Attraclion, Distraction, and Action: Multiple Perspectives on Attentional Capture 77
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# 4 Involuntary Orienting to Flashing Distractors in Delayed Search?

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Common sense suggests that abrupt change in the sensory environment often captures our attention, and early writers on attention generally endorsed this view. Titchcner (1908), for example, remarked that any sudden change or movement, including a change in pitch, could distract someone from concentration on something else (p. 192), and James (1890/1950) made similar suggestions.

Recent studies using visual search tasks to measure attention shifts have supported and refined this hypothesis. Abrupt appearance of a new object does indeed seem to trigger a shift of visual attention to the object even when the shift is unhelpful to performance. This is demonstrated by faster responses to targets that appear suddenly as compared to those that "fade in" (even when sudden appearance does not predict that a stimulus will be a target), and also by faster responses to cued items that follow nonpredictive cues (Yantis, 1994; Yantis & Hillstrom, 1994). Remington, Johnston, and Yantis (1992) found that even in blocks of trials in which the target *never* appeared in the position of the onset cue, thus providing a maximum incentive to ignore it, the cue still apparently drew attention. Contrary to the views of early writers, however, other changes such as offsets or changes in color do not generally seem to produce involuntary orienting (see Yantis, 2000, for an overview).

While the findings just described would seem to imply that orienting to onsets is completely involuntary, recent results challenge this view, and suggest that onset-triggered shifts may be contingent on what task set a person has chosen to adopt. Folk, Remington and Johnston (1992) had subjects make a speeded discrimination, choosing between an = and an X (see Figure 1). Two different tasks were paired with two different cue sequences. In the single-item task (the upper box on the right), a single symbol (= or X) was presented in one of four positions at the corners of an imaginary square. In the color-selection task (lower right box), there were four symbols; one of these was red, and subjects responded to that one. One of the cue sequences consisted of tiny flashing disks surrounding one of the positions (Onset Cue sequence). Onset cues seemed to produce involuntary orienting in the single-item task (performance was worsened by the presence of the cue even when its location never predicted the target position). They did not have this effect in the. color-selection task, however. In the Color Cue sequence, red dots surrounded one location and green dots surrounded the other locations. Color cues interfered with performance in the color-selection task even in blocks where the cued location never

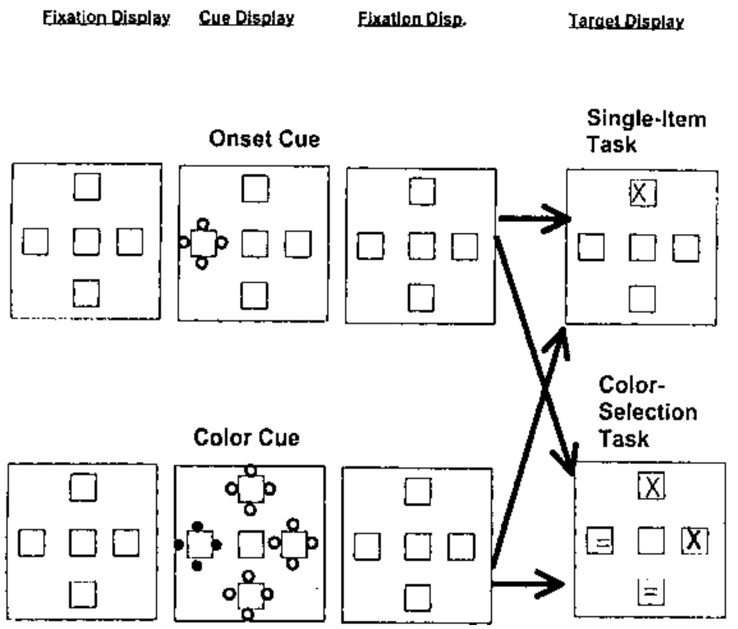


*Figure 1.* Design used by Folk, Remington and Johnston (1992). Subjects see a sequence of four displays, proceeding from left to right. The four arrows depict different cue-target sequence conditions.

predicted the location of the target. Not surprisingly, they had no such effect in the single-item task.

