The Effect of Emotional Sounds on Multiple Target Search[*]

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This study examined the effect of emotional sounds on satisfaction of search (SOS). SOS occurs when detection of a target results in a lesser chance of finding subsequent targets when searching for an unknown number of targets. Previous studies have examined factors that may influence the phenomenon, but the effect of emotional sounds is yet to be identified. Therefore, the current study investigated how emotional sound affects magnitude of the SOS effect. In addition, participants' eye movements were recorded to determine the source of SOS errors. The search display included abstract T and L-shaped items on a cloudy background and positive and negative sounds. Results demonstrated that negative sounds produced the largest SOS effect by definition, but this was due to superior accuracy in low-salient single target trials. Response time, which represents efficiency, was consistently faster when negative sounds were provided, in all target conditions. On-target fixation classification revealed scanning error, which occurs because targets are not fixated, as the most prominent type of error. These results imply that the two dimensions of emotion - valence and arousal - interactively affect cognitive performance.

Key words : satisfaction of search, visual search, emotional sound, eye tracking

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Satisfaction of search (SOS) is a concept which initially originated from the radiological community. It refers to the situation where detection of a target lesion results in a lesser chance of finding subsequent targets when searching for an unknown number of targets (Andriole et al., 2011). Specifically, radiology states that SOS occurs when a lesion is detected in an image in which it is the only target but missed when it is presented with another target (e.g. pulmonary nodule) that must be found as well (Berbaum, Franklin, Caldwell, & Schartz, 2010; Fleck, Samei, & Mitroff, 2010). For physicians, failure to identify all the lesions could lead to fatal consequences. As such, the importance of investigating SOS cannot be emphasised more.

Previous studies from radiology have suggested some causes of the phenomenon. It was first believed that SOS emerges because all subsequent searches are terminated once a target is found (Tuddenham, 1962, cited in Berbaum et al., 2010). Perceptual set theory states that when searchers successfully find a certain type of target, they are inclined to search for more of the same type targets and consequently become less successful in finding a different target (Berbaum et al., 2010).

Other possibilities come from eye movement studies. Three types of errors have been identified, including scanning, recognition and decision error. Scanning error arises when the target is not fixated. Recognition error emerges when the target is fixated but not for long enough. Decision error is similar to recognition error; it occurs when the target is fixated for long enough but it is not declared as a target (Kundel, Nodine & Carmody, 1987, cited in Berbaum et al., 2010). Berbaum et al. (1996) examined gaze dwell times from readings of abdominal x-ray images by 10 radiographers. The result identified decision error as the major contributor to the SOS phenomenon, followed by recognition and scanning errors.

Another eye tracking research by Alzubaidi, Black, Patel, and Panchanathan (2009) investigated the effect of expertise. The authors compared more and less experienced radiologists' x-ray image search patterns. Experienced radiologists were able to detect

abnormalities with fewer fixations, dispersed widely across the entire image. In other words, experts were better at parafoveal processing - processing a larger area around the fixated region.

Recently, several psychological studies have begun to test generalisability of the SOS effect. Indeed, there are real-life, non-radiological situations in which SOS is expected to occur frequently. Airport security checkpoint is an example; the screener has to inspect x-ray images of luggage in search of threats like guns and knives. Fleck et al. (2010) examined the effect of target saliency, time pressure and expectations about the number of targets on SOS. The experimental task was to find perfect T-shaped targets among distorted T or L-shaped distractors on an abstract cloudy background. Their results showed that SOS arises when searchers have a biased expectation about target types and the number of targets. Time pressure also exacerbated the error. Anticipatory anxiety is also known to cause SOS. Cain, Dunsmoor, LaBar, and Mitroff (2011) demonstrated that anticipatory anxiety induced by expectation of an electric shock generates SOS in a condition which did not produce SOS in Fleck et al.'s (2010) experiment.

In addition to SOS, the current study borrows the idea that emotional stimuli may influence various task performances by regulating attention. In the real world, multiple search happens every day, from finding friends in a crowded theme park to locating harmful bugs and avoiding them in the woods. Special cases include soldiers finding enemies on the battlefield. In most cases, these situations involve emotional context and failure to detect all targets may incur serious costs. Hence, by introducing emotional sounds to the visual search task, we attempted to add an emotional context. Identifying the relationship between emotional sounds and SOS would provide implications for ways to reduce search errors.

