Further Correspondences and Similarities of Shamanism and Cognitive Science: Mental Representation, Implicit Processing, and Cognitive Structures

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Abstract

Properties of mental representation are related to findings in cognitive science and ideas in shamanism. A selective review of research in cognitive science suggests visual images and spatial memory preserve important functional information regarding physical principles and the behavior of objects in the natural world, and notions of second-order isomorphism and the perceptual cycle developed to account for such findings are related to shamanic experience. Possible roles of implicit processes in shamanic cognition, and the idea that shamanic experience may involve normally unconscious information becoming temporarily available to consciousness, are considered. The existence of a cognitive module dedicated to processing information relevant to social knowledge and social interaction is consistent with cognitive science and with shamanism, and may help account for the extension of intentionality and meaning that characterize shamanic practice. Overall, findings from cognitive science and ideas from shamanism exhibit a number of correspondences and similarities regarding basic properties of cognition, and this suggests that shamanic and

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nonshamanic cognition may not be fundamentally different. *Key words: shamanism, mental representation, implicit cognition, second-order isomorphism*

Of late there has been a resurgence of interest in the possible validity of shamanic ideas and phenomena (e.g., Harner 1990; Kalweit 1992; Krippner 2000, 2002; Ripinsky-Naxon 1993; Winkelman 2000). Hubbard (2002) highlighted several correspondences and similarities between ideas in shamanism and ideas in contemporary cognitive science; these correspondences and similarities were based on an extension of meaning into the natural world, and suggested elements of shamanic cognition reflected the use or application of structures or processes used in nonshamanic cognition. Consequences of such an extension include (a) a greater perceived similarity and relatedness of humans to nonhuman elements of the natural world, (b) a subsequent extension of intentionality toward nonhuman elements of the natural world (i.e., a conception of nonhuman elements of the natural world as rational agents possessing human-like beliefs, desires, and mental states), and (c) the appearance of social biases in attributions regarding the behaviors and actions of nonhuman elements of the natural world. An extension of intentionality and the subsequent appearance of social attribution reflect correspondences and similarities between shamanism and cognitive science at an intentional and social level, but do not address whether analogous correspondences and similarities exist at a more basic cognitive level.

The discussion here focuses on correspondences and similarities between shamanism and cognitive science at a basic cognitive level, and also builds upon the descriptions and ideas in Hubbard (2002). Part I focuses on the notion of mental representation and the way mental representation reflects properties of the natural world, and suggests proposals in cognitive science regarding a second-order isomorphism between mental representation and elements of the natural world and of a perceptual cycle are consistent with ideas in shamanism regarding the relationships and interconnectedness of humans with elements of the natural world. Part II focuses on the idea of implicit (i.e., nonconscious) processing, and suggests ways in which implicit processing may be involved in shamanic cognition. Part III focuses on cognitive structures, and suggests how selected issues in modularity and in the evolutionary history of the mind may relate to shamanic experience. In addition to highlighting further correspondences and similarities of findings in cognitive science to views in shamanism, the discussion here also underscores the notion that many aspects of shamanic cognition are not fundamentally different from nonshamanic cognition.

Part I: Mental Images, Perception, and the World

Hubbard (2002) highlighted how properties of connectionist models of memory were similar to properties of the web of life; however, that discussion focused on the relationships of individual elements to other elements within such networks, and did not explicitly address the nature of those individual elements. A closer examination of the nature of the individual elements of cognition suggests that properties of the individual elements of mental representation may resemble properties of the natural world. Findings in cognitive science supporting this hypothesis will be reviewed, and how such a hypothesis might relate to elements of shamanic experience will then be discussed.

What is Mental Representation?

A "mental representation" refers to information (provided by either memory or perception) used or stored by a cognitive (mental) structure or process (e.g., see Markman

1998; Paivio 1986; Palmer 1978; Stich & Warfield 1999). In general, information may be represented in any of a variety of different formats (e.g., images, verbal abstractions), and the specific format used for a given piece of information makes it more or less easy to represent or retrieve specific types of information with that representation (e.g., if the representation of a given apple involves a picture or an image, information regarding the specific shape and color of that apple is necessarily present in that depiction, but information regarding taxonomic classification is not necessarily present; however, if the representation of a given apple involves a verbal description, information regarding taxonomic classification might be present, but information regarding the specific shape and color of that apple might not be present; see Kosslyn's 1980 discussion of "description" and "depiction"). Although the numbers and types of formats used in or by mental representation are not universally agreed upon, many cognitive scientists accept the existence of at least two formats of mental representation: (a) a verbal, abstract, propositional, and descriptive format, and (b) a concrete, sensory, imagistic, and depictive format.

Visual Imagery

Verbal, abstract, propositional, or descriptive representations may be instantiated in network models, and Hubbard (2002) suggested properties of contemporary connectionist network models of semantic memory resembled properties of the web of life view of the natural world. However, it could be suggested that resemblances between properties of the natural world and properties of mental representation should be even more apparent if we consider less abstract or descriptive types of representation and more concrete or depictive types of representation. Indeed, some of the earliest evidence within cognitive science for similarities and resemblances of properties of mental representation and properties of the natural world came from studies of concrete and sensory-like visual imagery.

Mental Rotation and Image Scanning. In some of the initial studies examining properties of visual imagery, Shepard and Metzler (1971) presented observers with views of two objects, and observers judged whether the views were of the same object in different orientations or were of different objects (see Figure 1). When views were of the same object in different orientations, observers' response times increased as the difference in orientation increased (e.g., observers took longer when the orientations of the stimuli differed by 60degrees than by 45degrees). This was interpreted as suggesting observers imaged one object rotating to match the orientation of the other object, and that a mentally rotating image passed through intermediate (imaged) orientations just as a physically rotating object passed through intermediate (physical) orientations (for an overview, see Shepard and Cooper 1982). Therefore, the visual image preserved functional information regarding spatial configuration and alignment. Similar findings were reported when observers imaged maps of actual or fictitious locations and imaged traveling between pairs of locations on a given map and also when observers scanned across a single imaged object; observers' response times increased with increases in the distance to be scanned (e.g., see Kosslyn 1980). This preservation of distance information reveals a clear functional resemblance between the image and the object, and so results of experiments on mental imagery support the claim that properties of mental representation resemble properties of the natural world.

