracles, divine revelation, and prophecies. Whereas there is controversy among rabbinic scholars and theologians about whether the miracles happened through natural or supernatural forces, either way, the miracles were still immediately recognizable as acts of God. However, since the destruction of the Jerusalem

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2 For a few very recent examples: *The Divine Order, the Human Order, and the Order of Nature: Historical Perspectives,* Edited by Eric Watkins (Oxford University Press); Jeremy Brown, *New Heavens and a New Earth: The Jewish Reception of Copernican Thought* (Oxford University Press, 2013); Moshe Meiselman, *Torah, Chazal & Science* (New Jersey: Israel Bookshop Publications, 2013); Yoram Bogacz*, Genesis & Genes* (New York: Feldheim, 2012).

3 Nicholas Saunders*, Divine Action and Modern Science* (Cambridge: Cambridge University Press, 2002).

Temple in 70 CE, those aspects of the Jewish understanding of God's manifestation are absent from our modern world. Religious philosophers in the Jewish intellectual legacy, who will be discussed below, have offered many explanations for how God may intervene in our lives in a post-open-revelation era. Furthermore I will focus on more recent advances in the understanding of quantum mechanics as they have altered the discussion since a decade ago when Saunders concluded that SDA was not consistent with his understanding of modern theories of nonlinear dynamics (a theory that will be discussed in greater detail later) and quantum mechanics.

Free Will and God's Intervention: the Dilemma

One of the unresolved dilemmas that have troubled monotheistic religions over the past two millennia is the apparent contradiction between man's free will and providence, which is God's plan for the world and universe. On the one hand, the dilemma assumes that in order for accountability, human choice must be free. On the other hand, God has a specific plan for the future of the world. During times of miracles and revelation, God's immediate influence over world events and personal lives was unquestionable. However, in a time where God's immediacy is not inherently apparent, defining the nature of free will's relationship with divine providence is much more difficult.

At first approach, the Jewish tradition appears to be most comfortable with the view that man has unlimited free choice. This tradition begins with the text of the Bible, God telling the people of Israel: "See I have placed before you today two choices, those that will lead to a blessing and those that will lead to a curse" (Deuteronomy 11:26). In the most central of Jewish prayers, the Shema, the second of the three paragraphs deals extensively with the concept of reward and punishment, in response to good or bad. As Saadiah Gaon in the 10th century suggested, it would be inconceivable that God would reward or punish people based on their actions if they did not have free choice.[4]

However, one only need to look earlier in the Hebrew Bible for a contradicting source. God tells Abraham in a prophetic conversation: "Your descendants will be strangers in a land that is not theirs where they will be enslaved and worked for four hundred years. And the nation whom they will serve, I will judge them and afterward [your descendants] will leave with great wealth" (Genesis 15:13-14). This declaration by God would seem to imply that Abraham, his descendants, and the civilization

[4] Rabbi Saadiah ben Yosef Gaon c. 882–942. *Emunot v-Deot*, Treatise 5, standard edition.

of Egypt will have no agency in preventing these events from unfolding in any other way than God decreed. This would seem to imply that God's divine providence, and not man's independent free choice, determines the course of history.

Furthermore, with regard to the exodus story, God seems to transcend the boundary of influencing global events to influencing the choices of an individual person. The verses in the exodus story where God hardens Pharaoh's heart can be interpreted as divine influence over free will.[5] This story demonstrates a biblical understanding that God does indeed have a mechanism to alter personal free will.

However, this unique story may be interpreted as the exception that proves the rule exemplifying God's reticence to manipulate free will. At no other point in the biblical stories does it recall this device again, even when it would have been advantageous. Moreover, the language of the verse can be read and interpreted differently. It is not clear that God forcibly changed Pharaoh's mind or independently hardened his heart. The verse could imply that God manipulated external events in such a way as to subtly influence Pharaoh to harden his own heart.

If the two precepts of free will and divine providence are true, God must influence the world and human action while not trampling on free choice, a balance that seems impossible. This paradox has troubled religious philosophers from a variety of religions for at least two millennia.[6] According to Josephus this dilemma was one of the major factors responsible for the development of different Jewish sects at the time of the second Temple.[7] The Sadducees,[8] Pharisees, and Essenes each had a widely disparate view on reconciling the unlimited free choice of individuals with the belief in a specific divine plan that guides events in the world. The Essenes[9] believed in predestination and vastly limited the scope of man's apparent free will. In contrast, the Sadducees believed that God's involvement in the world did not extend to controlling events. Finally, the Pharisees, who formed the basic tradition of rabbinical Judaism throughout the past two millennia, took a balanced approach and attempted to reconcile the inherent contradiction of faith in an activist deity who planned

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5 See Exodus 9:12 and biblical commentaries.

