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Running head: Relative prevalence

The impact of relative prevalence on dual-target search for threat items from airport X-ray screening

Hayward J. Godwin[1], Tamaryn Menneer[1], Kyle R. Cave[2], Shaun Helman[3], Rachael L. Way[3], and Nick Donnelly[1]

[1.]University of Southampton

[2.]University of Massachusetts

[3]QinetiQ

Address for correspondence:

Hayward Godwin

University of Southampton

School of Psychology

Highfield, Southampton

Hampshire

SO17 1BJ

Email: hayward.godwin@soton.ac.uk

Tel: +44(0)2380 595078

Abstract

The probability of target presentation in visual search tasks influences target detection performance: this is known as the prevalence effect (Wolfe, Horowitz & Kenner, 2005). Additionally, searching for several targets simultaneously reduces search performance: this is known as the dual-target cost (DTC: Menneer, Barrett, Phillips, Donnelly & Cave, 2007). The interaction between the DTC and prevalence effect was investigated in a single study by presenting one target in dual-target search at a higher level of prevalence than the other target (Target A: 45% Prevalence; Target B: 5% Prevalence). An overall DTC was found for both RTs and response accuracy. Furthermore, there was an effect of target prevalence in dual-target search, suggesting that, when one target is presented at a higher level of prevalence than the other, both the dual-target cost and the prevalence effect contribute to decrements in performance. The implications for airport X-ray screening are discussed.

Keywords: airport security, visual search, signal detection, low prevalence, dual-target search

PsycINFO Classification Code: **2323** (Visual Perception)

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When airport screeners search for threat items in X-ray baggage, they are required to search for multiple categories of items (e.g., guns, knives, liquids, etc.). The fact that screeners search for more than one category of threat item (target) is important. A number of studies have shown that conducting a simultaneous visual search for two dissimilar targets produces a decrement in performance (e.g., Menneer, Barrett, Phillips, Donnelly, & Cave, 2004; Pashler, 1987; Smith, Redford, Gent, & Washburn, 2005; Smith, Redford, Washburn, & Taglialatela, 2005). This ‘dual-target cost’ (DTC) is reflected as an increase in reaction time slopes, coupled with a decrease in response accuracy, when compared to single-target search baselines (Menneer, Barrett, Phillips, Donnelly, & Cave, 2007). Recent research using eye-movement recordings has demonstrated that the cost results from a lack of effective guidance during visual search (Menneer, Stroud, Cave, Donnelly, & Rayner, 2008). When searching for a single target, observers tend to fixate objects in the display that resemble the target. However, when engaged in dual-target search, observers not only have a high probability of fixating objects in the display that resemble either target, but also have an elevated probability of fixating objects in the display that do not resemble either target. As a result, time and resources are spent processing objects in the search displays that could never be targets, leading to the emergence of the DTC (Menneer et al., 2008).

The laboratory DTC studies are simplified versions of real-world X-ray baggage search. The approximation is, however, poor in several key respects, one of which will be explored in detail here. Studies of the DTC have thus far assumed equal prevalence of threat items. However, in the real world, threat items do not appear with an equal level of prevalence (i.e., probability of target presentation) to one another. For example, passengers may often unintentionally leave razorblades in their baggage. In contrast (and thankfully), passengers rarely place an explosive device in their baggage. The consequence of this asymmetry in target prevalence is that screeners must search for multiple targets, but the likelihood of targets from specific categories being present is unequal. In relation to the DTC, this asymmetry in target prevalence is explored in the present study by asking the question: how is target search performance affected when, in dual-target search, one target is presented at a higher prevalence level than the other?

The role of target prevalence is important to consider because it has been demonstrated in several studies that low-prevalence targets are missed more often than high-prevalence targets (Fleck & Mitroff, 2007; Wolfe, Horowitz, & Kenner, 2005). There has been a recent debate in the literature as to whether the effects of prevalence on detection occur because of a criterion shift in decision-making (Wolfe et al., 2007), or because of motor priming (Fleck & Mitroff, 2007). In the context of the present study, motor priming is equated across dual-target and single-target conditions. We achieve this by presenting a target on 50% of trials overall in all conditions. Doing so, makes the study conducted here very similar to studies conducted within the stimulus probability effect literature.