Researches have produced results that negative stimuli may contribute to improved performance. Saliency of fear-related stimuli captures attention more quickly, catalysing

detection of such targets (Schupp, Markus, Weike, & Hamm, 2003; Vuilleumier, 2005). From an ecological point of view, such function is indeed vital for survival as it helps to quickly detect danger and avoid it (Maiworm, Bellantoni, Spence, & Röder, 2012; Öhman, Flykt, & Esteves, 2001).

Evidence that targets of negative value influence attention has repeatedly been produced with various paradigms. Visual search task by Öhman et al. (2001) revealed that fear for the target object (snake) facilitated search for that object. In a dot-probe task, preattentive processing of threat drove attention to be deployed quickly to its location (Armony & Dolan, 2002; Mogg & Bradley, 1999). Studies that utilised rapid serial visual presentation paradigm demonstrated that the magnitude of attentional blink is reduced when the second target stimuli are negative words (e.g. Anderson & Phelps, 2001). In this process, arousal is thought to facilitate entry of stimulus representation into awareness (Anderson, 2005). Memory is also influenced by negativity; negative events are remembered with greater accuracy (Kensinger, 2009), because negative affect induces greater concentration on detail (Gasper & Clore, 2002; Storbeck & Clore, 2005).

While the studies mentioned above focused on targets that possess emotional value, there also exist reports of exposure to emotional stimuli affecting subsequent performance. Studies that investigated the relationship between music and cognitive ability are an example. Properties of music such as tempo and mode alter listener's arousal and mood state and this in turn affects cognitive ability (e.g. Thompson, Schellenberg, & Husain, 2001). Becker (2009) discovered that pre-exposure to threatening stimuli improves processing of subsequently presented neutral target. This was possible because threat-related stimuli enhanced overall search efficiency towards any type of target. Maiworm et al. (2012) proposed that magnitude of ventriloquist effect is reduced when participants are exposed to threatening auditory stimuli prior to the ventriloquist experiment. Also, detection of a visual target was improved after exposure

to anger prosody (Brosch, Grandjean, Sander, & Scherer, 2008) and negative words (Zeelenberg & Bocanegra, 2010).

Although the effects of emotional stimuli have been studied quite extensively, not many have attempted to analyse the effect of emotion on SOS. Therefore, the current study attempted to examine how emotional sounds influence performance in multiple target search. In line with research that demonstrated facilitatory effect of negative sounds, better performance was expected when negative sounds are provided compared to when no sound is given.

This study also attempted to examine the source of SOS errors by recording participants' eye movements. Analysis of on-target fixation counts should allow determination of sources of SOS errors. Unlike evidence from radiology, it was expected that scanning error would be the most frequent type. The crucial part in reading medical images is not just simply detecting abnormality but also providing a suitable diagnosis for it. In addition, participants in radiological SOS research would have at least the basic knowledge of where to look for abnormalities. Such factors make scanning error less likely. In contrast, participants in psychological SOS research would be relatively new to the task and thus be more prone to scanning error.

EXPERIMENT

Methods

Experimental design

The experiment had a 2 x 3 repeated design, including number of targets and sound conditions as independent variables. Sounds were prepared in positive and

negative conditions. No sound condition was added as a control and also in an attempt to discover any difference between noise-present and noise-absent environments. For each trial, the number of targets could be either one or two.

Visual stimuli

The current study modified the visual stimuli used in Fleck et al.'s (2010) experiment. Based on the evidence from osteoradiology that saliency differences between targets strengthened the SOS effect (Berbaum et al., 1994, cited in Fleck et al., 2010), they also manipulated target saliency and frequency. In addition, when designing the experiment, they assumed an airport security checkpoint scenario in which screeners have to detect infrequent, less salient items (e.g. sharp objects) among more frequent, salient items (e.g. a water bottle). They expected that such manipulation would give rise to SOS by biasing searchers' expectation towards more frequently occurring target.

As a background, 29.7° x 23.8° sized grey scale cloudy images ranging from 10% to 24% black were used for the experiment. Each search display contained either 23 distractors with two targets or 24 distractors with one target. The search items were placed at a random (x, y) coordinate within the background image.

