

**Religion's Possible Role in Facilitating
Eusocial Human Societies.
A Behavioral Biology (Ethological) Perspective**

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Abstract:

Eusociality is the most successful animal social system on earth. It is found in many social insects, a few crustacean species, and only three vertebrates: two African naked mole rats and human beings. Eusociality, so unusual for a vertebrate, is one of main factors leading to human beings becoming the most successful land vertebrate on earth by almost any measure. We are also unique in being the only land vertebrate with religions. Could the two be related? This article will present evidence, illustrated primarily with Judaism and Christianity, that these two seemingly unrelated social systems – eusociality and religion – that correlate temporally in our evolution, are possibly related. Evidence will also be presented that a (mostly) non-reproducing exemplar caste of celibate clergy was a eusocial-facilitating aspect of religion in western social evolution.

Keywords: celibacy, Christian, eusocial, ethology, evolution, in-group marker, priest, religion.

1. Introduction

The term ‘eusociality’ was first used by Batra [4] to describe the unique social behavior of bees. Eusociality is sometimes called ‘ultrasociality’ [58], [114]. Today, eusociality has a loose and restricted definition. The loose definition requires: (1) multigenerational care of young, (2) cooperative care of young, (3) a division of labor, and (4) defense of communal locales, often containing foodstuff. The more restricted definition requires that in (3) one component of the division of labor involves a non-reproducing caste.

An emergent feature of eusociality is that an individual’s behavior benefits the in-group breeding population more than and often at a cost to one’s self, similar to a corporate or military culture in which the corporation’s or military’s needs take precedence over those of the individual. In that

respect, eusociality differs from altruism, where costs and benefits, ideally based on measures of reproductive success, are determined on an inter-individual basis. Eusociality's emergence and maintenance, like that of altruism, can be mathematically modeled by kin-selection [62] or among non-related persons by multi-level group selection [101].

Eusociality evolved independently at different times and through different mechanisms in many taxa of social insects [145], a few crustaceans [38], and in three mammals: human beings [146] and two species of under-ground-living, naked African mole rats [126], whose modest claim to success is being the longest living rodent and by being resistant to any kind of cancer. Quoting the most influential authors on this topic, Martin A. Nowak, Corina E. Tarnita, and Edward O. Wilson,

[E]usociality is not a marginal phenomenon in the living world. The biomass of [eusocial] ants alone composes more than half that of all insects and exceeds that of all terrestrial nonhuman vertebrates combined. Humans, which can be loosely characterized as eusocial, are dominant among the land vertebrates [101, p. 1057].

Humans can meet even the restricted definition of eusociality if celibate clergy, who emerged early in Christianity but were absent among the Judeans from whom Christianity emerged, are considered a caste of eusocial exemplars, admired people considered an example of what should be copied.

In this article the terms 'clerical' or 'cleric' or 'clergy' will refer to the male originators, elders, and evangelizers of early Christianity as well as ordained ministers – priests, bishops, cardinals, and popes – in Roman Catholic Christianity. Married permanent deacons in the Church today, although technically clerics, are being excluded when the term 'cleric' is used in this article. Modern clerics are of two types: religious order, who usually live in all male communities and take vows of chastity, poverty and obedience; and diocesan presbyters (parish priests) and bishops, who usually live alone and make a promise to be celibate. Celibacy means not married. Chastity means sexual relations only between a husband and wife. For convenience, the term celibacy will be used unqualified for both religious order and diocesan clerics to mean a cleric living in an unmarried and chaste state. Religion's role as a possibly contributing and possibly necessary but not sufficient cause of the emergence and maintenance human eusociality will also be addressed. Other contributing and possibly necessary causes include other types of non-religious, rule-generating social institutions [109] and our transition to agriculture approximately 10,000 years ago [58].

Although the article is about religion, it is written from a somewhat unique perspective of behavioral biology (ethology), an academic discipline in which the object of study is behavior [41], [42]. The ethological perspective has been applied to religion before [49], [64], [138]. Ethologists usually ask four questions about behavior: (1) What is its phylogeny (evolutionary history), if it has one? (2) How does it develop within the lifespan of the individual (i.e., its ontogeny)? (3) What are its proximate causal mechanisms (i.e., behavioral physiology)? and (4) How does it contribute to reproductive success, if it does, which is called its adaptedness [132]? Hopefully, the reader whose background is other than biology will see how this unique perspective can make a contribution to our understanding of religion by showing how some components of religion, probably not the ones most readers think, have possibly contributed to our reproductive success.

I will develop the argument that some components of religion possibly contributed to our reproductive success by facilitating human eusociality in two ways: at first by being in-group markers for a breeding population, which was coexistent with one's religion until very recently; and second, by having as a part of early Common Era (CE) European religion, celibate, eusocial-exemplifying clergy. In order for religion to have evolved by selection, at least some of the structural design features within religion would have to have been adaptations, meaning that individuals possessing them had better reproductive success than individuals who possessed other structural variants with the same function.

In behavioral biology natural and cultural selection, which are interactive, can produce evolutionary change. When I use the term ‘selection’ unqualified, I mean both.

The term ‘function’, which will be used throughout this article, means the use (roughly synonymous with ‘purpose’) of a *structural design feature*, which is a feature of an organism that has static (as in an anatomical feature) or moving (as in behavior) architectural mass by which the feature can be defined or described. The architecture is the pattern of movement of body parts with mass in 3-D space. The distinction between a structural design feature’s definition versus just its description is very important in behavioral biology. When something is *defined*, it is first put into a recognizable general category; then one says how it is different from the other items in the same general category. In contrast, a *description* is just a transformation of some of the perceivable features of what is being described using a different format, such as spoken language or in writing [51].

Appreciate that natural selection can treat certain heritable, coordinated patterns of movement, like what is called LSV behavior (to be explained) that can be *defined* by its form (pattern of movement of body parts in 3-D space) the same as if the behavior was an anatomical feature, like a bone [51]. Some structural design features, if they can be *defined* by their form, can be passed across generations either by their blueprints in DNA (i.e., in genes) or culturally by social learning. These two mechanisms, both of which can generate change (i.e., copying errors in genes or cultural innovations), are interactive and influence one another in what is called either gene-culture evolution or biosocial evolution. Most important, cultural institutions (including religions) can cause changes in the genome that favor cultural fitness [115].

I am proposing that certain structural design features associated with religion that can be *defined* by their form, whether they are passed across generations by DNA or by cultural (social) learning, facilitated our acquisition of eusociality primarily by being in-group markers for the (religious) breeding population. This eased our transition from kin-based to non-kin based social organizations during our bio-cultural evolution. Richerson & Boyd [115, p. 90] call this ‘marking of group boundaries by cultural symbols.’ This means being an in-group marker for a breeding population would have been the ‘ultimate function’ of the religious ‘cultural symbols’ (using Richerson and Boyd’s terminology) when they were under positive selection pressures. This would have occurred for the first time many tens of thousands of years ago. Of course, metaphorically speaking, natural selection did not ‘know’ that this (i.e., being an in-group marker) was their ultimate function, as natural selection has no brain and cannot ‘know’ anything. The only currency that natural selection accepts is reproductive success. Human in-group breeding populations that had a stronger in-group identity must have had a selective advantage in multi-level group selection for eusociality.

An important principle in biology is that structural design features (or forms) can change function (i.e., what they do) over evolutionary time (phylogeny) as well as during the developmental lifespan of an individual (ontogeny). And, a structural design feature can have two or more different functions at the same time. With that as background, and given the phenomenal success of eusociality as an animal social system, any variation of a structural design feature that facilitated eusociality in an individual would almost certainly have been and still be an adaptation for that individual through either kin selection among related persons [62] or through multi-level group selection among non-related persons as societies grew in eusocial complexity [101].

Theoretically, one could argue that a function other than in-group marker was the ultimate function of these religious structural design features when human beings first acquired religions. As a modern example of another function for a religious structural design feature, in poorer parts of the world today wearing a gold cross on a gold chain around one’s neck is also a status symbol, which would make status display the function. Ironically, some Japanese teenage girls, who are Buddhist, wear gold crosses around their neck, not as cultural symbols of religion, but as fashionable, high status, ‘western-style’ jewelry. Today, as in the past, some religious people wear religious items on their

person as the religious equivalent of good luck charms, which is another possible function of religious structural design features. I am open to these other possibilities; but within multi-level group selection I cannot think of a more adaptive function for religious structural design features than being eusocial-facilitating in-group markers for a breeding population.

