

Dr Christos' homepage: <http://www.justgeorgeous.net>

MEDIA RELEASE

28 October 2003

New dreamtime and creativity theories surface from downunder

Why do we dream? Why have practically all mammals evolved to dream? Although dreaming clearly serves some important biological function, the answer to this question has eluded neuroscientists, evolutionary biologists, and psychologists for the best part of the last century. Dr George Christos, a mathematician/theoretical physicist studying neural networks at Curtin University in Perth, believes he has come up with the answer, while at the same time advancing a theory of where our creative thoughts actually come from. "We dream to generate creative ideas, to be more adaptive, to think, and to prepare ourselves for new learning", he says. These theories are outlined in his new book 'Memory and Dreams: The Creative Human Mind', which was published this year by Rutgers University Press in the USA, and has just been published by UNSW Press in Australia. The book should be available in stores around Australia by late October.

Dr Christos said there were all sorts of fanciful theories about why we dream (such as psychological, night entertainment, infant development, rehearsal, keeping the brain warm, keeping the eyes wet, and even erection theories), but they do not incorporate all of the neurobiological, neurochemical, neurophysiological, and cognitive evidence known about dream sleep. Many people believe that dreaming serves some sort of psychological function, but this is not true. Sigmund Freud thought we dream when we are distressed but he did not know that mammals dream, that infants dream for much longer than adults, and that we all dream for about the same amount of time each night (about two hours) irrespective of our state of mind. These facts only became known after the discovery in the 1950s that we dream during a phase of sleep called rapid-eye-movement (REM) sleep. "Freud was wrong, but he did not know all the facts. What pressing psychological need could an infant (or animal) have for some much dream sleep?" said Dr Christos.

According to Dr Christos one of the most interesting scientific theories on the function of dream sleep, on which he has based his own theory, was proposed in 1983 by Nobel Laureate Francis Crick (co-discoverer of the structure of DNA) and Graeme Mitchison. They suggested that when we dream the brain is engaged in a reverse-learning (or unlearning) process. During this process the brain is supposed to remove so-called spurious memories (or parasitic modes), among other things. Spurious memories are memories which are generated by the brain itself because of the way memories are stored in a distributed overlapping fashion in the brain, sharing common neurons and synapses. This is quite different to the way memories are stored on a computer, where each memory has its own distinct location. Spurious memories have been observed in mathematical models and there is every reason to think that they are also present in the brain. They are generally comprised of combinations of features of stored memories. The Crick-Mitchison hypothesis fits in with the neuroscientific evidence, such as the fact that the

neurotransmitters associated with learning (like norepinephrine and serotonin) are switched off while we dream, and explains why we do not generally remember our dreams. "It is a very appealing theory, especially the reverse-learning idea, but what I have found, in my computer simulation experiments, with more realistic neural network models, is that the proportion of spurious memories actually increases after reverse-learning", said Dr Christos.

Dr Christos suggests that the importance of spurious memories had been overlooked. "For starters they may be the basis of our creative ideas. Where else would they come from?" he asks. Dr Christos' theory about the importance of spurious memory represents a major shift from previous thinking, as most researchers have been trying to getting rid of these states in neural network models since their discovery, also in 1983. Dr Christos points out that the problem was that people were working with biologically unrealistic models, which had too much symmetry and consequently too many spurious memories. In more realistic models there are much fewer spurious memories. While writing his book Dr Christos came to realize that spurious memories might be a lot more important for understanding how the brain works than even he first thought. "Spurious memories are also required for the brain to learn something new. Without them the brain would only be able to recall already stored information (like a computer or a tape recorder), and we would not be able to think and adapt to new situations" he said. "The brain is not just a recording device. It is a thinking machine", he said. "These earlier models were misleading, but were important for identifying spurious memories nonetheless. We might never have noticed them otherwise", said Dr Christos. "I would really like to give them another name, as they are not really spurious or parasitic at all. They are internal states generated in the brain that are crucial to how it functions, he said.

