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Sitting duck or scaredy-cat? Effects of shot execution strategy on anxiety and police officers' shooting performance under high threat

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Purpose. Law enforcement may require police officers to inhibit intuitive responses to high threat and thereby affect their emotional reaction and operational effectiveness. Upon this premise, the current study reports two experiments which compare the impact of two relevant shot execution strategies on police officers' shooting performance under high threat, including (1) fire at an armed assailant and then step away from the assailant's line of fire ('fire-step') or (2) step away from the assailant's line of fire and then fire ('step-fire').

Method. In Experiment 1, 15 experienced police officers performed both shot execution strategies against a stationary assailant who occasionally shot back with coloured soap cartridges (high threat), while we measured their state anxiety, movement times and shot accuracy. In Experiment 2, the same 15 officers remained stationary and fired at the assailant who now performed both shot execution strategies in random order, thereby providing an indication of the risk (i.e., chance to get hit) associated with performing either strategy.

Results. Experiment 1 showed that officers preferred using the step-fire strategy and that using this strategy resulted in lower levels of anxiety, increased time for aiming and more accurate shooting than the fire-step strategy. Experiment 2, however, indicated that the step-fire strategy also increases one's chance of getting hit.

Conclusions. Findings suggest that inhibition of preferred responses under high threat (as in the fire-step strategy) may increase state anxiety and negatively affect shooting performance in police officers. Future work is needed to reveal underlying mechanisms and explore implications for practice.

Under high threat, people behave differently. Fortunately, most individuals rarely experience this, as truly threatening situations are not often encountered. For some individuals, however, high-threat situations are more common, for instance, because it is at the very heart of their jobs. Think, for instance, of fire-fighters trying to rescue someone from a burning house, or a police officer in confrontation with a dangerous assailant. In

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such situations, successful performance is crucial and slight changes in behaviour that occur as a result of threat can have very serious consequences (e.g., Nieuwenhuys & Oudejans, 2010; Smith, Petruzzello, Kramer, & Misner, 1997).

It is generally acknowledged that strong emotions give rise to automatic motivational orientations (or 'action tendencies'; Frijda, 1988) that facilitate specific behavioural responses. For example, emotions such as fear and anxiety are known to stimulate alertness (Bishop, 2007) and promote immediate responding to threat, thereby protecting individuals from physical or psychological harm (Lang, Davis, & Ohman, 2000). Although these responses clearly have an evolutionary function, specific performance situations may require individuals to override their initial responses and enforce the execution of goal-directed action (e.g., Eysenck, Derakshan, Santos, & Calvo, 2007; Nieuwenhuys & Oudejans, 2012). For example, when a police officer has to eliminate an armed assailant, the officer is expected to concentrate on the target and maintain a good level of shot accuracy, while not letting the urge to run away or take cover interfere with his/her shooting performance too much (Nieuwenhuys & Oudejans, 2010).

When a specific situation requires individuals to override their initial responses to emotion-provoking stimuli, this is typically associated with marked increases in physiological arousal and affective distress (Gardner & Moore, 2004; Gross, 2002). For example, work by Gross and Levenson (1997) showed that individuals who were instructed to use suppression in relation to emotion-provoking film clips showed greater skin conductance, greater activation of the cardiovascular system and greater respiratory activity than individuals who were allowed to let their emotions run freely. Similarly, Feldner, Zvolensky, Eifert, and Spira (2003) showed that in reaction to physical stress (i.e., inhalation of 20% carbon dioxide-enriched air), situational as well as habitual use of emotional suppression could result in higher levels of state anxiety and affective distress.

Following this line of reasoning – and knowing that high levels of state anxiety typically decrease performance (see Eysenck *et al.*, 2007; Nieuwenhuys & Oudejans, 2012, for reviews) – one might assume that task execution strategies that require individuals to override their initial behavioural responses to threat may be more difficult to execute and potentially lead to poorer performance than execution strategies that (to some degree) accommodate for these responses. Focussing on the shot execution strategies that police officers may adopt in confrontation with armed assailants, the current study aimed to test this assumption.

