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The effect of varying danger controllability on attention to threat messages

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Summary

The objective of this study is to determine whether attention toward fear messages is affected by variation in the controllability of the associated danger. There is no consensus regarding the effectiveness of fear appeals in driving adaptive behaviour, and it may be the case that threat messages fail to capture attention if the associated danger is not explicitly controllable. One hundred and sixty undergraduate university students completed a computer task that involved exposure to threat cues signalling a danger (money loss). In high control blocks, attending to threat cues provided a high chance of avoiding the danger, whereas in low control blocks, attending to threat cues provided little chance of avoiding the danger. Attentional capture by threat was measured. A mixed-design analysis of variance showed there was greater attentional capture by threat cues in high control blocks compared with low control blocks. This effect was observed with a short stimulus exposure duration and was magnified with a long exposure duration. Fear appeals could capture attention to a greater degree if the danger related to the threat message was communicated as being controllable. This has significant practical implications for the implementation of fear appeals.

KEYWORDS

attentional bias, capture, controllability, danger, fear appeals

1 | INTRODUCTION

Threatening public messages (otherwise known as fear appeals) are designed to instil fear, to alter problematic human behaviour by making an impending danger salient (Roskos-Ewoldsen, Yu, & Rhodes, 2004). These threat messages have been employed for around 60 years, becoming particularly prevalent in the last 30 years in print, on television, and recently online (Ruiter, Kessels, Peters, & Kok, 2014). A typical threat message exposes individuals to threatening information concerning a future danger, with the intention of encouraging adaptive behaviours that reduce the risk of this danger (Witte & Allen, 2000). Smoking, poor diet, substance use, and poor occupational safety are some behaviours commonly targeted using this approach. Such behaviours are generally accepted as harmful to health and yet continue to be practiced to the detriment of individuals and society (Marteau, Hollands, & Fletcher, 2012).

Despite a large amount of research into the impact of threat messages, there is no consensus within the literature regarding their effectiveness in reducing health-related maladaptive behaviours. In the area of health promotion, many people advocate the use of threat messages (Tannenbaum et al., 2015; Fishbein et al., 2001). This is based on the assumption that highlighting the negative consequences of maladaptive behaviours will motivate individuals to adopt more adaptive behaviours. This assumption is bolstered by findings from various studies that suggest this approach does adaptively alter behaviour. For example, in a study examining smoking rates before and after a nationwide television advertising campaign rollout, it was found that recent exposure to the fear-inducing content of the antismoking advertisements was related to a significant decrease in cigarette consumption (Wakefield et al., 2008). Additionally, Leventhal, Singer, and Jones (1965) demonstrated a link between the level of fear caused by a tetanus-related threat message and the intention to obtain vaccination. Furthermore, McMath and Prentice-Dunn (2005) evidenced that more threatening messages about skin cancer were associated with greater intent to reduce risky behaviours, such as sunbaking.

However, many other studies demonstrate findings suggesting that fear appeals have no effect on reducing maladaptive behaviour. For example, in a study by Geller, Kalsher, Rudd, and Lehman (1989), televised threat messages failed to increase the use of safety belts while driving. Similarly, a study by Kinder, Pape, and Walfish (1980) presented drug-related threat messages, which failed to decrease substance abuse in teenagers. In certain cases, using threat messages has even been feared to be counterproductive, with higher severity of fear-inducing messages found to increase the likelihood of maladaptive behaviours (Quinn, Meenaghan, & Brannick, 1992). This inconsistency in findings highlights the need for rigorous laboratory-based research into the factors that may contribute to how threat messages are perceived.

Researchers investigating why some threat messages are effective in changing maladaptive behaviours, but others are less so, have developed various models of the psychological constructs involved when exposed to these threat messages (Ruiter et al., 2014). One of the most well-known and best-validated models is the extended parallel processing (EPP) model (Witte, 1992; Witte & Allen, 2000). This model purports that exposure to threat will or will not drive action to control the danger, depending upon the degree to which individuals believe that they are able to control the danger signalled by the threat. Specifically, this perception is informed by two subjective evaluations: whether an individual believes that performing a particular action will indeed reduce the danger (response efficacy) and whether they are personally capable of performing this action (self-efficacy; Witte, 1992). Combined, these two factors determine the controllability of the danger. When self-efficacy and response efficacy are high, the danger is seen as controllable, and individuals are likely to engage in danger control behaviour. In contrast, when self-efficacy and response efficacy are low, the individual perceives their ability to control the danger as low and consequently does not engage in danger control but in fear control instead. According to this model, when individuals do not believe they can control the danger signalled by a threat, then this will result only in reduced attention to such threat, without an attendant reduction in maladaptive behaviour (Witte, 1992).

