



Why magic works? Attentional Blink with Moving Stimuli

Marta Kryven and William Cowan

Computer Graphics Lab, David R. Cheriton School of Computer Science, University of Waterloo, Canada



Stage magicians know how to hide actions in plain sight. One method is to perform two actions in succession so that the audience attends to the first action, but misses the second. For example, a magician waves a magic wand and immediately drops a coin missed by the spectator.



Fig. 1: Magic wands are used to perform a trick-irrelevant movement before a trick.

Such a technique resembles attentional blink, a phenomenon when the detection of the second of the two visual targets presented in close succession is impaired. The subjects respond to the first target, T1, but if the second target, T2, is presented within about 500ms of T1, it is often missed. In a typical attentional blink experiment targets are letters or digits (MacLean & Arnell, 2012). To investigate whether attentional blink may create magic effects we show that it occurs even when both task require discriminating motion.

EXPERIMENT 1

Procedure. T1 is a letter presented at fixation. Surrounding the letters is a dim red circle comprising $4dov$, T2. On half of the trials the circle shrinks or grows a small amount shortly after T1 is presented. Subjects respond to T1 by indicating whether the target is a vowel or a consonant and to T2 by indicating whether motion was present. We varied difficulty of T1 masking: the easy and the hard T1 condition.

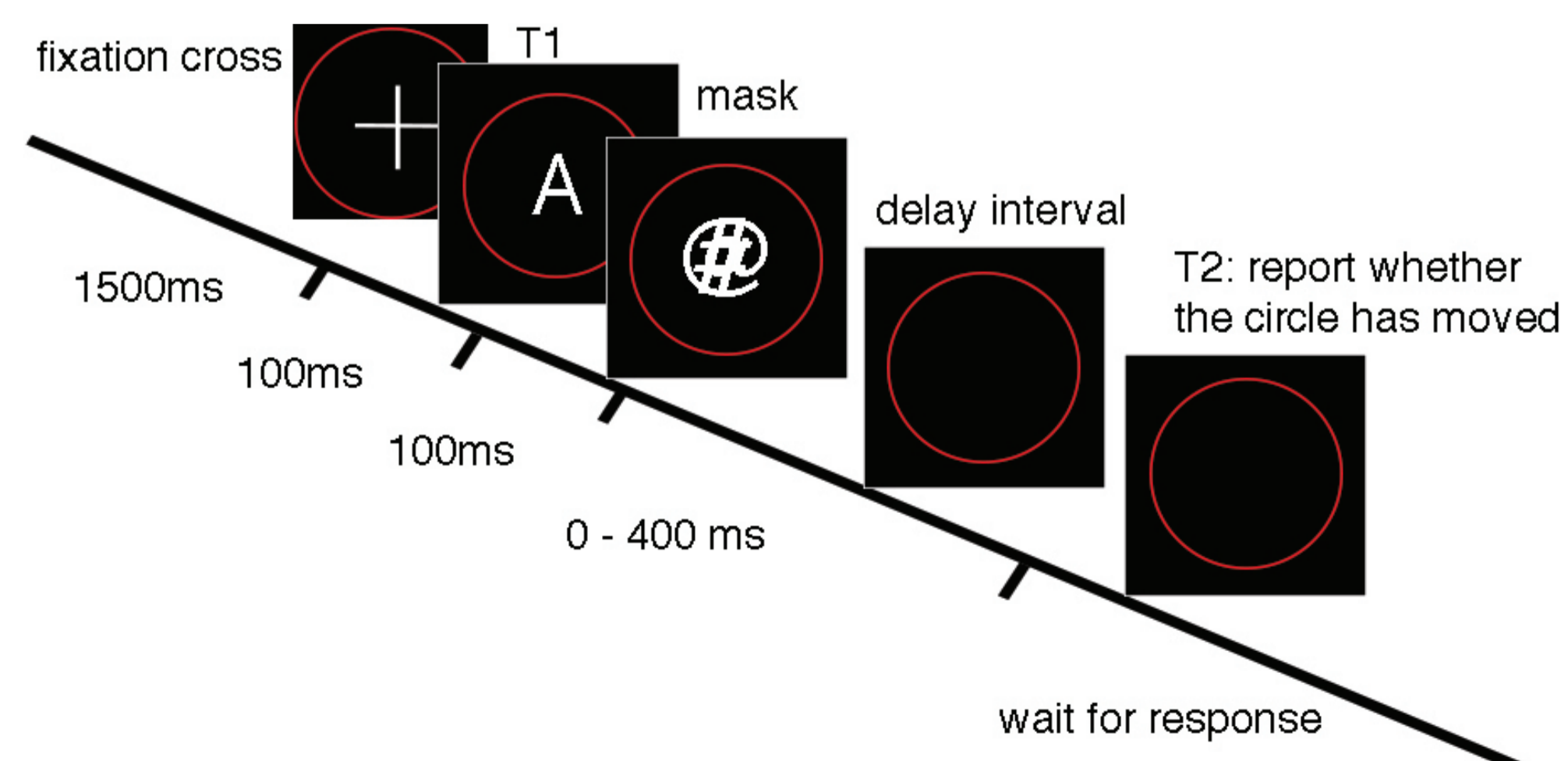


Fig. 2: The time-course of a trial in Experiment 1. T1 targets are letters. T2 is detecting motion.

