An exploration of the functions of religious monumental architecture from a Darwinian perspective

Yannick Joye and Jan Verpooten

University of Leuven

Abstract

In recent years, the cognitive science of religion has displayed a keen interest in religions' social function, bolstering research on religious prosociality and cooperativeness. The main objective of this article is to explore, from a Darwinian perspective, the biological and psychological mechanisms through which religious monumental architecture (RMA) might support that specific function. A frequently held view is that monumental architecture is a costly signal that served vertical social stratification in complex large-scale societies. In this paper we extend that view. We hypothesize that the function(s) of RMA cannot be fully appreciated from a costly signaling perspective alone, and invoke a complementary mechanism, namely sensory exploitation. We propose that, in addition to being a costly signal, RMA also often taps into an adaptive "sensitivity for bigness". The central hypothesis of this paper is that when cases of RMA strongly stimulate that sensitivity, and when commoners become aware of the costly investments that are necessary to build RMA, then this may give rise to a particular emotional response, namely awe. We will try to demonstrate that, by

exploiting awe, RMA promotes and regulates prosocial behavior among religious followers and creates in them an openness to adopt supernatural beliefs.

Keywords: religious monumental architecture, sensory exploitation, costly signaling, awe, supernatural beliefs

Introduction

Monumental architecture has been independently expressed across many large-scale civilizations belonging to different eras and situated in different geographical regions. Well-known monumental structures are – for example – the *Giza Pyramids* in Egypt, *Angkor Wat* in Cambodia or the *Teotihuacan Pyramids* in Mexico (Trigger, 1990). It is commonly assumed that the defining feature of such monumental constructions is their large scale, which vastly exceeds the scale of the everyday buildings and built structures of the epoch in which they were built. Very probably, experiencing a particular edifice as monumental depends on the particular timeframe or the culture in which one lives, as well as on one's previous exposure to built monumental structures. For example, while for a 21st century urbanite, accustomed to massive modern skyscraper buildings, Neolithic ashmounds might not look particularly spectacular, these structures probably felt as considerably more impressive for Neolithic people, for whom they were amongst the biggest built structures of their era (Johansen, 2004).

Throughout architectural history different types of monumental architecture have been constructed. In early civilizations, fortifications, palaces, temples and tombs were among the most common types, whereas in classical Rome and Greece, public buildings such as arenas, theatres or

public baths also often exhibited monumental aspects (Trigger, 1993, 75). In this article we will concentrate on monumental architecture that was built to fulfill particular functions related to religious doctrines, i.e., *religious monumental architecture* (henceforth abbreviated as RMA). While the possible roles of monumental architecture for religions have already been briefly hinted at in evolutionary accounts of religions and religious behavior (e.g., Gervais & Henrich, 2009; Atran & Henrich, 2010), in this article we aim to give an in-depth and tentative analysis of the potential function(s) of this type of architecture for religious doctrines.

The theoretical backdrop of our analysis is the view that religions are complex "devices" that help(ed) creating, regulating and enacting (large-scale) community living (e.g., Wilson, 2002; Graham & Haidt, 2010). In agreement with Graham and Haidt (2010) we see religion as "… a complex system with many social functions, one of which is to bind people together into cooperative communities organized around deities" (140). This perspective on religion has received much attention in recent evolutionary approaches to religion and has bolstered research into the relation between religiousness and cooperative, prosocial behavior (e.g., Shariff & Norenzayan, 2007). The question as to whether religions' social function has come about as a result of selection pressures at the level of the individual, the group, or both (cfr., Wilson, 2002) is still unsettled. Rather than choosing sides of either one of these positions, we aim to shed light on the mechanism(s) through which RMA supported religions' social function.

Within the field of archaeology, monumental architecture is sometimes interpreted as a costly signal that evolved to deter rival (religious) elites (Neiman, 1998). In this paper we will argue that in order to fully understand the cultural and temporal pervasiveness of RMA, this costly signaling account needs to be complemented with insights from sensory exploitation theory (Ryan, 1998). Sensory exploitation is a concept from biological signaling theory that grasps how in animal

communication particular sensory sensitivities can be exapted. In this paper we will argue that not only the costliness underlying RMA supports the social function(s) of religion, but also the fact that such architecture seems to taps into an adaptive "sensitivity for bigness". In so doing, RMA exploits a particular emotional response (i.e., awe), which – we hope to demonstrate – supports the process of religious community building.

This article is organized as follows. In the first section, we offer a discussion of Darwinian approaches to monumental architecture. We complement and extend the view that such edifices are costly signals, and claim that sensory exploitation theory has additional explanatory value to explain the occurrence of RMA. We conjecture that, while being a costly signal, RMA also plays on the adaptive tendency to associate size cues with dominance/power, both of which may trigger awe in spectators. The two following sections aim to demonstrate how experiencing awe supports the social function of religions. Specifically, in the second section it is argued that awe-provoking instances of RMA contribute to vertical stratification within religious communities, to bonding between (religious) community members and to monitoring social life. The third part discusses the relationship between RMA and religious beliefs. Specifically, such edifices are deemed to be commitment signals, whose specific emotional charging creates in religious followers openness to religious/supernatural beliefs. The fourth section suggests that RMA's social function can only be fully grasped if seen as being intimately intertwined with religious ritual behavior and activities.

1. Darwinian approaches to (religious) monumental architecture

A number of (archeological) researchers have attempted to shed light on the origin and function(s) of monumental architecture from a Darwinian perspective. In the following sections we consider the specific evolutionary model that is commonly invoked by these researchers, i.e., costly signaling

theory, and complement it with sensory exploitation theory. We further discuss one particular sensitivity which we think is exploited by RMA, and dwell on a typical emotional response that can derive from this exploitation process and from observing the costliness underlying cases of RMA, namely awe. For our discussion of awe we mainly rely on Keltner and Haidt's prototypical account of awe (Keltner & Haidt, 2003)

1.1. Monumental architecture as a costly signal

The archeological record shows that there is a correlation between the emergence of monumental architecture and the rise of stratified communities (e.g., Trigger, 1990; Kolb, 1994; De Marrais, Castillo & Earle, 1996). Based on this, some authors presume that building monumental architecture actively contributed to vertical social stratification. But by which mechanism could this have happened? One view which has received considerable attention in the literature on monumental architecture is that monumentality is a non-ambiguous and reliable signal of power. Trigger (1990), for example, argues that building monumental architecture required massive amounts of energy, and only those who actually had power and controlled it could have been capable of recruiting and managing the energy and labor necessary for building such edifices. Monumental buildings thus "… symbolize the ability of those for whom they were made to control … energy to an unusual degree" (Trigger, 1990, 125). By participating in constructing such power symbols, commoners acknowledged their lower ranking with regard to the leading elites, which further underlined their social inferiority. As embodying vast amounts of labor and energy, and the elites' ability to control these, monumental architecture became one of the instruments for achieving social organization/stratification.

While Neiman (1998) also recognizes the social organizational role of monumental architecture, his main interest lies in elucidating, from a Darwinian perspective, how wasting energy on non-utilitarian monumental architecture could have conveyed an adaptive benefit to the elite builders. There are different indications that such buildings actually did have little pragmatic, i.e. non-signaling use. For example, monumental structures could oftentimes not be accessed, or only by a small religious elite. When such type of architecture could be entered by the public (cfr., churches or cathedrals), the roofing of the interior space often surpassed the height that was strictly necessary for the events and activities taking place there (e.g., religious services, marketplace). The fact that, at times, this increased the risk of collapse suggests that the shape of the building surpassed its specific utilitarian/pragmatic requirements. Also the use of visual illusions in religious monumental architecture, which further augments the apparent grandeur of the structure, illustrates that, over and above possible pragmatic functions, such architecture was also built to impress its viewers (for a further discussion of this issue, see section 1.2.4).

By relating the occurrence of monumental architecture to Zahavi's handicap principle (Zahavi, 1975) Neiman (1998) attempts to theoretically extend Triggers (1990) account. Specifically, building on a case study of Classic Mayan monumental architecture, he contends that such "wasteful" constructions illustrate costly signaling. Such edifices are analogous to non-human animal threat displays, like costly nest decorations of black kites (Sergio et al., 2011). They reliably signal that the elites who have built them had an energy surplus over competing elites and signaled to the latter that engaging in competition would be futile. To non-elites they provided an opportunity to accurately assess the elites' qualities as potential leaders (Aranyosi, 1999). Monumental architecture can thus be considered as '… a form of "smart advertising," wherein the signaler accrues the benefits of increased access to labor and resources as a result of paying the cost of construction, and non-

signalers can benefit from associating with more capable elites' (Aranyosi, 1999, 357). Because monumental architecture thus signaled superior competitive ability, the elites who built these structures had privileged access to resources and mates, which ultimately increased their reproductive fitness.

In both Trigger (1990) and Neiman's (1998) account it is mainly by wasting energy through labor and resources that monumental architecture plays it social organizational role. We suspect, however, that a mere focus on wastefulness cannot fully capture the characteristics of RMA. The reason is that while a costly signaling perspective focuses on the effort/energy that has gone into creating the architectural form, it remains silent on the question of how these structures' particular aesthetic appearance might also have contributed to some of the proposed functions of RMA, such as social organization/stratification.

In our framework, we bring together two theoretical perspectives to explain the functions of RMA. We agree with Neiman (1998) that many instances of RMA are costly signals, illustrating wastefulness of – among other things – time, material, or labor. However, claiming that RMA merely embodies wastefulness greatly under-constrains the precise form of these edifices. The history of architecture shows us that during different epochs and among different cultures wasteful advertising through monumentality mainly occurred by erecting structures whose most constant and distinctive feature is their very large *size*, most often expressed through height (cfr., towers, pyramids, ziggurats). This historically constant feature is not addressed by signaling accounts.

There is little doubt that concentrating the waste of energy and material into one massive structure that stands out from the environment allows observers to fairly easily estimate the effort that has gone into building the structure. We are however convinced that something more than signal efficiency is operating here (Endler, 1992). In our dual account of RMA, Neiman's costly signaling

account is complemented with another theoretical perspective on signal evolution, namely sensory exploitation theory. In so doing, we hope to further address the question of why exactly size, and specifically height, have become attractors for wasteful monumental building activities. In the following sections we explain the basic principles of sensory exploitation theory and try to demonstrate that the primary sensorial sensitivity which is being exploited in RMA is an adaptive "sensitivity to bigness".

1.2. RMA involves sensory exploitation

1.2.1. The mechanism of sensory exploitation

In a costly signaling system, receivers' responses to senders' signals are determined by the extent to which these signals indicate underlying (genetic) quality of the sender (Zahavi, 1975). Although being an influential perspective, in animal communication research costly signaling is only one of the many models which biologists use to explain how signals evolve. Another model that has received much attention is *sensory exploitation* (SE) (e.g., Ryan, 1998; Arnqvist, 2006). Central to SE is that senders evolve display traits to exploit pre-existing sensitivities of receivers[1], or sensitivities that are under strong selective pressure in another context than the SE system. These traits may often be costly, but that does not necessarily mean that they reliably correlate with quality, which is a requirement to regard the trait as a costly signal. In recent years, theoretical (e.g., Fuller, Houle & Travis, 2005) and empirical evidence (e.g., Rodriguez & Snedden, 2004) for the role of SE in sexual selection has been steadily accumulating, establishing it as a valuable alternative to traditional indirect benefit models, such as costly signaling.

