Explaining order in religious systems[1]

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Abstract

Ours is a problem of order, cognitive and cultural. Were religion simply chaotic, we would not recognize it as an object of study. In this article, I outline two complementary approaches to religious phenomena; both aim to explain different aspects of order in religion. First, recently-developed cognitive theories of religious phenomena account for some aspects of cultural order in terms of cognitive constraints. Second, complexity theory offers hypotheses about the emergent dynamics of entire religious systems. Before examining these theories themselves, however, I will explain in more detail the problem of order and the place of these theories in explaining it.

1. Reduction and emergence

"Reductionist," in the humanities these days, is a very bad name, rather like "racist" or "sexist". This results partly from a misunderstanding of reduction and a neglect of the related phenomenon of emergence.

Reduction is the discovery that a particular theory is so powerful that it will do the explanatory work of another theory in addition to its own. Although the specific requirements for the establishment of this discovery are the subject of some debate, the general question is whether or not the theory being replaced produces any understanding which the replacing theory does not. If it does not, the extraneous theory is removed from its responsibilities. This, however, does not mean that it is laid off.

One new job the replaced theory may be given is the characterization of emergent phenomena. Complex systems sometimes generate overall system behaviours which display an order not fully explicable in terms of their parts. A common example of an emergent phenomenon is the beautiful crystalline

shape of a snowflake, which is not determined by any of its parts, but emerges from the physical system as a whole. Our thoughts and moods provide another example: arising from complex chemical and electrical systems in our brains, they probably are not reducible to any given chemical or electrical state. Emergent organization is ubiquitous in the natural world and, I will argue, in culture, and specifically religion, as well.

Emergent organization,[2] however, is often difficult to characterize and even more difficult to explain. It tends to be nebulous, displaying an order we recognize but cannot adequately describe. Can we completely describe a particular thunderhead, pain, or dream? Faced with these difficulties, many scientists feel that instances of emergent organization can best be approached through the study of the underlying systems from which they arise. This approach is reductionistic, because it focuses on the underlying substrata, but recognizes the emergent properties as real and interesting phenomena in need of explanation.

Reduction is an important epistemic asset without which science would be considerably impoverished. Economy of explanation gives science its epistemic integrity: the multiplication of theories to no explanatory advantage compromises the claim of science to epistemic priority over other forms of knowledge. The company that pointlessly increases its overhead loses stockholders.

2. Religious systems

Anyone who has studied different religions notices interesting similarities, similarities which are difficult to describe, but definitely present. Faced with these similarities, cultural relativism simply denies them: each culture must be understood "in its own terms", and similarities are only apparent. According to this argument, the concept "mother" is not really similar from culture to culture. Another response to similarity is the creation of *ad hoc* categories to describe the phenomena: people who gain a following through their charismatic personalities are "shamans", but not all shamans are alike because they have different "cultural contexts". Although this strategy does identify some recurrent features of religious systems, the features which actually recur are specified rather loosely and it tempts scholars to mistake the *identification* of recurrence for an *explanation* of it (the nominal fallacy). Recent advances in cognitive science and complexity theory enable us to go beyond these

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2. It matters little whether emergent properties are conceptualized in an ontological or organizational sense, because ontological concepts are themselves defined by their organizational role in the mental models in which they participate.

strategies to develop a richer and more powerful approach to the similarities between religious systems.

Before proceeding further, however, I must clarify my use of two terms: "religious model" and "religious system". "Religious models" are *cognitive* entities. Advances in cognitive psychology enable us to say a great deal about religious models. I will survey three cognitive theories of religious phenomena below. Religious models are mental models which include at least one superhuman agent and which are linked to a specific situation, in service to a specific goal, through perceptual categories. The perceptual categories are themselves determined by the model and the cognitive system supporting the model.

The goal toward which the model is employed is frequently computational. Computational systems are characterized by three important features: they are representational systems; they involve operations performed over those representations; and people care about what the entire system computes (Churchland – Sejnowski 1993: chapter 3). There can be no question that religious concepts such as "sin", "call to ministry", "jihad", and "riba" are computational tools employed by religious people (Christians and Muslims in this case) to mentally "compute" an explanation and evaluation of real-world events. If we are to understand the form, function, and dynamics of such computations, we must develop theoretical accounts of the concepts and operations involved. Of just such theories are the cognitive sciences made.