Second-Order Isomorphism. Cognitive scientists refer to a resemblance between different types or domains of stimuli (such as mental images and physical objects) as an *isomorphism*, and the question arises as to the strength or level of the isomorphism of a mental

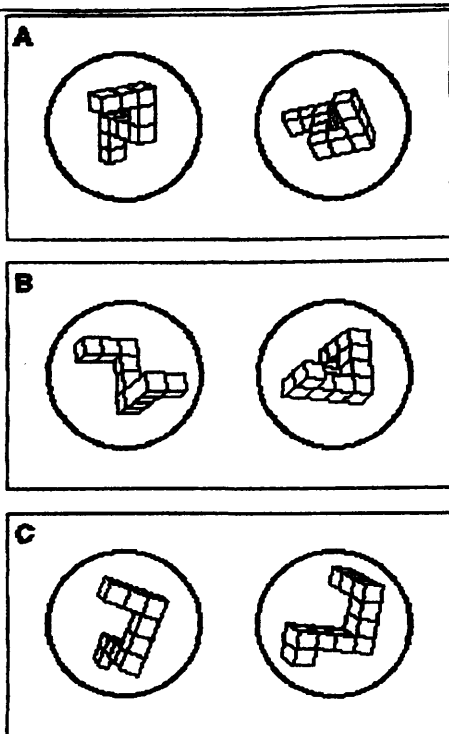

Figure 1. An illustration of stimuli in mental rotation experiments. In panel (a), there are two views of the same object that differ in orientation in the picture plane. In panel (b), there are two views of the same object that differ in orientation in the depth plane. In panel (c), there are views of two different objects. Adapted from Shepard and Cooper (1982).

image to the referent physical object (i.e., to the object depicted by that image). An image of a physical object is clearly not the same size, shape, and color as that object (e.g., a person who forms a visual image of a green giraffe would not have some neural structure within his or her head that is actually green and shaped like an giraffe, nor would mental rotation involve any actual rotation of neural cells), and so there is not a strong first-order isomorphism between the image and the referent object.

However, images do preserve important functinal information about the structure of the imaged object (e.g., if points A and B were close in physical space, then imaged points A' and B' would be close in image space), and this weaker resemblance has been called a *second-order isomorphism* (see Shepard 1975, 1981). A second-order isomorphism preserves important functional information regarding the referent of the image, and the emphasis on functionalism within second-order isomorphism is consistent with Hubbard's (2002) suggestion that connections between the neural network of an individual and elements of the natural world are functional connections.

The idea of a second-order isomorphism in which functional properties of the referent object are preserved within a mental image of that referent object, but in which the mental image is not physically identical to the referent object, might have important implications for elements of shamanic practice. For example, during a shamanic episode a shaman might have a subjective experience of transforming into some nonhuman element of the natural world. Rather than experiencing a literal transmutation or metamorphosis (i.e., a first-order isomorphism) in which every aspect and property of the shaman would be physically transformed, perhaps a shaman experiences a more abstract or functional transmutation or metamorphosis (i.e., a second-order isomorphism) in which he or she experiences, utilizes, or accesses specific properties of elements of the natural world that are (functionally) present in his or her mental representation but which are not normally experienced, utilized, or accessed. According to such an interpretation, transmutation would depend upon the degree of similarity or resemblance between mental representations and elements of the natural world captured by second-order isomorphism and would involve only those properties or experiences functionally relevant to the shamanic task[1]. For example, a shaman who experienced transmutation into a bird might access second-order isomorphic information regarding flight (or other characteristics salient in bird experience), but would not exhibit first-order isomorphism in which he or she physically transmuted from a human into a bird.

Displacements in Spatial Memory

Investigations and models of mental imagery have focused primarily on visual properties of objects (e.g., geometric aspects of space such as shape and distance), but many properties of the natural world are not visual properties. It could be argued that if properties of mental representation resemble properties of the natural world, then physical principles and forces that describe the functioning of the natural world should also describe the functioning of mental representations of the natural world. More concretely, physical principles and forces that describe or constrain the behavior of objects in the natural world should be reflected within the architecture of mental representation, and this should constrain the representation of the stimulus. Indeed, evidence suggestive of such constraints has been found, as the mental representation of a given stimulus is often biased in ways consistent with subjective effects of physical principles that would have operated on the referent physical stimulus (Hubbard 1999).

Implied Physical Principles. Memory for the final position of a moving target is usually displaced in the direction of anticipated motion (for review, see Hubbard, 1995, 2003). In many studies on this topic, observers viewed computer-animated displays in which a moving target was shown. After the target vanished, observers used a computer mouse to indicate the remembered final position of the target. As shown in Figure 2, observers typically indicated a position slightly in front of where the target actually vanished (i.e., further along in the direction of anticipated future target motion). This forward displacement was initially attributed to an internalization of the

