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Abstract

This paper studies belief formation for two kinds of religion. The main conclusion is that they follow different mechanisms. Specifically, for religions relying on supernatural powers, people formulate beliefs based on their prior beliefs and experiences, and they may claim their beliefs for some realistic considerations. For religions based on self-sufficiency, mainly Buddhism, beliefs are formed by an awareness of suffering and dependent arising.

Keywords

Bayesian updating, Buddhism, prospect theory, uncertainty, dependent arising, utility stabilization

Introduction

Religious belief is one of the most important elements in the life of human beings. In our opinion, religion is generated by human beings' desire to eliminate suffering in the face of uncertainty, especially uncertainty about important events such as the afterlife. Uncertainty is key to understanding religion. If a person is certain that there is no afterlife, then he/she is not likely to

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believe in God, since there is no benefit from doing so. Smith (1991) provides an excellent introduction to all main religions in the world. The confines of this paper prevent a detailed description of each religion. Rather, we divide religions into two categories and explore the essence of each category. The first kind of religion emphasizes obedience and relies on supernatural powers, such as God in Christianity, Allah in Islam, Brahma in Hinduism, etc. To simplify, we use “God” to represent all such supernatural powers in this paper. For this kind of religion, a disciple does not need to understand why God exists or why the words of God are correct; what he/she needs to do is just to believe in the existence of God and follow the word of God. The second kind of religion emphasizes liberation or enlightenment and relies on oneself. The main religion of this kind is Buddhism. Buddhism is a non-theistic religion; for example, the Buddha (624–544 B.C.) is a human being and Buddhists follow him to learn his wisdom in eliminating suffering (rather than to go to Heaven). So Buddhism is more like modern science; it is called a religion because of the belief of Buddhists in one axiom, the law of *dependent arising* (interested readers can jump to “Dependent arising” section for a detailed description). In this sense, Buddhism is similar to mathematics whose axiomatic system is commonly attributed to Euclid (325–265 B.C.).¹

We briefly introduce Buddhism here. Buddhism was started by the Buddha who was the Prince of a small country in the Northeastern India. He left his palace to pursue the way of liberation at the age of 29 after he realized the human suffering of getting old, being sick and dying. After was enlightened at the age of 35, he shared his insights to help people eliminate suffering until his death at the age of 80. The Buddha’s teachings are summarized by the *Four Noble Truths*: the truth of suffering, the truth of the origin of suffering, the truth of the cessation of suffering, and the truth of the path leading to the cessation of suffering. We will present details of the Four Noble Truths in the language of economics in “Religions based on self-sufficiency” section. Two major branches of Buddhism are *Theravada* (“The School of the Elders”) and *Mahayana* (“The Great Vehicle”). Theravada has a widespread following in Sri Lanka and Southeast Asia (Cambodia, Laos, Thailand, Myanmar etc.), and Mahayana is popular in East Asia (China, Korea, Japan, Vietnam, Singapore, Taiwan etc.). The two branches rest on the same fundamental belief (i.e. dependent arising) with some subtle differences. According to the Pew Research Center (2012), Buddhists account for about 488 million or 7.1% of the world population (for comparison, Christianity, 31.5%; Islam, 23.2%; Hinduism, 15%) and about 1% of the population in North America. Buddhism is also recognized as one of the fastest growing religions in the West.

Iannaccone (1998) provides an excellent review on religion from the economic point of view, but all the literature he reviews assumes that people already hold a belief (of the first kind) and analyzes aspects such as

churchgoing, contributions, criminal activities, returning to schooling, etc. For example, Azzi and Ehrenberg (1975) and Iannaccone (1990) study church attendance from the angle of religious household production and religious human capital accumulation, respectively. There is also some literature on the implications of Buddhism on economics. The starting point is the criticism of modern economics from the Buddhist's perspective in Schumacher (1973); more discussion can be found in Pryor (1990, 1991), Zadek (1993) and Daniels (2005), among others. At the end of Iannaccone's review, he mentions that the very first question of religion economics is how the belief is formed; at the beginning of Montgomery (1996), the author also mentions "the deepest problem with the economic approach to religion lies in its treatment of belief formation". This paper attempts to fill this gap by providing some formal models of belief formation. Here, we must emphasize that we do not agree with the view that religion is only a primitive-mind tradition or an irrational choice; see Stark et al. (1996) for related discussions. Rather, we treat religion as a rational choice of human beings. Furthermore, we do not make any judgments on the applicability or superiority of any religion; we believe that all religions are respectable, and there is no single religion suitable to all people; the purpose of this paper is only to provide some understanding on why people believe in one religion or another.

