# Did Meditating make us Human?

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## Abstract

This paper proposes that campfire rituals of focused attention created Baldwinian-type selection pressure for enhanced working memory capacity among our *Homo sapiens* ancestors. This model is grounded in five propositions including: that the emergence of symbolism occurred late in the archaeological record, that this emergence was caused by a fortuitous genetic mutation that enhanced working memory capacity, that a Baldwinian process where genetic adaptation follows somatic adaptation accounts for the mechanism of this emergence, that mediation directly affects brain areas critical to attention and working memory, and that shamanistic healing rituals were fitness-enhancing in our evolutionary past. Each proposition is discussed and defended; supportive evidence and potential future tests are presented.

Archeologist Steven Mithen envisions a late Paleolithic shamanistic ritual:

> Night descends, the meat is eaten and candles are lit. One of the men appears older than the others and wears a necklace of pierced fox teeth around his neck. Throughout the evening he has been lowering his face close to the smoldering herbs and inhaling deeply. He now takes a flat slab of slate and draws upon the surface, cutting into it with a flint point. As he does so the other people gently chant. Within a few minutes he is finished, and the engraved slate is passed around the circle. He has drawn a horse; it has been carefully depicted and proportioned quite correctly. This slate is placed to one side. The old man – a shaman – starts again: a deep intake of the intoxicating smoke, a few minutes of intense concentration amid more chanting, another slate to pass around the circle. That too has the figure of a horse. And so this continues... (Mithen, 2003, 130-1).

...and continues...

Imagine you traveled back in time 100,000 years and happened upon a group of our ancestors gathered around an evening campfire. Would anyone be surprised to find them chanting, clapping, dancing in unison, or maybe just sitting mesmerized before the flickering flame? The thesis of this paper is that it was precisely this type of commonplace campfire activity (which I will call campfire rituals of focused attention) that produced the human mind as it is today. These ritualized gatherings before an open fire – repeated night after night, generation after generation for thousands of years – created the conditions that selected for the uniquely human cognitive characteristics of enhanced working memory capacity and symbolic thinking

The scenario for which I will argue can be summarized as follows: anatomically modern humans emerged about 150,000 years ago, initially differing little from other hominid forms. Consciousness-altering rituals, often taking the form of shamanistic healing rituals, constituted an important and unique aspect of the human selective environment. This environment targeted those areas of the brain involved in focused attention and working memory, and in time, facilitated the genetic mutation(s) that ultimately fixed enhanced working memory and symbolic function in the human population.

The scenario is grounded in the following five propositions: (1) convincing evidence of symbolism in the form of body adornments, artwork, and grave goods appears late in the archeological record (largely after 50,000 years ago [ya]) and postdates the emergence of anatomically modern humans. (2) Recent work combining cognitive science and archeology has built a compelling case for explaining the late emergence of symbolism as the result of a fortuitous genetic mutation that enhanced human working memory capacity. (3) Evolutionary developmental biology indicates that genetic adaptation often follows somatic adaptation (the Baldwin effect). Put another way, environmental conditions that require *bodily adaptation* (such as high altitude conditions which require the production of more red blood cells), simultaneously create selection pressure for genetic mutations that more permanently establish the adaptive phenotypic state. (4) Neuroscience studies indicate that meditation produces short-term and long-term effects on both the structure and function of those areas of the brain closely associated with working memory and focused attention such as the dorsolateral pre-frontal cortex. (5) Hypnotizability, or the ability to achieve a ritually-induced, health-enhancing, suggestibility-prone conscious state, is individually variable and heritable; and would have been fitness-enhancing in our ancestral past.

The current paper discusses and defends each of these propositions. The bottom-line conclusion can be stated straight-forwardly and succinctly: nightly around the fire – singing, chanting, eyes fixated on the hypnotic flame – our ancestors built their brains into human brains.