[1] Usually the term "Sensory Exploitation" is interpreted quite broadly, referring not only to the exploitation of sensory sensitivities, but also to the exploitation of receivers' emotional and cognitive sensitivities. Moreover, these sensitivities do not need to be innate, but can be learned as well, given that they are maintained by strong functionality outside the signaling context. Therefore, sometimes the more inclusive term "receiver psychology" is used.

Several empirical studies lend support to the plausibility of the SE mechanism as an alternative account of signal evolution (for a review, see Fuller et al., 2005; Arnqvist, 2006). For example, Rodd and colleagues (2002) suggest that male guppy color patterns are food mimics. Specifically, they found that, among populations, variation in female mating preferences for males with orange spots can be explained by the attraction to orange food objects. Given the fact that these animals frequently eat orange food items, selection for easy detection of orange food items might have resulted in selection for preferences for orange males.

Admittedly, demonstrating a correlation between attraction to orange food and orange males by itself does not tell us anything about the direction of causation. It may be that the "orangeness" of males is actually an adaptive indicator of male quality (because, for instance, producing the color requires ingesting carotenoids), and that the preference for orange food is merely a by-product of mate choice. It may also be that the preference for orange food and orange males evolved independently in these guppies (Fuller et al., 2005). A final possibility is that costly signaling and SE operate simultaneously and complement each other, and thus each explains a particular aspect of the evolved display. In the case of the guppies example, it may be that, initially, females are attracted to orange males because they mimic food. Because this orangeness is also hard to produce for males, females can – secondarily – also be selecting for male quality (Arnqvist, 2006).

This last interpretation is a "weaker" version of SE, one that is not mutually exclusive with costly signaling and that may even complement it. This account is commonly considered to explain specific aspects of costly signal evolution, for example, why a costly signal takes on a specific wasteful form rather than another one. This weaker version of SE is also called "sensory drive" and often focuses on signal efficiency (Endler, 1992). It needs mention, however, that a clear distinction between sensory drive and SE is unwarranted and usually these theoretical variants are lumped

together. The argument put forward in this paper is mainly based on this weaker version of SE. In particular, we propose that in addition to costly signaling, SE has explanatory potential for RMA and can uncover why in RMA costliness is perennially embodied in *high* structures.

Although both SE and costly signaling are usually applied to explain patterns in sexual selection, they can also describe the interactions between senders and receivers of any signaling system, even a cultural one. Whereas in sexual selection SE drives the evolution of male display signals (e.g., ornaments, behaviors, sound production) in the signaling system we propose, SE drives the evolution of particular features about RMA (i.e., increased size and height of built structures) to reinforce religions' social function. SE operates because receivers have pre-existing sensory, cognitive or emotional sensitivities for visual, aural or other perceptual stimuli/features. In our signaling system RMA is supposed to exploit what we coin a "sensitivity for bigness".

1.2.2. RMA exploits an adaptive sensitivity for bigness

The primary sensory sensitivity which seems to be exploited by instances of RMA is the tendency to consider large-sized objects or agents as powerful or dominant. This sensitivity seems to be widespread in the animal kingdom. With regard to humans it has been suggested that it originates from parent-child interactions, where the correlation between the parent's size and its influence over the child becomes a benchmark for estimates about social power later on in life (Schwartz, Tesser & Powell, 1982). Others, however, consider such a "sensitivity for bigness" to be a deeply homologous trait, which might explain why it is shared among different animal species. Judge and Cable (2004), for example, note that in the animal kingdom height and size are employed to assess the power and strength of other animals, thus acting as a direct cue on the basis of which fight-or-flight decisions are made. According to this view a sensorial sensitivity to bigness is basically adaptive perception.

Within groups of (social) animals this sensitivity for bigness seems to be exploited during dominance displays, in an effort to establish or further consolidate social hierarchies (De Waal, 1982). For example, during dominance displays of non-human primates dominant individuals try to make themselves appear taller than they actually are (e.g., by extending arms and legs) and also exhibit traits (e.g., pilo-erection) which increase their perceived size (De Waal, 1982). In captivity primates have even been reported to intensify the power of their display by making high structures with some of the objects available in their enclosures.

The association of size cues with power is also apparent from human behavior. For example, bank directors' offices are often located in the uppermost parts of office buildings, whereas after sporting contests the winner is invited to take the top spot on the podium. Empirical research shows that individuals who take on postural positions that augment their perceived size feel more powerful than their "constricted" counterparts (Huang, Galinsky, Guenfueld & Guillory, 2011) and are commonly considered as more socially dominant by viewers (Marsh, Henry, Schechter & Blair, 2009; see also Tiedens & Fragale, 2003). Higher social power/ranking is also attributed to human figures which are placed on an elevation as opposed to figures in a non-elevation position (Schwartz, Tesser & Powell, 1982). When faces are presented in a raised position they are evaluated as being more dominant than their "lowered" equivalents (Mignault & Chaudhuri, 2003). Recent research suggests that, in humans, this sensitivity for bigness is already present from a very early age. Specifically, Thomsen and colleagues (2011) report that, as of ten months old, infants use relative size as a cue for predicting dominance in a conflict of goals.

Of relevance for our argument about RMA is that this sensitivity for bigness does not only become activated by a social agent's body size or by its specific bodily posture (e.g., grandstanding). Recent research demonstrates that already very simple height, verticality and size cues create

impressions of power. While the effects of such cues are mainly studied from the perspective of embodied cognition research, they are consistent with the evolutionary perspective taken in this paper. For example, Schubert (2005) showed (among others) that respondents are faster at identifying powerful groups when these groups were represented on top of a computer screen than at the bottom, supporting the view that the concept of power is visually represented as a vertical difference (see also: Fiske, 1992; Haidt & Algoe, 2004). When in an organization chart the vertical line which connects the leader to the employees is made longer, then the leader is judged as being more powerful (Giessner & Schubert, 2007). Schubert, Waldzus and Giessner (2009) found that subjects were faster and more accurate in indicating whether a concept described a powerful group (e.g., "professor") when this concept was written in large as opposed to small fonts, which is consistent with the view that size cues correlate positively with perceptions of power. Similar results speak from the fact dominant individuals have a visual preference for the vertical dimension in space (Moeller, Robinson & Zabelina, 2008) and that activating concepts referring to powerful groups/individuals (e.g., "president") drives attention to higher spatial positions (Zanolie et al., 2012).

We hypothesize that in as much as size, and especially height are characteristic to RMA, such edifices can be interpreted as cultural signals that exploit in spectators the sensitivity for bigness, i.e., the tendency to see and feel power/dominance in objects/features that are big, or at least suggest bigness. This particular claim receives further support from the finding that power and dominance are also associated with ecologically relevant stimuli (i.e., mountainous topographies) (Gagnon et al., 2011), and not only with the aforementioned simple height, verticality or size cues. Thus, in addition to the fact that in RMA power is evident from the fact that massive amounts of energy and labor were necessary to erect these structures (cfr., Trigger, 1990; Neiman, 1998), the SE perspective extends

that view by suggesting that also particular formal attributes of these buildings (especially height) lead to subjective impressions of power[2].

1.2.3. RMA galvanizes cultural evolution

According to the framework outlined so far, instances of RMA not only signal wastefulness (cfr., Neiman, 1998), but they also tap into an adaptive sensitivity for bigness. It is worth noting that the two components central to our dual account of RMA (i.e., costliness, bigness) are not exclusive to human built accomplishments, but are sometimes even characteristic to animal constructions. Consider for example, the *Vogelkop* bowerbird species which builds bowers that are many times higher than their makers. Such structures too seem to be characterized by both costliness (in precision and construction cost) and monumentality (in size). This conspicuous similarity between (aspects of) certain human and animal constructions illustrates how cross-species comparisons can shed light on the possible ultimate functions of human building behavior, suggesting that also the aesthetics of human architecture is constrained by evolutionary factors (see for example Hersey, 1999).

In the bowerbird example, female bowerbirds use the male bower as quality-indicators of its builder. Analogously, in Neiman's account (Neiman, 1998), building monumentally is assumed to convey a fitness advantage to their Mayan builders because the fact that they were able to expend valuable amounts of energy and resources on such inherently useless structures reliably illustrated their genetic fitness. In our dual account, however, the function of RMA should not necessarily be restricted to a sexual selection framework (cfr., Miller, 2000). Rather than solely serving genetic

[2] Along similar lines, clothing and garments that artificially increase an individual's height (cfr., thick boots, high heels, tall hats, miters) can be understood as culturally evolved objects that exploit the sensitivity to bigness. Like RMA ,they are one of the possible ways in which people use designed elements or artifacts to appear powerful and dominant.

transmission, RMA can also be a vehicle for cultural transmission. For example, according to dual inheritance theory (DIT; Richerson & Boyd, 2005) culture – being understood as "knowledge stored in brains" – is adaptive, and the evolution and transmission of cultural variants is driven and guided by social learning, imitation and teaching. Of particular interest is that cultural learners employ a number of fast and frugal heuristics to identify good learning models that allow them maximize the success of social learning. Learners are, for example, biased to learn from and imitate models (e.g., individuals or groups) that send out signals that are indicative of cultural success, such as prestige (Henrich & Gil-White, 2001). Inasmuch as massive religious edifices signal prestige, such structures can galvanize the transmission of the particular cultural variants adhered to by the cultural models. One of the central tenets of DIT is that cultural and genetic evolution do not always operate in unison. Dual inheritance allows to view the prestige which RMA enjoys not only as an indicator of good genes, but also as an indicator of good "cultural variants," thus being one of religions' devices to promote and facilitate their own cultural dissemination.

1.2.4. Religious monumental architecture exploits awe

Having sketched the main lines of our dual account of RMA, in the next sections we will turn to another aspect which has received little attention in accounts of monumental architecture, namely, the emotions that are experienced when encountering such massive structures. In Neiman's costly signaling account (Neiman, 1998), the emotional impact of RMA remains largely implicit. Our aim is to open this black box and to bring the "hot", i.e., the emotional impact of RMA to the foreground. Specifically, our account attributes a central role to the emotion of *awe*, and attempts to explain how its experience interlocks with RMA, and the associated religious doctrine's possible functions. In the

ensuing sections we first give a brief overview of the central characteristics of awe, after which we discuss which characteristics of RMA might possibly trigger this particular emotion.