A similar type of unanswered question occurs regarding the evolution of religion as a whole within the cognitive science of religion with adaptation and by-product proponents each making their arguments [17]. Of course, non-material functional entities in the non-material mind, such as the ‘modules’ within the cognitive science of religion, cannot be adaptations, but they can confer adaptedness (or adaptiveness) on the structural design features in the brain whose functions they are. In behavioral biology the argument seems more settled. At least today, the structural design features associated with religion, from information-laden religious beliefs (and the behaviors they predictably bias in the active state of believing) to crosses around people’s neck to hijabs, are and were actual in-group-marking cultural adaptations for a breeding population. Among hunter gatherers, which is where we as a species have spent 95% of our time, religious beliefs and behavioral rituals probably would have been the main structural design features (i.e., cultural symbols) associated with different religions.

Our closest non-human primate relatives, the chimpanzees and bonobos, are neither eusocial nor religious. At some time in the 6 million years since our last common ancestor, eusociality and religion came to characterize us. There is no evidence that our recently extinct other human species, *Homo neanderthal*, who lived approximately 500,000 to 40,000 years ago and with whom we share more than 99% of our DNA and with whom there was some inter-breeding, was any more eusocial than chimpanzees or bonobos. Nor, is there evidence of true religion in Neanderthals, although there is some evidence of proto-religion, such as burying the dead. There is absolutely no evidence of either eusociality or religion in the tool-making common ancestor of *H. neanderthal* and *H. sapiens*, who was *Homo erectus* and who lived 1.9 million to 70,000 years ago.

In reconstructing history, ‘possible’ is the best standard of evidence that can be presented at this time for the relationship between religion and eusociality. As more hypotheses are tested and more data accrues, the evidence might become probable. Given the inability to test hypotheses in long-gone ancestral environments where human proto-religions [142], [6] and proto-eusociality [146] evolved, most likely the standard of evidence for religious structural design features ever having had an actual causal role in human eusociality will never get to within the realm of scientific certainty. In the meantime, we will consider if the evidence to date is at least plausible.

2. Religion and Its Evolution

Evidence points to religion emerging as a cultural institution from about 200,000 years ago to about 50,000 years ago when humans lived in small hunter-gather bands of 25 to 50 persons. Religion’s evolution [46], [120], [138], which is a separate question from God’s evolution, or at least the evolution of human ideas about God [19], [64], [148], is a complex topic as religion is composed of religious beliefs, emotions and behaviors. There are also other features of religion, such as religious myths and sacred texts and commentaries, which for convenience, I’m bundling within religious beliefs as the linguistically represented components that contribute to the creation of religious beliefs. Apart from some arguments to the contrary [17], [138], it is unlikely that religion as a whole, including its inborn and culturally acquired components, could have evolved *directly* by selection, which can only act *directly* on structural design features, as previously discussed, be they genetically or culturally transmitted across generations [50].

There is one obvious structural design features of all religions that was previously mentioned: the phylogenetically old (and therefore heritable), coordinated motor pattern of make-oneself-lower-*or*-smaller-*or*-more-vulnerable (LSV) behavior used in humans in the non-vocal aspect of petitioning

prayer. Each religion has a somewhat distinguishable local variation on the common and general LSV theme by which the behavior is *defined*. This local, learned and culturally acquired and transmitted variation on the common LSV theme is why one can tell the difference between a praying Jew, Christian or Muslim [51]. LSV behavior, because it is a heritable, coordinated pattern of movement that can be defined by its form, can be a *direct* object of gene-changing natural selection. The local, culturally acquired learned variation on LSV behavior that is specific for particular religion, which can also be defined by its form, can be a direct object of cultural selection.

There are also bodily features that are structural design features of religion, such as the circumcised penises and religious beards of Jewish and Muslim men. There are also cultural items that are symbols of specific religions, such as the semantic representation of specific partially counter-intuitive and partially counterfactual religious beliefs, a gold cross worn around a Christian woman's neck on a chain or the hijab head covering of Muslim women or the Yamaka skull cap worn by religious Jewish men. Most important, all of these structural design features are religiously mediated in-group markers.

Some more can be added about religious beliefs as religiously mediated in-group markers. There are two ways in which a belief can be conceptualized: the philosophical-psychological way and the behavioral biological way. In philosophy and psychology, a belief is some version of that which is held to be true, and where knowledge is a justified true belief. In philosophy and psychology, beliefs are non-material/non-physical concepts in the non-material mind. Using the word 'belief' or 'believe' in language, as in 'I believe P,' is not evidence for the presence of a belief. It is only evidence of what someone says that they believe. It is subject to deception and may not be evidence that someone harbors the belief at all.

By contrast, in behavioral biology, where components are preferentially referenced to behavior (movement), a belief can be conceptualized as a quantity of information, which when in the brain and formatted above the level of an individual neuron (i.e., not just in an individual neuron but within a neural network or circuit), biases behavior in a predictable way; and when the individual is in the active state of believing, the behavior (movement) is constitutive of the belief and not just evidence of the belief [54]. If beliefs are composed of information, and if information is always 'physical,' beliefs are always physical. From the third person objective perspective, the mind is what the cognitive-related structures of the brain do, such things as thinking, planning, praying, etc. What things do in biology is in a different, non 'physical' ontological realm from what things are, which is framed in biology as the form/function distinction. 'Mind,' from the first person perspective and the issue of Cartesian dualism, etc., is a separate issue not being addressed.

The state of believing, which would be what the beliefs (as well as the individual who harbors the belief) are doing, would be a non-material (third person perspective) function in the non-material mind when the individual who harbors the belief is in the active state of believing. In behavioral biology causation can't cross the ontological boundary between form and function, which has lots of application to the causes of religious behaviors. Beliefs, because they are information-laden physical entities in brain, can make bodies move. That is because beliefs are in the same form/function ontological realm as bodies. They are both forms.

This behavioral biology perspective on beliefs is a particularly useful way of conceptualizing beliefs in religion, where an (if not *the* most) important biological function of a ('physical') religious belief is to act as an in-group marker by biasing people's religiously motivated behavior in a predictably similar way. What people do behaviorally, based on a belief they harbor, is more important than what they say about what they believe, as in 'I believe P.'

I'm saying that religious structural design features – from beliefs to gold crosses to hijabs – are in-group breeding population markers dogmatically rather than conjecturally because from my behavioral biology perspective the evidence, some of which was just discussed, is compelling. More

will be said later. Arguing that it feels good to believe and to have faith cannot be the primary function of religious beliefs. Metaphorically speaking, natural selection does not ‘care’ if someone feels good or bad. Rather, the good feelings in people of faith in the state of believing are just natural selection’s way of having someone have religious beliefs.

Also, utility trumps truth in behavioral biology, meaning that the truth value of the propositions in the linguistic representations of religious beliefs are not relevant, as counter-intuitive as that might sound. What is important for religious beliefs, from a behavioral biology perspective, is that people who harbor them believe together, pray together (in the same way) and then lay together and then have babies together, the religiously-motivated ingredients of an in-group breeding population.

3. Religion’s Possible Role in Eusocial Evolution

Religion’s possible role in the emergence of eusociality can be understood in a series of stages that I am calling ‘isms,’ meaning distinctive practices, styles, beliefs, and behaviors through which human societies have progressed. The issue at hand is religion’s role in when and how (i.e., by what proximate mechanisms) individuals came to put the welfare of their in-group breeding population above that of themselves, a necessary and emergent property of eusociality. Different mechanisms were probably involved in these different stages, starting with the family group and ending with the western-style industrialized democracies in parts of the world today. What follows are the stages.

3.1 Nepotism

As pointed out a number of decades ago by Richard Dawkins [28], we (or at least most) humans are essentially vehicles for caring for and then sexually combining our genes with someone of the opposite sex and then caring for the resultant progeny during our very transient and short individual lifetimes. We die but our genes survive, if not in our children than in our siblings’ children (i.e., our nieces and nephews) and our less closely related cousins’ children, etc. As a result, most of our behavior, as gene carriers, is directed at doing what is best for and in propagating our immortal genes that are scattered among our relatives. For all of us, there are more of our genes in our relatives than in ourselves. As a result, because our genes appear to be such important drivers of our behavior, family comes first, sometimes to our own personal detriment, which goes under the heading of nepotism.