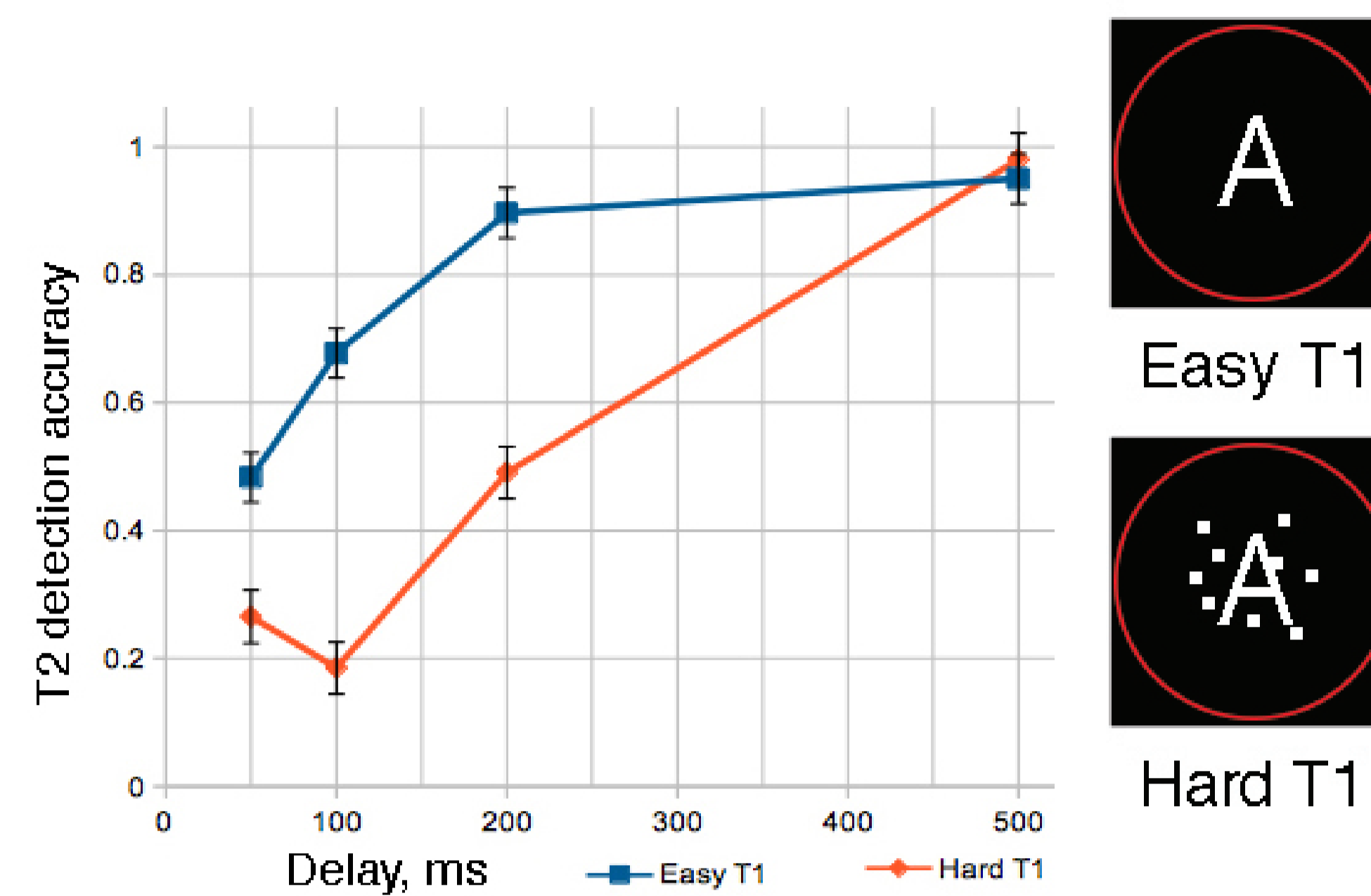


Fig. 3: Motion detection accuracies in the easy T1 condition compared to the hard T1 condition. Error bars represent standard error of the mean. Images on the right show a T1 stimulus in the easy T1 and in the hard T1 conditions.

Result:

- Significant main effect of delay in both conditions ($p < 0.0001$).
- Significant main effect of condition ($p < 0.0001$).
- Significant effect of condition at equal delays ($p < 0.0001$ at delay 100ms and 200ms): Harder visual discrimination of T1 deepens attentional blink.

EXPERIMENT 2

A moving background during an attentional blink task was observed to attenuate attentional blink for literal stimuli, possibly due to peripheral motion inducing a diffused attentional state (Arend, Johnston & Shapiro, 2006). We investigate whether the same effect extends to attentional blink with motion detection tasks. **Procedure.** A moving background of 32 particles varying in diameter and moving away from the center of the screen is presented in the periphery while the subjects performs T1 and T2 as in Experiment 1.