**Proposition 1: The late emergence of symbolism**

Genetic and fossil evidence points to the emergence of anatomically modern humans (*Homo sapiens sapiens)* at around 150,000 ya in Africa (Deacon, 1989; Ingman, Kaessmann, Paabo, & Gyllensten, 2000; Ke et al., 2001; McDermott et al., 1996; Stringer, 1996; Underhill, et al., 2001; White et al., 2003) Controversy surrounds the issue of exactly when modern human behaviour emerged (Henshilwood & Marean, 2003; Klein & Edgar, 2002; McBrearty & Brooks, 2000). Some have argued that the relatively sudden appearance of sophisticated tools, body adornments, ritualized burial with grave goods, and image-making in the European Upper Paleolithic signifies a ‘revolution’ in human thought and behaviour (Klein & Edgar, 2002; Mellars, 1996; Mithen, 1996). This

‘Upper Paleolithic revolution’ model has been challenged by those who see evidence of an incremental accumulation of modern behaviours in the African archeological record (e.g. McBrearty & Brooks, 2000). For example, evidence of blade production, red ochre use, and barbed points date to 100,000 years or more in the African record, and recently-found beads and ochre engravings suggest that symbolic thinking may extend as far back as 70,000 ya or more (Henshilwood et al., 2004; 2002).

While it seems reasonable to grant the ‘incremental’ model some validity, even within this model the appearance of clearly symbolic artifacts such as perforated beads, representational images, and burials with grave goods is relatively late and, with only a few exceptions, occurs largely after 50,000 ya (McBrearty & Brooks, 2000; White, 2003, 155). In a recent review of the various traits that have been used to identify modernity in the archeological record (e. g. sophisticated tools, large mammal hunting, trade networks, survival in harsh environments, etc.), Henshilwood and Marean (2003) conclude that only evidence of symbolic behaviour is consistently diagnostic of modern humans. The current paper concurs with this conclusion. Furthermore, while the differential preservation of earlier over more ancient artifacts undoubtedly contributes to the late emergence of symbolism, the position adopted by the current paper is that this is not a complete explanation. In other words, the late emergence of symbolism is real. Whether this late emergence constitutes a ‘revolution’ or not is debatable; what is pivotal for the current argument is that symbolism is late-emerging and postdates the arrival of anatomically modern humans.

**Proposition 2: The fortuitous mutation**

Many of the same explanations that have been used to account for the emergence of modernity in general, such as fully recursive language, technological innovations, population pressures, competition with Neanderthals, etc., could be more narrowly applied to just symbolism (Bar-Yosef, 1998; Gamble, 1999, 381-7; Davidson & Noble, 1989). However, as Klein and Edgar (2002, 214-215, 268-9) point out these explanations almost inevitably lead to question-begging about deeper sources of causation (e.g. what caused the population pressures or what produced fully recursive language?). For Klein the ultimate causal mechanism must come down to a fortuitous genetic mutation that reorganized brain structure and function thus giving *Homo sapiens* a cognitive advantage over other archaic hominid forms (Klein, 1995; Klein & Edgar, 2002).

Recently, in a series of articles Coolidge and Wynn (Coolidge & Wynn, 2001; Coolidge & Wynn, 2005; Wynn & Coolidge, 2004; Wynn & Coolidge, 2003) have elaborated on Klein's proposal, arguing that the most likely target of this mutation would have been an enhancement of working memory capacity. In this context, working memory capacity refers to the ability to hold information in mind, especially information about behavioural procedures and intended goals, in spite of interfering stimuli or response competition (Kane & Engle, 2002). According to Coolidge and Wynn, enhanced working memory capacity is essential for cognitive innovation and experimentation. Neanderthals and other archaic hominids regularly demonstrated expertise in their tool-making (for example, in utilizing the Levallois technique); they did not, however, show much capacity for innovation. This innovative capacity was the key to *Homo sapiens*' symbolism. Coolidge and Wynn's proposal echoes that of Lewis-Williams (2002, 93-4, 189-90) who has argued that the key differences between Neanderthals and Cro-Magnons were in memory and higher-order consciousness. Unlike Neanderthals, *Homo sapiens* could voluntarily recall and manipulate the experiences they had in altered states of consciousness[1] (such as in dreams or fantasies) and use these images as a basis for their art.

Coolidge and Wynn set a broad time frame for the possible emergence of this mutation. In their view it could have accompanied the arrival of anatomically modern humans (around 150,000 ya) or it could have emerged much later (closer to say 70,000 ya). For purposes of this proposal the exact time of emergence is less important than when this mutation became widespread in the population, which I would argue was not until around 50,000 ya, immediately prior to the emergence of symbolism.

As an explanatory mechanism, the fortuitous mutation would seem to require no deeper causal force. Mutations, it has generally been thought, are more-or-less inevitable and largely random. However, recent work in evolutionary developmental biology has provided a more structured framework for understanding how random genetic mutations are translated into non-random phenotypic variations (Kirschner & Gerhart, 2005; Jablonka & Lamb, 1995; West-Eberhard, 2003). The important lessons of this work appear to be that mutations may be far less 'random' than originally thought, and evolved developmental processes place constraints on how genetic mutations get expressed in the phenotype.