Studies of the stimulus probability effect have typically employed a two-alternative-forced-choice task involving the detection of single letters, with one item shown on each trial. Typically, multiple letters are potential targets but the frequency with which letters appear as targets is manipulated. In general they have demonstrated that high-prevalence targets are not only more likely to be detected than low-prevalence targets, but detected more rapidly as well (Estes, Burke, Atkinson, & Frankmann, 1957; Fitts, Peterson, & Wolpe, 1963). In one experiment of similar design to the experiment conducted here, LaBerge and Tweedy (1964) asked participants to respond with one response button to the presence of either of two target items (e.g., red or blue rectangles), and a different button to a third item (e.g., a green rectangle). A red or blue target was presented on 50% of trials, meaning that motor priming was equated across the red/blue versus green responses, and the relative prevalence of red or blue targets was manipulated so that one target appeared at a higher level of prevalence than the other. Critically, differences in the prevalence of the targets were reflected in the response times (RTs) and detection rates, despite the fact that motor priming was equated across the different responses.

In the present study, we explore the effect of varying relative prevalence of targets in dual-target search on target detection. Wolfe et al. (2007) explored this question by asking participants to search for multiple targets of varied prevalence (they used 1%, 5%, 10%, 34% and 50% prevalence for different targets simultaneously). They found that the reduced target detection rates as prevalence decreased. However, we modify the design of Wolfe et al. (2007) and provide a single-target condition as well as a dual-target condition. In doing so, we address the issue of how target prevalence influences detection in dual-target search. Furthermore, we also provide data from single-target conditions matched for overall target frequency. Together, these data reveal the pattern of performance decrement due to searching for multiple targets versus single targets, and the effect of differential target prevalence within dual-target search. We do so in terms of RTs and response accuracy, a combinative measure that takes both RT and response accuracy into account (Townsend & Ashby, 1983), and signal detection. We hypothesise that changes in relative prevalence in dual-target search will influence search performance in terms of prevalence effects occurring for individual targets. This prediction is based upon the studies of the stimulus probability effect, as well a series of experiments conducted by Wolfe et al. (2007).

Method

Eighteen participants (five males and thirteen females) took part in the study, with ages ranging from 19 to 53 (mean=24.5 years, SD=10.5 years). All participants were undergraduates and postgraduates with no previous experience of the stimuli, and self-reported normal colour vision. Participants received course credit or payment for their participation. All participants completed the study within 18 days (mean completion time=9.4 days, SD= 4.7 days).

Apparatus

The experimental software was produced using the VisionShell libraries (Raynald Comtois), and was run on an Apple Macintosh G4, with stimuli presented on a Formac ProNitron 19/600 monitor, with a refresh rate of 75 Hz and a resolution of 1600x1200 pixels. Responses were given via a Cedrus RB-610 button box connected via the USB port, with buttons labelled “present” and “absent”. Head restraints were not used, and viewing distance was approximately 60cm from the monitor. The experiment took place in a moderately-lit room.

Stimuli

The stimuli were X-ray images of threat and non-threat items. Targets consisted of X-ray images of metal threats (guns and knives) and improvised explosive devices (IEDs). Previous research has shown that guns and knives can be searched for simultaneously as if a single category (Menneer, Cave, & Donnelly, 2009) because metals are represented by blue in X-ray images. Distractors consisted of X-ray images that one would normally expect to see in baggage, such as keys, sunglasses, shoes, children’s toys, and so on. The colour of the images ranged across orange, green and blue, and was dependent on the atomic number, atomic density and thickness of the medium through which the X-ray travelled. The objects were photographed in up to five orientations, consisting of a canonical view and rotations through 45˚ and 90˚ in both the x- and y-planes. In total, 195 metal images were used (95 guns and 100 knives), as well as 69 IED images, and 1302 distractor images.

In each trial, the search field contained a total of twelve separate objects. On target-present trials, only one target image was presented (even in dual-target search), resulting in one target image and eleven distractor images. Targets and distractors were selected from the image library at random, and then randomly rotated by 0˚, 90˚, 180˚, or 270˚ through the plane of the monitor screen. The objects were randomly placed on a virtual 4 × 4 grid laid out across the display. Objects were moved from the centre of each square in the grid by a randomly generated distance, in a randomly generated direction. The images were displayed in 32-bit colour, and subtended 0.5-7.0˚ of visual angle. Each square of the virtual grid subtended 8.73˚ by 8.70˚ of visual angle, with the whole display subtending 26.2˚ by 34.8˚ of visual angle.

