A critical component of visual motion processing is segmentation, or parsing. Because of the aperture problem, moving objects typically emit motion signals with a range of directions, and these must be integrated to compute the motion of the object as a whole. This is a particularly difficult problem because of the risk of combining motion signals from different objects. Since the 'global' motion of separate objects has no meaning, visual motion cues must be parsed either before or concurrently with integrative processing.

The neural mechanisms of parsing, or segmentation, are poorly understood. This is at least partly due to the fact that segmentation is not a stimulus property, but rather a perceptual result. While earlier studies have linked neural responses to stimulus components that generally convey a sense of coherence or transparency (separateness), there has been no direct link to perception; that is, a neuro-perceptual correlate in the absence of any stimulus variation.

We trained two rhesus monkeys to view superimposed moving gratings (plaids), then report whether the gratings moved coherently (univectorial percept) or tranparently (bivectorial percept). Superimposed gratings are inherently ambiguous because of the aperture problem: because of the absence of contrast along the lengthwise dimension of the gratings, there is no motion signal; thus one sees only the orthogonal. However, by faintly texturing the gratings, the stimuli could be made to look either transparent or coherent in a majority of trials. This was used as a basis for training the animals. Other stimuli were included, however, without any texture; thus, these were ambiguous in terms of coherence vs. transparency.

We recorded from area MT neurons while monkeys performed this task, then analyzed neural data from trials where the stimulus was ambiguous. In 15/24 (63%) of neurons tested, firing rates were significantly correlated with the monkey's judgment of the stimulus (coherent or transparent). In the majority of these (12/15, 80%) this perceptual effect was consistent with the neuron's responses to the textured stimuli; that is, neurons that responded better to the (texture-defined) coherent stimuli tended to respond more to the ambigous stimulus when the monkey judged it to be coherent.

These findings suggest that perceptual decisions involving the coherence or separateness of moving targets may involve relative firing rates of MT neurons.