Belief formation is a complicated psychological process. People may accept a belief through different psychological paths. As argued in Montgomery (1996), "the diversity of religious belief poses an important and difficult challenge for economic theorists". There are a few papers on this topic but all discuss only the belief formation for religions of the first kind. Montgomery (1996) treats belief formation as a non-rational process and tries to explain it using the cognitive-dissonance theory. This theory claims that "individuals may (subconsciously) alter one (or more) of their conflicting cognitions or add additional cognitions that help reconcile the original cognitions". In the case of the first kind of religion, conflicting cognitions are "God exists" and "God does not exist". But we would rather think that even such a reconciling process has a reason to happen. In other words, we agree with Becker (1976) that the rational choice approach "provides a valuable unified framework for understanding all human behavior"; we believe that everything can be ultimately explained (even if right now we do not have the right way to explain it) rather than throwing it into the basket of "non-rationality". In his Section III, Montgomery (1996) mentions "...religious participation alters subjective probabilities as well as utilities". More specifically, for the first kind of religion, we emphasize the altering of subjective probabilities, while for the second kind, we emphasize the altering of utilities (though in a different way from that in Iannaccone

(1990)). To this end, we agree with Montgomery that subjective probability formation is a key element in belief formation, but disagree with him that belief formation is non-rational. Hardin (1997) focuses on the costs and benefits that lead people to favor some beliefs and some sources of information over others, but as argued in Iannaccone (1998), both his approach and Montgomery's "remain largely undeveloped".

In this paper, we will discuss the belief formation for each of the two kinds of religion. Our discussion of the first kind is related to that of Durkin and Greeley (1991) which is the first rational choice model of religious behavior, and we will compare our approach with theirs. Our main conclusion is that the mechanisms of belief formation in these two kinds of religion are different. Specifically, for the first kind of religion, people formulate their beliefs based on their prior beliefs and experiences, and they may claim beliefs for some realistic considerations; for the second kind of religion, we argue that the belief is formed by people's awareness of suffering and dependent arising. In the economic explanation of Buddhists' views, we point out that the usual hedonic formulation of economic models does not capture the essence of Buddhism; Buddhists believe that varying our utilities with losses and gains will incur suffering eventually, and thus the only solution to eliminate suffering is to stabilize our utility function through practice.

The structure of this paper is as follows. We will discuss belief formation for the first and second kind of religion in the second and third sections, respectively. Since Buddhism may be not familiar to Western readers, we introduce the fundamental belief of Buddhism, i.e. dependent arising, and some implications of it in "Dependent arising" section. Economic explanations of two critical concepts to belief formation for Buddhists, suffering and Nirvana, are given in "Suffering" and "Nirvana" sections. The paper concludes in "Concluding remarks" section.

Religions relying on supernatural powers

We do not want to get involved in the philosophical debate that rationality of beliefs should be epistemically justified or pragmatically justified (see, for example, Kelly, 2002). In philosophy, epistemic rationality is the kind of rationality built on adequate evidence, while pragmatic rationality is based on the consequences, or the expected consequences, of holding a belief. Accepting such a division, we will provide a coherent model to explain how these two evaluations of beliefs are formulated and affect each other, and emphasize that interpreting evidence depends on one's personal experiences.

To understand why people believe in the first kind of religion, we must distinguish two types of beliefs: the true belief and the claimed belief. The

former is the belief in one's mind, while the latter is the belief one claims in public. These two may not be consistent as one's claim is usually affected by realistic considerations. In the following, we first analyze the first type of belief, and then analyze the second type, based on the first type. Here, we discard the first two rules of the conventional economic approach which assume that all beliefs are objective, grounded in common priors, and derived rationally through Bayesian updating (see Montgomery, 1996, for related discussions). Rather, we assume that belief in God is subjective and prior beliefs may vary from person to person.

True belief

Suppose at time t , one holds a belief that the probability of God's existence is $p(t)$. We assume $p(t) \in [0, 1]$ is unknown, so there is *uncertainty* (instead of *risk*) in the terminology of Knight (1921). The question is how $p(t)$ is formed. We cast this problem as a standard Bernoulli decision problem. As suggested by Montgomery (1996), we use the Bayesian learning model to understand this problem. For such a model, we must specify the priors and the information up to t . If the probability of God's existence is θ , then the probability that a "miracle" happens in an event is θ . That is, the occurrence of a miracle follows a Bernoulli distribution with parameter θ . Whether an event is a miracle depends on the observer's personal interpretation. In general, when an event is hard to explain or mysterious, people tend to interpret it as a miracle, e.g. being saved from an inescapable traffic accident.

Assume the prior takes the conjugate form of the Bernoulli distribution

$$\pi(\theta) = \text{Beta}(\alpha, \beta) \equiv \frac{1}{B(\alpha, \beta)} \theta^{\alpha-1} (1-\theta)^{\beta-1}, 0 \leq \theta \leq 1, \alpha > 0, \beta > 0$$

which is a Beta distribution with parameters α, β , where $B(\alpha, \beta) = \int_0^1 t^{\alpha-1} (1-t)^{\beta-1} dt$ is a Beta function with parameters α, β . This prior is formed during one's childhood, that is, before one is able to think independently. Technically, it can be viewed as experiencing $(\alpha + \beta)$ events with α miracles. Here, an event can be a Bible story heard from one's parents or from a priest. So the mean probability of God's existence is $E[\theta] = \frac{\alpha}{\alpha + \beta}$. If one has no prejudice about God, then $\pi(\theta)$ should be a uniform distribution, that is, $\alpha = \beta = 1$, so $E[\theta] = \frac{1}{1+1} = \frac{1}{2}$, a very natural result! If one was born into a Christian family, maybe $\alpha = 1000$ and $\beta \approx 0$, then $E[\theta] \approx 1$, that is, he/she would absolutely believe in God. If one was born into an atheistic family, maybe $\alpha \approx$

