# How ritual made us human

**Matt J. Rossano**

Department of Psychology

Southeastern Louisiana University

Hammond, LA 70402 USA

Email: mrossano@selu.edu

ORCID ID: 0000-0002-1484-1105

## Abstract

This chapter argues that ritual made us human, and it is because of ritual that we (and not some other hominin) are Earth's dominant species. The argument rests on the following propositions: (1) Humans are unique in their cooperative abilities (more clearly so than our rational abilities). (2) Cooperative communities are constructed using costly rituals. (3) Supernatural belief provided the motivation and the individual fitness advantage necessary for humans to engage in costly rituals, and (4) archaeological evidences indicates that *Homo sapiens* engaged in higher-cost ritual activity than other hominins (specifically, Neanderthals). It was the communal cooperative advantage, constructed using costly rituals, that gave *Homo sapiens* the decisive edge over other hominins as they spread across the globe.

**Keywords**: cooperation, costly ritual, group competition, *Homo sapiens*, Neanderthals, ritualized behavior, supernatural belief, synchronized movement.>

**Author bio:** Matt Rossano is Professor of Psychology at Southeastern Louisiana University where he studies the evolution of ritual, religion, and cooperation. His books include: *Supernatural selection: How religion evolved* (Oxford) and *Mortal rituals* (Columbia University Press).

Sergio Catalan could be forgiven for being wary. As he checked on some cattle at the foothills of the Andes mountains, he spotted two scraggly-haired, emaciated 'mountain men' frantically waving at him from across the Rio Azufre. The rushing current made it impossible to hear them, but their desperation was obvious. Who were these men? Bandits? Drug dealers? Revolutionaries on the run from the Army? As one of them drew nearer to the river bank, his eyes locked with Catalan. Then he stopped, just short of the river, fell to his knees and with hands clasped to the heavens, he begged for his life. Catalan's heart was moved. Where once had been trepidation, pity now swelled. "Tomorrow," he shouted to them. As promised, Catalan returned the next morning, saving the lives of the two young men and their fourteen companions back at the crash site, 12,000 feet high in the Andes mountains. Catalan's encounter with the wild-looking 'mountain men' was the beginning of the end of what has come to be known as the 'Miracle in the Andes.'

On October 13, 1972, a chartered plane carrying the Old Christians rugby club of Montevideo, Uruguay crashed in the Andes Mountains. The team, along with family, friends, and others, were on their way to Santiago, Chile for a match. When rescue efforts failed, the world assumed the worst. But 16 of the original 45 passengers survived 10 weeks stranded in the mountains. The fact that their survival required anthropophagy (using the bodies of the dead as food) stirred international attention.

For this chapter's purposes, however, it is the encounter with Catalan that is more significant. For in it we see that which distinguishes *Homo sapiens* from all other species. The two 'mountain men' – Roberto Canessa and Nando Parrado – were close to death from exhaustion.

They had trekked ten days across the Andes Mountains, a journey that had taken them up and over a 15,000-foot peak without any mountain-climbing equipment or training. By the time Catalan saw them, Canessa had collapsed from dysentery and was sitting listlessly against a tree while Parrado gathered sticks and other combustibles near the river bank. Parrado was in better shape physically, but he was badly nearsighted and had lost his glasses weeks ago in the plane crash. Canessa was all but immobile, but he had good eyes. He spotted Catalan across the river. With words "I see a man," Canessa initiated the dramatic encounter, wherein the very essence of humanity was put on display – that being our unmatched cooperative abilities.

Upon hearing the words, Parrado ran recklessly toward the riverbank. His nearsightedness combined with the late afternoon's long shadows made it impossible for him clearly distinguish Catalan across the river. Canessa attempted to guide him – 'to the left. No, no, too far, to the right,' It would have been slapstick comedy if the stakes had not been so terribly high. Instead, it was human cooperation, *par excellance*: The lame leading the blind in a joint effort to save their lives. We also see the mechanism by which humans have forged cooperation over the course of our evolutionary history: ritual. Once Canessa got Parrado more-or-less lined up with Catalan, somehow Parrado had to convey the crucial message: "For the love of God don't fear us. Save us." He did that by using a ritualized act, understood by any human across the globe. He fell to his knees and begged for his life. With that gesture, all divisions of nationality, social class, age, and education dissolved. One needed only to be human to understand the message.

In this chapter I shall try to present a credible case for idea that it is ritual that makes us human and it is because of ritual that we are here. More specifically, my case breaks down the following

propositions: (1) Humans are unique in their cooperative abilities (more clearly so than our rational abilities). (2) Cooperative communities are constructed using costly rituals. (3) Supernatural belief provided the motivation and the individual fitness advantage necessary for humans to engage in costly rituals, and (4) archaeological evidences indicates that *Homo sapiens* engaged in higher-cost ritual activity than other hominins (specifically, Neanderthals). It was the communal cooperative advantage, constructed using costly rituals, that gave *Homo sapiens* the decisive edge over other hominins as they spread across the globe.

**A uniquely rational animal?**

Traditionally, humanity has been thought unique among animals by virtue of our rational abilities (Farah & Heberleine, 2007). Humans had rational souls. We possessed unique cognitive abilities such as language, theory of mind, abstract thinking, and episodic memory. But as evidence of these faculties accrued in non-human species, a clear definition of humanity built strictly on rational terms proved elusive (Hurley & Nudds, 2006; Tomasello & Hermann, 2010). However, Tomasello and colleagues have built a strong empirical case that it is *social* intelligence that separates humans from other species (Hermann, Call, Hernandez-Lloreda, Hare & Tomasello, 2007; Tomasello, Melis, Tennie, Wyman, & Herrmann, 2012; Tomasello, 2014). For example, Hermann et al. (2007) gave an extensive battery of tests assessing both physical and social cognition to two-and-a-half-year-old children and two species of our closest great ape relatives (chimpanzees and orangutans). Though the children were barely literate and without any formal education, they surpassed the apes on tests of social cognition. There were no differences between the children and the chimpanzees on tests of physical cognition. Tomasello

and colleagues argued that this provided strong support for the hypothesis that *Homo sapiens* were selected for a unique form of cultural cognition, not found in other apes.

Other studies have shed more light on the specifics components of this cultural cognition. An important part of it appears to be a powerful motivation to cooperate with other members of our species.

Children as young as 18 months show surprising cooperative abilities exceeding that of adult chimpanzees. For example, Tomasello and colleagues had children and chimpanzees play the 'trampoline' game, where players hold different ends of a large fabric attempting to keep a ball from rolling off (Tomasello & Carpenter, 2005; Warneken, Chen, & Tomasello, 2006). Chimpanzees failed miserably. Unlike human children, they showed no evidence of understanding the importance of complementary roles in achieving the joint objective. By two years of age, however, human children are skilled game players, readily coordinating activities to achieve the common end (Carpenter, Tomasello, & Striano, 2005; Tomasello & Carpenter, 2005; Warneken, et al., 2006). Unlike chimpanzees, children appeared to understand the different roles from an objective, "bird's eye" perspective, thus allowing them to easily engage in role reversal (Fletcher, Warneken, & Tomasello, 2012). Furthermore, if a partner quit his or her role, the child often took assertive action to re-engage the partner, something chimpanzees never did.

Importantly, chimpanzees' cooperative failings are unlikely to originate from cognitive shortcomings. Chimpanzees can identify intentional behaviors and infer goals and thus understand that someone reaching for an object intends to possess it (Call, Hare, Carpenter, & Tomasello, 2004; Tomasello & Carpenter, 2005; Warneken & Tomasello, 2006). This allows

them to offer simple "helping" behaviors such as retrieving an object for another or assisting another in obtaining food (Melis, Warneken, Jensen, Schneider, Call, & Tomasello, 2011; Warneken, Hare, Melis, Hanus, & Tomasello, 2007). They can also work with a partner to achieve a joint goal (Melis, Hare, & Tomasello, 2006a; Melis & Semmann, 2010).