Central characteristics of awe – "vastness" and "need for accommodation"

Religious monumental architecture can trigger a wide range of emotions in human individuals, among others admiration, beauty, delight, goose bumps, aesthetic chills, fear, dizziness, romance or hope. One of the core assumptions of the argument put forward in this paper is that a common and frequent emotional response on perceiving instances of RMA is – and always has been – awe. While grand natural scenes are perhaps amongst the most widely known elicitors of this emotion (cfr., the *Grand Canyon*), it is very likely that cases of religious monumental architecture that have a comparable splendor and grandeur are also able to spark feelings of awe (Shiota, Keltner & Mossman, 2007). Awe is for example experienced by heritage tourists upon visiting cathedrals (Francis, Williams, Annis & Robbins, 2008), and height, which often is characteristic to RMA, has also been found to provoke feelings of awe and respect in human individuals (Schubert, 2005). As will be argued further on, triggering this particular emotional response supports the community function of religions.

The emotion of awe has received a fair bit of attention in the religious, philosophical and sociological literature, but it is only since the last decade that it has become studied from a psychological perspective – albeit still to a limited extent (e.g., Keltner & Haidt, 2003; Shiota, et al., 2007; Armstrong & Detweiler-Bedell, 2008). One of the most in-depth psychological discussions of this emotion has perhaps been provided by Dacher Keltner and Jonathan Haidt (Keltner & Haidt, 2003). In their "prototypical" approach to awe, Keltner and Haidt consider awe to primordially be a social emotion, which can be traced back to the submissive feelings which (low-ranked) individuals

experience in the face of powerful individuals or leaders. The adaptive function of this emotion, they maintain, is to affirm and consolidate prevailing social hierarchies. A crucial point, according to Keltner and Haidt (2003), is that awe is not only experienced in response to powerful or dominant social *agents*, but "… generalizes to other stimuli … to the extent that these new stimuli have attributes associated with power" (Keltner & Haidt, 2003, 306-307).

Based on a reading of the relevant literature on awe, Keltner and Haidt (2003) contend that two primary appraisals are at the heart of prototypical awe experiences. First, awe can arise when (social or non-social) stimuli are encountered that are powerful or "vast" with regard to a particular frame of reference (Keltner & Haidt, 2003; see also Shiota et al., 2007). According to Keltner and Haidt (2003) "vastness" should not necessarily be restricted to physical size, as applies for example to the majestic *Pyramid of the Sun* at Teotihuacan (Mexico). Awe-inspiring stimuli might – among others – also be vast in time, space, degree of elaboration, or ability. On this account, recognizing that gargantuan efforts have gone into constructing a religious monumental structure might also color one's experience of the edifice with awe.

If only appraisals of vastness were to occur in response to a particular stimulus, people would probably be more likely to feel – say – reverence or submission, rather than awe. According to Keltner and Haidt (2003) full-blown awe only occurs when this vastness is of an overwhelmingly high intensity. Put differently, by its "vastness", the awe-evoking stimulus does not only co-opt the human sensitivity for dominance signals, but it also becomes a super-stimulus by exceptionally exaggerating that vastness (Tinbergen, 1951). While such exceptional vastness can create a sense of physical insignificance in spectators, Keltner and Haidt (2003) contend that the second important dimension of awe relates to how individuals cognitively appraise those feelings of insignificance. Specifically, the experience of exceptional vastness deeply challenges or "shakes" an individual's

cognitive conceptions, involving an inability to assimilate the awe-provoking experience into current mental structures. This is supposed to trigger a compensatory need to "accommodate" the awe-filled experience, involving an adjustment of existing mental schemes (Keltner & Haidt, 2003). Notice that such awe-provoking, (cognitively) overwhelming vastness often seems to be an intrinsic characteristic of instances of RMA. For example, the *Notre Dame Cathedral* in Paris very probably triggered awe in the medieval peasant population because its splendor and massive scale was unlike any built structure they had ever seen. It largely surpassed these individuals' mental conceptions of possible human creative accomplishments.

Note that underlying the argument that RMA is/was a common trigger of awe is the assumption that RMA has had similar emotional effects across different cultures and epochs. But is there any evidence for this? Already two decades ago, Ekman (1992) speculated that awe should be considered a basic emotion, but he also noted that empirical support for this speculation was lacking. Likewise, Haidt and Keltner (2002) anticipate that awe is experienced among most cultures, although there might be between-cultural variation in the importance attached to the emotion. Although systematic research is lacking, there are some indications for the cross-cultural prevalence of awe. For example, in the *Natyashastra*, an ancient Indian treatise on the performing arts, awe/wonder ("*Vismaya"*) is an essential part of the repertoire of nine basic emotional responses. Research by Haidt and Keltner (1999) furthermore shows that both American and Indian respondents employ awe to label particular emotional facial expressions (Haidt & Keltner, 1999), whereas these two cultural groups are also able to correctly identify wonder/awe in the dynamic (facial and bodily) expressions in classic Hindu dance performances (Hejmadi, Davidson & Rozin, 2000). From a cross-species perspective, so-called "waterfall-displays" by chimpanzees are sometimes associated with awe. While such displays involve the primates to dance near the waterfalls that emerge after heavy

rainfalls, they have also been found to contemplate this natural event for many minutes, as if standing in wonder and awe about it (Goodall, 1986). Thus, while more empirical research is required to settle the issue as to whether awe occurs cross-culturally and cross–temporally, these studies and observations at least tentatively suggest that it is likely to be the case.

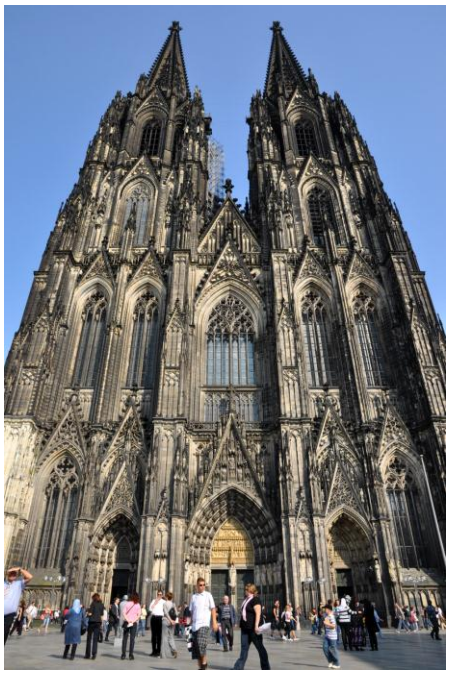

Figure 1: Some examples of religious monumental architecture. Top: Buddhist temples at Bagan, Burma; Middle: Pyramid of the Moon (Teotihuacan, Mexico). Bottom: Cologne Cathedral (Cologne, Germany).

Triggers of awe in RMA

But what exactly is it about RMA that can trigger awe? In accordance with Keltner and Haidt's (2003) prototypical approach to awe, the vastness inherent to RMA can be considered as the primary cause of awe. But what does this "vastness" exactly amount to? First of all, vastness can – of course – refer to the sheer physical size of the monumental structure. However, the "raw" or absolute scale of RMA is probably not the only physical source of awe. Consider the fact that in human mate choice, large breasts and buttocks can provoke awe or awe-related states in males, whereas large upper body muscles can trigger awe in females. These observations suggest that awe is based on implicit contrasts to what is normal, rather than on absolute scale. Monumental (religious) structures, such as cathedrals or pyramids, are massive and awe-evoking even by today's standards (pyramids,

cathedrals). However, despite the fact that many monumental built structures of small-scale societies are considerably smaller absolutely, they were still much larger than any surrounding structures, and could therefore well have been a source of awe during their epoch. Our argument thus not only applies to the "traditional" examples of RMA, like pyramids or cathedrals, but extends to monumental structures such as ashmounds, barrows, longhouses, or stone circles (e.g., *Stonehenge*) (see figure 1 for examples of RMA).

As outlined in our characterization of awe (section 1.2.4), certain immaterial characteristics can also be considered as "vast", such as the "big" personality of charismatic leaders (cfr, Martin Luther King), or extraordinary physical accomplishments (e.g., finishing an ultra-marathon). In an analogous way, the (effortful) *processes* involved in, or necessary for constructing monumental religious buildings (e.g., the vast amount of work) can also be a source of "vastness" (besides direct physical appearance). Building monumentally almost per definition requires huge amounts of labor, energy and time, and recognizing this might amplify, or further support the awesomeness triggered by the vast physical form. Vastness might also refer to extraordinary craftsmanship, such as speaks from the accuracy of the decorative stonework in the *Alhambra* (Spain), or from the technical/structural virtuosity necessary to construct a vaulting spanning a huge stretch of space in a medieval cathedral. It might refer to the use of materials that are notoriously difficult to collect or that are very labor-intensive to work or process. Of course, all these processes need to be managed, and this managerial ability can itself be a source of awe when it takes on extraordinary proportions. A recent example is the *Beijing Airport* which has been built at the occasion of the 2008 Olympic Games and took less than four years from plan to completion. The airport's physical scale is not only impressive, it also represents an awesome display of bureaucratic efficiency.

It thus appears that there are two principal sources of vastness in RMA – and hence of awe – and these run along the same lines as the two perspectives brought together in our dual account of RMA. That is, (a) the direct perception of "bigness" can be a source of awe as much as (b) the costliness (i.e., wastfulness) underlying the construction of that bigness. Note however, that a certain amount of knowledge might be required to be awed by costly building activities (i.e., condition (b)). Consider the case of a tiny temple built atop a huge mountain. Although this temple might fulfill the physical vastness condition (i.e., (a)) because it is built on a high place, the building could be seen as a form of cheating because it derives its high position solely from the height of the mountain. However, learning/knowing that the mountaintop was absurdly inaccessible at the time of the construction of the temple might still fill one's experience of the building with awe. Probably, when both the physical size of the building (condition (a)) and the costly investments made to construct it (condition (b)) are impressive, and embodied in one and the same building, then it becomes very likely that an intense awe response to the building will occur.