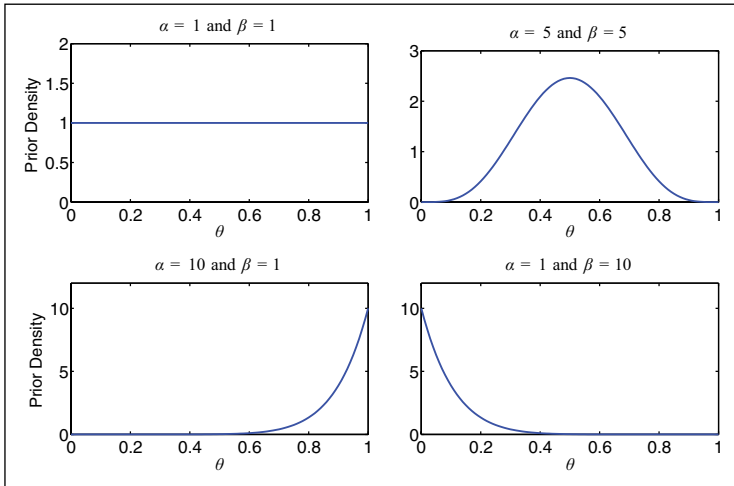


Figure 1. Four prior densities.

0 and $\beta = 1000$, then $E[\theta] \approx 0$, that is, he/she does not believe in God at all. Figure 1 shows four typical examples of the prior.

When a person starts to experience events on his/her own and think about the problem of God independently, he/she will update his/her prior and hold an updated belief (called a *posterior belief*). Suppose until time t , $t \geq 0$, he/she experiences $N(t)$ events, among which $M(t)$ are miracles; then by the Bayes' rule, the posterior belief at time t is

$$p(t) = p(\theta \mid \text{experience}) \propto \theta^{\alpha-1} (1-\theta)^{\beta-1} \\ \theta^{M(t)} (1-\theta)^{N(t)-M(t)} \propto \text{Beta}(\alpha + M(t), \beta + N(t) - M(t))$$

So

$$E[p(t)] = E[\theta \mid \text{experience}] = \frac{\alpha + M(t)}{\alpha + \beta + N(t)}$$

This simple formula can explain many phenomena in the worldly life. A few of them will be discussed below. We use the case without God to illustrate our points; needless to say, all arguments below can be reversely applied to the case with God.

- (i) Suppose the truth is that there is no God, and two persons with the same prior, say $\alpha = \beta = 1$, experience events that are interpreted objectively. For the first person, $N(t) = 2$ and $M(t) = 0$, where $M(t) = 0$ because no miracle can happen if there is no God. For the second person who is more experienced, $N(t) = 200$ and $M(t) = 0$. Now, for Person 1

$$E[\theta | \text{experience}] = \frac{1+0}{1+1+2} = \frac{1}{4}$$

and for Person 2

$$E[\theta | \text{experience}] = \frac{1+0}{1+1+200} \approx 0$$

That is, the belief of a more experienced person is closer to the truth ($\theta = 0$ in this example), while the belief of a less experienced person will mainly reflect his/her prior belief.

- (ii) Larson and Witham published a letter in *Nature* (Larson and Witham, 1998), which reported that among the members of the US National Academy of Sciences, only 7.0% of them believed in a personal God, as compared to more than 85% of the general US population. There are two possible reasons for this. First, these members tend to interpret events in a scientific way and in their eyes, not many things are miracles. Second, as a distinguished group in their field, these people experience more than ordinary people.
- (iii) Although a rational person tends to disbelieve in God, there are exceptions. One famous example is Immanuel Kant, one of the greatest philosophers in history. He was extremely rational but still believed in God. Bertrand Russell had the view that this is because Kant was strongly affected by his mother in his 1927 essay "Why I Am Not a Christian". In our framework, Kant's prior is so strong (i.e. α is much larger than β) that he cannot update it efficiently (he did not go further than 10 miles from his hometown of Königsberg all his life, so $N(t)$ is small).
- (iv) A more experienced person can also believe in God more deeply if he/she lives in a Christian environment (e.g. his/her family members are all Christians) and goes to church frequently, so he/she may encounter more miracle-like events.

- (v) *Ceteris Paribus*, a woman is more likely to believe in God than a man, given that men tend to be more socially active ($N(t)$ is larger) and more logical ($M(t)$ is smaller) than women.²
- (vi) Marriage tends to be endogamous since couples are more likely to affect each other such that $M(t)$ values between couples are highly correlated.