Instead, chimpanzee cooperation suffers from a motivational deficit, largely attributable to their social hierarchy. Why cooperate when a more dominant chimp will monopolize the subsequent rewards? This disincentive was demonstrated in two studies where chimpanzees and children worked in same-species pairs pulling on ropes together to obtain treats (Melis, et al., 2006b; Warneken, Lohse, Melis, & Tomasello, 2011). The treat was either pre-divided into equal piles or was in one big pile. Both chimps and children successfully cooperated when the reward was pre-divided. The difference was in the single pile condition. Children readily divided the pile roughly equally and thus their cooperation continued. Chimps did not. Their cooperation broke down because the food was always taken by the more dominant chimp.

From these studies, Tomasello (2014) concluded that young children have a "sense of distributed justice that is closely tied to collaborative activities" (p. 189) – something not found in our closest primate relatives. While chimpanzees will protest when another tries to take food or other desirables from them (e.g., Jensen, Call & Tomasello, 2007), they do not seem to connect effort with reward.

Something happened over the course human evolutionary history that forced our ancestors to make the connection between cooperation and justice. Tomasello (2014) argues that the key

selective event was “obligate cooperative foraging.” At some point in hominin evolutionary history, the most basic survival activity, getting food, required cooperative effort. Those of our ancestors who could not work successfully with others simply ‘starved’ out of the breeding population. The remaining successful cooperators were those who had connected effort with reward in their minds (and ‘guts’), and thus could be counted on to share when spoils of joint endeavors were realized.

**Group competition**

Over time, argues Tomasello (Tomasello, et al., 2012), cooperatively foraging groups came in contact with one another vying for scarce resources. This initiated a stage of group competition in hominin evolutionary history. In this competition, groups where members were more intensely committed to shared cooperative norms, outcompeted others. This helps to explain the distinctively tribal minds of humans.

Ethnographic, archaeological and genetic data support the notion of group competition playing an important role in human evolutionary history. Evidence from traditional societies in both North America and New Guinea indicates that intergroup conflicts were not uncommon. In New Guinea, over a 25-year period, extinction rates for tribes in different regions ranged from 8% to 31% (Jorgensen, 1980; Soltis, Boyd, & Richerson, 1995). A worldwide sampling of hunter-gatherers shows that 64% engage in warfare at least once every two years, and only 10–12% could be considered “peaceful” (Ember, 1978). A specific case study in group competition was carried out by anthropologist Raymond Kelly (1985) who studied the conflict between the Nuer

and Dinka tribes in Southern Sudan. Kelly concluded that had British colonialism not interfered, the Dinka would have eventually been wiped out by Nuer expansionism.

The archaeological record also provides evidence of increased inter-group interactions. Around 300,000 ybp (years before present), evidence of the procurement and processing of pigment for ritual use emerges (Barham, 2002; Watts, 1999). Around 100,000 ybp evidence of beads and body ornaments is present (Vanhaeren et al., 2006). These remains suggest that both ritual activity and tribal marking were increasing or intensifying at this time, both indicators of increased inter-group contact and competition (Kuhn & Stiner, 2007; Sterelny, 2014). This evidence is complemented by genetic studies showing a rapid expansion in certain human sub-populations beginning around 70,000 years ago. Archaeologist Paul Mellars (2006) argues that a socially and technologically advanced group of modern humans expanded precipitously at this time, absorbing or replacing both adjacent African hominin populations and, in relatively short order, far-flung archaic hominins worldwide.

Group competition selected humans for a tribal mentality unique among primates, where successful groups would have been populated by individuals with an intense commitment to group norms of cooperation and self-sacrifice. This mentality has been revealed in laboratory studies beginning with the seminal work of Solomon Asch. More recent studies have compared humans and chimpanzees on the extent to which groups influence individual decisions. Haun, Rekers, and Tomasello (2012) found that both chimps and children would allow a 'majority opinion' to influence their individual choices. Thus, if the subject did not know which option (A, B, or C) led to a reward, but most other group members selected A, then the subject would select

A as well. However, only children would change a known rewarded decision if other group members selected a different option. Thus, if the child had selected option C and it led to a reward, but other group members insisted that A was the proper choice, then the child (not the chimp) would change his/her decision (Tomasello, 2014, p. 191). Unlike chimps, for children it's more important to demonstrate group commitment than to be certain of an individual reward.

Furthermore, children show a heightened sensitivity to in-group reputational status compared to chimpanzees. When being watched, chimps are equally likely to behave selfishly or cooperatively. Not so with five-year-old children, who were far more likely to behave cooperatively when watched – especially if the observers were in-group members (Engelmann, Herrmann & Tomasello, 2012; Engelmann, Over, Herrmann & Tomasello, 2013). What these studies suggest is that from a very young age, children are motivated to exhibit behaviors that identify them as good group members.

**Marines vs. hippies**

*Homo sapiens* is distinguished by its unparalleled cooperative abilities. Our intense tribalism – forged by group competition in our ancestral past – is a testament to these sentiments. In this section, I will try to make the case that ritual, *costly* ritual specifically, was the mechanism by which *Homo sapiens* constructed highly cooperative, tribally-minded communities.

Imagine two hominin groups, roughly a half-million years ago, jockeying for control of a scarce resource (a grove of fruiting trees or prime hunting ground). Imagine one group displays the

order, discipline, and commitment of a Marine regiment, while the other the laissez-faire individualism of a hippie commune. Which is more likely to successfully claim the resource?

Assuming that group competition played an important role in the evolution of our species, it is not unreasonable to assume that more "Marine-like" groups held an advantage over more "hippie-like" groups. More realistically, the point is that group competition selected our ancestors for more Marine-like characteristics compared to hippie-like characteristics. So, what is it that distinguishes Marines from hippies? Attitudinally, Marines live by a code – a code that puts duty to the Corps above individual concerns. Behaviorally, Marines march together, drill together, and suffer together; and in doing so form an intense emotional bond amongst one another. Marines aren't born; they are made. In fact, for centuries militaries across the globe have been taking 'hippies' and turning them into Marines. A mechanism key to this transformation is ritual.

**What is ritual?**

To answer this question, one must first begin by defining ritualized behavior. Ritualized behavior refers to attention-getting, stylized, invariantly-sequenced, and often repetitious gestures or vocalizations designed to send social signals (for a more in-depth discussion see Rossano, 2012). Each of these qualities can be seen in the baboon "scrotum grasp ritual" used to cement male coalitions (Smuts & Watanabe, 1990; Whitham & Maestripieri, 2003). Grabbing and ripping at the genitals is not uncommon when primates fight. Thus, the scrotum grasp is undoubtedly *attention-getting*. However, it is a *stylized* or more restricted form of the fighting act (i.e. a momentary grasp rather than aggressive grabbing and ripping). A stylized gesture can also be a

more deliberate or exaggerated form of a gesture, such a dramatic ball-room bow. The scrotum grasp also follows a fairly *strict sequence*: While making affiliative gestures such as lip-smacking and flattening of the ears, one baboon strides up to another using a rapid, straight-legged gait. The other responds in like fashion, and then after a quick hug each presents his hind-quarters to the other, often repeatedly (*repetitious*).