Notice that in the case of RMA, bigness often *necessarily* goes hand in hand with costliness. In the age of dazzling skyscrapers, it is easy to forget how difficult it was in the past to achieve great height. Without great width, depth and mass, massive structures often ran the risk of collapsing, as is illustrated – for example – by the case of the *Notre Dame d'Amiens* (France). In this cathedral the flying buttresses were initially placed too high, and were barely able to counteract the lateral forces that came from the ceiling arch. First, this was resolved by placing lower buttresses, but when after some time cracks in the lower walls of the building began to appear, builders finally installed an iron bar chain running inside the walls, holding the cathedral together (Nova, 2012). This example clearly shows that it is difficult to exploit the sensitivity to bigness on the cheap. In the past building high almost necessarily was a costly enterprise, requiring – among others – technical ingenuity, large

455 human labor investment and an abundance of material resources. One of the few "easy" ways in
456 which height – or rather subjective impressions of height – could be increased was through illusion.
457 In gothic cathedrals, for example, impressions of height are sometimes amplified by the (vertical)
458 shafts running from the floor up to the ceiling. Other methods for creating the optical illusion of
459 added height is to taper the walls of the monumental structure, or to paint the higher versus the lower
460 parts in different shades (the higher the lighter the shade), like is the case in the *Eifel Tower*[3].
461
462
463
464 ***Ever higher***
465 If triggering dominance perceptions and awe experiences is indeed an important function of religious
466 monumental buildings, it can be expected that their religious (or ideological) builders will have
467 attempted to build as high as they were capable of. In agreement with this prediction, it appears that
468 throughout history the achieved height of the world tallest buildings increased synchronously with
469 the development of new engineering and technological skills (Figure 2). However, apart from their
470 pure height, also the height to width ratio of monumental buildings seems to have increased over
471 time, probably stemming from an increased ability to overcome the technical limitations hampering
472 building high structures. For example, the highest church in the world, the *Ulm Minster* (Ulm,
473 Germany, 1890 AC, 161,5m) only slightly exceeds the *Great Pyramid of Giza* (±2560 BC, 146,5m)
474 in height, but it is far more slender than the pyramid, even though buttresses had to be added to keep
475 the church buildings upright. Skyscrapers of the first decennia of the 20th century, such as the New
476 York *Empire State Building* (1931 AC, 381m), achieved approximately two times the height of the

[3] Note that male bowerbirds also use forced perspective in their bowers, possibly to appear bigger to females (cfr., Endler, J.A., Endler, L.A. & Doerr, 2010).

world's tallest churches, but with a similar height to width ratio. Finally, the height of the *Burj Khalifa* (2010 AC, 828m), a skyscraper in Dubai, doubles that of the *Empire State Building*, whereas its basis has approximately the same width.

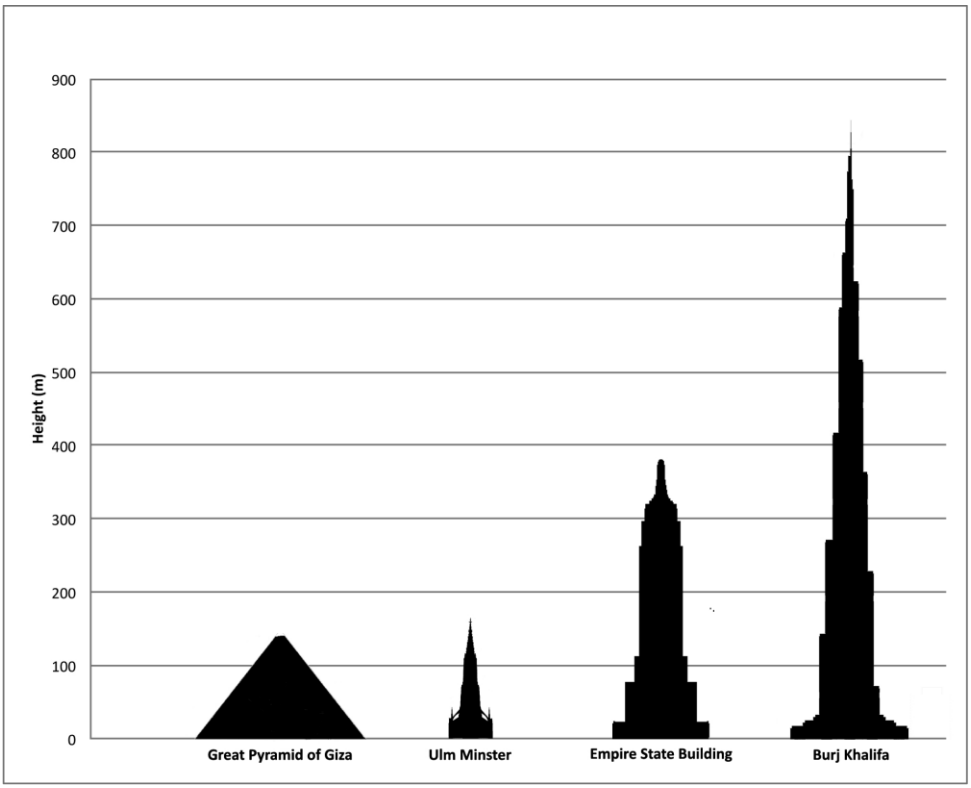

Figure 2: Heights of four of the world's tallest buildings throughout history.

2. Building communities by exploiting awe

In a nutshell, in the previous sections we argued that RMA exploits feelings of awe in spectators by being at the same time a costly signal and a structure that taps into our shared sensitivity to bigness. Having made this framework explicit, in the following sections we will elucidate how awe experiences interlock with and promote religions' social function. In the first section, the role of awe in vertical social stratification is discussed, while the second section touches upon the possible community building effects of experiencing this emotion. In the third section, we explain how RMA

might have coordinated and monitored social life. Note that in these sections we aim to shed light on the function(s) of RMA from the perspective of the (large-scale) religious community in which the instance of RMA was embedded. We do not exclude, however, that RMA might have had analogous functions for certain smaller groups or even for the particular individuals *within* those communities. While RMA might be interpreted as a means of religious communities to yield prestige, it is of course entirely possible that RMA might also have increased individuals' own prestige because, for example, they actively contributed to building the structure. We refer to the discussion section for a further consideration of the possible consonances and conflicts between the functions of RMA on the group versus the individual level.

2.1. The role of religious monumental architecture in vertical social stratification

There is ample evidence that in the presence of dominant individuals, or visual cues correlating with actual dominance, people are inclined to behave obediently or submissively. In the infamous obedience experiment by Milgram, for example, volunteers went so far as to give (seemingly) lethal electroshocks to a stranger because an authority figure (i.e., the experimenter) pressed them to do so (Milgram, 1963). Recent research demonstrates that watching individuals power posing (e.g., taken an open posture) leads to hormonal changes that correlate with submissive behavior (i.e., decrease in testosterone, increase in cortisol) (Carney, Cuddy & Yap, 2010). When individuals are faced with a dominant confederate, their submissive behavior is evident from the fact that they tend to adopt constricted postures (Tiedens & Fragale, 2003). A study by Fennis (2008) shows that individuals behave more submissively towards confederates when the latter surround or associate themselves with high status brands/products.

Inasmuch as RMA can, by its size and height, be considered as an architectural embodiment of a dominant/powerful religious group or entity, the foregoing research suggests that commoners are prone to behave more obediently and submissively when faced with such grand edifices. Thus, as a signal tapping into the aforementioned sensitivity for bigness and its (emotional) effects (especially awe), RMA's physical appearance might have actively contributed to the process of vertical stratification and social ranking. This complements the costly signaling view on monumental architecture outlined earlier (section 1.1). According to that view, social organization and stratification result from the building process, i.e., from the recognition that the builders were capable of mobilizing and controlling large amounts of energy and labor (cfr., Neiman, 1998).

It is important to note that the mechanism through which RMA has its socially stratifying effects probably deviates from that underlying dominance displays. During such displays, size cues (e.g., grandstanding) are also often employed, but the dominant individual – or the one trying to dominate – uses these to *enforce* a hierarchical relationship upon another individual. If RMA would play a closely analogous role, then it mainly would have functioned as a device for oppressing and intimidating people. If that were RMA's sole function, then it needs to be explained why instances of RMA are often also highly aestheticized, and are often attractive rather than merely oppressive. This suggests that such edifices also functioned to attract or "seduce" commoners, rather than to merely intimidate them (Huyssen, 1996).

It seems that by exploiting awe RMA can have it both ways. On the one hand, due to the fact that awe is primordially rooted in submissive feelings toward dominant individuals (Keltner & Haidt, 2003), RMA might tap into emotions related to submission. On the other hand, contrary to "pure" dominance displays, those feelings seem to be *willingly* conferred to the stimulus that provokes awe (cfr., Henrich & Gil-White, 2001). Or as Frijda and Parrott (2011) put it: "Awe recognizes the power

and quality of someone, some object, or some performance. One willingly and openly recognizes the target's superiority, refrains from competing, and from challenging the target's power" (411). The sense of smallness and cognitive inadequacy that derive from perceiving the grandeur of RMA might thus define and consolidate hierarchical ranking, but that relationship seems primarily to result from freely "surrendering" to the awe-producing authority, rather than that it is caused by an attempt at (enforced) submission by that authority.

RMA is thus not solely intimidating and oppressive, but it can also deeply impress the (religious) spectator, being attractive rather than repellant. However, in addition to the vastness inherent to RMA, further particularities of the construction process and of the building's shape, can give RMA either a more oppressive or impressive/attractive "flavor". Appraisals of "oppressiveness" or "impressiveness" can derive from the building process itself. For example, throughout history constructing monumental architecture has frequently been a way of leaders to mercilessly oppress and dehumanize certain (ethnic) groups or minorities, like it happened in Hitler and Speer's monumental architecture program. The specific shape or layout of the building, or particular architectural features can however also bring about feelings of oppression or impression. Oppressiveness can, for example, be due to including anxiety inducing elements in RMA, such as sharp spires/towers or piercing forms (Larson, Aronoff, Sarinopoulos & Zhu, 2009), dark enclosed spaces (Stamps, 2005) or representing threatening animals in ornament (Barrett, 2005). On the other hand, incorporating shiny and glistening surfaces (Coss, 2003), brightly colored architectural features (cfr., gothic rose windows) or ornaments of nonthreatening elements might make a monumental structure attractive rather than intimidating.

2.2. The role of religious monumental architecture in communal bonding

Besides introducing and enacting social ranking and facilitating "vertical" attachment to religious leaders and deities, we conjecture that RMA is also capable of generating "horizontal" attachment, that is, increased bonding and attachment *among* religious followers. The actual physical appearance and geographical location of such buildings might already play a role in this process. Due to their massive scale, inside and around instances of RMA there often is a lot of space for large groups of people to gather, providing ample opportunities for social interaction and social sharing. Medieval cathedrals, for example, are known to have served as civic gathering places or even marketplaces (Estabrook, 2002).

In addition to providing physical opportunities for gathering, we deem that by triggering awe, RMA can also *psychologically* facilitate social gathering/bonding. Examinations of the *direct* effects of awe suggest that this particular emotion indeed has community building potential by making people feel connected and act prosocially toward each other. Shiota and colleagues (2007), for example, discovered that experiencing awe causes people to feel as belonging to a large group, whereas this effect did not occur for other positive emotions, such as pride. Similarly, Saroglou, Buxant and Tilquin (2008) found that watching awe-eliciting events/scenes, such as natural scenery, made respondents feel more connected and committed to others, when compared to respondents who had seen an amusing video-clip. Van Cappellen and Saroglou (2012) recently replicated this effect by showing that in spiritual/religious respondents, experiencing awe leads to sentiments of oneness with close others and with humanity as a whole, as opposed to experiencing humor. Awe makes people also more willing to spend their time on helping others (Rudd, Vohs & Aaker, 2012). Our own research findings are consistent with this and point out that exposure to natural, awe-evoking scenes makes people more inclined to act prosocially towards others compared to mundane natural scenes/elements (Joye & Bolderdijk, unpublished data).

