Eye Movements and Pupil Dilation During Event Perception

Dr. Tim J. Smith*, Martyn Whitwell, Dr. John Lee

Institute for Communicating and Collaborative Systems (ICCS),
School of Informatics, University of Edinburgh, UK

*contact = tim.smith@ed.ac.uk
http://homepages.inf.ed.ac.uk/s9732397/

Goal of this Study

To use eye-tracking to identify if eye movements and other ocular events (such as pupil dilation) are related to the perceptual act of event segmentation.

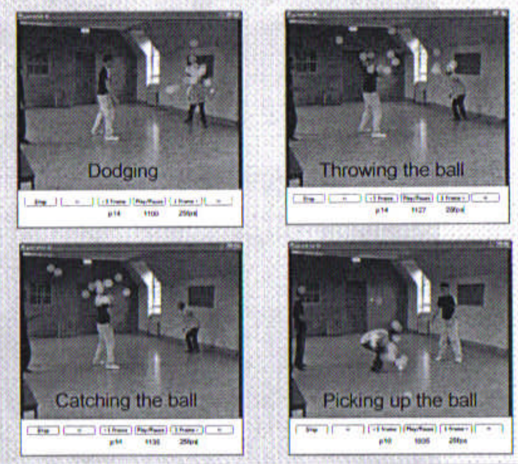
What is Event Segmentation?

Event Segmentation refers to our ability to 'parse' continuous visual actions into discrete and consistent events. These events can be small ("fine") or large ("coarse") with clusters of fine-grained segments relating hierarchically to coarse segments.

This phenomenon was first discovered by Darren Newtson in the 1970s but has recently under gone renewed interest due to neuro-imaging evidence that parsing occurs during normal viewing [Zacks et al. 2001].

Segmentation behaviour is associated with neural activity in the Medial Temporal complex (MT+) and Frontal Eye Field (FEF) under both active and passive segmentation conditions [Zacks et al. 2001].

These two brain regions are known to be active during the processing of visual motion (MT+) and guiding saccadic eye movements (FEF). This, along with behavioural evidence [Zacks 2004], indicates that visual motion may play an important role in identifying events.



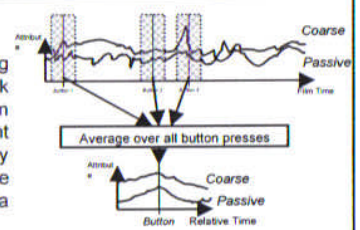
Methodology

19 subjects (aged 18-34, 6 males) performed three stages of segmentation: **passive**, **active coarse**, and **active fine**. The subjects were instructed to press a button to mark off the behaviour of the person or people into the largest (coarse) or smallest (fine) units that seemed meaningful.

Eye movements were recorded using an Eyelink II (SR Research Inc.) eye tracker recording at 500Hz.

Analysis

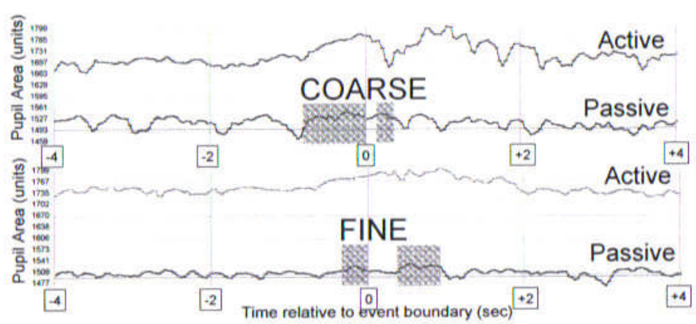
The event boundaries identified during the coarse and fine segmentation task were superimposed onto the data from the passive viewing condition. All event boundaries at a particular granularity were then aligned to create an average pattern of ocular activity around a passive event boundary.



Results: Pupil Dilation

Pupil area was significantly larger than the mean immediately before the event boundary under passive and active, coarse and fine conditions. This can be interpreted as indicating a high degree of cognitive load [Hess and Polt 1964]. This cognitive activity can be attributed to the encoding of the event in memory [Newtson and Engquist 1976].

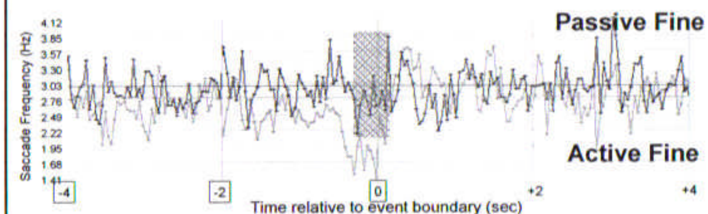
Immediately after event boundaries (0-120ms for coarse, 0-400ms for fine) pupil area returned to the mean before increasing again. The subsequent increase could be attributed to the cognitive activity required to process the new event.



Results: Saccade Frequency

There was a significant decrease in saccade frequency 260ms prior to a passive fine event boundary followed by a sudden increase 140ms after the boundary. A similar decrease was observed during active segmentation.

This increase can be interpreted as visual search conducted to orient to the new event. No effect was observed for coarse boundaries.



Conclusions

This eye-tracking evidence confirms neuro-imaging and behavioural evidence that changes in eye movements may be involved in the perception of fine event boundaries. The results also indicate that there are signs of increased cognitive load immediately before and just after all event boundaries (indexed as pupil contraction). Taken in combination this evidence can be interpreted as indicating that the perception of human behaviour is event based, beginning with visual search and ending with encoding of the event in memory.

Acknowledgements

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