This would be the earliest theoretical stage of human proto-eusociality, where self is self and ‘other’ is family. What parent would not give up their own life to save their children. As a result, many of our family-first behavioral traits have evolved by what is called kin selection [62]. We don’t know the social history of our primate ancestors well enough to know if some of them prior to our last common ancestor with the chimpanzee 6 million years ago lived in small monogamous family groups, such as the Asian gibbons live today [83]. Extant primate societies are very variable [128].

3.2 Bandism

Even though several extant African hunter-gather groups now have courtship-initiated marriages, there is both genetic and cultural evidence of family-arranged transfer of reproductive age adolescent individuals among hunter-gather bands in our human past in what is called reciprocal exogamy [139]. On a less formalized basis, female adolescent transfer between flexible fission-fusion groups [128] is found in the chimpanzees and bonobos, our closest primate relatives. In humans, among current hunter-gathers [68], as in many more modern societies, either sex can disperse (transfer) from their natal group to marry.

The fact that human groups are and probably were more stable than the less enduring fission-fusion groups of chimpanzees and bonobos is probably why multi-level/group selection, by which eusociality primarily evolved, worked better on us than it did on them. In-group marking religious structural design features and stronger human affectual bonds among more than mother and offspring (e.g., romantic love and paternal-offspring bonds) would have made our groups more enduring in composition than groups of chimpanzees and bonobos. That would have occurred sometime after our proposed transition from multi-male and multi-female (i.e., polyamorous) mating in the earliest *Homo sapiens*, which will be discussed below in the work of Ryan and Jetha.

As a result, compared to a family kin group in which everyone is genetically related, hunter-gather bands are composed of genetically related and non-related persons. The theoretical kin group, as a social unit, would not have needed religion as an in-group marker to put the extended family's needs above that of the individual. We evolved to put family first by kin-selection, as explained above, given that our genes are 'selfish' but widely distributed among our kin.

What would have been needed in hunter-gather bands to cause individuals to put the groups' needs above that of one's self are symbolic, culturally-acquired, in-group markers. Such markers would have included in-group distinguishing language (or dialect within a language), dress, hairstyle, adornments, jewelry, cultural rituals, and community held partially counter-factual and partially counter-intuitive beliefs, which is where religion comes into the picture. All religions contain such beliefs as well as religion-specific and therefore in-group specific linguistic and behavioral rituals [111].

Adult human males in hunter-gather bands, even those who are not genetically related, are relatively cooperative and egalitarian with each other [11], especially for a primate. A provocative proposal has been made by Ryan & Jetha [119] that in our early hunter-gather band stage our mating system was multimale-multifemale (polyamorous), somewhat like chimpanzees and bonobos are today, and that our penises (but not that of the chimpanzee and bonobo) are as responsible for the high degree of adult male: adult male cooperative behavior as our brains.

The shape of our penises could also be as much a contributing cause of our eusociality as our religions! The adult human male's glans penis even today is essentially a scoop which in pre-ejaculatory penile-vaginal thrusting would dislodge and remove the sperm of other males who had recently ejaculated in the adult female. We are the only primate with such a 'device,' which Ryan and Jetha argue (somewhat persuasively) evolved sometime after our last common ancestor with the chimpanzee to allow adult human males to compete at the sperm level, which then freed them to cooperate within the hunter-gather band at the behavioral level for big game hunting and communal defense. In comparison to our closest non-human primate relatives, adult human males have been called '*SuperCooperators*' [99]. Fifty non-related stranger human males can sit on a city bus together peacefully, which would be an impossible task for fifty, non-related adult male chimpanzees.

The pattern for religions in hunter-gather bands is to change rapidly in ritual and belief as bands split apart, which is common. There are good data documenting this among the Apache Native American bands in the American Southwest [47, p. 38], [57, pp. 1–2], [94, pp. 8–13]. Appreciate the advantage of religion as an in-group marker for a hunter-gather band. A newly arrived adolescent might have a different dialect or even a different accent from having been in another hunter-gather band prior to puberty. Dialects and accents get fixed at puberty. Our brains react differently to someone who speaks our language with a dialect or accent compared to a native speaker [8]. Their different dialect or accent would identify that immigrant person as not a member of the new in-group. However, the adolescent would have strong emotional motivation for acquiring the new religious beliefs as well as the new dress, adornments, hair style, etc. So in that respect, religious beliefs and rituals come in as in-group markers where language dialect and accent stop [131].

3.3 Tribalism

The next more complex type of organization in human social evolution is the tribe, which can consist of hundreds to thousands of individuals, often divided into genetically related (through the maternal or paternal line) clans. And when small scale horticulture and husbandry became adopted, tribes could grow in size. Because tribal members are even more un-related genetically than members of a hunter-gather band, religion would have taken on even more importance as an in-group marker for the tribe as a way of predisposing people to put the in-group's needs above that of one's self. Tribal religions are more elaborate than simple hunter-gather band religions. In tribes one can see the beginning of the transition from the more behaviorally based imagistic to the more belief-based doctrinal modes of religion [41]. Compared to the relative simplicity of hunter-gather religions [46], the religious myths that make up the belief system of Navajo Tribal religion, as an example, take over 856 pages to document [113], which is actually 31 pages longer than the *Catechism of the Catholic Church* [21] and a little more than half the number of pages in the *New American Bible* [97].

3.4 City Stateism

The invention of agriculture circa 10,000 years ago allowed larger numbers of humans to live together and grow their food in the surrounding countryside. A city state is a sovereign city and the surrounding countryside, often governed by a ruling family. European city states, which also had their ruling families, had their own professional armies. Our evolved sense of in-group and out-group tribalism is what held these city states together. In addition, almost all city states contained people of the same religion. So there were two in-group markers, the symbols of the city states, such as coats of arms, flags, etc. and the symbols of the religion.

3.5 Nationalism

The next stage in our social evolution would be the nation, at least historically composed of confederations of many tribes, city states, and states (as in 'The United States'). It is at the nation state level that national symbols take predominance from flags to songs, to currencies, etc. Some nations consist of citizens of the same religion, where one can see state religions. In other nations of diverse people, like the United States, nationalism appears to act in a similar way to religion as being an in-group marker. The United States is not a single breeding population, as people assortatively (preferentially) mate (i.e., marry) primarily on the basis of religion, although this is rapidly changing with secularization.

People have always been willing to die for God and country, which shows how the two different types of culturally-created social institutions, religious and political, are related. Both religion and the nation state act as eusocial-facilitating in-group markers, especially where the in-group is also a breeding population. Nationhood is a less effective eusocial-facilitating in-group marker when there are factions within the in-group that don't exchange genes. Such was the case in Europe with the Jews and Christians prior to World War II, and now with the European Muslims and Christians.

Ironically, secularization, where religion's influence on who marries whom declines, will allow for more gene flow among previously genetically isolated religious in-groups within nations. This will facilitate the nation's ability to act as an in-group marker. With all its symbols, nations, like religions, are well suited for the task. Appreciate that the more that nation-specific in-group markers disappear, such as a nation-specific religion or currency or passport-requiring borders, the less effective the nation becomes as a eusocial-facilitating in-group. That conflict is evident in the European Union (EU) today where English is becoming the common language and the Euro is becoming the common currency and

one can cross national borders in the EU without passports. That which is considered the in-group is expanding, which causes cognitive and emotional distress in traditionalists.

4. Prosocial Behavior, Cooperation, Altruism, Eusociality, and Parochial Altruism: What Are the Differences?

First, one can model these different entities with the same or similar equations and computer simulations [13]. That is because one issue is the same among them, which is the interaction of self with other. The 'other' can be another individual or any group of other individuals. Given the current popularity of cognitive science and cognitive science of religion, the various ways in which these entities are modeled primarily address cognitive and rational ways of behaving and downplay the emotional, which is difficult to model [107]. Emotions don't follow laws of logic that can be modeled. To have a more comprehensive understanding as to what causes these different entities, and as a general principle with which to understand human behavior, imagine a triangle with thoughts, emotions, and behavior at the three corners. If there is a change any one of these three items, it almost always has an influence on the other two.