To account for this pattern of results, Folk et al. proposed what they termed the Contingent Involuntary Orienting (CIO) hypothesis. According to this theory, there is no truly automatic (task-set independent) orienting to onsets, unique colors, or any other stimulus property. Rather, what appears to be involuntary orienting occurs when observers have adopted a task set to optimize performance in the primary task, and this task set governs the response to the cues as well as the display that requires a response. If the relevant item is going to appear suddenly in uncertain locations, according to the CIO account, people adopt a set to orient to onsets. It is evidently impossible to have this set in place by the time the display appears without having it set up at least 200 ms earlier, and thus the set affects processing triggered by the cue as well as the target display. Consequently, a rapid-onset cue causes some degree of orienting to its location even when this orienting is predictably disadvantageous. Presumably, the disadvantage of orienting to the cue is more than compensated for by the benefit of having this set in place when the target display appears. Similarly, the set to select red stimuli, adopted in anticipation of a color-selection task, spills over to produce seemingly involuntary orienting to a red cue.

The Folk et al. data are consistent with the CIO hypothesis, but for the present author at least, the results (and supporting evidence amassed by Folk & Remington, 1999, and Gibson & Kelsey, 1998) seemed less than fully convincing. For one thing, the onsets that were successfully ignored in the color-selection task appeared prior to, rather than concurrently with, the display. Thus, the results do not necessarily demonstrate that observers can shut out interfering onset stimuli while they are happening (cf. Gibson & Wenger, 1999). For another, the cue effects are relatively small (26 ms effect of onset cues in the onset target condition), as one might expect given the small display load, making it difficult to gauge their presence and their nature with complete confidence (Luck & Thomas, 1999). A third reason that the Folk et al results seem less than compelling is that their account of the color-selection task is puzzling in certain respects. The four stimuli displayed in the color-selection task are all rapid onsets, after all. While the property of being an onset does not discriminate target from distractor, neither did it in many studies finding involuntary orienting to onsets (Jonides & Yantis, 1988). Further, even in the onset task, it is not clear in exactly what sense the property of being an onset is essential; it is not needed to discriminate target from distractors, because there are no distractors.

CIO would seem to make a simple and, to the author, quite counterintuitive prediction to which the objections or conceptual puzzlements just mentioned would not apply. The prediction is this: while people search a crowded display based on color, attempting to ignore interspersed distractors of a different color, it should make no difference at all if the distractors flash on and off while the search is underway. The problem in testing this prediction is that, according to the CIO hypothesis, the prediction will not hold if the relevant stimuli themselves appear suddenly as they do in a conventional search experiment. If relevant stimuli are onsets, observers may be expected voluntarily to set themselves to orient to onsets as they arc presumed to have done in the single-item task used by Folk et. al. To get around this problem, search displays in the experiment described below were presented before the subject knew what target he or she would be searching for. The subject was informed about the target by a spoken message played through the computer speakers.

To produce robust distractor effects, very busy displays were used. Each search display consisted of 30 red digits scattered quasi-randomly throughout the CRT monitor screen, sometimes with 30 additional distractors added (Figure 2 and 3). Three hundred milliseconds after onset, the computer played a wave file consisting of a spoken digit and the subject began searching the red items to determine if this target digit was present. In no-distractor blocks, the display contained only the 30 red digits. In static-distractor blocks, it contained the red digits plus another 30 green digits interspersed among them (some of which might have the same numerical identity as the target). In flashing-distractor blocks, the display contained the red digits plus 30 green digits flashing 200 ms on, 200 ms off, and so on.

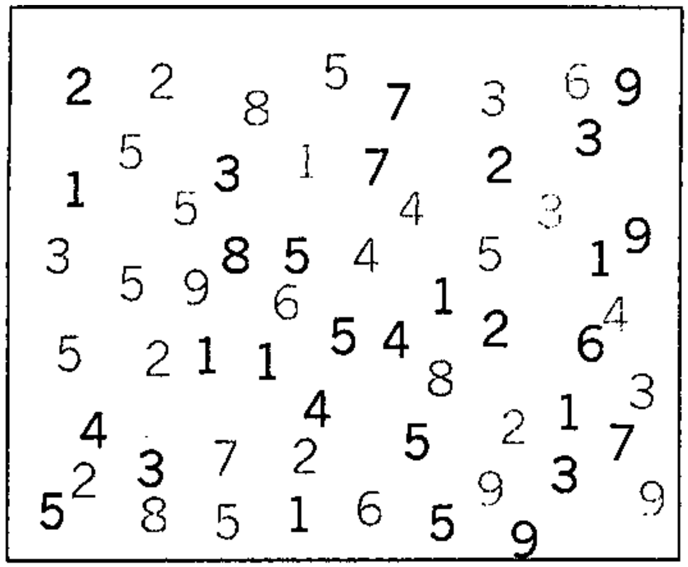

*Figure 2.* Schematic of display used in present experiments; 30 red target digits (shown black) interspersed with 30 green distractor digits (shown gray).