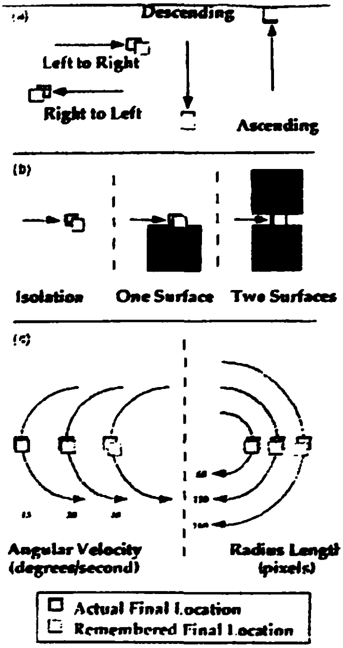

Figure 2. Typical findings from studies of representational momentum, gravity, friction, and centripetal force. In panel (a), representational momentum is indicated by forward displacement of remembered position, and representational gravity is indicated by downward displacement for horizontally moving targets and larger forward displacement for descending targets than for ascending targets. In panel (b), representational momentum is indicated by forward displacement of remembered position, and representational friction is indicated by the decrease in forward displacement with increases in implied friction. In panel (c), representational momentum is indicated by forward displacement of remembered position along the tangent, and representational centripetal force is indicated by inward displacement of remembered position toward the center of the circular path. Adapted from Hubbard (2003).

principle of momentum (i.e., just as a moving physical object such as an automobile cannot stop immediately upon application of the brakes, but continues to move forward because of its momentum, the mental representation of a moving physical target exhibits an analogous form of momentum and cannot stop immediately), and so has been referred to as *representational momentum* (e.g., Freyd & Finke, 1984). Intriguingly, representational momentum can be evoked by just the suggestion or implication of motion; observers shown a "frozen action" still photograph from within a longer motion sequence (e.g., a dancer in mid-leap, a wave crashing on a beach) are more likely to subsequently confuse the initially viewed photograph with a photograph from slightly later in the motion sequence than with a photograph from slightly earlier in the motion sequence (Futterweit and Beilin 1994).

Although researchers interested in the effects of physical principles on memory have focused primarily on effects of momentum, evidence that other physical principles also influence displacement in spatial memory has been reported (see Hubbard 1999, 2003). In general, memory for moving or stationary targets is displaced downward in the direction of implied gravitational attraction, and this has been referred to as *representational gravity* (see top of Figure 2). If a moving target encounters implied friction, forward displacement is decreased, and this decrease in forward displacement has been referred to as *representational friction* (see middle of Figure 2). Furthermore, increases in representational friction result in decreases in forward displacement. Memory for a target traveling a circular path is displaced forward along the tangent and inward toward the center; the forward displacement reflects representational momentum, and the inward displacement has been referred to as *representational centripetal force* (see bottom of Figure 2). Additionally, displacements due to implied physical principles combine with each other (e.g., in descending targets, representational momentum and representational gravity operate in the same direction, and so they sum and forward displacement is relatively large; in ascending targets, representational momentum and representational gravity operate in opposite directions, and so they partially cancel and forward displacement is relatively small) and with other biases (e.g., landmark attraction effects, observer's expectations of future target behavior) to determine the ultimate displacement of a given target.

Environmental Invariants Hypothesis. The effects of implied physical principles on remembered spatial position suggest that the mental representation of the spatial position of a physical object is influenced by the same physical principles that influence the actual spatial position of that physical object. More concretely, the existence of representational momentum and related types of displacement suggest that our cognitive system responds as if the mental representation of a physical object were subject to the same physical principles that influence a referent physical object. Of course, mental representation could not exhibit actual physical momentum because neurons depicting (or otherwise encoding) motion would not themselves be in motion. However, mental representation does preserve important functional information about the consequences of physical principles that act on physical objects. Much as visual imagery appears to reflect a second-order isomorphism between geometric properties of physical objects and properties of the mental images of those objects, the mental representation of the spatial position of an object appears to reflect an analogous second-order isomorphism between properties of physical principles that would act upon that object and properties of that mental representation. This notion has been called the *environmental invariants hypothesis* (Hubbard, 1999), and is consistent with the idea that properties of mental representation resemble properties of the natural world.[2]

Mental Representation and the World

A second-order isomorphism of spatial and dynamic properties of mental images with spatial and dynamic properties of physical objects is consistent with the hypothesis that properties of mental representation resemble properties of the environment (Shepard 1984, 1994) or have been shaped by the environment (Hubbard 1995, 1999). The idea that properties of mental representation resemble properties of the environment suggests an interplay of mental representation and the environment, and a way that mental representation

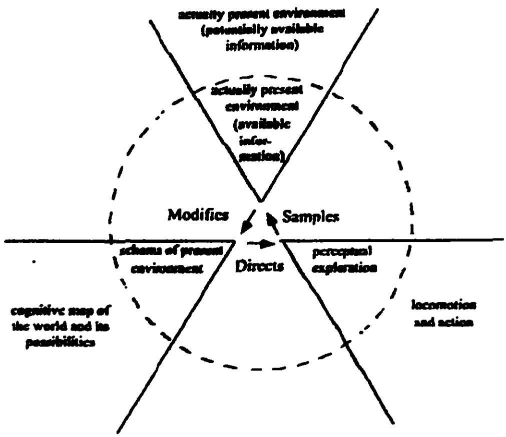

Figure 3. An illustration of the "perceptual cycle." Adapted from Neisser (1976).

might resemble or have been shaped by properties of the environment, that is consistent with Neisser's (1976) idea of a perceptual cycle. In the perceptual cycle, mental schemata (i.e., organizations of knowledge based on previous experience) direct perceptual exploration of the environment, perceptual exploration of the environment samples from available information in the environment, and this available information modifies schemata which in turn direct further sampling from the environment (see Figure 3). Functional relationships between different elements in the perceptual cycle suggest that a person's cognitive structure and functioning are not separate or apart from nature; rather, properties of the natural world form an integral part of the cognitive structure and functioning of that person. Such a conclusion from cognitive science is completely compatible with ideas regarding the similarity and inter-relatedness of humans with elements of the natural world from shamanism.