6 See R.C. Sproul, *Willing to Believe: The Controversy over Free Will* (Grand Rapids: Baker Books, 1997).

7 *Antiquities*, 13:5:9.

8 For a brief description of this sect see the insert Sadducees in the Jewish Encyclopedia.

9 For a brief description of this sect see the insert Essenes in the Jewish Encyclopedia.

and controlled events in the world, and faith in the primacy of free choice for individuals. This dichotomy fueled many discussions in rabbinic Judaism.[10]

Returning to the dilemma of reconciling free will with divine intervention in a modern context, it is clear that in order to be considered free will, free-willed choice has to be unconstrained by the laws of nature and not determined by physical phenomena. Therefore, if the universe contains free will, then an exercise in free will must transcend both the determinism of classical physics and the randomness of quantum mechanics. This definition of free will demands the existence of each person's persistent consciousness free from a pure causal influence from outside physical sources.[11] However, the classical understanding of divine providence assumes that while individuals may influence the events around them, it is only with Divine approbation that the world is changed.[12] At the extreme, the two claims that free will exists and that God's providence influences the future are undeniably at odds with one another. Even if we suggest that the paradox of unfettered free will and divine providence is easier to reconcile as the degree of control one assumes that God chooses to exerts over day-to-day events diminishes, the very existence of God's power of providence, whether it is used or not, maintains the paradox.

In addition, to further clarify the relationship between an omniscient deity and the freedom of man, a parallel issue must be considered: the issue of free choice and divine foreknowledge. Some Jewish philosophers and theologians who believed that God accurately knows what choices

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10 In the rabbinic literature, the most famous avowal of both God's providence and man's free will is made by Rabbi Akiva, who is recorded as saying, "everything is seen and freedom of choice is given" (Mishnah *Avot* 3:19). Though commonly understood to mean that everything is *foreseen*, there have been those who interpreted the term in the sense of *not able to be hidden*. For example, Ephraim Urbach writes, "The content of the Mishna likewise shows that R. Akiba's intention was not to resolve the contradiction between [God's] foreknowledge and [man's] freewill, but to make man realize his responsibility for his actions. This responsibility is grounded in two factors: in the permission given to man to choose his own way and in the realization that man is destined to account for his actions before Him who sees and examines his ways" (Ephraim Elimelech Urbach, *The Sages*, Volume 1 pp: 257-8 (Jerusalem: Magner Press, 1975). Yet Urbach was not the first to interpret Rabbi Akiva's words as such. See Dr. Michael Shmidman, "Radical Theology in Defense of Faith: A Fourteenth-Century Example," *Tradition* (41:2), for medieval exponents of this interpretation.

11 A. J. Ayer, "Freedom and Necessity," *Philosophical Essays* (London: Macmillan, 1954).

12 Mordechai's speech to Esther, *Megilat Esther,* 4:13-14.

man will make in the future considered that this knowledge could preclude free choice. This presents a fundamental question in theology: How can one's choices be free if the end result is already known? Other thinkers, such as Saadiah Gaon, who suggested that knowledge is not necessarily causative or determinative, are therefore not troubled by this paradox.[13] However, some modern Jewish philosophers, primarily leaders of the Mussar movement, continue to insist that man's free will is often limited (Rabbi Dessler[14]).[15] For those who do not think like Saadiah Goan, resolving the contradiction between unfettered free choice and unrestricted divine foreknowledge of events would seem to require the limiting of one or the other.

Other modern Jewish philosophers have attempted to gloss over this thorny issue and in an attempt to resolve the contradiction focus their efforts on better defining man's relationship with morality (Kant)[16] or with God (Buber).[17] It is fair to say that despite more than 2,000 years of inquiry, an accepted rational solution that reconciles the essential contradiction between providence and man's free will has not been widely recognized.

Religious philosophy and scientific advances

There is a long history of using scientific advances to illuminate theological and philosophical dilemmas. For example, there were attempts to synthesize theology and science by the medieval Jewish philosopher and rabbinical authority Gersonides, who suggested that divine influence on the world was mediated through the contemporary science of astrological theory[18]—a system of divination based on the premise that there is a relationship between astrological bodies and human events.[19]

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13 *Emunot v-Deot*, Treatise IV.