## Experiment 1

### Method

*Subjects.* Fifty-four UCSD undergraduates (11 male) participated, 53 in partial fulfillment of a course requirement, one in return for payment.

*Apparatus and Stimuli.* Experiments were controlled by Pentium II computers controlling 15-inch SONY Trinitron Multiscan 100GS SVGA monitors. Each display consisted of 30 red digits, and, in some conditions, an additional 30 green digits (using readily discriminable, high-saturation colors). Each digit measured .6 cm in height by .5 cm in width (based on a viewing distance of 70 cm, this corresponded to visual angles of .49 by .40 deg). The digits were scattered in a quasi-random fashion about the entire CRT display, which measured 21.5 cm high by 28.5 cm wide (17.1 X 22.2 deg visual angle). This was done as follows. The overall display was divided into a grid of subregions (6 high and 10 across). Thirty of these were selected at random without constraint independently on each trial, and a single red digit was placed randomly within each of these 30 subregions. If green digits were present, one of them was placed in each of the remaining 30 subregions.

*Design.* Each subject performed 9 blocks of 40 trials per block. The three conditions (no-distractor; static-distractor; flashing-distractor) were presented in

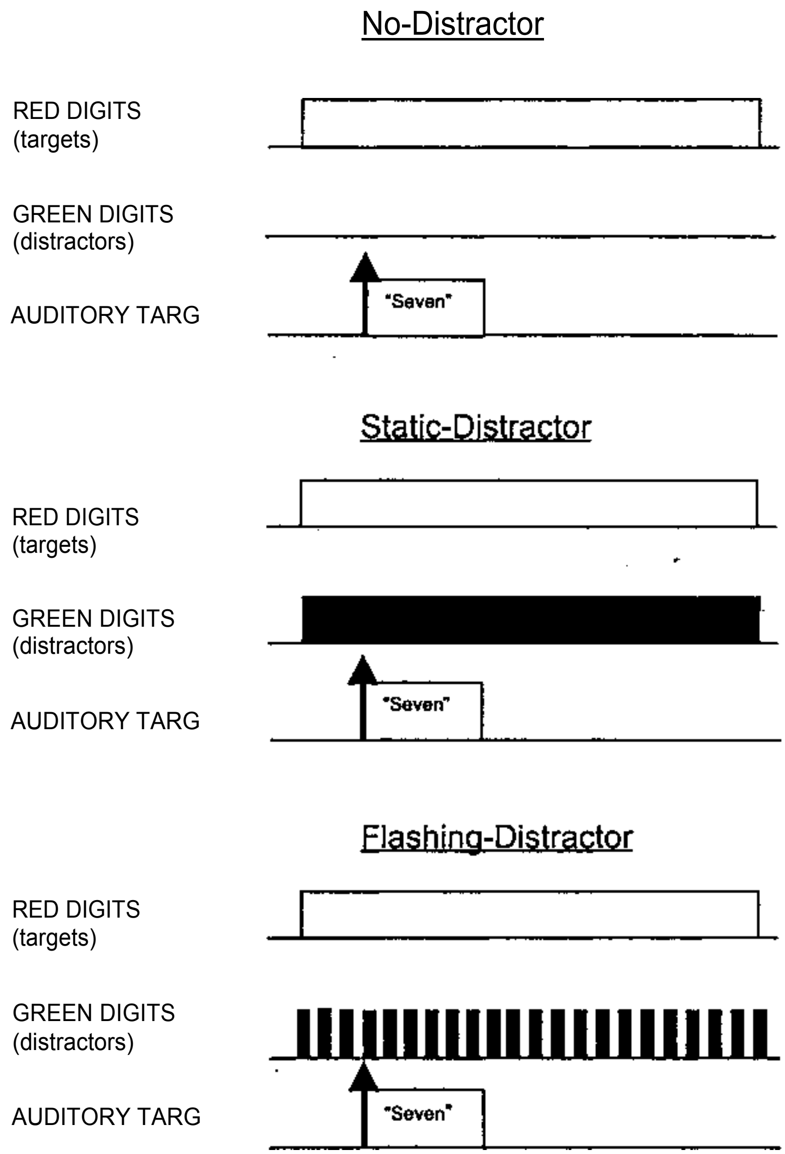


*Figure 3.* Procedure used in both experiments. Target is specified auditorily 1 sec after onset of display. In no-distractor condition only red digits are present; in static-distractor condition, green digits remain present throughout. In flashing-distractor condition, green digits flash on 200 ms, off 200 ms, etc.