Police shot execution strategies

International surveys indicate that over the past decades, police officers are increasingly often confronted with serious crimes that involve the use of firearms (e.g., Timmer & Pronk, 2011). Following this development, effective responding has become increasingly critical while, at the same time, the righteousness of police use of force is ever more subject to public opinion and debate. In confrontation with an assailant who suddenly draws a firearm, police officers are required to quickly eliminate the imposed threat while at the same time take care of their own safety. In the Netherlands, where the current study was conducted, police officers are currently taught two shot execution strategies to achieve this. The first strategy is to step away from the assailant's line of fire as quickly as possible and then shoot (i.e., *step-fire*), the second strategy is to shoot first and then step away from the assailant's line of fire (i.e., *fire-step*). Essentially, both strategies consist of the same movements (i.e., firing and stepping) but differ with respect to the order in which both movements are executed.

Unpublished data from a sample of 183 Dutch officers (Nieuwenhuys, 2011) show that, on the shooting lane, police officers' perform equally well with both strategies; featuring hit percentages of 93.6% (*SD* = 13.3%) and 95.1% (*SD* = 16.8) for the step-fire and fire-step strategy, respectively, $t(183) = 1.01$, $p = .31$, $d = .075$ (two-tailed paired samples *t*-test). Based on these data, one might conclude that under low-threat conditions the order in which the stepping and firing movements are performed in both strategies does not lead to noticeable differences in shot accuracy. In real-life situations, however, this may be entirely different because motivational orientations that arise as a result of the imposed threat (e.g., fight or flight; Lang *et al.*, 2000) may promote the execution of one specific movement more than the other.

The current study

Against this background, the current study tested how different shot execution strategies may differentially affect police officers' shooting performance under high threat. This was carried out in two experiments. In a first experiment (Experiment 1), we tested the effect of shot execution strategy (i.e., step-fire vs. fire-step) on state anxiety and shot accuracy in a high-threat shooting task (Nieuwenhuys & Oudejans, 2010). In a second experiment (Experiment 2), we used the same set-up to test the extent to which performance of both strategies may differentially affect police officers' safety (i.e., their chance to get hit). From a theoretical perspective, findings were expected to provide knowledge about how the order of behavioural responses under high threat may affect emotional experience and performance. From an applied perspective, findings were expected to provide indications concerning the effectiveness of two highly relevant shot execution strategies that police officers use in threatening situations.

EXPERIMENT 1

In Experiment 1, we tested the effect of shot execution strategy (i.e., step-fire vs. fire-step) on state anxiety and shot accuracy in a high-threat shooting task. Police officers performed the step-fire and fire-step strategies while intending to hit a stationary assailant who occasionally shot back with coloured soap cartridges. Being hit with these cartridges causes a sensation of pain, the threat of which was known to induce high levels of state anxiety (e.g., Nieuwenhuys & Oudejans, 2010; Shipley & Baranski, 2002; Vickers & Lewinski, 2012). It is crucial to note that in our experiment, the level of threat with which officers were confronted was not manipulated. Instead, by having the officers perform the two different shot execution strategies, we manipulated the *order* of officers' behavioural responses while keeping the level of threat constant.

Our reasoning was as follows: assuming that high threat promotes specific behavioural responses (e.g., fight or flight; Lang *et al.*, 2000), the different orders represented in both strategies may either be facilitated or impeded, depending on the degree to which they are congruent with officers' intuitive responses to high threat. More specifically, if a strategy would require an officer to inhibit or suppress his/her intuitive response (e.g., shoot first, while the intuitive response would be to immediately step away), this was expected to be accompanied by higher levels of state anxiety (e.g., Feldner *et al.*, 2003; Gross & Levenson, 1997) and – consequently – lower levels of shooting performance (Behan & Wilson, 2008; Causer, Holmes, Smith, & Williams, 2011; Nieuwenhuys &

Oudejans, 2010, 2011). Vice versa, if a strategy would accommodate an officer's intuitive response, this should be accompanied by lower levels of state anxiety and better performance. Regarding which of the two strategies (i.e., step-fire or fire-step) would be facilitated or impeded – or whether this would be the same for all participants – we had no *a priori* expectations.

Method

Experiment 1 was approved by the ethical committee of the research institute. Given the involvement of firearms, the experiment was executed under the responsibility of certified police firearms instructors, following their standard safety protocol.

