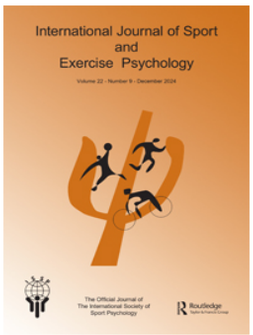

International Journal of Sport and Exercise Psychology

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rijs20

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To cite this article: Jeremy Oldfield, Rob Oldfield & Danny Holmes (02 Dec 2024): The effects of different types of crowd noise on penalty taking performance in football, International Journal of Sport and Exercise Psychology, DOI: 10.1080/1612197X.2024.2432996

To link to this article: https://doi.org/10.1080/1612197X.2024.2432996

Published online: 02 Dec 2024.

INTERNATIONAL JOURNAL OF SPORT AND EXERCISE PSYCHOLOGY
https://doi.org/10.1080/1612197X.2024.2432996

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The effects of different types of crowd noise on penalty taking performance in football

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ABSTRACT

Crowd noise impacts sporting performance, although little is known about this effect on penalty taking in football. This study explored the effect of crowd noise (positive, negative, stress-inducing, or no sound) on penalty-taking performance (accuracy and ball speed), and whether psychological skills contributed to this relationship. Twenty-four footballers took 20 unopposed penalties (with no goalkeeper present) whilst listening to pre-recoded crowd noises (5 penalties per the four conditions, presented in a counterbalanced order). After each condition, the same 16-item psychological skill questionnaire was completed by participants that measured, self-talk, imagery, relaxation, and emotional control. The results indicated that penalty-taking accuracy, although not ball speed was worse when listening to negative crowd noise. Self-talk is used more by players who were less accurate, and no psychological skill was able to moderate any negative effects of noise type on penalty taking. Encouraging players to train under different crowd noises might enhance performance and decision-making when in competition.

ARTICLE HISTORY
Received 5 January 2024
Accepted 11 November 2024

KEYWORDS
: Distraction; pressure; performance

Noise can be a significant distraction when performing cognitive and motor tasks, often leading to performance decrements (Szalma & Hancock, 2011). Despite considerable research on how noise affects memory, attention, and decision-making within the psychological literature (Beaman, 2005; Hanczakowski et al., 2018; Ratcliff & Smith, 2010), limited research has especially looked at this within a sporting context (Herrebrøden et al., 2017). The few studies that have investigated the effects of noise on sports players' performance have often reported inconsistent results, for example, Herrebrøden et al. (2017) failed to find noise as a salient distracting influence that negativity affected expert golfers, whereas Jeon et al. (2014) reported noise as a distracting influence on badminton players. The differences reported in these studies may be a product of the unique sporting environments in which sport is played. In some sports i.e., golf, noise is kept to a minimum when players are taking shots, in tennis, the crowd is silent during the serve but not whilst the points are being played, and in football the crowd makes continuous noise

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throughout the match. The effects that noise has upon player performance should, therefore, be investigated within its unique sporting context.

Within football, there is a lack of evidence exploring the impact of crowds on the player's performance. Harris et al. (2020) have investigated the effect of crowds on goal scoring in professional football, assessing data from professional football matches when crowds were not permitted to attend during the COVID-19 pandemic. They found a statistically significant increase in the number of goals scored when crowds were not present, compared to the previous four seasons. Suggesting the reductions in pressure experienced by players contributed to this effect. Otte et al. (2021) investigated the impact of stadium noise on footballers' passing speed and accuracy. These researchers found that footballers were slower at passing whilst hearing a negative noise (i.e., boos and jeering) and when normal auditory information was masked, compared with when the hearing was not distracted at all. Interestingly, no differences were noted in the footballer's passing *accuracy* between the conditions. These studies suggest that external auditory cues do impact performance and when normal auditory information is masked performance can suffer (Stanton & Spence, 2020).

Where noise distraction in football might be particularly pertinent is when a player takes a penalty kick. Penalty-taking in football is widely seen as one of the most high-pressured sporting situations (Ellis & Ward, 2022). It can cause anxiety even when they have been manipulated experimentally (Wilson et al., 2009). Players' heart rates are known to increase under these high-pressure situations (Navarro et al., 2012), which could contribute to their performance. Lusk et al. (2004) demonstrated that heart rates tend to rise in the presence of noise, which can induce pressure although Ellis and Ward (2022) found no evidence of heart rate increasing in their pressure condition. Further exploration of the relationship between different types of crowd noise and its relationship on heart rate and subsequent performance is, therefore, warranted.

Park et al. (2022) have investigated crowd noise as a potential factor that can lead to performance decrements in penalty taking. These researchers analysed video footage of penalty kicks in professional games and found evidence that in the presence of a hostile crowd, players made more avoidance-based decisions, (measured by where they kicked the ball in relation to where the keeper was standing on the goal line), compared to when in the presence of a more supportive crowd. Ellis and Ward (2022) conducted a mixed-methods study showing that the performance of professional football players in penalty taking was reduced when crowd noise was present, although additional pressure measures alongside the noise of the crowd were also included, such as ego threat, evaluation from others and giving the goalkeeper knowledge about the direction of the penalty. Interestingly, in their follow-up interviews, participants mentioned crowd noise was a direct distraction that affected decision-making.