The terms ritual and ritualized behavior are frequently used interchangeably. There is, however, an important distinction. Ritualized behavior refers specifically to a stylized, attention-getting, invariantly-sequenced, often repetitious social signal. Rituals are larger than this. They take ritualized behaviors and embed them within ceremonial, traditional, and symbolic elements, heightening their emotional impact and memorability (Bell, 1997). Mosque worship, for example, contains ritualized behaviors such as bowing and praying repeatedly, holding the palms upward, and touching the head to the ground. These behaviors, however, are surrounded by larger ceremonial and symbolic elements such as the design of the mosque, the dress of the worshipers, and the requirement of facing toward Mecca. While ritualized behaviors are common across the animal kingdom, ritual is uniquely human.

**Ritualized behavior in the natural world**

Ritualized behaviors are common across the animal kingdom where ever important social signals must be effectively transmitted. For example, given their large size and aggressive nature, male elk (and other large male ungulates) usually elicit fear and avoidance among females. How then does a male get close enough for mating purposes? To signal amorous intentions, male elk use a "low stretch ritual" (Guthrie, 2005 p. 68). The stretch position emulates that of a calf wanting to

nurse and puts the female at ease. Similarly, among many waterfowl, ritualized mating dances are used both for selecting mates and building social bonds between them (Kraaijeveld & Mulder, 2002). Finally, many dog owners are familiar with the "play bow ritual" often seen at the opening of a rough-house play session. The dog lowers its head to the ground between its front paws with its hind end raised and tail wagging. The bow transmits the important message that seemingly aggressive acts (growling, chasing, biting, etc.) are intended as play, not genuinely aggressive.

As highly social creatures, our primate cousins have an array of ritualized behaviors for regulating their social lives. For example, chimpanzees, bonobos, and spider monkeys use ritualized embraces, kisses, pant-hoots, and grooming to re-affirm social bonds and reinforce the social hierarchy (Goodall, 1986). Gelada baboons use rhythmic back-and-forth approach vocalizations to signal benign intent during close-quarter feeding sessions. These vocalizations allow two baboons to peacefully feed near one another without threat (Richman, 1987). Finally, among chimpanzees, reconciliation between combatants is signaled by submissive bows, plaintiff vocalizations, and the hand-out begging gesture (on the part of the loser) followed by embraces and kisses (from the winner, de Waal, 1990). Given their primate heritage, our ancestors were pre-adapted with a rich repertoire of ritualized behaviors for regulating social life.

Ritualized behaviors are purely indexical in their social function (Rappaport, 1999). This means that they signal or call attention to an organism's immediate intentions or present state of mind. The dog performing the play bow is in a playful state of mind – he wants to play, not fight. The scrotum grasping baboon wants affiliation, not conflict. Human rituals are also indexical, but

they frequently add a second, canonical function as well. The canonical function refers to the fact that rituals also reinforce and/or transmit important values. Muslim prayer reinforces a central value of Islam, submission to God's will. Wedding ceremonies indicated the state of mind of the marrying couple – they are in love and desire to commit to one another. But by virtue of the ceremony's traditional and symbolic elements (readings from sacred texts, exchanging of rings, lighting of candles, etc.), such values as the importance of fidelity and family are reinforced and transmitted to all in attendance. The value-laden symbolism of ritual combined with the deep evolutionary roots of ritualized behavior are probably why rituals often have such a powerful emotional impact on us.

**Ritual synchrony**

Group competition transformed our ancestors from 'hippie-like' groups to 'Marine-like' tribes. Very likely, a specific and frequent feature of ritual activity, synchronized movement, played a crucial role in this transformation. Rituals involving synchronized or coordinated movements, such as dancing, chanting, or singing together, are universal among humans and are extra-ordinarily powerful in creating group unity and commitment. It is all but impossible to find a traditional society that does not engage in frequent ritual singing, dancing, and chanting. For example, among the !Kung San, healing dances are held every two weeks (or so) and are considered vital to community spirit and well-being (Katz, 1982). The Hadza, traditional hunter-gatherers of East Africa, engage in hours-long *epeme* dancing on nights with a new moon, but dancing often occurs on other nights as well and can erupt spontaneously when meat is brought back to camp (Marlowe, 2010). All human cultures engage in synchronized actions in the form

of dance and music; and rituals and celebrations involving dance and song qualify as human universals (Blacking, 1973; Brown, 19991; Ehrenreich, 2008).

Synchrony is also common among non-human species. Examples include the (aforementioned) mating dances of waterfowl, the side-by-side swimming of sea horses, and the swimming and surfacing of dolphins and pilot whales (Connor, Smolker, & Bejder, 2006; Kraaijeveld & Mulder, 2002; Senigaglia, Stephanis, Verborgh, & Lusseau, 2012). Additionally, synchronized croaking (frogs), flashing (fireflies), appendage movements (fiddler crabs, and kadydids), pant-hooting (chimpanzees) and vocal duetting (gibbons) have also been documented (Buck, 1988; Deputte, 1982, p. 68-69; de Waal, 1988; Greenfield & Roizen, 1993; Mitani & Brandt, 1994). In experimental settings, parrots and sea lions have shown an ability to synchronize their motor movements to an external beat and there are anecdotal accounts of horses synchronizing their gait to a musical beat (see Patel, 2014 for review and discussion). The universality of synchrony amongst humans combined with its frequency among non-humans, suggests deep evolutionary roots in our ancestral past.

**Muscular Bonding**

Historian William McNeill (1995) was one of the first to describe how engaging in communal dancing, chanting, or marching produced a euphoric mental state leading to "muscular bonding" among participants. While marching into battle is a dubious military strategy, marching-as-group-bonding is highly effective.

The power of synchronized movement in creating social cohesion has been empirically demonstrated by Lakens (2010) who found that moving to a common rhythm created a sense of social unity exceeding that of other factors such as skin color. Other recent studies have found that synchrony can generate sentiments and emotions fostering unity. As people move together, they tend to like each other more, trust each other more, empathize more with each other, see each other as more similar, and are more willing to extend compassion and cooperation to each other (Hove & Risen, 2009; Lang, Shaw, Reddish, Wallot, Mitkidis, & Xygalatas, 2015; Valdesolo & DeSteno, 2011; Wiltermuth & Heath, 2009). For example, Wiltermuth and Heath (2009) found that moving together increased trust and cooperation. They had subjects either move in synchrony (walking in step, singing together, singing and moving together), move asynchronously (walking at individual paces, singing and moving individually) or not at all. Later, subjects played an economic game where they could extend varying levels of trust and cooperation to other players. Subjects who moved in synchrony were found to be significantly more trusting and cooperative than those who did not.

Later studies have found that moving together also enhances perceived similarity, empathy, and a sense of shared scared values. These perceptions can, in turn, motivate greater within-group altruism (Fischer, Callander, Reddish, & Bulbulia 2013; Valdesolo & DeSteno, 2011). Synchrony's impact on perceived similarity even extends to a blurring of self-other boundaries. Paladino, Mazzurega, Pavani, and Schubert (2010) brushed a participant's cheek while the participant watched a video of a stranger's cheek also being brushed, either synchronously or asynchronously with their own. Compared to the asynchronous condition, synchronously brushed participants reported greater confusion regarding whether the stimulation was self- or

other-experienced. They also claimed that the synchronously brushed face resembled their own more and that the person had more personality traits in common with them.