David Sloan Wilson [144] says that altruism is both a motivation of behavior and a behavior. He points out that the most altruistic species on earth are eusocial insects in whom we don't ask questions about their motivation. He then argues that in terms of trying to understand human altruism, we should concentrate on ways of modeling the behavior and how it could evolve and be maintained and forget about the behavior's emotional motivation. That modeling principle would apply to eusociality as well. In respect to humans, modeling equations and computer simulations, although showing how such behaviors could evolve by natural selection, would not be very predictive for a particular individual in whom emotions as well as idiosyncratic life history variables play a part in behavioral decisions.

4.1 Prosocial Behavior

Prosocial behavior means two things: (1) helping others individually or in groups, and (2) following social norms. In terms of the first meaning of prosocial behavior, in the human (as contrast to an ant) the motivation for 1:1 prosocial behavior is often said to be altruism, but that is just kicking the can down the road because we then have to ask what motivates altruism, which on a 1:1 basis is empathy and will be discussed below. Also, the costs and benefits in this type of prosocial helping behavior do not have to be as profound as units of reproductive success. Holding a heavy door open for an old lady when she is coming into a restaurant behind you costs almost nothing for you in calories and a few seconds of time but the small act of human kindness might benefit her significantly. Human prosocial helping behavior can be on a 1:1 basis or on a 1:group basis, such as donating money anonymously to large charity. The motivations are different between the two and will be covered below.

The other meaning of prosocial behavior, following social norms, does not have to be related to altruism or eusociality at all. Examples of social norm following include wearing the currently fashionable, society-specific and expected clothing, obeying driving rules, belonging to the state religion when there is one, and showing common courtesy and politeness expected of one in one's social group. Cultural manners are a type of cultural in-group-marking, such as the greeting ceremony of shaking hands in Europe and bowing in Japan [42]. These types of ritualized, culture-specific social behaviors are motivated by our tendency towards normative coercion and the tendency or need of people to do what most people do and especially what high status people do [92], [95], [102]. The motivations behind such conformity behaviors are complex. Following driving rules, one of the examples of prosocial behavior just used, requires cooperation, the next topic.

4.2 Cooperation

Human cooperation can be generated just from the (rational) thought corner of the thought-emotion-behavior triangle previously explained [2], whereas human altruism and eusociality are almost always generated from the emotional corner. By contrast, appreciate that in a eusocial ant cooperation is just genetically programmed given the appropriate releasing stimuli. Although social and cultural factors are involved in human cooperative behavior, there is also a heritable component, just like in the eusocial ant [23]. Even though cooperativeness is widespread among the Animal Kingdom [135], many authors conflate human cooperation with human altruism as a single entity, primarily because they can be modeled with the same computer simulations and equations. They use the terms synonymously. There is an advantage in separating cooperation from altruism, especially in humans. All altruism involves some degree of cooperation but one can be cooperative just on a genetically programmed basis (ants) or on more volitional, rational cognitive basis (humans). Humans don't have to have any positive feelings at all for the person with whom they are cooperating. People can even cooperate with people with whom they have negative feelings, such as cooperating together in an organization to compete with other organizations. So even though cooperation and altruism can be modeled with the same computer simulations and equations, altruism, at least in humans, implies an emotional-motivational component that is not needed in simple cooperation.

There are two main types of cooperation, direct and indirect [100], which are also called direct and indirect reciprocity. Robert Trivers [134] was the first to show mathematically how direct cooperation, in which there is at least a temporary cost to self and a benefit to another individual, could have evolved by what he called reciprocal altruism. One helps one's neighbor knowing that if one needs help in the future, one's neighbor will be more likely to return the favor. This is extending social reciprocity credit to one's neighbor. Many tribal societies (e.g., the Navajo of North America) are held together by such webs of social reciprocity credit.

Allomaternal care (non-relatives taking care of juveniles), a type of cooperation, is widely distributed among birds and mammals and common among primates [70]. Adult male primates also interact with juveniles in many ways and for many different reasons [129]. But we (*Homo sapiens*) are the only primate in which fathers take intimate care of offspring that can, except for nursing, can be identical to the type of intimate care given by mothers [90]. We and chimpanzees are also the only primates that engage in cooperative food sharing among adults. Human beings, at least in more advanced societies, are also the only primate with a division of labor where specialists help and cooperate with each other for goods and services. In simpler societies most people are generalists. Issues like reputation and cheating, in relationship to cooperating, are also involved and are complex and beyond the scope of this article. But it can be mentioned that reputation allows for what is called indirect reciprocity [100], where the favor is simply passed on to other community members, as long as the person asking for help in the future does not have a bad reputation as being a cheater who does not reciprocate. The take home point about cooperation is that in humans it can be generated by cognitive, rational factors alone.

4.3 Altruism

We discussed the relationship between cooperation and altruism above. There are certain features in common between altruism and eusociality, which will be discussed below. In humans, these two types of social interaction, altruistic and eusocial, have different underlying emotional motivational systems. Altruism involves a 1:1 interaction where one does something to benefit someone else at a cost to self. The emotion of empathy is primarily and usually what motivates this type of human altruistic interaction [31], [33], [35]. As a result, and to reiterate, computer simulations and games, which don't

involve face to face interactions with real people in need, reduce the role of empathic emotion as a motivating factor in human altruism, which is why maps (computer simulations, equations, and games) don't always accurately reflect the territory (real life situations). There are also experimental data supporting the role of empathy as the motivation underlying human altruism [5], [45], [133], [137].

We also know something about the neurological mechanisms that generate empathy, including mirror neurons [56] and oxytocin [3]. We empathically understand what others feel by a mechanism of action representation [20]. Empathy does not require a prior affectual bond between the two people. We can cooperate and even be empathic with total strangers or even to birds and non-human mammals. One theory of empathy is that one behaves altruistically to reduce the negative empathic feelings we have in ourselves when we observe someone else in distress. Natural selection does not metaphorically care much about how people feel but can utilize unpleasant feelings in sculpting our behavior.

Cloninger & Kedia [24, p. 97], who also go into the neuroscience behind their argument, claim that

[A]ltruism is an attitude that is only possible in an animal that has the capacity for self-transcendence, which requires identification with what is beyond the existence of the individual. Altruism is an expression of self-awareness that emerges for the first time in modern human beings along with self-aware consciousness and the capacity for sublimation. Altruism depends on brain structures that are only present in human beings and not in non-human primates.

This finding is another way of differentiating human altruism from the more ubiquitous non-human animal prosocial behavior and cooperation.

In spite of strong arguments to the contrary [98], [110], the evidence is weak for religion's role in the evolution and maintenance of altruism [55], [91] or that altruism can explain religion [104]. Although some of the world's great religions have an emphasis on altruism [96], many of the ancient state religions created gods that could not care less about how humans behaved towards one another. This lack of evidence for religion's role in altruism or vice versa does not preclude religion's relationship with eusociality, where religion acts as an in-group marker. One's common religion, with all its symbols, facilitates acting in ways that benefit the in-group at a cost or potential cost to self. To illustrate the principle, school uniforms, sports teams, boy scouts, and armies also dress the same to increase their sense of in-group.

4.4 Eusociality

Appreciate that in most eusocial species, like the social insects, there is nothing in either the broad or restricted definition of eusociality that involves individuals being emotionally altruistic to one another on a 1:1 basis in the multi-generational and cooperative care of the young and division of labor. Humans also can baby sit and watch each other's children as a job for money with no emotional involvement with the child even though that is usually not the case for most people when they care for other people's children that they know and which at least involves what Sarah Hrdy [70] calls mutual understanding. In contrast to altruism, which is interactions on a 1:1 basis, an emergent property of eusocialism is individuals acting so as to benefit their in-group often at a cost to themselves.

Tribalism is the general term for what underlies this behavior, although tribalism is now extended to more advanced and complex societies where it is called nationalism. Richerson & Boyd [115] call this the 'tribal social instincts hypothesis.' However, ethologist Niko Tinbergen [132, p. 118], who won the Nobel Prize in Physiology and Medicine in 1973 for his discovery (along with fellow ethologists Konrad Lorenz and Karl Von Frisch) of the mechanisms of instincts, very strongly

argues that within the hierarchical organization of behavior ‘there is no such thing as a [i.e., in the singular] social instinct.’ Instincts occur at lower hierarchical levels and can contribute to social behavior. As such, tribalism (or ‘colonyism’ in social insects) is not in itself an eusocial-facilitating *instinct* either in ants or in us.