"Religious systems" emerge when these cognitive systems are socially connected. The complexity of the system increases as more and more cognitive systems are linked together socially. As the complexity of the socio-cognitive system increases, it is able to support more phenomena. Group performance, communication, and evolutionary dynamics emerge from socio-cognitive systems. Although I readily concede that a religious system can emerge from a single cognitive system, the religious system that does so is considerably impoverished in comparison to religious systems that emerge from *socio*-cognitive systems, for reasons I will examine below.

It is remarkable that some sort of order naturally emerges from the societal conglomeration of people. It is even more remarkable that relatively few similar types of order recur in many different social systems. Some explanation of this phenomenon is definitely in order, but psychology cannot do the entire trick here, though it will take us part of the way. The human mind certainly has universal properties and these will be reflected in the structure of religion. These universals, however, quickly will be exhausted. When they are, the order apparent in religion still will be insufficiently explained.

One of the reasons why this is true is the plasticity of the human mind; it learns and therefore is engaged in *co-evolutionary* relationships with religious systems, other cultural systems, and the world itself. We humans

change the world and are ourselves changed in turn. This type of relationship was established when Michelangelo painted the ceiling of the Sistine Chapel, impressing future generations with God's grandiose plan in history; when Muhammad cleaned out the Ka'ba, ensuring that worship at the Ka'ba could never again be interpreted as the worship of tribal deities; and when I jotted myself a reminder, intending that car repairs come to my attention later. The establishment or production of symbols, and their later effect on people, are co-evolutionary relationships fundamental to religion. Overall, these relationships form a complex system with regular dynamics leading to emergent order.

Fortunately, scholars of religion are not unique in facing this problem of emergent order. Economists, physicists, biologists, mathematicians, chemists, and anthropologists are all faced with the same problem. Following a series of theoretical developments in these fields, it appears that definite, general features characterize complex dynamical systems. The study of such systems is the domain of complexity theory, a new field which developed out of the study of chaos and which is proving increasingly relevant to a number of fields. Scholars of religion stand to benefit from it as well.

Therefore, two complementary approaches are needed for the study of religion: a psychological approach, in which the object of study is individual religious thought and practice; and a systems theory approach, in which the object of study is the recurrence of certain types of order and certain holistic features of entire religious systems. I believe that recent developments in the cognitive sciences and in complexity theory give us a good start in both directions.

3. Cognitive theories of religious phenomena

E. Thomas Lawson and Robert N. McCauley (1990) have suggested that religious systems can best be approached through the study of their underlying substratum, human cognition. As indicated above, I agree with this reductionist strategy. Here I will survey three important cognitive theories of religious phenomena and suggest an interpretation of their significance.

3.1 Dan Sperber: Symbolism

The earliest cognitive theory of a religious phenomenon was a theory of symbolism. Dan Sperber (1975) argues against the pervasive semiotic view of symbolism. He demonstrates first that symbols do not have meaning in the linguistic sense of the term, because symbols do not admit of analyzability

or paraphrase. Nor do symbols have meaning in the information-theoretic sense: no code connects symbols to their meanings. Furthermore, structuralist analyses of symbolism, although interesting and useful, do not provide any account of what symbols mean.

Sperber's alternative theory is that symbolism is in the head, not the world. On Sperber's view, human knowledge may be functionally separated into two distinct types: encyclopedic knowledge (knowledge about the world) and semantic knowledge (knowledge about the extension of categories). Language draws on both of these types of knowledge and, in turn, provides the information by which they are modified. Symbolism, however, functions as a cognitive system independent of language because symbolic knowledge is unrelated to semantic knowledge and not integrated into encyclopedic knowledge.

Functionally, symbols may be understood as propositions in quotation marks, being cognitively represented in the form " 'p' is true", where 'p' is a symbolic proposition. Because it is represented in this form, 'p' itself may not be fully understood and any invalidation of 'p' (perhaps by encyclopedic knowledge) leads only to the reinterpretation of 'p', not its rejection.

Symbolic knowledge is not knowledge about the world, it is knowledge about knowledge about the world – it pertains to the encyclopedic entries of categories. When the mind encounters some conceptual representation which is inexplicable or irrelevant, but which is motivated, then the symbolic mechanism takes over, forming a meta-representation of the initial representation and attempting to establish the relevance of the initial failure to understand. For example, when a Dorze man is told that the leopard is a Christian animal, he cannot make sense of this statement; but he does not disregard it, because the speaker is speaking in earnest and he can tell that this is an important statement, even though he does not understand it. His mind gives up on the initial task of understanding the statement directly and shifts its focus to understanding why the statement is impossible to understand.