A key factor in the pro-social effects of synchrony is the shared emotional state that it creates. As people move in synchrony, their heart and breathing rhythms become entrained (Bernardi, Sleight, Bandinelli, Cencetti, Fattorini, Wdowczyc-Szulc et al., 2001; Vickhoff, Malmgren, Åström, Nyberg, Engvall, Snygg et al., 2013) and their pain thresholds heighten most likely due to the release of endogenous opiates (Cohen, Ejsmond-Frey, Knight, & Dunbar, 2010; Tarr, Launay, Cohen, & Dunbar, 2015). This mutual autonomic entrainment may even be present at the neuronal level (Wheatley, Kang, Parkinson, & Looser, 2012). These ANS effects facilitate empathetic identification, bringing people into a common positive emotional state leading to greater social connectedness (Pearce, Launay, & Dunbar, 2015; Fischer, Xygalatas, Mitkidis, Reddish, Tok, et al., 2014). The release of endogenous opiates very likely accounts for the euphoric mental state reported by McNeill (1995). Long ago, our ancestors discovered that if you want people to put the group and its values above those of individual self-interest, moving in synchrony can't be beat.

**Costly ritual**

A notable quality of the dancing and singing of traditional societies is that it is often quite vigorous. The !Kung San, Australian Aborigines, Andaman Islanders, and the Hazda are but a few of the many traditional people who engage in night-long sessions of energetic (sometimes frenetic) singing and dancing where 'going to exhaustion' among some is not unheard of (Marlowe, 2010; Wade, 2009, pp. 107-114). Similarly, among Lau Fijians, ceremonial *Meke*

dancing requires months of preparation including daily and sometimes twice daily practice sessions (Thompson, 1940 p. 76). Furthermore, in many traditional societies other ritual activities, such as initiation ceremonies can highly demanding, both physically and psychologically. So much so that anthropologist Harvey Whitehouse (1996) has referred to some as 'rites of terror.'

For example, female initiations among many traditional societies in southern Africa involve forced seclusion, bloodletting, genital cutting and laborious training in ceremonial dances (Knight et al. 1995; Power 1998, 122–5). Beatings, deprivation, exhaustive physical exertion, exposure to harsh elements, genital mutilation, scarring, tooth removal and forced dancing and chanting are among the rigors of many male initiation ceremonies among Australian aborigines, native Americans, New Guinea tribes, Pacific Islanders, and many African tribes (Catlin 1867; Glucklich 2001; McCauley 2001; Whitehouse 1996). Possibly the most dramatic of these initiations was the famous Mandan Indian Sun Dance ceremony where new warriors were suspended from the top beam of a large ceremonial enclosure with ropes attached to skewers embedded in their chests (Catlin 1867). They might remain there for hours or days as dancing and chanting continued below.

Creating 'Marine-like' cooperative groups entails more than just ritual activity; more than just singing, dancing or marching together. It requires that these ritual activities exact a cost to the participants which ensures their honest commitment to the groups. It requires not just ritual, but costly ritual.

Free-loading represents a threat to any cohesive group. Free-loaders feign commitment in order to reap the rewards of group life without contributing the effort necessary to maintain group stability. Weeding out free-loaders requires imposing ritual costs that serve as effective deterrents to uncommitted individuals. Lots of people like to sing and dance. That alone does not necessarily mean that when the chips are down they will put the group above themselves. Far fewer people will sing and dance *all night long*. Marine boot camp, two-a-day summer football practice, fraternity initiations, and other 'hazing' type ordeals are modern analogues of costly ritual activity. The baboon 'scrotum grasp' provides a good example of costly ritual in the animal world. The willingness to literally put one's reproductive success into the hands of another is an act too risky for a 'faker' to chance (Whitham & Maestripiari, 2003).

**Supernatural motivation**

Regardless of the potential benefits, any activity that entails pain, deprivation, psychological stress and physical exhaustion is heavily disincentivized. So, what motivated our ancestors to engage in such activity? Psychological studies dating back to the time of James Mark Baldwin have consistently confirmed a fundamental fact regarding human behavior: We always behave better when watched. When people know their actions are under public scrutiny they adhere more assiduously to expected group standards and norms. This means being more honest, courteous, generous, reasonable, and (for males especially), courageous than when alone. Indeed, empirical studies have demonstrated exactly this (Andreoni & Petrie, 2004; Burnham & Hare, 2007; Rege & Telle, 2004; Rossano, 2007).

So powerful is the effect, that the 'public scrutiny' can be more imaginary than real and still have significant impacts on behavior. Significantly more pro-social behavior has been documented when only a picture of human eyes (Bateson, Nettle, & Roberts, 2006), a robot-image face (Burnham & Hare, 2007) and a suggestion of a nearby ghost (Bering, McLeod, & Shackelford, 2005) have been used as triggers of 'social observation.' For humans, concerns about public reputation is a powerful motivator when it comes to getting us to obey community standards. A central tenant of religious belief is supernatural monitoring, whether it be the omniscient God of present-day world religions or the natural and ancestral spirits of traditional religions. Supernatural monitoring has proven to be an effective means of inducing 'right behavior,' including participation in costly ritual activity (Shariff & Norenzayan, 2007). Religious communities have proven to be more enduring because community members more willingly engage in costly ritual activity relative to comparable secular communities (Sosis, 2004).

**The supernatural advantage**

The supernatural not only motivates people to engage in costly rituals, it enhances the power of those rituals. Supernaturally-enhanced rituals have greater potential fitness benefits compared to 'secular' rituals. For example, a meta-analysis comparing spiritual meditation to secular meditation found spiritual meditation more frequently resulted in health benefits such as lower blood pressure, reduced heart rate and improved mental health (Alexander, Rainforth & Gelderloos, 1991). Similarly, devotional prayer was more effective in reducing anxiety, anger, and muscle tension in Christian subjects compared to progressive relaxation training (Carlson, Bacaseta, & Simanton, 1988).

Wacholtz and Pargament (2005) compared the effects of spiritual and secular meditation on anxiety reduction, pain tolerance, and mood. Spiritual meditators focused on a religious phrase such as “God is love” or “God is peace,” while secular meditators used the alternative mantras of “I am happy” or “I am joyful.” In later tests, it was found that the spiritual meditators had higher pain tolerance (they were able to keep their hands in the near-freezing water twice as long) and they had lower anxiety and a more positive mood.

The supernatural advantage in pain tolerance was replicated in another study that subjected devout Catholics and non-believers to electric shock (Weich, et al., 2008). While shock was administered, subjects sequentially viewed either a religious image – *Vergine Annunciate* by Sassoferrato (the Virgin Mary praying) – or a similar nonreligious image – *Lady with an Ermine* by Leonardo da Vinci. A significant increase in pain threshold was found exclusively for the Catholic subjects when viewing the religious image. In other words, when the Catholic subjects contemplated the image of the Virgin Mary they could endure higher levels of shock compared to when they contemplated the *Lady.* Furthermore, when viewing the Virgin Mary, they could endure more intense shock compared to the non-religious subjects regardless of what picture they viewed. Differences between the religious and non-religious subjects were also found at the brain level. When the Catholic subjects viewed the Virgin Mary, they showed increased activity in an area of the brain known to be involved in the evaluation and modulation of pain (the right ventrolateral prefrontal cortex, rVLPFC). Similar activation was not found for the nonreligious subjects. A recent review confirms that positive religious coping strategies aid people in dealing effectively with chronic pain (Dedeli & Kaptan, 2013).

Supernatural belief also plays an important role in placebo healing effects. A review study found that spirituality (defined as 'concerned with the transcendent, addressing ultimate questions about life's meaning with the assumption that there is more to life than what we can see or fully understand,') served as a predictor of placebo effects (Kohls, Sauer, Offenbacher, & Giordano, 2011). In other words, the more spiritual one is and the more spiritual practices (e.g. ritual activity, prayer, meditation, etc.) one incorporates into his or her life, the more susceptible one is to placebo healing, pain reduction, and successful pain management. Furthermore, brain areas and nervous systems responses associated with spiritual experiences and practices overlap with those known to be involved in placebo effects. Religion's positive health effects are mental as well as physical. Supernatural beliefs are generally associated with lower levels of anxiety, depression, and other psychiatric symptoms such as agoraphobia, paranoid ideation, somatization (Flannelly, 2017).