Crowd noise whilst taking a penalty kick may add to players feeling an increase in pressure to perform. Research has demonstrated that a player's performance in penalty-taking is often below par in high-pressured situations (Jordet et al., 2007; Wilson et al., 2009). This phenomenon is often termed "choking". Two notable theories are often proposed to explain this phenomenon: Attentional Control Theory (ACT) (Eysenck et al., 2007) and Self-focus theories (i.e., Baumeister, 1984). These theories can be applied to understand how the penalty taker is impacted by crowd noise. ACT proposes that the penalty taker becomes distracted by focusing more on the crowd noise

rather than the kick itself. The increased anxiety they feel from the noise reduces attentional control, so resources that should be directed at the desired behaviour are weakened, as and influence of the distracting stimulus i.e., the crowd becomes greater. Self-focus theories (i.e., Baumeister, 1984), on the other hand, propose that participants under pressure by the crowd noise consciously focus on their previously automated skill which then becomes controlled and more prone to error. There is extensive literature on choking (Mesagno et al., 2021; Roberts et al., 2019) although not all these studies have analysed whether crowd noise contributes to building this pressure.

Despite some footballers experiencing performance decrements in penalty taking due to crowd noise distractions, others are not hindered in this way and seem to be displaying resilience. Resilience is "*a dynamic process encompassing positive adaption within the context of significant adversity*" (Luthar et al., 2000, p. 543). In the context of penalty taking, hearing crowd noise may be a source of significant stress or pressure that can lead to decrements in performance. However, if certain psychological skills are used, these might be able to moderate the stress experienced and act as protective factors that ultimately lead to success in penalty taking. Psychological skills, such as self-talk, imagery, relaxation and emotional control, are potential protective factors that have been identified as beneficial under noise distraction conditions (Galanis et al., 2018; Jeon et al., 2014). Indeed, the most successful athletes appear to pay more attention to these skills (Konter et al., 2019). Research has highlighted the importance of these psychological skills especially for footballers (Sadeghi et al., 2010) and has evidenced that these psychological components hold the largest influence on penalty outcomes (Jordet et al., 2007).

Positive self-talk is linked with increased focus and attention (Konter et al., 2019) and is seen as important in fine-tuning technique, movements and skills execution (Beilock et al., 2002). Farina and Cei (2019) have evidenced how self-talk can be particularly important in enhancing decision-making skills and moderating anxiety in football players. Daftri et al. (2010) have also found that self-talk had several cognitive benefits on Iranian professional football players including lowering reaction times as well as improving focus, attention and decision-making. As self-talk improves concentration by redirecting attention towards skills being carried out (Hardy & Oliver, 2014; Johnson et al., 2004), it could be a protective factor that moderates the negative effects of crowd noise (Galanis et al., 2018).

Imagery is often used by athletes to regulate emotion, increase confidence, reduce anxiety levels, and improve skill acquisition (Jones et al., 2002; Williams & Cumming, 2012). More experienced football players are more likely to use imagery in their skill performance than novice players (Grushko et al., 2016). An imagery intervention using the PETTLEP model (Holmes & Collins, 2001) was effective in aiding decision-making in elite academy football players (Pocock et al., 2019). Using this skill can have a significant effect on performance (Toth et al., 2020) and can enhance motor performance as well as enhance affective and motivational outcomes (Simonsmeier et al., 2021). It is likely that Imagery could moderate any negative effects of crowd noise on penalty taking.

Relaxation techniques are effective in aiding athletes to respond effectively to stress experienced in competition (Fletcher & Hanton, 2001; Wadey & Hanton, 2008), and improve sports performance and self-confidence (Parnabas et al., 2014). In relation to football performance, research with sub-elite footballers has shown that a progressive muscle relaxation intervention had a positive effect on several footballing skills including

accuracy in passing, ball control and overall performance (Golmohammadi et al., 2018). Ferrell et al. (2006) noted that athletes who were performing at their optimal levels often reported feeling relaxed and a sense of calm and were not thinking about their performance, suggesting that relaxation is a key psychological skill. Relaxation could, therefore, moderate the negative effects of crowd noise.

Emotional control has also been shown to be of particular benefit to athletes in competition (Kaiseler et al., 2009), and research with footballers has demonstrated that those who reported higher levels of emotional control had a greater sense of professional achievement (Stradomska, 2021). Castro-Sánchez et al. (2019) have evidenced that from a sample of adolescent footballers those who reported higher levels of anxiety demonstrated lower levels of emotional intelligence, and more negatively regulated their emotions, thus indicating those with more control of their emotions felt less anxious and could potentially enhance their performance. Footballers who can manage their emotions effectively by using various psychological skills are likely to achieve higher performance levels (Konter et al., 2019). Emotional control could, therefore, moderate the negative effects of crowd noise on performance in penalty taking.

Noise can be a distracting influence on sports performance, nonetheless, several questions remain as it is unclear how footballers are influenced by different types of crowd noise and how this could affect penalty-taking performance. There is limited evidence that has investigated the unique influence of crowd noise on performance outside of other measures of pressure (i.e., ego threat). Therefore, it is important to tease out this unique influence upon performance in penalty taking. Psychological skills, such as self-talk, imagery, relaxation and emotional control, are pertinent for sporting success but are they used differently under different crowd noises? Can they moderate any crowd noise distraction experienced that would lead to performance decrements?

The aim of the present study was, therefore, to explore how different types of crowd noise impact performance in penalty taking, and whether different psychological skills could moderate any negative effects of crowd noise on performance.

Research questions

1. Is penalty-taking performance (accuracy and ball speed) affected by different types of crowd noise?
2. Is a player's heart rate affected by different types of crowd noise?
3. Are psychological skills (self-talk, imagery, relaxation, and emotional control) used differently depending on the type of crowd noise?
4. Are psychological skills and heart rate related to penalty-taking performance, independent of crowd noise?
5. Is the relationship between psychological skills and penalty performance different under different types of crowd noise?