According to Sperber, symbolic processing consists of *focalization* and *evocation*. In order to understand the importance of both aspects, we must contrast them with the mind's normal information-processing. Normally, when new information is encountered it is conceptualized as a new representation and background information on its constituent parts is called up from passive, long-term memory and shunted into short-term memory. Auxiliary statements are then deduced from the conjunction of the new representation and the background information. The auxiliary statements perform a crucial function: they relate the new representation to the background information and thus allow the new information to be integrated into regular encyclopedic memory.

Two conditions in particular are likely to cause the failure of this normal conceptual process: the new representation may be insufficiently ana-

lyzable such that the background information cannot be located and shunted into short-term memory; or the attempt to form auxiliary statements may be thwarted because the new representation is either irrelevant to or contradicts the background information.

When either condition obtains, the normal conceptual process fails and the symbolic mechanism takes over. The first activity of the symbolic mechanism is focalization. Attention shifts from the attempt to form auxiliary statements between the new representation and the background information to the reason for the failure of the attempt. The symbolic mechanism now engages in a memory search for any information which might enable it to successfully form auxiliary statements. This time, however, the search in memory is not through the background information, but through a new evocational field in passive memory. The new evocational field consists of all information which might possibly provide the failed auxiliary statements which constitute the new focus of the search.

Although the new representation determines the auxiliary statements and the evocational field, it does not determine the paths of evocation. The symbolic mechanism has great freedom in searching through the evocational field, and "[t]his relative freedom of evocation is at the very basis of the social use of this psychological mechanism, symbolism" (Sperber 1975: 122). In this way it is possible to understand the role that ostensible "translations" and commentaries on symbols play: they serve to help delimit the evocational fields of the symbols' interpreters. According to Sperber (1975: 137):

The more numerous are the beliefs, rituals, etc., which are taken into account, the more the evocational field is determinate, the more restricted is the range of possible evocations, and the more the members of a single culture are led to similar evocations.

As the symbolic mechanism searches the evocational field, it frequently becomes more interested in what it finds there than it was in the initial search and branches off into its own path, a path not necessarily related to the initial search condition, but still within the evocational field selected by the initial search. The results of the search are then fed back into the normal conceptual mechanism, which now succeeds, because the initial failure of the auxiliary statements has been successfully connected to other information (in the process of evocation). The symbolic mechanism is thus a feedback mechanism to the normal conceptual mechanism.

This model explains the irrationality of symbolism, because the information that is connected via the evocational process is not connected according to the same standards that are used by the normal conceptual process. The criteria of the normal process are two-fold: first, is it relevant, and second, is it logically consistent? The criterion of the symbolic mechanism as it searches

through the evocational field is simply this: is it interesting? Obviously, these conditions will be filled by very different materials.

Sperber's theory has explanatory power because it explains: the apparent irrationality of symbols, their multivalence, the use of symbolic commentaries, and the relationships between symbolism and language and between symbolism and metaphor. It represents a tremendous step forward for anthropological theory, which generally has been so obsessed with denying the "irrationality" of symbol users that it has been lax in accounting for the symbols themselves.

3.2   E. Thomas Lawson and Robert N. McCauley: The representation of ritual form

The second theory I will examine is a theory of the representation of ritual form. Lawson's and McCauley's hypothesis is that the representation of religious ritual form is a function of the religious conceptual scheme's penetration of the cognitive system for the representation of actions. The religious conceptual scheme includes normal concepts, special (religious) concepts, and some other conceptual markers. The action representation system is the system we use on a minute-by-minute basis for the representation of all sorts of actions. It employs a set of formal rules operating over category symbols; the tentative list of rules provided by Lawson and McCauley is as follows (1990: 100):