separate blocks, with rotation through the blocktypes and the initial block type counterbalanced across subjects. On a given trial, the target was selected randomly and independently from the range 1-9. The red distractors were selected randomly from the other 8 digits. When the green distractors were present, they were selected randomly with replacement from entire the range 1-9, so usually there would be green distractors identical to the target digit (which would not themselves count as targets, of course).

*Procedure.* Subjects were given written instructions, stating that they would begin each trial by fixating on the center of the screen; that they would be told by the computer what digit to look for, and that they should look for this target only among the red digits; that there would sometimes be green distractor digits that they would need to ignore; and that they should respond as rapidly and accurately as possible. Each trial began with a plus sign presented for 1 second, followed by 500ms second blank screen, and then the appearance of the display. Not until three hundred milliseconds after the display onset did the computer begin playing a wave-file of the spoken target name, resulting in a significant delay from the onset of the display to the time where the subject knew what to search for. Of course, different wave files took slightly different amounts of time to communicate this information, but these differences were not confounded with the variables of interest. Subjects pressed the M key for target present, and the N key for target absent; as soon as they had done so, the display disappeared from the screen. The computer provided feedback by playing different sounds after errors and correct responses. A period of 2.5 sec elapsed before the next fixation point was presented. At the end of each block, the average response time and percent correct during the preceding block was displayed, and the subject was allowed to rest until he or she felt ready to resume.

## Results

Data from four subjects was discarded because they had overall error rates in excess of 25%, leaving 50 subjects. RTs (measured from onset of the display) that exceeded the mean by three standard deviations were trimmed (simulations by van Selst & Jolicoeur, 1994, suggest that this procedure is appropriate under conditions like these).

Figure 4 shows the mean reaction times for correct responses in target-present and target-absent trials in the three conditions. The effect of flicker condition was significant, $F(2,98)=37.9$, $p<.001$, as was the effect of target presence/absence, $F(1,49)=217$, $p<.001$. The two variables did not interact, $p>.10$.

Flashing-distractor displays produced faster rather than slower responses (3035 ms) compared to static-distractor displays (3148 ms); this difference was reliable, $F(1,49)=15.4$, $p<.001$.

Error rates are shown in Table 1. Most errors were misses (18%) rather than false alarms (2%), as is typical in visual search tasks. The presence of distractors increased the miss rate compared to the no-distractor condition. There was no significant effect of flashing- vs. static-distractors on overall errors rates (p>.60) nor any significant interaction of this variable with type of error, i.e., false alarm vs. miss (p>.15). The slight elevation in mean false alarm rates with flashing distractors (3% vs. 2%) was tested by itself and proved not to be statistically significant (p>.35).

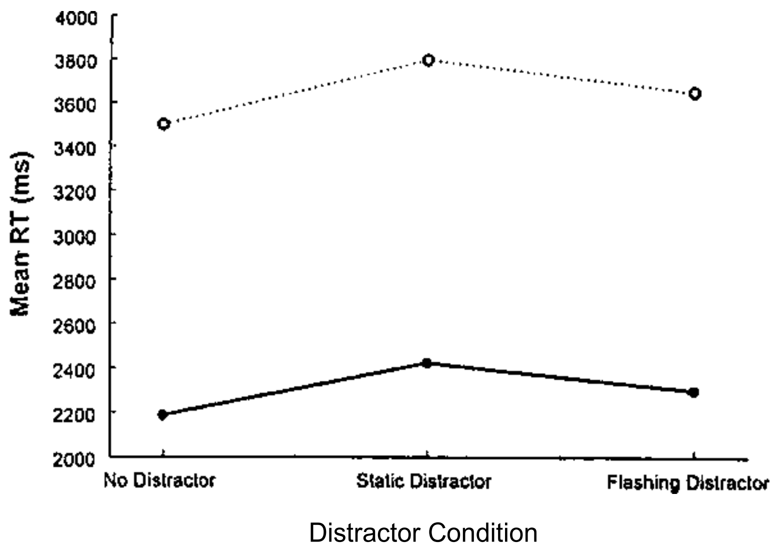


*Figure 4.* Mean correct RTs (in ms) in Experiment 1 (same green digits flash on and off) as a function of distractor condition and target presence/absence.