Tribalism, which is not an instinct, is also not a known or understood basic human emotion that causes behavior. The closest set of behaviors to tribalism might be those related to territorial defense, where aggression is the primary emotion used to defend territory. However, aggression does not accommodate the important emergent property of eusociality, which is putting the needs and welfare of one’s in-group breeding population above that of one’s self. There are probably several different emotions underlying what is called tribalism. Xenophobia, which is a fear of strangers who are not members of one’s in-group, is one such emotion that creates our sense of in-group versus out-group.

In the past 10,000 or so years with the advent of agriculture, aggression in territorial defense would have been more adaptive than in the long hunter-gather phase of our social evolution. So fear and aggression are two emotions. There are others as well. Patriotism is a component of tribalism. People often get emotional feelings, including sympathetic arousal (i.e., ‘goose bumps’) and sometimes even get tears in their eyes when they hear their national anthem sung. Perhaps that is a manifestation of awe. Tribalism emotions appear to be sublimated by fans of sports teams, who get very emotional cheering on their surrogate in-group sports team.

4.5 Parochial Altruism

This is a term for costly in-group cooperation and then inter-group aggression without expectations of future returns. Not surprising, the concept, being somewhat of a hybrid between two different human motivational systems, has conflicting evidence supporting it being natural kind [149].

5. The Behavioral Biology of Human Eusociality

To review, eusociality requires (1) multigenerational care of young, (2) cooperative care of young, (3) a division of labor, and (4) defense of communal locales, often containing foodstuff. The more restricted definition requires that in (3) one component of the division of labor involves a non-reproducing caste.

Given the number of elements that comprise eusociality, there is certainly not a human ‘eusocial gene,’ even though a mutation in one or more human genes could theoretically impair an individual’s ability to behave eusocially. In addition, because eusociality evolved in a number of very diverse taxa (insects, crustacean cleaning shrimp, naked African mole rats, and human beings) that are so distant taxonomically, it is a reasonable presumption that there is more than one way, i.e., different mechanisms, in which a species can become eusocial.

From a behavioral biology perspective, eusociality is a highly efficient social organization for a society where the individuals in the society are analogous (same function but different evolutionary history) to the different specialized cells in a multi-cellular organism. Human beings have gone through a progression in complexity of social organizations since we first evolved, which was previously discussed. At each stage, we became more eusocial. Compared to eusocial insects, human being social organization is not genetically determined in such a fixed way. We are more flexible, as evidence by the different human social organizations just in the past few thousand years around the world. Now, the behavioral biology of the components of human eusociality will be discussed separately with occasional comparisons with other eusocial species.

5.1 Multigenerational and Cooperative Care of the Young

Multigenerational and cooperative care of the young (i.e., cooperative breeding) are present in species that are not eusocial, including many non-human primate species. But, as previously stated, what is unique to human beings is that adult males, especially fathers, are much more involved in care of the young, including infants. Besides mutual understanding [70], one of our other mechanisms of multi-generational and cooperative care of the young is our capacity to form affectual empathic bonds even with non-related juveniles [70], which derives from maternal care that evolved independently in birds and mammals [42]. Irenäus Eibl-Eibesfeldt captured this capacity with the beautiful phrase, ‘with maternal care love came into the world’ [43, p. 158]. There is a neuroscience behind this capacity that is beyond the scope of this article [30].

5.2 Defense of a Communal Local, Often Containing Foodstuff

Defense of a communal local, often containing foodstuff, requires that we as human beings can distinguish between in-group and out-group members. Based on twin studies there is evidence that in humans what is called in-group love (i.e., patriotism and nationalism) and out-group derogation (i.e., prejudice and xenophobia) have a small heritable component [74], which is almost certainly polygenic and not presently known but which might be mediated by oxytocin [32]. Compared to social insects, who have colony-specific pheromones, human beings have average-generating mechanisms in our brains that average variations of kind on common sensory themes. Our brains appear to ‘know’ what is average, as what is average is more aesthetically pleasing to the brains’ owners. For example, when one takes photographs of the faces of many different women, who for example work in the same organization, and then morph all the faces into one face using morphing software, the picture of the morphed face, which is the average face, is considered more aesthetic and attractive than the face of any of the individual women [59, p. 191]. We can give meaning to (i.e., identify) a particular face so easily by knowing (or at least our brain ‘knows’) how and to what degree the particular face differs from the average face.

We, or at least our brains, have a similar mechanism for ‘knowing’ what is average for features about which we are familiar other than human faces. Each human in-group breeding population, which historically has been synonymous with a religion, has culturally unique features that can be detected with our senses. Such features include language, dress, hairstyle, jewelry, manners, customs, etc. We know (because our brains learn) what is average from seeing so many examples as we grow up in a society. In a strange society, not knowing what is average produces what is called ‘culture shock.’ We are particularly sensitive to outliers, who are in the tails of the distributions for what is average in our own society, as average is the exemplar of the in-group. When an individual is more than a few standard deviations from average in a culturally transmitted feature in our own society, the individual is looked at with suspicion as not being an in-group member. Average is beautiful is true in biology even if it is counter-intuitive.

Racial features and how we react to them on fMRI fall into this same average is beautiful principle, as they can be quantitatively distributed across in-groups and show variation within and across what are called races rather than being discrete kinds [117]. For example, people get progressively more Asian looking as one moves east from the Middle East farther into East Asia. Races are modeled as clines in genetics, which reflect a geographic center and then quantitative changes in gene frequencies as one moves away from the geographic center. Human races are not discrete kinds. Humans also don’t have an innate racial bias as humans evolved in the Pleistocene where most people only saw people of the same race. What at first could be interpreted as evidence for racial bias on fMRI appears to be just driven by norm (i.e., average) violation [122]. By contrast, other features, like a

different language, are more qualitative ways of differentiating someone as an out-group member. The outward manifestations of religion, from dress to behaviors to beliefs, are often qualitative distinguishers. A meta-analysis reveals that we determine that someone is an out-group member based on many different quantitative and qualitative features that utilize different brain regions [127].

We have out-group prejudice (‘xenophobia’), identifiable on fMRI and quantitative EEG analysis, for people who even have a different dialect of the same language we speak, when all we hear are their voices [8]. When people of the same race are put in groups based on something that they believe that they have in common, their brains react differently on quantitative EEG measures to in-group versus out-group members [67], [112]. Our brains even react differently on fMRI to an out-group with whom we are in current conflict versus a distant out-group with whom we have never had any interactions [16] or between a moderately different versus an extremely different out-group [65] or to politicians faces of the same or different political persuasion than our own [75]. Our brains react differently to pictures of people who look like us, meaning they are of the same race and ethnic group, depending on whether there is a national flag of our country or another country in the picture, showing that out-group bias can occur with symbols and doesn’t depend on facial difference cues [27].

That later finding has obvious implication for religious symbols, such as the gold cross or hijab, as in-group and out-group markers. Our brains even react differently when we hear pro out-group versus pro in-group words spoken by someone else [15]. When doing tasks, our brains react measurably differently, using quantitative EEG analysis, in the presence of an in-group or out-group observer [69]. Our brains react differently on fMRI when an in-group member is harmed by another in-group member compared to being harmed by a member of an out-group [93].

We also know something about in-group preference or ethnocentrism at the neurohormonal level. As previously stated, oxytocin, a brain peptide that is associated in women with uterine contractions and childbirth, also promotes in-group favoritism and to a lesser degree, out-group derogation [32]. People differ in the degree to which they have this in-group preference tendency based on which of several polymorphic oxytocin receptor genes they have [86]. Of interest in terms religion’s function as an in-group marker, a recently published placebo controlled study has shown a relationship between intra-nasal oxytocin administration in middle age men and self-reported measures of spirituality [136]. In-groups and spirituality (i.e., politics and religion) might be related because they both appear to be mediated, at least in part, by oxytocin.

5.3 A Non-Reproducing Caste

The general and figurative definition of a caste in the online *Oxford English Dictionary* [105] is ‘a system of rigid social distinction in a community.’ Given that the *Catechism of the Catholic Church* [21, p. 441] claims that ordination confers a permanent ontological change on the cleric, the general and figurative meaning of a caste seems applicable. Human males become non-reproducing clerical caste members for a variety of reasons.