Participants

Fifteen police officers (12 men, 3 women), with a mean age of 38.2 years (SD = 9.0) and a mean working experience of 14.8 years (SD = 7.5), volunteered to participate in the experiment. All participants were patrol officers and – as is common in the Netherlands – performed emergency response work on a regular basis. They had a full licence to carry a handgun and were familiar with the step-fire and fire-step shooting strategies. As measured with the STAI (A-Trait Scale; Van der Ploeg, Defares, & Spielberger, 1980), participants' trait anxiety scores were significantly lower than the norm (M = 27.9, SD = 3.7, t = 8.61, p < .001; one-sample t-test), indicating that they had no extraordinary tendency to respond to specific situations with strong elevations in state anxiety. Before the experiment started, all participants provided written informed consent.

Procedure

Participants were measured individually, on a single day. The experiment consisted of 40 trials of a high-threat shooting exercise, which were executed using two different shot execution strategies: step-fire (SF) or fire-step (FS; see Figure 1). To mimic a sudden encounter with deadly force (and following the procedure of their annual shooting test), participants holstered their gun before each trial. On each trial, participants responded to a starting signal (whistle) by drawing their gun and – as quickly and accurately as possible –

Figure 1. Overview of the step-fire (SF) and fire-step (FS) shooting strategy (a) and experimental set-up (b). [Colour figure can be viewed at wileyonlinelibrary.com]

firing one round at a stationary assailant who was fitted with a white chest target (28 × 28 cm). The location and size of the target were chosen in consultation with experienced firearms instructors and based on national law enforcement procedures, which – in emergency situations as in the current experiment – would prescribe a chest shot. The assailant, who was played by an experienced firearms instructor, also drew his gun at the starting signal and, on each trial, also fired one round at the participant. On most trials, the assailant's gun would be loaded with blanks. However, to make sure that the exercise was conducted under high threat, the blanks were occasionally replaced with coloured soap cartridges, causing participants to be actually hit on 5–7 trials (Nieuwenhuys & Oudejans, 2010, 2011). The distance between the participant and the assailant was set at 5 m, which is in line with average shooting distances seen in reality (e.g., Naeyé, Timmer, & Beijers, 2001).

The order in which participants performed both shot execution strategies (SF and FS) was randomized across trials. Before each trial, participants were informed about the specific strategy that they were supposed to execute. In the SF condition, participants first stepped 1 metre to the left or right and then fired at the assailant's chest target (see Figure 1a, top). In the FS condition, participants first fired at the assailant's chest target and then stepped 1 metre to the left or right (see Figure 1a, bottom). To make sure that the assailant would show realistic responses in relation to the participants' actions, the indication of strategy (SF or FS) and direction of the step (left or right) was only made visible to participants and not to the assailant. For both strategies, half of the stepping movements was made to the left and half of the stepping movements was made to the right (randomized across trials). In all cases, participants were explicitly instructed to act as quickly as possible but to make sure that they would hit the target. To prevent automaticity in participants' responses, the execution of SF and FS trials was alternated with catch-trials, in which participants were instructed to fire while remaining stationary. Trials were ended as soon as both the participant and the assailant had fired their gun. On average this lasted approximately 2 s. After each trial, participants immediately returned to their starting position to await instructions for the next trial, which would typically follow within 10–15 s. In total, the experiment lasted approximately 10 min.

Material

The experiment was executed in a large dojo (12 × 12 m) at the facilities of the police academy. Participants and the assailant shot with 9 mm handguns, which were identical to the officers' duty weapon (Walther P5), but specifically prepared to fit coloured soap cartridges (Simunition®, FX® Marking Ammunition; Nieuwenhuys & Oudejans, 2010). For safety reasons, the participant and the assailant both wore a protective overall, a face mask and a throat protector. To analyse participants' shot and movement execution, the entire experiment was recorded on video using two high-definition digital video cameras (Creative VADO® HD, 30 Hz, Creative Technology Ltd, Singapore, Republic of Singapore). One camera (camera 1) recorded a close-up of the participant (see Figure 1a), while the other camera (camera 2) recorded an overview of the experimental set-up (see Figure 1b). After the experiment, the images of both cameras were uploaded on a personal computer and synchronized for later analysis using Adobe Premiere® video editing software (Adobe Systems Inc., San Jose, CA, USA). In this process, the images of both cameras were de-interlaced, thereby increasing the frame rate to 60 Hz (i.e., 17 ms per frame).