Design and Procedure

Participants took part in four sessions, each lasting around 45 minutes. The first session was treated as a practice session and was not included in the analyses, in order to allow the participants to be exposed to both the stimulus set, and to the levels of target prevalence. Before the trials began, the nature of the targets was described. Participants were also guided through twenty examples of each type of threat item presented at a number of different orientations. The key colours that identify targets (blue for metals, orange for IEDs) were made clear to the participants, as was the range under which those colours could fall.

Each session was blocked by trial type: single-target search for metals, single-target search for IEDs, and dual-target search for metals and IEDs. Each block began with five practice trials, followed by 160 experimental trials (giving rise to 480 experimental trials overall per session). Participants were able to take a break every 50 trials. All sessions were identical, with the exception of the training given in the practice session. The order of blocks was counter-balanced across participants.

The study used a repeated-measures design, with three independent variables, consisting of: Target Type (metals, IEDs, absent); Search Type (single-target search, dual-target search) and the dual-target prevalence condition (Relative Prevalence). In both single- and dual-target search, a target was present on 50% of trials. The dual-target prevalence condition described the relative prevalence of the two target classes in dual-target search.

The three conditions of Relative Prevalence were *High-Prevalence Metals / Low-Prevalence IEDs* (HP-metals), *High-Prevalence IEDs / Low-Prevalence Metals* (HP-IEDs), and *Equal Prevalence* (EP). Relative Prevalence was a between-subjects factor, with six participants in each Relative Prevalence level. In the HP-metals and HP-IEDs conditions, the higher-prevalence target appeared nine times more regularly than the lower-prevalence target. In the EP condition, targets appeared at an equal prevalence to one another. Note that dual-target versus single-target comparisons were equated for overall target probability and not the prevalence of specific items. Irrespective of the composition of blocks, a target appeared on 50% of trials. This means that, in EP dual-target search, a metal was presented on 40 trials per session, and an IED was presented on 40 trials per session. In the conditions where Relative Prevalence was manipulated (HP-metals; HP-IEDs), the higher-prevalence target was presented on 72 trials per session, whilst the lower-prevalence target was presented on eight trials per session.

Each trial began with the appearance of a small fixation cross for 500ms at the centre of the display, followed by the presentation of the search field. There were two possible responses from the participants in any trial: “present” or “absent”. The dual-target condition was a disjunctive search: only one of the two possible target types was present on any one trial, and the correct response on those trials was “present”. Note that the dual-target disjunctive search paradigm should not be confused with experimental paradigms exploring Satisfaction of Search (SOS). SOS has been investigated in radiology (e.g., Berbaum, Franken, Dorfman, Caldwell, & Krupinkski, 2000) and observers must try to detect all possible targets presented within an image. In the present experiment, only one target could ever be present in an image.

The search field remained visible until the participant made a response, which ended the current trial and began the next. There was a 1000ms interval between trials. When a participant gave an incorrect response, an audible tone was produced by the computer. Participants responded as quickly but as accurately as possible.

Results

We begin by replicating previous studies of the DTC by testing for a DTC across all conditions in terms of analysis of RT, Error (including signal detection analyses) and a composite measure RT/proportion correct (Townsend & Ashby, 1983). With some consistency across measures, the results reveal a DTC, as well as an impact of target prevalence.

Single versus Dual-target Search

Error Rates. Previous examinations of the DTC have demonstrated that dual-target search leads to elevated error rates when compared to single-target search (Menneer et al., 2007). In the first set of analyses, it is important to note that overall performance in dual-target search was calculated (i.e., summed across metals and IEDs) for error rates and RTs. Overall error rates were compared using a 3 (Search Type: Single-target Metals, Single-target IEDs, Dual-target) x 2 (Target Presence: Present, Absent) x 3 (Session: 1,2,3) x 3 (Relative Prevalence: EP, HP-IEDs, HP-Metals) ANOVA (see Figure 1, below), with Relative Prevalence entered as a between-subjects factor. The ANOVA revealed a main effect of

Target Presence (*F*(1,15)=57.7, *p*< .001) and of Search Type (*F*(2,30)=22.4, *p* <.001), and an interaction between the two (*F*(2,30)=3.6, *p*< .05). The Relative Prevalence factor failed to reach significance as a main effect (*F*(2,15)=0.4, *p*=.65), or as an interaction with any other factors (*F*s<1.9, *p*s>.13).