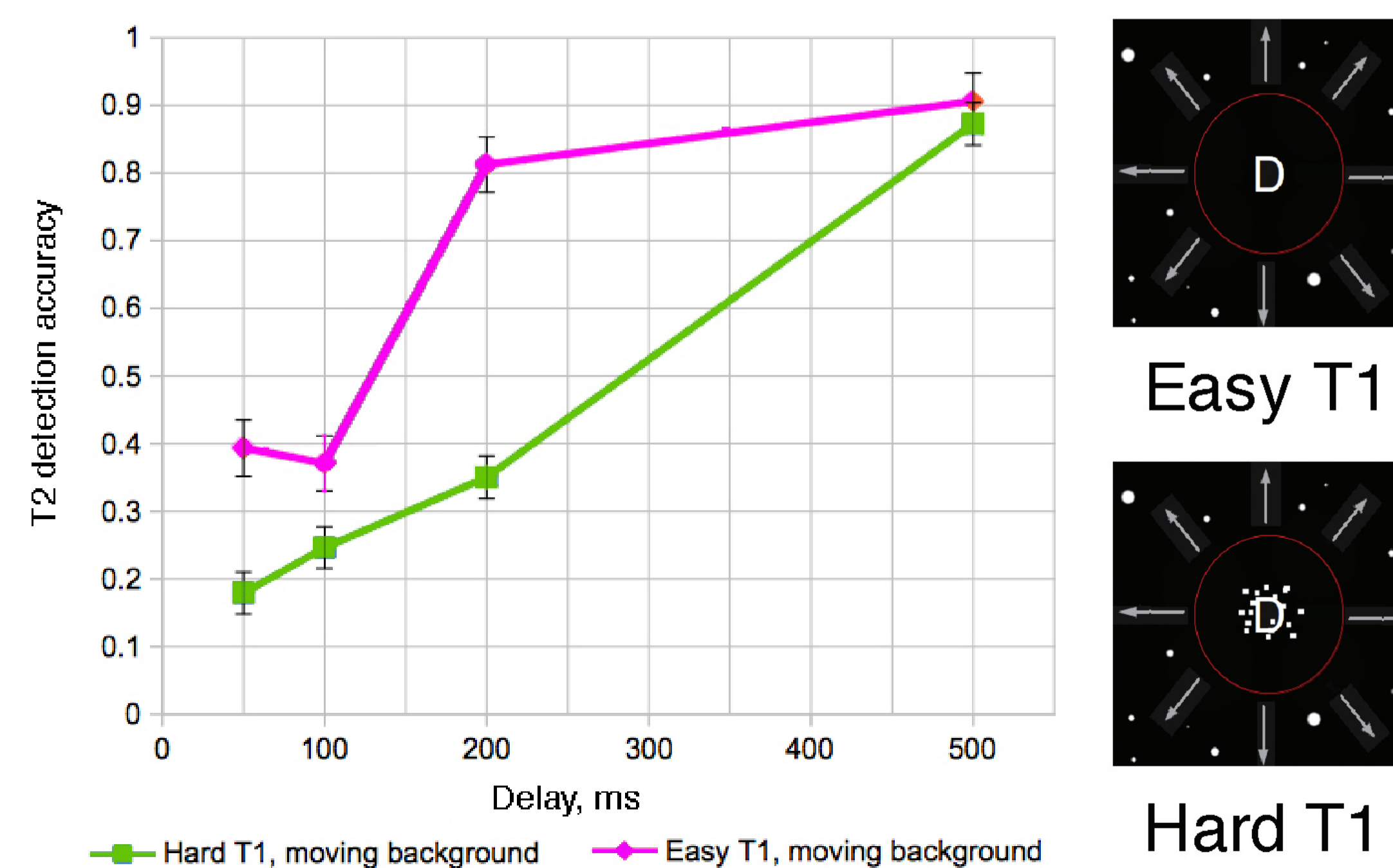


Fig. 4: T2 detection accuracies for the easy T1 with a moving background and the hard T1 with a moving background conditions. Error bars represent standard error of the mean. Images on the right show a T1 stimulus in the easy T1 and in the hard T1 conditions.

Result:

- Significant main effect of delay in both conditions ($p < 0.0001$).
- Significant effect of condition between the easy T1 with a moving background and the hard T1 with a moving background ($p < 0.0001$ at delay 200ms).
- Significant main effect of condition ($p < 0.0001$).
- No significance of condition at equal delays between easy T1 and easy T1 with moving background as well as between hard T1 and hard T1 with moving background. Attenuation of attentional blink with moving background did not occur, possibly, because the distractors moving in the background compete for attention with the moving stimulus T2.

EXPERIMENT 3

Does attentional blink occur when both tasks require a response to moving graphics? **Procedure.** T1 is 3 or 4 moving dots presented for 100ms within $2dov$ of fixation, immediately followed by many more moving dots acting as a mask. Subjects report whether the number of dots is odd or even. T2 is a dim red circle, as before.