**Proposition 3: The Baldwin effect updated**

The Baldwin effect – independently proposed in 1896 by James Mark Baldwin, Conway Lloyd Morgan, and Henry Fairfield Osborn – provided a non-Lamarckian way for environmentally-induced somatic modifications (resulting either from learning or physiological adaptation) to become heritable changes (Jablonka & Lamb, 1995; Simpson, 1953). According to this principle, acquired traits do not directly affect genes, however, these traits could create or importantly contribute to selective conditions that would, in time, genetically establish those traits in the population.

The classic example of this was provided by Waddington (1975), who exposed pupal fruit flies (*Drosophila melanogaster*) to heat shock. Some of the heat-shocked pupae later developed into flies without the typical cross-vein pattern on their wings. Waddington bred the no-cross-vein flies and once again exposed their pupal offspring to heat shock. After successive breedings, Waddington found that the no-cross-vein trait would emerge in nearly 100 percent of the offspring even in the absence of heat shock. In other words, an initially environmentally induced trait (no-cross-veins) eventually became encoded and transmitted genetically. In this example, the target trait (the absence of cross-veins) was only adaptive in the sense that Waddington consciously selected for it. However, in later studies he showed that a naturally adaptive trait, the ability to expel sodium in a sodium saturated environment, could also be first somatically acquired and then genetically fixed. Studies with lab rats have shown that this effect can also be found in mammals (Deneberg & Rosenberg, 1967; Ressler, 1966).

Bjorklund and Rosenberg (2005) provide another related example with clear implications for human evolution. They showed how chimpanzees, raised in a species-atypical environment (human-raised ‘encultured’ apes), acquired a cognitive capacity (deferred imitation) that is generally not found among wild apes. They argue that this could provide a potential model for how hominids acquired increasingly complex cognitive skills. These skills may first have appeared as novel acquired traits induced by atypical environmental demands. Then, as those demands persisted, a Baldwinian process could have led to the traits becoming genetically heritable and stabilized. Interestingly, over the course of hominid evolution, the atypical environmental demands were increasingly products of hominids themselves.

**Mechanisms behind the Baldwin Effect**

A number of mechanisms have been proposed to account for the Baldwin effect. Waddington originally explained the effect as resulting from the slow accumulation of the various alleles necessary for the expression of the trait. Suppose, for example, that there is some non-zero positive correlation between two alleles required to produce the no-cross-vein trait. As the environment reveals the presence of one allele (heat shock produces the no-cross-vein phenotype) and the associated trait increases fitness (potential mates prefer the trait or all-powerful experimenters only allow trait-bearers to breed) then the second, related allele is simultaneously favored as well (given the correlation between the two). The no-cross-vein 'team' thus gradually builds in the population.

A second possible mechanism is that environmental stress actually affects the rate and character of genetic mutations (see Jablonka & Lamb, 1995, 54-78; or White, 2004 for reviews and discussions). It has been Darwinian dogma for over a century that genetic mutations are 'random' either with regard to selection pressures or in terms of predictability (see Dawkins, 1986 for example). However, studies questioning this have a long history and have recently been gaining greater legitimacy. For example, both Jollos (1934) and Plough and Ives (1935) found that mutation rates increased in heat-treated fruit fly larvae and the resulting mutations were specific to certain loci and related to the heat-induced somatic modifications. Similar evidence of 'environmentally-directed mutations' has been reported in the bacterium *E. coli* (Wright, 1997). Wright (2004) has recently reviewed a range of studies providing support for the process of 'stress-directed mutagensis,' where feedback mechanisms within the organism allow environmental stressors to target specific genes that must mutate in order to surmount the stress. Though a great deal is still to be learned about how mutations arise, it is becoming increasingly clear that dismissing them as random is oversimplified.

Kirschner and Gerhart (2005) have recently proposed a third possible mechanism called 'facilitated variation,' where directed evolutionary change is facilitated by the organism itself. In this view, genetic mutations are still largely random, however, developmental constraints bias which mutations are passed along as phenotypic modifications. Modifications are more likely to arise in those systems that are under selection pressure – where the adaptive range of a physiological system is under stress. Any mutation or genetic reassortment that resets the range of a physiological system to a more adaptive level would then be positively selected by environmental conditions. Thus, a population of humans relocated to higher altitudes is biased toward the expression of any mutation that permanently resets their baseline levels of red blood cell production.