Methods

A repeated measured experimental design was adopted with the dependent variables measuring penalty=taking accuracy, ball speed, heart rate, and four psychological skills,

(self-talk, imagery, relaxation, and emotional control). Participants took five penalty kicks in four noise conditions whilst these measures were taken. The four noise conditions involved participants listening to either a positive crowd noise; negative crowd noise; no artificial noise or a pressure noise condition. While taking the penalties participants' heart rate, ball speed and penalty accuracy were measured. After each condition, participants completed a brief 16-item questionnaire to measure the four psychological skills. This measure was repeated after each condition. Conditions were randomly counterbalanced to prevent any order or practice effects.

Participants

Twenty-four participants were recruited which is the minimum number required to detect a medium effect, at a *p*-value of 0.05, and a power of 0.80 (GPower, Faul et al., 2007). Twenty-two participants identified as male, and 2 participants as female. The mean age was = 34.92, with an SD of 13.89. Participants were recruited via opportunity sampling and had various levels of footballing experience, ranging from semi-professional to recreational. Participants self-identified and categorised themselves at their current skill level from recreational ($n = 4$), amateur competitive league ($n = 17$) or semi-professional ($n = 3$).

Penalty task

Participants took penalty kicks into a full-size goal (7.32×2.44 m) from 11 metres from the goal line. Participants used a size 5-mitre Football that was inflated to 12PSI. All penalties were unopposed (with no goalkeeper present), and participants were instructed that more "points" would be achieved by being more accurate (penalties being closer to the corners) and by kicking the ball with higher speed. Participants took five penalties in the four noise conditions.

Noise conditions

Participants wore wireless Bluetooth in-ear headphones whilst taking the penalties. These headphones played different types of crowd noise during the four different conditions. Condition 1: "positive" (samples of cheering and celebrating). Condition 2: "negative", (samples of booing and jeering). Condition 3: "no noise", participants could just hear the normal background sound. Condition 4: "pressure", this sound contained the boos and jeers of condition 2 but is sampled using a "Sheppard's Tone" backdrop which is an audio illusion characterised by increasingly intense sound which never reaches a crescendo (Shimizu et al., 2007). This sound is created to enhance a sense of pressure and tension. Condition 1 and 2 were samples from Premier League Football matches and were naturally occurring.

Materials and measures

Accuracy and ball speed

Two cameras were set up on the football pitch to measure ball speed and accuracy. One camera positioned on a tripod at 5 metres behind the goal was used to measure the

accuracy of the penalty shot. The camera was positioned to record the whole goal width and height and record 1 metre around the goal. A 12 × 4-foot grid was imposed upon the video file to divide the goal into 48 locations (each location was 2 × 2 feet) and were awarded points from 1 to 10 for accuracy (10 for the corners and 1 in the middle of the goal – see Figure 1). Other positions scored in between these values. One point was also awarded for near misses (those within 2 feet of the crossbar or posts). Shots outside of this range were scored as 0. A group of 5 footballers were presented with the grid and asked to come to a consensus about how each location would be scored. To measure ball speed a second camera was positioned focusing along the goal line from approximately 10 metres to the left of the goal post. Cameras 1 and 2 were synced so that ball speed could be measured from when the participant kicked the ball to when the ball crossed the goal line. Measures were taken in miles per hour (mph), (a similar method has been used to measure ball speed in other studies i.e., Ellis & Ward, 2022). A measure of penalty-taking *ability* was also taken which involved multiplying participants' accuracy scores with their ball speed scores. This measure was taken to assess how the skills were used in combination and remove any effect of players only concentrating on accuracy or speed rather than both.

Heart rate: Whilst participants took the penalties their heart rate was measured with a Polar H10 Heart rate sensor chest strap. Heart rate is measured in beats per minute (bpm) with a lower heart rate, indicating more efficient heart function. The average heart rate reading was taken over the duration of each condition whilst the participant took the 5 penalties. Four readings for HR for each participant were taken during the experiment.

Psychological skills

The Test of Performance Strategies (TOPS) survey (Hardy et al., 2010) was taken at the end of each condition. The present study utilised 4 of the psychological skills measured within this survey "Self-Talk", "Imagery" "Relaxation" and "Emotional Control". Each construct was measured using four items i.e., "*I talked positively to myself to get the most out of my performance*" (self-talk); "*I rehearsed my performance in my mind before the task*" (imagery); "*I was able to relax if I got too nervous*" (relaxation); "*My emotions got out of control under the pressure of the task*" (emotional control). Each item was scored on a 5-point Likert scale from *strongly agree* to *strongly disagree*. A mean score for each construct was taken after each noise condition, with a maximum possible score of 5 and a minimum possible score of 1.

Accuracy Score Locations. Points Were Awarded for the Position of Each Penalty

10	9	8	6	4	2	2	4	6	8	9	10
9	7	5	3	2	1	1	2	3	5	7	9
9	7	5	3	2	1	1	2	3	5	7	9
10	8	6	4	2	1	1	2	4	6	8	10

Figure 1. Accuracy score locations. Points were awarded for the position of each penalty.

Procedure

Ethical approval was awarded for this study by the University ethics committee. Participants fitted the heart rate monitor to their own chest and the researcher checked it was recording correctly. Participants were then asked to take five practice penalty kicks from the penalty spot into a full-size goal. Participants were reminded that they would score more points for shots closer to the corners and for higher ball speed. The penalties were taken on a 11 a side University-owned 3G Astro Turf football pitch, with a full-size goal. There was no goalkeeper present for any of the penalties. After the practice, kicks participants were presented with the 4 conditions in a counterbalanced order. Participants were given headphones to wear and told not to remove them until all five penalties had been taken. During each condition, the crowd sound was played, at an approximate volume of 80 dB.

