Contraband could hide in plain sight, research shows

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As airport security employees scan luggage for a large variety of banned items, they may miss a deadly box cutter if they find a water bottle first.

According to new research at Duke University, identifying an easy-to-spot prohibited item such as a water bottle may hinder the discovery of other, harder-to-spot items in the same scan.

Missing items in a complex visual search is not a new idea: in the medical field, it has been known since the 1960s that radiologists tend to miss a second abnormality on an X-ray if they've found one already. The concept -- dubbed "satisfaction of search" -- is that radiologists would find the first target, think they were finished, and move on to the next patient's X-ray.

Does the principle apply to non-medical areas? That's what Stephen Mitroff, an assistant professor of psychology & neuroscience at Duke, and his colleagues set out to examine shortly after 2006, when the U.S. Transportation Security Administration banned liquids and gels from all flights, drastically changing airport luggage screens.

"The liquids rule has introduced a whole lot of easy-to-spot targets," Mitroff said.

In the new study, published online in the *Journal of Experimental Psychology: Applied*, Mitroff and his group asked college students to identify specific targets on a computer display - in this case, two

perpendicular lines that form the letter "T" amid distracters, such as Ls and non-Ts. In some cases, Ts were easy to spot, and in other cases more difficult because they blended in with the background.

In an initial set of experiments, Mitroff and his colleagues altered the frequency of easy- and hard-to-spot targets. When the two kinds of targets appeared with equal frequency, subjects apparently had no trouble finding the hard-to-spot target in the presence of an easy one. But when the easy-to-spot item was two or three times more common, the subjects tended to overlook the hard-to-spot targets.

When Mitroff's group doubled the time allowed for each search, they saw that the students used barely a second of extra time but were significantly more accurate.

"It didn't seem to do with time itself, but it seems to be the time pressure," Mitroff said. "When you have the impending time pressure of going quickly, you are more likely to miss a second target."

Intriguingly, the data do not suggest subjects miss the second targets because they are too quick to end their search, an idea that would have bolstered the original satisfaction-of-search principle. "There seems to be some other mechanism, but it's not exactly clear what it is," Mitroff said.

One possible explanation is an idea called "attentional set," which suggests that finding one kind of target will make you more likely to find that same type of target rather than a new, different one. In radiology, it is like finding a fracture, which makes you more likely to find a second fracture rather than some other anomaly.

In an additional set of experiments, the researchers added time and accuracy pressure to the test by introducing small baggage icons that

appeared along the top of the screen, mimicking a new bag on the security conveyer belt. One bag disappeared when subjects finished searching each display. They earned points for each display and the more quickly and accurately the subjects could identify the targets, the higher the points they received.

For one group of subjects, researchers set the speed of bags based on the each person's performance in a previous practice session. That group wasn't any worse at finding the second target than the first. In contrast, subjects following a brisk rate set by the researchers were worse at finding the second target.

"The results fit with what we think would happen if you remove the searcher from seeing the line," Mitroff said. In a remote search, the screeners will not know whether there is one person or 500 people waiting. "It's not in use, but these data suggest that it might be something worth trying."

Mitroff's group next has plans to replace T-targets with multiple targets of different types, such as tools and bottles.

More information: Generalized "satisfaction of search": Adverse influences on dual-target search accuracy. Fleck, Mathias S.; Samei, Ehsan; Mitroff, Stephen R. Journal of Experimental Psychology: Applied. Vol 16(1), Mar 2010, 60-71. doi:10.1037/a0018629

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