Two additional follow-up ANOVAs were conducted to explore the source of the Search Type x Target Presence interaction by considering target-present and target-absent trials separately. For both target-present and target-absent trials, Search Type was significant (present trials: *F*(2,30)=13.9, *p*< .001; absent trials: *F*(2,30)=7.9, *p*< .01). Subsequent Bonferroni-corrected comparisons indicated that, in target-present trials, error rates were higher in dual-target search than both single-target metals and single-target IEDs (*p*s <.01), and that there was no difference between single-target metals and single-target IEDs error rates (*p*= .6). For target-absent trials, error rates were higher in dual-target search than in single-target metals (*p* <.001), but there was no difference between single-target IEDs and dual-target search (*p* =.14), or between single-target IEDs and single-target metals (*p*=.6). So, examination of the overall error rates confirmed the presence of the DTC, with dual-target error rates higher than single-target error rates. Importantly, these comparisons also confirmed that there were no overall differences in error rates between the EP, HP-IEDs, or HP-metals conditions. This result was expected as overall prevalence was held at 50% prevalence across all of these conditions, but the result is important as particular targets appeared with different prevalence levels within these conditions.

Previous studies of the DTC and the prevalence effect have examined error rates in terms of the signal detection theory parameters for sensitivity and the criterion (Menneer, Donnelly, Godwin, & Cave, submitted; Wolfe et al., 2007). The error rate data in the present study were also analysed in terms of signal detection theory (Macmillan & Creelman, 2005). Sensitivity (*d'*, which provides an overall index of performance in a task) and criterion (*c*, which provides an index of response bias towards ‘present’ or ‘absent’ responses) were examined using two separate ANOVAs of 3 (Relative Prevalence: HP-Metals, HP-IEDs, EP) x 3 (Session) x 3 (Search Type: Single-target Metals, Single-target IEDs, Dual-target Search) design. Relative Prevalence was entered as a between-subjects factor. For the criterion, no effects reached significance (all *F*s<2.3, *p*s>.12), signifying that the response bias was equal across all Relative Prevalence conditions. However, for sensitivity, Search Type was significant (*F*(2,30)=20.8, *p*<.001) but the effect of Relative Prevalence failed to reach significance (*F*<1). Sensitivity was lower in the dual-target condition than either of the single-target conditions (comparing dual-target search to metals: *F*(1,15)=43.9, *p*<.001; to IEDs: *F*(1,15)=27,2, *p*<.001). The effect of Session showed evidence of a strong trend (*F*(2,30)=3.2, *p*=.053), as did an interaction between Session and Search Type (*F*(4,60)=2.3, *p*=.074). Despite this interaction, even in the final session, there was an effect of Search Type (*F*(2,30)=6, *p*<.01), with dual-target search showing lower sensitivity than the single-target conditions (compared with metals: *t*(17)=2.8, *p*<.05; IEDs: *t*(17)=3.7, *p*<.01). All other effects and interactions failed to reach significance (all *F*s<2.3, all *p*s>.09).

In summary, sensitivity in dual-target search was lower than in single-target search, which was to be expected given that error rates in dual-target search were higher than in single-target search (dual-target mean *d’*= 1.8, SEM=0.15; single-target metals mean *d’*=2.4, SEM=0.13; single-target IEDs mean *d’*=2.2, SEM=0.14). Criterion between target-present and target-absent trials did not vary between the different Relative Prevalence conditions, suggesting that, overall, regardless of the Relative Prevalence condition, participants were responding ‘present’ and ‘absent’ in an equal manner. Therefore, the DTC in accuracy represents a change in sensitivity with the number of targets being searched for. There were no differences in search error rates or signal detection parameters between the different prevalence conditions (i.e., between EP, HP-IEDs, or HP-metals).