This model suggests it is important that individuals perceive control over a signalled danger, as this can determine the success of threat messages in changing maladaptive behaviour. This can be illustrated by studies that have manipulated whether or not information about the controllability of the danger is included in the threat message. For example, Leventhal, Jones, and Trembly (1966) conducted a study that examined the impact of threat messages on individuals' decision to receive tetanus shots. They compared approaches that did or did not include specific instructions demonstrating how easy it is to get the shot. Individuals who were exposed to threat messages about the danger of tetanus that included the instruction on how to control the danger had a greater likelihood of seeking out tetanus shots, compared with those who were not provided with this instruction (Leventhal et al., 1966). Adding to this, Witte (1994) manipulated perceived danger controllability in regards to condom use, by providing study participants health information that either emphasised the effectiveness of condoms for the prevention of AIDS or emphasised the occasions in which condom use had failed to prevent the contraction of AIDS. Participants who received the information emphasising condom effectiveness were more likely to have reported using condoms compared with participants who did receive the other information, at a 6-week follow-up (Witte, 1994). Furthermore, a study focusing on information technology threats to encourage end users to comply with recommended security acts showed a link between behavioural compliance to security recommendations and the perceived efficacy of these acts (Johnston & Warkentin, 2010). Thus, it appears that when the capacity to control a signalled danger is not emphasised, threat messages are rendered less effective.

It may be that this reduced effectiveness is driven by reduced attention to threats that signal dangers people consider to be uncontrollable. According to the EPP model, individuals will demonstrate reduced attention to threat information communicating a danger that is perceived to be less controllable, relative to the attention that would be allocated to a threat message if the signalled danger was perceived to be more controllable. In the smoking example, smokers who do not believe they can control their smoking behaviour will, in order to reduce their level of fear, pay less attention to messages that convey negative information about smoking compared with smokers who do believe they can control their smoking behaviour (Roskos-Ewoldsen et al., 2004; Witte & Allen, 2000). So, Kuang, and Cho (2016) demonstrated via self-report measures that participants had heightened attention to information about how to protect against disease using vaccines, after observing threatening information concerning disease. This effect was further demonstrated in a study measuring attentional allocation of smokers via eye movements. In this study, participants paid more attention to written information about how to stop smoking and control the associated danger, compared with threatening images with no information about controlling the danger (Kessels & Ruiter, 2012). However, the messages individuals received varied not only in the degree of controllability communicated but also in form; the message highlighting controllability was written, whereas the message that did not highlight controllability was pictorial. The differential attentional effects could then be attributed not just to different communications of danger controllability but other factors also. This highlights the need for an experimental approach in which participants are exposed to the exact same threat information, with only the degree of danger controllability being manipulated.

The EPP model thus proposes that attentional allocation to threat messages will differ as a function of the controllability of the signalled danger. As yet, the validity of this hypothesis has not been empirically tested. The purpose of the current study is therefore to empirically evaluate the hypothesis that threat cues signalling more controllable danger are attended to more than the case for threat cues signalling less controllable danger.

Given the limitations of previous research, we sought to adopt a rigorously controlled cognitive–experimental approach to test this hypothesis. Specifically, we adapted laboratory procedures previously used to assess variation in attentional allocation to threat cues or *attentional bias to threat*. Such studies commonly utilise an interference approach, in which threat cues and neutral cues are presented simultaneously. Participants are typically required to perform a task using the neutral cues, and the degree to which the presence of the threat cues interferes with this task performance is assessed. For example, participants can be asked to respond to the orientation of an arrow in a central location shortly after exposure to peripheral stimuli that can be either threatening, positive, or neutral (e.g., angry faces and neutral faces; Mogg, Holmes, Garner, & Bradley, 2008). Allocation of attention to the threat cues can then be inferred through impaired performance on the arrow identification task in the presence of threatening peripheral stimuli, relative to performance on the main task in the absence of these threat cues (Lavie, 2005; Theeuwes, 1993). A greater attentional bias to the threat cue is evidenced by a higher degree of interference on a central task when threat cues are present, compared with when they are not.