Based on these empirical findings we propose that RMA can exploit the social unification effects of awe, and as such, can also "horizontally" contribute to religious community building. Further research is however needed to uncover the exact mechanism responsible for this effect. Our own hypothesis is that the community-building effect of awe is driven by two interlocking psychological mechanisms, which directly tap into the two central features of awe experiences, proposed by Keltner and Haidt (2003), i.e., vastness and need for accommodation.

A first mechanism is linked to the vast physical scale of these religious edifices. Research shows that priming individuals with large versus small spatial distances makes them frame and consider things in terms of more abstract mental representations or "construals" (e.g., "fruit" versus "apple") (Henderson & Wakslak, 2010). Of particular interest for our argument is that Meyers-Levy and Zhu (2007) found that high versus low ceiling heights makes individuals classify objects into broader and more inclusive categories. In an analogous way, we conjecture that exposure to the massive scale and height of RMA will have made it more likely that religious followers represented fellow-followers in terms of a "collective" entity or group, rather than as a collection of separate individuals. This focus on the communal might be further reinforced by the fact that the highly attention-grabbing character of awe-triggering stimuli brings about a diminished sense of self in the viewer and a strong focus on external events and elements (Shiota et al., 2007).

However, neither focusing on others (instead of on oneself), nor viewing them in terms of a collectivity will necessarily motivate an individual to turn to or to *attach* to a group of individuals. A second mechanism which we identify (for community building) relates to the feeling of mental/cognitive inadequacy that might arise from perceiving the vastness inherent in RMA. Specifically, people are likely to turn to, or to rely on others to compensate for the sense of insignificance and (cognitive) uncertainty that can be caused by experiencing awesome events or

elements (Derbaix & Vanhamme, 2003; Marigold, McGregor & Zanna, 2009). In as much as RMA created – through awe – feelings of uncertainty and insignificance (cfr., Griskevicius, Shiota & Neufeld, 2010) and shook an individual's mental structures, a tendency for religious followers to "flock together" would have constituted a compensatory strategy to curb those feelings (for a review, see: Kay, Gaucher, McGregor & Nash, 2010; Rucker & Galinsky, 2008).

The crux about the previous argument is that RMA exploits psychological dispositions closely interwoven with awe, which – indirectly – facilitate communal bonding. On the one hand, we assume that the subjective sense of (cognitive and physical) insignificance caused by RMA leads to a compensatory need for attachment to others. On the other hand, monumental architecture's massive spatial scale makes that people's representations of those others tend to transcend the level of "particular selves". Notice that this last conclusion dovetails with the proposition that in religions experiences of self-transcendence contribute to generating group cohesion (Durkheim, 1915). Self-transcendent states are commonly reached during ritual performances or acts, in which individuals participate in, for example, singing or synchronous rhythmic behavior. Research confirms that jointly making music (Kirschner & Tomasello, 2010) and moving synchronously (i.e., walking in step) (Wiltermuth & Heath, 2009) leads to increased cooperation and helping behavior, which can foster communal living. As will be further discussed in section 4, RMA should be viewed as being an integral part of, and supporting this ritual component of religious doctrines.

2.3. Religious monumental architecture as a social monitoring device

Inevitably, religious communities are faced with the challenge of regulating communal/religious living. Without appropriate social monitoring, freeloaders might reap the benefits of the prosocial and cooperative efforts of fellow community members without themselves complying to the social rules

627 and norms. It has been hypothesized that religions have a number of built-in adaptive strategies to
628 deal with problems of defection and freeloading. One proposal, made (among others) by Rossano
629 (2007) is that ever-present supernatural beings are a means for social scrutiny, encouraging social
630 cooperation among community members and, in so doing, consolidating social community living
631 (see also: Alcorta & Sosis, 2005).

632 In religions it is commonplace to use artifacts to remind people of the customary religious
633 *ethos* (e.g., the cross in Christianity). Quite probably, instances of RMA will have played a similar
634 social regulatory role (cfr., Atran & Henrich, 2010). In so doing, such edifices complement the
635 regulatory function of physically present social monitors (e.g., priests) and supernatural monitors
636 (e.g., deities). Due to their massive scale, monumental constructions are often extraordinarily salient,
637 grab and engage attention, and are therefore suited for regulating social/religious life across
638 considerable spatial distances. Of further importance is that the interpretation of such "monumental
639 monitors" does not depend on language, age, gender or culture and that they can be simultaneously
640 accessed by large groups of individuals, and this during different epochs (De Marrais et al., 1996;
641 Alcorta & Sosis, 2005). We anticipate that exposure to awe-evoking RMA will have made it more
642 probable that followers live up to the prosocial norms that are embodied in, or evoked by such
643 buildings, as opposed to non-awe-provoking religious buildings. This is because awe involves an
644 (implicit) recognition of the presence of a superior and highly powerful authority (Keltner & Haidt,
645 2003), almost literally "looking down" on religious followers and (implicitly) commanding them to
646 live up to the prevailing social rules and norms[4].

[4] It might be noted that there is a seeming contradiction between the "monumental monitors" idea and the claim that RMA should be understood in terms of a costly signal. Could it not be the case that the height of cases of RMA is merely a prerequisite for optimally performing the monitoring function? In other words, is RMA, considered from the perspective of monitoring, not just efficient design instead of strategically wasteful design? Against this, it can be pointed out that monitoring only seems to require that the structure stands out so much among surrounding (built) structures that it (significantly) enters the visual field. One often sees, however, that RMA is vastly higher than the surrounding buildings and fills a substantial portion of the visual field. Moreover, the use of elements which increase subjective

What is the mechanism through which such architectural monitoring could have taken place? Two pathways can be distinguished. A first one is directly related to the finding that priming individuals with religious concepts (e.g., "divine") makes them more inclined to conform to prosocial norms, and to behave and act more prosocially towards other members of their social group (that could also imply behaving non-socially toward out-group members) (see: Preston, Ritter & Hernandez, 2010; cfr., Shariff & Norenzayan, 2007; Saroglou, Corneille & Van Cappellen, 2009; Pichon, Boccato & Saroglou, 2007). Recent research confirms that similar prosocial effects can occur when religious *buildings* are employed as primes, rather than religious concepts (cfr., Atran & Henrich, 2010). Specifically, Pichon and Saroglou (2009) found that when religiousness is primed by a church, people express to be more willing to help the homeless than when they are primed with a non-religious building (i.e., a gymnasium). Meier and colleagues (2007) also found that vertical space and upward position – both of which are typical to RMA – activate divinity-related cognitions, which, in turn, might make particular (pro)social norms salient.

A second possible pathway underlying monumental monitoring is that spectators actually associate, or attribute supernatural social agency to the monumental structure. This may make commoners feel as if being watched or monitored, thereby stimulating them to act and behave prosocially. This claim is in line with evidence showing that the presence of (minimal) social cues (e.g., eye-spots) makes individuals behave more generously in economic games (Haley & Fessler, 2005) and more willing to donate to a good cause (Bateson, Nettle & Roberts, 2006). Note that, consistent with this view, in different religions religious monumental buildings are assumed to be the dwelling places of supernatural beings. For example, the Egyptian word for temple – *hwt-nṯr* – literally means "god's House" (Trigger, 1993).

impressions of height and the use of adornments and decorations, suggest that such edifices were not only intended to monitor commoners, but also to appear attractive to them.

669 Belief in the presence of divine agency in RMA could, of course, merely be an article of faith
670 shared by many religions, which followers acquire after having become acquainted with the religious
671 doctrine. However, it is also possible that attributing (supernatural) agency to monumental edifices is
672 partially independent from the particular teachings of a doctrine. Being an intentionally made
673 structure, RMA might already activate cortical networks that lead to mental state attributions, even if
674 the monumental structure does not contain any direct cues of social agency (Steinbeis & Koelsch,
675 2009). Those ascriptions of agency might get flavored with supernaturalness as a way to make the
676 structure's mind-boggling grandeur and complexity more intelligible (cfr., Bloom, 2007).

677 Note that monumental buildings can also contain, or be accompanied by visual
678 features/elements that make spectators inclined to (implicitly) ascribe agency to RMA. Some cases of
679 religious (monumental) architecture are, for example, adorned with human-like figures or are
680 "guarded" by monumental statues (e.g., the *Sphinx* at Giza), while others contain eye-like schemas,
681 such as, Imre Makovecz's church in Siófok or the stupa of the Swayambhunath buddhist temple in
682 Kathmandu. Some (monumental) buildings from the Classic Mayan period are even adorned with
683 breathing imagery, suggesting that these constructions were in a sense "alive" (Saturno, Taube, Stuart
684 & Hurst, 2005). Given the finding that vertical upward motion is associated with animacy (Szego &
685 Rutherford, 2008), the upward movement embodied in many instances of RMA can also be a trigger
686 of perceptions of agency.

687 The view that RMA has regularly been imbued with (supernatural) agency can perhaps
688 expand one's understanding of why such type of building has also been a perennial target for
689 destructive acts and why that destruction was often followed by extremely violent retaliations. Within
690 religious doctrines, the installment of new religious leaders often went hand in hand with cycles of
691 demolishing and rebuilding RMA (sometimes even taking on ritual forms), which has been

692 interpreted as a way of these (religious) elites to legitimize their newly obtained leadership, to cut
693 commoners' ties with previous rulers and to create and strengthen new attachments. However, it is
694 also very common for RMA to be attacked by external groups, belonging to rival ideologies and
695 religions[5]. Consider for example the Taliban's dynamiting of the *Buddha's of Bamyam* (2001,
696 Afghanistan) or the demolition of the *Babri Mosque* (1992, India) by Hindus. Of course, as being
697 conspicuous religious symbols, cases of RMA might just be the "easiest" and most visible targets to
698 eliminate. However, inasmuch as RMA is truly a materialization of supernatural agency, then
699 destroying such buildings might be considered as an attempt to almost literally "kill" a religion's
700 (supernatural) agents, and one of the most powerful (psychological) ways to try to wipe out the rival
701 religious/ideological doctrine. Annihilating these monumental monitors may make followers to feel
702 as being deserted by their deities, leading to widespread despair and vulnerability.

703 The fact that especially *high* monumental buildings are perceived as signaling devices of
704 religious or ideological dominance is illustrated by the 9/11 attacks on the *World Trade Center*
705 (WTC) towers in New York. First, there is the remarkable fact that destroying the extraordinarily
706 high towers of the WTC imposed such psychological distress on Americans, whereas they did not
707 seem nearly as upset by the big hole blown in the horizontally-expansive Pentagon – and perhaps
708 they would not have, even if the Pentagon had been utterly destroyed. Second, the *Twin Towers* were
709 perceived as quasi-religious monuments, both by attackers and the attacked. For example, Osama bin
710 Laden declared that the attacks on the WTC were acts in a Muslim "holy war", i.e., a religious war
711 against the United States of America. Some American Christians, from their part, still tried to see
712 traces of their god's presence in the remains of the buildings after the attacks. Specifically, the steel
713 beams shaped like a cross which were discovered in the aftermath of the 9/11 attacks by a worker

[5] The destruction of competitors' conspicuous signaling devices is not limited to the human species. The analogy we previously drew with bower construction applies here as well: in some bowerbird species males destroy bowers of competitors (Borgia 1985; Borgia & Müller 1992).

from the rubble at Ground Zero (New York) were seen as "a sign that God never abandoned us at Ground Zero" (Reuters, 2011).