Participants were instructed to pick up the football from the centre circle and walk to the penalty spot, to mimic taking a penalty in a competition. They took the penalty in their own time. After each penalty, they were told to return to the centre circle, pick up a new football and begin walking again to the penalty spot and take the next penalty. After five penalties had been taken, participants removed the headphones and completed the TOPS survey. Once completed, the second condition started which followed the same format as the first. This pattern was utilised for all four conditions.

Results

The descriptive statistics relating to penalty-taking performance (ball speed; accuracy; and ability); psychological skills (self-talk, imagery, relaxation, and emotional control) and heart rate across the four crowd noise conditions are displayed in Table 1.

The descriptive statistics displayed in Table 1 show the penalty-taking accuracy mean score was lowest in the negative condition and highest in the no-noise condition. For ball speed, the differences between conditions are consistent, whereas for ability the higher mean scores were within the positive condition and the no noise condition and lower in the negative and pressure conditions. Heart rate was lower in the no-noise condition, whereas scores on the psychological skills measures appear to be consistent across conditions.

Research question 1: is penalty taking performance (accuracy and ball speed) affected by different types of crowd noise?

Three one-way repeated measures ANOVAs were conducted on the data. Penalty accuracy, ball speed and ability as the outcomes were compared across the four crowd noise conditions.

Accuracy

A one-way repeated measures ANOVA was conducted to compare accuracy scores in penalty taking across the four crowd noise conditions (positive, negative, no noise and pressure). There was a statistically significant effect for the noise condition, Wilks' Lambda = *.68, F (3,21) = 3.375, p = .038*, indicating that the type of noise participants listened to whilst taking penalties did affect how accurate they were. Multivariate partial

Table 1. Means and standard deviations in parenthesis for penalty taking performance, psychological skills and heart rate across the four crowd noise conditions.

		Condition				All Conditions	
		Positive	Negative	No Noise	Pressure	Average for all conditions	The range for all conditions
Penalty performance	Accuracy	4.81 (1.35)	3.98 (1.49)	4.97 (1.47)	4.36 (1.67)	4.50 (1.09)	2.80–7.30
	Ball Speed (mph)	42.13 (8.45)	42.21 (8.41)	41.40 (8.58)	42.57 (8.89)	42.08 (8.41)	24.52–52.94
	Ability (Accuracy × Ball Speed)	206.67 (84.24)	171.18 (83.00)	206.96 (80.70)	185.04 (78.65)	192.46 (69.20)	91.31–358.31
Physiological response	Heart Rate (bpm)	122.21 (21.90)	121.67 (21.43)	119.54 (22.33)	122.00 (21.96)	121.35 (21.52)	85.50–155.50
Psychological Skill	Self-Talk	3.41 (0.49)	3.29 (0.71)	3.29 (0.65)	3.17 (0.54)	3.29 (0.36)	2.69–3.94
	Imagery	3.71 (0.69)	3.64 (0.80)	3.72 (0.68)	3.67 (0.77)	3.68 (0.61)	2.31–4.63
	Relaxation	3.75 (0.68)	3.59 (0.83)	3.97 (0.57)	3.56 (0.75)	3.72 (0.51)	2.44–4.50
	Emotional Control	3.79 (0.77)	3.58 (0.97)	4.11 (0.56)	3.60 (0.76)	3.77 (0.57)	2.63–5

eta square = .325 (which equates to a large effect size, Cohen, 1992). Post hoc tests using the Bonferroni Test for multiple comparisons observed the mean value for accuracy was significantly different between the negative condition and the no-noise condition, (p = 0.040, 95% C.I. = −1.95 to −.032). There was no statistically significant difference between any of the other conditions. These results indicated that participants were significantly more accurate in the no-noise condition compared with the negative condition.

Ball speed

A one-way repeated measures ANOVA was conducted to compare ball speed in penalty taking across the four crowd noise conditions. There was no statistically significant effect for noise condition, Wilks' Lambda = .77, F (3, 21) = 2.05, p = .0137. This finding indicates that the type of noise participants listened to whilst taking penalties did not affect how fast they kicked the ball.

Penalty ability

A one-way repeated measures ANOVA was conducted to compare penalty-taking ability (accuracy × ball speed) across the four crowd noise conditions. There was no statistically significant effect for noise condition, Wilks' Lambda = .71, F (3, 21) = 2.89, p = .059. This indicates that the type of noise participants listened to whilst taking penalties did not affect penalty-taking performance.

Research question 2: is a player's heart rate affected by different types of crowd noise?

A one-way repeated measures ANOVA was conducted on the data. Heart Rate was the outcome which was compared across the four crowd noise conditions. There was a statistically significant effect for condition, Wilks' Lambda = .63, F (3, 20) = 3.906, p = .024**, indicating that participants' heart rates were affected by the different crowd noises. Multivariate partial eta square = .369 (which equates to a large effect size, Cohen, 1992). Post hoc tests using the Bonferroni Test for multiple comparisons observed the mean value for accuracy was significantly different between the no-noise condition and the positive condition, (p = 0.021, 95% C.I. = .399–6.731). There was no statistically significant difference between any of the other conditions. These results indicated that participants' heart rates were significantly higher in the positive condition compared with the no-noise condition.

*** This analysis was calculated on 23 rather than 24 participants as an HR reading was not recorded for 1 participant.*

Research question 3: are psychological skills (self-talk, imagery, relaxation, and emotional control) used differently depending on the type of crowd noise?