Dependent variables

Preference

To indicate whether participants had a preference for executing the SF or FS strategy, after finishing the experiment, each participant was asked which strategy had felt most natural to them: (1) SF, (2) FS or (3) no difference.

State anxiety

To indicate the extent to which executing the SF and FS strategy under high threat led to acute feelings of anxiety, directly after the experiment, participants reported how anxious they had felt while executing the respective strategies. In line with previous studies (e.g., Colin, Nieuwenhuys, Visser, & Oudejans, 2014; Nibbeling, Oudejans, Ubink, & Daanen, 2014; Nieuwenhuys & Oudejans, 2010, 2011) – which indicated that self-report measures of anxiety show good discriminatory validity and often reflect physiological responses to threat (also when conditions are randomized across trials; e.g., Gladwin, Hashemi, Van Ast, & Roelofs, 2016) – this was carried out using a 10 cm long visual analogue scale (ranging from *'not anxious at all'* to *'extremely anxious'*) called the 'anxiety thermometer' (Houtman & Bakker, 1989). As reported by Houtman and Bakker, concurrent validity and test–retest reliability of the anxiety thermometer are fair, with correlation coefficients ranging between .60 and .78.

Shot accuracy

For both conditions (SF and FS), shot accuracy was assessed by calculating the percentage of trials (%) on which participants managed to hit the assailant's chest target.

Shot execution

For both conditions (SF and FS), we registered the time between the starting signal (whistle blow) and the moment (video frame) at which participants (1) first started to draw their gun (i.e., *shot initiation time*; in ms); and (2) shot at the assailant (i.e., *shot completion time*; in ms). In addition, we calculated the duration of each shot (i.e., *shot duration*; in ms) by subtracting the shot initiation time from the shot completion time. Finally, as a reference value, we also registered the moment (relative to the starting signal) at which the assailant fired his gun (*shot completion time – assailant*; in ms).

Step execution

For both conditions (SF and FS), we registered the time between the starting signal and the moment (video frame) at which participants (1) first started to step aside (i.e., *step initiation time*; in ms); and (2) ended their step (i.e., *step completion time*; in ms). In addition, we calculated the duration of each step (i.e., *step duration*; in ms) by subtracting the step initiation time from the step completion time. To identify the start and end of the stepping movement, shoulder displacement was used as an indicator.

Statistical analysis

Differences between the two conditions (SF and FS) were analysed using two-tailed, paired sample *t* tests. In addition, for both conditions, we compared shot completion times of the participants' and the assailant's shot completion times using two-tailed independent sample *t* tests. In all cases, the alpha level for significance was set at $p = .05$. Effect sizes (Cohen's *d*) of around 0.25, 0.50 and 0.80 are reported as small, medium and large effects, respectively (Cohen, 1988).

Results

As appeared from the preference data, participants clearly favoured one strategy over the other. That is, 12 of 15 participants (80%) indicated that executing the SF strategy had felt most natural and 3 of 15 participants (20%) indicated that they had no preference. None of the participants indicated that he/she had preferred executing the FS strategy. Completely in line with the expressed preferences, participants reported to experience significantly less anxiety in the SF than in the FS condition, $t(14) = 2.19$, $p = .046$. $d = 0.51$, and shot considerably more accurate, $t(14) = 2.32$, $p = .036$, $d = 0.42$ (see Table 1).

With respect to movement execution, shot and step execution times revealed that participants consistently adhered to the instructed strategies, with step initiation and step completion times being significantly earlier in the SF than in the FS condition, $t(14) = 5.95, p < .001, d = 1.58$ and $t(14) = 6.17, p < .001, d = 1.68$, and shot initiation and shot completion times being significantly earlier in the FS than in the SF condition, $t(12) = 3.92$, $p = .002$, $d = 1.19$ and $t(14) = 4.38$, $p = .001$, $d = 1.17$ (Table 2). Interestingly, in both conditions, the shot and step execution times showed considerable overlap between the firing and stepping movements, in a sense that the second movement was often started before the first movement had ended (Table 2; see Figure 2 for a visual illustration). In line with this effect, shot duration was significantly shorter in the FS

Table 1. Overview of the results (*M* and *SD*) for each dependent variable in the step-fire (SF) and fire-step (FS) condition (Experiment 1)