3. RMA builds religious beliefs by exploiting awe

Up to now, we have said little to nothing about the beliefs which permeate religious communities. In the cognitive science of religion, religious beliefs are often considered to be beliefs in supernatural agents. One influential view is that belief in such agents is similar to attributing intentional agency to simple geometric shapes moving on a screen (Heider & Simmel, 1944), both of which are little more than misapplications of mental modules for detecting agency (Barrett, 2000; Atran & Norenzayan, 2004). In the ensuing sections we explore how feelings of awe, triggered by RMA, might have influenced and interacted with the process of adopting supernatural beliefs. In the first section we argue that RMA can create ideological/religious openness in followers, whereas the second section discusses how, as being a signal of religious commitment, such architecture can further support the process of religious belief adoption. Notice that the community perspective still constitutes the backdrop of this exploration. That is, belief commitment is deemed to actually support or reinforce the social function of religions (for a discussion, see, e.g., Atran & Henrich, 2010).

3.1. Religious monumental architecture creates ideological openness

Keltner and Haidt (2003) conjecture that feeling awe can foster (religious) belief adoption and/or ideological transformation. Research by Shiota and colleagues (2007) supports this claim by showing that individuals with a high disposition to experience awe are indeed more willing to revise their mental structures, or to admit their inadequacy, compared to individuals who have a high disposition for other positive emotions (i.e., dispositional pride and joy). The impact of experiencing awe on

spirituality and religious openness has been directly investigated in a few experiments. A qualitative ethnographic study among wildlife tourists by Curtin (2009), for example, reveals that experiencing awe and wonderment, caused by watching wildlife, sparks spiritual feelings in participants. Research by Saroglou and colleagues (2008) points out that respondents score higher on spirituality measures after having watched an awe-eliciting video (e.g., involving nature scenery, among others) rather than a comedy, or an emotionally neutral video. When recalling an event filled with awe, religious/spiritual people are also more inclined to undertake a journey to a spiritual destination (i.e., Tibet) than to a hedonic destination (i.e., Haiti) as opposed to respondents recalling an event triggering pride (Van Cappellen & Saroglou, 2012).

If, as the foregoing findings seem to suggest, awe can indeed foster ideological/religious openness, then RMA can be interpreted as an artful device to make the minds of potential followers more open to the religious beliefs that are preached in, or associated with such religious contexts. This ideological/religious openness might subsequently make (potential) followers to actually take up particular supernatural, and hence, inherently counterintuitive concepts, beliefs or narratives. Note that this effect was clearly exploited in reformation Europe (among others). As Brown (2004) documents, during that epoch the papal patrons appointed artistic geniuses like Bernini and Michelangelo to create awesome architectural spaces, such as the *Saint Peters Cathedral* in Rome, in an attempt to further propagate the faith.

What is the possible mechanism through which cases of awe-provoking RMA might promote ideological/religious openness? Probably, this relates to the fact that when experiencing awe one's available mental frameworks prove to be inadequate for fully grasping the object or event that triggers awe (Keltner & Haidt, 2003). Due to a compensatory need to update or revise those frameworks, individuals might become more willing to embrace new or alternative

beliefs/frameworks that enable them to surmount this mental inadequacy (Shiota et al., 2007; Kay et al., 2010). At the same time, this cognitive inadequacy is caused by structures that transcend the scale and complexity of common built accomplishments to the highest degree. This probably makes people more open to invoke *supernatural* beliefs into the process of cognitive accommodation, or tips them into believing that the building cannot be other than the work of the god(s) (Bloom, 2007), as compared to smaller, hence, non-awe provoking religious buildings.

3.2. Religious monumental architecture illustrates belief commitment

The picture emerging from the previous section is that cases of awe-inducing RMA can instill ideological openness in religious followers. Of course, the transition from being open to a set of religious beliefs to actually adopting those particular beliefs depends on many factors. For example, when individuals have experienced awe, they appear to process messages more deeply rather than heuristically, with the result that weak propositions are considered as substantially weaker than when they have experienced other positive emotions (e.g., amusement) (Griskevicius, Shiota & Neufeld, 2010). The implication is that while awesome RMA might foster openness to religious beliefs, only those beliefs that are backed up by sufficiently "strong arguments" will be favored and retained. There are probably a number of "context biases" that mediate the relationship between ideological openness and actual belief adoption. For example, given the influence of prestige signals on social learning (Richerson & Boyd, 2005), beliefs that are endorsed by prestigious individuals have more chance of being retained by learners than those that do not have such endorsement.

While we do not have the intention to provide an exhaustive review of possible mediating factors, we would like to touch upon one potential characteristic – often intrinsic to RMA – that can facilitate the transition from ideological openness to actual religious belief adoption. Following

Henrich (2009), religious monumental buildings can be interpreted as illustrating the principle of "actions speak louder than words" (Gervais & Henrich, 2010; Atran & Henrich, 2010). Specifically, Henrich (2009) argues that learners should be more willing to overtake beliefs from religious models (e.g., priests) who support their (supernatural) beliefs with acts or behavior that demonstrate that they are actually committed to those beliefs, than from models who just verbally or symbolically express those beliefs. Individuals will, for example, be more inclined to take over a prestigious individual's belief in altruism when (s)he backs this belief up by donating money to a good cause, rather than when (s)he merely preaches that belief.

While specific religious practices (e.g., ritual bloodletting) are often considered as key examples of such "credibility enhancing displays" (CREDs) (Henrich, 2009), constructing monumental architecture might be another way to demonstrate religious belief commitment (cfr., Atran & Henrich, 2010). Religious leaders/institutions, but also members of the general population who physically or financially contributed to constructing such edifices (e.g., through taxation) illustrated by this toward potential followers or fellow-followers that they were actually committed to particular supernatural beliefs. Therefore, belief structures which are backed up by monumental building achievements had more chance of being overtaken from models than beliefs which are not, or to a lesser degree supported by such accomplishments. When RMA not only produced ideological openness through awe (see section 3.1), but at the same time also represented a reliable signal of commitment to those ideas, then this might have been the kind of "strong argument" (cfr., Griskevicius et al., 2010) that could further stabilize or "fix" religious beliefs in the minds of followers, which ultimately contributed to religious steadfastness. In other words, when an awe-evoking instance of RMA also was a CRED, then this might have bolstered actual adoption of, and commitment to the associated supernatural beliefs. Thus, in addition to the fact that creating height in

RMA was costly due to constructional/technical limitations (see section 1.2.4), the foregoing argument suggests that costliness might also be required for strengthening belief commitment.

4. Religious monumental architecture as context for religious activities and rituals

Up until now we have mainly considered RMA as an isolated phenomenon. It needs to be noted, however, that the emotional impact of these religious structures also depends on, and interacts with the specific activities that are/were performed in or near them. Specifically, rather than standing on its own, this type of architecture should be viewed as being part and parcel of, and supporting the ritual component of religious doctrines (De Marrais et al., 1996). But how should this cross-fertilization between rituals and RMA be conceived? On the one hand, the emotional impact of a monumental religious building might have been further intensified or colored by the fact that such edifices regularly were the stage of rituals or ritualistic activities, and were an intrinsic part of a network of religious beliefs (Alcorta & Sosis, 2005). Such "supplementary" emotional charging might have been particularly important when, after repeated exposure, habituation to RMA would kick in, diminishing the intensity of the original awe response.

On the other hand, by causing awe, RMA might also have emotionally charged particular religious (ritual) activities, beliefs or narratives. For example, due to conditioned association, beliefs voiced in or near monumental religious contexts could have become further emotionally loaded and sanctified, reinforcing their regulative and coordinative function (Alcorta & Sosis, 2005). Research furthermore indicates that beliefs or messages that are arousing (Berger, 2011), or that trigger strong emotions, such as disgust (Nichols, 2006; Heath, Bell & Sternberg, 2001), awe (Berger & Milkman, 2011) or surprise (Derbaix & Vanhamme, 2003), have a mnemonic advantage over beliefs/norms that have less emotional salience. Together, these findings suggest that, in as much as beliefs or religious

messages can be embodied in, or communicated by the overall building, beliefs exemplified in awe-evoking RMA will have had a mnemonic, and hence, transmission advantage over beliefs exemplified in more mundane religious structures.

In addition, by providing a physical context for performing or attending rituals, such emotionally arresting environments might have made that the rituals or religious happenings, and the specific messages/beliefs implied in those, became more firmly anchored in the minds of participants. For example, as certain rituals functioned to initiate or reinforce belief commitment, awe-evoking contexts will have further emotionally colored such happenings, and in so doing, contributed to making such episodes more memorable. This is nicely illustrated in one of the key-scenes of the film *Apocalypto* (2006, Mel Gibson), where the powerful emotional impact of Mayan ritual human killings is amplified by the fact that these take place on top of monumental pyramids. Such dramatic monumental backgrounds probably made it more likely that followers "kept the faith" and increased the chances that such beliefs became transmitted in the religious community. Monumental architecture thus seems to be part and parcel of what Whitehouse coins the "imagistic" component of religious systems (Whitehouse, 2004). In this mode, remembering religious beliefs and vows does not so much depend on repeated learning of central aspects of the doctrine (i.e., the "doctrinal" component), but it rather follows from partaking in highly arousing events.

Finally, notice that in our view, RMA is – initially – not emotionally neutral, as opposed to, for example, water which has been turned into *holy* water during ritual practices (Alcorta & Sosis, 2005). Such edifices rather seem to play on pre-existing, and possibly pre-wired emotional/aesthetic sensitivities (e.g., sensitivity to bigness). A concern might be that our argument was mainly built around two "structural" features of awe (i.e., vastness, cognitive inadequacy) (cfr., Keltner & Haidt, 2003), but remained largely silent about the specific emotional valence of awe-evoking instances of

RMA. In recent discussions awe is commonly considered as a positive emotion (cfr., Griskevicius et al., 2010). However, in as much as this emotion, and the elements which are able to trigger it, encompass mental inadequacy or insignificance, awe can also have some negative loading. In addition, and as already mentioned in section 2.1, RMA can exhibit characteristics, unrelated to the two central features of awe, which further emotionally "flavor" the experience of the awe-provoking structure, in positive as well in negative ways. This might, in turn, amplify some of the proposed effects of RMA. For example, the dark and shadowy interior of a particular instance of RMA can flavor the experience of awe with fear (Keltner & Haidt, 2003), through which potential freeloaders might become more strongly motivated to behave prosocially compared to RMA that has no such flavoring (Alcorta & Sosis, 2005).