There are two main reasons (or proximate, contributing causes that are neither necessary nor sufficient causes) that facilitate a human male being able to be a celibate cleric, both of which involve reproductive suppression but by two very different mechanisms:

- reproductively suppressed in adolescence or young adulthood by acquiring, through indoctrination, various counter-intuitive religious beliefs,
- reproductively suppressed *in utero* in the third trimester of pregnancy by steroid sex hormones.

First, before explaining these two mechanisms in more detail, something must be said about ‘reproductive skew’, which is the ratio of non-reproductive to reproductive members of a breeding

population [61]. The higher the ratio, the higher the reproductive skew. Compared to other eusocial species, humans have an extremely low reproductive skew. Reproductive skew is modeled in two ways: the *transactional model* assumes that each individual has full control over reproduction but self-restrains from reproducing. The *compromise model* assumes that all individual will at least try to claim a share of the breeding.

The reproductive suppression of clerics, including the two main reasons mentioned above, is most compatible with the transactional model, although ‘self-restrains’ should not be confused with ‘free will.’ In the *transactional* model of reproductive skew ‘self-restrains’ in reproducing occurs by different mechanisms in different species. It also occurs by at least two different mechanisms in clerics of the human species. It is sometimes reversible and sometimes not, which also applies to humans. The following applies to humans except where reference is made to the naked mole rat.

5.3.1 *Reproductive Suppression in Adolescence or Young Adulthood*

This mechanism is associated with clerics who are *primarily* attracted to adult women. It is potentially reversible. This celibate behavioral phenotype is a manifestation of a very strong religious belief, almost certainly acquired with accompanying emotions, that biases the cleric’s behavior towards eusocial cooperativeness where they put the reproductive success of their in-group breeding population above that of themselves. In some clerics in religious orders, who joined the orders in adolescence, wanting to be a member of a relatively a high status and locally admired ‘we-group’ [44] could also be a contributing factor. Except in earlier centuries when illegitimate children of clerics were common (Betzig, 1995), giving up romantic love, sex and children in the modern world for God in such clerics is a very different phenomenon from simply having less reproduction as a result of reproductive cooperation among males, which is common among primates [37] and is modeled by the compromise model of reproductive suppression.

One could argue (albeit not without controversy) that the reversible, non-reproductive status in celibate clergy who are *primarily* attracted to women occurs by an analogous submissive interaction with a dominant, same sex, higher social status individual, which is the mechanism that produces reproductive suppression in the naked mole rat [150]. Analogy can be a source of knowledge (Lorenz, 1974). Same sex clergy higher up in the hierarchy impose beliefs that facilitate the acceptance of the ‘discipline’ of non-reproducing celibacy on all clerics, including those who are *primarily* attracted to reproductive age women. The effect of this discipline is felt most by diocesan clerics who are *primarily* attracted to adult women and who usually live alone in rectories. After Vatican II in the 1960s, when many clerics were disappointed that celibacy was not made optional, tens of thousands of them left, mostly to get married. By contrast, celibacy is quite understandable and natural for religious order clergy, who live in all male communities. Appreciate that among the primates groups of non-reproducing males are not unique to religious order clerics who live together in religious communities [116]. Such ‘bachelor groups’ are different from another primatological term, ‘peripheral males’, a category that appears applicable to diocesan clerics (i.e., parish priests) who live alone in rectories.

5.3.2 *Reproductive Suppression in Utero in the Third Trimester of Pregnancy by Sex Steroid Hormones*

This type of reproductive suppression is not reversible. It is not initially and sufficiently caused only by intra-individual-controlled factors in the fetus, as the mother’s physiology appears to plays a very important role. It results in less romantic and sexual attraction to reproductive age girls and women, which makes a celibate clerical lifestyle easier. Psychodynamic explanations for this type of reproductive suppression, once quite popular in the 20th century, no longer have scientific credibility.

The behavioral neuroendocrinology is quite complex and beyond the scope of this article [40], [48], [52], [72], [140].

Even in small scale human societies there is always a small percentage of adults who do not reproduce [118]. In addition, there is always more variance in human male compared to human female reproductive success. A common interpretation of the last common ancestor of all living women appearing to be older than the last common ancestor of all living men by tens of thousands of years, and also there being more genetic polymorphisms on the human X versus somatic chromosomes, is that there were more breeding females for each breeding male (i.e., polygyny) when we first speciated into *Homo sapiens* [143], [63]. Reproductive skew for men but not for women (i.e., less men breeding) went up over time as subsistence intensified in human societies from hunter-gathers to herder-gardeners to full time agriculturists in the first civilizations [10].

Ironically, Mathew 19:10-12 in the New Testament of the Bible addressed this issue 2,000 years ago. When asked by his disciples if it is better for a man not to marry, words attributed to Jesus say,

Not all can accept [this] word, but only those to whom that is granted. Some are incapable of marriage because they were born so; some because they were made so by others; some, because they have renounced marriage for the sake of the kingdom of heaven. Whoever can accept this ought to accept it [97, pp. 1040-1041].

6. In-Group Breeding Population Markers in General and in Humans in Particular

An in-group breeding population, a phrase that has been used throughout this article, is a group of individuals of the same species in which breeding occurs but in which there are at least some barriers to gene flow from other in-group breeding populations of the same species. In many cases the barriers to gene flow are physical, such a body of water or a mountain range. However, individually carried physical barriers, like religious in-group-marking clothing and beliefs, can also exist even when there are not environmental physical barriers separating the two groups. These in-group markers allow two different in-group breeding populations of the same species to live together with very little if any gene flow between them.

The Christians and Jews prior to World War II in Poland are good examples of this religiously-mediated separation of genes. The degree of gene flow across in-group breeding populations is quite variable across different species, which is one of the arguments as to why multi-level group selection is not universally effective in all species. In 19th century Europe, Catholic and Protestant religions were once barriers to gene flow. They are much less so today. Nevertheless, eusocial species are particularly good at having in-group breeding population markers.

In eusocial insects [77], cleaning shrimp [22], and naked mole rats [103], identification of non-colony intruders is olfactory, although some social insects also use visual cues. In human beings there are many different in-group markers for breeding populations that use different senses. Outside of the kin-group, who might be able to recognize one another by bodily-emitted olfactory cues [71], larger social organizations (bands, tribes, city states, nations) predominantly use visual cues, such as culture-specific behaviors, clothing, hair style, adornments, food, etc. However, there are also auditory cues in terms of language and music and even olfactory and taste cues based on local foods. And finally, since we are the primate that talks, in addition to our behaviors being biased in predictable ways by our beliefs, we can also talk (generated by behavior) about what we believe, thereby creating a mobile, sound-wave-generated in-group symbol that can also repel potential out-group suitors.

Eibl-Eibesfeldt [44, pp. 37-38] frames in-group attachment in terms of indoctrinability, which he defines as ‘a special learning disposition to form an affective attachment to symbols and values

characterizing the quasi-familial we-group... Once acquired, individuals seem substantially fixated to their religious... values and to the symbols typical for the we-group.'

Religious beliefs, which are symbols either in their semantic representations or in the behaviors that they bias in predictable ways during the active state of believing, are almost always divisive and as such, are quite good in-group markers. Religious beliefs are good in-group markers because their semantic representations are hard for outsiders to acquire without strong emotional commitment; but yet they can be acquired ontogenically when emotional motivation is strong, as when new adolescents enter a new breeding population. Lastly, religious beliefs, as in-group markers, can change very rapidly when an in-group breeding population splits [47], [57], [82].

7. Celibate Clergy as Eusocial Caste Exemplars

Many of the earliest Christian clerics, like most men of their day, were married. Clerical marital continence (i.e., you can't have sex with your wife) crept in incrementally over the first millennium; and mandatory celibacy (i.e., you can't have a wife) for Latin-rite clerics was finally instituted in the 12th century [66], [108]. Theological rationalizations for the hierarchy-imposed discipline of clerical celibacy today include the 'gift' [125], apostolic origins [25], children of clerics inheriting church property, and Jewish ritual Purity Laws once Mass began being celebrated daily. Higher personal religiosity is cross-culturally associated with lower sexually permissive attitudes and behaviors [121], a lowering that approaches zero in many clerics. There is a well known inverse relationship between spirituality and sexuality in many religions, especially Buddhism, that goes beyond the scope of this article. 'Celibacy requires a good prayer life' is often taught to Roman Catholic seminarians and men religious during their formation.