Four one-way repeated measures ANOVAs were conducted on the data. Self-talk, imagery, relaxation, and emotional control as the outcomes were compared across the four crowd noise conditions.

There was no statistically significant effect for noise condition for either self-talk, (Wilks' Lambda = .87, F (3, 21) = 1.063, p = .386), imagery (Wilks' Lambda = .98, F (3, 21) = 0.138, p

= .936) or relaxation (Wilks' Lambda = .77, F (3, 21) = 2.019, p = .142) indicating that participants did not use these psychological skills differently across the four conditions.

There was a statistically significant effect for noise condition for emotional control, Wilks' Lambda = .64, F (3, 21) = 3.871, p = 0.024 indicating that participants did use emotional control skills differently across the four conditions. Multivariate partial eta square = .356 (which equates to a large effect size, Cohen, 1992). Post hoc tests using the Bonferroni Test for multiple comparisons observed the mean value for accuracy was significantly different between the no-noise condition and the pressure condition, (p = 0.026, 95% C.I. = .044 to .977). There was no statistically significant difference between any of the other conditions. These results indicated that participants used significantly more emotional control skills in the no-noise condition compared with the pressure condition.

Research question 4: are psychological skills and heart rate related to penalty taking performance independent of crowd noise?

The average measure for each of the psychological skills and heart rate were taken across the four conditions. The average penalty-taking performance (accuracy, ball speed, and ability) were also taken across all the conditions. A Pearson's correlation was conducted upon the data. Table 2 shows the results.

These findings show that a significant relationship emerged between accuracy and self-talk, indicating that those who were more accurate displayed lower levels of self-talk. No other statistically significant relationships emerged between measures of penalty-taking performance and any psychological skill or heart rate.

Research question 5: is the relationship between psychological skills and penalty performance different under different types of crowd noise?

To answer this question participants were split into those with high vs. low levels of the 4 psychological skills measured (self-talk, imagery, relaxation, and emotional control – based on a 50% split). Separate analyses were undertaken with the outcome being penalty-taking ability (comprised accuracy × ball speed). This outcome was selected as being more robust than accuracy or ball speed alone. The effect of the levels of each psychological skill were assessed across the four conditions for penalty-taking ability. This resulted in 4 separate mixed 4 × 2 ANOVA's. The first variable was condition (a within-participants variable) with the four noise conditions. The second variable was

Table 2. Correlations between penalty-taking performance, psychological skills and heart rate.

	1	2	3	4	5	6	7	8
1. Accuracy	–	.226	.794**	−.111	−.414*	−.228	−.215	.128
2. Ball speed	–	–	.756**	.321	.043	.162	.318	.253
3. Ability	–	–	–	.119	−.213	−.044	.096	.312
4. Heart rate	–	–	–		.007	−.020	.266	.383
5. Self-talk	–	–	–	–		.548**	.323	.140
6. Imagery	–	–	–	–	–		.615**	.010
7. Relaxation	–	–	–	–	–	–	.	550**
8. Emotional control	–	–	–	–	–	–	–	–

* = p < . 05; **p < .01.

the level of psychological skill (a between-participants variable) with two groups (high or low).

For each of the mixed ANOVA's the interaction effect was assessed to establish whether any moderation had occurred. There was no significant interaction effect between noise condition × self-talk (Wilks Lambda = *.932, F (1, 22) = .49, p = .694*), noise condition × imagery (Wilks Lambda = *.836, F (1, 22) = 1.31, p = .298*), noise condition × relaxation (Wilks Lambda = *.703, F (1, 22) = 2.82, p = .065*) or noise condition × emotional control (Wilks Lambda = *.772, F (1, 22) = 1.97, p = .534*). These results suggest that participants' levels of psychological skills do not impact penalty ability differently in the different conditions. Psychological skills were, therefore, not able to moderate any negative effects that noise has on penalty-taking performance.

Discussion

This research investigated the effects of different types of crowd noise on penalty-taking performance, and whether psychological skills and player heart rate also contributed to this relationship. The results indicated that penalty-taking accuracy, although not ball speed is influenced by the type of crowd noise a player is exposed to. Specifically listening to a negative crowd noise was significantly worse than listening to no noise. The results also showed that heart rate was lower when players were not exposed to crowd noise and emotional control skills were used more by players when in the no-noise condition compared with when listening to pressure crowd noises. Self-talk is used more by players who were less accurate, and no psychological skill was able to moderate the negative effects of noise on penalty-taking performance.

Crowd noise and penalty-taking performance

Accuracy

The results demonstrated that accuracy was higher in the no-noise condition compared with the negative-noise condition. Few studies have explored the unique effects of crowd noise on penalty-taking performance. Some research, however, has investigated the impact of crowd noise on other football skills such as passing accuracy but failed to find any difference under different types of crowd noise (Otte et al., 2021). This study instead showed that players were slower at performing the task under a negative noise condition. The differences reported here may reflect the skill being undertaken with accuracy appearing to be unaffected by crowd noise in active play but when the task is more static (i.e., penalty kick) accuracy is impeded.

It is worth considering whether penalty-taking performance is impacted more by the type of noise or merely its presence or absence. Within the present study, normal auditory input was masked by listening to high-volume crowd noises in three conditions (positive, negative, and pressure), whereas this was not the case in the no-noise condition. When normal auditory information is masked performance does decrease (Stanton & Spence, 2020) which could explain the findings here. Indeed, the performance of professional footballers is reduced when crowd noise is present (Harris et al., 2020), and noise has been reported to be a direct distraction that affects decision-making (Ellis & Ward, 2022). Further investigation on whether it is the type or presence of noise that holds the greatest effect on performance is warranted.