The above examples show that whether a person believes in God is a complicated problem; it is hard to predict whether an educated person will believe in God, or whether one brought up in a Christian family will believe in God. Nevertheless, some of the predictions given above are justified by the information on Christians in China. According to the 2010 *Blue Book of Religions* compiled by the Chinese Academy of Social Sciences' (CASS) Institute of World Religions, about two-thirds of Christians in China are female, only 2.6% of Christians have college or above education, more than 60% of Christians are aged between 35 and 64, and one main reason for converting to Christianity is the tradition of family.³

Claimed belief

For the second type of belief, people may claim they believe in God or go to church when their $E[p(t)]$ is very low. This behavior can be analyzed in the usual expected utility framework. In this case, one makes a decision between two choices: claim to believe in God and claim not to believe in God. For the first choice, the expected utility is

$$E[p(t)](U_1 - C_1(a)) + (1 - E[p(t)])(-C_1(a))$$

and for the second choice, the expected utility is

$$E[p(t)](-U_0 - C_0(a)) + (1 - E[p(t)])(-C_0(a))$$

Here, we use $E[p(t)]$ to represent the probability that God exists in one's mind, since, as argued in Arrow (1970), under some axioms, the distinction between risk and uncertainty is unimportant. The utility U_1 includes the afterlife bliss in Heaven and the lifetime utility (e.g. the meaning of life, surviving diseases, etc.) from the existence of God, and $-U_0$ includes the afterlife punishment in Hell and the lifetime disutility (e.g. the feeling of

loneliness, losing loved ones, etc.). The cost C_1 includes the time and money that would be spent on activities associated with the religion as well as the moral pressure on oneself, and the cost C_0 includes the social pressure and the concomitant inconvenience if most of one's relatives and friends believe in God. a represents the expected remaining age. Both C_1 and C_0 are increasing (maybe non-linear) functions of a . Now, if

$$E[p(t)](U_1 - C_1(a)) + (1 - E[p(t)])(-C_1(a)) > E[p(t)](-U_0 - C_0(a)) + (1 - E[p(t)])(-C_0(a))$$

or

$$E[p(t)](U_1 + U_0) > C_1(a) - C_0(a)$$

then one will claim that he/she believes in God. This simple formula has many interesting implications.

- (i) Even if one barely believes in an afterlife, he/she may still claim to believe in God because the lifetime utility in $U_1 + U_0$ may be significantly greater than zero.
- (ii) As argued in Iannaccone (1990) and Durkin and Greeley (1991), C_1 is a decreasing function of religious human capital, so a person who often goes to church will continue going to church.
- (iii) An old or dying person tends to claim to believe in God (or go to church) since $C_1(a)$ is small as a is small. The aphorism "There are no atheists in foxholes" matches this prediction.
- (iv) When one's $E[p(t)]$ is very low, he/she may still claim to believe in God if C_0 from the social pressure is very high.
- (v) A person with a low wage tends to go to church often since the opportunity cost of his/her time, a component of C_1 , is low.

Note that the model used here is quite different from that proposed by Durkin and Greeley (1991). First, we distinguish between claimed belief and true belief, while Durkin and Greeley (1991) mix them together. They assume $E[p(t)]$ is known and try to choose the level of faith. As argued in Montgomery (1992), "if salvation depends on subjective belief but belief is not an act of volition, rational choice analysis cannot explain religious participation through a 'salvation motive'". As a remedy, we model the process of $p(t)$ explicitly. Also, we feel that the concept of faith is ambiguous (maybe more or less like our $E[p(t)]$). In

their empirical section, they interpret faith as the response to two questions in the survey: (1) How important were the teachings of their church or religion in helping them make decisions regarding their life? (DECCHURH); and (2) How close did they feel to God? (NEARGOD). The first question is related to $M(t)$ in our model, that is, how many miracles were experienced such that the belief in God's existence was strengthened? The second question is how high $E[p(t)]$ is. Responses to other questions can also be treated as revealing $E[p(t)]$, e.g. whether they believe in life after death (POSTEXP) and their degree of doubt regarding the existence of God (NODOUBT). Therefore, many questions in their survey are tautological; it is no wonder that the correlations between them are so high in their Table 1. Second, since our model is different from theirs, the relationships between many factors are different. For one example, in their model, one first chooses the level of faith and then goes to church to maintain the faith, while in our model, going to church can affect $E[p(t)]$ and $E[p(t)]$ can also affect the decision of churchgoing (that is, the relationship between $E[p(t)]$ and churchgoing is dynamic and mutual). Another example is that they assume the cost of faith is determined by the amount of faith exhibited by all participants in a particular religious community and the level of religious human capital. In our model, the first factor affects $E[p(t)]$ (through $M(t)$) instead of C_1 , and the second factor affects both $E[p(t)]$ and C_1 . Finally, they believe that the ability to accumulate religious capital is higher in endogamous than exogamous marriages⁴ and when more family members participate together. In our model, these factors affect $E[p(t)]$ as well as C_1 .

Religions based on self-sufficiency

For the second kind of religion, an awareness of human suffering is necessary in one's belief formation. The awareness of suffering will trigger a strong motive in one's mind to explore the origin of suffering and eliminate suffering, which is the starting point to form the belief. But this is not sufficient; an awareness of dependent arising, i.e. all things arise in dependence upon causes and conditions, is also needed. With this awareness, one will not attribute suffering to supernatural powers; rather, he/she will see the decisive role of him/herself in the arising and elimination of suffering, find the origin of suffering within, and pursue the state of enlightenment called Nirvana. In this section, we will first introduce the law of dependent arising as it is the central concept of Buddhism, and then present economic explanations of Buddhists' view of suffering and Nirvana.