Reaction Times. Analyses of the overall RTs, computed as the median from correct-response trials only, detected the presence of the DTC after being compared using a 3 (Search Type: Single-target Metals, Single-target IEDs, Dual-target) x 2 (Target Presence: Present, Absent) x 3 (Session: 1,2,3) x 3 (Relative Prevalence: EP, HP-IEDs, HP-Metals) ANOVA (see Figure 1, below), with Relative Prevalence entered as a between-subjects factor. Although the RTs for miss errors and false alarms would have been of interest, there were insufficient errors made across the different conditions to provide any meaningful measure of RTs in incorrect response trials. The ANOVA revealed main effects of Search Type ($F(2,30)=29.4$, $p < .001$), Target Presence ($F(1,15)=33.7$, $p < .001$), Session ($F(2,30)=6.9$, $p < .01$), and an interaction between Search Type and Target Presence ($F(2,30)=9.8$, $p < .01$). The main effect of Session was due to the fact that overall RTs decreased between Session 1 and Session 3 ($p < .05$), with no other comparisons being significant.

Follow-up analyses of the Search type x Target Presence interaction demonstrated that there was a main effect of Search Type for both target-present and target-absent trials (present trials: $F(2,30)=33.8$, $p <.001$; absent trials: $F(2,30)=22.4$, $p < .001$). Post-hoc comparisons (Tukey’s HSD) demonstrated that there was a DTC for both target-present and target-absent trials, when comparing single-target metals with dual-target search, and single-target IEDs with dual-target search (all *p*s < .05). Additionally, RTs for single-target IEDs were more rapid than those for single-target metals on target-absent trials ($p<.05$), but no difference in the time needed to detect IEDs and metals in target-present trials.

To summarise, the DTC was present for RTs on both target-present and target-absent trials. As with the examination of the error rates reported above, comparing the RTs across the prevalence conditions confirmed no overall differences in RTs between EP, HP-IEDs, and HP-metals. Again, as with the error rates, we expected this result because overall prevalence was held at 50% in all of these conditions.