This attentional bias to threat cues can occur as an automatic process, with attentional allocation to threat occurring rapidly; however, it can also be subject to later strategic influences (Cisler & Koster, 2010). The relative contribution of automatic versus strategic process to attentional biases is typically examined by observing patterns of attentional bias at short versus long stimulus exposure durations. Research has shown that threatening information can automatically capture attention, meaning that attentional processes will be rapidly deployed to its location, and consequently, an attentional bias to threat cues can be observed at a short exposure duration (Schmidt, Belopolsky, & Theeuwes, 2015). However, such rapid attentional allocation to threat does not always lead to sustained attentional engagement; that is, after threatening information draws attention, an individual may attend to another stimulus if time permits attentional movement (Mogg, Bradley, Miles, & Dixon, 2004). Thus, in experimental paradigms, longer stimulus exposure durations allow such strategic influences and comparison between long and short exposure duration permits evaluating the relative contribution of strategic influences. Although short and long exposure durations are both subject to automatic influences, only long exposure durations permit strategic processes to occur.

It is crucial to examine whether attention is biased more towards threats signalling more controllable dangers than to threats signalling less controllable dangers and whether this is the result of automatic or strategic processes. Indeed, threat messages signalling more controllable dangers could be attended more because they automatically attract attention or because individuals strategically allocated more attention to them. In contrast, ineffective messages may be the result of threatening information either failing to capture attention automatically or individuals strategically choosing to attend elsewhere. Therefore, the current study will not only examine the difference in attentional biases to threat cues signalling more controllable and less controllable danger but also examine how threatening information signalling more controllable danger is impacted by automatic and/or strategic attentional processes as compared with threatening information signalling less controllable danger. In the current study, danger controllability has been operationalised as the opportunity to avoid a danger occurrence through personal action.

To examine this, a conventional attentional bias assessment paradigm (Notebaert, Crombez, Van Damme, De Houwer, & Theeuwes, 2011) was adapted to allow examining automatic and strategic attentional bias to threat cues signalling more and less controllable dangers. The current study's paradigm consisted of a neutral cue presented in the centre of the screen, which contained a digit, presented briefly. On each trial, participants could accrue a small amount of money through correct digit identification. On some trials, this central cue was surrounded by a peripheral ring of coloured circles, and on some trials, this peripheral ring of circles contained a threat cue. The threat cue was a circle of one particular colour, which predicted a loss of money implemented at the end of the trial. Attentional bias to the threat cue was assessed by determining whether threat cues interfered with central task performance. This was done by comparing the accuracy of central task performance on trials that had peripheral stimuli with a threat cue present with trials that had no threat cue among the peripheral stimuli. Critically, the danger signalled by the threat cue (the money loss) differed in controllability across blocks. Participants could control the danger by foregoing entering the digit presented in the central circle and instead entering the digit presented in the threat cue. Critically, in high control blocks, this response was very effective and resulted in a high chance of avoiding money loss, whereas in low control blocks, this response was not very effective and resulted in a low chance of avoiding money loss. In order to examine whether any observed attentional bias to threat was due to automatic or strategic processes, for one group of participants, the circle stimuli were presented for a short (250 ms) exposure duration, whereas for another group, the stimuli were presented for a long (1,000 ms) exposure duration before a response could be made (i.e., before the digits were presented).

Based on the hypothesis proposed by the EPP model, we predict that participants will demonstrate reduced attention to threat cues in low control blocks, compared with high control blocks. In addition, the exposure duration manipulation will allow examining whether any effects observed are primarily automatic (if no differences between short and long exposure duration conditions are observed) or strategic (if effects are evident in the long exposure duration condition, but not in the short exposure duration condition).

2 | METHOD

2.1 | Participants

One hundred and sixty undergraduate students completed the study in partial fulfilment of course credit. They were recruited from an Australian university participant pool in which the mean age was

20.07 (*SD* = 6.03), and 63.1% were female. All had normal or corrected-to-normal vision and reported not to be colour blind. All participants gave informed consent and were advised that they could terminate their involvement in the study at any time. None made use of this option. The study was approved by the ethics committee of the School of Psychological Science at an Australian university.

2.2 | Materials

2.2.1 | Apparatus

The interference paradigm was programmed using the E-Prime software package (Psychology Software Tools Inc., Sharpsburg, PA, USA; Schneider, Eschmann, & Zuccolotto, 2002). Monitors used were LG Flatron E2211 with a 21.5-cm screen.

2.2.2 | Stimuli

The colours of the circle stimuli presented in the interference paradigm were generated with the Microsoft Windows 10 Paint program. The display was composed of a central dark grey circle (RGB: 128, 128, 128) and a peripheral ring of coloured circles. All circles had a radius of 7.5 mm and a colour band (0.5 cm) with a transparent centre. This circle centre could contain a digit from one to nine. The transparent centre of the circles ensured the digits presented within were equally easy to discriminate from the background across all colours used (Notebaert et al., 2011).