Targets and distractors were produced by combining a longer bar and a shorter bar within a 1.2° x 1.2° sized square frame. When the shorter bar was attached to the centre of the longer bar, the resulting item was referred to as a perfect T-shape. Perfect T-shapes were targets and all other distorted T or L-shapes were distractors. The shapes appeared in one of the four possible rotations (0, 90, 180 or 270 degrees). Targets could either be highly salient or low salient. Highly salient targets were 66%-70% black, whereas low salient targets were 28%-40% black. Distractors had no saliency discrimination - all distractors were 28%-66% black (Fig. 1).

Introduction of target saliency resulted in three possible types of trials: high-salient

Figure 1. A sample dual target trial search display used in the experiment which contains one high salient target and one low salient target.

single target, low-salient single target and dual target which contains one high-salient and one low-salient target. In order to induce SOS, proportion of the trials was manipulated. A study from Cain, Adamo, and Mitroff (2013) demonstrated that high-salient single target, low-salient single target and dual target ratio of 1 : 1 : 8 with a 15 seconds time limit successfully induced SOS. The current experiment slightly modified the ratio and used 1 : 1 : 6.25 (24 : 24 : 150 trials for each target condition), considering the number of sound conditions that needs to be included.

Auditory stimuli

Four sounds (two positive, two negative) from the International Affective Digitized Sounds-2 (Bradley & Lang, 2007) were selected. Positive sounds were a man screaming with excitement as he plays a slot machine (SlotMachine1, 73dB) and rock and roll

music (RockNRoll, 74dB). Negative sounds included flying bees (Bees, 75dB) and baby cry (BabyCry, 77dB). Positive and negative sounds differed only in their pleasure scores. All sounds had similar arousal scores.

The original stimuli lasted six seconds, but considering the 15 seconds time limit for each trial, they were reduced down to 2.7 seconds. The modified sounds were evaluated for their valence and arousal levels by 10 participants. Repeated measures analysis of variance (ANOVA) revealed that all sounds were similar in their arousal levels, $F(3, 27) = 1.65$, $p > .05$. For valence, within-subjects contrasts revealed that sounds in the same conditions had similar scores, $F(1, 9) = 0.24$ for positive sounds and $F(1, 9) = 0.64$, for negative sounds, all ps $> .05$. Sounds of different conditions were significantly different in their valence scores, between Bees and SlotMachine1, $F(1, 9) = 81.0$, Bees and RockNRoll, $F(1, 9) = 49.0$, BabyCry and SlotMachine1, $F(1, 9) = 23.49$, and BabyCry and RockNRoll, $F(1, 9) = 24.25$, all ps $< .05$ <Table 1>. For trials that contained sounds, they were played once, at the onset of search display.

Table 1. Valence and arousal scores of the selected sounds (Out of 9 points, 6 male and 4 female participants)

Sound	IADS-2 Sound Number	Valence	Arousal
SlotMachine1	716	$M = 7.30$, $SD=1.34$	$M = 4.90$, $SD=1.79$
RockNRoll	815	$M = 6.90$, $SD=1.19$	$M = 6.00$, $SD=2.31$
Bees	115	$M = 3.40$, $SD=0.97$	$M = 4.40$, $SD=2.67$
BabyCry	261	$M = 3.10$, $SD=1.60$	$M = 4.80$, $SD=2.49$

Experimental apparatus

During the experiment, participants' eye movements were tracked using a SensoMotoric Instruments RED-m eye tracker (SensoMotoric Instruments GmbH,

Teltow, Germany). Eye movement data were sampled at 120Hz. Stimulus presentation was controlled by E-Prime software (Psychology Software Tools, Pittsburgh, PA).

Participants

Thirty five people (15 males, 20 females) with a mean age of 22.6 years participated in the experiment. All gave informed consent and self-reported that they have normal or corrected-to-normal vision and hearing. 20 participants were randomly selected for eye movement recording.

Procedure

The experiment consisted of six blocks of 33 trials, in total 198 trials. Each trial had a time limit of 15 seconds. Using a mouse, participants had to search and click on the targets within the time limit. If they completed the search before the given time, they were advised to press the spacebar to continue to the next trial. They were informed that the search display may contain either one or two targets. Before starting the experiment, participants were provided 12 practice trials to familiarise themselves with the task. Practice trials were identical to the actual experiment, except that sounds were not provided.

