C17



The Multi-Element Visual Tracking (MVT) Task

In the MVT task, a group of identical stimuli move independently around a display while observers track a subset of them. Observers can typically track about 4 or 5 separate stimuli (Pylyshyn & Storm, 1988).



Targets Cued

Tracking Interval: All Stimuli Move



Targets Must **Be Selected**

Successful tracking is possible even if all stimuli disappear for a 300-400 ms gap (Alvarez, Wolfe, Horowitz, & Arsenio, 2001; Keane & Pylyshyn, 2003).



How do observers remember which stimuli were tar-

gets during the gap and how do they reacquire them

Tracking Interval

after the gap?

First Post-Gap Frame

Location-Matching

Account

Memorized - pre-gap target

On target trajectory: identified as target.



memorized location identified as target.







Target Reacquisition Strategies in Multiple Object Tracking David E. Fencsik^{1,2}, Todd S. Horowitz^{1,2}, Sarah B. Klieger¹, & Jeremy M. Wolfe^{1,2} Brigham & Women's Hospital (1) Harvard Medical School (2)

Contact: fencsik@search.bwh.harvard.edu

Experiments 1 and 2

In Experiments 1 and 2, we varied stimulus reappearance location following the gap (cf. Keane & Pylyshyn, 2003).



- All stimuli reappeared in the same relative positions.
- Observers tracked 5 of 10 stimuli.
- Experiment 1 included Position 0 and Position 1.
- Experiment 2 added Position -1 and used slower moving stimuli.



- Position 0 is better than Position 1: »Replicates Keane & Pylyshyn (2003). » Supports location-matching.
- Position -1 equals Position 0 and is better than Position 1

» Suggests other types of target reacquisition.

Experiments 3 and 4

In Experiments 3 and 4, we compared tracking performance with and without motion information prior to the qap



- Experiment 3: observers tracked 1 or 4 of 10 stimuli.
- Experiment 4: they tracked 1, 2, 3, or 4 of 10 stimuli.



- When there are 1-3 targets, Moving is better than Static.
- When there are 4 targets, Moving equals Static.
- Supports trajectory-matching for about 1-2 stimuli.



Conclusions

 Observers track both location and trajectory information in MVT tasks.

» Experiments 1 and 2 support location-matching.

» Experiments 3 and 4 support trajectory-matching.

- The present results, along with previous results, suggest that location information is limited to 4-5 oblects.
- Experiments 3 and 4 suggest that trajectory information may be limited to just 1-2 objects.

Remaining Questions

- Can we find converging evidence for the capacity limit on trajectory information?
- How long is this information retained?
- What other information can be tracked for moving objects and how is it stored?
- Are the capacity limits related to the limit of visual short-term memory (Vogel, Woodman & Luck, 2001)?

References

- Alvarez, G. A., Wolfe, J. M., Horowitz, T. S., & Arsenio, H. C. (2001). Limits on multielement tracking [Abstract]. Journal of Vision, 1(3), 347.
- Keane, B. P., & Pylyshyn, Z. (2003). Does tracking disappearing objects in MOT involve predicting the locus of reappearance? [Abstract]. Journal of Vision, 3(9), 583.
- Pylyshyn, Z. W., & Storm, R. W. (1988). Tracking multiple independent targets: Evidence for a parallel tracking mechanism. Spatial Vision, 3, 179-197.
- Vogel, E. K., Woodman, G. F., & Luck, S. J. (2001). Storage of features, conjunctions, and objects in visual working memory. Journal of Experimental Psychology: Human Perception and Performance, 27, 92–114.
- We thank George Alvarez for important suggestions. Sponsored by NIH.

Reprints available at: http://search.bwh.harvard.edu/