The perceptual cycle as it was originally proposed suggested a flow of information and influence in only one direction. However, the discussion in Hubbard (2002) focused on how meaning was extended into the world, and the environmental invariants hypothesis, as well as the proposal of a second-order isomorphism between images and referent objects, suggests that the flow of information and influence might be more bi-directional and symmetrical: not only is meaning extended from mental representation into the natural world, but properties of the natural world are extended into mental representation. Thus, connections and influences between cognition and the natural world are from the individual to elements of the natural world (as illustrated by the notion that connectionist networks put meaning "out in the world" discussed in Hubbard 2002; see also Hardy 1998) and from elements of the natural world to the individual (as illustrated by the sensitivity of imagery and spatial memory to functional and dynamic properties of the natural world discussed here). Humans participate in cognitive interactions with the natural world: properties of mental representation resemble properties of the represented objects and properties of the natural world, and functional characteristics of the natural world appear to be incorporated into mental representation. Such a conclusion is consistent with cognitive science and with shamanism, and significantly deepens the correspondences and similarities noted in Hubbard (2002).

Part II:The Unconscious (Implicit) Mind

There is a growing consensus within cognitive science that a significant portion of cognitive processing occurs in the absence of any conscious awareness of that processing (e.g., Graf and Masson 1993; Stadler and Frensch 1997), and that perception, learning, and retrieval from memory may all occur without conscious awareness (e.g., Kirsner, Speelman, Maybery, O'Brien-Malone, Anderson, and MacLeod 1998). Furthermore, individuals are often unaware of the true causes of much of their behavior, and may fabricate explanations that appear plausible but are demonstrably false (e.g., Nisbett and Wilson 1977); similarly, in "trance logic" hypnotized subjects often invent reasons for their behaviors or perceptual experiences (e.g., Orne, 1959; but see Spanos, 1986). Given connotations associated with the terms "subconscious," "preconscious," and "unconscious," many theorists prefer the term "implicit" when referring to cognitive processes that occur without (or in the absence of) conscious awareness and the term "explicit" when referring to cognitive processes that occur within (or accompanied by) conscious awareness. Given the importance of implicit processes in nonshamanic cognition, it could be suggested that implicit processes might be important in shamanic cognition.

Implicit Connections to the Natural World

The existence of meaningful connections within neural networks need not depend upon conscious awareness of those connections; indeed, the presence of priming (i.e., when a previously perceived stimulus facilitates the processing of a subsequently perceived stimulus) when a person does not consciously remember having been previously exposed to the initial stimulus is usually interpreted as evidence of implicit memory for that initial stimulus (e.g., Tulving and Schacter 1990). More generally, humans may not have conscious awareness of the stages or parts of their cognitive processes, but may have conscious awareness of the products or outputs of those processes (e.g., when asked "what is two plus two," adult humans do not know how they arrive at the answer "four," but usually report the answer just "pops" into their heads; when a person touches a dangerously hot object with his or her hand, the hand will be jerked away from that hot object by a reflex mediated by the spinal cord, and it is only after that reflex has removed the hand from danger that the person becomes consciously aware of the heat of the object and that his or her hand moved). Given that meaningful connections within neural networks need not depend upon conscious awareness of those connections, it is plausible that the extension of meaning from neural networks to elements of the natural world need not depend upon conscious awareness of such connections, either.

Masks and Costumes. The importance of the unconscious in shamanic experience may be highlighted by the use of masks and costumes by shamans. Not only might masks and costumes reflect magical thinking such as the law of similarity and the even stronger notion that the wearer transmutes into the object represented by the mask or costume, but by concealing the (conscious) identity of the wearer, masks and costumes could symbolically (or even literally) force a confrontation with what is unknown or unconscious. By the act of donning a mask or costume, the shaman enters a more sacred space that is separate from the surrounding profane space (Eliade 1964), and similar to the contents of the unconscious mind or implicit processes, this sacred space is not "known" by or in normal waking consciousness. In a sense, a shaman's mask and costume become a vehicle for a journey into the unknown or unconscious, and the outward symbols of that mask or costume may provide a powerful imagery for capturing and encoding elements of that shamanic experience. This may occur because donning a mask or costume increases the physical resemblance (i.e., increases the apparent visual first-order isomorphism) between the shaman and the entity or object depicted by the mask or costume, and this in turn may facilitate the ability to access normally implicit second-order isomorphic information.

Imagery. Translation into human language of a confrontation with the unknown or unconscious during a shamanic experience may be difficult if such experiences involve pre-literate (or pre-verbal) symbols and signs, and so imagery may be more effective in transferring information between the unconscious mind and the conscious mind (see discussion in Ripinsky-Naxon 1993) and in capturing elements of knowledge not amenable to the abstraction characteristic of verbal representation. Furthermore, verbal language may not provide sufficient terms to capture all possible distinctions that might be made (e.g., each human language has a limited number of terms denoting different colors, but the human eye can discriminate millions of different hues). Discussions of imagery within cognitive science suggest a *principle of implicit encoding* which specifies that images may include information that might not have been explicitly (i.e., verbally) encoded but that nonetheless was preserved within the image (e.g., see Finke 1989), and it might be that such implicit encoding allows imagery to function as a vehicle capable of transporting large amounts of meaningful information across different levels of mind. Indeed, shamanic experiences are usually filled with vivid and extensive imagery, and this may occur in part because information retrieved during a shamanic experience originates in or is processed by the unconscious of the person having the shamanic experience, and so is not amenable to verbal description or other forms of relatively abstract representation.

