Journal Club

Mine's a packet of crisps…

We all know that toiling outside on a hot day can conjure up all sorts of fantasies about long, cool drinks, but does working up a thirst actually affect our perceptions of reality? This is the question that Changizi and Hall pose in a new paper in *Perception* [1]. They reasoned that it would be highly adaptive for individuals to be biased toward perceiving water when they are thirsty; it is much less costly to see water mistakenly in a place where there isn't any, than to think that there isn't any water available when, in fact, there is. Changizi and Hall therefore suggested that we should expect thirsty individuals to show perceptual biases towards water-like properties of visual scenes. The specific attribute they chose to test was transparency, because this is a typical property of water and also because there is no obvious association between thirst and transparency, so subjects would not realize what was being tested and thus bias the results.

Seventy-four subjects were divided into two groups: a 'thirsty' group, who ate a packet of salty crisps before the experiment, and a 'non-thirsty' group, who drank water to satiation. Subjects were then tested on one of two stimulus sets. One set consisted of a circular pattern in which there were 'definitely' transparent stimuli, 'ambiguously' transparent stimuli and 'definitely not' transparent stimuli. The second set of stimuli was of the same format, except that the patterns were rectangular. Changizi and Hall predicted that thirsty subjects would be more likely to classify 'ambiguous' stimuli as transparent than the non-thirsty subjects, but that they would show no difference in cases where the stimuli were definitely transparent or not transparent.

Overall, for both stimulus sets, there was a significant difference between groups in the number of ambiguous stimuli perceived to have a transparent surface: 58% of thirsty subjects perceived transparency, whereas only 47% of non-thirsty subjects did so. In addition, the number of 'pro-transparency' subjects (those who perceived more than half of the ambiguous stimuli to be transparent) was greater for the thirsty group than the non-thirsty group – for all stimuli combined, only 14 of 37 non-thirsty subjects were pro-transparency compared with 25 of 37 thirsty subjects. As also predicted, there was no difference between groups in how they perceived the unambiguous stimuli.

The results thus supported Changizi and Hall's hypothesis and, moreover, showed that a very small change in the subjects' biological state (small enough to be induced by a single packet of crisps) was sufficient to have a significant influence on how they perceived a visual scene. The authors conclude that, in real-world settings, such biases would undoubtedly contribute to individuals' subsequent behavioural responses, increasing their likelihood of making beneficial decisions. And on that note, I'm off to the pub.

1 Changizi, M.A. and Hall, W.G. (2001) Thirst modulates a perception. *Perception* 30, 1489–1497

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Monkeys, motion and magnetic resonance

The visual image on the retina is almost constantly in motion. Correct interpretation of that motion is a vital component of visual perception. A number of attempts have been made, using brain imaging techniques, to establish which parts of the human brain encode image motion. But what constitutes a fair test? If we simply look for activity generated by a moving pattern, we won't know whether it is the movement, or the pattern itself, that causes the activity. If we compare the activity with that elicited by a stationary version of the same pattern, this will help, but the difference between the two activity levels might reflect a response to local luminance changes (i.e. flicker), rather than to motion *per se*, and so on.

Tolias *et al.* [1] have applied an ingenious technique, introduced recently by Grill-Spector and colleagues in the context of object perception, that can be characterized as 'adaptation rebound' and which looks set to spawn a great many more applications. Using fMRI, Tolias *et al.* repeatedly imaged a monkey's brain while the animal viewed continuous motion in a single, unchanging direction. As expected, the response became gradually smaller as visual neurons adapted. Then the direction of motion was abruptly reversed. The measured brain activity immediately showed a partial recovery, or rebound. The extent of this rebound gives an index of the average direction sensitivity of neurons in the cortical region under study, as all aspects of the stimulus other than direction of motion remain unchanged. After making a separate measurement of rebound in each visual area, the degree of direction sensitivity was compared across areas. The result will surprise primate vision specialists: area V4 is apparently just as sensitive to direction of motion as is V5 (MT), in stark contrast with results from single-neuron studies in macaque monkeys.

Because the imaging studies were performed, unusually, in macaques rather than humans, the conflicting results cannot be attributed to a species difference. An obvious and somewhat depressing alternative is that the blood-oxygen-level-dependent (BOLD) response on which fMRI is based does not faithfully reflect the level of underlying neural activity, an issue which is currently the subject of hot debate. However, Tolias *et al.* point out that if two inputs with opposite direction sensitivities were pooled by a V4 neuron, the neuron would be non-directional, but only until one input became more adapted than the other. The computational advantage of creating and then destroying direction selectivity is not obvious, although it might form part of a general normalization or alerting system designed to favour any stimulus that differs from the recent stimulation history. A simple experiment should be able to reveal whether unexpected directionality appears in single V4 neurons following adaptation to motion. Until it is done, those of us who have taken the fMRI plunge might remain anxious about the less attractive interpretation.

1 Tolias, A.S. *et al.* (2001) Motion processing in the macaque: revisited with functional magnetic resonance imaging. *J. Neurosci.* 21, 8594–8601

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1364-6613/02/$ – see front matter