Results

The basic procedure for data analysis was borrowed from Cain et al.'s (2013) work. SOS was operationalised as the difference between dual target accuracy and single target accuracy. A larger value indicates that participants were more prone to the SOS

error. Performance for the low-salient target was of specific interest in the analysis. Single target accuracy was computed by dividing the number of correct low-salient single target detections (correct T1LS) by the total number of single target trials (total T1LS). Dual target accuracy computation involved dual target trials in which the high-salient target was detected first to add more conservativeness in the analysis. It was calculated by dividing the number of dual target trials in which both targets were detected (T2 all) by the sum of this number and the number of dual target trials in which only the high-salient target was successfully detected (T2HS). These can be represented as the following equations:

$$Low-salient\ single\ target\ accuracy = \frac{Correct\ T1LS}{Total\ T1LS}$$

$$Dual\ target\ accuracy = \frac{T2\ all}{T2\ all + T2HS}$$

Behavioural data

Data from one participant was excluded from the analysis because the participant did not complete the experiment properly. A 2 x 3 repeated measures ANOVA was conducted on the accuracy data with number of targets (single or dual) and sound conditions (positive, negative or no sound) as within-subjects factors. The analysis revealed a significant main effect of target, $F(1, 33) = 68.63$, $p < .05$, but not of sound, $F(2, 66) = 1.05$, $p > .05$. The significant difference in the performance between single target low-salience trials and dual target trials demonstrated an overall SOS effect.

An interaction between the two factors was also present, $F(2, 66) = 3.65$, $p < .05$. For low-salient single target trials, the effect of sounds on accuracy was marginally significant, $F(2, 66) = 3.04$, $p = .055$. Within-subjects contrasts revealed that accuracy

for the negative sound condition was significantly higher than the no sound condition, $F(1, 33) = 7.55$, $p < .05$. All other pairs were non-significant; positive and negative sounds, $F(1, 33) = 3.10$ and positive and no sound, $F(1, 33) = 0.21$, all ps $> .05$. No significant effect of sound was found in dual-target trials, $F(2, 66) = 0.45$, $p > .05$ (Fig. 2). By definition, the current result suggests that negative sounds produced the largest SOS. However, this is attributable to higher accuracy in low-salient single target trials.
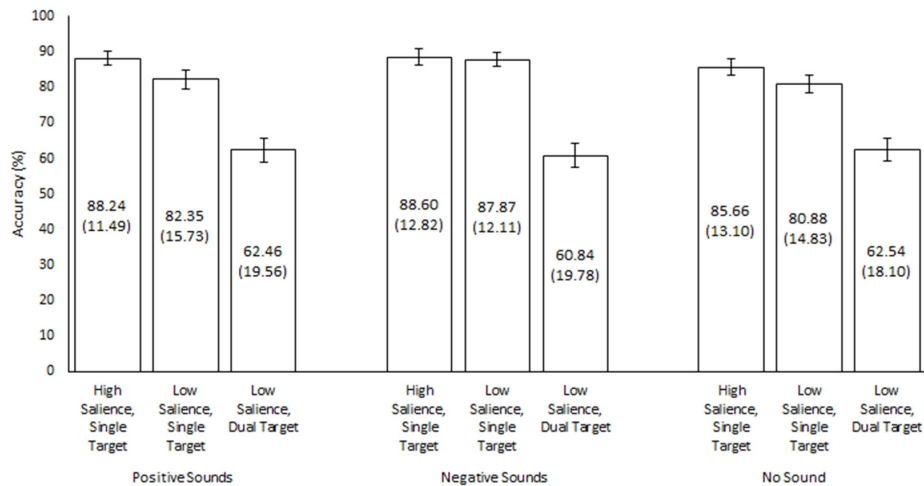

Figure 2. The mean accuracy as a function of trial type for each sound condition. The values in the parentheses represent standard deviations. Error bars show standard errors of the mean.

Although the primary index for SOS is accuracy, response time (RT) data for each level of target condition were also examined to better understand the phenomenon. Only RTs for correct trials were included in the analysis. A one-way repeated ANOVA was conducted on each target level with the three sound conditions as within-subjects factors. For low-salient single target trials, RT differences among the three sound

conditions were significant, $F_{(2, 66)}$ = 3.33, p < .05. Within-subjects contrasts confirmed that RT for positive sound trials was shorter than that of no sound trials, $F_{(1, 33)}$ = 4.77 and that RT for negative sound trials was shorter than that of no sound conditions, $F_{(1, 33)}$ = 4.55, all ps < .05. No significant effect was observed between positive and negative sounds, $F_{(1, 33)}$ = 0.03, p > .05.