One might complain that many of the studies showing a supernatural advantage in health, healing, and pain tolerance have used religious subjects. While this is true, if hunter-gatherers are any indication, then in our ancestral past, non-religious subjects would have been few and far between. The important point is that for those open to supernatural beliefs (which our ancestors almost certainly were), then the inclusion of those beliefs in ritual activity would have enhanced the power of those rituals to bring about fitness-enhancing health and healing effects. Thus, supernatural ritual would not just have had group-level benefits, it would have provided individual-level benefits as well.

**The emergence of costly rituals**

Why *Homo sapiens* displaced all other hominins has been a point of debate and discussion for over a century. While evidence of significant cognitive differences between *Homo sapiens* and other hominins (e.g. Neanderthals) has diminished, important social differences have remained (for discussion see Rossano, 2015). Both archeological and genetic evidence indicate that *Homo sapiens* had larger, more complex and interconnected social groups compared to Neanderthals. This social difference may very well have been decisive when the two species encountered one another in Europe. Cohesive social groups are built with costly rituals. Archeological evidence shows that *Homo sapiens* were engaging in costly rituals to far greater extent than Neanderthals.

Four types of archaeological evidence can be used as indices of ritual behavior: Beads, red ochre, burials, and deep cave ventures. Rossano (2015) reviewed evidence in each of these categories and concluded that costly ritual activity was far more evident among *Homo sapiens* than Neanderthals.

*Red Ochre*

Red ochre is a mineral pigment used extensively among traditional societies in ritual activity. Both *Homo sapiens* and Neanderthal sites show evidence of red ochre collection. Evidence of red ochre collection occurs earlier for *Homo sapiens*, with most sites being dated to around 100-150,000 ybp, while most Neanderthal sites are dated to around 50,000 ybp. Additionally, there are far more *Homo sapiens'* sites with substantial amounts of pigment compared to Neanderthals. Of 14 well-documented Neanderthal sites (see Rossano, 2015 Table 2), only two (14%) have

amounts numbering over 100 pieces. By contrast, of 20 well-documented *Homo sapiens* sites (Table 1), 16 (80%) have amounts of 100 pieces or more, seven of which (35%) have over a thousand pieces. Most well-documented Neanderthal sites (8 of 14 or 57%) have 3 pieces or less. Presently, there is no evidence of *Homo sapiens'* sites with so little ochre. Collecting and processing ochre to make pigment for ritual activity takes time, effort, and a certain degree of skill, all of which *Homo sapiens* were expending to a much greater degree than Neanderthals.

*Beads*

Beads are used extensively in traditional societies in ritual gift-giving and as body decoration. They are also known to have been used by hominins in ritual burial. As with red ochre, the appearance of beads in the *Homo sapiens'* archaeological record generally predates that of Neanderthals. A very recent study has dated three Neanderthal beads to over 115,000 ybp, making them the oldest beads to date (Hoffmann, Angelucci, Villaverde, Zapata & Zilhão, 2018). This, however, is exceptional as all other finds are dated to around 50,000 ybp. Bead production for AMH (anatomically modern humans), however, traces back to around 100 kya at both African and Levantine sites (Skhul, Oued Djebbana, Qafzeh, and Grotte des Pigeons).

At all Neanderthal sites, the number of beads is small (always less than 40 and often less than 10). The same is true at the oldest *Homo sapiens* sites, with the exception of Blombos Cave in South Africa (dated to around 75,000 ybp) with around 71 beads. Later *Homo sapiens* sites, however, have large numbers of beads. At sites such as Ksar'Akil, Ucagizli (in Asia Minor), Fumane Cave (Italy), Krems-Hundssteig (Austria) and Riparo Mochi (Italy) numbers of beads range from 128 to over a thousand. Beginning 75,000 years ago and intensifying at around

40,000 years ago, *Homo sapiens* were gathering and fashioning significantly more beads than Neanderthals. Even if only a portion of these were used in ritual activity, the amount of time, energy, and effort (i.e. cost) that *Homo sapiens* were expending far outstripped that of Neanderthals.

*Caves*

Venturing deep into caves for artistic, religious, or other potentially ritual purposes has been well-documented for *Homo sapiens* during the Upper Paleolithic (40-10,000 ybp). These ventures were often risky and dangerous. For example, reaching the painted chambers at Montespan Cave required fording through frigid waters for more than a kilometer. Accessing Nerja Cave in Spain involved a steep climb up a sheer rock face. The painted shaft at Lascaux necessitated dropping 16 meters into pitch darkness presumably by rope; while the Salon Noir chamber at Niaux Cave required negotiating a 450-meter passage and 200-meter climb. The danger was compounded by the fact that those venturing into caves carried torches, artistic supplies, and were frequently accompanied by (and therefore supervising and undoubtedly worrying about) children. Once in the cave, *Homo sapiens* often expended considerable time, energy, and resources in the deep cave chambers creating paintings or constructing ritual venues, such as the elaborate El Juyo "sanctuary" in northern Spain (Arias 2009; Freeman & Gonzalez Echegaray 1981). Thus, there is little question that Paleolithic spelunking was often a costly endeavor.

Although the most well-known and arguably the most impressive ritual use of caves occurred during the later UP (Altamira, Lascaux, El Juyo, etc.), *Homo sapiens* started penetrating into

caves well before this time. For example, the earliest evidence of the ritual use of caves is likely that of Rhino Cave in Botswana (Southern Africa) dated to around 70,000 ybp. Though the cave is not deep, the surrounding boulders and high walls effectively block out any direct sunlight and make access difficult.

Inside the cave, there is a natural snake-like outcropping. The outcropping was intentionally modified to enhance its serpentine qualities. The snake-rock is not the only unusual aspect of Rhino Cave. The cave floor is littered with an unusually large number of burnt and broken tools. The tools were produced in the cave using carefully selected, colorful, non-local ("exotic") raw materials. These raw materials were transported to the cave from distances ranging from fifty to several hundred kilometers. At the cave site, the raw materials were meticulous fashioned into tools which were then intentionally broken, destroyed and burned. From a practical standpoint, this behavior is odd and costly. Time, energy, and valuable material resources were exhausted for no clear utilitarian gain. But these are precisely the hallmarks of human ritual.

Neanderthals used caves as well, but they almost always remained near the cave entrance (Sandgathe, Dibble, Goldberg, McPherron, Turq, Niven, & Hogkin, 2011 p. 219). There are only two reasonably well-documented instances of Neanderthals venturing more than 100 meters into caves (although the recent re-dating of remains in Ardales Cave in Spain may add a third). The first is Gorham's cave in Gibraltar were an etching dated to around 40,000 ybp was found. The second instance, Bruniquel Cave in southwestern France, is more impressive. About 200 ms deep in the cave, after a very tight crawl through a narrow passage, there is a small (approximately 14 $m^2$) enclosed floor space that appears to be a ritual site. Stalagmites and stalactites have been

broken off and formed into two circles on the cave floor. Evidence of a fire is present in the larger of the two circles. The scene has been dated to around 175,000 ybp, long before AMH were present in the region (Jaubert. Verheyden, Genty, Soulier, Cheng, Blamart, et al., 2015).