Making the Unconscious Conscious. Although shamanic experience often involves vivid and extensive imagery, subsequent recollection of the cognitive content from a previous shamanic experience may result in a verbal translation or gloss of the retrieved imagery. It is possible that similarities in verbal structures across languages or cultures may contribute to apparent similarities in the retrieved content. Such a verbal recoding or elaboration may become stronger as the amount of time since the initial experience increases or with repeated recollections of the experience, and this would be consistent with the results of numerous studies of schematic effects on memory for unusual or atypical material (e.g., Bartlett 1932; Bower, Black, and Turner 1979). Such similarities in verbal or schematic structures might underlie some of the more common elements of shamanic experience. More positively, such verbally-based encoding and retrieval might involve image schemata that represent "foundational meanings" (cf. Vandervert 1997), a role that Krippner (2000) suggested may be reminiscent of Jung's (1970) notions of archetypes. Along these lines, Winkelman (1997) suggested that common elements of shamanic experience might reflect biological potentials that could form the basis of archetypal elements of experience such as those discussed by Jung (cf. Ryan 2002; readings in Sandler and Wong 1997). If so, then the gods, spirits, and others encountered during a shamanic experience may represent the landmarks (e.g., archetypes) of unconscious or implicit cognitive structures[3].

Heightened Attention. Shamanic experience might thus be seen as an extension of conscious awareness to include elements that might not normally be contained within conscious awareness or that might not normally occur in the presence of conscious awareness. Along these lines, Berman (2000) considers shamanic experience to be a heightened state of awareness and attention within normal waking consciousness rather than an altered state of consciousness per se. If such a heightened state of awareness or attention increased the scope of what was in awareness and did not significantly influence subjective experience or phenomenology, then shamanic experience would not constitute an altered state of consciousness. Of course, such a heightened state of awareness or attention need not be limited to dealings with supernatural or transcendental stimuli, but would also be useful in the very practical tasks of finding game animals, locating and using medicinal plants, harvesting crops, and other matters of daily survival (Krippner 2000). Alternatively, it might simply be that during the course of a thorough apprenticeship (or other training and experience) shamans acquire expertise that allows increased performance in these tasks, and so we might consider shamanic skills as simply another form of expert knowledge (e.g., a facilitation of pattern recognition and retrieval[4]; Bedard and Chi 1992; readings in Ericsson and Smith 1991).

Encoding Specificity and State-Dependent Learning. The notion that shamanic experience may result from a heightened state of awareness and attention rather than from an altered state of consciousness is consistent with the hypothesis that shamanic cognition is not fundamentally different from nonshamanic cognition. A similarity in shamanic cognition and nonshamanic cognition is consistent with long established findings regarding "encoding specificity" (e.g., Tulving and Thomson 1973) and "state dependent learning" (e.g., Blaney 1986; Overton 1985) on memory. In brief, encoding specificity and state dependent learning refer to how memory for a previously experienced stimulus is influenced by the similarity of the context (cues) present at the time a stimulus was experienced and at the time that stimulus is to-be-remembered: the greater the similarity, the greater the average recall. The specific structure or process involved in a given learning episode might form part of the greater context of that learning, and so if structures or processes involved in a shamanic experience were vastly different from structures or processes involved in recall of that shamanic experience during a subsequent nonshamanic state, then relatively little shamanic experience would be remembered during a subsequent nonshamanic state[5]; however, individuals who undertake a shamanic experience often appear to subsequently remember the experience in great detail. Also, if cognitive functioning during a shamanic task were vastly different from cognitive functioning during a nonshamanic task, then a shaman would not be able to use shamanic skills or knowledge in nonshamanic settings (e.g., finding game animals, etc.).

Implicit Learning and Explicit Attention. Given that implicit processing involves the absence of explicit awareness or attention, the hypothesis that shamanic experience involves a heightened level of awareness or attention initially seems to contradict the hypothesis that shamanic experience involves implicit processing. How may this apparent contradiction be reconciled? If during shamanic experience a shaman becomes aware of information normally unavailable to consciousness, it may still be that only a portion of the potentially relevant information is consciously accessed, and that much of the potentially relevant information remains beyond the conscious awareness of the shaman. The information that was consciously accessed may reflect a heightened awareness, whereas potentially relevant information that was not consciously accessed reflects an implicit processing rather than a heightened awareness. Thus, attention is heightened in the sense that new information is brought into conscious awareness, but because that new information was retrieved from implicit structures or processes, information about what the retrieved information is related to and how it was learned may remain beyond the heightened conscious awareness of the shaman. Alternatively, it may be that heightened awareness is itself implicit, as the shaman exhibits a greater sensitivity to the relevant information even though the information captured by such increased sensitivity is not known to conscious awareness (e.g., "gut feelings").

A different type of resolution of the apparent contradiction between a heightened awareness or attention and implicit processes involves when each type of process might be used. Research on the learning of simple rule-based (grammatical) systems suggests that in some circumstances learning is more efficient if carried out implicitly and that attempts to explicitly learn the rules of such systems results in less effective learning (e.g., Reber 1976, 1993). Given that the natural environments within which shamanic cultures are found typically contain varieties of plant and animal species that must be distinguished, perhaps shamans rely on implicit learning of at least some of the necessary distinctions. If shamans relied on implicit learning of the critical information, they would not be able to articulate what they had learned, and so their explanations would reflect plausible inventions or even appear magical. An initial implicit learning could guide or tune subsequent allocation of attention, and so shamans would have a heightened sensitivity to the appropriate environmental indicators but yet have no awareness of what those indicators are (and so they might fabricate plausible or magical answers). A heightened attention or awareness could involve more explicit processing, but regardless of whether the actual shamanic problem solving occurs at an explicit or implicit level, input to that problem solving may involve elements initially outside of nonshamanic conscious awareness.