**Table 1.** Mean percent errors in Experiments 1 and 2 as a function of target presence/absence and distractor condition.

| | No Distractor | Static Distractor | Flashing Distractor |
|---|---|---|---|
| Exp. 1 Target Present | 16.4 | 19.1 | 17.9 |
| Exp. 1 Target Absent | 1.8 | 1.9 | 2.5 |
| Exp. 2 Target Present | 19.5 | 17.2 | 18.4 |
| Exp. 2 Target Absent | 2.0 | 1.7 | 2.1 |

## Experiment 2

Using visual search designs, Yantis and colleagues have found that visual transient signals that do not signal the appearance of new objects generally do not produce involuntary orienting (Yantis & Hillstrom, 1994; see Yantis, 2000, for a review). It is not clear whether or not the reappearance of the green distractor digits in the displays used in Experiment 1 should be regarded as signaling the appearance of new objects. To see whether the flashing of the distractors would remain harmless (and indeed, helpful) even when new objects appeared, Experiment 2 was conducted with one change: when the green digits reappeared every 400 ms, each digit was replaced with a new (usually different) digit in the same location.

### Method

*Subjects.* Forty two UCSD undergraduates (9 male) participated in partial fulfillment of a course requirement.

The *Apparatus, Procedure* and *Design* were exactly as in Experiment 1. The only difference was that in the flashing-distractor condition, every 400 ms a new randomly chosen set of green digits flashed on.

### Results

No subjects had overall error rates in excess of 25%, and RTs were trimmed as in Experiment 1.

Figure 5 shows the mean correct reaction times for target-present and target-absent trials in the three conditions. The effect of distractor condition was significant, $F(2,82)=22.5$, $p<.001$, as was the effect of target presence/absence, $F(1,42)=298$, $p<.001$. The two variables interacted, $F(2,82)=4.1$, $p<.02$, apparently due to a slightly smaller effect of target absence in the no-distractor condition.

Flashing-distractor displays produced faster rather than slower responses (2999 ms) compared to static-distractor displays (3119 ms); this difference was reliable, $F(1,41)=10.3$, $p<.003$.

Error rates are shown in Table 1. Again, most errors were misses (18.4% of trials) rather than false alarms (1.9%). There was no significant effect of distractor condition on overall errors rates ($p>.10$) nor any significant interaction of this variable with type of error, i.e., false alarm vs. miss ($p>.15$).

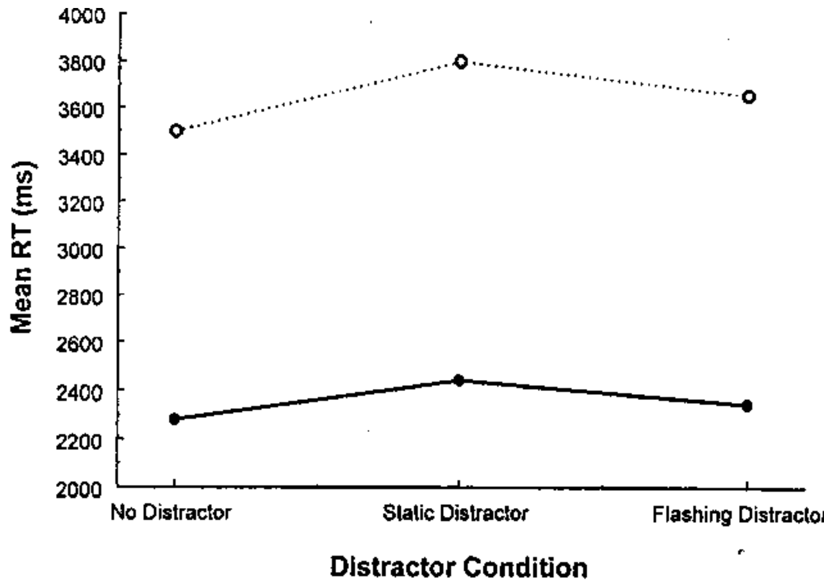


*Figure 5.* Mean correct RTs (in ms) in Experiment 2 (new green digits appear on each flash) as a function of distractor condition and target presence/absence.