Even Bruinquel, however, falls short in terms of behavioral cost compared to *Homo sapiens'* use of caves. A comparison of it to Rhino Cave highlights the differences. At Rhino cave, very particular (colorful) raw materials were transported to the cave from tens and possibly hundreds of kilometers away, while the materials at Bruniquel were found in the cave (stalactites and stalagmites). At Rhino, both the materials brought to the cave and materials found in the cave (the natural outcropping) were worked at the site, whereas no materials were worked at Bruniquel. Once worked, a considerable amount of raw material was destroyed at Rhino, whereas nothing comparable occurred at Bruniquel. If rituals were conducted at Rhino and Bruinquel caves, both may have involved important religious and/or symbolic content for the participants and in that sense were qualitatively equivalent. However, in terms of behavioral cost, Rhino appears to have exacted more from its participants than Bruniquel. Rhino Cave is not unique regarding how *Homo sapiens* used caves. The magnificent painted murals of Lascaux, Chauvet and numerous other sites, testify to the fact that *Homo sapiens* frequently brought materials deep into caves and labored extensively with those materials.

*Burials*

The earliest true burials among AMH are found at Skhul and Qafzeh Caves in Israel, dated to sometime between 120-90,000 ybp. Somewhere between 12-16 burials are present across these two caves. Most of the burials are simple, involving little more than a body being placed in an

excavated grave. A few, however, go beyond this, and include some potential grave goods such as animal bones, red ochre, and in one case, large blocks lining the grave area and a block placed atop the body itself. A somewhat later burial (76,000 ybp) has been documented at Border Cave in Southern Africa. Here, the partial skeleton of a four-to-six-month-old infant (BC3) was found placed into a deliberately cut grave, 24 cm deep, 38 x 30 cm in size.

The emergence of inhumation can also be seen among Neanderthals. However, as was the case with beads and red ochre, it generally occurs later than *Homo sapiens.* With the possible exception of burials Tabun Cave and some burials at La Ferrassie, nearly all Neanderthal burials date to 70,000 ybp or later, with most occurring between 60-50,000 ybp.

Similar to AMH, Neanderthals sometimes left grave goods with the burials. Indeed, their frequency of doing so was greater than that of early AMH. Nearly 70% of Neanderthal burials have grave goods while only four of ten (40%) early (Middle Paleolithic) AMH burials do. In both cases, the grave goods are almost entirely made up of materials frequently found at the grave site such as lithics, bones, and rocks.

In the Upper Paleolithic, however, the extent of elaboration of at some *Homo sapiens* burials is dramatically amplified. The most famous of which is the Sungir burial (in Russia) where three bodies were found lavishly adored with headbands, armbands, ankle bracelets, and necklaces laced with literally thousands of beads. In addition to this, ornamental weapons and other undisputable grave goods were interred with the bodies. It has been estimated that the hours of labor necessary for such a burial would have run into the tens of thousands. While nothing quite

matches Sungir in degree, other similarly elaborate burials have been documented at Le Madeleine, Dolni Vestonice, Saint-Germain-la-Riviere, and the famous "Red Lady" burial at Paviland. There is simply nothing in the Neanderthal archaeological record that even approaches the elaboration of these burials

The evidence reviewed can be summarize as follows: Every potential archaeological marker of ritual behavior shows more intensive use by *Homo sapiens* compared to Neanderthals. Specifically:

1. Pigments: Sixteen *Homo sapiens* sites (80%) have pieces numbering from hundreds to over a thousand, compared to only 2 (14%) Neanderthal sites. Most Neanderthal sites have three pieces or less. Collecting and processing ochre takes time, energy, and effort, something *Homo sapiens* were expending in far greater quantity than Neanderthals.
2. Beads: With one exception (where 40 beads were found), at all Neanderthal sites the number of beads is less than 10. Not only are there more *Homo sapiens* sites where beads have been found, there are many where the amount of beads is in the hundreds to over a thousand.
3. Caves: At most, there are only three instances of Neanderthals venturing more than 100 meters into caves. There are scores of examples of *Homo sapiens* venturing 100 meters or more into caves. AMH's use of caves was more resource intensive compared to Neanderthals, and in time reached a point of frequency and risk never approached by Neanderthals.
4. Burials: While both Neanderthals and *Homo sapiens* buried some of their dead, nothing in the Neanderthal archeological record approaches the degree of elaboration found at many *Homo sapiens* sites.

Both *Homo sapiens* and Neanderthal left evidence of ritual behavior. However, when we compared the time, energy, risks, and resources expended by the two, every indicator of ritual behavior shows that *Homo sapiens* were engaging in more costly ritual activity. Costly ritual binds communities. It may very well have been this crucial social difference that made the difference when the two species confronted one another in Europe tens of thousands of years ago.

**Conclusion**

Drop a lone human in the Amazonian Rainforest, the frozen Siberian steppe, or the Negev Desert and survival is unlikely. Yet collectively, humans live in all these places and more. Our hyper-adaptability is a byproduct of our hyper-sociality. By cooperating in resource acquisition, territorial control, and knowledge transmission and preservation, we humans have spread globally, displacing all competitors in our wake, including other hominins.

The message of this chapter is that this was accomplished using the same mechanism that all species use to establish cooperative relationships and regulate social life: ritualized behaviors. The human difference is one of degree, not kind. We took ritual to extreme levels to create extreme forms of cooperation. We built cooperative communities using costly rituals. The 'cost' of those rituals was 'repaid' in two ways: (1) through well-organized, highly cohesive groups (Marines) that out-competed more 'individualistic' ones (hippies), and (2) through individual health, healing, and strengthening benefits that accrue to ritual practitioners. Supernatural belief both motivated ritual participation and magnified its benefits. When the last non-sapiens hominin

died, the remaining void was filled by a tribal-minded, ritual-practicing, supernatural-believing human from which all of us have descended.

**References**


Alexander, C. N., Rainforth, M. V. & Gelderloos, P. (1991). Transcendental meditation, self-actualization, and psychological health: A conceptual overview and statistical meta-analysis. *Journal of Social Behavior and Personality, 6,* 189–248.

Andreoni, J. & Petrie, R. (2004). Public goods experiment without confidentiality: A glimpse into fundraising. *Journal of Public Economics, 88*, 1605-1623.

Barham, L. (2002). Systematic pigment use in the Middle Pleistocene of South-Central Africa. *Current Anthropology, 43*, 181–190.

Bateson, M., Nettle, D. & Roberts, G. (2006). Cues of being watch enhance cooperation in real-world setting. *Biology Letters, 2*, 412-414.

Bell, C. (1997). *Ritual: Perspectives and dimensions*. New York: Oxford University Press.

Bering, J. M., McLeod, K. A. & Shackelford, T. K. (2005). Reasoning about dead agents reveals possible adaptive trends. *Human Nature, 16,* 360-381.

Bernardi, L., Sleight, P., Bandinelli, G., Cencetti, S., Fattorini, L., Wdowczyc-Szulc, J., et al. (2001). Effect of rosary prayer and yoga mantras on autonomic cardiovascular rhythms: Comparative study. *British Medical Journal, 323,* 1446–1449. doi:10.1136/bmj.323.7327.1446

Blacking, J. (1973). *How musical is man*. Seattle: University of Washington Press.

Brown, D. (1991). *Human universals*. New York: McGraw-Hill.

Buck, J. (1998). Synchronized rhythmic flashing in fireflies II. *Quarterly Review of*

*Biology*, *112*, 265-289.

Burnham, T. & Hare, B. (2007). Engineering human cooperation: Does involuntary neural activation increase public goods contributions in adult humans? *Human Nature, 18,* 88-108.

Call, J., Hare, B., Carpenter, M. & Tomasello, M. (2004). Unwilling or unable: Chimpanzees' understanding of intentional action. *Developmental Science, 7,* 488-498.