Soul Flight and Soul Retrieval

If shamanic experience involves cognitive processes that are normally implicit, then in voyaging between ordinary reality and an Upper or Lower World, a shaman may (also) be voyaging between the conscious mind and different regions of the unconscious mind. The "soul flight" that often characterizes shamanism (e.g., see Eliade 1964) may reflect an application of consciousness or conscious processing to normally unconscious information. Different unconscious structures or processes may subjectively manifest in conscious experience as different types of archetypes. Within shamanic systems, these archetypes may appear as different types of entities (e.g., animals, gods, or other beings) encountered during shamanic experience, and these different entities usually each have different powers and gifts or teach different lessons. Under such an interpretation, a "loss of soul" might reflect a weakened or depleted archetype, and "soul retrieval" might involve a conscious re-energizing or balancing of that archetype. Thus, retrieval of a lost or missing soul may be metaphorical for consciously accessing or strengthening previously unconscious information. Shamanic experience would briefly expose elements of the unconscious mind to a more conscious or attentive processing (cf., Berman 2000; Winkelman 2000), and such a heightened level of conscious attention to normally unconscious material would be consistent with mythic accounts of Orpheus, Dante, and others who descended into a lower world for healing or to retrieve someone or something. Interestingly, such an account suggests shamanic healing might be effective because it follows the Freudian dictum of making the unconscious conscious, and is also consistent with the Socratic dictum to "know thyself."

A Gaian Speculation

To the extent that specific elements of shamanic experience reflect biological potentials (cf. Winkelman 1997), those elements of shamanic experience should be similar for all members of a given species. The idea of a similar or shared unconscious experience is reminiscent of the "collective unconscious" proposed by Jung (1970) and which consists of a "species memory" containing archetypal patterns and other memories and experiences common to all humankind. It is but a small step from Jung's idea of a collective unconscious that connects members of the same species to a broader and deeper memory that connects members of different species. Such a broader and deeper memory could appropriately be considered a "Gaian" unconscious (based on the "Gaia" notion of the web of life and how life on Earth is interconnected with and regulates its environment; see Lovelock 1979, 1988). It might be at the level of such a Gaian unconscious that meanings are extended and functional interconnections between individual humans and nonhuman elements of the natural world occur. Thus, just as functional connections between areas of the human nervous system allow homeostatic regulation of the human body, functional connections across nonhuman elements of the natural world allow a Gaia-like homeostatic regulation of Earth's biosphere. This notion is quite consistent with the claim in Hubbard (2002) of correspondences and similarities between properties of mental representation and properties of the web of life.

Part III: Cognitive Structures

As many have observed, evolution of the human cortex is built upon more primitive brain structures (e.g., the "reptilian," "paleomammalian," and "neomammalian" triune division proposed by MacLean 1973, 1990), and the extremely high overlap in DNA across species makes it quite probable that shared elements of cognitive processing exist across species. More specifically, to the extent that archetypal structures are physiologically based (cf. Stevens 1982), such cognitive content (e.g., archetypes or a Gaian unconscious) might be shared with nonhuman animals that possessed the relevant physiological structures. The overlap in brain structures and in genetic material, in conjunction with the notion that implicit or unconscious learning is a phylogenetically earlier form of learning than is explicit or conscious learning (see Reber 1993), suggests that unconscious structures or processes might be related to evolutionarily older brain structures found in both humans and nonhuman animals. If such reasoning is correct, and given some of the possible roles of the unconscious in shamanic experience that were considered earlier, then a further understanding of the cognitive aspects of shamanism might be gleaned from a brief consideration of some issues regarding the evolution of the human mind.

Cognitive Archeology and Evolutionary Psychology

The emerging paradigms of *cognitive archeology* (e.g., Mithen 1996; Pearson 2002), *cognitive anthropology* (D'Andrade 1995), and *evolutionary psychology* (e.g., Cosmides and Tooby 1992, 1994) emphasize that human brains reflect the environments within which the evolution of early humans occurred. Thus, human brains were shaped by natural selection, and the properties and characteristics of human brains today reflect the problems and challenges encountered by hunter-gatherer human ancestors[6]. To the extent that there are similarities in the cortical and subcortical structures of humans and nonhuman animals, and similarities in the environmental stimuli encountered (and cognitively processed) by humans and nonhuman animals, we might expect there to be similarities in the cognitive experiences of humans and nonhuman animals. Such similarities in cognitive experiences would be consistent with the attribution of human-like beliefs, desires, and mental states to nonhuman elements of the natural world discussed in Hubbard (2002). Indeed, the emphasis on continuities between human cognition and nonhuman cognition in theories that are based on evolutionary principles underscores yet another area in which ideas from contemporary cognitive science exhibit correspondences and similarities with ideas from shamanism; namely, that humans (and human cognition) are points along a continuum rather than discrete entities unconnected with the rest of terrestrial life and experience.

Modularity of Mind

Theories of mind based on considerations of the demands faced by the evolving brain usually suggest that human minds are more like a collection of highly specialized modules and less like a blank slate or general purpose computer; in other words, the mind is considered to be more analogous to a "Swiss army knife" with an myriad of different specialized blades and appliances and less analogous to a single generalized multipurpose tool. Such an organizational scheme could be quite adaptive, because having specialized modules could increase the speed and efficiency of problem solving, and thus lead to an increased probability of survival and reproduction. We might thus expect natural selection to favor the application of modules in problem solving situations. Indeed, such a modular approach is not limited to the "primitive mind," but may characterize the "contemporary mind" as well (for discussions of modularity, see Fodor 1983; Garfield 1991).[7] Although the precise number and content of modules varies from theory to theory, many researchers postulate the existence of a specialized module for processing information related to social knowledge and interaction (e.g., Mithen 1996) or to biological or animate forms (e.g., Atran

1995, but see Carey 1995).