(1) $ACTION \rightarrow [(P + ACMPLX), (P + ACMPLX + P)]$ P = participant
(2) $P \rightarrow [(AG + Q), (O + Q)]$ $ACMPLX$ = action complex
(3) $ACMPLX \rightarrow (A + AQ)$ AG = agent
(4) $AG \rightarrow (a_1, a_2, a_3, \dots, a_n)$ O = object
(5) $O \rightarrow (o_1, o_2, o_3, \dots, o_n)$ Q = quality
(6) $Q \rightarrow (PRP, ACTION)$ PRP = property
(7) $PRP \rightarrow (q_1, q_2, q_3, \dots, q_n)$ A = act
(8) $A \rightarrow (r1, r2, r3, \dots, r_n)$ AQ = action quality
(9) $AQ \rightarrow (AP, ACTION)$ AP = action property
(10) $AP \rightarrow (k_1, k_2, k_3, \dots, k_n)$ AC = action condition
(11) $AC \rightarrow (C + P)$ C = condition
(12) $C \rightarrow (c_1, c_2, c_3, \dots, c_n)$

In these rules, the symbol to the left of an arrow is explicated by the *explicatum* on the right in a process of embedding which terminates only with specific exemplars of a given category (denoted here by the lower-case letters with subscripts). These lowest level category symbols are "filled in" by the religious conceptual scheme, thus providing religious content to a normal action description. Note that the process of embedding can include entire

actions because some actions (including many rituals) directly presuppose the performance of others. In this manner, Lawson's and McCauley's theory allows the ritual itself and much of the thought surrounding it to be specified exactly.

For example, Sandy, a parishioner, wets her finger in the church vestibule and crosses herself, ritually blessing herself. The water is a necessary condition of the action (AC), because it links her performance of the ritual to a superhuman agent. The superhuman agent is implicated by means of a series of embedded rituals presupposed by Sandy's act of crossing herself. Sandy cannot use just any water; the water must have been blessed by a priest. The priest has become a priest because he has been ordained by the church. The church is able to do this because it has been instituted by Jesus, a superhuman agent in the Christian conceptual scheme. Each of these links is a religious action which transforms its logical object and which can be precisely described by Lawson's and McCauley's action structures. Lawson's and McCauley's action structures are able to identify the specific ritual links between Sandy's self-blessing and a superhuman agent. Furthermore, the type of link between the ritual and the superhuman agent has implications for the ritual's centrality, repeatability, and reversibility.

Lawson and McCauley propose universal principles of religious ritual that evaluate the output of the action representation system and provide feedback to the religious conceptual scheme. Specifically, they propose two universal principles of religious ritual.

(1) *The principle of superhuman agency*:

Those rituals where superhuman agents function as the agent in the ritual (for example, where Jesus institutes the church) will always prove more central to a religious system than those where the superhuman agents serve some other role (as, for example, when they serve as the passive recipient of a sacrifice). (Lawson – McCauley 1990: 125)

(2) *The principle of superhuman immediacy*: the fewer the embedded rituals which must be referred to in order to implicate a superhuman agent, the more central the ritual will be to its religious system. This principle has priority over the principle of superhuman agency.

The application of these principles to ritual structures produces a typology of rituals. The typology systematically predicts rituals' centrality, repeatability, reversibility, and susceptibility to ritual substitution. I will suggest below that the structures generated by Lawson's and McCauley's Action Representation System are partial accounts of cognitive scripts, the type of mental model most directly relevant to the representation of ritual actions. Lawson's and McCauley's hypotheses about ritual form offer unprecedented precision to descriptions and analyses of religious rituals.

3.3   *Pascal Boyer: The structure of religious concepts*

The final cognitive theory I will examine is Pascal Boyer's theory of the structure of religious concepts. In *The Naturalness of Religious Ideas: A Cognitive Theory of Religion*, Boyer suggests that the prevailing theory in anthropology, namely that the human mind is a *tabula rasa* upon which culture stamps its unique form, be replaced by a richer view of human memory, supported by experimental psychology, in which the human mind is seen as highly structured to begin with.

Findings in experimental psychology suggest that prior to any instruction or sufficient experience the human mind is already predisposed to form certain kinds of concepts, that memory is already structured. Central to Boyer's proposal is the partitioning of memory into different domains, especially the ontological, causal, and episodic registers.

Findings in experimental psychology suggest that people naturally develop expectations about the kinds of things that there are in the world, and that these default-value expectations may be ordered on an "ontological tree". The ontological tree is a normal tree diagram in which the main branches appear to be broad categories such as "living things", "artifacts", "abstract objects", "animals", and "events". The ontological tree reflects the structure of human memory: very young children have already developed definite expectations about exemplars of each of these categories. For example, told that a "hyrax (or other nonsense word) is hungry", children automatically know that while it might "be sleepy", it is not "made of metal" (Boyer 1994: chapter 4). Boyer emphasizes three features of the developmental research on default-value assumptions: they are domain-specific, utilizing different cognitive processes in different domains; they develop spontaneously, apart from either tuition or changes in the subjects' experiences; and the default-values constrain later conceptual development in complex ways. Further, these cognitive principles are cross-cultural universals.