## Experiment 3

The third experiment examined several diverse forms of transient activity in the distractors. The experiment included the three conditions of Experiment 2 (no-distractor, static-distractor, and flashing-distractors) plus two additional forms of distractor change. The first was "twinkling", whereby distractors disappeared and were replaced with new distractors independently, rather than pulsing off and on in synchrony with each other as in the previous studies. The second was a form of motion that will be referred to as "shimmying", whereby distractors shuttled back and forth along short individually determined paths (motion was constrained in this way because if distractors were free to wander, the overall geometry of the display would likely deform during the search, conceivably impairing search by disrupting eye movement control rather than grabbing attention). The preview period prior to the vocal presentation of the target was lengthened to one second to make it more certain that onset-hood would not be a useful criterion for locating relevant materials.

## Method

*Subjects.* Twenty-five UCSD undergraduates (10 male) participated in partial fulfillment of a course requirement.

The *Apparatus, Procedure* and *Design* were as in previous experiments except as noted. There were five conditions presented in separate blocks: no-distractors, static-distractor, flashing-distractor, asynchronously twinkling-distractor, and shimmying-distractor. Subjects performed 15 blocks of 24 trials per block with counterbalanced order of conditions. The first three conditions were as in Experiment 2. In the twinkling-distractor condition, four distractors were selected randomly every 100 ms and caused to disappear; 200 ms later, they were replaced with new items. A constraint on selecting distractors to disappear was that any distractor was ineligible to be selected while it was already undergoing replacement and for 400 ms after the appearance of its replacement. In this way, items scattered around the display were continuously seen to disappear with new ones popping up in their place; the span during which objects remained in the display varied greatly and the lifespans of individual items were temporally overlapping in a haphazard fashion. The shimmying-distractor blocks were constructed as follows. Distractors were pseudo-randomly assigned a home location, just as in the other conditions. For each individual distractor, a motion vector was determined in advance of the trial (with its tail on the home location, a length equal to approximately one-half character and a randomly chosen direction). Each distractor now had two resting places, its home location and the endpoint of this vector, at a distance equal to one-half the size of the letter. Every 200 ms, four distractors were selected at random from the entire display and moved to their alternative position. Thus, every 200 ms a random subset of the display would traverse on a fixed trajectory one-half character width in distance. Over the whole display, therefore, distractors could seen seen to exhibit temporally chaotic jumping motion, with different distractors moving in different directions. The wave file began playing played after a delay of 1 second in all conditions.

## Results

No subjects had overall error rates in excess of 25%, and RTs were trimmed as in Experiment 1.

Table 2 shows the mean correct reaction times for target-present and target-absent trials in the five conditions. As expected, the overall ANOVA yielded significant results, with the no-distractor condition fastest of all by a good measure (for distractor condition: $F(4,96)=9.0$, $p<.001$; for target presence/absence: $F(1,24)=170.7$, $p<.001$; for the interaction: $F(4,96)=2.7$, $p<.05$).

**Table 2.** Mean correct RTs (in ms) in Experiment 3 as a function of target presence/absence and distractor condition

| | Target Present | Target Absent |
|---|---|---|
| No Distractor | 3016 | 4226 |
| Static Distractor | 3141 | 4545 |
| Flashing Distractor | 3114 | 4379 |
| Twinkling Distractor | 3119 | 4325 |
| Shimmying Distractor | 3207 | 4517 |

**Table 3.** Mean percent errors in Experiment 3 as a function of target presence/absence and distractor condition.

| | Target Present | Target Absent |
|---|---|---|
| No Distractor | 16.8 | 1.4 |
| Static Distractor | 16.7 | 1.8 |
| Flashing Distractor | 16.2 | 1.4 |
| Twinkling Distractor | 25.4 | 1.7 |
| Shimmying Distractor | 17.9 | 1.9 |

As in Experiment 2, flashing-distractor displays produced faster rather than slower responses (3747 ms) compared to static-distractor displays (3843 ms); this difference was not quite reliable, however, $F(1,24)=4.0$, $p<.06$. The shimmying-distractor displays (3862) were not reliably different from the static-distractor displays (3843), $F(1,24)=0.17$, $p>.65$, nor did this difference interact with target presence/absence in a 2X2 ANOVA, $F(1,24)=2.1$, $p>.15$. Twinkling distractors, too, produced overall faster responses (3723) as compared to static distractors (3843), a significant speedup, $F(1,24)=5.5$, $p<.03$. Twinkling sped detection of target presence by 22 ms and responses to target-absent displays by 220 ms, yielding a significant distractor type X target presence-absence interaction in a 2X2 Anova, $F(1,24)=6.9$, $p<.02$.