14 Rabbi Eliezer Dressler c. 1892–1953.

15 *Mikhtav M-Eliyahu*, *Kuntres Ha-Bechirah.*

16 Emil Fackenheim, "The Revealed Morality of Judaism and Modern Thought: A Confrontation with Kant," *Contemporary Jewish Ethics*, Edited by Menachem Keller (New Jersey: Hebrew Publishing Company, 1978).

17 Martin Buber*, I and Thou*, translated by Walter Kaufmann (New York: Charles Scribner's Sons, 1970).

18 This should not be confused with astrology in the idolatrous sense. Gad Freudenthal, "Gersonides on the Disorder of the Sublunar World and on Providence," *Aleph* 12, 2 (2012) pp. 299–328.

19 *Milḥamot Ha-Shem*, Book 6, Chapter 10, standard edition.

One reason scientific discovery advanced in lockstep with theological innovation was that until the twentieth century, leading scientists and religious philosophers were often one and the same. For example, Sir Isaac Newton, one of the greatest physicists of all time, wrote extensively on Christian religion.[20] Maimonides,[21] in addition to being a leading Talmudist and rabbinic scholar, was also an honored court physician. These luminary figures often applied the same methods of explaining both physical and metaphysical realities.[22] In light of these examples, contemporary religious thinkers would have great precedent in using the scientific advances during the 1900s in response to the tension between the continuity of laws of science and the possibility of Divine intervention. However, Nicolas Saunders notwithstanding, there have been few attempts to do so to date.

20th Century Scientific Advances

Before we delve into contemporary science, we need to appreciate that in many ways, the first half of the twentieth century was the golden age of physics. Our contemporary understanding of the physical world bears almost no resemblance to our conception of it before the first Solvay Conference in 1911. In light of these advances, it is imperative to reexamine the issues of providence and free choice in a new context, i.e. that of quantum mechanics.

In order to relate this theory to our discussion of divine providence, two popular understandings of quantum mechanics must be explained. While it is clear that quantum mechanics makes predictions about microscopic events, an intuitive understanding of uncertainty in quantum mechanics has remained controversial. Indeed almost a century after quantum mechanics was developed there remains a fundamental disagreement about how to interpret quantum events. The Heisenberg Uncertainty Principle indicates that one cannot determine with certainty the location and momentum of a particle simultaneously, begging the question of where the particle actually is. Possible explanations include the Copenhagen Interpretation that all states of the particle exist simultaneously prior to measurement. In a variation of this interpretation, quantum particles are described by a waveform and thus the particle is not located in any single point until measurements are made, only after which the particle can be said to be located at a single point. A second theory to explain quantum mechanics involves a multiverse explanation in which each

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20 See Newton's *Observations upon the Prophecies of Daniel and the Apocalypse of St. John.*

21 Rabbi Moses ben Maimon c. 1135–1204. Public Domain Books, London, 1723.

22 See Maimonides' Prefatory Remarks of *Moreh Nevukhim.*

quantum possibility exists in a separate universe (i.e. a theory that stipulates there are an unimaginable large number of universes in which every possible course of events that can occur does occur).

How are these variations in interpretation related to the fundamental issue of divine intervention at a time without God's active revelation? In its most basic form, the uncertainty principle of quantum mechanics could potentially allow for divine intervention in the world. For example, through this interpretation of the principle, one could posit that God *undetactably* alters the state of matter. Since according to one interpretation of the Heisenberg Uncertainty principle in which the state of matter is not complete, the precise location and momentum of a particle cannot be determined no matter how advanced the measuring equipment, and no intervention within the envelope predicted by quantum theory can be discovered, God could alter events in the world in a way completely consistent with the principles of physics. Saunders[23] raises two fundamental objections to the possibility of divine intervention through quantum mechanics: 1) quantum mechanics using one variation of the Copenhagen Interpretation can be deterministic, because a waveform equation would describe events precisely, therefore there is no room for undetectable interference. 2) Proponents of divine intervention have not defined precisely how God's intervention on the quantum (microscopic) level could exert meaningful control over the world at distances greater than Planck's length.

