New Mexico State University
Vison Sciences and Memory Lab

Stopping the MADness:

Investigating the Effects of Dynamic Feature Prevalence and Quitting Behavior in Dynamic Visual Search

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Introduction

Visual attention is guided by basic visual features (Treisman & Gelade, 1980; Wolf, Cave, & Franzel, 1989), such as color, shape, and orientation. Dynamic features, like motion (McLeod et al., 1988), can also direct attention, but the effects of features that result in changes in a visual scene are unclear. Kunar and Watson (2011; 2014) used a Multi-element Asynchronous Dynamic (MAD) search display to test visual search performance in dynamic visual environments (like monitoring closed circuit security feeds for "suspicious activity"). They found that moving targets were missed more frequently and had higher search slopes than non-moving items. MAD search also resulted in higher miss rates (~30%) than what is usually expected in laboratory visual search experiments.

In the current experiments, we further investigated how searchers navigate dynamic environments, using a MAD search paradigm. Specifically, we tested the extent to which non-defining dynamic features can guide search when they are disproportionally associated with targets. We also investigated if dynamic search environments hinder a searcher's ability to establish consistent and effective quitting strategies, compared to a static search display.

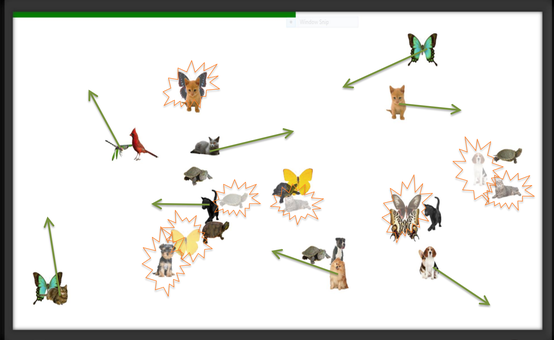
Experiment 1

- Do dynamic features (that do not define a visual target) create a categorical-prevalence-like effect?
- Are any particular dynamic features more prone to being missed than others, regardless of their association with targets?

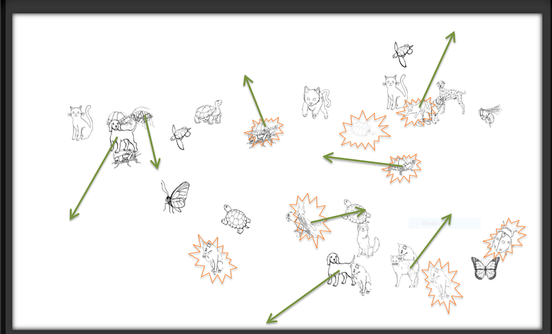
Experiment 2

- Is there a key difference in quitting behavior between dynamic and static searches?
- If misses occur in MAD search because search is terminated too quickly, then RTs should trend downward prior to a miss (below a searcher's average target-absent response time).

Experiment 1a



Experiment 1b & 2



Methods

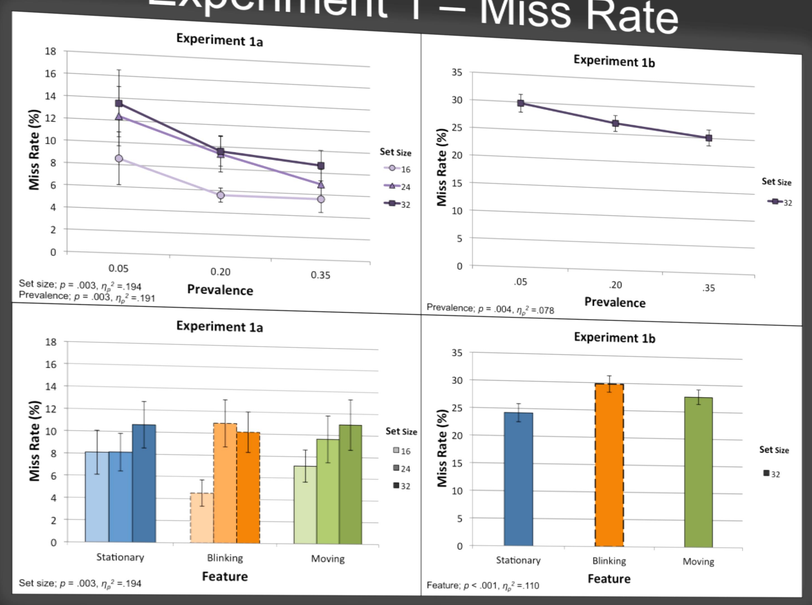
Experiment 1a & 1b: Testing dynamic feature prevalence effects.

Participants (Exp 1a N=28, M_{age} = 22.4; Exp 1b N=68, M_{age}=19.3) completed 500 trials of MAD search with picture stimuli. The overall target prevalence was 60%, but each dynamic feature appeared at a different rate (5%, 20%, 35% of trials). The rate of feature prevalence was randomized between participants. There was also a five second time limit. Stimuli in Experiment 1a were photorealistic images of animals, and stimuli in Experiment 1b were line drawings of the same animal categories.