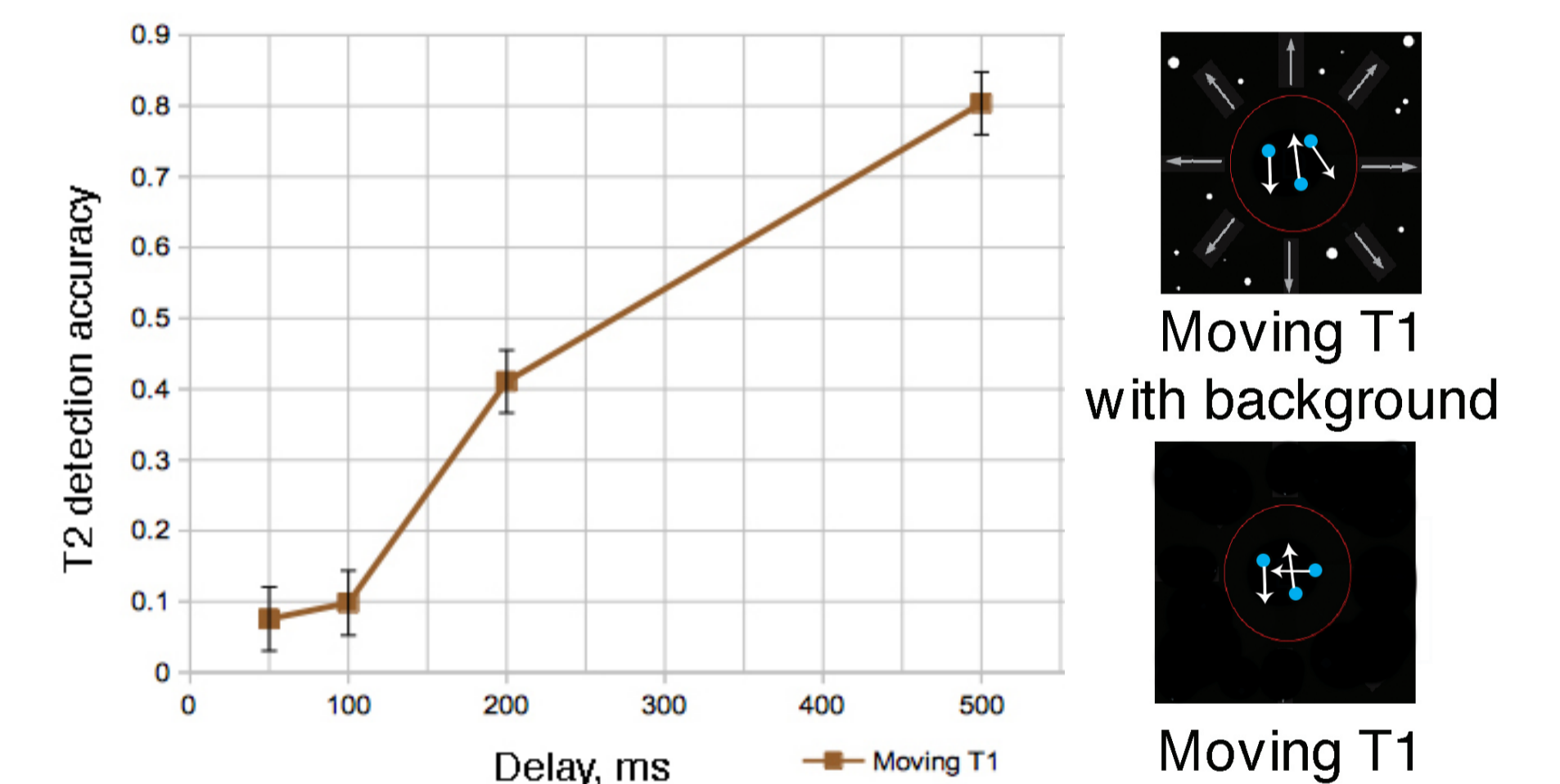


Fig. 5: T2 detection accuracies with moving T1. Error bars represent standard error of the mean. Images on the right shows a T1 stimulus.

Result:

- Significant main effect of delay ($p < 0.0001$).

DISCUSSION

Performing stage magic successfully requires precise timing. Even a slight delay can alert the spectator and ruin the effect. Attentional blink occurs within a time window of 100-500ms, within the ability of a practiced human. Attentional blink is likely to be one of the perceptual phenomena exploited in stage magic. It may be also useful for hiding rendering artifacts in computer animation.

References

- Arend, Isabel, Stephen Johnston, and Kimron Shapiro. "Task-irrelevant visual motion and flicker attenuate the attentional blink." *Psychonomic Bulletin & Review* 13.4 (2006): 600-607.
- MacLean, Mary H., and Karen M. Arnell. "A conceptual and methodological framework for measuring and modulating the attentional blink." *Attention, Perception, & Psychophysics* 74.6 (2012): 1080-1097.