Both of these objections depend in part on our ability to interpret the quantum state prior to intervention. In response to Saunders' two objections, it may be fair to say that only a waveform can describe the actual location of a particle but the collapse of the waveform is not predictable and it is precisely that collapse that determines future events. Thus, God could cause a waveform to collapse in a way that alters events. The second objection requires a careful analysis of the relationship between microscopic and macroscopic principles of physics.

Attempts over the past 80 years to reconcile quantum mechanics with the equations of general relativity dealing with the motion of objects larger than Planck's length have been unsuccessful, primarily because any changes that take place at the quantum level fail to manifest in measurements of systems larger than Planck's length. Most recently, for example, Witten and others have developed a hypothesis called string theory,[24]

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23 Nicholas Saunders, *Divine Action and Modern Science* (Cambridge: Cambridge University Press, 2002).

24 Edward Witten, "String Theory Dynamics in Various Dimensions," *Nuclear Physics* B 443 (1): 85–126 (1995).

which they believe intuitively will eventually resolve the contradictions between quantum mechanics and general relativity. Nonetheless, even this construct will leave intact some of the "weirdness" of quantum mechanics, including the notion that the location and momentum of an object cannot be simultaneously determined because the process of measuring these quantities will alter the results.

There is another branch of physics and mathematics that is subject to some of the same strange predictions that quantum mechanics provides, developed in the last half-century and fueled by the development of the computer. While fully deterministic, non-linear dynamics, or chaos theory, was developed in the latter half of the twentieth century. It states that in non-quantitative terms, the end result of its system state is highly dependent on initial conditions.

Take the following example to illustrate the complexity of non-linear dynamics and chaos theory: we look at a group of runners involved in a 10-kilometer race. In a linear system, one runner may run more quickly or more slowly than the other, but their relationship to each other is predictable. If two start running, with one runner five feet in front of the other, it will make only a five-foot difference in the outcome of the race. In contrast, in a non-linear system, the result will be quite different. A small difference in the starting point of the race may interact with an incalculable number of other variables to make a large difference in the outcome. For example, one runner starting five feet away from his original starting position may lead to his breaking an ankle and being unable to finish the race. There is ample evidence that a number of physical systems, such as the earth's weather and the electrical beat of the heart, are governed by non-linear systems. Indeed, many of the more complex phenomena throughout the world appear to be subject to non-linear dynamics.

Just as with quantum mechanics, the predications of non-linear dynamics seem counterintuitive. One can't help but wonder why the world that otherwise appears intuitive and ordered contains strange situations where physical laws do not apply to particles of all sizes, where the location of objects cannot be determined with certainty, and where a minute change in starting location can have a dramatic effect on where particles (or runners) end up.

To illustrate the counterintuitive implications of quantum mechanics, Schrödinger developed a thought experiment now famously called "Schrödinger's Cat," in which he attempted to show the strange predictions of quantum mechanics. In the hypothetical experiment, a cat is placed in a sealed box and exposed to radiation. Based on one state of a subatomic particle the radiation would be lethal, based on another state of that subatomic particle it would be benign. Since the final states of the

subatomic particle could not be defined with precision, one would not know until the box was open whether the cat was alive or dead. Indeed, rather than measuring the location of the subatomic particle, a box would be opened to confirm whether the cat was alive or dead, and this would seem to determine the result. A number of divergent explanations have intuitively defined the time at which Schrödinger's cat might be alive or dead. For example, according to the explanation of a waveform mentioned earlier, that all possible states exist simultaneously until measurement, the cat would be both alive and dead until the box was opened. While this famous thought experiment supports the hypothesis that macro-level reality can be influenced by quantum events, in this case the life or death of a cat, the nature of this specific case does not describe a medium for divine intervention that is scalable or useful.

Attempts at Reconciliation

Attempts to reconcile providence and free will in the Jewish intellectual tradition essentially fall into four categories. A first approach is to suggest that the paradox remains and is inexplicable to man. Although he attempts more complex and other explanations in the Guide for the Perplexed, Maimonides espouses this approach in his laws of repentance, where he addresses one of the problems of personal choice and divine foreknowledge. He essentially states that we cannot understand the nature of Divine knowledge and that we must simply take unfettered free choice on faith.[25] This approach has not stopped philosophers and theologians from probing the question further.