The paradigm required presenting circles in easy-to-discriminate colours. The central circle was always dark grey (hue = 160, luminance = 120). When present, peripheral circles each appeared in a light (luminance = 180), medium (luminance = 120), or dark shades (luminance = 60) of one of five colours, blue (hue = 159), aqua (hue = 119), green (hue = 72), yellow (hue = 39), and red (hue = 0). For each participant, one of these five colours was designated the threat cue, and circles presented in this colour always appeared in its medium shade, whereas the other peripheral circles each appeared in the dark or light shade of each of the four remaining colours.

2.3 | Interference paradigm

A novel interference paradigm was created in which threat cues signalled a future danger (money loss). In alternating blocks throughout this paradigm, participants had either a high or low level of control over this danger: in high control blocks, there was a high probability that participants would be able to control the danger, whereas in low control blocks, there was a low probability that participants would be able to control the danger. This allowed us to investigate the hypothesis that greater attentional allocation occurs to threats signalling more controllable dangers compared with threats signalling less controllable dangers. The interference paradigm was designed so that performance on a central task (via attentional allocation to this task) would allow participants to accrue money, and so that attentional bias to peripheral stimuli impaired performance on this task. As such, similar to previous research, the task took an interference approach, whereby impaired performance on this central task in the presence of peripheral distractors served to reveal an attentional bias to these distractors.

In each trial, a central dark grey circle stimulus was presented in the centre of the screen, after which a digit was presented briefly within the dark grey circle stimulus (numbered 1–9, font size 11). Entering this digit on the keyboard allowed participants to gain 3 cents per trial. The digit was presented for a brief exposure duration (100 ms) meaning that attention had to be located on the central dark grey circle when it appeared in order to accurately identify the digit, and so attentional distraction from this central circle would impair accuracy in identifying the digit presented within it. To measure attentional bias to threat cues, on some trials, a peripheral ring of coloured circles surrounded the dark grey circle, and on some trials, this peripheral ring contained a threat cue. One of the peripheral circle colours (counterbalanced across participants) predicted a loss of money thus representing a threat cue signalling a danger. Peripheral stimuli were placed with equal distance (5 cm) between each neighbouring stimuli and the centre of the screen.

Critically, two block types were created that varied in the degree to which the danger (money loss) signalled by the threat cue could be controlled by participant action. The danger could be avoided by entering the digit presented in the threat cue rather than the digit presented in the central circle. In high control blocks, entering the digit within the threat cue provided an 87.5% chance of avoiding the money loss (corresponding to successful control on seven out of eight trials). In low control blocks, this chance was 12.5% (corresponding to successful control on only one out of eight trials).

In each block, there were three trial types (see Figure 1). One third of trials presented only the central grey stimulus and digit (*Central Circle Only* trials, Panel a). One third of trials presented the central grey circle surrounded by peripheral stimuli with digits within, but no threat cues present (*Peripheral Circles Without Threat* trials, Panel b). In addition, one third of trials presented peripheral circles, including the threat cue (*Peripheral Circles With Threat* trials, Panel c). When a threat cue was present, on half the trials, this threat cue (as well as all other peripheral circles) contained a digit to allow participants to attempt avoiding danger by entering this digit rather than the digit presented in the central grey circle. However, the presence of these two relevant digits results in the possibility, despite the short exposure duration, that participants identify both the digit in the threat cue and the digit in the central cue. On such trials, responses could therefore be influenced by individual differences in the preference to report the central digit or threat cue digit. To avoid this noise source, on half of the trials on which a threat cue was present, four peripheral circles including the threat cue did not contain digits. These were the trials used to compute the measure of attentional bias (*Peripheral Circles with Threat* trials, Panel c).[1] Attentional allocation to the threat cue can be inferred by comparing participants' accuracy to identify the