Dependent arising

The law of dependent arising (or *dependent origination* or *dependent existence*) is the fundamental belief of Buddhism. All Buddhist sutras and tenets are corollaries of this belief. Two immediate corollaries are that nothing is constant (impermanence) and nothing has inherent essence (non-self).⁵ We will discuss a few interesting implications of this law in what follows.

The first implication of dependent arising is reincarnation (or *samsara*). Why are human beings born in this world? Why are some people born into a rich family and some into a poor one? Why are some born healthy and some with unhealthy conditions? Reincarnation provides explanations to all these phenomena. It is believed that the starting point of one's current life *depends on* the moral quality of his/her previous life's actions, and of course, the actions of this life will affect the starting point of his/her next life. Materialists think that nothing is left after death so they try to maximize their utility in this life even if this will hurt other people's interests. With the belief in reincarnation, Buddhists think that one will receive his/her punishment sooner or later, in this life or future lives. In other words, they believe in long-run justice.

The second implication of dependent arising is that God cannot exist independently. Buddhists believe that God is created by human beings rather than human beings are created by God. God is created because of human beings' desire for immortality. So the existence of God *depends on* the existence of human beings' desire. In the second section, we explained believing in God from the existence of miracles. In Buddhism, however, the existence of everything has its reasons, so no miracles exist.

The third implication of dependent arising is no-I. Buddhists think that "I" is nothing but a label of the five physical/psychological phenomena of sentient beings: form, sensation, perception, mental formations and consciousness. Since each of these itself *depends on* others and cannot exist independently, there is no inherent "I" in existence. A related proposition is "I think, therefore I am" by René Descartes. Buddhism interprets this proposition as a proof of non-existence rather than existence of "I" because the existence of "I" *depends on* the fact that I am thinking.

The fourth implication of dependent arising is non-existence of time. The essence of time is even a difficult problem to physicists. Based on the theory of relativity, time *depends on* space and cannot exist independently; only if there is change or movement (in space), there is time, and the speed of movement determines how fast or slow the time is.

The fifth implication of dependent arising is that all concepts are created for pragmatic purposes and have no inherent meaning. For example, a binary opposition such as "good" and "bad" *depends on* a criterion to

distinguish between “good” and “bad”, and this criterion itself *depends on* one’s personal experiences or social norms which in turn *depend on* many other factors. In other words, the distinction between “good” and “bad” has only relative meaning and no absolute meaning. Similarly, the concept “tree” is created to distinguish trees from other objects and has no inherent meaning.

Suffering

The belief of Buddhism starts with an awareness of human suffering. Buddhists claim that suffering is the essence of life. This seems to conflict with the worldly view of life in which suffering is only part of life and the other part is happiness. The reasoning of Buddhism is simple: as long as there is happiness, there is suffering; no happiness, no suffering. As a result, Buddhists try to transcend both suffering and happiness and achieve a state beyond them. Their arguments are hard to understand for ordinary people, which might be a reason why not many people are Buddhists. In the following, we will explain the Buddhists’ view of suffering from the economic point of view, which may be easier to understand.

In economics, a rational person maximizes the expected utility during his/her life by selecting the optimal consumption path, e.g.

$$\max_{\{c_t\}} E \int_0^T e^{-rt} u(c_t) dt \quad (1)$$

subject to some budget constraint, where $u(\cdot)$ is the utility function, $T < \infty$ is the expected age, r is the discount factor, and c_t is the consumption level at time t . c_t is random at the decision point (say $t = 0$), so economics interprets impermanence as randomness. Since c_t is random, $u(c_t)$ is also random and can be extremely large or small. Buddhism treats such a variation as suffering, and claims that in general all emotions (both pleasant and unpleasant) are suffering. Correspondingly, the teaching discusses the origin of this and how to cease it. So the goals of Buddhism and modern economics are very different: economics studies how to maximize utility while Buddhism studies how to eliminate disutility; economics studies how to maximize the utility *level* while Buddhism studies how to eliminate the utility *variation*. Moreover, economics believes that consuming more should be better than consuming less, and gaining should be better than losing, while Buddhism claims that if you look at things in this way, you are bound to suffer. We use a simple model below to illustrate this point.

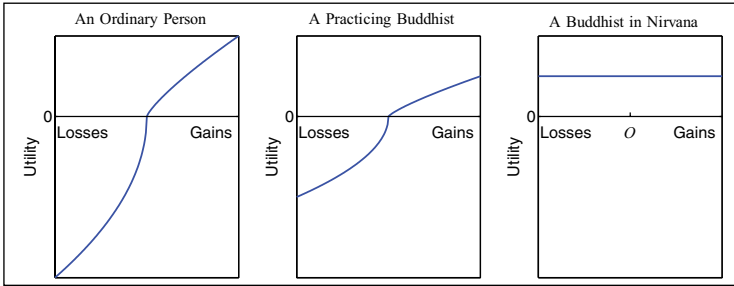


Figure 2. Utility functions of an ordinary person, a practicing Buddhist and a Buddhist in Nirvana.

