Seeing and doing: how vision shapes animal behaviour

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Publications devoted to vision often begin by claiming that vision is the most important sense. This is of course silly. Admittedly, if most people were presented with the option of only being allowed one sense, most would probably choose vision. However, a blind person would undoubtedly make a convincing case for hearing. Indeed, it could be argued that hearing, or at least the use we have put it to in terms of language, is the basis for the whole of human culture. A dog, on the other hand, might justly put in a plea for smell, whereas a homing pigeon might favour a magnetic sense and Xenopus might choose the mechano-sensory lateral line. Personally, one of us (having lost an eighth cranial nerve to a brain tumour) would sometimes gladly sacrifice all else for a functional vestibular system. All sensory systems are clearly important for survival.

However, although one can fruitlessly argue about the relative merits of various senses, of one thing there can be little doubt. For many animals, light perception is both the trigger and the controlling sense for many, if not most, behaviours. Hence the rather simple title for this Theme Issue ‘Seeing and doing’. Much of what an animal does is related to what it sees.

The papers included in this issue address current knowledge in the area where vision science—at the level of eye design, retinal function, photoreceptor physiology, motion vision or sampling of visual space—interfaces with animal behaviours such as navigation, signalling, predator evasion, food detection, orientation and even human activities such as driving.

Four papers examine the way ants [1,2], bees [3] and dung beetles [4] orientate themselves in the world, while two deal with colour vision in species as diverse as mantis shrimps [5] and birds [6]. How animals deal with the photon-limited depths of the ocean is the topic of two further papers [7,8], while how birds [9] and mantid shrimps [10] sample visual space is also examined. We then move to motion vision’s role in organizing behaviour, examining its astonishing sensitivity limits in insects [11] and how human decision-making can be revealed using eye movement analysis [12]. Fittingly, the special issue ends with a paper by Land [13] discussing some of his recent work on how changes in visual gaze are incorporated seamlessly into a neural model of the environment.

The coverage of these topics is cross-disciplinary and involves new approaches, particularly in modelling and the monitoring of actual behaviour. This will lead to a better understanding of the role played by vision in shaping behaviour in both vertebrates and invertebrates.

This issue arose out of an Applied Vision Association meeting in the summer of 2012 at the University of Sussex, organized by Daniel Osorio in honour of Mike Land’s 70th birthday. Although many speakers, including Mike himself, were initially sceptical about the value of such a publication, the quality of the presentations persuaded everyone otherwise. This issue presents a selection of papers based on the work presented at the meeting as well as some invited contributions from those who were not present.

Both editors have a long association with Mike Land as both a colleague and a friend. RHD encountered him as an impressionable undergraduate in the mid-1970s. The final year course Mike and his colleagues taught on ‘Sensory Systems’ has been the basis for his whole career and barely a day goes by where he does not use something he learnt all those years ago. TWC spent a sabbatical year working in Mike’s laboratory at the University of Sussex over two decades ago and hosted a return visit by Mike a few years later to his home university in Baltimore. Much
of his work in the ensuing years (including his paper in this issue) stems from interactions that took place with Mike’s group all those years back. Both RHD and TWC hope this issue in a very small way acknowledges someone who has been so influential for them and has ‘seen’ and ‘done’ more than most of us could ever hope to.

References