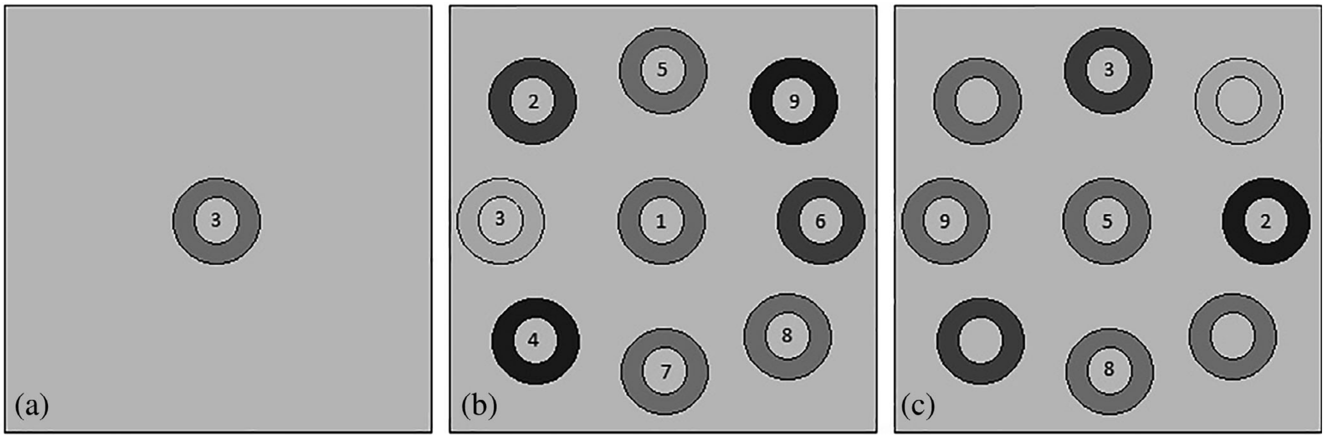

FIGURE 1 Attention Alignment Assessment task trial types. (a) *Central Circle Alone*; (b) *Peripheral Circles Without Threat*; (c) *Peripheral Circles With Threat*. The threat cue is represented by the red (darkest) stimulus

central digit on *Peripheral Circles with Threat* with participants' accuracy to identify the central digit on *Peripheral Circles Without Threat*. A greater attentional bias to the threat cue would result in more impaired performance when the threat cue is present among the peripheral circles, compared with when the threat cue is not present among the peripheral circles.

In each trial, all the circle stimuli appeared on a light grey background (RGB: 192, 192, 192) on-screen first without a digit. After a brief period, the circles remained on-screen, and digits were added for 100 ms. To examine automatic and strategic attentional processes, for half of participants, the circle stimuli were presented for 250 ms before the digits were presented, whereas for the other half, they were presented for 1,000 ms before the digits were displayed. When all the circle stimuli were presented, each circle contained a unique digit. Following the 100-ms presentation of digits within the circle stimuli, the screen was cleared, and participants were required to enter a digit using the number pad of the keyboard. The screen remained blank until a number was entered. Following this response, a screen showed the amount of money gained (e.g., "+3") or lost (e.g., "−10") on that trial. The intertrial interval was 1,000 ms, during which the screen was blank.

The task consisted of eight blocks of 48 trials, totalling 384 trials. In each block, the threat cue was presented twice in every possible peripheral location, once with a digit and once without. There were four high control blocks and four low control blocks, which were alternated with the starting block counterbalanced across participants. Participants were instructed that in high control blocks, there was a high chance that entering the threat cue digit would control money loss, whereas in low control blocks, there was a low chance that entering the threat cue digit would control the money loss.

2.4 | Procedure

Participants were seated approximately 60 cm from the computer monitor. Written instructions were given on-screen regarding the interference paradigm. The paradigm started with a staged practice component, first requiring participants to complete 10 trials (five *Central Circle Alone* and five *Peripheral Circles Without Threat*), which allowed them to rehearse entering the digit presented in the central circle and gaining money. Next, participants were instructed that one of the presented colours signalled the danger of losing 10 cents at the end of the trial. Participants then completed another 16 practice trials, in which the threat cue was present on eight trials, four of which were followed by the money loss. Following these practice trials, participants were instructed about the possibility of controlling the danger by entering the digit presented in the threat cue and how the probability of successful control would be varied across blocks. Next, participants completed eight blocks of the experimental task. Participants were informed with written information prior to block commencement whether it was a high control or low control block and therefore whether there was a high or low chance of successfully controlling the danger by entering the digit within the threat circle.

At the completion of each block, participants were informed on-screen how much money they had earned overall across all trials up to that point. At completion, they were informed of the total amount they would receive. The experimenter then provided this amount in AUD and debriefed the participant regarding the nature of the experiment.

3 | RESULTS

Table 1 presents mean proportional accuracy rates to identify the central digit in each condition. For each trial type, the score represents the proportion of trials of that type on which participants accurately identified the central digit. A score of 1 indicates that the central digit was identified correctly on every trial. This accuracy score would therefore decrease if participants were not attending to the central circle but were, for example, attending to the threat cue and reporting the digit in the threat cue instead.

TABLE 1 Mean proportions of central digit accuracy during every trial type

	Low control				High control			
	Short exposure		Long exposure		Short exposure		Long exposure	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Central Circle Alone	0.987	0.038	0.991	0.020	0.987	0.037	0.991	0.025
Peripheral Circles Without Threat	0.981	0.040	0.990	0.026	0.972	0.035	0.989	0.028
Peripheral Circles With Threat	0.864	0.125	0.815	0.133	0.780	0.152	0.655	0.165

We sought to examine whether participants showed differential attentional bias to threat cues, depending on the controllability of dangers signalled by these threat cues. Additionally, we sought to examine whether attentional bias was automatic or strategic. As such, proportional accuracy scores for identifying the central digit were subjected to a $2 \times 2 \times 2$ mixed-design analysis of variance that included a block type (high and low control) and trial type (*Peripheral Circles with Threat* and *Peripheral Circles Without Threat*) as within-subjects factors, and exposure duration (long and short) as a between-subjects factor.