Carlson, C. A., Bacaseta, P. E. & Simanton, D. A. (1988). A controlled evaluation of devotional meditation and progressive relaxation. *Journal of Psychology and Theology, 16,* 362–368.

Catlin, G., (1867). *O-kee-pa: A religious ceremony and other customs of the Mandans*. London: Trubner

Carpenter, M., Tomasello, M. & Striano, T. (2005). Role reversal imitation and language in typically- developing infants and children with autism. *Infancy, 8,* 253-278.

Cohen, E. E. A., Ejsmond-Frey, R., Knight, N. & Dunbar, R. I. M. (2010). Rowers' high: behavioural synchrony is correlated with elevated pain thresholds. *Biology Letters, 6,* 106-108. doi: 10.1098/rsbl.2009.0670

Connor, R. C., Smolker, R. & Bejder, L. (2006). Synchrony, social behaviour and alliance affiliation in Indian Ocean bottlenose dolphins, *Tursiops aduncus. Animal Behaviour, 72,* 1371-1378. doi: 10.1016/j.anbehav.2006.03.014

Dedeli, O. & Kaptan, G. (2013). Spirituality and religion in pain and pain management. *Health Psychology Research, 1,* e29.

Deputte, B. L. (1982). Duetting in male and female songs of the white-cheeked gibbon

(*hylobates concolor leucogenys*). In C. T. Snowdon, C. H. Brown & M. R. Peterson (Eds.), *Primate communication,* (pp. 67-93), Cambridge, UK: Cambridge University Press.

de Waal, F. B. M. (1988). The communicative repertoire of captive bonobos (*Pan paniscus*) compared to that of chimpanzees. *Behavior, 106,* 183-251.

de Waal, F. B. M. (1990). *Peacemaking among primates*. Cambridge, MA: Harvard University Press.

Ehrenreich, B. (2008). *Dancing in the streets: A history of collective joy*. New York: Henry Holt.

Ember, C. R. (1978). Myths about hunter-gatherers. *Ethnology, 17,* 439–448.

Engelmann, J. M., Herrmann, E. & Tomasello, M. (2012). Five-year-olds, but not chimpanzees, attempt to manage their reputations. *PLoS ONE, 7,* issue 10, e48433.

Engelmann, J. M., Over, H., Herrmann, E. & Tomasello, M. (2013). Young children care more about their reputation with ingroup members and possible reciprocators. *Developmental Science, 16,* 552–558.

Farah, M. J. & Heberlein, A. S. (2007). Personhood and neuroscience: Naturalizing or nihilating? *The American Journal of Bioethics, 7(1),* 37–48.

Fischer, R., Callander, R., Reddish, P. & Bulbulia, J. (2013). How do rituals affect cooperation? An experimental field study comparing nine ritual types. *Human Nature*, *24*, 115-125. doi:10.1007/s12110-013-9167-y

Fischer, R., Xygalatas, D., Mitkidis, P., Reddish, P., Tok, P, Konvolinka, I. & Bulbulia, J. (2014). The fire-walker's high: Affect and physiological responses in an extreme collective ritual. *PLoS ONE 9*(*2*): e88355. doi:10.1371/journal.pone.0088355

Flannelly, K. J. (2017). *Religious beliefs, evolutionary psychiatry, and mental health in America*. New York: Springer.

Fletcher, G. E., Warneken, F. & Tomasello, M. (2012). Differences in cognitive processes underlying the collaborative activities of children and chimpanzees. *Cognitive Development, 27,* 136–153.

Geissmann, T. (2000). Gibbon songs and human music from an evolutionary perspective. In N. L. Wallin, B. Merker & S. Brown (Eds.), *The origins of music* (pp. 103-123). Cambridge, MA: MIT Press.

Glucklich, A. (2001) *Sacred pain.* New York: Oxford University Press.

Goodall, J. (1986). *The chimpanzees of Gombe.* Cambridge, MA: Harvard University Press.

Greenfield, M. & Roizen, I. (1993). Katydid synchronous chorusing in an evolutionary stable outcome of female choice. *Nature, 364,* 618-620.

Guthrie, R. D. (2005). *The nature of Paleolithic art*. Chicago: University of Chicago Press.

Haun, D. B. M., Rekers, Y. & Tomasello, M. (2012). Majority-biased transmission in chimpanzees and human children, but not orangutans. *Current Biology, 22*, 727–731.

Hayden, B. (2003). *Shamans, sorcerers, and saints: A pre-history of religion*. New York: Smithsonian Books.

Hermann, E., Call, J., Hernandez-Lloreda, M. V., Hare, B. & Tomasello, M. (2007). Humans have evolved specialized skills in social cognition: The cultural intelligence hypothesis. *Science, 317,* 1360-1366.

Hove, M. J. & Risen, J. L. (2009). It's all in the timing: Interpersonal synchrony increases affiliation. *Social Cognition, 27,* 949-961.

Hurley, S. & Nudds, M. (eds, 2006). *Rational animals.* Oxford, UK: Oxford University Press.

Hoffmann, D. L., Angelucci, D. E., Villaverde, V., Zapata, J., & Zilhao, J. (2018). Symbolic use of marine shells and pigments by Iberian Neanderthals 115,000 years ago. *Science Advances, 4*, (2), eaar5255 doi: 10.1126/sciadv.aar5255

Jaubert, J., Verheyden, S., Genty, D., Soulier, M., Cheng, H., Blamart, D., et al., (2015). Early Neanderthal constructions deep in Bruniquel Cave in Southwestern France, *Nature, 534*, 111-114.

Jensen, K., Call, J. & Tomasello, M. (2007). Chimpanzees are vengeful but not spiteful. *Proceedings of the National Academy of Sciences, 104,* 13046–13051.

Jorgensen, J. G. (1980). *Western Indians. Comparative environments, languages, and cultures of 172 western American Indian tribes.* San Francisco: W. H. Freeman.

Katz, R. (1982). *Boiling energy: Community healing among the Kalahari !Kung*. Cambridge, MA: Harvard University Press.

Kelly, R. C. (1985). *The Nuer conquest: The structure and development of an expansionist system*. Ann Arbor: University of Michigan Press.

Kohls, N., Sauer, S., Offenbacher, M., & Giordano, J. (2011). Spirituality: An overlooked predictor of placebo effects. *Philosophical Transactions of the Royal Society B, 366*, 1838-1848.

Kraaijeveld, K. & Mulder, R. A. (2002). The function of triumph ceremonies in the black swan. *Behavior, 139*, 45-54.

Kuhn, S. L. & Stiner, M. C. (2007). Paleolithic ornaments: Implications for cognition,

demography, and identity. *Diogenes, 214*, 40–48.

Lakens, D. (2010). Movement synchrony and perceived entitativity. *Journal of Experimental Social Psychology, 46*, 701–708

Lang, M., Shaw, D. J., Reddish, P., Wallot, S., Mitkidis, P. & Xygalatas, D. (2016). Lost in rhythm: Effects of rhythm on subsequent interpersonal coordination. *Cognitive Science*, 40, 1797-1815. DOI: 10.1111/cogs.12302

McCauley, R.N., 2001. Ritual, memory, and emotion: comparing two cognitive hypotheses. In J. Andresen (Ed.), *Religion in mind*, (pp. 115-140). Cambridge: Cambridge University Press.

Marlowe, F**.** (2010), *The Hadza hunter-gatherers of Tanzania*. Berkeley: University of California Press.

McNeill, W. H. (1995). *Keeping together in time: Dance and drill in human history*. Cambridge, MA: Harvard University Press.

Melis, A., Hare, B. & Tomasello, M. (2006a). Chimpanzees recruit the best collaborators. *Science, 311*, 1297–1300

Melis, A., Hare, B. & Tomasello, M. (2006b). Engineering cooperation in chimpanzees: Tolerance constraints on cooperation. *Animal Behaviour, 72*, 275–286.