The ontological tree is important to the study of religious concepts because, whereas some of its default-value assumptions are violated by religious entities, others are incorporated into the religious concept and form the basis for people's systematic judgments about these entities. Ghosts, as "persons", are naturally expected to desire, plan, and reason, and religious people find these features rather unremarkable. What religious people do find remarkable, however, is that ghosts violate people's physical and biological expectations for "persons". Transmission, therefore, focuses on the latter characteristics of ghosts.

The causal register is very closely related to the ontological tree, because the features which distinguish the branches of the ontological tree are the causal relationships in which entities are involved. Boyer suggests that peo-

ple employ a very loose general notion of causality supplemented by specific causal relations derived from the ontological tree. "Magical" causation, therefore, must be understood not in terms of some exotic theory of causation but in terms of the placement of the causal agent on the ontological tree.

The episode register, on Boyer's view, consists of general cognitive scripts, such as "go to restaurant", and specific markers indicating the details of the actual event. Rituals are specific examples of cognitive scripts in which the script's accompanying goal-structure is largely absent, and to which ontological concepts are only abductively related. Ritual performances are distinguished from other actions by the expression of an innate "ritual mode". The formality of ritual is accounted for in virtue of its missing goal-structure: people perform a ritual the way they learned it because, since the goal structure is underspecified, they do not know what changes are acceptable.

According to Boyer, religious concepts evolve toward a cognitive optimum in which they affirm enough default-value expectations to be learnable and violate enough default-value expectations to be attention-demanding and, therefore, are likely to be transmitted. They must satisfy the demands of memory and the demands of imagination.

3.4   Preliminary conclusions

Sperber's theory of symbolism is important for the study of religious systems because it highlights the independent working of cognitive mechanisms and delineates the role that things external to the individual, such as symbols and commentaries, play in constraining the freedom of individual thinking. The constrained freedom of individual thought is essential to an understanding of the evolutionary dynamics of religious systems.

The structures generated by Lawson's and McCauley's theory of religious ritual representations are mental models. They mobilize and apply religious concepts to specific situations in the real world. The structures generated by their theory are first approximations of cognitive scripts, but must be modified to include some representation of actions' goals. These goals are an important aspect of mental models: the perceived relevance of a model to a situation is determined by the relevance of its goal(s), not its form (though form plays an important role in other respects). So modified, Lawson's and McCauley's scheme is largely consistent with Boyer's hypotheses about religious ritual, to which their scheme adds considerable specificity and organization.[3]

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3. Three problems, however, still remain. First, some account must be given of the stability and permutability of scripts: the formation system (or conceptual scheme) must contain pre-arranged script sequences, and some element in the system must exist to re-arrange the script

Boyer suggests that our ability to perform inferences with concepts is directly related to their affirmation of default-value assumptions. According to Boyer, because religious concepts violate some significant default-value assumptions, there are aspects of religious concepts from which people are uncertain what follows. Stories sometimes exploit this uncertainty: ghosts violate our physical expectations for "persons"; while they may pass through walls, they may also shake chains. Although I agree with Boyer that the counter-intuitive aspects of religious concepts do not support inferences, it seems to me that people do in fact discuss and apply at least some counter-intuitive aspects of religious concepts fairly readily. This discrepancy between prediction and performance can be explained easily: the application of these counter-intuitive aspects of concepts is a result of the relevance of formulaic mental models which incorporate them. Religious models necessarily have formulaic aspects, because people cannot be sure what inferences the counter-intuitive aspects of concepts will support. This has consequences for the transmission of religious models: formulaic aspects of mental models must be explicitly taught; they cannot be inferred.

The cognitive theories presented here are important for several reasons: they are genuinely explanatory; they pertain to the behaviour of religious people; they are inter-disciplinary; they explicitly relate religion to the rest of the world. Most importantly, cognitive theories move much of the organization of cultural material from the ether into real persons' heads where it is more easily observed (Lawson – McCauley 1990: chapters 4, 7). If a science of religion is ever to go places, it will need solid legs such as these to stand on.