	Condition	
	SF *M* (*SD*)	FS *M* (*SD*)
Anxiety (0–10)	3.74 (2.02)	4.85 (2.29)*
Shot accuracy (% hits)	51.33 (17.16)	44.00 (17.85)*
Shot execution		
Shot initiation time (ms)	157 (91)	73 (55)***
Shot completion time (ms)	951 (180)	768 (129)***
Shot duration (ms)	786 (147)	659 (79)***
Shot completion time – assailant (ms)	758 (188)	778 (122)
Step execution		
Step initiation time (ms)	268 (168)	693 (259)***
Step completion time (ms)	1,224 (233)	1,717 (344)***
Step duration (ms)	956 (134)	1,022 (201)*

*$p \leq .05$, ***$p \leq .001$.

Table 2. Overview of the results (*M* and *SD*) for each dependent variable in the step-fire (SF) and fire-step (FS) condition (Experiment 2)

	Condition	
	SF *M* (*SD*)	FS *M* (*SD*)
Anxiety (0–10)	3.73 (2.67)	4.91 (2.02)†
Shot accuracy (% hits)	49.00 (18.54)	40.00 (19.64)*
Shot execution		
Shot initiation time (ms)	121 (72)	163 (136)
Shot completion time (ms)	780 (101)	750 (100)**
Shot duration (ms)	646 (70)	576 (126)*
Shot completion time – assailant (ms)	869 (113)	574 (88)**

*$p \leq .05$, **$p \leq .01$, †$p = .093$.

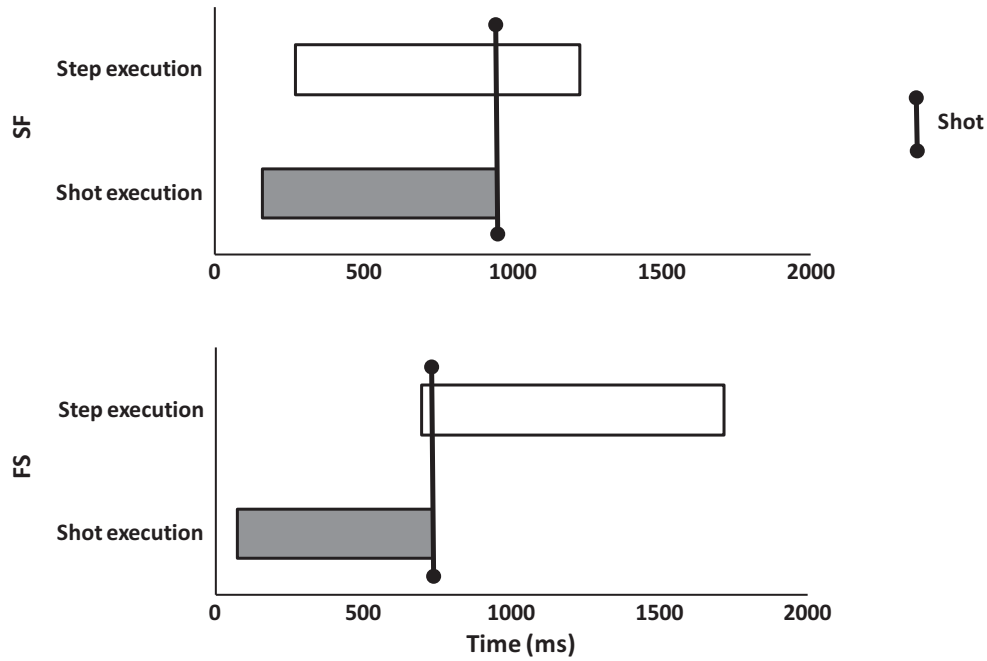

Figure 2. Timing of shot and step execution in the step-fire (SF) and fire-step (FS) condition (Experiment 1).

condition than in the SF condition, $t(12) = 4.67$, $p = .001$, $d = 1.08$, while step duration was significantly shorter in the SF condition than in the FS condition, $t(14) = 2.51$, $p = .025$, $d = 0.39$ (see Table 1). In the SF condition, participants' shot completion times were significantly later than shot completion times of the assailant, $t(20) = 2.62$, $p = .016$, $d = 1.13$, while in the FS condition, shot completion times of participants and the assailant did not differ significantly, $t(20) = 0.54$, $p = .60$, $d = 0.23$.