The course of human evolution seems to provide numerous examples of this process at work. For example, hominid locomotor, social, and digestive systems appear to have been far more prone to adaptation than the sensory systems, especially vision. In response to hotter, dryer, patchier woodland environments, our ancestors might have adapted by becoming more nocturnal. Primate visual systems, though, appear highly conserved. Instead, our ancestors had a wider adaptive range in terms of locomotor movement (where among extant apes we fine knuckle-walking, orthograde clambering, brachiating, and bipedialism), social systems (monogamy, fission-fusion societies, harems) and diet (apes are notorious omnivores). Hence, physiological constraints biased our evolution toward bipedal meat-sharers rather than solitary nocturnal bug eaters.

**The hominid brain: A poised system**

Throughout hominid evolution the brain appears to have been a repeated target of selection pressure. With a volume of around 400-545 cubic centimeters (cc), the brain of *Australopithecus* was only modestly larger than that of the average chimpanzee. Substantial increases in brain size occurred with the advent of the genus *Homo* and its various species. Early species of *Homo* (*H. habilis, H. rudolfensis*) had brains ranging from 500 to 750 cc, while *H. erectus/ergaster* ranged anywhere from 800-1100 cc or up to 80 percent of the average modern human volume of 1300 cc (Falk, et al., 2000; Holloway, 1973; Wood & Collard, 1999). Some of this increase is attributable to increases in body size, however; the encephalization quotient (EQ), which adjusts brain size for body size has also risen dramatically from two and one half in *Australopithecus* to over seven in modern humans (Jerison, 1973). Since the emergence of anatomically modern humans about 150,000 ya, no substantial changes in brain volume or EQ have occurred. Thus, no discernable brain change is associated with the onset of symbolism; and the brains of Neanderthals were, if anything, slightly larger than that of modern humans. This is what has prompted Klein (1995) to argue for a mutation that affected brain organization, rather than gross brain size.

The brain changed significantly over the course of hominid evolution. Thus, it appears to have been one of those systems poised to adapt under changing environmental conditions. If one of these adaptations was, in fact, Klein's fortuitous-working-memory-enhancing-mutation then two important questions emerge: (1) what were the conditions that prompted its emergence and spread, and even more importantly, (2) why did those conditions only affect *Homo sapiens* and not other archaic hominids?

**Proposition 4: Meditation and the brain**

Recent brain-imaging and EEG studies have shown that the areas of the brain associated with working memory and focused attention, such as the dorsolateral prefrontal cortex and the anterior cingulate, are activated during mediation (Lazar et al., 2000; 2005; Lutz et al., 2004; Lou et al., 1999; Newberg et al., 2001; Wallace, Benson, & Wilson, 1971). For example, Lazar et al (2000) used fMRI to show that subjects practicing Kundalini meditation, where attention is focused on breathing and silent mantra recitation, had significant metabolic increases in many brain structures including the dorsolateral prefrontal cortex and anterior cingulate. Newberg et al. (2001) used single photon emission tomography (SPECT) on eight experienced Buddhist meditators and found increased activation in the dorsolateral and orbital prefrontal cortices, anterior cingulate cortex, and the sensorimotor cortices.

Lutz et al. (2004) used EEG measures to assess brain activity in practitioners experienced with ‘compassionate’ meditation (where one is supposed to cultivated universal compassion for all things). Compared to novices, they found that the experienced meditators self-generated high-amplitude gamma wave synchrony over the frontoparietal regions of the brain, indicating that neural assemblies widely distributed across these areas were synchronizing their activation. The level of synchrony in some of the subjects was, according to the authors, ‘the highest reported in the literature in a nonpathological context’ (Lutz et al., 2004, 16372). Furthermore, the resting level ratio of gamma band activity (25-42 Hz) to slow wave oscillation (4-13 Hz) was higher in meditators compared to controls, suggesting that meditative practice had affected long-term baseline brain activity.

The notion that mediation might have long-term effects on brain structure and function has been supported in at least two other recent studies. Lazar et al (2005) measured cortical thickness in meditators experienced with ‘insight’ or ‘mindfulness’ mediation (where the goal is to increase one’s nonjudgmental awareness of present stimuli). They found that, relative to controls, mediators had significantly thicker regions of the prefrontal cortex including the right anterior insula, and the right middle and superior frontal sulci. As hypothesized, these areas are ones associated with attention and sensory processing. Some of the largest between-groups differences were found among the older subjects, prompting the authors to speculate that mediation may work to reverse age-related thinning of the prefrontal cortex.