Our model is based on the prospect theory of Kahneman and Tversky (1979). According to this theory, the utility function $u(\cdot)$ (or what they called the *value function*) under uncertainty⁶ is (i) defined on deviations from the reference point (so-called *reference dependence*, see Tversky and Kahneman (1991) for more discussion), (ii) generally concave for gains and commonly convex for losses (so-called *diminishing sensitivity*), and (iii) steeper for losses than for gains (so-called *loss aversion*). The left panel of Figure 2 displays such a utility function which is S-shaped. Also, people tend to evaluate the probability of an event not based on its objective probability p but a weighting function $\pi(p)$. Tversky and Kahneman (1992) extend the weighting function to *capacity* which is a non-additive set function. Here we still denote it as π . The capacity for gains and losses may be different. For both positive and negative prospects, the implied weight function Π by π is a probability distribution, while for mixed prospects, it may not be. π also satisfies diminishing sensitivity which implies that $\pi(p)$ is concave near $p = 0$ and convex near $p = 1$. The left panel of Figure 3 shows a typical $\pi(p)$ function which is inverse S-shaped.

Based on the prospect theory, the expected utility of an ordinary person at $t = 0$ is

$$U(W_0) + E_\pi \int_0^T e^{-rt} u(\sigma_t B_t) dt \tag{2}$$

Here, W_0 includes the endowment at $t = 0$ and the discount value of a smoothed consumption path, and $U(\cdot)$ is the utility function for such non-random outcomes,⁷ so $U(W_0)$ represents the utility from the wealth effect and daily consumption. $\sigma_t B_t$ is the consumption deviated from the reference

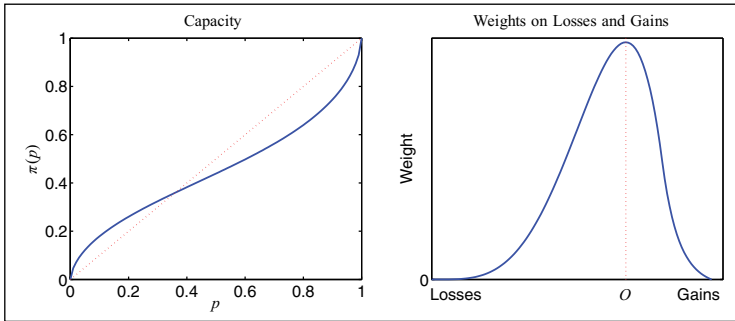


Figure 3. Capacity and implied weight function.

point at time t . As mentioned in Kahneman and Tversky (1984), the reference point is not fixed and can be affected by many factors such as the conventions of society. σ_t is introduced to normalize the variance of B_t as 1. E_π means that the expectation is based on the weight function Π which is implied by π . Of course, Π may depend on t . To understand Buddhism, we must have a deep understanding of Π . First, Π is heavy-tailed since $\pi(\cdot)$ exaggerates small probabilities which usually appear at the tails of the objective distribution. Second, Π is negatively skewed. The justification of this conclusion for Buddhism is related to Brickman and Campbell's (1971) concept of the *hedonic treadmill*. Typically, a pleasant feeling is always followed by an unpleasant one since the reference point has rapidly adapted to the pleasure level, and displeasure will thus result when one goes back to the ordinary level. However, this is not the case when we experience an unpleasant feeling since it usually lasts much longer. Another justification is from the loss aversion of $u(\cdot)$. As mentioned in Tversky and Kahneman (1991), "because of this asymmetry a decision maker who seeks to maximize the experienced utility of outcomes is well advised to assign greater weight to negative than to positive consequences". So even if one stays in a neutral environment, he/she tends to feel displeasure more often than pleasure. This explains why people tend to complain rather than commend. A typical Π is shown in the right panel of Figure 3.

Given the loss aversion of $u(\cdot)$, the two properties of Π imply that $E_\pi \int_0^T e^{-rt} u(\sigma_t B_t) dt$ is very negative. Therefore, for a person who has adequate food, clothing, shelter and medicine, $U(W_0)$ is dominated by $E_\pi \int_0^T e^{-rt} u(\sigma_t B_t) dt$. This situation cannot be avoided through merely economic development since there are large variations in life (e.g. the financial crisis that started in 2008) even in developed countries. Furthermore, as

pointed out in Kahneman and Tversky (1979), W_0 and $\sigma_t B_t$ need not be associated with assets or the consumption of goods, and they can be non-sensory attributes such as health, prestige, safety, quality of life, etc. For example, a negative realization of B_t may represent a decrease of consumption categories (rather than quantity of consumption), unemployment, death of a loved one, injustice inflicted on oneself, etc. and a positive realization of B_t may represent the converse. In this case, the shape of the utility function also makes sense. For example, the mental pain of parents from the death of their child definitely dominates the pleasure from his/her birth; a hurting word cannot be offset by a comforting word; the pain in divorcing is stronger than the happiness in marrying. See the references in Kahneman and Tversky (1984) for more discussion on this point.