Melis, A. & Semmann, D. (2010). How is human cooperation different? *Philosophical Transactions of the Royal Society, B 365*, 2663–2674

Melis, A. P., Warneken, F., Jensen, K., Schneider, A.-C. Call, J. & Tomasello, M. (2011). Chimpanzees help conspecifics obtain food and non-food items. *Proceedings of the Royal Society B, 278*, 1405–1413.

Mellars, P. (2006). Why did modern human populations disperse from Africa *ca.* 60,000 years

ago? A new model. *Proceedings of the National Academy of Science, 103,* 9381–9386.

Mitani, J. C. & Brandt, K. L. (1994). Social factors affect the acoustic variability in the long-distance calls of male chimpanzees. *Ethology, 96,* 233-252.

Paladino, M.-P., Mazzurega, M., Pavani, F., & Schubert, T. W. (2010). Synchronous multisensory stimulation blurs self-other boundaries. *Psychological Science, 21*, 1202–1207.

Patel, A. D. (2014). The evolutionary biology of musical rhythm: Was Darwin wrong? *PLoS Biol 12(3):* e1001821. doi:10.1371/journal.pbio.1001821

Pearce, E., Launay, J. & Dunbar, R. I. M. (2015). The ice-breaker effect: Singing mediates fast social bonding. *Royal Society Open Science, 2*: 150221.http://dx.doi.org/10.1098/rsos.150221

Rappaport, R. A. (1999). *Ritual, religion and the making of humanity*. Cambridge, UK: Cambridge University Press.

Rege, M. & Telle, K. (2004). The impact of social approval and framing on cooperation in public goods situations. *Journal of Public Economics, 88,* 1625-1644

Richman, B. (1987). Rhythm and melody in gelada vocal exchanges. *Primates, 28*, 199-223.

Rossano, M. J. (2015). The evolutionary emergence of costly rituals. *PaleoAnthropology, 2015*, 78-100.

Rossano, M. J. (2012). The essential role of ritual in the transmission and reinforcement of social norms. *Psychological Bulletin, 138,* 529-549.

Rossano, M. J. (2007). Supernaturalizing social life: Religion and the evolution of human cooperation. *Human Nature, 18,* 272-294.

Sandgathe, D. M.. Dibble, H. L., Goldberg, P., McPherron, S. P., Turq, A., Niven, L. & Hogkin, J. (2011). On the role of fire in Neandertal adaptations in Western Europe: Evidence from Pech de l'Azé IV and Roc de Marsal, France. *PaleoAnthropology, 2011*: 216-242.

Senigaglia, V., de Stephanis, R., Verborgh, P. & Lusseau, D. (2012). The role of synchronized swimming as affiliative and anti-predatory behavior in long-finned pilot whales. *Behavioural Processes, 91*, 8-14.

Shariff, A. F. & Norenzayan, A. (2007). God is watching you: Priming God concepts increase prosocial behavior in anonymous economic game. *Psychological Science, 18*, 803-809.

Smuts, B. B. & Watanabe, J. M. (1990). Social relationships and ritualized greetings in adult male baboons (*Papio cynocephalus anubis*). *International Journal of Primatology, 11*, 147–172

Soltis, J., Boyd, R. & Richerson, P. J. (1995). Can group-functional behaviors evolve by cultural group selection? An empirical test. *Current Anthropology, 36*, 473–494.

Sosis, R. (2004). The adaptive value of religious ritual. *American Scientist, 92*, 166-172.

Sterelny, K. (2014). A Paleolithic reciprocation crisis: Symbols, signals, and norms. *Biological Theory, 9*, 65-77.

Tarr, B., Launay, J., Cohen, E. & Dunbar, R. (2015). Synchrony and exertion during dance independently raise pain threshold and encourage social bonding. *Biological Letters, 11*, 20150767. http://dx.doi.org/10.1098/rsbl.2015.0767.

Thompson, L. (1940). *Southern Lau, Fiji: An ethnography.* Honolulu: Bernice P. Bishop Museum Bulletin 162.

Tomasello, M. (2014). The ultra-social animal. *European Journal of Social Psychology, 44*, 187–

194

Tomasello, M. & Carpenter, M. (2005). The emergence of social cognition in three young chimpanzees. *Monographs for the Society for Research in Child Development 70,* Issue 1.

Tomasello, M. & Hermann, E. (2010). Ape and human cognition: What's the difference? *Current Directions in Psychological Science, 19,* 3-8.

Tomasello, M., Melis, A. P., Tennie, C., Wyman, E. & Herrmann, E. (2012). Two key steps in the evolution of cooperation: The interdependence hypothesis. *Current Anthropology, 53(6),* 673–692.

Valdesolo, P. & DeSteno, D. (2011). Synchrony and the social tuning of compassion. *Emotion, 11,* 262-266.

Vanhaeren, M., d'Errico, F., Stringer, C., James, S. L., Todd, J. A. & Mienis, H. K. (2006). Middle Paleolithic shell beads in Israel and Algeria. *Science,* 312, 1785–1788.

Vickhoff, B., Malmgren, H., Åström, R., Nyberg, G., Engvall, M., Snygg, J., Nilsson, M. & Jörnsten, R. (2013) Music structure determines heart rate variability of singers. *Frontiers in Psychology, 4*: 334 http://dx.doi.org/10.3389/fpsyg.2013.00334

Wacholtz, A. B. & Pargament, K. I. (2005). Is spirituality a critical ingredient of meditation? Comparing the effects of spiritual mediation, secular meditation, and relaxation on spiritual, psychological, cardiac, and pain outcomes. *Journal of Behavioral Medicine, 28,* 369-384.

Wade, N. (2009). *The faith instinct: How religion evolved and why it endures*. New York: Penguin Books.

Warneken, F., Chen, F. & Tomasello, M, (2006). Cooperative activities in young

children and chimpanzees. *Child Development, 77*, 640–663.

Warneken, F., Hare, B., Melis, A. P., Hanus, D. & Tomasello, M. (2007). Spontaneous altruism by chimpanzees and young children. *PLOS Biology, 5*, e184.

Warneken, F., Lohse, K., Melis, A. & Tomasello, M. (2011). Young children share the spoils after collaboration. *Psychological Science, 22*, 267–273.

Warneken, F. & Tomasello, M. (2006). Altruistic helping in infants and chimpanzees. *Science, 311,* 1301-1303.

Watts, I. (1999). The origin of symbolic culture. In R. Dunbar, C. Knight, & C. Power, (Eds.), *The evolution of culture* (pp. 113-146). New Brunswick, N. J.; Rutgers University Press.

Wheatley, T., Kang, O., Parkinson, C. & Looser, C. E. (2012). From mind perception to mental connection: Synchrony as a mechanism for social understanding. *Social and Personality Psychology Compass, 6/8,* 589–606, 10.1111/j.1751-9004.2012.00450.x

Whitehouse, H., (1996). Rites of terror: emotion, metaphor and memory in Melanesian cults. *Journal of the Royal Anthropological Institute, 2,* 703–15.

Whitham, J. C. & Maestripieri, D. (2003). Primate rituals: The function of greetings between male Guinea baboons. *Ethology, 109*, 847-859.

Wiech, K., Farias, M., Kahane, G., Shackel, N., Tiede, W., & Tracey, I. (2008). An fMRI study measuring analgesia enhanced by religion as a belief system. *Pain, 139,* 467–476.

Wiltermuth, S. S. & Heath, C. (2009). Synchrony and cooperation. *Psychological Science*, 20, 1-5.