Professor Terry Bossomaier

Director
Centre for Research in Complex Systems
Charles Sturt University
Bathurst 2795
Australia

February 16, 2013

Terry Bossomaier has had a lifelong interest in perception and cognition. He graduated from Cambridge in Natural Sciences and continued with a PhD at the University of East Anglia in the UK. He then went on to work for five years as an image physicist, studying the perception of images and the measurement of image quality. He then returned to academic life at the Australian National University in Canberra Australia.

His work on arrival in Canberra centred on visual cognition, especially the problems of image sampling. At that time, the early 80s, consumer digital cameras were a long way into the future. The first CCDs were first appearing for astronomical use, but the technology was in its infancy. But animal retinas sample the retinal image with a discrete array of rods and cones, the photoreceptors. It turned out that the sampling strategies were different to traditional engineering theory and that many animals undersampled the retinal image [12].

His vision work included studying the information characteristics of colour vision [11] and aspects of perception such as size constancy [15] His interest in sensory information processing continues with a new book published in 2012 [2].

Simulation proved an important tool in understanding vision, which led to an increasing interest in high performance and parallel computing [6]. Parallel and distributed computing, which of course are fundamental characteristics of the brain, lead naturally to the idea of complex systems. He co-organised the first Australasian conference in complex systems in 1992, a biennial series which continues today [3]. He also began in 1998 the first biennial complex systems research summer school series, also continuing into the present.

After moving to Charles Sturt University in 1996, he set up CRiCS, the Centre for Research in Complex Systems. His interests in information theory developed in sensory processing, continued into the study of financial markets [9], the flow of information in complex systems [1] and the aspects of measuring creativity [5, 14]

Information theory has been at the heart of his work in understanding human expertise in Go and important to understanding transitions. The idea of staged learning in cognition goes back to Piaget, but we can now measure transitions using information theoretic arguments, because there is a vast amount of data available online. It proved possible to show that phase transitions occur in the acquisition of expertise in Go [8] and that these transitions occur at a perceptual level [10]. There are also transitions which occur as somebody starts to see the big picture and integrate global information [4].

A key development in cognition over the last decade has been an increase in understanding of how high level concepts suppress low level detail [7, 13]. In a recent paper it was shown that this strategy can lead to savings of energy in the brain, thought to be an important driver in evolution.

The use of online data to investigate cognition opens up new possibilities for understanding how expertise develops. Future work will look at Poker. This game adds risk assessment and human behavioural modelling to the strategic elements of games such as Go and Chess. It also has the advantage that there are millions of hands online. Few other domains of cognition provide such huge amounts of data.

References

[1] L. Barnett and T. Bossomaier. Transfer entropy as a log-likelihood ratio. *Phys. Rev. Lett.*, 109:138105, 2012.

[2] T.R.J. Bossomaier. *Introduction to the Senses*. Cambridge University Press, 2012.

[3] T.R.J. Bossomaier and D.G. Green, editors. *Complex Systems*. Cambridge University Press, 2000.

[4] T.R.J. Bossomaier and M. Harré. Global context influences local decisions. In *Proc. Cognitive 2011, Rome*, 2011.

[5] T.R.J. Bossomaier, M. Harré, A. Knittel, and A.W. Snyder. A semantic network approach to the creativity quotient. *Creativity Research Journal*, 21(1):64–71, 2009.

[6] T.R.J. Bossomaier and A.R. Loeff. Parallel computation of the hausdorff distance between images. *Parallel Computing*, 19:1129–1140, 1993.

[7] T.R.J. Bossomaier and A.W. Snyder. Absolute pitch accessible to everyone by turning off part of the brain? *Organised Sound*, 9:181–189, 2004.

[8] M. Harré, T. Bossomaier, A. Gillett, and A.W. Snyder. The aggregate complexity of decisions in the game of go. *European Physical Journal B*, 80:555–563, 2011.

[9] M. Harré and T.R.J. Bossomaier. Phase-transition – behaviour of information measures in financial markets. *Europhysics Letters*, 87:18009, 2009.

[10] M. Harré, T.R.J. Bossomaier, and A.W. Snyder. The perceptual cues that reshape expert reasoning. *Nature Scientific Reports*, 2(502), 2012.

[11] D. Osorio and T.R.J. Bossomaier. Human cone pigment spectral sensitivities and the reflectances of natural scenes. *Biological Cybernetics*, 67:217–222, 1992.

[12] A.W. Snyder, T.R.J. Bossomaier, and A. Hughes. Optical image quality and the cone mosaic. *Science*, 231:499–501, 1986.

[13] A.W. Snyder, T.R.J. Bossomaier, and D.J. Mitchell. Concept formation: object attributes dynamically inhibited from conscious awareness. *Journal of Integrative Neuroscience*, 3:31–46, 2004.

[14] A.W. Snyder, J. Mitchell, T. Bossomaier, and G. Pallier. The creativity quotient (cq) - an objective scoring of ideational fluency. *Creativity Research Journal*, 16:415–420, 2004.

[15] G.W. Stuart, T.R.J. Bossomaier, and S. Johnson. Preattentive processing of object size. *Perception*, 22:1175–1193, 1993.