Economic development mainly increases W_0 , while institutions such as the property system, the social security system and the law enforcement system mainly decrease σ_t .⁸ In other words, most of human beings' efforts are to increase their utility by improving the *external* environment. In contrast, Buddhism suggests increasing the utility by changing people's *internal* utility function $u(\cdot)$, although it does not object to improving the external environment as well.⁹ Buddhism argues that varying utility with gains and losses is not necessary: through Buddhism practice, one can change his/her utility function from the left panel of Figure 2 to the middle panel, corresponding to improving the second term of equation (2), and eventually, achieve the constant state as shown in the right panel of Figure 2 when he/she is enlightened. Equivalently, we can treat the utility function of an enlightened person as the same as an ordinary person except that the reference point is changing along $\sigma_t B_t$ such that there is no randomness in the consumption path of equation (2). So the arguments here are consistent with Stigler and Becker (1977) who assume the utility function never changes. Professor Richard J Davidson at the University of Wisconsin-Madison conducted some experiments to show that Buddhism practice such as meditation can indeed change the way the mind operates. An early paper on this topic is Lutz et al. (2004); see also Davidson and Lutz (2007) for a readable review for economists.

Buddhism also provides reasons for the changes of the utility function with losses and gains. First, one holds the concept "I", so he/she cares about something called "my utility". In other words, I do not have problems; I AM the problem. Second, one holds concepts like losses and gains, so losses and gains will enter his/her utility function and induce variations. From the discussion in "Dependent arising" section, the fundamental belief of Buddhism (i.e. dependent arising) implies that no "I" exists and no concept has inherent meaning. In this view, all suffering is essentially nothing but delusions, and will disappear sooner or later.

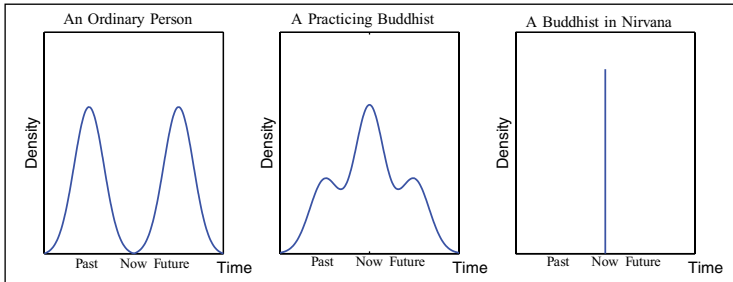


Figure 4. Mind concentration for an ordinary person, a practicing Buddhist and a Buddhist in Nirvana.

Nirvana

The state beyond concepts or with permanent cessation of suffering is called Nirvana in Buddhism. An enlightened person will stay in this state. Since Nirvana is beyond concepts, it is hard to describe with words.¹⁰ Nevertheless, we provide some characteristics of Nirvana based on the description in sutras. First, there is no worry, no fear and no regret in Nirvana. Second, there is no doubt and nothing to learn in Nirvana. Third, once Nirvana is reached, it will never be forgotten or lost. Another feature of Nirvana is the disappearance of time. As mentioned in “Dependent arising” section, time depends on movement so cannot exist in Nirvana. Since past and future can exist only if time exists, there is no past and future in Nirvana too, and the only moment is NOW. Tolle (1999) provides a detailed description of practicing based on living in the NOW. Intuitively, NOW is indeed the only moment one can live in; one can plan the future or recollect the past, but one cannot escape from NOW. Figure 4 illustrates the mind concentration for different people. The mind of an ordinary person always stays in the past or future and never in the NOW, the mind of a practicing Buddhist concentrates in the NOW more often but still wanders around the past and future from time to time, and the mind of a Buddhist in Nirvana would stay in NOW forever.

The method to achieve Nirvana, according to the Buddha, is to follow the Noble Eightfold Path (NEP). The NEP consists of three sets of elements: wisdom (understanding of dependent arising), ethical conduct (e.g. right speech, action and livelihood), and concentration (e.g. meditation). The three sets are logically linked. Wisdom is the forerunner of the whole NEP. Understanding dependent arising and the origin of suffering will encourage the intention of practicing and ethical conducts will be followed. Ethical conducts will help the practitioner restrain greed, hatred and delusion and

make concentration or mindfulness easier. Concentration can then make one’s mind calm down and a calm mind will inspire further wisdom until liberation.

Practicing Buddhism may be painful. A person who plans to convert to Buddhism must compare equation (2) with the utility from practice. Even if a person does not believe in dependent arising (and all its corollaries) fully, he/she can still benefit from believing in part of the teachings. For example, if a person believes that there is past and future and does not believe in reincarnation,¹¹ then his/her utility from practice is

$$U(\tilde{W}_0) + E_\pi \int_0^T e^{-rt} \tilde{u}(\tilde{\sigma}_t B_t) dt - \Lambda \tag{3}$$

where \tilde{u} is a utility function taking less intense values than u as shown in the middle panel of Figure 2, \tilde{W}_0 should be higher than W_0 and $\tilde{\sigma}_t$ should be smaller than σ_t , since the peaceful characteristic of Buddhism should help one’s career, and Λ is the cost of practice, the magnitude of which varies from person to person.¹² Comparing equations (3) and (2), we predict that a person with a more negatively skewed and more heavily tailed Π (e.g. a person who suffers from obsessive compulsive disorder or a pessimistic disposition), or a low W_0 (e.g. a person who lives in a poor family, loses a loved one in an accident or lost all their property in the recent financial crisis) or a large σ_t (e.g. a person who lives in an unstable political or law system)¹³ is more likely to believe in Buddhism. If a person believes in dependent arising fully, then he/she will practice Buddhism definitely even if he/she cannot achieve Nirvana in this life. This is because for a devotional Buddhist, the utility in achieving Nirvana from practice is no less than