Finally, Carter et al, (2005) found that Tibetan monks experienced at one-point mediation (a type that involves focused attention on a single object) were able to exert conscious control over a typically automatic attentional phenomenon – binocular rivalry. Binocular rivalry occurs when each eye’s fovea is presented with a different image. Usually this results in an attentional switching as perception changes back and forth between the competing images. Over half of the one-point meditators were able to significantly slow the switching rate, while three of them were able to achieve complete image stabilization during the five minute testing period. This result shows that individuals trained in mediation can exert voluntary attentional control over what are normally involuntary attentional fluctuations. As the researchers point out, these results contrast dramatically with results reported from numerous previous studies involving over 1000 mediation-naïve subjects.

**Were our ancestors meditating?**

This accumulating body of research indicates that mediation specifically targets those areas of the brain involved in attention and working memory. These areas are the ones critical for the enhancement of working memory capacity. This enhancement may very well have given *Homo sapiens* a competitive edge over their archaic hominid counterparts and produced the emergence of symbolism about 50,000 ya. However, it can be rightly pointed out that it seems quite unlikely that our ancestors of 100,000 years ago or more were engaging in one-point or compassionate mediation. While this is true, numerous other studies have shown that far more mundane tasks involving memory and attention also activate these same brain areas.

The very reason why we know that the dorsolateral prefrontal cortex is important in working memory and attention is because of a variety of neuroscience studies where memory and attention tasks, not involving specific meditative practices, have been used. For example, Smith and Jonides (1994) had subjects view a display containing three dots. After a three second delay they saw another display with a circle and were required to indicate if the circle encircled one of the previous dots. PET scans showed a significant increase in activation in the right prefrontal cortex. A similar object matching test was done where subjects had to judge whether a later-presented pattern matched an earlier one. In this instance, it was the left prefrontal cortex that was significantly activated.

Thus, using a relatively simple task, Smith and Jonides were able to show the involvement of the prefrontal cortex in working memory, with the right being more important for spatial memory and the left being more important for form recognition. Numerous other studies with similarly simple cognitive demands have indicated that the dorsolateral prefrontal cortex is important as a high-level attentional filter, sustaining cognitive energy on relevant information while suppressing the processing of and responding to irrelevant signals (Duncan, 2001; Heinz et al., 1994: Kane & Engle, 2002; Wheeler, Stuss, & Tulving, 1997; see Geary, 2005, 211-20 for review and discussion).

The campfire rituals of focused attention practiced by our hominid ancestors need not have been as meditatively disciplined as that of Tibetan monks to have activated the brain regions important for attention and memory. However, as will be discussed in the next section, they were probably more intensive than those used in typical neuroscience studies. There are good reasons to suspect that our ancestors engaged in regular ritualized activities that taxed attentional and working memory systems. Furthermore, unlike tool-making, hunting, and other routine activities that also require focused attention and working memory, these rituals could easily have included children on a regular basis, thus opening up the possibility for adaptive modifications of brain ontogeny. Environmentally-induced changes in brain structure and function could, over time, have become genetically heritable as a result of the selective pressure of the rituals themselves (a Baldwin effect). Finally, there is evidence to suggest that these conditions were unique to *Homo sapiens* and not a regular part of the social worlds of Neanderthals and other archaic hominids.

**Proposition 5: Shamanistic healing rituals**

Though anthropologists often clash when it comes to defining shamanism, for present purposes it refers any form of religious practice where a specialized practitioner (the shaman) achieves an altered state of consciousness in order to connect with spiritual forces for the benefit of his/her community (Hultkrantz, 1973; Townsend, 1999). There is considerable evidence that shamanism is humanity's oldest form of religion (Halifax, 1982; Guenther, 1999; Lee & Daly, 1999; Winkelman, 1990). It is nearly impossible to find a traditional society that does not have some form of shamanistic practice (Townsend, 1999; Vitebsky, 2000). Furthermore, an increasing number of scholars agree that some of the Upper Paleolithic cave art and artifacts reflect shamanistic rituals and/or experiences (Downson & Porr, 1999; Eliade, 1972; Hayden, 2003; Lewis-Williams, 2002; Lommel, 1967: Winkelman, 2002). These two qualities, ubiquity and antiquity, suggest that the roots of shamanism run deep in human history. Indeed, a recent find from the Fumane cave in Italy seems to confirm this. Stone slabs dated to around 35,000 ya recovered from this cave bear images of a human form with the antlered headgear typical of a shaman (Balter, 2000). These images could represent the oldest evidence of shamanistic rituals. If so, it also suggests that shamanism pre-dates the Upper Paleolithic since the depiction reflects an already present system.