The second approach involves placing extensive limitations on free will, so that free will can be controlled through divine intervention. The Jewish tradition that conceives of an active creator who manages the world on a day-to-day basis ought to allow for this to occur. Some sources beginning with the Talmud support the notion that all events in the world are carefully controlled by God. The Talmud in Tractate *Ḥullin* suggests that a person does not bruise his thumb unless it is ordained from above.[26] However, several sources, which we will discuss below, have a problem with the system of reward and punishment in which the dice are loaded. While it is possible that somewhat of a limitation on free will exists,[27] this

25 *Hilkhot Teshuva* 5:5.

26 BT *Ḥullin* 7b.

27 Baḥya ibn Pakuda, *Ḥovot ha-Levavot*, ch. 3.

does not eliminate the problem of how to adjust for the influence of disruptive, freely made choices with an activist plan for the world.

Modern Hasidic tradition is more explicit in its support for unlimited divine providence.[28] The Ba'al Shem Tov[29] believed that every blade of grass in the world was directly controlled by God's intervention through His emanations.[30] Nothing was left to chance. Nothing could be felt that was not under direct control. Regardless of the extent to which God exerts direct daily control over each of the objects in the world, we conclude that all traditional Jewish sources believe that a plan is in place for both the world as a whole and the people of Israel, and that plan is under direct or indirect control. Placing limitations on Providence also directly contradicts this interventionist theory.

A third approach is to limit the extent of providence. That is to say, whether God has a specific plan for the world or not, his ability and/or will to influence the world ends at the sovereignty of free will.[31] However, the issue arises when we ask the question whether the limit of God's influence is self-imposed. In this case, one can make a free choice only if God declines to intervene. While the implications of this question would question the nature of free will, it assumes that from the human perspective as well as from a scientific perspective, free will must be absolute.

During the century following Maimonides' time, Gersonides,[32] a rabbinic authority mentioned earlier, presents a view that creates a complex system of rules for the world involving a number of physical phenomena that include the motion of the planets to define events and outcomes. Yet this system, which proscribes an observable schematic for divine action, disallows a particularized Divine providence.[33] This contention has not

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28 This position is predated by Rabbi Ḥasdai Crescas, who argues for a complicated reconciliation between free will and providence. Rabbi Crescas argues that free will exists because humans are ignorant of the causes by which they are affected. See *Ohr Hashem*. See also Meyer Waxman, "The Philosophy of Don Ḥasdai Crescas: Chapter V," *The Jewish Quarterly Review*, New Series, Vol. 10, No. 1 (Jul., 1919), pp. 25–47.

29 Rabbi Yisroel ben Eliezer 1698–1760. Gad Freudenthal, "Providence, Astrology, and Celestial Influences on the Sublunar World," in Shem-Tov ibn Falaquera's "De'ot ha-Filosofim," *The Medieval Hebrew Encyclopedias of Science and Philosophy* (2000) 335–370.

30 An oft-quoted saying by Ba'al Shem Tov, based on *Bereshit Rabba* 10:7. For example, see Joseph Isaac Schneersohn, *Sefer Ha-Ma'amarim Kuntresim*, Vol. II, p. 740 (New York: Kehot, 1977).

31 *Milḥamot Hashem*, Book 6, Chapter 10.

32 Rabbi Levi ben Gershon also known as RaLbaG 1288–1344.

33 *Milḥamot Hashem*, Book 6.

been widely accepted, primarily because Jewish tradition seems far more comfortable with the concept that God cares and intervenes in events on a day-to-day basis. Although the Gersonides approach helps to explain the relationship between the righteousness of one's actions, God's influence through astrological forces, and their outcomes, it places God too far from the daily events we experience to be widely accepted by mainstream Jewish thinkers.[34]

The fourth and final approach is to search for ways to reconcile unfettered free will with divine providence without limiting either. There have been extensive attempts to do this by Jewish philosophers starting in the Babylonian Talmud, where it refers to accidents and events resulting in death that illustrate this point. One such instance is based on the verse in Deuteronomy 21:8—"If you build a new house, you shall make a fence for your roof, so that you will not place blood in your house if a fallen one falls from it." The Talmud on Shabbat comments: "When the fallen one falls"—this man was destined to fall since the time of creation, for he had not yet fallen, yet the Torah designates him as a "fallen one." Here is an example of the legal intersection of personal responsibility and divine providence being discussed in classic Jewish sources. The fall had been decreed upon the falling man by Providence, but it was the homeowner's negligence that caused the faller to fall on the owner's property.