Error rates are shown in Table 3. Again, most errors were misses (18.6% of trials) rather than false alarms (1.6%), numbers very similar to those of the previous experiment. In this case, however, there was a significant effect of distractor condition on error rates, $F(4,96)=8.2$, $p<.001$, and this variable interacted with target presence, $F(1,24)=7.9$, $p<.001$. This chiefly reflected an excess of about 8% in misses occurring in the twinkling-distractor condition (a comparison of twinkling against static showed a significant effect on errors and a significant interaction as well).

## General Discussion

### Conclusions

When people searched the red digits in a large crowded display for a target that was specified by a spoken message played after the display had been previewed, the presence of interspersed green distractors slowed them down, as one might expect. In this task the relevant and irrelevant material was all present at the beginning of the search and remained so until response. Thus, the events on the trial were contrived so that there was no need or reason to attend to or search for rapid onsets (especially in Experiment 3, where the display was previewed for a full second before the verbal presentation of the target began). For that reason, the contingent involuntary orienting hypothesis (Folk et al., 1992) predicts that having the green digits flashing on and off throughout the search will not cause them to be any more disruptive than the static digits. Indeed, it would suggest that they might even be them less disruptive because flicker provides an additional feature that differentiates them from targets.

The first two experiments examined the situation where distractors pulsed off and on again in synchrony with each other (newly chosen distractors replacing old ones in Experiment 2). In both studies, the CIO prediction was strikingly (and, to the present author, unexpectedly) born out, with flashing distractors producing faster, not slower, responses as compared to static distractors. The great majority of subjects' errors were misses. Flashing digits cause a small and statistically nonsignificant reduction in the miss rate, and a tiny and nonsignificant increase in the false alarm rate, but were nonetheless far more helpful than harmful overall.

Experiment 3 again replicated this observation, but also included two more chaotic forms of distractor-related transients: temporally unpredictable motion ("shimmying") and disappearance and replacement occurring at unpredictable and typically asynchronous moments in time ("twinkling"). Shimmying distractors did not impair performance as compared to static distractors. Twinkling the distractors had a more complex effect. It sped up correct RTs, but much more so on target-absent trials as compared to target-present trials, and produced some modest but significant elevation in the miss rate. Terms like "speed-accuracy tradeoff do not do full justice to this pattern. One possible interpretation is that the twinkling distractors caused subjects prematurely to give up on a small proportion of trials, or to mistakenly conclude they had already searched the entire display. While puzzling in some respects, the effects of this kind of twinkling are modest and do not particularly seem to suggest that twinkling distractors have any unusual power to summon attention involuntarily.

In summary, the results suggest that the contingent involuntary orienting hypothesis is much closer to reality than is the traditional common-sense view espoused by Titchener and others quoted in the Introduction. It does appear that one form of distractor activity ("twinkling") has some modest effects on search performance but these do not appear to indicate involuntary grabbing of attention on any large proportion of trials. All in all, then, CIO is well supported; most importantly, it seems to describe what happens when people must deal with protracted transient activity while engaged in an ongoing selective attention task, not merely their response to single isolated flashes occurring prior to their engagement in an attention task.

## Limitations

A number of limitations of this study should be noted. First, the selective attention task was relatively easy. While the aggregate cost of the distractors was substantial, the cost per distractor was quite small. This was expected given the degree of chromatic contrast present (red vs. green). While it would be interesting to see if the same results hold with a less discriminable selection criterion, this would have to be done with some caution. If the color judgment had been much more difficult, an alternative strategy would be encouraged: detecting any digit targets regardless of their color and then checking their color. Obviously, such a strategy would thwart the design of the experiment.