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sequence in service to non-standard situations. The script "go to restaurant" is stable enough to suggest that it is cognitively pre-packaged, but it is difficult to see how this might fit into Lawson's and McCauley's account. On the other hand, this pre-packaged script is adjustable to fit non-standard situations, so the system must contain some element to check the usefulness of the pre-packaged script and make adjustments. Second, the formal action descriptions must include some link to (possibly unspecified) background conditions: it is not clear that Action Qualities and Properties will do the entire trick here. Third, Boyer maintains that the links between the ritual mode and religious concepts are strictly *abductive*. The significance of this claim is difficult to assess, because the "ritual mode" (insofar as it is defined) is not a set of actions itself, but only an innate "behavioral mode" in which those actions are performed. Lawson and McCauley maintain that the connection between ritual actions and superhuman agents pertains to either the participants or the actions themselves, not just the actions' modality (though Lawson's and McCauley's theory is capable of accommodating the modality as an Action Quality). Lawson and McCauley also propose richer structural relations between superhuman agents and ritual actions than simple abduction. Evidence for Boyer's hypothesis is rather difficult to come by, because such evidence must include an example of the undefined "ritual mode", isolate a link between the ritual mode and religious concepts, and demonstrate that the link is abductive and not causal. Such examples are conspicuously absent from Boyer's discussion.

Although cognitive theories make an essential contribution to our understanding of religious models, there remains order to explain. For example, the identification of the molecules in a snowflake as H_2O does not adequately describe the crystalline result. And in the study of phenotypes, molecular biology is not the only game left in town. A second body of theory is needed to explain the order that emerges from complex socio-cognitive systems.

4.   Complexity theory

As noted above, cognitive theories of religion have moved a great deal of cultural order into the heads of individuals. There are limits, however, to the amount of order for which cognitive explanations can account. A great many more religious systems are consistent with cognitive constraints than those which we actually observe. The reason for this is straightforward: cognitive theories can account for the judgments of only individuals or completely homogenous communities in which all concepts are cognitively optimal. (Otherwise the reiteration of cognitive processes in transmission drives the concepts toward cognitive optimality, but the cumulative dynamics of such interactions are not, strictly speaking, cognitive.) The moment when one element of society differs from the rest, a complex feedback system is established and the dynamics of the society change.   .

As mentioned earlier, religious models are computational systems in that they are used by people to "compute" analyses and evaluations of real-world events. Conceptual differentiation within a society increases the computational capacity of a religion, because a *socio-cognitive* system can store more information and perform more operations than a *cognitive* system, especially if the socio-cognitive system is organized.

Complexity theory offers some insights into computational systems such as those we are talking about. Complexity theory is a theory about the behaviour of complex dynamical systems, studied topographically (at all parameter settings simultaneously). Complex dynamical systems are systems which include non-linear functions. Such systems can display different kinds of overall dynamics at different parameter settings.

One class of dynamics, chaotic behaviour, has caught the public imagination. The intuition of traditional physics was that any system, left alone, would eventually settle down into a stable state or set of states. Chaotic dynamical systems do not. The radical discovery with respect to chaotic behaviour, though, is that it can be generated even by very simple non-linear equations once they pass a threshold in the value of some parameter. The parameter varies from system to system. For example, in Stuart Kauffman's NK model, the crucial parameter is K, the connectivity between elements in the system

(Kauffman 1993: chapter 5). And in Robert May's exploration of the logistic difference equation for population growth, the crucial parameter turned out to be the population's rate of growth. Chaos theory was revolutionary for its suggestion that extremely complex behaviours could be described by simple equations.

In another topographic region, complex systems display complexity. Complexity, like chaos, is a variety of behaviour, and should not be confused with the notion of a complex system. Complexity is a variety of behaviour which a dynamical system exhibits at just that point where, in the topography of the entire system, it crosses the crucial parameter threshold from frozen order to chaotic behaviour. Complexity, in a slogan originating with Norman Packard, is "life at the edge of chaos" (Lewin 1992).

Complex dynamical systems exhibit some characteristic tendencies, three of which I will describe. First, complex systems *self-organize* (Bak – Chen 1991; Kauffman 1993). As complex systems evolve through time, they organize themselves. The best example here is that of an ecosystem: ecosystems naturally organize themselves, often intricately, to a point where ecological niches are created and filled in a delicate balance. Kauffman (1993) has argued that self-organization is statistically characteristic of complex systems. Self-organization is capable of accounting for the emergence of order in a system.