RT data for dual target trials were separated into two groups: RT to the first click (high-salient target detection) and RT to the second click (low-salient target detection). Analysis of the first click RT revealed a significant difference between the three sound conditions, $F_{(2, 66)}$ = 20.76, p < .05. Within-subjects contrasts confirmed that trials with negative sounds resulted in significantly shorter RT than those with positive sounds, $F_{(1, 33)}$ = 27.93, and no sound trials, $F_{(1, 33)}$ = 33.47, all ps < .05. Positive and no sound conditions did not yield a significant effect, $F_{(1, 33)}$ = 0.02, p > .05.
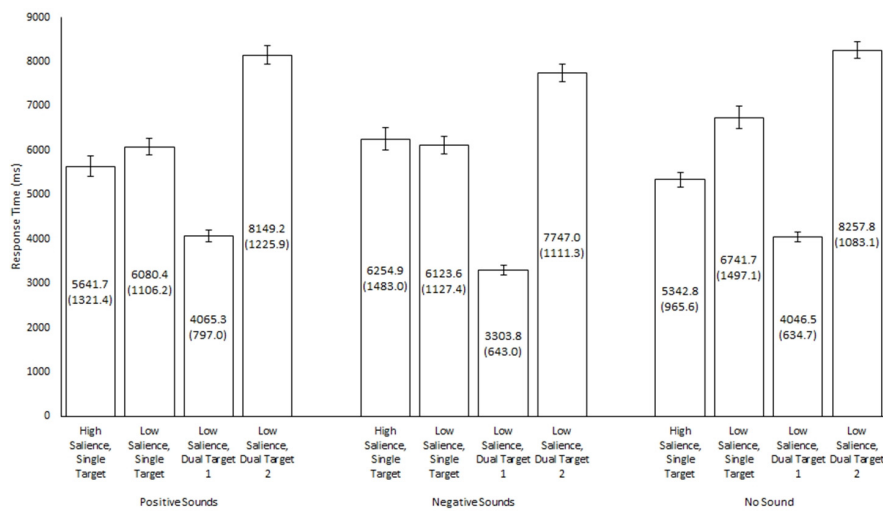

Figure 3. The mean response time as a function of trial type for each sound condition. The values in the parentheses represent standard deviations. Error bars show standard errors of the mean.

A similar pattern was found in RT to the second click. Significant differences in RT among the sound conditions were observed, $F(2, 66) = 8.48$, $p < .05$. Positive sound trials produced longer RT than negative sound trials, $F(1, 33) = 8.40$, and no sound trials produced longer RT than negative sound trials, $F(1, 33) = 17.01$, all ps $< .05$. There was no significant effect between positive and no sound trials, $F(1, 33) = 0.71$, $p > .05$ (Fig. 3).

Eye movement data

Analysis of eye movement data was restricted to dual target trials in which the high-salient target was detected on the first mouse click but the low-salient target was missed (SOS trials). Fixation was detected with the minimum fixation duration of 200 milliseconds. Trials with too many blinks were removed from the analysis (3.1% of total SOS trials). Data from four participants were excluded from the analysis either because they misunderstood the task instruction or their eye movement was not recorded properly, leaving 16 participants to be included in the analysis.

AOI hit fixation counts were classified according to whether participants fixated on the missed low-salient target. If the participant never fixated on the missed target, SOS is due to scanning error. If the participant fixated on the missed target but not declared it as a target, then it is recognition or decision error (Kundel, Nodine & Carmody, 1978, cited in Berbaum et al., 1996). As no clear definition of "long enough" fixation was provided, recognition and decision errors were grouped together in the analysis.

Classification result suggested that of all the trials in which the low-salient target was missed, 68.3% was attributable to scanning error. 31.7% was due to recognition or decision error. Negative sound trials produced more scanning error than no sound and positive sound trials. Trials in which low-salient target was fixated was categorised

in a similar way. Results revealed that negative sound trials produced less recognition or decision error than no sound and positive sound trials. Unlike in the low-salient target not fixated trials, sounds behaved in an opposite way, as negative sound trials showed reduced recognition or decision error <Table 2>.

