Commentary on **J. D. Smith, W. E. Shields & D. A. Washburn (2003). The comparative psychology of uncertainty monitoring and metacognition. BBS 26(3): 317–339.**

Abstract of the original article: Researchers have begun to explore animals' capacities for uncertainty monitoring and metacognition. This exploration could extend the study of animal self-awareness and establish the relationship of self-awareness to other-awareness. It could sharpen descriptions of metacognition in the human literature and suggest the earliest roots of metacognition in human development. We summarize research on uncertainty monitoring by humans, monkeys, and a dolphin within perceptual and metamemory tasks. We extend phylogenetically the search for metacognitive capacities by considering studies that have tested less cognitively sophisticated species. By using the same uncertainty-monitoring paradigms across species, it should be possible to map the phylogenetic distribution of metacognition and illuminate the emergence of mind. We provide a unifying formal description of animals' performances and examine the optimality of their decisional strategies. Finally, we interpret animals' and humans' nearly identical performances psychologically. Low-level, stimulus-based accounts cannot explain the phenomena. The results suggest granting animals a higher-level decision making process that involves criterion setting using controlled cognitive processes. This conclusion raises the difficult question of animal consciousness. The results show that animals have functional features of or parallels to human conscious cognition. Remaining questions are whether animals also have the phenomenal features that are the feeling/knowing states of human conscious cognition, and whether the present paradigms can be extended to demonstrate that they do. Thus, the comparative study of metacognition potentially grounds the systematic study of animal consciousness.

Let's not forget about sensory consciousness

Anil K. Seth, David B. Edelman, and Bernard J. Baars

The Neurosciences Institute, San Diego, CA 92121. **seth@nsi.edu**
David_Edelman@nsi.edu **baars@nsi.edu**
http://www.nsi.edu/users/seth
http://www.nsi.edu/public/scientists/index.php
http://www.nsi.edu/users/baars/

Abstract: The metacognitive stance of Smith et al. (2003) risks ignoring sensory consciousness. Although Smith et al. rightly caution against the tendency to preserve the uniqueness of the human mind at all costs, their reasoned stance is undermined by a selective association of consciousness with high-level cognitive operations. Neurobiological evidence may offer a more general, and hence more inclusive, basis for the systematic study of animal consciousness.

Smith et al. (2003) say "we invite colleagues to take seriously the claims of a hundred years of cognitive scientists who noted that *the highest levels of information processing, and particularly consciousness,* present themselves when difficulty, complexity, and indeterminacy are encountered" (sect. 15, para. 6, emphasis added). It may well be true that environmental complexity evokes complex cognitive responses, but it is entirely another matter to assume that these are the only situations in which consciousness may be involved. Conscious events can have both sensory content, relating to entities in the world, and metacognitive content, relating to the contents of sensory consciousness or other mental contents. Metacognitive conscious content therefore assumes sensory consciousness, but the converse is not true: Sensory content need not be overlain by metacognitive content in order to constitute a conscious event.

Smith et al. focus on the (metacognitive) states of uncertainty elicited by the discrimination tasks they cite, overlooking the fact that these discriminations also involve sensory phenomenal features. Presupposing that consciousness is grounded in metacognition, they can then claim that "the comparative study of metacognition potentially grounds the systematic study of animal consciousness" (abstract).

Such a "metacognitive stance" implausibly assumes that metacognition arose in evolution before, or at least in parallel with, sensory consciousness. The phylogeny of consciousness cannot, however, be restricted to a history of metacognitive adaptations. Consciousness may have been good for many things, such as adaptively linking current perceptual categorizations to a previous individual history (Edelman 1989), distilling a stable representation of the external world from an enormously variable succession of sensorimotor transformations (Merker, in press), or mobilizing and integrating otherwise separate and independent brain functions by enabling "global access" of conscious information throughout the nervous system (Baars 1988). Tononi and Edelman (1998) have proposed that the occurrence of one particular conscious state over billions of others is *informational,* in the specific sense of a reduction in uncertainty. These examples represent just a small sample of the current literature.

Relinquishing the strong metacognitive stance of Smith et al. reveals new opportunities for grounding the systematic study of consciousness in animals (Edelman et al., in press; Seth et al., in press). One such opportunity is provided by neurobiological evidence for sensory consciousness.

Physiologically, two fundamental facts stand out about sensory consciousness. First, there is the finding, dating back to Hans Berger in 1929, that waking consciousness seems to be associated with low-amplitude, irregular gamma-range activity in cortex (John et al. 2001). Conversely, unconscious states like deep sleep, coma, general anesthesia, and epileptic states of absence show slow-wave, high-amplitude, and more regular voltages. Conscious perceptual input also appears to involve greater spatial coherence in gamma activity than matched input that does not become conscious (Srinivasan et al. 1999).

The second fundamental fact is that sensory consciousness seems to be distinctively associated with the thalamus and cortex. Damage to the brainstem, including the thalamus, can abolish the state of consciousness, and damage to posterior cortex appears to delete specific conscious features such as color vision, visual motion, the perception of objects and faces, and the like. No other brain areas show these effects when damaged.

These basic facts are unlikely to be limited to humans. For one thing, posterior cortex is structurally and functionally conserved across a wide range of mammalian species (Rosa 1999). Thalamic midline and intralaminar nuclei are also widely conserved and have been associated with conscious events in both humans and nonhuman animals (Van der Werf et al. 2002). Furthermore, gamma-range coherence has been observed in diverse species, including rabbits, rats, cats, and monkeys (see Bragin et al. 1995; Bressler et al. 1993). Finally, disturbing the integrity of either the thalamocortical system or gamma coherence in animals leads to changes in both conscious state (e.g., coma; Bogen 1995) and conscious perception (Cowey & Stoerig 1995).

In summary, it should not be assumed that metacognition is necessary for consciousness. It is likely that metacognitive adaptations played an important role in the evolution of human consciousness. However, the assumption that such adaptations are required for the emergence of consciousness in general occludes a great deal of evidence suggesting both the early emergence of sensory consciousness in evolution and its presence in many extant species. Smith et al. are quite right to warn us away from the ten-

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dency to preserve the uniqueness of the human mind, but their own metacognitive stance leads them back toward this very mistake.

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There is no Authors' Response to this continuing commentary.

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