Dr Christos says that when we learn something new, a weak spurious memory, which already exists in the brain (corresponding to some combination of memories or facts), is strengthened to become a strong stored memory itself. This happens through a well-known process called Hebbian learning, whereby the link between two simultaneously excited neurons is strengthened. Dr Christos' theory offers a new paradigm for autonomous brain function. The brain generates new spurious memories based on previous experiences and learns from them, generating new ones in the process.

"What is also particularly interesting about all of this is that, since spurious memories are based on previous knowledge, everything you are about to learn is in a sense already in your head", said Dr Christos. "This shouldn't be so surprising as you could hardly learn something about quantum field theory unless you already knew something about it already. It wouldn't mean anything to you if you knew nothing about it", he said. Dr Christos also points out that, if he is right, we may have to supplement Albert Einstein's famous statement that "imagination is more important than knowledge" with the premise that imagination itself is based on knowledge, and there is no imagination without knowledge.

Dr Christos now suggests that, among other things (see below), we dream to generate spurious memories, states which are important for brain function. "We dream to roughen

up our 'memory space', or that is, generate more spurious memories, so we can learn new things the next day, so we can be more creative, so we can adapt to new situations, and so we can think", he says. Dreaming (through reverse-learning) also help to process recent memory, ease obsession (the dominance by a few strong memories), and help us to forget useless and weak old memories. "This may explain why we tend to dream a lot about a relative just after they after they have died, and recall trivia from our childhood, during dreaming", said Dr Christos.

"Crick and Mitchison suggested that reverse-learning, and their idea that spurious memories are pruned, would allow mammals to have much smaller and more compact brains. Part of this was based on the fact that the echidna, an Australian ant-eating egg-laying primordial mammal, did not seem to have any REM sleep and had a much larger brain than other mammals, but it was recently discovered that the echidna also has REM sleep. The Crick and Mitchison hypothesis cannot explain why the size of one's head is so important. Why do water mammals, like whales and dolphins, need to have any REM sleep? The weight of their heads is supported by the buoyancy of water. In any case, the Crick-Mitchison hypothesis is not supported by my computer simulation experiments with more realistic models, which now suggest the opposite is true. Dreaming, or reverse-learning, generates more spurious memories", said Dr Christos. Dr Christos proposes that when we dream, we reverse-learning, but instead of eliminating spurious memory we generate more of them. This prepares us for new learning the next day, and allows us to be more creative, flexible and adaptive in an ever-changing environment, he said. "This would explain why we and all other mammals have evolved to dream, and why infants may need so much REM sleep", he said.

Dr Christos is also well known internationally for his fascinating theory on the cause Sudden Infant Death Syndrome (SIDS), which is also based on dreaming, and is also presented in his book 'Memory and Dreams'. "We dream about our memories and scientists have discovered that we try to act out our dreams, as much as is possible. When a sleep researcher dreamt he was swimming underwater, he actually held his breathe", he said. "A little baby could dream about when it was back in the womb and stop breathing, just like the sleep researcher did, because in the womb its mother supplied it with oxygen and it did not have to breathe." Dr Christos maintains that his SIDS theory is the only theory that is consistent with all of the known facts about SIDS, including the fact that there is a hiatus in the first month after birth. "The neural apparatus required for dreaming, such as the connections from the brain stem to the thalamus and onto the neocortex are not properly developed until 2 or 3 months after birth", he said.

Further information about Dr Christos' dream sleep, creativity and SIDS theories is available on his website <http://www.justgeorgeous.net>

[Blurbs/comments](#)

[Rutgers University Press](#)

"Why do we sleep? Why do we dream? How does the brain turn a collection of new experiences into memories, dreams, and creative thoughts?....."

UNSW Press

""What are dreams? Why do we dream? What is the relationship between dreams and creativity? How does the brain turn a collection of new experiences into memories, dreams and creative thoughts? What causes SIDS (sudden infant death syndrome)? These questions and many, many more are answered in this extraordinary and stimulating book from Perth's George Christos."

"Christos's Memory and Dreams is an elegant book that, in one fell-swoop, opens our eyes to new possibilities in psychology, neuroscience, mathematics and medicine."

Ben Goertzel, Professor of Computer Science at the University of New Mexico. Ben Goertzel has published some 6 books himself on artificial intelligence and complex systems.