A eusocial exemplar is someone whose life is a witness for behaving in ways that benefits one's in-group above that and often at a cost to one's self. In Darwinian natural selection, costs and benefits are measured in units of reproductive success. By being celibate or by taking a vow of chastity, clerics are not acting to promote their own reproductive success, which makes all aspects of their life eusocial exemplars by definition. Whether they are cooperative in doing domestic chores in monasteries or meet their obligations for common prayer or act altruistic towards their fellow monks in their all male religious communities are not relevant factors to them being eusocial exemplars to the laity. 'Reproductive altruism' was and still is central to the public image of clerics to the laity in both the early [89] and the modern [124, pp. 151-152] Church.

Non-clerical males in their adolescent and early adult years are highly competitive with one another over reproductive age teenage girls and women. They engage in lots of high risk behavior in this pursuit, causing their mortality rate to be several times that of teenage girls and women of the same age. This is especially true in polygynous societies [78]. Even in later adulthood, the mortality rate of non-clerical males is significantly higher than women due to diseases, some of which in the modern world are related to lifestyle [79]. By contrast, a corresponding exaggerated sex difference in mortality in Bavarian religious monk clerics above age 25, when compared to cloistered nuns, was not seen between 1870 and 2000. And in the post World War II period, the life expectancy of Bavarian monks was significantly higher than non-clerical Bavarian men [87]. Male clerics, as eusocial exemplars, are not competing and engaging in life-shortening high risk and often show-off behaviors (i.e., bravery displays) among themselves, jockeying for higher social status for better access to higher reproductive value, reproductive-age teenage girls and women. Rather, they are acting in relatively non-competitive ways that benefit the children of other in-group breeding population members, from ministering to their spiritual needs to teaching, etc.

Appreciate that up until modernity, when the social status of clerics in western society started to decline, Christian celibate clerics were regarded as very high status persons, not to say that they still are

in more religious countries, most of which are now south of the Equator. And as high status persons their behavior would have had a much greater influence on the populace at large than the behavior of persons of lower status, which is why I have called them eusocial exemplars. People tend to imitate the behavior of high status persons until most people do the behavior at which time the laggards are swept up into conformity by normative coercion [92], [95], [102].

The Judean community from which Christianity emerged in the first century CE was bound together by a heterosexually-positive religion of genetically-related persons. Monotheism, which started among the Jews and Zoroastrians in the first millennia BCE, facilitated the in-group marking function of religion [76], [123]. Polytheists are more tolerant of each other and often acquire each other's gods. A eusocial-witnessing non-reproducing clergy caste was not needed to influence the Judeans to put the welfare of their in-group above that of themselves. They would have been predisposed to do this naturally through kin selection [62]. There are remnants of this same sentiment today in modern Israel, exemplified by what an Israeli friend once told me, 'It feels like we're all cousins.'

To facilitate eusociality, with all its benefits, early Christianity, as a new religious movement of non-genetically related persons, needed something more. I am proposing that this something was an exemplar caste of Christ-story-emulating, non-reproducing male clerical evangelists, who were promulgating even marital continence among themselves [25]. In the first few centuries of the CE such men, like their portrayed Jesus, would have been unusual witnesses for a strict eusocial religious in-group society. Centuries later this non-reproducing status of clerics was extended to religious order brothers and sisters. It is ingenious that the terms devised for these non-reproducing ministers of the church (father, mother, brother, sister) and the faithful laity (children) create a eusocial-facilitating, fictive kin group. Although religious brothers and sisters (nuns) are not considered clerics today, what is said about clerics certainly applies to them as well. They just would not have been as effective as eusocial exemplars because of their relatively lower social status.

8. Human Eusocial Exemplars Other Than Celibate Clergy

Celibacy is institutionalized only within religions. One does not have to be celibate or take a vow of chastity to do any other emotionally (and even physically) intimate human occupation, such as a physician. That itself is evidence of at least a relationship between religion and eusocial-facilitating celibacy. Celibacy is also found in other great religions that are beyond the scope of this article [1]. There are other human eusocial exemplars besides celibate clergy that will now be discussed.

There are two very strong examples of human eusociality having to do with suicide. In World War II, when the Japanese realized that they were losing the war to the Americans, kamikaze suicide bombers turned their propeller driven fighter planes into precision-guided bombs targeting American warships. The pilots were dying for country, which in Japan, with the populace believing that Emperor Hirohito was a deity, meant that they were also dying for God. For God and country (*Pro Aris et Focis*) go together so well because they both have similar if not the same tribalism-related motivations. Tribes, as contrast to more egalitarian hunter-gather bands, also have high status leaders. And, people relate to God behaviorally as though (almost always) He is an alpha male leader [53]. Hirohito was just an example of an Imperial cult in which the ruler is worshiped as a God, exemplified also by divine kings. Such theocracies have existed in ancient Egypt, China, Rome, and several places in ancient Southeast Asia. Today, one sees remnants of this type of religious-like devotion to an otherwise secular communist dictator in North Korea with Kim Jon-un as the 'Supreme Leader.' Some North Korean women have been seen on videos overcome with emotion and crying just by being in his presence.

The other suicide-related example of eusociality is Muslim suicide bombers, who give up their own life while hopefully (on their part) killing more of the infidel out-group members in the process.

Human suicide has been considered an example of a behavior that evolved by kin selection [29] and is considered by Joiner et al. [73] to be an example of deranged human eusociality. Lankford [80] presents a weak argument trying to refute a relationship between human suicide and eusociality.

The final example of non-religion-related eusocial exemplars are military forces where individuals take great risks and can and often die for their country in great numbers as witnessed by the enormous slaughter of military personnel in World Wars I and II. Sometime there is an obligatory draft where citizens (usually just male) are conscripted by their country to fight the country's wars. However, at other times men (and now women in many countries) volunteer for the armed services. Examples of where this volunteering occurred in great numbers was after the Japanese bombing of the American naval base in Pearl Harbor, Hawai'i in 1941 and after the Muslim terrorist-hijacked airplanes crashed into the two World Trade Center towers in New York City in 2001.

9. Testing the Possible Association Between Religion and Eusociality

There are many ways in which one can test the association between religion and eusociality. We know the two are at least temporally correlated in human evolution, given that our closest living relatives (chimpanzees and bonobos), with whom we had a common ancestor 6 million years ago, are neither religious nor eusocial today. But so did other major factors come into existence with our speciation, including our capacity for symbolic language. What follows is not meant to be either an exhaustive or systematic review of the literature. I am just mentioning areas in which future research will lead to better understanding of the relationship between religion and eusociality illustrated with some of the recent literature. What follows are data supporting a relationship between religion and eusociality that can be interpreted as possibly being more than a simple temporal correlation in our evolution as a species.

9.1 Association of Nationalism with Religion

Apart from the older imperial cults and the divine rights of kings and so called contemporary state religions like the Anglican Church in England and the Lutheran Church in Sweden and the Muslim theocracies in the Middle East, there are other contemporary associations between nationalism and religion. I'll cite some examples about which I'm familiar from the United States. Appreciate that the United States is a country in which there is a constitutionally mandated separation between church and state. Yet, on our currency it says, 'In God we trust.' In our pledge of allegiance to the flag we say, 'One nation, under God.' Prior to the congress starting a session there is an opening prayer by a member of the clergy. Presidents and presidential candidates almost always end speeches with 'God bless the United States of America.' God and nation, which is just the larger version of the tribe, simply evoke very similar emotions. Separation between church and state is very recent in human history.

The Old Testament as well as the Koran, both religious books, are also law books. And appreciate that there were very close ties between the monarchies of Europe and the Roman Catholic Church from the 5th to the early 16th century, when the Protestant reformation began. The takeaway point from the above is that religion and politics are closely intertwined with one another so much that folk wisdom is that one does not discuss religion and politics in polite company because of the similar strong emotions associated with the belief systems in both of them. Religious beliefs are very similar to political beliefs in many ways including both are often partially counter-factual and partially counter-intuitive and both are difficult to change. There are probably similarities in the emotions as well. Awe might be a common emotion between nationalism/tribalism (i.e., politics) and religion. And both politics and religion also share fear and aggression given that religions evolved in setting in which one's religion was coexistent with one's in-group breeding population. Many people have certainly

been killed over religious differences in the world in times and places where religions helped to isolate people as separate in-group breeding populations. Appreciate the human pattern for social groups is to grow > divide > culturally differentiate > compete. Religion is a very good cultural differentiator.