Ball speed

Unlike accuracy, there were no differences across the sound conditions in ball speed. The effect of crowd noise on penalty performance may, therefore, depend on the skill being assessed. In the present study to achieve a high score for accuracy, participants were required to engage in some decision-making about where to kick the ball alongside effectively using their motor skills to perform the task. Ball speed, however, is a more simplistic skill that predominantly involves motor skill use and is likely to be relatively fixed to the relative strength and ability of each participant. Accuracy may have been seen as the most important element of the task and a more complex skill which could then be more prone to performance decrements when exposed to noise. Attentional Control Theory (Eysenck et al., 2007) could explain this effect by assuming the penalty taker becomes distracted by focusing more on the crowd noise than the kick. As more cognitive resource is required for accuracy than ball speed, performance decrements under noise conditions are more commonly observed. Alternatively, self-focused theories (i.e., Baumeister, 1984) could explain this idea too, as noise becomes a distracting or pressurising influence that causes players to consciously focus on automated skills which players may try and control or overthink and, therefore, lead to errors. This might be pertinent in more complex tasks like accuracy, and less pronounced in more simplistic skills like ball speed. Skill execution accuracy may be more vulnerable than ball speed (a more simplistic motor skill) to noise distraction. Players could have traded off the attentional capacity on one skill to focus more on the other, although further research is needed to test these ideas. Nonetheless, the implications to arise from this finding could involve players training to perform these motor skills under crowd noise to improve this skill during competitions.

Crowd noise and heart rate

Participant heart rates were affected by different types of crowd noise. Rates were significantly lower in the no-noise condition, compared with the positive condition although no other statistically significant differences were noted. Previous research has shown that heart rates do rise in the presence of noise (Lusk et al., 2004), so having a lower heart rate in the no-noise condition was expected.

A more surprising finding was that heart rate differences across the other three conditions were similar and not statistically different. It was expected that the pressure condition (designed to build tension and increase stress) would lead to higher heart rates, but this was not the case, suggesting this condition was not more stressful than the others. Research has demonstrated that heart rates are higher under high-pressure situations (Navarro et al., 2012) and evidence more anxiety (Oudejans & Pijpers, 2010), although in the present study, this was not the case and heart rates did not increase in the pressure condition, like the findings from Ellis and Ward (2022).

In further studies, the sound designed for the pressure condition may need reviewing, as it should lead to increases in player heart rates. If a sound could be produced that does evoke elevated heart rates, this could be important for aiding in training, to help players cope in high-pressure environments. As heart rates were lower in the no-noise condition this has implications for crowds to be quieter during high-pressure situations if the aim is to lower a player's heart rate which can be an indicator of stress.

Crowd noise and psychological skills

Whether psychological skills are used differently in the four crowd noise conditions was investigated. The findings revealed that for self-talk, imagery, and relaxation, these skills were not used differently under the different crowd noise conditions. Participants who were aware of the importance of these skills are likely to have demonstrated them in every condition. Whereas participants who were either not aware or who did not acknowledge these skills as important were unlikely to have utilised them in any condition.

In relation to emotional control, however, when participants were in the nonoise condition, they were able to use more emotional control skills compared to when in the pressure condition. Presumably emotional control skills were easy to use when there was no noise distraction but when in a more pressured condition participants were more distracted and not able to rely on the same emotional control skills. There are implications from this finding that players should practice penalties in high-pressure environments to rehearse their emotional control skills which might be particularly relied upon when in competition.

Psychological skills and penalty-taking performance

An unexpected finding was that a significant negative relationship emerged between self-talk and accuracy. Although no causation can be inferred here, the finding does suggest that self-talk was used more by players who were less accurate. This is counter to the research evidence that suggests more successful athletes pay additional attention to psychological skills and positive self-talk is linked with increases in focus, attention and enhanced decision-making (Farina & Cei, 2019; Konter et al., 2019), all of which are important to increase accuracy in penalty taking.

One explanation of this finding could be that those who were lower in confidence or experienced a psychological response to the study may have tried to use self-talk to mitigate the negative impacts this was having on their performance. The less skilled players perhaps used more self-talk to coach themselves through the task, whereas the more skilful players, who were likely more confident, did not perceive self-talk as necessary for the simplistic task. The sample within the present study was broad, ranging from recreational to semi-professional players, which may have influenced the findings, and could be rectified in future studies. Nonetheless, the implication of these findings is that the use of self-talk might be most relevant and targeted at those who do feel less confident.

Moderation effects

This research also aimed to demonstrate whether high levels of any psychological skills could overcome the negative effects that noise has upon penalty-taking performance. The results failed to find any significant interaction effect, suggesting psychological skills were not able to moderate the negative effects that noise has on penalty-taking performance. Evidence of resilience could, therefore, not be demonstrated.

Psychological skills have been identified as beneficial under noise distraction (Galanis et al., 2018; Jeon et al., 2014), with self-talk seen to improve concentration (Hardy & Oliver, 2014; Johnson et al., 2004), imagery to enhance motor performance (Simonsmeier et al., 2021). and relaxation and emotional control have been linked to higher performance (Ferrell et al., 2006; Konter et al., 2019). Nonetheless, these skills do not appear to be

powerful enough to mitigate the negative effect that noise has on penalty-taking performance. Further investigation is needed to establish whether psychological skills can act as protective factors to moderate the negative effects of noise as this would have profound implications on player performance.