Similarly, on the verse in Exodus 21:13: "And if a man lie not in wait, but God caused it to come to hand," the Talmud on Makkot explains that: "If one man killed a person accidentally, and another slew a person intentionally, the willful murderer … falls by the hand of the innocent." This approach allows free choice to be integrated with a divine plan. If the man closes his roof thereby avoiding accidentally killing a person, God will cause the faller to die in another way. These excerpts from the Talmud demonstrate a complex relationship between free will and divine providence; however, they do not clearly define a mechanism for their interaction.[35]

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34 See Gersonides' commentary on *Iyov*. Amos Funkenstein, "Gersonides' Biblical Commentary: Science, History and Providence" (or: The importance of being boring), *Studies on Gersonides* (1992) 305–315.

35 The tension between free will and Divine providence is manifest in a number of examples that demonstrate the general disagreement between Rabbi Akiva and Rabbi Ishmael. Rabbi Ishmael has an idea of intergenerational cause and effect, which does not contradict his school's distinction between living by virtue of a forefather's merit versus one's own; rather, reconciliation must be understood through his understanding of providence. Contrary to the view of Rabbi Akiva, which primarily focuses on man's understanding the power of his own actions

In the Guide for the Perplexed, Maimonides suggests a sliding scale mechanism in which the degree to which divine providence influences a person's life depends upon the state of intellectual perfection and unity with God that an individual achieves. However, at other points, he suggests that all individuals, and perhaps objects regardless of their state of intellectual perfection, may be subject to divine providence.

The 11thcentury prayer *Unesanoh Tokef*[36] from the text of the High Holiday services seems to balance the outcomes of divine judgement based on our individual efforts. This language implies a philosophy of reward and punishment in which human choice has a clear relationship with divine action.

Gersonides suggests a different apparatus for this relationship. He believed that God created a series of natural forces that rule the world and determine events on both the large and small scale. In some cases, God may choose not to pay attention to the details on a day-to-day basis. This radical approach is not shared by many others, but it has its adherents. For example, *Sefer ha-Ḥinuch* reads that a fence must be put around a roof, because there are some individuals who may not merit such providence

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to affect the world around him, Rabbi Ishmael broadens the discussion to acknowledge God's foreknowledge of events. For example, regarding the verse "When the faller falls from it" (Deuteronomy 22:8), the school of Rabbi Ishmael comments that this man was predestined to fall since the six days of Creation, for, behold, he has not yet fallen, and Scripture already calls him a faller. (BT *Shabbat* 32a) If the man was destined to fall anyway, one would think that the commandment to build a parapet is irrelevant. The existence of the commandment reinforces the idea of free will, albeit without negating God's foreknowledge, as exemplified by the following statement of Rabbi Ishmael: "'When I shall see the blood…' Rabbi Ishmael says: Is not all revealed before Him, as it states, 'He knows what is in the darkness, and light dwells with Him' (Daniel 2:22), and also, 'Even darkness obscures not from You.' (Psalms 139:12) What is 'When I shall see the blood…' coming to explain? Rather, that as the reward of the commandment that you do, I will be revealed and have pity upon you." (*Mekhilta d-Rabbi Ishmael*, *Bo, Masekhta Pisha* 6).

36 "Let us now relate the power of this day's holiness, for it is awesome and frightening. On it Your Kingship will be exalted; Your throne will be firmed with kindness and You will sit upon it in truth. It is true that You alone are the One Who judges, proves, knows, and bears witness; Who writes and seals, Who counts and Who calculates. You will remember all that was forgotten. You will open the Book of Remembrances—it will read itself—and each person's signature is there. And the great shofar will be sounded and a still, thin voice will be heard. Angels will hasten, a trembling and terror will seize them—and they will say, 'Behold, it is the Day of Judgment, to muster the heavenly host for judgment!'—for even they are not guiltless in Your eyes in judgment."

and who may fall off and die if a fence is not present. This would imply, as Gersonides suggests, that God does not necessarily control the day-to-day events of a person's life. In the context of this discussion, some peoples' lives are governed by providence while others are left to the vicissitudes of chance and free will. However, the Rabad,[37] who wrote a commentary that debated Maimonides and who lived prior to Gersonides, suggested that while astrological theory has power over the world, free will has the power to overcome the force of that influence. I would like to suggest an alternative approach to address this paradox by applying Jewish sources to modern science.