Arguably, religious systems also self-organize. As new ideas are created and old ones forgotten, religious systems gravitate toward one of a few different varieties of order, those which we actually observe in the world. At this point, this explanation is completely *ad hoc*, as I have not shown what makes these types of order so probable. (I offer some more comments about this self-organization below, to make this hypothesis less vacuous.) Nonetheless, it is at least feasible that some sort of self-organization does occur, especially because religious systems display the next two features of complex systems much more clearly.

Second, complex systems evolve toward *criticality* (Bak – Chen 1991). The standard example here is that of a pile of sand on a circular platform. As sand is slowly trickled onto the top of the pile, the sand pile organizes itself into a roughly conical shape of maximum slope. Once the sand pile has attained this organization, however, it behaves in a very surprising fashion. Rather than simply losing a grain of sand for every one added, it generally accepts new grains, unpredictably avalanching in cascades of widely ranging sizes. This avalanching behaviour displays criticality: unpredictably, any new grain, no different than the one before, may cause the system to display large or small changes. Small, similar causes result in effects of widely varying sizes. Moreover, these criticality effects follow a power-law distribution: small effects are common, large effects are rare.

Religious systems clearly display criticality. Not all significant changes in religious systems can be strictly accounted for in terms of socio-cultural causes. I would suggest that at least some of these reflect the typical behaviours of systems displaying complexity. Given the number of unsuccessful prophet-claimants in Arabia at the time of Muhammad, we intuitively look for some distinctive feature of Muhammad or his situation to account for his success. Criticality suggests that the cause of Muhammad's success might be negligibly small. Conversely, religious systems sometimes show remarkable stability in the face of considerable social change. Thus, although Islam is hardly monolithic, the sense of community felt by Muslims all over the world is rooted in genuine similarity of belief and practice, maintained despite considerable variation in social situations. Furthermore, most people's contributions to religious systems are small, but a few people's are large, suggesting that these effects may follow a power-law distribution (though this has not yet been established).

Third, complex systems evolve toward *maximum computational capacity* (Lewin 1992). In my opinion, this is the most important feature of complexity for the study of religious systems. Complex systems naturally evolve toward a point such that the entire system maximizes its computational potential. Although this is quite an abstract notion when applied to ecosystems and sand piles, it is more apparent in cultural systems. On this account, the development of all cultural systems should be similar in some respects. (They seem to be. Thomas Kuhn's [1970] model of scientific development, taken entirely from the physical sciences, has been usefully applied to a wide range of cultural developments. I take this as an indication that his model captures some statistically-typical features of at least one broad class of cultural systems.)

Religious systems are particularly interesting in this regard, because the counter-intuitive nature of religious concepts makes them powerful and extremely flexible computational tools. Boyer has emphasized that people are unsure of what inferences the counter-intuitive aspects of religious ideas will support, but that the flexibility of such notions is constrained by their intuitive aspects (which all concepts have, because the concept that is completely counter-intuitive cannot be learned). In many cases, this inferential flexibility is amplified by observational variability: "demons", "angels", and "jinn" can appear in a great many observable forms. These factors combine to give religious systems nearly unlimited explanatory power. As Lawson and McCauley note: "There is no experience, no problem, no idea that they cannot accommodate." (1990: 155)

The computational capacity of religious systems, however, is limited by the socio-cognitive substrata from which they emerge. Cognitively, religious systems are strongly constrained by factors of memory, probability of transmission, and learnability. Socially, religious systems are strongly constrained

by the connectivity of the underlying socio-cognitive system: the computational power of a religious system diminishes as the integration of the social system decreases.[4] A key factor in maintaining integration is communication, which presupposes shared assumptions, thereby ensuring that mental models must be sufficiently shared for the system to develop emergent order.