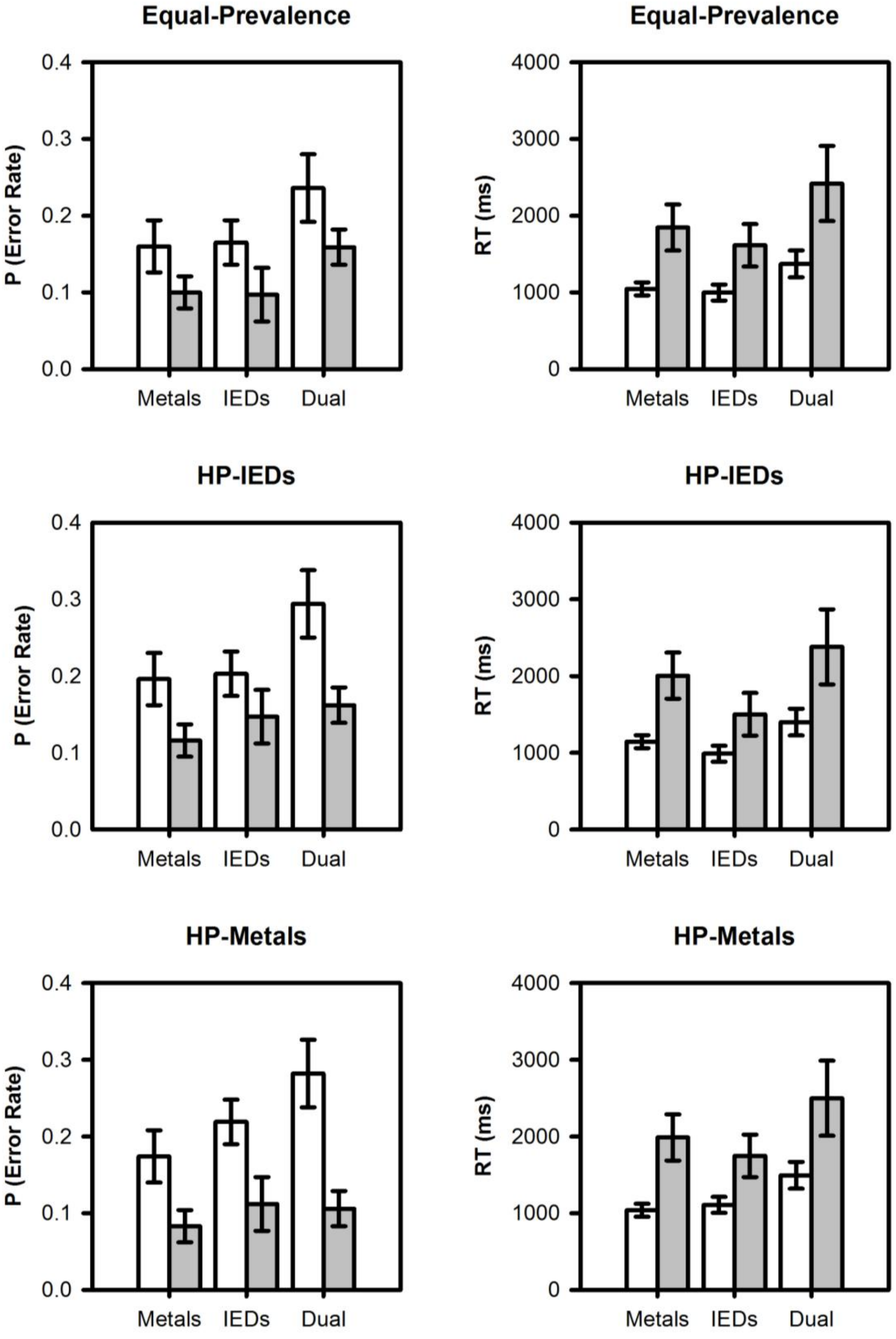

Figure 1. Error rates and correct-response RTs in the different relative prevalence conditions. The left column of graphs are the error rates, the right column of graphs are the RTs. In both, a target was presented overall on 50% of trials. White bars represent target-present trials; shaded bars represent target-absent trials. Metals=Single-target metals; IEDs=Single-target IEDs; Dual=Dual-target search. Error bars represent ±SEM.

The effect of Relative Prevalence in Dual-Target Search: Error Rates and Reaction Times

So far, we have examined overall performance in both single- and dual-target search, and have not examined the impact of relative prevalence upon target detection rates and RTs in dual-target search. To do this, four separate ANOVAs were run: two each for metals and IEDs (RTs and error rates, see Figure 2). The ANOVAs all had a 3 (Session: 1, 2, 3) x 3 (Prevalence: 5%, 25%, 45%) design with the Prevalence factor between subjects. For metals, there was an impact of Prevalence on RTs ($F(2,15)=4$, $p<.05$) and error rates ($F(2,15)=4.7$, $p<.05$). However, for IEDs, there was no impact of Prevalence for either RTs or error rates (RTs: $F(2,15)=2.5$, $p=.11$; error rates=$F(2,15)=1.5$, $p=.25$).

Subsequent post-hoc tests of the metals RTs and error rates (Tukey’s HSD) indicated that, for both RTs and error rates, there were differences between 5% and 45% Prevalence (ps<.05). RTs to detect metals in dual-target search in the 5% Prevalence condition were significantly longer than those in the 45% Prevalence condition, and both were not significantly different to the 25% condition. Similarly, error rates for metals in dual-target search were higher in the 5% Prevalence condition than the 45% Prevalence condition, and both were not significantly different to the 25% Prevalence condition.

These data suggest that prevalence affects the detection of metals only. One issue that could account for the lack of an effect for IEDs is that IEDs are difficult targets to detect for participants who, unlike airport screening personnel, have not undergone a considerable period of training. This difficulty could have lead to increased variance across both IED error rates and RTs. In an attempt to counteract this problem, we reanalysed the error and RT data in a composite measure involving both accuracy and RTs (here termed as ‘scaled RT’, taken by dividing RT by response accuracy: see Ashby and Townsend, 1983). The scaled RT measure is useful here because, based upon previous studies (Miller & Bauer, 1981), decreases in prevalence should have resulted in an increase in RT coupled with a decrease in response accuracy, and such a pattern of results would be evident as an increase in the scaled RT parameter. Analyses of the scaled RT data demonstrated an effect of Prevalence for both metals and IEDs (see Figure 2, below - metals: $F(2,15)=12.9$, $p<.01$; IEDs: $F(2,15)=4.1$, $p<.05$). Post-hoc comparisons (Tukey's HSD) revealed that scaled RT scores were higher in the 5% Prevalence condition than the 45% Prevalence condition for both metals and IEDs (all *p*s <.05). Additionally, for metal targets only, scaled RT scores were higher in the 5% Prevalence condition than the 25% Prevalence condition ($p< .05$). In summary, when using the combinative scaled RT measure, the impact of Prevalence is significant for both metals and IEDs.