Physics and the Paradox

The recent advances in physics noted above provide a potential mechanism for resolving the paradox between divine providence and free choice. As theories have improved, and as the accuracy of physical measurement has dramatically increased, the number of macroscopic events that occur by chance has become more limited. Therefore, it is hard to reconcile direct divine providence with modern scientific practical observation. However, the combination of theories of quantum mechanics and non-linear dynamics provides a model through which direct divine intervention can act unobserved. One could even argue that physical principles were designed by God to allow direct divine intervention to occur in an apparently deterministic and scientifically advanced world.

Both the theories of quantum mechanics and non-linear dynamics are necessary to maintain this potential model of divine providence, which does not necessarily interfere with free choice. It is reasonable to suggest that the Heisenberg Uncertainty Principle exists precisely because it allows divine providence to be undetected. Therefore, no level of scientific advancement will allow us to know both the position and momentum of a particle. This concept is almost a century old, though it has significant limitations when applied to our problem.

It is difficult to understand how God's undetectable control of an electron's position can affect macroscopic events in a way that would alter observable events in our world, let alone reconcile that intervention with an alteration and free choice. This has indeed been one of the major objections to suggesting that by manipulating quantum events God might affect events in the universe, and was Saunders' second objection.[38] Two advances in physics, one going back decades and one more recent, may

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37 Rabad, commentary on the *Mishneh Torah*, *Laws of Repentance* 5:5, standard edition.

38 Op. cit.

have altered the principles on which this prior skepticism was based. They are non-linear dynamics and recent advances in a phenomenon called quantum entanglement.

As previously noted, the popularization of non-linear dynamics in the last 25 years, as well as advances in its understanding, creates a new paradigm in which microscopic events could be amplified, and affect observable occurrences in a way that they might modify the apparent outcome in daily life. The classic scientific example that is used to represent this point is that a butterfly might flap its wings over the Pacific Ocean and through the amplification of non-linear dynamics cause a hurricane in the Atlantic Ocean. A similar cascade of events could be postulated to occur when the location of individual subatomic particles is altered in an undetectable way, similar to Schrödinger's cat. Small perturbations in the location or movement of subatomic particles could result in larger macroscopic perturbations, such as alterations in weather conditions, the creation of seismic activity or other natural phenomena that could affect events in the world. This theory could, for example, explain the occurrence of a catastrophic event, such as Hurricane Sandy, based on undetectable intervention on a microscopic level.

However, until recently evidence of subatomic events manifesting beyond Plank's length to macroscopic events was lacking. That is, although one could postulate that quantum events could appear on a microscopic scale and be amplified through non-linear dynamics up to Planck's length, there was no direct experimental evidence that this could function at larger distances. Indeed a property called quantum decoherence suggests that when quantum particles exist on a macroscopic scale, they lose their quantum-like properties in a very short time period. However, work in the past 3 years has begun to demonstrate that quantum properties can be maintained in macroscopic systems.[39] Barthel et al (2014) demonstrated the ability of particles to maintain their quantum properties on a macroscopic scale by showing that multi-particle systems "shield" quantum effects from the decoherence or breakdown that occurs with single particles.

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[39] Anthony J. Leggett, "Macroscopic quantum systems and the quantum theory of measurement" *Progress of Theoretical Physics Supplement* 69 (1980): 80-100. Université of Genève. "What if quantum physics worked on a macroscopic level? Researchers have successfully entangled optic fibers populated by 500 photons," *Science Daily*, 25 July 2013. <www.sciencedaily.com/releases/2013/07/130725104851.htm>.
Yong-Chun Liu and Yun-Feng Xiao, "Macroscopic mechanical systems are entering the quantum world," *National Science Review* first published online August 19, 2014, Doi:10.1093/nsr/nwu050

Quantum Entanglement is an area of scientific advancement that would allow for the projection of microscopic events over large distances. One of the objections raised to quantum mechanics by Einstein and others (ERP 1935) was that the predictions of quantum theory led to the possibility that "information" would be passed faster than light. Suppose two coin flips were linked on a quantum level, the link being that if one was heads the other must be tails. Now suppose that these two coins were separated by a light-year. Determining whether one of the coins was heads or tails would simultaneously determine the state of the other coin (heads or tails). In that scenario the instantaneous revelation of information about the distant coin would travel faster than light. Einstein believed this impossible. However, quantum entanglement as this phenomenon is called has been shown experimentally to be valid on the macroscopic level. Two studies from the University of Geneva have demonstrated that quantum entanglement can occur in small and in fiber optic cable transmission (Gisin et al 2011, 2013).