These dynamics combine to organize religious systems toward criticality and maximum computational potential. Specific institutions, ideas, and practices can be specified in terms of their roles in these system dynamics. A few general principles of this process are summarized in figure 1.
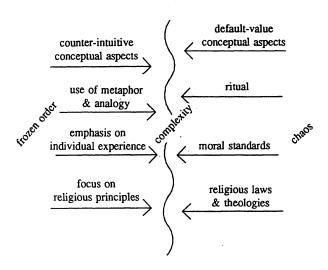

Figure 1: Some of the forces optimizing the computational complexity of religious systems

The counter-intuitive aspects of religious concepts drive the system toward chaos, but they are constrained by the default-value assumptions implicit in all religious concepts. Obviously, ritual serves to limit the flexibility of religious systems, and group rituals function more powerfully in this respect than do private rituals, because they constrain the flexibility of shared religious models (see Sperber above). Established theologies, religious laws, moral systems, and other normative aspects of religious systems generally serve

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4. "Integration" here refers to the number of communicative connections between members of a society, not to the homogeneity of the members' cognitive representations. The computational capacity of a socio-cognitive system is limited by both the size and the integrity of its information loops. Also, some information loops may be domain-specific.

to keep the system ordered. Forms of religion which emphasize individual experience serve to increase the flexibility of the entire system, and for this reason the solicitation and the interpretation of these experiences are usually carefully constrained (extensive bodies of doctrine pertain to the mystical path). Metaphor and analogy have the potential to expand the applicability of religious ideas without limit; therefore, in practice, narrow consensual bounds are quickly established. An emphasis on general religious principles over against highly-specific applications (i.e., the spirit of the law in preference to the letter of the law) also serves to increase the flexibility of religious ideas and drives the system toward chaos. These dynamical forces, and many others, serve to maintain a religious system at a computationally optimal point.

I must emphasize that figure 1 is a somewhat oversimplified account of the dynamical forces in religious systems: almost all of the institutions which constrain the flexibility of religious systems also provide channels for maintaining some flexibility. For example, although the Shari'a was initially intended to constrain the flexibility of individual judges' religious models, in time it served to extend the application of existing religious models to new domains. Conversely, theologies are often innovative in their initial formulation, and only later, once established by consensus, do they serve to constrain the flexibility of further thought. It is also highly doubtful that personal experience is entirely unconstrained even internally. The fact that similar mystical experiences seem to recur frequently suggests that in fact these experiences are highly constrained. This caveat notwithstanding, it is a plausible conjecture that the forces identified in figure 1 function roughly in the manner described.

Nor is the roughness of their descriptions inescapable. Each of the forces listed in figure 1 is susceptible to further specification as cognitive theories of these phenomena are developed. Lawson's and McCauley's theory of ritual offers a picture of what is possible; their ritual structures offer an extremely precise way of describing the flexibility internal to ritual (which drives the system to chaos), and of evaluating the extent to which specific religious ritual models are shared (the strength of its organizing function). The function of ritual in a religious system can be usefully fragmented along the divisions suggested by a theory of ritual cognition. I expect that the other dynamical forces will yield to similar approaches.

Though all religious systems naturally evolve toward complexity, not all hit the complexity mark at every point in their evolutionary histories. Some become rigid and inflexible as the forces of innovation succumb to excessive restraint by the forces of order. I would suggest that when this happens, the stage is set for radical innovation, such as is found in the cases of reformers or new founders. On the other hand, Protestantism has limited the extent

and importance of some restraining forces and I would suggest that this has caused this religious system to enter the chaotic regime. The chaotic regime is a fascinating one, because the chaos is interrupted, regularly, by small pools of order, each of which reflects the organization of the overall system. These pools themselves become chaotic in turn, giving rise to smaller pools of order. I believe that the tendency of Protestantism to fragment into or- dered denominations, which themselves often fragment into smaller systems, reflects the dynamics of the chaotic regime. Where Protestantism is com- pletely chaotic, we do not recognize it; in the small pools of order which we do perceive, we recognize the shimmering reflection of the larger religious system of which they are a part.

5. Conclusion

Complexity theory is able to offer us some insights into the emergent proper- ties of religious systems. These properties are fascinating in their own right, but must not be divorced from a thorough grounding in their socio-cognitive underpinnings. Fortunately, both cognitive psychology and complexity theory are developing at an impressive rate, largely because both fields command the attention of scholars in many disciplines. Often, the deepest changes in our knowledge result from such inter-disciplinary cooperation.

I have outlined a preliminary strategy for making sense of the order ob- served in different religious systems. Some aspects of this order can be ex- plained in terms of cognitive constraints and this research is progressing quickly. Other aspects of this order, however, are forever beyond the reach of purely psychological explanations (though never beyond their influence). These aspects, I have argued, are usefully accounted for in terms of complex- ity theory as it is applied to the co-evolutionary relationships which people naturally develop with the world. These are the stuff of culture and display culture's observable organization.

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