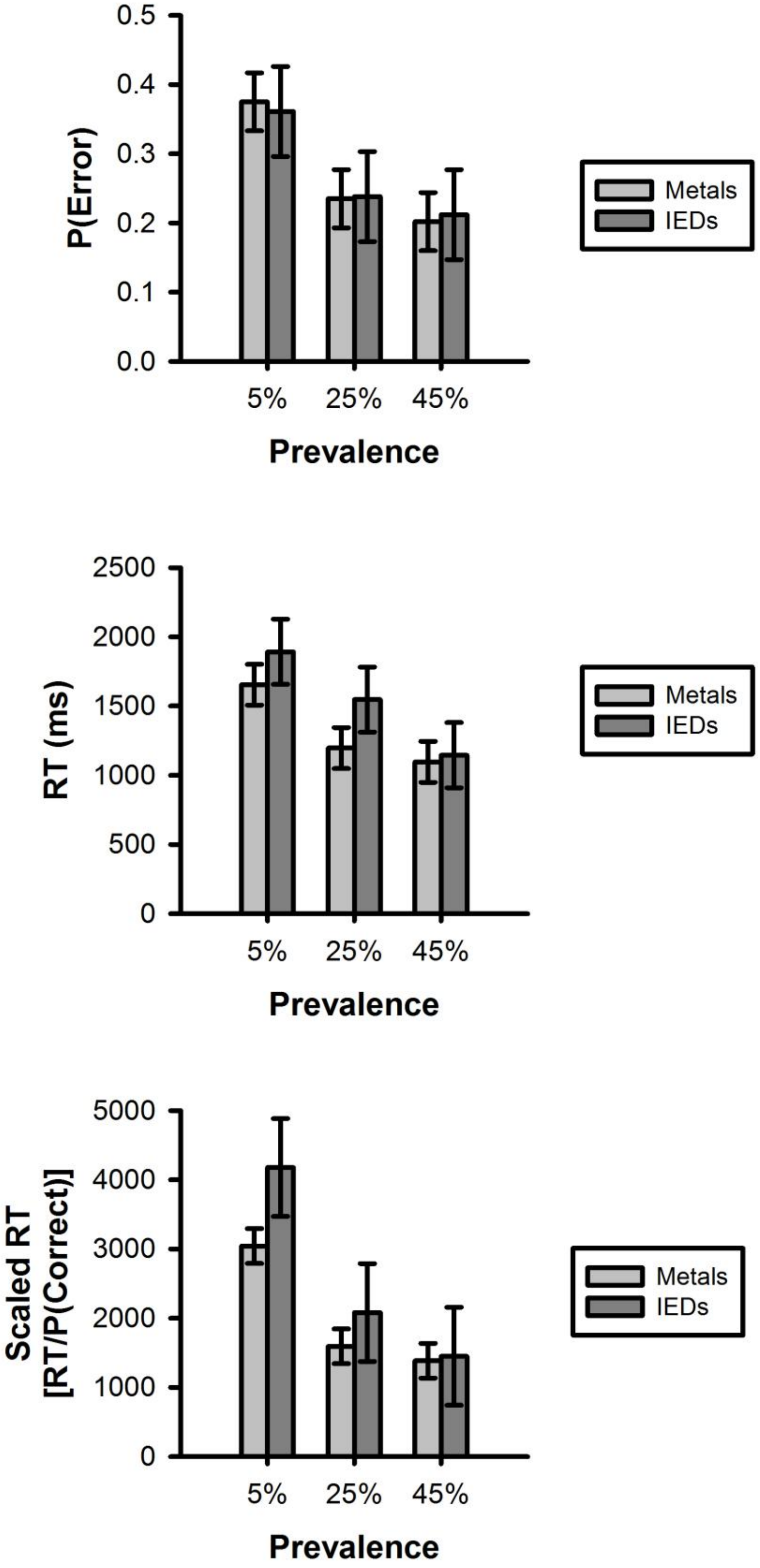

Figure 2. Error rates, correct-response RTs and Scaled RT for metals and IEDs in dual-target search, as a function of each target's prevalence level. Error bars represent ±SEM.