In a problem solving situation involving elements of the natural world, an individual (lacking specific design or physical information) might appeal to his or her most efficient cognitive module, and if such a module is specialized for social information, then nonhuman elements of the natural world would be conceptualized in social and intentional terms (e.g., Father Sun, Brother Wolf). Such use of a cognitive module specialized for processing information related to social knowledge and social interaction would foster the extension of intentionality into the natural world and the expansion of the social in-group to include nonhuman elements of the natural world that are typical of shamanism (see discussion in Hubbard 2002), and is also consistent with archeological findings that place the origins of shamanic practice very early in human history (e.g., see Clottes and Lewis-Williams 1998). Furthermore, the possible existence of a cognitive module specialized for processing information related to social interaction and social knowledge is consistent with observations that present-day analogues of primitive hunter-gatherers (e.g., Australian aborigines) perceive their landscape in social terms (e.g., see Cowan 1992), and is also consistent with attributions of meaning, purpose, and intentionality to both animate and inanimate objects that are observed in shamanism.

A different role of modularity in shamanism has been proposed by Winkelman (2000, 2002), who suggested characteristics of shamanism result from a cross-modal integration of at least three distinct modules (e.g., perception of the social other, perception of intentionality, knowledge of animal behavior). However, if a cognitive function is truly modular, an integration of modules per se would not be possible given that a defining (and necessary) feature of a module is "information encapsulation," the constraint that the processing within a module is not influenced by any other beliefs, knowledge, or expectations of that organism (i.e., once information is input into a module, no information from outside that module can influence the processing within that module, see Fodor 1983). Such an integration of knowledge as Winkelman refers to might indeed occur, but that integration might rely on the *outputs* of modular processing rather than on an *integration* of modular processing. In contrast, the role of modularity suggested here is a simpler one that does not involve an integration of modules or of different types of information, but rather involves the application of a single module specialized for processing information related to social knowledge and social interaction.

Dynamic Mental Representation

Early metaphors of cognition in cognitive science were based on the digital serial computer, and so considered mental representations as relatively static "data arrays" operated on by various processes or mapped from one structure to another structure. However, more contemporary theorizing in cognitive science rejects the view that mental representations are static and posits a more dynamic character to mental representation (e.g., Freyd 1987; Jones and Boltz 1989; Kelso 1995; Port and van Gelder 1995). Indeed, the interplay of mental representation and the environment described by the perceptual cycle is consistent with the emerging view that mental representations are more appropriately conceived of as dynamic processes rather than as static entities, and the interrelatedness and mutual influence suggested by the perceptual cycle are consistent with the dynamic nature of the web of life. Furthermore, arguments presented here and in Hubbard (2002) regarding the incorporation of properties of the world into mental representation, and that connections between mental representation and the natural world involve extension of meaning into the natural world, are consistent with a more dynamic view of mental representation and underscore additional salient correspondences and similarities of findings from cognitive science and views from shamanism.

Summary and Conclusions

Numerous correspondences and similarities between cognitive science and shamanism regarding properties of cognition were discussed. Properties of mental images resemble important functional properties of the referent imaged objects (e.g., distance, spatial configuration), and spatial representation reflects subjective consequences of physical principles (e.g., displacement in memory for the final location of a moving target is consistent with effects of momentum); such preservation of functional information reflects a second-order isomorphism between mental representation and the natural world. Although the hypothesis of a second-order isomorphism was derived from research in cognitive science, the underlying idea that mental representation is integrated with and reflects properties of the natural world is consistent with shamanism, and so the existence of second-order isomorphism is consistent with Hubbard's (2002) claim of similarities and correspondences between cognitive science and shamanism. Furthermore, the relationship of mental representation and the natural world is bidirectional: not only is meaning extended from mental representation into the natural world (as discussed in Hubbard 2002), but properties of the natural world are extended into mental representation (as shown by second-order isomorphism). The extension of meaning into the world and the incorporation of functional properties of the world into mental representation discussed by cognitive science parallel the interdependence of elements of the web of life discussed by shamanism.

Aspects of shamanic cognition may involve implicit processes or may result from making previously unconscious experience or information temporarily available to conscious processing. The use of masks and costumes in shamanic practice, and the prevalence of imagery in shamanic experience, may reflect attempts to access or encode implicit or nonverbal information. Along these lines, shamanic experience may involve access to second-order isomorphic information not normally available to conscious awareness, and soul flight or soul retrieval might involve conscious accessing or re-energizing of previously nonconscious information. To the extent that implicit processing is involved in the successful performance of shamanic tasks, shamans would not be able to articulate the source of their knowledge, and so their performance might appear magical. Even if shamanic experience arises in part from implicit information, such implicit information might also be accessible by nonshamanic processes, and this is consistent with the suggestion that shamans might also be able to use such implicit information in nonshamanic tasks of daily survival. Alternatively, shamanic experience may involve a heightened state of attention or awareness rather than an altered state of consciousness, but such a heightened attention or awareness of specific stimuli may have been tuned or shaped by prior implicit learning. These ideas are all consistent with the notion that processes and structures underlying shamanic cognition are not fundamentally different from processes and structures underlying nonshamanic cognition.

A consideration of some selected issues regarding the possible evolutionary history of the human mind further underscores the similarity and relatedness of human cognition and nonhuman cognition. To the extent that cognitive experiences are based in bodily structures (e.g., see Lakoff and Johnson 1999; Varela, Thompson and Rosch 1991), the overlap in DNA and the similarity in subcortical structures across numerous species suggest some aspects of human cognition might be shared with nonhuman animals. Evolution of the human brain built upon older neural structures, and it is possible that some cognitive processes might be related to evolutionarily older neural structures found both in humans and in nonhuman animals. Theories based in such evolutionary approaches usually suggest cognitive functioning involves a set of modular domain-specific structures, and many theorists accept the hypothesis that a cognitive module specifically dedicated to the processing of information regarding social knowledge and social interactions emerged early in human evolution. Characteristics of a shamanic view (e.g., an extension of meaning into the natural world and the use of an intentional stance in which elements of the natural world were considered as rational agents possessing human-like beliefs, desires, and mental states) are consistent with the existence of such a module, and the early appearance of shamanism in human evolution is consistent with the early emergence of such a module.