9.2 Charitable Giving

One way of testing the association of religion with eusociality is in anonymous charitable giving. When one gives to a large charity, one is usually not doing something on a 1:1 face basis with the needy recipient of the charitable giving that would tend to invoke 1:1 altruistic empathy. Charitable giving is one method to learn about the relationship between an activity that benefits large number of less fortunate individuals in the in-group at a cost to self. However, that being said, there are times today when a great disaster anywhere in the world, such as the tsunami that occurred in Asia a few years ago, allows one to see people in great personal distress on the television news, even when they are continents away. Actually seeing the human suffering on the television news after the Asian tsunami prompted me to send a donation to a charity that was going to help these people. But that is the exception rather than the rule in terms of people's usual anonymous charitable giving. Recent research from the Pew Research Center shows that in 2014, in the United States persons who were highly religious (said that they pray daily and attend religious services at least once a week) donated significantly more to charities than persons identified as not highly religious [84]. Similar findings at other times have also been found [14], [60], [94], [81], [106], [147].

9.3 Volunteering for Military Service

The United States has had an all voluntary military since 1973. Volunteering to serve in the military as an enlisted (i.e., non-commissioned officer), where one is benefiting one's in-group often at a cost to self, is another potential measure of eusociality. In the United States there is a statistically significant correlation with the number of enlistments per 1,000 18-24 year olds with what is called the 'Bible Belt' in the United States, which are the most highly religious states in the South Atlantic, East South Atlantic, and West South Atlantic [7]. However, there were other variables that were not controlled, such as the large numbers of military bases in this region as well as economic factors. Another large sociological study that controlled for a number of possible intervening variables found that young, non-college educated males who identify as 'highly religious evangelical' are more likely to enlist in the United States military [18].

The United States Defense Manpower Management Center published a Table presenting data in 2009 [26] that queried 1,407,580 active duty military personnel on 107 possible religious preferences including atheist, agnostic, and no religious preference. They found that 0.5% of active duty military personnel identified as atheist, 0.09% as agnostic, and 20% as no religious preference. If one compares the 0.5% of active duty military claiming to be atheist in 2009 to Pew Research Center data from 2007 [84], 1.6% of all Americans claim to be atheists and 2.4% claim to be agnostic. Given that atheism and agnosticism are much higher in younger and military aged Americans, it is a reasonable interpretation of these data that military personal claim to be more religious than the general American population. Religionism appears to be correlated with nationalism and the group > self manifestation of eusociality.

10. Conclusion

It has been shown that religion and eusociality are related temporally in that they both entered our species sometime after we split from our last common ancestor with the chimpanzees and bonobos. The bigger question is whether our religions, which are unique to us among all members of the Animal

Kingdom, could have facilitated our becoming eusocial. The argument has pretty much been refuted that religion is what facilitates our behaving altruistically and vice versa on a 1:1 basis. Although there are religions in which altruism is praised [96], some of the great polytheistic state religions that preceded Judaism and Christianity and Islam created gods who could not care less about how humans treated each other. Nevertheless, there is strong evidence that Christianity in particular acted as a group-binding in-group marker for the ‘people of God’ during the formative period of Christianity and up until at least the reformation [88]. Religiosity has been shown to still promote in-group favoritism [39].

But do religious feelings facilitate the feelings that underlie human eusociality? If moods are considered ‘*specific* readinesses’ to act [41, p. 48], and if feelings are considered self-awareness of our moods, certain mood states facilitate or make more difficult other mood states. When they facilitate other mood states, they are considered proximate moods. So could the mood states associated with religions lower the threshold and therefore facilitate the acquisition of mood states necessary for eusociality?

Reverence to a deity, especially in petitioning prayer, is motivated by many emotions. One of the most important is fear, which can be deduced by the types of prayer postures used in petitioning prayer, which are the make-oneself-lower-*or*-smaller-*or*-more-vulnerable (LSV) behaviors associated with the non-vocal aspect of petitioning prayer. LSV behavior probably preceded vocalized linguistic behavior in the earliest expression of religion in our evolutionary history. One can show LSV behavior without uttering a single word of symbolic human speech. The earliest objects of human LSV religious behavior were the earliest deities (ancestors and great elements and forces of nature). Appreciate that LSV behavior used in the non-vocal aspect of petitioning prayer is an exaptation (a new function for an existing structural design feature) of very similar LSV behavior that was and still is used in fear-based submission throughout all social vertebrates.

In order to have social governance, as in the beginning of early tribal societies with chiefs’ etc., humans would have needed to express more hierarchicality than they expressed in the more egalitarian hunter gather bands. Boehm [11] argues that egalitarian social structure in extant hunter gatherers is not a default mode but is rather imposed by coalitions of sub-dominants. So even hunter-gatherers would and could have exhibited LSV religious behavior towards the referents of animistic spirits as well as in 1:1 social interaction behavior with more dominant tribal members. But religion is and presumably was very primitive in hunter-gather bands, primarily imagistic and behavioral with unsophisticated beliefs in their supernatural animistic spirits in almost everything around them. Religion did not start to get complex until our tribal stage. Subservience to God and subservience to one’s political leader are just two different variations on the same LSV theme.

Chimpanzees definitely display LSV behavior towards dominants. And yet, there is no religious behavior among chimpanzees. If one then asks what came first in human beings, the LSV behavior of subservience to other humans or the LSV behavior in the non-vocal aspect of petitioning prayer, the subservience to other humans would have been first given that chimpanzees also show this behavior. So at best one could say that the presence of LSV subservient political behavior might have facilitated the development of LSV religious behavior. We appear to have been political before we were religious. Chimpanzees are political beings [34]. Their cousins, the bonobos, show behavioral manifestations of proto-humanism [36].

But LSV behavior is not the main link between religions, political organizations, and eusociality. It seems as though the main way is in terms of religion being an in-group marker for the political in-group breeding population. Religions have behaviors and beliefs that are in-group specific. As explained, they can easily be acquired by an immigrating adolescent who might never as an adult speak the new in-group language without an accent or dialect. It was discussed how in-group breeding population specific religious beliefs and rituals can and do change easily when hunter-gather bands

split and a new religion is formed in the splintered group. In-groups identify by various in-group symbols. So it is reasonable to presume that religions facilitated governances and eusociality by affording in-group-specific religious symbols to individuals and with which people could identify with the in-group. It is also important to re-emphasize that in terms of religious beliefs, what is important from a biological perspective is their utility, which is what they do. Their truth value is irrelevant to this biological function as long as they act as an in-group marker and bias the behavior of the faithful in a predictably similar way.

In summary, although the evidence is weak to non-existent that religion in general facilitates 1:1 altruistic acts among individuals or vice versa, there is evidence both theoretical and in preliminary data reviewed that religion facilitates human eusociality by being an in-group marker for a breeding population. As eusociality got more restricted with more specialization, including a non-reproducing clergy caste, western society became even more eusocially complex.

What also can be said is that religion, which is a natural ‘biological’ product of human gene-culture co-evolution, follows the same ‘form follows function’ principle that is ubiquitous in biology. As function wanes, so does form. Religion is a bio-cultural form. Remember that from a behavioral biology perspective religious beliefs, the force that hold doctrinal religions together, are information-laden physical forms, as information is always physical. And if information is that which is necessary to make decisions, in the modern age, religious beliefs are slowly losing that secondary function as well. Beliefs in general bias our behavior in predictable ways but religion is having less and less of an effect on what we believe in the modern world relative to the very important role it played in antiquity.

In the parts of the world, such as the western industrialized democracies, in which religion’s influence as an in-group marker for a breeding population is diminishing, religion wanes. In biology forms with no biological function slowly become vestigial and eventually disappear. In reference to religion, this is called secularization. Much has been written on the topic [130]. Hopefully I have shown that it is at least plausible that religion played a role in our eusocial evolution by helping us go from kin based societies to the modern industrialized information age. Historians can sort out the details.

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