Discussion

The present study explored the simultaneous search for two X-ray threat targets. In addition to previous studies, the effect of differential prevalence across targets was explored. As in previous studies, a DTC was detected in overall error rates, RTs, and sensitivity. Elsewhere we have suggested that the target template that guides dual-target search is less well specified than that guiding single-target search (Menneer et al., 2008). Having confirmed the DTC, the additional question asked here was how search performance was affected when relative prevalence was varied within dual-target search. The findings are straightforward, and agree with previous studies that have manipulated prevalence in a similar manner (Wolfe et al., 2007). When engaged in dual-target search, higher-prevalence targets are better detected than lower-prevalence targets. This is a classic impact of stimulus probability (our present results have essentially replicated those of LaBerge & Tweedy, 1964), and target prevalence (Wolfe et al., 2005; Wolfe et al., 2007), and was the case irrespective of whether IEDs or metals were the higher-prevalence target. As motor priming was held constant across prevalence conditions (by having overall target prevalence set to 50%), the effects observed here cannot be accounted for by motor priming across prevalence conditions (Fleck & Mitroff, 2007).

It is important to note that participants did not give up entirely on searching for lower-prevalence targets. Error rates for the lower-prevalence targets did not reach ceiling. More importantly, there was still a DTC for the target-absent trials, regardless of the relative prevalence condition that the participants had been placed in. If participants had entirely abandoned searching for the lower-prevalence target, then performance in *both* target-present and target-absent trials should have been equal to single-target search. This was not the case for target-absent trials, suggesting that participants were still searching for both targets in dual-target search, but that the efficiency of target detection in dual-target search was limited by a prevalence effect.

One crucial question that remains, however, is this: how and why were low-prevalence targets missed in dual-target search? According to the criterion-shifting account of the stimulus probability effect (Miller & Bauer, 1981), observers hold an internal criterion or threshold for detection of a target (this is comparable to the criterion-shift account of Wolfe et al., 2007). Once the criterion is reached, a decision/response is made that the target is present. In the case of dual-target search, we suggest that each target in dual-target search has a criterion for detection. If each target has a criterion for detection, and if low-prevalence leads to, as has been suggested previously (Miller & Bauer, 1981; Wolfe et al., 2007), a higher criterion for detection, then this would account for why the lower-prevalence targets exhibited a higher scaled RT score in dual-target search. Under Miller and Bauer’s (1981) shifting-criterion account, a consequence of a higher criterion is that more evidence (and therefore more time) is required to detect the target. Conversely, in conditions of higher-prevalence, a lower criterion will be set for target detection, leading to a reduction in RTs and an increase in the chance that the target will be detected. Given a higher criterion for the low-prevalence target, the search termination threshold (Chun & Wolfe, 1996) could be reached and a target-absent response could occur before enough evidence has been acquired to identify a target. In essence, participants may be giving an ‘absent’ response when the lower-prevalence target is present simply because the target has failed to reach the criterion for detection by that point. A similar account has been used to explain why low-prevalence targets are often missed (Wolfe et al., 2005), and here the same effect occurs even though the target-absent responses are not speeded. This higher-criterion explanation accounts for the data, and suggests that each target does indeed have its own criterion.

As eye-movement recordings have contributed to exploring the nature of the DTC so far (Menneer et al., 2008), we suggest that future studies investigating the impact of relative prevalence would also benefit from examining eye-movement behaviour in dual-target search. When searching for targets of varied prevalence, do participants show some form of preferential guidance for the higher-prevalence target? The present results suggest that this may be the case, based upon the analyses of the target-present trials. However, based upon the analyses of the target-absent trials, which still suggested poor guidance in dual-target search by demonstrating the presence of the DTC, it may be the case that the mere act of searching for two targets leads to an inescapable reduction in the quality of guidance in visual search.

From an applied perspective, these results are valuable because they suggest that previous examinations of the DTC may have underestimated the DTC for low prevalence targets in real-world visual search. Accuracy may therefore be high in search for high-prevalence targets, but finding these high-prevalence targets (e.g., bottles of liquid which were recently banned from carry-on baggage, razor blades), could come at the price of missing low-prevalence targets (e.g., explosives, guns). These results, in conjunction with previous work (e.g., Wolfe et al., 2007) suggest that the real-world task of airport screening be modified such that screeners are exposed to increased numbers of low-prevalence targets, using the Threat Image Projection system, which builds computer-generated threat images into the displays presented to screeners. This may be able to counteract the impact of low prevalence for these targets.

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