**Ritual healing theory**

Among tradition societies shamanism is not esoteric or 'optional' spiritualism. It is, instead, the very framework that provides meaning to life and the cosmos. It seems reasonable to suppose that this was true in our ancestral past as well. Furthermore, shamanistic rituals very likely served an important adaptive function in our past. McClenon (1997; 2002) has marshaled considerable evidence indicating that those of our ancestors who were most susceptible to the beneficial physical and psychological effects of shamanistic rituals had a selective advantage over others in surviving illness or injury, overcoming debilitating emotional states, and enduring the rigors of childbirth. This 'ritual healing' theory is based on a number of converging lines of evidence, including:

1. The universality (or near universality) of ritual healing practices across traditional societies (Winkelman, 1990; see McClenon, 2002, 67)

2. The fact that ritual healing always involves hypnotic processes and altered states of consciousness (see McClenon, 2002, 67-71)

3. Evidence showing that hypnotizability or the ability to achieve a mental state highly prone to suggestion is measurable, variable, and has heritable components (Katz, 1982; Morgan, 1973; Wilson & Barber, 1978; see McClenon, 2002, 93-6 for review)

4. The finding that ritual healing is often highly effective for a range of maladies where psychological factors are involved such as chronic pain, burns, bleeding, headaches, skin disorders, gastrointestinal disorders, and the discomforts and complications of childbirth (see McClenon, 2002, 46-67 for review)

5. The evidence from comparative and archeological studies indicating the existence of ritual, altered states of consciousness, and care of the sick among our primate cousins and hominid ancestors (Goodall, 1986; Hayden 2003; Jolly & White, 1995, 345; Lewis-Williams, 2002; Trinkaus, 1983, 409-11)

6. The fact that the earliest medical texts (from Mesopotamian and Egyptian civilizations) closely connect healing with religious ritual (McClenon, 2002, 39-43 for review).

7. The finding that anomalous events associated with ritual, such as 'miraculous' healing, are effective in inducing supernatural beliefs (see McClenon, 2002, 70, 132-5, 150-1).

The potential antiquity of shamanistic healing rituals is further strengthened by evidence that neither sophisticated linguistic skills nor ideologies are needed for the rituals to be efficacious. It is the compelling nature of the ritual experience and not belief in a specific theology that is critical (e.g. a Muslim may find relief in a Christian-based healing practice so long as he/she accepts the power of the ritual itself, see McClenon, 2002, 10, 79-83). Furthermore, only minimal verbal expression is required (if at all) to add to the persuasive impact of the ritual ('relax,' 'heal,' etc.). Indeed, part of the power of spiritual healing is that it is something beyond words and logic. Among the !Kung hunter-gatherers, ritual healing is caused by a powerful, but mysterious spiritual energy call n/um (Katz, 1982, 34). N/um itself bears some resemblance to the very ancient and widespread notion of a pervasive but equally mysterious spiritual force called mana (Smart, 1976). Thus, what is required for spiritual healing appears to be well within the behavioural and cognitive repertoire of our hominid ancestors: a belief in a healing spiritual power, a capacity for ritual, and an understanding that this power is accessed through consciousness-altering rituals.

It is not hard to imagine that our *Homo sapiens* ancestors of 100,000 ya or more were engaging in campfire rituals of focused attention. At times these rituals may only have involved group chanting, dancing, or hypnotic silence before the flames (the benefits of which should not be casually dismissed). At other times these rituals may have involved intensely dramatic shamanistic rituals where soul flight, supernatural encounters, and miraculous healings took place. Undoubtedly, it was the immediate positive psychological and physical effects of these rituals that provided the motivation for their enactment. More than likely some participants experienced 'healings' that they attributed to the rituals, which reinforced and (probably) intensified the practice. What is critical is that these rituals required focused attention which activated those areas of the brain associated with attention and working memory. Those whose brains were most ‘ritually-capable’ would also have been the ones to reap the greatest fitness reward. Enhanced working memory capacity was a byproduct of ritually-induced fitness-enhancing brain changes.

**What made humans different?**

Certainly, campfire rituals were not the only regular activities that taxed attentional and working memory systems. However, these rituals may have been the only ones that consistently differentiated *Homo sapiens* from other hominids. These rituals were a unique aspect of *Homo sapiens'* selective environment, not shared by non-sapiens hominids.