Results showed a significant main effect of trial type: $F(1, 158) = 116.23$, $p < .001$, $\eta^2 = .42$, indicating reduced accuracy on *Peripheral Circles with Threat* trials ($M = 0.849$, $SD = 0.092$) compared with *Peripheral Circles Without Threat* trials ($M = 0.913$, $SD = 0.078$). This suggests that overall, attention was biased towards threat cues. There was a significant main effect of block type: $F(1, 158) = 437.08$, $p < .001$, $\eta^2 = .73$, indicating higher central task accuracy in low control blocks ($M = 0.983$, $SD = 0.018$) compared with high control blocks ($M = 0.779$, $SD = 0.124$). The third main effect of exposure duration was also significant: $F(1, 158) = 12.06$, $p = .001$, partial $\eta^2 = .07$, indicating higher central task accuracy in short exposure duration ($M = 0.901$, $SD = 0.087$) compared with long exposure duration ($M = 0.862$, $SD = 0.103$).

Results also showed a significant interaction between trial type and exposure duration: $F(1, 158) = 8.52$, $p = .004$, $\eta^2 = .05$; between block type and exposure duration: $F(1, 158) = 26.05$, $p < .001$, $\eta^2 = .14$; and between trial type and block type: $F(1, 158) = 114.68$, $p < .001$, $\eta^2 = .42$. However, all two-way interactions were subsumed within a significant three-way interaction between trial type, block type, and exposure duration: $F(1, 158) = 8.06$, $p = .005$, $\eta^2 = .049$. To clarify this interaction, we computed Attentional Bias Index scores for each participant, by subtracting accuracy on the central task for *Peripheral Circles with Threat* trials from accuracy on the central task for *Peripheral Circles Without Threat* trials. A higher score thus indicates greater attentional bias to the threat cue. These Attentional Bias Index scores for each block type and exposure duration condition are presented in Figure 2.

Follow-up t tests showed that Attentional Bias Index scores were greater in high control blocks ($M = 0.263$, $SD = 0.172$) than in low control blocks ($M = 0.146$, $SD = 0.128$). This is consistent with the hypothesis that there would be greater attentional bias to threat cues signalling more controllable dangers than to threat cues signalling less controllable dangers. In addition, paired-samples t tests showed that Attentional Bias Index scores were significantly higher in high control blocks relative to low control blocks within each exposure duration, with a medium effect size in the short exposure duration condition: $t(1, 79) = 5.96$, $p < .001$, Cohen's $d = .67$; and a large effect size in the long exposure duration condition $t(1, 79) = 8.90$, $p < .001$, Cohen's $d = .99$. As can be seen in Figure 2, this difference between block types was greater in the long exposure duration than in the short exposure duration condition. These suggest that there is both an automatic and strategic component to the increased attentional bias to threat cues signalling more controllable dangers.

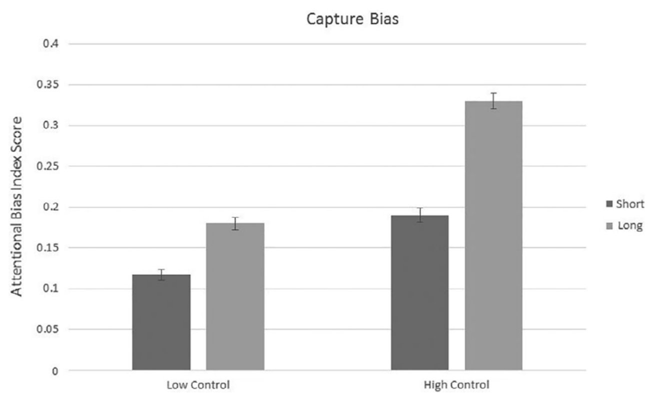

FIGURE 2 Attentional Bias Index Scores for each block type and exposure duration

4 | DISCUSSION

This study tested the veracity of the hypothesis proposed by the EPP model (Witte, 1992; Witte & Allen, 2000) that individuals will allocate more attention to threat cues signalling more controllable danger compared with threat cues signalling less controllable danger. We tested this hypothesis and additionally examined whether any differential attentional bias observed was the result of automatic and/or strategic processes. This was done by manipulating the duration stimuli that were exposed for prior to digits being presented. A short exposure duration allowed examining the degree to which threat cues were automatically allocated attention (Schmidt et al., 2015), whereas a long exposure duration allowed examining the degree to which threat cues were strategically attended to (Mogg et al., 2004).