$$E \int_0^\infty \bar{u} dt - \bar{\Lambda} = \infty \tag{4}$$

where \bar{u} is the constant positive utility level in Nirvana, and $\bar{\Lambda}$ satisfying $\infty > \bar{\Lambda} \geq \Lambda \geq 0$ is the upper bound of the cost to achieve Nirvana. There are a few differences between equations (3) and (4). First, since in Nirvana, there is no time and the only moment is NOW, there is no consumption smoothing as in the usual economics literature, the upper limit of the integral is ∞ and the discount factor $r = 0$.¹⁴ Second, since there is no “I” in Nirvana, there is no subjective evaluation, and the expectation in equation (4) is based on the objective probability. Since u is constant, this distribution does not affect the ultimate utility evaluation. Indeed, Buddhism does not discuss how to

evaluate the objective probability; it only assumes that it is non-degenerate. Since the utility function is constant, the consumption level does not affect the utility level. This is why Buddhists tend to consume less than ordinary people.¹⁵ The ∞ utility from Nirvana can explain why the Buddha chose to pursue Nirvana even though as a Prince, his $U(W_0)$ was very high. This ∞ utility from Nirvana is also one of the main advertisements of Buddhism.

Though people can benefit from practicing even part of Buddhism's teachings, Buddhism has the fewest disciples among the three most popular religions in the world. There are many possible reasons for this. First, compared to other religions especially Christianity, there is a lack of systematic advertisements in Buddhism. The popularity of Buddhism in East and Southeast Asia is mainly due to the effect of their family traditions which can be explained by the Bayesian updating model in the second section. Second, Buddhism's teachings aim to alleviate people's suffering, while an ordinary person tries to increase his/her secular happiness through material or service consumptions. The myopia and incapability of human beings in predicting and evaluating future events makes it hard to convince them that pursuing secular happiness will incur more suffering before they learn that from personal experience.

Concluding remarks

From the discussion in the second and third sections, we can see that the mechanisms of belief formation are different in the two kinds of religion. For religions relying on supernatural powers, people form their beliefs through Bayesian updating, while for religions based on self-sufficiency, people form their beliefs through awareness of suffering and dependent arising. Although Buddhists believe that following the Buddha's teachings is potentially beneficial to everyone, they do not oblige other people to accept their belief.¹⁶ Indeed, they would rather believe that modest suffering is indispensable to becoming a Buddhist. In other words, suffering has its relative meaning to enlightenment: no suffering, no transcending of suffering, and so no Nirvana.

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Notes

1. Further evidence is required to ascertain whether Euclid was affected by the Buddha.

2. To avoid misinterpreting this statement as a discrimination against women, we must emphasize that this statement (as many other statements in this paper) is a *statistical* one; there are definitely excellent female politicians (and mathematicians) who are more socially active (and logical) than most men.
3. Another main reason is illness of oneself or family members. This reason is more related to the second type of belief since it is of pragmatic consideration.
4. Iannaccone (1990) also believes that the intramarriage will mainly affect the religious capital accumulation, and “a shared faith should have only *indirect* effects on individual belief”.
5. These two corollaries are often termed *emptiness*.
6. The randomness in human life is uncertainty rather than risk.
7. Note that $u(\cdot)$ is suitable only under uncertainty.
8. Institutions are commonly argued to improve W_0 . Here, we emphasize their role in improving people’s utility by reducing σ_t .
9. A minimum income and a stable environment seem necessary for a person to pursue enlightenment in modern society. In principle, Buddhism allows any conduct as long as it is helpful to one’s enlightenment and will not hinder other people’s enlightenment.
10. An obvious paradox here is that the fundamental belief of Buddhism, dependent arising, is also a concept, is it also transcended in Nirvana? The answer is YES. The Buddha proposed dependent arising only to help his followers to achieve Nirvana, and the concept itself does not have inherent meaning. This is so-called “emptiness is empty”.
11. If he/she believes in reincarnation, the upper limit of the integral below will change to ∞ , and the benefits from practice are even larger.
12. If one only changes his/her opinions on ordinary things in his/her life such that u is changed for part of $\tilde{\sigma}_t B_t$, then Λ is close to zero since no practice is necessary. In this case, Buddhism improves one’s utility without increasing his/her consumption level.
13. Large σ_t and low W_0 may be correlated.
14. The usual economic writing $\int_0^{\infty} e^{-rt} u(c_t) dt$ does not make sense to a Christian since if there is Heaven, his/her utility should be $\int_0^T e^{-rt} u(c_t) dt + U_1$, where U_1 is the afterlife utility in Heaven. $\int_0^{\infty} e^{-rt} u(c_t) dt$ can only be understood from the perspective of a Buddhist who believes in reincarnation but still holds the concept of time.
15. Consuming less is both the cause and the effect of Nirvana.
16. Actually, in some cases in the history of Buddhism, the Buddha’s teachings were not disclosed even when asked by a person in deep suffering, if it was not the right time or the right person.

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