Prior to 50,000 ya there is very little evidence that anatomically modern humans differed in any significant way from their archaic hominid counterparts. In fact, tens of thousands of years before the Neanderthals were displaced by Cro-Magnons in Europe, *Homo sapiens* and Neanderthals shared space in the Levant region of the Middle East (Shea, 2003; Tchernov, 1994). But the Levant 100,000 years ago was not Upper Paleolithic Europe. As Neanderthals moved in from the north and west, *Homo sapiens* moved out. It is unclear whether there was direct competition or sequential habitation based on changing climates. In either case, at this point in history, *Homo sapiens* were no match for either Neanderthals or for increasingly cold conditions (conditions that were obviously not too difficult Neanderthals). But over the next 50,000 years or so, something changed. When *Homo sapiens* moved into Europe around 40,000 ya, it was for good. Neither Neanderthals nor cold conditions stopped them from laying claim to the entire continent. Whatever it was that changed them, did not similarly affect Neanderthals. So what was the difference?

Both groups engaged in tool-making. As Klein and Edgar point out both Neanderthals and *Homo sapiens* 'commonly struck flake-blades from carefully prepared cores.' (Klein & Edgar, 2002, 230) Furthermore, a recent analysis demonstrates that Neanderthal tool manufacture required a degree of expertise on par with modern human blacksmithing (Wynn & Coolidge, 2004). Both groups also collected natural pigments, built fires, and engaged in large mammal hunting. In fact, recent studies have shown that Neanderthals were highly skilled hunters and foragers, whose abilities compared favorably with Cro-Magnons and contemporary hunter-gatherers (d'Errico, 2003; Grayson & Delpech, 2003; Sorensen & Leonard, 2001) Thus, it is hard to argue that the cognitive demands of hunting, tool-making, or of survival in harsh climates differentiate *Homo sapiens* from Neanderthals. In other words, if these activities created selection pressures for enhanced working memory capacity and symbolism then these traits would have arisen in Neanderthals as well as anatomically modern humans.

Paradoxically, however, some scattered archeological evidence indicates that Neanderthals were not entirely devoid of symbolic abilities. A few artifacts have been recovered from Neanderthal sites that appear to qualify as 'art.' For example, a 'proto figurine' in the shape of a human face was recently uncovered from a Neanderthal site at La Roche-Cotard in France dated to around 35,000 ya (Marquet & Lorblanchet, 2003). The object shows signs of intentional modification in order to enhance its face-like qualities. Chatelperronian Neanderthals manufactured beads, pendants, and other body adornments, along with sophisticated tools and other artifacts that appear to have symbolic significance (Hublin, Spoor, Braun, Zonneveld, & Condemi., 1996). Finally, evidence exists indicating that Neanderthals, like Upper Paleolithic Cro-Magnons, explored deep caves and may have used them as ritual sites (see Hayden, 2003, 108-15).

Collectively this evidence suggests that a mental capacity for symbolism was present in some nascent or measured form in Neanderthals and under certain environmental conditions (such as when in close contact with Cro-Magnons) this capacity fluoresced. But apparently those conditions were not a regular aspect of the Neanderthal world prior to the Upper Paleolithic. This again emphasizes the fact that something was different about the *Homo sapiens'* world. Something that was generally not present in that of other hominids.

**Why Neanderthals didn't meditate.**

If the critical difference between *Homo sapiens* and other hominids was what I have termed 'campfire rituals of focused attention,' then why didn't Neanderthals engage in this seemingly natural activity? Aren't they and other archaic hominids just as likely to have been singing, chanting, and encountering healing spirits around their campfires? Odd as it may seem, the answer to this seems to be no. Evidence suggests that Neanderthals had neither the time nor the energy to engage in such activities. They lived hard lives – harder apparently than Cro-Magnons.

Studies of Neanderthal bones indicate that they endured a high level of head, neck, and upper body trauma (Berger & Trinkaus, 1995). Evidence of extensive wear and tear and degenerative bone disease was commonplace. Tellingly, Trinkaus (1995) failed to uncover a single instance of a healed lower limb injury among Neanderthals, suggesting that constant mobility was essential to their lifestyle and those who were unable to keep up simply didn't survive. Nutritional stress also seems to have afflicted Neanderthals to a greater extent than Cro-Magnons (Soffer, 1994). Evidence of cannibalism owing to nutritional stress is present from Neanderthal sites (Defluer, Dutour, Valladas, & Vandermeersch, 1993; Defleur et al., 1999). Cro-Magnon sites, however, have yet to reveal any similar evidence (see Klein & Edgar, 2002, 198). To some degree then, *Homo sapiens* must attribute their advanced cognitive faculties to the 'dumb luck' of having evolved in the tropics of Africa rather than the harsh cold of Europe.