Quantum entanglement adds a dimension to the potency of nonlinear dynamics in amplifying quantum events past Plank's length. Not only can localized quantum events contribute to shielding a quantum system from decoherence, because of entanglement, quantum events at significant distance can also contribute to this phenomenon without being constrained by locality. Both non-linear dynamics and quantum mechanics make the tools of divine intervention more powerful in separate ways.

If we apply these findings to our paradox and our discussion of free will, I would argue that the universe was intentionally designed with quantum mechanics to allow divine providence to be undetected. I propose that God's undetected intervention might alter a particle's location by moving it to one of several positions that fall within the location probability distribution, which I would term "Quantum Manipulation." This quantum disturbance would set off a pre-calculated chain reaction, magnified through the mechanism provided by non-linear dynamics and preserved beyond Planck's length, to affect observable phenomena and alter reality in an intended and specific way.

While this postulated mechanism combining quantum manipulation with non-linear dynamics in a particle state "shielded" from decoherence explains how divine intervention could be undetectable in the physical world, despite substantial advances in measurement techniques, it does little to enhance understanding of how free choice could be preserved in such a circumstance. It does avoid the need for direct divine intervention in human choice or in the thought process in order for God to affect our reality, but does not easily explain how free choice can be preserved in the presence of divine intervention.

This problem can be further analyzed using similar physical principles. To a large extent, the choices we make as human beings are based on the situations and problems we are forced to solve. If our circumstances were altered by undetectable divine intervention, that would manipulate the choices available to us and alter our future while maintaining our freedom of choice. For example, most of us will never have to face the choice of whether to resort to cannibalism after having crashed in the Andes Mountains. However, if those survivors were immediately rescued, that could represent divine intervention removing the need to choose cannibalism. Thus, the existence of a mechanism for undetected divine intervention does not exclude our free choice, however it means that we are not guaranteed that the intended results of our choices will be realized if God intends otherwise.

There is a theory that stipulates free choice is only a perception. It goes on to explain that our so-called choices are defined by a combination of our inborn genetic dispositions reacting with the stimuli of our environment and then modified through our learned behaviors. However, regardless of the philosophical underpinnings of such a theory, for the purpose of this discussion, we are dealing with the practical implications of free choice.[40]

Furthermore, the extent to which divine providence is universally exerted on every event in the world, depending on size of the event, affects how easy it is for us to understand that these physical mechanisms are operational. If only the broad strokes of large events are defined by God and defined so roughly as to disregard the details, it is relatively easy to see how those large events could be controlled using the combination of quantum mechanics and non-linear dynamics. However, it is more difficult to understand how these seemingly complex and indelicate mechanisms could control events on a minute and detailed scale. Because of the inherent complexity in the system, we must conclude that within all the uncountable possible locations for each and every particle in the universe, there must be one arrangement of all matter and energy that will change the universe in a specific and intentional way. But the complexity of achieving small changes to reality would not be immediately obvious and require "divine" intelligence to fully actuate.

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[40] David Shatz, "Is Matter All that Matters? Judaism, Free Will, and the Genetic and Neuroscientific Revolution," *Judaism, Science, and Moral Responsibility* (Lanham: Rowman and Littlefield, 2006) 54–103.

Conclusion

If one wanted to construct the universe in which events, large or small, were controlled through divine providence, yet preserved free choice, there would be two requirements. First, divine intervention would have to be undetectable so that there is no interference with free choice. This can potentially be explained through divine intervention in the state of matter. Secondly, microscopic events in which intervention could not be identified would require amplification to the point where they would alter our observable world and lives.

While the combination of quantum mechanics and non-linear dynamics in systems shielded from decoherence does not prove the existence of God, it would indeed be a very intelligent way for Him to have designed the universe to allow a measure of control through nature, while preserving the concept of a human being's freedom of choice. When Einstein said, "God does not play dice with the universe," Niels Bohr responded, "Einstein, stop telling God what to do." As our scientific knowledge grows, we have faced criticism and concern from some religious thinkers who believe that science is an affront to religion. However, an educated approach to these big questions reveals that not only is there a history of using scientific lenses to better understand religion, an advanced knowledge of the complexities of our world magnifies the awesomeness of God. Galileo famously said that when he looked through his telescope, at the magnificence of the universe, he saw God. ☙