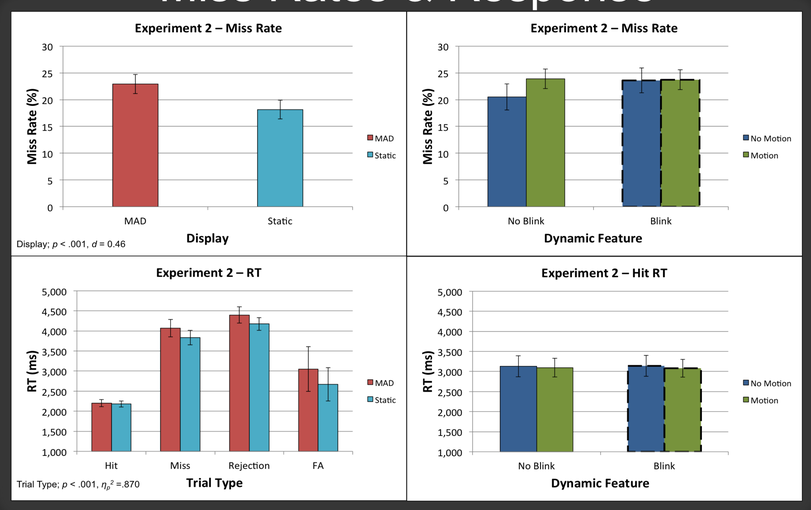
Experiment 2: Testing quitting threshold differences.

Participants (N=36; M_{age} 20.6) completed 250 trials each of MAD search and static search. Dynamic features occurred at equal rates across targets, and participants were given accuracy feedback after each trial. There was no time limit in this experiment.

Experiment 1 – Miss Rate



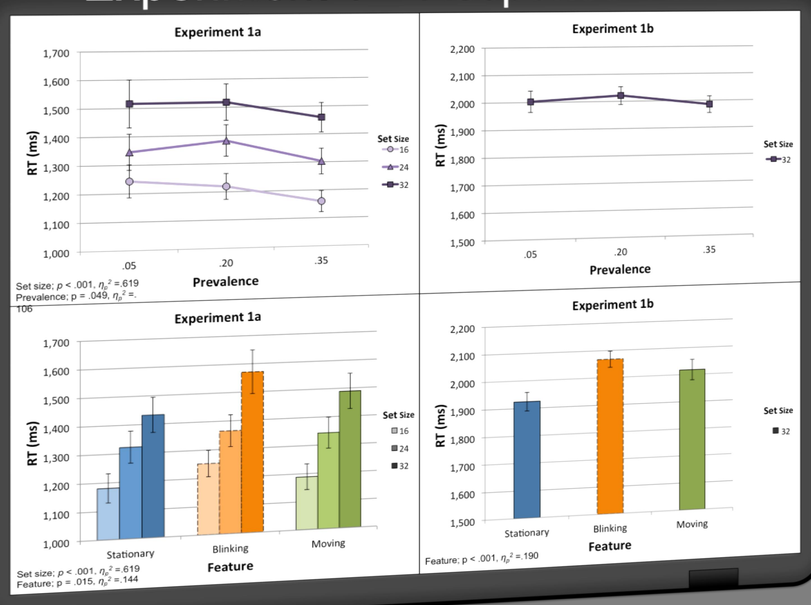
Experiment 2 – Miss Rates & Response



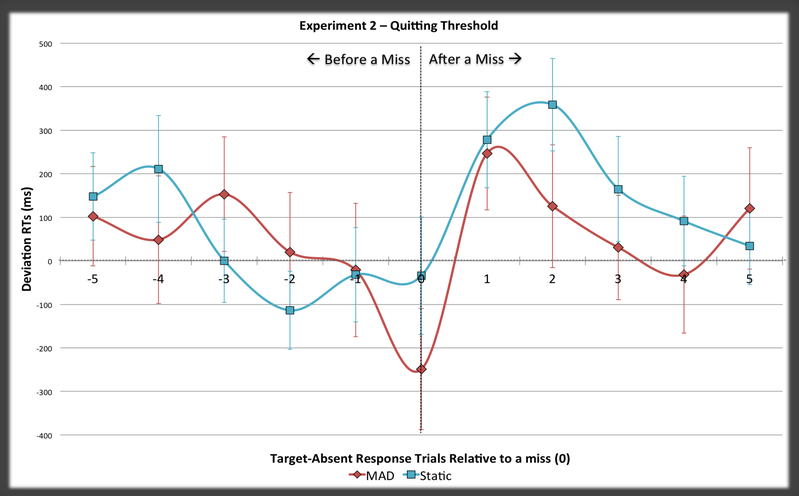
Discussion – Exp 1

- Targets that possessed a rarely occurring dynamic feature tended to be missed more frequently than regularly occurring features.
  - These dynamic features did not define targets or single targets out in a bottom-up fashion, yet it seems the association of a regularly occurring feature reduced the likelihood of missing a target when it possessed that feature.
- The effects of specific dynamic features were somewhat inconsistent between experiments, but blinking tended to impair search performance for targets.

Experiment 1 – Response Time



Experiment 2 – Target-Absent Response RTs Relative to a Miss



Discussion – Exp 2

- MAD search resulted in higher miss rates than static search.
- Moving targets were not missed more frequently, nor did they take longer to locate compared to non-moving targets.
- Misses in MAD search tended to be proceeded by a series of quickening target-absent responses, while target absent responses before a miss in static search tended to be more steady. This might reflect an inconsistent search strategy in dynamic environments, resulting in hindered performance.