**Summary**

Symbolism, and the advanced mental capacities that it entails, arrived late in human evolution. The *Homo sapiens* that gave up the Levant were no different from any other hominid species. When times got tough, they moved out. But between the Levant and Upper Paleolithic Europe something happened – symbolism and the all that goes with it – emerged, and *Homo sapiens* would never again give ground to another hominid. Klein (1995; also Klein & Edgar, 2002) is right to argue that ultimately the explanation for this must come down to some genetically heritable change. It is unclear as to precisely when this change occurred, however, it is clear that by 100,000 ya it was not widespread enough to be of any consequence. Additionally, this change was not necessarily unique to *Homo sapiens*. Neanderthals may very well have had it too; only too little, too late. The best explanation for how this genetic change emerged and became widespread in the population is a Baldwinian-type process, where an environmentally-induced trait, over time, becomes genetically heritable.

There are two relevant examples that provide potential models for how this might have occurred – at least in its initial stages. First, the archeological record indicates a very brief and fleeting emergence of symbolism in the last days of the Neanderthals. Secondly, studies with human-encultured apes demonstrate that they can acquire cognitive capacities unprecedented among wild apes. In both these cases, human culture appears to have played a key role in producing the ‘new’ cognitive capacity. If human culture can affect other species, it certainly could have affected our ancestors.

One aspect of human culture that is universal and ancient is shamanism – specifically shamanistic rituals of healing. These rituals were not only potentially fitness-enhancing, but they directly targeted those areas of the brain critical for enhanced working memory capacity and symbolic thinking. Furthermore, unlike tool-making, hunting and other activities that require focused attention, campfire rituals were likely unique to *Homo sapiens,* and youngsters could have participated as well as adults. Generation after generation of our ancestors grew up chanting before the flame and as they did they changed their brains into human brains.

**Testing the model**

All theoretical models pertaining to human pre-history involve some speculation and the current model is no exception. However, the current model strives to remain grounded in evidence and therefore open to testing and falsification. Each of the five propositions on which the model is based is potentially falsifiable. Their fate reflects on the plausibility of the overall theory. For example, if archeological evidence accumulates that contradicts the assumption of the late emergence of symbolism, then this model would be in jeopardy. Or if Baldwinian mechanisms for translating an environmentally-induced change into a genetic one are found too weak to be of any consequence in the evolution of complex traits (such as intelligence or memory capacity etc.) then again this model would suffer.

Along with negative evidence arising from the weakening of the model's foundational assumptions, positive evidence is also predicted. For example, this model would predict that cognitive science research would continue to deepen the physiological and psychological connections between attention and working memory on the one hand, and ritual and meditation on the other. For example, preliminary data from O'Hara (see Motluk, 2005 for a brief summary) indicates that meditation improves performance on psychomotor vigilance tasks (tasks requiring constant focused attention). These improvements were found even for sleep-deprived subjects. Furthermore, another recent study has shown that spiritual meditation is more effective than secular mediation in reducing anxiety and increasing pain tolerance (Wachholtz & Pargament, 2005). This supports the notion that in our past, meditative rituals that called upon healing spirits could have had tangible emotional and physical benefits that increased fitness.

Additionally, this model would predict that archeological research would continue to uncover evidence of the ancientness of shamanism and religious rituals associated with shamanism, continually pushing back in time the potential emergence of this religious form. Furthermore, it is predicted that evidence of behavioural and cognitive similarity among hominid species, prior to 50,000 ya, will continue to accumulate. This will be true especially for tool-making and hunting and increasingly it will be compelling evidence of symbolism alone that will distinguish anatomically modern humans.

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[1] Altered states of consciousness is a notoriously vague term. In this context, I follow Lewis-Williams (2002, 121-30) who describes a spectrum of consciousness ranging from typical wakeful consciousness to increasingly intensified states. Typical wakeful (baseline) consciousness is characterized by a problem-solving orientation and rational processing of external signals. Intensified or altered states are characterized by increasingly non-rational processing and internally-directed focus ranging from fantasy to hypnagogic imagery to sensory hallucinations.