A second limitation is the use of relatively large amounts of transient activity. In the first two experiments, all the distractors flashed; even in the asynchronous twinkling condition of Experiment 3, a substantial amount of transient activity occurred per second. Thus, the results do not rule out the possibility that set-independent attention capture by transients does occur, but only when some special set of conditions is met, which includes a requirement that the transients be isolated.[1] (Of course, the putative set of necessary conditions just mentioned would have to include some factors not satisfied by the studies of Folk et al., 1992, either).

A third limitation that should be kept in mind is the fact that the transient activity here was always confined to the distractors, not the targets. Thus, not only did subjects lack an incentive to attend to transients - they were given a very strong incentive to ignore them. It would be interesting to know if transient activity that was orthogonal to, rather than negatively correlated with, task relevance, would also prove as innocuous as that examined here. Answering this question might not be straightforward, however, because flashing or moving the relevant stimuli might change the difficulty of the task due to sensory and perceptual factors unrelated to attention capture.

## Broader Questions

The new support for CIO presented here raises an obvious question that relates back to points mentioned at the beginning of the Introduction above: why does it seem almost self-evident to most people (including distinguished early writers on attention) that stimuli that flash, move, or jump involuntarily attract our attention? Are advertisers, for example, wasting their time and money in putting flashing lights on signs by roadsides or on websites? Perhaps not. When we are engaged in passive viewing with no particular task to perform, we may adopt a "default" setting that favors orienting to transients (as Folk et al, 1992, suggested). Alternatively, there could be a more general default setting, to orient to whatever is unusual; in most visual scenes (some parts of Las Vegas being a possible exception) static objects are much more common than flickering or moving ones. Recent work from our laboratory (Pashler & Harris, in press) has examined spontaneous allocation of attention in tasks not involving any set to locate targets or even reports. For example, in experiments using just a single trial, we told subjects they would be required to make an aesthetic judgment, and only after the display had been presented did we ask them to describe what they had seen. The results supported the suggestion that there is a default tendency to attend to transients, and even more strongly, to attend to stimuli bearing unique properties (Pashler & Harris, in press). It is possible, therefore, that the commonplace observations correctly describe this default mode, while the Folk et al. model correctly describes a mode that people readily adopt when presented with the requirement to search (see Pashler, Ruthruff & Johnston, 2001, for further discussion).

Some previous research suggests that effects of abrupt pre-cues can sometimes be eliminated by allocating attention in advance to a relevant position (Yantis & Jonides, 1990; Juola, Koshino, & Warner, 1995). Potentially, therefore, one might view the present results as showing that this generalization extends even to cases where relevant (attended) locations are spatialfy intertwined with distractor locations. This assumes of course that attention can be simultaneously allocated to noncontiguous locations, as some research indicates (e.g., Awh & Pashler, 2000; Bichot, Cave & Pashler, 1999; Kramer & Hahn, 1995; but see Pan & Eriksen, 1993).

On the other hand, nullification of the ef/ects of abrupt-onset cues by advance knowledge of distractor locations (in situations where the relevant items are onsets) has proven to be a rather tenuous phenomena. Several studies by Folk and Remington (1996) found that involuntary orienting continued to occur when the position of the irrelevant stimulus was fixed for a whole block of trials. Further, it should be kept in mind that in the experiments reported here, the distractors were not ineffective; in aggregate, they imposed total costs much larger than one typically finds in experiments involving displays of just a few items. Additionally, displays in the present studies were large in spatial extent and required several eye movements to search exhaustively.[2] Thus, the relevant and irrelevant stimuli occupied different retinal locations at different times during the search. Even if knowledge of distractor positions is generally sufficient to nullify effects of abrupt-onset distractors within a fixation (which is questionable, as noted above), it is hardly obvious this would apply when saccades occur, altering the retinal locations of all the stimuli during the time the search is taking place.

In summary, the results of the present study suggest that when people adopt a set to search for stimuli of a particular color, rapid onsets of the other color are deprived of much ability to "grab" attention involuntarily even under demanding conditions that provide every opportunity for involuntary orienting to show itself (search of a busy display with intertwined items flashing on and off). Indeed, the very properties often hypothesized to produce automatic grabbing of attention seem to facilitate exclusion by adding additional redundant features that help differentiate relevant and irrelevant inputs.

## Footnotes

[1] The author is grateful to Jan Theeuwes for pointing this out.

[2] Though eye movements were not measured, skeptical readers are invited to scatter .6-cm-high digits about a whole CRT display and try to search them from a single point of regard.

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