**Background**

Fire is a complex and dynamic phenomenon. Characterised by rapidly shifting patterns of colour and motion, it evokes rich visual percepts as well as aesthetic responses. We report an investigation of the visual features useful for discrimination between similar fires, the processes responsible for comparing them, and the specificity of the neural representations involved.

Over the last 1.8 million years, the evolving human visual system has been exposed to a large amount of flamelike stimuli \cite{ bowman2009fire}whose perception, control and mastery conferred a key evolutionary advantage\cite{ bowman2009fire}. We characterised

**Zoom**

**Hooks**

To engage the neural structures involved in fire perception, we used a delayed-match-to-sample task whose stimuli comprised short video clips of a hearth fire. In each trial, subjects viewed a sample clip followed by two slightly longer candidate clips, one of which was a padded version of the sample.

In such a 2-alternative forced choice task, evidence for either option is accumulated until a decision can (or must) be made\cite{bogacz2006physics}. We characterised the evidence present in fire clips by looking at the relationship between clip length and discrimination accuracy.

Fire clips provide different kinds of evidence: colour detail and luminance detail. Luminance-defined motion is processed better than colour-defined motion\cite{ramachandran1978does,cavanagh1984perceived,cabanagh1991contribution,mullen1992absence}, but colour-defined motion is nevertheless perceptible\cite{cropper1996rapid}. We measured the importance of colour-defined motion using monichromatic test stimuli.

Motion is categorised as either first- or second-order\cite{cavanagh1989motion,ledgeway1994evidence}. First-order motion is due to displaced form (the motion in time of correlations in space), whereas second-order motion is due to dynamic contours (motion of patterns which when still are not differentiable from the background).

Attention to these patterns of motion induces activation in separate neural structures\cite{ashida2007fmri,vaina1998selective}, implying that they may be processed differently. A third type of motion percept, apparent movement, is induced by noncontinuous displacement (as in the \phi and \beta phenomena)\cite{steinman2000phi}. We altered the frame rates and temporal playback direction of video stimuli to examine the effets of different types of motion.

Object recognition is a key function of vision\cite{pelli2013object,dicarlo2012does} and is linked with outline shape\cite{hayward1998effects} because outlines delineate objects' spatial extent. To investigate whether object perception is important in fire perception, we measured subjects' discrimination accuracy on fire clips altered to show just object edges.

The visual system is specialised for certain types of stimuli, such as faces\cite{gauthier2001development,de2002specialization} or words\cite{cohen2004specialization}. Some stimuli provoke responses which differ in accuracy or response time\cite{fox2000facial}. We wondered whether the evolutionary benefit conferred by fire had specialised the human visual system. Expertise is commonly indicated by a performance boost when discriminating upright stimuli\cite{valentine1998upside}, and we found no evidence of an orientation-specific model for faces.

----Should we put the results in here, or leave them as a hook?

**Result summary**

**Lead-in**

**2AFC process**

**What aspects**

**What kind of motion**

**Tuned to orientation?**

**Materials and Methods**