Discussion

Experiment 1 tested the effect of shot execution strategy (i.e., step-fire vs. fire-step) on state anxiety and shot accuracy in a high-threat shooting task. Based on the assumption that high threat may promote specific behavioural responses (e.g., fight or flight; Lang *et al.*, 2000), we predicted that if a specific strategy would require officers to suppress their intuitive (preferred) response to threat, this may be accompanied by (1) higher levels of state anxiety; and (2) lower levels of shooting performance. The observed pattern of results generally confirms these predictions.

First, a vast majority of participants (80%) indicated that – under the current high-threat circumstances – they generally preferred executing the step-fire strategy. Although our experimental design prevents conclusions regarding the extent to which such a preference indeed resembles a motivational orientation that resulted from the imposed threat (i.e., performance under high threat was not compared to performance under low threat), the observed anxiety scores do suggest that execution of the fire-step strategy required officers to inhibit or suppress what may have been their most intuitive response. This observation is in line with earlier work by Gross and Levenson (1997) and Feldner *et al.* (2003), who showed that suppression of behavioural responses to emotion-provoking stimuli may (ironically) be accompanied by increases in physiological activation and state anxiety (also see Gardner & Moore, 2004).

Second, participants' shot accuracy was significantly better in the step-fire than in the fire-step condition (Table 1). Knowing that under baseline (low-threat) conditions police officers shoot equally accurate with both strategies (Nieuwenhuys, 2011), one explanation for this effect may be the anxiety that was experienced while executing both strategies. That is, several studies have shown that high levels of state anxiety are typically accompanied by lower levels of shot accuracy (e.g., Behan & Wilson, 2008; Nieuwenhuys & Oudejans, 2010, 2011), potentially because anxiety reduces attentional control and causes individuals to take less time to aim (Eysenck *et al.*, 2007; Nieuwenhuys & Oudejans, 2012). Although this explanation may apply in the current situation, it must be noted that a direct relation between (self-reported) state anxiety and shot accuracy cannot be inferred from our findings. Future work which directly compares shot execution strategies between conditions of high and low threat is needed to investigate this.

Underlying the results for shot accuracy, our movement execution data revealed that rather than executing the stepping and firing movements in serial fashion, participants tended to execute both movements simultaneously (see Figure 2). Clearly, this may partly explain why the overall level of shot accuracy (i.e., 48%) was so much lower than what is typically seen during annual shooting tests (i.e., 94%; Nieuwenhuys, 2011). Moreover, our movement data also showed that the time that was taken to execute the shooting movement was significantly shorter in the fire-step condition than in the step-fire condition (Table 1), which may offer an additional explanation for why shot accuracy was observed to be lowest in the fire-step condition. Although baseline differences in shot execution time cannot be excluded completely, literature indicates that it is likely that the relatively high levels of anxiety that officers experienced when executing the fire-step strategy (Table 1) also caused them to be more prone to speed-up their performance in an attempt to reduce the chance of getting hit (Nieuwenhuys & Oudejans, 2010), thereby explaining (part of) the observed difference in shot execution time between both strategies.

All in all, Experiment 1 showed that the order of officers' behavioural responses to threat – as represented within their shot execution strategies – influences their emotional

response and shooting performance. Given that officers' shot accuracy was consistently better in the step-fire condition, Experiment 1 thus seems to indicate that – under high-threat circumstances – police officers' should consider applying the step-fire rather than the fire-step strategy.

An important question that remains, however, is whether both strategies may differentially affect police officer safety, that is, their chance to get hit by an assailant. In this respect, it is noteworthy to mention that in the step-fire condition (but not in the fire-step condition) officers completed their shot significantly later than the opponent (see Table 1), which – at least in theory – might have increased their chance of getting hit. Whether both shooting strategies may indeed differentially affect police officer safety was investigated in Experiment 2.

EXPERIMENT 2

Experiment 2 tested whether the order of movements as represented in the step-fire and fire-step shot execution strategies may differentially affect police officers' chance to get hit. To this end, we used the same experimental set-up as in Experiment 1 but – in order to properly standardize procedures – now asked our participants to remain stationary while shooting at a threatening assailant who executed both strategies in random order. As such, participants' shot accuracy was taken as an indication of the relative risk associated with using either strategy (i.e., with high and low accuracy indicating high and low risk, respectively).