Limitations

The results of the present study must be interpreted considering the limitations, primarily the task selected involved participants taking penalties in unopposed goals (with no goalkeeper) which lacks ecological validity and limits the findings' transferability. Nonetheless, the study was designed in this way to focus on the impact of crowd noise on two important penalty-taking skills, accuracy, and ball speed, and to avoid any inconsistency that would be present with a goalkeeper. Ecological validity could be increased in future studies by adding in goalkeeper or audience effects, although considerations around consistency between trials would need to be considered.

Accuracy was an important variable within the present study and was measured by dividing the goal into 48 locations which were awarded different points. How the points were awarded for each area was decided by a consensus of five footballers, although in future studies a more objective and reliable measure of accuracy could be taken. One example could be telling participants where they needed to shoot rather than giving them a choice as this would prevent participants from repeating the same penalty (i.e., always kicking it in the bottom right corner) and therefore mitigate any practice effects.

Some further design modifications could include randomising the noise participants heard after *each* penalty rather than taking 5 penalties in a row under the same noise condition. In this way the noise would appear novel each time and prevent players from becoming accustomed to the sound and essentially blocking it out. The noise conditions were sampled from Premier League matches and included cheers for the positive condition and boos for the negative condition. However, no measure was taken of how participants perceived the noise as it was intended. Interviewing participants after the event to assess whether they felt the boos were hostile and the cheers supportive, or a questionnaire item about the extent to which each condition elicited any pressure would be beneficial for further research.

A pertinent limitation concerns the participants' individual characteristics such as their varying skill levels, their age, and gender. Although all were recreational footballers, the skill level ranged from "playing regularly with friends/recreational" to "semi-professional". Confidence and ability could have played a role in the performance of the task, although future research would be needed to test this idea. Higher-quality players may have felt more confident in the simplistic nature of the task and therefore were not affected by the crowd noise to the same extent as a lower-quality player with less confidence. To overcome some of these limitations, further research could sample only players of a similar competency skill level.

A further issue with the sample was that there were only two females, compared with 22 male participants. This gender imbalance did not allow any comparisons to be made, so in future studies, a more balanced participant sample should be included. Years of playing experience and position played are also likely important confounding variables

although these data were not collected so no analysis could not be carried out, but should be in future research.

Measuring heart rate was important in order to assess whether any player experienced any stress or pressure from the noise conditions, although in future studies recording a baseline heart rate before each condition began would be beneficial. Measuring whether crowd noise has any other physiological effects such as upon respiration rate (Ellis & Ward, 2022) or brain activity, and acknowledging how this impacts performance would be an interesting pursuit. Finally, analysing the time it took players to take penalties, and whether this was different under different crowd noises might be particularly pertinent (Otte et al., 2021).

Conclusion

The aim of the present study was to investigate the influence that different types of crowd noise have on penalty-taking performance, and whether psychological variables and heart rate are involved in this relationship. Participants had lower heart rates and were more accurate in taking penalties when in the no-noise condition. Emotional control skills were also used more when players were in the no-noise condition, and self-talk skills were used more often by less accurate players. Psychological skills were not able to moderate the negative effects that noise has on penalty-taking performance.

This research demonstrates that crowd noise does influence penalty-taking performance. Encouraging footballers to train under different noise conditions, specifically when taking penalties and making decisions might be helpful in enhancing performance in competition when the pressure is greater.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The data that support the findings of this study are available from the first author.

References

Baumeister, R. F. (1984). Choking under pressure: Self-consciousness and paradoxical effects of incentives on skillful performance.. *Journal of Personality and Social Psychology*, *46*(3), 610–620. https://doi.org/10.1037/0022-3514.46.3.610

Beaman, C. P. (2005). Auditory distraction from low-intensity noise: A review of the consequences for learning and workplace environments. *Applied Cognitive Psychology: The Official Journal of the Society for Applied Research in Memory and Cognition*, *19*(8), 1041–1064. https://doi.org/10.1002/acp.1134

Beilock, S. L., Carr, T. H., MacMahon, C., & Starkes, J. L. (2002). When paying attention becomes counterproductive: Impact of divided versus skill-focused attention on novice and experienced performance of sensorimotor skills. *Journal of Experimental Psychology: Applied*, *8* (1), 6–16. https://doi.org/10.1037/1076-898X.8.1.6

Castro-Sánchez, M., Zurita-Ortega, F., Ubago-Jiménez, J. L., González-Valero, G., García-Mármol, E., & Chacón-Cuberos, R. (2019). Relationships between anxiety, emotional intelligence, and

motivational climate among adolescent football players. *Sports*, *7*(2), 34. https://doi.org/10.3390/sports7020034

Cohen, J. (1992). Quantitative methods in psychology: A power primer. *Psychological Bulletin*, *112*(1), 155–159. https://doi.org/10.1037//0033-2909.112.1.155

Daftari, O., Sofian, O. F. M. (2010). Effects of self-talk on football players performance in official competitions. *Researcher in Sport Science Quarterly*, *1*, 29–37. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=6f03ec43c5851d5309150a0402f0c4475d26bdf5

Ellis, L., & Ward, P. (2022). The effect of a high-pressure protocol on penalty shooting performance, psychological, and psychophysiological response in professional football: A mixed methods study. *Journal of sports sciences*, *40*(1), 3–15. https://doi.org/10.1080/02640414.2021.1957344

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, *7*(2), 336–353. https://doi.org/10.1037/1528-3542.7.2.336

Farina, M., & Cei, A. (2019). Concentration and self-talk in football. In E. Konter, J. Beckmann, & T. Loughead (Eds.), *Football psychology: From theory to practice* (pp. 241–254). Routledge. https://doi.org/10.4324/9781315268248