Table 2. Error type and number of trials for all combinations of fixation type and sound conditions. Values in the parentheses represent percentages relative to the total number of SOS trial for each sound condition. Total number of SOS trial was 505, which breaks down into 150 positive, 178 negative and 177 no sound trials. LST stands for low-salient target and HST stands for high-salient target.

Fixation type	Error type	Trial count			
		Total	Sounds		
			Positive	Negative	No sound
LST not fixated	Scanning error	345 (68.3%)	92 (61.3%)	132 (74.2%)	121 (68.4%)
HST not fixated		93 (18.4%)	31 (20.7%)	35 (19.7%)	27 (15.3%)
HST fixated		252 (49.9%)	61 (40.7%)	97 (54.5%)	94 (53.1%)
LST fixated	Recognition or decision error	160 (31.7%)	58 (38.7%)	46 (25.8%)	56 (31.6%)
HST not fixated		31 (6.1%)	14 (9.3%)	5 (2.8%)	12 (6.8%)
HST fixated		129 (25.5%)	44 (29.3%)	41 (23.0%)	44 (24.9%)

DISCUSSION

This study attempted to investigate how emotional sounds influence SOS. From behavioural results, trials with negative sounds added insights to uncovering the nature of the SOS effect. Also, classification of the fixation data revealed that unlike radiological evidence, scanning error was the most common type of error.

Magnitude of the SOS effect, as represented by the difference between low-salient single target accuracy and dual target accuracy, was larger when negative sounds were played than when no sound was provided. However, this result has to be interpreted with caution, because the differing effects of the sound conditions originated from low-salient single target accuracy; dual target accuracies were similar among the sound conditions, while low-salient single target accuracy was significantly superior when negative sounds were presented. For a genuine SOS effect to occur, dual target accuracy, rather than single target accuracy, should have been different among the sound conditions, because the main focus of SOS is on the impairment of dual target searches. Thus, it would be inappropriate to conclude that exposure to negative sounds increases vulnerability to the SOS error.

Accuracy and RT results for low-salient single target trials revealed that negative sounds produced shorter RTs, yet higher accuracy. In other words, negative sound trials had both efficiency and effectiveness improved (Derakshan & Eysenck, 2009). Here, efficiency refers to the level of performance relative to the amount of effort invested in the task and effectiveness refers to quality of performance (i.e. accuracy). Dual target trials had no accuracy differences among the sound conditions. However, negative sounds produced shorter RTs for both clicks. Search in dual target negative sound trials was efficient, but this efficiency was not translated into improved performance. Yet, low-salient single target negative sound trials had superior efficiency and effectiveness, and this widened the gap between the two trial types.

Then why is it the case that negative sounds produced shorter RTs but accuracy did not differ in dual target trials? One of the possible explanations is that the effects of valence and arousal are not independent; it is their interaction that produces enhanced performance. Indeed, for auditory and visual stimuli, neural coding of valence and arousal is inseparable (Anderson et al., 2003). Studies have shown that effects of valence and arousal are interactive (Fernandes, Koji, Dixon, & Aquino, 2011; Jefferies, Smilek, Eich, & Enns, 2008; Lang, Dhillon, & Dong, 1995). For example, in Bolls, Lang, and Potter (2001)'s experiment, although valence allowed participants to pay more attention to messages in advertisements, it did not translate into better memory for message content. The authors suggested that low task performance is due to low level of arousal. This implies that for enhanced performance, both valence and arousal should be in effect. Similarly in the current study, although negative valence led to an increased level of vigilance and hence improved efficiency, accuracy remained the same because performance might have been dependent on arousal.

Eye movement data showed that scanning error is the major contributor to SOS errors. When the low-salient target was not fixated, negative sounds produced more scanning error but this pattern was reversed when the low-salient target was fixated – recognition or decision error was reduced. This suggests a facilitatory effect of negative sounds in target discrimination. Although they may initially hinder searchers from fixating on the required target, once searchers fixate on it, they helped to determine whether the fixated item is a target.