Although our analysis was largely explorative, we expected participants' shot accuracy to be influenced by at least three factors, including: (1) the time that is taken for aiming (e.g., Vickers, 2007); (2) the anxiety that is experienced (e.g., Nieuwenhuys & Oudejans, 2010); and (3) the difficulty associated with shooting at a moving versus a stationary target (e.g., Causer *et al.*, 2011). Based on the order of movements represented in both strategies, we anticipated that the assailant would require more time to complete the shot with the step-fire strategy than with the fire-step strategy (also see Experiment 1). If so, we anticipated participants to take more time for aiming and experience less anxiety when performing against the step-fire strategy, both of which would positively influence their shot accuracy (Behan & Wilson, 2008; Nieuwenhuys & Oudejans, 2010; Wilson, Wood, & Vine, 2009). At the same time, however, performing against the step-fire strategy would require participants to shoot at a moving target, while this may not (or less so) be the case when performing against the fire-step strategy. Because hitting a moving target is more difficult than hitting a stationary target (e.g., Causer *et al.*, 2011), this was expected to reduce participants' shot accuracy. Regarding which of these factors (more time and lower anxiety vs. shooting at a moving target) would actually occur or have the largest influence on participants' shooting performance we had no *a priori* expectations.

Method

Experiment 2 was approved by the ethical committee of the research institute. Given the involvement of firearms, the experiment was executed under the responsibility of certified police firearms instructors, following their standard safety protocol.

Procedure

In Experiment 2, the same 15 police officers as in Experiment 1 participated.[1] The experimental set-up and procedure were exactly the same as in Experiment 1 (see Figure 1), with the sole exception that –to provide a robust comparison of the relative risk associated with using the step-fire (SF) and fire-step (FS) shooting strategy – participants now remained stationary while the assailant acted according to both strategies in random order. As in Experiment 1, participants performed 20 trials in each condition (40 in total). With the exception of step execution (participants now remained stationary), dependent variables were the same.

Results

As can be seen in Table 2, participants on average reported lower levels of anxiety in the SF condition than in the FS condition. The overall effect, however, failed to reach significance, with $t(14) = 1.80, p = .093, d = 0.50$. Regarding shot execution it appeared that while shot initiation times did not differ significantly between conditions, $t(12) = 1.32$, $p = .21$, $d = 0.42$, participants' shot completion times were significantly later, $t(14) = 2.98$, $p = .01$, $d = 0.77$, and shot durations significantly longer, $t(12) = 2.21$, $p = .047$, $d = 0.30$, in the SF condition than in the FS condition (Table 2). In line with these results, participants' shot accuracy was significantly better in the SF condition than in the FS condition, $t(14) = 2.267$, $p = .040$, $d = 0.47$ (see Table 2). Finally, comparison of shot completion times of participants and the assailant indicated that participants tended to complete their shot earlier than the assailant in the SF condition, $t(18) = 2.09$, $p = .051$, $d = 0.94$, but completed their shot later than the assailant in the FS condition, $t(18) = 3.82$, $p = .001$, $d = 1.71$.

Discussion

Experiment 2 tested whether executing the step-fire and fire-step shot execution strategies would differentially affect police officers' chance to get hit. Officers remained stationary and shot at a threatening assailant who executed both strategies in random order. Based on the literature, we expected at least three factors to influence officers' shot accuracy in relation to either strategy; including (1) the time that is taken to aim, (2) the level of anxiety that is experienced, and (3) shooting at a moving versus a stationary target.

As appeared from the results, officers' shot accuracy was significantly better in the step-fire than in the fire-step condition (Table 2), thus indicating that performing the step-fire strategy involves greater risk than performing the fire-step strategy. This interpretation was further supported by our analysis of shot completion times which showed that in the step-fire condition, officers' were not only more accurate but were also faster than the assailant, while the opposite was true for the fire-step strategy (i.e., less accurate and slower than the assailant; see Table 2).