5. Discussion

In this paper we attempted to demonstrate that a Darwinian approach can shed light on (some of) the evolved functions of architecture, and of religious monumental architecture in particular. We started our argument with a discussion of Trigger (1990) and Neiman's (1998) account of monumental architecture, according to which the costliness of such building accomplishments signals the competitive ability of their elite builders. Our dual account of RMA extends Neiman's costly signaling account in three respects. First, in addition to costly signaling theory, we invoked sensory exploitation theory to more fully explain particular formal characteristics of RMA. Specifically, in RMA there is a perennial tendency to express costliness/wastefulness through height, and we interpreted this as a way of RMA to exploit the adaptive tendency to associate height and size with power and dominance (i.e. "sensitivity to bigness"). Second, we challenged the view that RMA's evolved function can solely be grasped from the perspective of sexual selection (cfr., Neiman, 1998).

Rather than signaling the "good genes" of their builders, such buildings can also be interpreted as prestige signals that, once picked up by social learners, galvanize cultural evolution. Third, our framework extends common accounts of RMA in that it gives center stage to the emotional impact of RMA. In particular, the emotion of "awe" was considered as one of the most typical emotional responses to the two different types of vastness inherent in RMA i.e., vastness in size and vastness in effort.

Once the theoretical structure of our model was spelled out, we argued that RMA – being understood as a (culturally) evolved device for inducing awe – served four interrelated functions in religious communities: to contribute to vertical stratification; to facilitate bonding between religious community members; to monitor religious/social life across time and space; and to create ideological/religious openness in the religious population. Notice that it is very probable that (some of) these hypothesized functions of RMA are also being exploited in secular contexts by monumental non-religious built structures, such as corporate skyscrapers, government buildings, courthouses, banks, sports stadia, airports, railway stations, statues or even virtual constructions in video games.

In this paper, religion was considered as a culturally evolved device that help(ed) creating, regulating and enacting (large-scale) community living. Our purpose was to look at how far we could understand the physical appearance, as well as the wasteful processes underlying instances of RMA, from that social perspective. We want to stress, however, that besides this social function, RMA might have had, or obtained functions which are largely unrelated to that community perspective. Building a massive religious edifice provided an occasion for many parties to gain a little more money, prestige, and glory for themselves, regardless of the monumental building's religious content and symbolism. For example, in the context of medieval cathedral building the apprentice stone-mason promoted to master mason might have attracted a mate, impressed by his wonderful gargoyles

or flying buttress details. The head priest of the religious monumental building might consider the structure not only as a way to strengthen community solidarity, but also as a means to increase his own prestige, and his influence and authority over commoners.

Our exploration of the social function of RMA was situated at intersection of religious doctrines and the religious communities associated with them. It must be clear however that instances of RMA are at the nexus of very complex, shifting, multi-generational networks of people, families, groups, (rival) ideologies, each trying to nudge the benefits of RMA in their own favor. With its focus on the group level our paper has mapped only a fraction of that complexity. We hope that future research will further unravel the possible (evolved) functions of RMA obtained for these other stakeholders.

It is furthermore very much possible that the community function of RMA sometimes conflicted with other (individual and group) levels and interests. For example, religious/ideological leaders might have tried to increase their own prestige and that of their communities by pushing for ever bigger monumental buildings, which were however beyond what the population could bear in terms of taxation and labor. Not only might this have made followers turn against their leaders, when there were insufficient monetary or physical resources to complete the monumental building it might become a source of (ingroup and outgroup) ridicule and embarrassment, rather than a source of communal pride and bonding. The still unfinished, and 330 meter high *Ryugyong Hotel* in North Korea, whose building started during the Cold War, is perhaps one striking example of monumental architecture gone awry.

The research that was presented in this paper can be viewed as being part and parcel of a broader research agenda that tries to map out why human minds generate religious beliefs. How do we construct such beliefs, why do we accept them, how do we spread them, and how can they cause

otherwise rational human beings to be murderous in the name of supernatural agents? Against this particular research background, we hope that our exploration of the (culturally) evolved functions of RMA provides an addition to the field of religious studies. We are furthermore confident that our argument also illustrates that an evolutionary approach to architecture can offer valuable insights into the emergence, persistence and occurrence of particular types of architecture.

References

Alcorta, C., & Sosis, R. (2005). Ritual, emotion, and sacred symbols: The evolution of religion as an adaptive complex. *Human Nature, 16*, 323-359.

Aranyosi, E.F. (1999). Wasteful Advertising and Variance Reduction: Darwinian Models for the Significance of Nonutilitarian Architecture. *Journal of Anthropological Archaeology, 18*, 356-375.

Armstrong, T., & Detweiler-Bedell, B. (2008). Beauty as an Emotion: The Exhilarating Prospect of Mastering a Challenging World. *Review of General Psychology, 12*, 305-329.

Arnqvist, G. (2006). Sensory exploitation and sexual conflict. *Philosophical Transactions of the Royal Society of London - Series B, 361*, 375-386.

Atran, S., & Henrich, J. (2010). The Evolution of Religion: How Cognitive By-Products, Adaptive Learning Heuristics, Ritual Displays, and Group Competition Generate Deep Commitments to Prosocial Religions. *Biological Theory, 5*, 18–30.

Atran, S., & Norenzayan, A. (2004). Religion's evolutionary landscape: Counterintuition, commitment, compassion, communion. *Behavioral and Brain Sciences, 27*, 713-770.

Barrett, H. C. (2005). Adaptations to predators and prey. In D. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 200 –223). Hoboken, NJ: Wiley.

944 Barrett, J.L. (2000). Exploring the natural foundations of religion. *Trends in Cognitive Sciences, 4*,
945 29–34.
946 Bateson, M., Nettle, D., & Roberts, G. (2006). Cues of being watched enhance cooperation in a real-
947 world setting. *Biology Letters, 3*, 412-4.
948 Berger, J. (2011). Arousal Increases Social Transmission of Information. *Psychological Science, 22*,
949 891-893.
950 Berger, J., & Milkman, K. (2011). Social Transmission, Emotion, and the Virality of Online Content.
951 *Wharton School Working Paper*. Retrieved on July 20, 2012 from:
952 http://marketing.wharton.upenn.edu/documents/research/virality.pdf
953 Bloom, P. (2007). Religion is natural. *Developmental Science, 10*, 147-151.
954 Borgia, G. (1985). Bower destruction and sexual competition in the satin bowerbird (*Ptilonorhynchus*
955 *violaceus*). *Behavioral Ecology And Sociobiology, 18*, 91-100.
956 Borgia, G., & Müller, U. (1992). Bower Destruction, Decoration Stealing and Female Choice in the
957 Spotted Bowerbird (*Chlamydera maculata*). *Emu*, *92*, 11 - 18
958 Brown, R.E. (2004). The propagation of awe: public relations, art and belief in Reformation Europe.
959 *Public Relations Review, 30*, 381-9.
960 Carney, D.R., Cuddy, A.J.C., & Yap, A.J. (2010). Power posing: Brief nonverbal displays affect
961 neuroendocrine levels and risk tolerance. *Psychological Science, 21*, 1363–1368.
962 Coss, R. G. (2003). The role of evolved perceptual biases in art and design. In E. Voland & K.
963 Grammer (Eds.), *Evolutionary Aesthetics* (pp. 69-130). Heidelberg: Springer-Verlag.
964 Curtin, S. (2009). Wildlife tourism: the intangible, psychological benefits of human-wildlife
965 encounters. *Current Issues in Tourism, 12*, 451-474.

De Marrais, E., Castillo, L.J., & Earle, T. (1996). Ideology, Materialization, and Power Strategies. *Current Anthropology, 37*, 15-31.

De Waal, F.B.M. (1982). *Chimpanzee politics: Power and sex among apes*. London: Jonathan Cape.

Derbaix, C., & Van Hamme, J. (2003). Inducing word-of-mouth by eliciting surprise – a pilot investigation. *Journal of Economic Psychology, 24*, 99-116.

Durkheim, E. (1915). *The elementary forms of the religious life*. New York: Free Press.

Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion, 6*, 169-200.

Endler, J.A. (1992). Signals, Signal Conditions, and the Direction of Evolution. *The American Naturalist, 139*, 125-153.

Endler, J.A., Endler, L.A., & Doerr, N.R. (2010). Great bowerbirds create theaters with forced perspective when seen by their audience. *Current Biology, 20*, 1679–1684.

Estabrook, C.B. (2002). Ritual, Space, and Authority in Seventeenth-Century English Cathedral Cities. *Journal of Interdisciplinary History, 32*, 593-620.

Fennis, B.M. (2008). Branded into submission: Bran attributes and hierarchisation behavior in same-sex and mixed-sex dyads. *Journal of Applied Social Psychology, 38*, 1993-2009.

Fiske, A.P. (1992). The four elementary forms of sociality: Framework for a unified theory of social relations. *Psychological Review, 99*, 689–723.

Francis, L.J., Williams, E., Annis, J., & Robbins, M. (2008). Understanding Cathedral visitors: Psychological type and individual differences in experience and appreciation. *Tourism Analysis, 13*, 71-80.

Frijda, N.H., & Parrott, W.G. (2011). Basic Emotions or Ur-Emotions? *Emotion Review, 3*, 406-415.

Fuller, R.C., Houle, D., & Travis J. (2005). Sensory Bias as an Explanation for the Evolution of Mate Preferences. *American Naturalist, 166*, 437-446.

Gagnon, S.A., Brunyé, T.T., Robin, C., Mahoney, C.R., & Taylor, H.A. (2011). High and Mighty: Implicit Associations between Space and Social Status. *Frontiers in Psychology, 2*, article 259.

Gervais, W., & Henrich, J. (2010). The Zeus Problem: Why Representational Content Biases Cannot Explain Faith in Gods. *Journal of Cognition and Culture, 10*, 383-389.

Giessner, S.R., & Schubert, T.W. (2007). High in the hierarchy: How vertical location and judgments of leaders' power are interrelated. *Organizational Behavior and Human Decision Processes, 104*, 30-44.

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

Graham, J., & Haidt, J. (2010). Beyond beliefs: Religions bind individuals into moral communities. *Personality and Social Psychology Review, 14*, 140–150.

Griskevicius, V., Shiota, M.N., & Neufeld, S.L. (2010). Influence of Different Positive Emotions on Persuasion Processing: A Functional Evolutionary Approach. *Emotion, 10*, 190–206.

Haidt, J., & Algoe, S. (2004). Moral amplification and the emotions that attach us to saints and demons. In J. Greenberg, S.L. Koole & T. Pyszczynski (Eds.), *Handbook of Experimental Existential Psychology* (pp. 322-335). New York: Guilford.

Haidt, J., & Keltner, D. (1999). Culture and facial expression: Open-ended methods find more expressions and a gradient of recognition. *Cognition and Emotion, 13*, 225-266.

Haidt, J., & Keltner, D. (2002). Awe/responsiveness to beauty and excellence. In C. Peterson & M.E.P. Seligman (Eds.), *The VIA Taxonomy of Strengths*. Valves in Action Institute, Cincinnati, OH.