The existence of second-order isomorphism between mental representation and the natural world external to the organism reflects an incorporation of information regarding important functional characteristics of the natural world into the functional architecture of mental representation. This is consistent with the hypothesis that neural networks may be functionally related to the larger web of life and with the distribution of cognitive processing across elements of the natural world (see Hubbard 2002), and so properties of both networks and images resemble properties of the natural world. The possible role of implicit processes in shamanic experience is consistent with the accepted role of implicit processes in nonshamanic cognition, and both cognitive science and shamanism conceive of cognition as involving dynamic processes. The existence of a cognitive module dedicated to processing information regarding social interactions, and the emergence of such a module early in the evolutionary history of humanity, is consistent with both cognitive science and with shamanism. In general, there are a number of correspondences and similarities between cognitive science and shamanism at a basic cognitive level, and in conjunction with correspondences and similarities at the intentional and social level discussed in Hubbard (2002), make a strong case that views in contemporary cognitive science and views in shamanism are convergent, and also that numerous aspects of shamanic cognition may not be fundamentally different from nonshamanic cognition.

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Notes

[1]In discussing transmutation, broader aspects of magical thinking may also appear relevant. For example, it might be objected that the appearance of resemblances between properties of mental representation and properties of the natural world might reflect magical thinking and application of the law of similarity as discussed in Hubbard (2002). However, such criticism overlooks a critical point: the properties of mental representation discussed here are replicable findings from carefully controlled laboratory experimentation, and only after a sufficient mass of data accumulated was the notion of second-order isomorphism proposed.

[2]Such a resemblance might initially seem obvious or trivial, but it is possible that other relationships between mental representation and the natural world could have occurred. Indeed, when the nature of representation is considered more broadly, the majority of non-mental forms of representation do not incorporate explicit information about physical principles or forces that would act upon the represented object (e.g., a videotape of an automobile crash would not contain or incorporate the force of the collision), and so experimental findings that mental representation does contain or incorporate such information tells us something interesting about the relationship between mental representation and the natural world.

[3]Of course, the outward forms of gods, spirits, and others encountered during a shamanic experience may be specified in large measure by the culture of the person who is having that shamanic experience (e.g., a Native American may encounter animals, a Christian may encounter saints and martyrs of the Church, and a Buddhist may encounter buddhas and boddhisattvas), but the core essence of those landmarks may be specified by unconscious structures or processes.

[4]In what has become a paradigm study of the effects of expertise on memory, experimental participants varying in expertise in chess were briefly shown chessboards containing various configurations of chess pieces, and those participants were subsequently provided with empty chessboards and asked to reconstruct the configurations of the chess pieces (reviewed in Holding 1985). When configurations were of plausible game positions or were drawn from a real game, chess masters outperformed chess novices because the chess masters could draw on their knowledge of typical configurations to maximize the number of pieces they

could encode (e.g., a king behind three pawns could be encoded as a "castled king" by a chess master knowledgeable about typical configurations, and that would require only one "chunk" of memory, whereas that same configuration might require four "chunks" of memory, one for each piece, by a novice who would not recognize that configuration), and this allowed chess masters to encode the locations of more total pieces. By analogy, a person with expertise in shamanism might appear to encode or be sensitive to more total information regarding his or her environment, and this could result in such a person being more likely to encode whatever information was necessary for successful completion of a given task.

[5]A similar example may be found when we consider memory for nocturnal dreams. Laboratory research has clearly shown that people dream during the episodes of REM sleep that occur 3-4 times per night; however, most people fail to remember the majority of their dreams (e.g., see Dement 1972; Hobson 1988). One possible explanation for the failure to remember all of these dreams involves state-dependent effects: The dream state differs from the waking state in a variety of physiological measures (for overview, see Anch, Browman, Mitler, and Walsh 1988), and so the failure to recall a dream after subsequent awakening may result from differences between the physiology of the dream state and the physiology of the waking state. Of course, such an explanation is a hypothesis, and there are numerous other hypotheses for the failure to remember dreams (e.g., decay and failure to rehearse dream content, Koulack and Goodenough 1976; incompatibility or interference of dream generation and mnemonic encoding processes, Cohen 1979; Foulkes 1985).

[6]Such an approach is not necessarily typical of nor consistent with traditional approaches in psychological science that stress the idea of association (e.g., in traditional behaviorism, the emphasis on reinforcement as the primary determinant of learning; in classical cognitivism, the emphasis on top-down effects of schematic activation and categorical knowledge on the interpretation of stimuli) and that brains are like blank slates or general purpose computers capable of mapping any set of stimuli onto any other set of stimuli. As Hubbard (2002) noted, it is with more contemporary connectionist models of semantic memory (rather than in earlier hierarchical or spreading activation models) that we see a greater convergence of ideas from cognitive science and ideas from shamanism; similarly, it is with more contemporary evolutionary models (rather than in earlier associationist models) that we see a greater convergence of ideas from cognitive science and ideas from shamanism.

[7]A similar idea may be found in recent theories suggesting humans have "multiple intelligences." Although not "modules" in a technical sense, the list of separate "intelligences" often includes an intelligence that involves social interaction (e.g., an "interpersonal intelligence" that involves processing of information regarding other people's moods, temperament, motivations, and intentions, and an "intrapersonal intelligence" that involves understanding, using, and interpreting one's own emotions; see Gardner 1983).

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