In an attempt to explain the observed differences in shot accuracy, the analyses of shooting times revealed that in both conditions, officers were likely to fire at the assailant while he was executing the stepping movement (see Table 2). As such,

[1] *To prevent potential order effects, the order in which Experiment 1 and 2 were performed was counterbalanced between participants. Each participant performed Experiment 1 and 2 on the same day. Between both experiments a break of approximately 15 min was taken to allow participants enough time to rest.*

differences in shot accuracy between conditions cannot be attributed to the complexity that is associated with shooting at a moving versus a stationary target (Causer *et al.*, 2011). At the same time, shot durations were significantly longer in the step-fire than in the fire-step condition, which indicates that in the step-fire condition (i.e., when the assailant took more time to complete his shot) officers' may have taken more time to aim. Because longer aiming is generally associated with superior shooting performance (Vickers, 2007), this may explain part of the observed difference in shot accuracy between conditions. In addition, self-reported anxiety tended to be lower in the step-fire condition (Table 2), which may have further supported shot accuracy in this condition (Behan & Wilson, 2008; Nieuwenhuys & Oudejans, 2010, 2011; Wilson *et al.*, 2009).

All in all, Experiment 2 shows that being confronted with a shot execution strategy that allows more time to respond is associated with better shot accuracy, potentially because anxiety is reduced and more time is taken for aiming. From an applied perspective, however, findings indicate that for police officers, performing such a strategy yourself may reduce safety as it increases the chance to get hit.

GENERAL DISCUSSION

In two experiments, the current study tested how different shot execution strategies (i.e., step-fire vs. fire-step) may differentially affect police officers' shooting performance under high threat. Experiment 1 tested the effect of shot execution strategy on state anxiety and shot accuracy in a high-threat shooting task. Experiment 2 tested the extent to which performance of both strategies may affect police officers' safety (i.e., chance to get hit).

From a theoretical perspective, findings of both experiments show considerable overlap and provide insight into how the order of behavioural responses under high threat may affect emotional experience and performance. Findings of Experiment 1 indirectly suggest that high threat may trigger a motivational orientation that causes officers to prefer maintaining a specific order within their behavioural responses (Frijda, 1988). As our data confirmed, performing a shot execution strategy that required officers to inhibit their preferred response to threat (in this case: being required to fire first while the preferred response was to immediately step aside) was accompanied by higher levels of self-reported state anxiety (Feldner *et al.*, 2003; Gross & Levenson, 1997), less time for aiming (Nieuwenhuys & Oudejans, 2010) and less accurate shooting (Behan & Wilson, 2008; Wilson *et al.*, 2009). These findings were confirmed in Experiment 2, which revealed similar associations between anxiety, aiming time and shot accuracy.

Although conceptually the findings thus appear to stress the importance of aligning operational procedures with intuitive (preferred) responses to high threat, from an applied perspective, the findings reveal a message that is arguably more complex. That is, while officers may be able to shoot more accurately when using the step-fire rather than the fire-step strategy (Experiment 1), using the step-fire strategy may also put them at greater risk of being hit by an assailant (Experiment 2). In this sense, what is considered to be the optimal shot execution strategy in real life may be more dependent on constraints that are represented in specific situations (e.g., the opportunity to step aside or take cover, the speed of an assailant's responses) than being fixed across contexts.

Surely, the current study is not without limitations. From a methodological perspective, these include the absence of a high- and low-threat condition, which currently prevents attribution of findings to observed differences in self-reported state

anxiety. Second, to reliably compare both shot execution strategies, possible variation in officers' responses was experimentally controlled. For example, in our experiment officers only fired one round per trial and always stepped one metre to the left or right, whereas in real life, officers may fire more than once (e.g., to increase their chance of hitting or to afford safe withdrawal), may effectively hit assailants in other places than the chest (e.g., head or torso), and move over considerably greater (or smaller) distances (e.g., Naeyé *et al.*, 2001). In addition, in real life, officers are likely to select the nature of their responses based on an analysis of the environment and the level of threat with which they are confronted (Renden *et al.*, 2017), whereas, in the current experiment, experimental control required forced execution of both shot execution strategies. As such, before drawing implications for practice it is important to test the selection and effectiveness of both shot execution strategies under increasingly variable conditions. Finally, it should be noted that the current sample size ($n = 15$) was relatively small. Still, with respect to our main outcome measures (anxiety and shot accuracy), effect sizes were medium to large (with Cohen's d's ranging between 0.42 and 0.51), indicating that the observed differences between both strategies may be considered robust.

In sum, the current study shows that the order of officers' behavioural responses – as represented in their shot execution strategies – may affect their emotional experience and shooting performance under high threat, while at the same time influence their own safety. Future work is needed to reveal underlying mechanisms as well as to explore implications for practice.

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