"Memory and Dreams provides a much needed integration of computational and neurobiological theories of REM sleep generation and its significance for learning."

Allan Hobson, professor of psychiatry at Harvard Medical School, recognized as one of the world's leading authorities on REM sleep dreaming and acclaimed author of "The Dreaming Brain", "Sleep", and "Dreaming".

"...the relationship of spurious memories to creativity has long intrigued me, and I was very happy to see you writing at length about it"

John Hopfield, professor of Molecular Biology, Princeton University, neural network guru (originator of attractor neural networks), and co-discoverer of spurious memories

"Christos's theory (SIDS) is interesting, original and deserves further consideration"

Warren Guntheroth, pediatrics professor at the University of Washington School of Medicine in Seattle and one of the world's leading SIDS researchers.

"My concern is that it is difficult to test his hypothesis," he told Reuters in an e-mail message. **"On the other hand it is highly original and attractive."**

Prof Guntheroth when he spoke to Reuters Health, 4 August 2003.

REVIEWS extracts (see webpage)

New Scientist

.....fascinating book on the relationship between memory and dreams.

".....Controversial? Possibly. Fascinating? Definitely."

The West Australian (aka "The Dream Weaver")

".....Dr Christos offers a new and insightful interpretation of why we dream and how memories are formed, stored and retrieved by the brain in Memory and Dreams....."

Campus Review ("Grey Matters")

".....a remarkable new book....."

"Christos's book is a fascinating read for anyone concerned with how the human mind works."

Metapsychology book reviews

".....presents an interesting and engaging introduction to research findings regarding REM sleep..."

"..delivers his proposal about two fascinating issues: the cause of sudden infant death syndrome (SIDS) and the nature of creativity."

"One of the most pleasing features of the book is that Christos presents complex issues and their factual bases in a manner that makes them accessible to readers from different walks of life without undermining the intricacy of the issues and their relevance."

"Another engaging feature of the book is Christos' overview of the current understanding of the functioning of the brain with respect to memory and dreaming in which he successfully integrates knowledge from diverse areas of inquiry (i.e., neurobiology, physiological, evolutionary and cognitive psychology, and computer science)."

"..likely to generate interest in these issues and, by doing so, advance scientific knowledge of two puzzling phenomena."

Leonardo Reviews (MIT Press)

"This book covers a lot of ground, and quickly. It could quite easily have been three times the length and still not exhausted the subject of memory and the purpose of dreaming. What Christos has achieved is a sharp, clear, no "waffling on" presentation of the latest findings in neurophysiology, neurobiology and dream sleep experiments concerning how the brain stores, processes and develops memory and the relationship of dreams to memory. From his exhaustive research into memory and how the brain is involved in "creative" pursuits, Christos has developed a unique and highly plausible theory to explain the cause of SIDS (Sudden Infant Death Syndrome). Any theory which attempts to explain the cause of this mysterious and tragic syndrome should be welcomed with open arms. Especially when such a theory does not contradict any of the existing empirically known facts of the syndrome."

".....essential reading for anyone involved at any level with SIDS."

The Times Literary Supplement (London)

Why do we dream, and do our dreams mean anything? Why are even the mightiest computers incapable of what we call creativity? Why, if we have a difficult problem, does "sleeping on it" so often help? These are some of the questions to which George Christos gives answers in his neuroscientific and mathematical exploration of "The creative human mind".

Sometimes, though, input can lead to an attractor that is not itself a memory, but is formed from components of existing ones, known as a spurious state. It is argued that, far from being a nuisance, these states enable us to generate creative new ideas from existing memories.

Christos believes that dreams are caused by random brainstem stimulation of the cerebral cortex, and that their function is to unlearn some of what was learned the previous day and generate new spurious states to stimulate creative problem solving. We do not dream the actual solutions to problems, but dream to "roughen up" the memory landscape so that these solutions are more likely to be generated later.

Memory and Dreams is an informed, intuitive and refreshingly opinionated fusion of established science.

Dr George Christos, Dphil(Oxon)

Website: <http://www.justgeorgeous.net>