Our results showed that participants demonstrated a greater attentional bias to threat cues in high control blocks, compared with low control blocks. This attentional bias was evidenced by an impairment in central task performance when a threat cue was present among the peripheral circles, compared with when no threat cue was present. Results further showed that this differential attentional bias was subject to both automatic and strategic influences. Specifically, participants in the short exposure duration's increased attentional bias to threat cues in high control blocks (as compared with low control blocks) suggest that threat cues signalling more controllable dangers automatically attract more attention than threat cues signalling less controllable dangers. Participants in the long exposure duration also showed a greater attentional bias to threat cues in high control blocks than in low control blocks; however, this difference in attentional bias between blocks was exaggerated when compared with the difference in attentional bias between blocks in the short exposure duration condition. This suggests that, in addition to automatic influence, the observed increased attentional bias to threat cues signalling more controllable dangers is also subject to strategic influences.

These findings support the attentional hypothesis proposed by the EPP model (Witte, 1992; Witte & Allen, 2000), which purports that reduced attention will be paid to threat messages if the individual does not believe the danger signalled by the threat message is controllable. This attentional hypothesis has previously been used to explain the differential effectiveness of threat messages relating to health behaviours. Specifically, it was proposed that some threat messages may be ineffective in effecting behavioural change because they do not emphasise the controllability of the danger and therefore receive less attention compared with threat messages that clearly articulate how the danger can be controlled (Roskos-Ewoldsen et al., 2004; Witte & Allen, 2000). However, no previous research has evaluated whether individuals indeed allocate more attention to threat messages signalling more controllable danger than to threat messages signalling less controllable danger. The current study was able to provide empirical evidence for this hypothesis using a laboratory-based cognitive computer paradigm.

A distinct advantage of our experimental approach is that the paradigm uses an objective behavioural measure of attentional allocation to potential threat cues (accuracy impairment on the central task), rather than asking individuals to report on whether they would attend more to certain types of measures. Self-report measures considering participant responses to threat messages have the potential to be biased or influenced by factors unrelated to the threat message (MacLeod, 1993). Furthermore, insight into one's own cognitive processes can be difficult to achieve; at best, individuals are able to report on what they believe they will pay more attention to (MacLeod, 1993; Nisbett & Wilson, 1977). The current approach circumvents these issues and allows us to examine precise attentional processes to provide a more thorough, nuanced understanding of attentional response to threat messages. Moreover, the current task yielded highly reliable indices of attentional bias. We computed the split-half reliability of the Attentional Bias Index scores by calculating for each block type (high control and low control), the correlation between the average Attentional Bias Index across the first and third presentations of that block, and the average Attentional Bias Index across the second and fourth presentations of that block. The resulting correlation was corrected using the Spearman–Brown prophecy formula. The predicted reliability of the Attentional Bias Index in high control blocks was .775, and the predicted reliability of the Attentional Bias Index in low control blocks was .772. This suggests that the current paradigm is a reliable tool to index attentional bias to threat cues (MacLeod, Grafton, & Notebaert, 2019).

The current study utilised a paradigm that, while involving the critical components required to test our hypothesis, provided a less ecologically valid approximation of threat messages than those that people are typically exposed to. This is an important shortcoming of the current paradigm to consider. However, doing so enabled us to provide a clean measure of attentional responses to more and less controllable dangers, free from the influence of variables at play when individuals are exposed to threat messages. For example, individuals exposed to an advertising campaign about the importance of seatbelts could have various interpretations of how controllable the danger is ("will wearing a seatbelt *really* stop me from being hurt?"). The current study's paradigm circumvented this with a tightly controlled experimental design that presented dangers that are objectively high or low in controllability and measured the attentional response. The disadvantage of such tight experimental control however is a loss of ecological validity. Although the types of fear-relevant attentional biases observed in abstract laboratory tasks have also been observed in more naturalistic settings (Chen, Clarke, MacLeod, & Guastella, 2012), it remains unknown whether similar attentional patterns would be observed for more complex threat messages that differ in the degree to which they are perceived as controllable. In light of the current findings, future research should aim to provide converging evidence for the tested hypothesis using a more naturalistic paradigm. This could be done for example using eye-tracking technology to investigate whether individuals allocate more attention to articles or images conveying information about more controllable threat relative to articles or images conveying information about less controllable threat.