Unlike the radiological evidence, scanning error was the most prominent type of error in this study. Berbaum et al. (2010) proposed possible causes of SOS in chest radiology. Premature halting which occurs when searchers terminate search after finding a target was proposed, but further researches have shown that this is not the case, because SOS continued to occur even if search was not terminated immediately after detecting an abnormality. The current study reinforces arguments against the premature

halting explanation. Search duration of dual target trials where participants detected one target but not the other was approximately 10 seconds. Search duration for SOS dual target trials well exceeded the time it took to identify both targets. Indeed, search termination studies propose that searchers set quitting time threshold with reference to average time needed to scan a single item and low level features of the search display, such as colour and visual complexity (Wolfe, 2012). Considering that each trial had similar number of items and similar appearance, it is likely that a threshold established at the initial phase of the experiment have been maintained throughout the session, regardless of number of targets that may be present in each trial.

Another possibility is the perceptual set theory, which occurs when physicians find an abnormality and are inclined to make a diagnosis based on the found abnormality, when in fact, an additional abnormality which could lead to a different diagnosis might be present. It may be suitable to explain the current experiment because it contained different type of – high-salient and low-salient – targets. However, Fleck et al. (2010), in one of their experiments, demonstrated that SOS can still occur without saliency discrimination. Thus, this theory may not be the whole story.

The current study has a number of limitations. First, addition of no sound condition as a control may raise questions regarding validity. Although the primary intention was to compare between noise-present and absent situations, there may exist differences in physical properties between auditory stimuli present and absent conditions, which may produce a completely different result. If this is the case, neutral sounds would have served a more suitable control condition. Second, the current study presented different types auditory stimuli for every trial, in an attempt to delay habituation. However, a more robust result between the sound conditions may have been produced if each condition was presented in independent blocks. Finally, it may be a concern that the current study did not include a no-target condition. Although it succeeded in replicating the SOS effect, the absence of no-target trials may not fully reflect

real-world searches, as medical imaging airport security screening are often susceptible to low target prevalence. However, a study by Biggs, Cain, Clark, Darling, and Mitroff (2013) demonstrated that the same error appears with Transportation Security Administration Officers when no-target trials were not included in the experiment. This suggests that the current study design is sufficient to provide implications for real-world situations (Cain et al., 2013).

In conclusion, the current study adds meaningful contributions to the existing literature on SOS by demonstrating varying effects of emotional sounds on inducing the SOS effect. Although negative sounds produced the largest SOS per se, a closer look at the phenomenon indicated that it is because accuracy of negative sound low-salient single target trials was exceptional. Eye tracking results identified scanning error as the most frequent type of error. Future research should investigate properties of dual target trials that attenuated effects of sound emotion from appearing in the current study. Also suggested is introducing a context to the experiment paradigm instead of using abstract T and L shapes, so that it provides more implications for real-life situations.

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〈요 약〉

정서적인 소리가
다중 목표 자극 탐색에 미치는 영향

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　본 연구는 정서가를 가진 소리가 시각탐색만족현상에 미치는 영향에 대해 알아보고자 하였다. 시각탐색만족현상은 목표자극이 여러 개 존재하는 상황에서 하나의 목표자극을 찾고 나면 나머지 목표자극을 찾을 가능성이 낮아지는 현상이다. 이러한 현상에 대한 원인 규명에 대한 연구들 중 정서정보를 가진 자극의 효과를 알아본 연구는 부족한 실정이다. 따라서 본 연구는 소리의 정서가가 시각탐색만족현상에 어떤 영향을 주는지 알아보기 위하여 실험을 진행하였다. 또한 시선추적을 통해 시각탐색만족현상이 일어나는 원인을 찾고자 하였다. 참가자들이 알파벳 T자를 탐색하는 과제 도중 긍정적, 부정적 소리를 제시하였다. 그 결과, 부정적 소리가 제시되었을 때 사전적 정의의 시각탐색만족현상이 가장 크게 나타났다. 하지만 이는 현저성이 낮은 단일 목표자극 시행의 정확도가 월등히 좋았기 때문에 나타난 것이다. 효율성의 지표인 반응 시간은 목표자극 조건과 관계없이 부정적 소리가 주어졌을 때 가장 빨랐다. 목표자극 위에 떨어지는 응시점을 분류해본 결과, 목표자극을 응시하지 않아서 생기는 주사 오류가 가장 많이 나타났다. 본 연구의 결과는 소리의 유인과 각성수준의 상호작용에 의해 인지적 수행이 영향을 받는다는 관점에서 이해될 수 있다.

주제어 : 시각탐색만족, 시각탐색, 소리, 정서가, 시선추적