Haley, K.J., & Fessler, D.M.T. (2005). Nobody's watching? Subtle cues affect generosity in an anonymous economic game. *Evolution and Human Behavior, 26*, 245-256.

1012 Heath, C., Bell, C., & Sternberg, E. (2001). Emotional selection in memes: the case of urban legends.
1013 *Journal of Personality and Social Psychology, 81,* 1028-41.
1014 Heider, R., & Simmel, M. (1944). An experimental study of apparent behavior. *American Journal of*
1015 *Psychology, 57*, 243–259.
1016 Hejmadi, A., Davidson, R., & Rozin, P. (2000). Exploring Hindu Indian Emotion Expressions:
1017 Evidence for Accurate Recognition by Americans and Indians. *Psychological Science, 11*,
1018 183-187.
1019 Henderson, M.D., & Wakslak, C.L. (2010). Over the Hills and Far Away: The Link Between
1020 Physical Distance and Abstraction. *Current Directions in Psychological Science, 19*, 390-394.
1021 Henrich, J. (2009). The evolution of costly displays, cooperation and religion: credibility enhancing
1022 displays and their implications for cultural evolution. *Evolution and Human Behavior, 30*,
1023 244–260.
1024 Henrich, J., & Gil-White, F.J. (2001). The evolution of prestige: Freely conferred status as a
1025 mechanism for enhancing the benefits of cultural transmission. *Evolution and Human*
1026 *Behavior, 22*, 165-196.
1027 Hersey, G. (1999). *The Monumental Impulse: Architecture's Biological Roots*. Cambridge
1028 Massachusetts: MIT Press.
1029 Huang, L., Galinsky, A.D., Gruenfeld, D.H., & Guillory, L.E. (2011). Powerful Postures Versus
1030 Powerful Roles: Which Is the Proximate Correlate of Thought and Behavior? *Psychological*
1031 *Science, 22*, 95-102.
1032 Huyssen, A. (1996). Monumental Seduction. *New German Critique, 69,* 181-200.
1033 Johansen, P.G. (2004). Landscape, monumental architecture, and ritual: a reconsideration of the
1034 South Indian ashmounds. *Journal of Anthropological Archaeology, 23*, 309-330.

Judge, T.A., & Cable, D.M. (2004). The effect of physical height on workplace success and income: Preliminary Test of a theoretical model. *Journal of Applied Psychology, 89*, 428-441.

Kay, A.C., Gaucher, D., McGregor, I., & Nash, K. (2010). Religious Belief as Compensatory Control. *Personality and Social Psychology Review, 14*, 37-48.

Keltner, D., & Haidt, J. (2003). Approaching awe, a moral, spiritual, and aesthetic emotion. *Cognition and Emotion, 17*, 297-314.

Kirschner, S., & Tomasello, M. (2010). Joint music making promotes prosocial behavior in 4-year-old children. *Evolution and Human Behavior, 31*, 354–364.

Kolb, M.J. (1994). Monumentality and the rise of religious authority in precontact Hawai'i social evolution. *Current Anthropology, 35*, 521-47.

Larson, C.L, Aronoff, J., Sarinopoulos, I.C., & Zhu, D.C. (2009). Recognizing threat: Simple geometric shapes activate neural circuitry underlying threat detection. *Journal of Cognitive Neuroscience, 21*, 1523-1525.

Marigold, D.C., McGregor, I., & Zanna, M.P. (2009). Defensive conviction as emotion regulation: Goal mechanisms and interpersonal implications. In R.M. Arkin, K.C. Oleson & P.J. Carroll (Eds.), *Handbook of the uncertain self* (pp. 232-248). New York: Psychology Press.

Marsh, A.A., Henry, H.Y., Schechter, J.C., & Blair, R.J.R. (2009). Larger than life: Humans' nonverbal status cues alter perceived size. *Public Library of Science, ONE, 4*, e5707.

Meier, B.P., Hauser, D.J., Robinson, M.D., Friesen, C.K., & Schjeldahl, K. (2007). What's "up" with God? Vertical space as a representation of the divine. *Journal of Personality and Social Psychology, 93*, 699–710.

Meyers-Levy, J., & Zhu, R. (2007). The Influence of Ceiling Height: The Effect of Priming on the Type of Processing People Use. *Journal of Consumer Research, 34*, 174–86.

Mignault, A., & Chauduri, A. (2003). The many faces of a neutral face: head tilt and perception of dominance and emotion. *Journal of Nonverbal Behavior, 27*, 111–132.

Milgram, S. (1963). Behavioral Study of Obedience. *Journal of Abnormal and Social Psychology, 67*, 371–378.

Miller, G. (2000). *The mating mind*. New York: Penguin.

Moeller, S.K., Robinson, M.D., & Zabelina, D.L. (2008). Personality dominance and preferential use of the vertical dimension of space: Evidence from spatial attention paradigms. *Psychological Science, 19*, 355-361.

Neiman, F. (1998). Conspicuous consumption as wasteful advertising: A Darwinian perspective on spatial patterns in Classic Maya terminal monument dates. In C.M. Barton & G.A. Clark (Eds.), *Rediscovering Darwin: Evolutionary theory in archaeological explanation* (pp. 267–290). Arlington: American Anthropological Association.

Nichols, S. (2002). On the genealogy of norms: A case for the role of emotion in cultural evolution. *Philosophy of Science, 69*, 234–255.

Nova (2012). *Building the great cathedrals*. Retrieved on July 19, 2012 from: http://www.pbs.org/wgbh/nova/ancient/building-gothic-cathedrals.html

Pichon, I., Boccato, G., & Saroglou, V. (2007). Nonconscious influences of religion on prosociality: A priming study. *European Journal of Social Psychology, 37*, 1032–1045.

Pichon, I., & Saroglou, V. (2009). Religion and helping: Impact of target thinking styles and just-world beliefs. *Archive for the Psychology of Religion, 31*, 215–236.

Preston, J.L., Ritter, R.S., & Hernandez, J.I. (2010). Principles of religious prosociality: A review and reformulation. *Social and Personality Psychology Compass, 4*, 574–590.

Reuters (2011). *Steel girders shaped like cross headed back to Ground Zero*. Retrieved on July 20, 2012 from: http://www.reuters.com/article/2011/07/18/us-sept11-museum-cross-idUSTRE76H5ZG20110718.

Richerson, P.J., & Boyd, R. (2005). *Not By Genes Alone: How Culture Transformed Human Evolution*. Chicago: University of Chicago Press.

Rodd, F.H., Hughes, K.A., Grether, G.F., & Baril, C.T. (2002). A possible non-sexual origin of mate preference: are male guppies mimicking fruit? *Proceedings of the Royal Society of London B, 269*, 475–481.

Rodriguez, R.L., & Snedden, W. (2004). On the functional design of mate preferences and receiver biases. *Animal Behaviour, 68*, 427-432.

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

Rucker, D., & Galinsky, A.D. (2008). Desire to Acquire: Powerlessness and Compensatory Consumption. *Journal of Consumer Research, 35*, 257–267.

Rudd, M., Vohs, K.D., & Aaker, J. (2012). Awe Expands People's Perception of Time, Alters Decision Making, and Enhances Well-Being. *Psychological Science*, forthcoming.

Ryan, M.J. (1998). Sexual Selection, Receiver Biases, and the Evolution of Sex Differences. *Science, 281*, 1999-2003.

Saroglou, V., Buxant, C., & Tilquin, J. (2008). Positive emotions as leading to religion and spirituality. *Journal of Positive Psychology, 3*, 165-173.

Saroglou, V., Corneille, O., & Van Cappellen, P. (2009). "Speak, Lord, your servant is listening": Religious priming activates submissive thoughts and behaviors. *International Journal of the Psychology of Religion, 19*, 143–154.

Saturno, W.A., Taube, K.A., Stuart, D., & Hurst, H. (2005). The Murals of San Bartolo, El Petén, Guatemala, Part 1: The North Wall. *Ancient America, 7*.

Sergio, F., Blas, J., Blanco, G., Tanferna, A., López, L., Lemus, J.A., & Hiraldo, F. (2011). Raptor nest decorations are a reliable threat against conspecifics. *Science, 331,* 327-330.

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

Schubert, T. (2005). Your Highness: Vertical positions as perceptual symbols of power. *Journal of Personality and Social Psychology, 89,* 1-21.

Schubert, T.W., Waldzus, S., & Giessner, S.R. (2009). Control over the association of power and size. *Social Cognition, 27,* 1-19.

Schwartz, B., Tesser, A., & Powell, E. (1982). Dominance cues in non-verbal behavior. *Social Psychology Quarterly, 45,* 114-120.

Shiota, M., Keltner, D., & Mossman, A. (2007). The Nature of Awe: Elicitors, Appraisals, and Effects on Self-Concept. *Cognition and Emotion, 21,* 944-963.

Stamps, A. (2005). Visual permeability, locomotive permeability, safety and enclosure. *Environment and Behavior, 37,* 587-619.

Steinbeis, N., & Koelsch, S. (2009). Understanding the intentions behind man-made products elicits neural activity in areas dedicated to mental state attribution. *Cerebral Cortex, 19,* 619-623.

Szego, P.A., & Rutherford, M.D. (2008). Dissociating the perception of speed and the perception of animacy: a functional approach. *Evolution & Human Behavior, 29,* 335-342.

Thomsen, L., Frankenhuis, W.E., Ingold-Smith, M., & Carey, S. (2011). Big and mighty: Preverbal infants mentally represent social dominance. *Science, 331,* 477-480.

Tiedens, L.Z., & Fragale, A.R. (2003). Power moves: Complementarity in dominant and submissive nonverbal behavior. *Journal of Personality and Social Psychology, 84*, 558–568.

Tinbergen, N. (1951). *The Study of Instinct*. Oxford: Oxford University Press.

Trigger, B.G. (1990). Monumental architecture: a thermodynamic explanation of symbolic behaviour. *World Archaeology, 22*, 119-32.

Trigger, B.G. (1993). *Early Civilizations: Ancient Egypt in Context*. Cairo: American University in Cairo Press.

Van Cappellen, P., & Saroglou, V. (2012). Awe activates religious and spiritual feelings and behavioral intentions. *Psychology of Religion and Spirituality*. Forthcoming.

Whitehouse, H. (2004). *Modes of religiosity: A cognitive theory of religious transmission*. Lanham, MD: Rowman & Littlefield.

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

Wilson, D.S. (2002). *Darwin's cathedral: evolution, religion and the nature of society*. Chicago: University of Chicago Press.

Zahavi, A. (1975). Mate selection - a selection for a handicap. *Journal of Theoretical Biology, 53*, 205-214.

Zanolie, K., van Dantzig, S., Boot, I., Wijnen, J., Schubert, T.W., Giessner, S.R., & Pecher, D. (2012). Mighty metaphors: Behavioral and ERP evidence that power shifts attention on a vertical dimension. *Brain and Cognition, 78*, 50-58.