Despite the current paradigm's lower degree of ecological validity (relative to other fear appeal experimental paradigms), our findings have implications for health researchers seeking to develop more effective fear appeal messages. Our findings indicate a media-based fear appeal would attract the most attention if the danger referred to is viewed as highly controllable. This form of fear message would be more likely to automatically capture viewer attention and to be strategically attended to. There are several ways in which information about danger controllability could be incorporated into fear appeals. Consider, for example, a television advertisement aiming to reduce smoking by featuring fear-inducing images of lung cancers. Viewers may avoid attending to this fear message if they believe they have little control over their smoking behaviour. To increase attentional allocation to this message, it should include clear instructions on how to reduce smoking, testimonials of people who successfully quit smoking, and reference to support resources. Alternatively, a staggered approach could be taken, in which information about the controllability of a danger is provided first, after which fear messages informing people of the risk of encountering this danger are distributed. Our research suggests such an advertisement would be automatically and strategically attended to more so, when compared with one that relied solely on fear-inducing images.

An alternative approach to increasing the effectiveness of fear messages could be increasing the degree to which the message presented attracts attention, by manipulating visual or other properties of the message. Wolfe, O'Neill, and Bennett (1998) purport attention can be captured by stimuli that are unique in colour, orientation, curvature, size, and shape. Therefore, presenting threat messages in which the critical information is unique in one of these features could facilitate greater attentional capture of this information. Additionally, fast shot cuts and edits, sudden noises, and highly emotional content are all associated with greater attentional capture by television advertisements (Lang, 1990). Incorporating such elements into fear messages could potentially overcome the reduced attention given to fear messages signalling a danger that an individual feels they have little control over. Critically however, further research is needed to examine whether increasing attentional allocation purely through modifying perceptual properties of the threat message will be sufficient in producing behavioural change, as it is possible that perceived control over the danger is a necessary condition for such change. If this is the case, future research could usefully examine whether combining visually "attractive" threat messages with information about the controllability of the danger would lead to more effective behavioural change as compared with either of these components alone.

Future research could further expand understanding of the attentional processes involved in exposure to threat messages by using different measures of attentional allocation, such as those that can be obtained using eye-tracking technology. The benefit of eye-tracking measures is they allow continuous recording of spatial attention across time (Chen & Clarke, 2017). As such, eye-tracking could examine the extent to which time is spent attending to a fear message embedded within a display containing various information sources (such as a health warning printed in a magazine; Huhmann & Brotherton, 1997). Eye-tracking has been used to assess attentional allocation to fear appeals varying in threat level (Kessels & Ruiter, 2012); examining these dynamic patterns of attentional allocation in response to varying degrees of danger controllability could serve to further understanding about the attentional processes involved in evaluating threat messages.

Future researchers could examine the current hypothesis using ERP technology, utilising the methodologies of Kessels, Ruiter, and Jansma (2010). ERPs have shown utility in measuring attentional allocation to fear appeals, with smokers demonstrating larger ERP amplitudes for threatening smoking images compared with nonthreatening images, thus demonstrating greater attentional allocation toward threatening images (Kessels et al., 2010). ERPs have also been used to measure attentional allocation to HPV-related fear appeals, with greater amplitude ERPs showing a relationship with increased likelihood of obtaining a HPV vaccination (Venkatesan, 2010). Such methodologies could be applied to the current study's paradigm, providing neuroscientific evidence of attentional allocation toward more and less controllable dangers.

Limitations of the current study need to be acknowledged. Although the experimental design afforded tight control over the assessment of attentional bias and the manipulation of danger controllability, we presented only one source of danger (money loss) that may have not been equally relevant to all participants. Future research could replicate and extend these findings in a variety of settings, by using a range of different threat cues and dangers that are aligned with the types of dangers commonly experienced. Furthermore, we did not seek to examine the relationship between patterns of attentional bias and behavioural change. Future researchers could focus on the relationship between increased attentional allocation to more controllable threats and adaptive behavioural change, using paradigms that provide opportunity to engage in adaptive behaviour in response to more and less uncontrollable threats.

In conclusion, this study was the first to empirically support the attentional predictions generated by the hypothesis of the EPP model, by demonstrating that individuals show a greater attentional bias to threat cues signalling more controllable dangers than by threat cues signalling less controllable dangers. This study's laboratory-based cognitive–experimental design provided tight experimental manipulation of danger controllability and assessment of automatic and strategic attentional biases. We hope the results of this study contribute to the refinement and improvement of fear appeals, resulting in more successful positive behavioural change.

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ENDNOTE

[1] Inclusion of responses on trials where a digit was presented in the threat cue in the computation of attentional bias did not change the pattern of results.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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