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146

Ferrell, M. D., Beach, R. L., Szeverenyi, N. M., Krch, M., & Fernhall, B. (2006). An fMRI analysis of neural activity during perceived zone-state performance. *Journal of Sport and Exercise Psychology*, *28*(4), 421–433. https://doi.org/10.1123/jsep.28.4.421

Fletcher, D., & Hanton, S. (2001). The relationship between psychological skills usage and competitive anxiety responses. *Psychology of sport and exercise*, *2*(2), 89–101. https://doi.org/10.1016/S1469-0292(00)00014-5

Galanis, E., Hatzigeorgiadis, A., Comoutos, N., Charachousi, F., & Sanchez, X. (2018). From the lab to the field: Effects of self-talk on task performance under distracting conditions. *The Sport Psychologist*, *32*(1), 26–32. https://doi.org/10.1123/tsp.2017-0017

Golmohammadi, B., Kashani, V. O., & Khosravi, A. (2018). The effect of a relaxation program on performance of sub-elite Football players. *Journal of Motor Learning and Movement*, *10*(3), 385–411. https://doi.org/10.22059/jmlm.2018.208261.1095

Grushko, A. I., Haidamashko, I. V., Ibragimov, R. R., Kornienko, D. S., Korobeynikova, E. Y., Leonov, S. V., & Veraksa, A. N. (2016). Does the motivation, anxiety and imagery skills contribute to football (soccer) experience? *Procedia - Social and Behavioral Sciences*, *233*, 181–185. https://doi.org/10.1016/j.sbspro.2016.10.189

Hanczakowski, M., Beaman, C. P., & Jones, D. M. (2018). Learning through clamor: The allocation and perception of study time in noise. *Journal of Experimental Psychology: General*, *147*(7), 1005–1022. https://doi.org/10.1037/xge0000449

Hardy, J., & Oliver, E. J. (2014). Self-talk, positive thinking, and thought stopping. In T. Gershon & R. C. Eklund (Eds.), *Encyclopaedia of sport and exercise psychology*. Thousand Oaks, CA: Sage. https://durham-repository.worktribe.com/preview/1679742/11950P.pdf

Hardy, L., Roberts, R., Thomas, P. R., & Murphy, S. M. (2010). Test of Performance Strategies (TOPS): Instrument refinement using confirmatory factor analysis. *Psychology of Sport and Exercise*, *11*(1), 27–35. https://doi.org/10.1016/j.psychsport.2009.04.007

Harris, D., Wilson, M., & Vine, S. (2020). *The effect of crowd removal on goal scoring in professional football*. [Unpublished manuscript]. https://doi.org/10.31234/osf.io/n4egb

Herrebrøden, H., Sand Sæbø, E., & Hystad, S. W. (2017). Are auditory distractions disturbing and detrimental to the performance of expert golfers? A field experiment. *Journal of Applied Sport Psychology*, *29*(3), 323–336. https://doi.org/10.1080/10413200.2017.1286696

Holmes, P. S., & Collins, D. J. (2001). The PETTLEP approach to motor imagery: A functional equivalence model for sport psychologists. *Journal of applied sport psychology*, *13*(1), 60–83. https://doi.org/10.1080/10413200109339004

Jeon, H., Kim, J., Ali, A., & Choi, S. (2014). Noise distraction and mental practice in closed and open motor skills. *Perceptual and Motor Skills*, *119*(1), 156–168. https://doi.org/10.2466/25.23.PMS.119c14z7

Johnson, J. J., Hrycaiko, D. W., Johnson, G. V., & Halas, J. M. (2004). Self-talk and female youth soccer performance. *The Sport Psychologist*, *18*(1), 44–59. https://doi.org/10.1123/tsp.18.1.44

Jones, M. V., Mace, R. D., Bray, S. R., MacRae, A. W., & Stockbridge, C. (2002). The impact of motivational imagery on the emotional state and self-efficacy levels of novice climbers. *Journal of Sport Behavior*, *25*(1), 57–73. https://www.proquest.com/openview/21e5649452f26baa3bfbb8e9fee6d062/1?pq-origsite=gscholar&cbl=30153

Jordet, G., Hartman, E., Visscher, C., & Lemmink, K. A. P. M. (2007). Kicks from the penalty mark in soccer: The roles of stress, skill, and fatigue for kick outcomes. *Journal of Sports Sciences*, *25*(2), 121–129. https://doi.org/10.1080/02640410600624020

Kaiseler, M., Polman, R., & Nicholls, A. (2009). Mental toughness, stress, stress appraisal, coping and coping effectiveness in sport. *Personality and individual differences*, *47*(7), 728–733. https://doi.org/10.1016/j.paid.2009.06.012

Konter, E., Beckmann, J., & Mallett, C. (2019). Psychological skills for football players. In E. Konter, J. Beckmann, & T. Loughead (Eds.), *Football psychology: From theory to practice* (pp. 179–197). Routledge. https://doi.org/10.4324/9781315268248.

Lusk, S. L., Gillespie, B., Hagerty, B. M., & Ziemba, R. A. (2004). Acute effects of noise on blood pressure and heart rate. *Archives of Environmental Health: An International Journal*, *59*(8), 392–399. https://doi.org/10.3200/AEOH.59.8.392-399

Luthar, S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, *71*(3), 543–562. https://doi.org/10.1111/1467-8624.00164

Mesagno, C., Tibbert, S. J., Buchanan, E., Harvey, J. T., & Turner, M. J. (2021). Irrational beliefs and choking under pressure: A preliminary investigation. *Journal of Applied Sport Psychology*, *33*(6), 569–589. https://doi.org/10.1080/10413200.2020.1737273

Navarro, M., Miyamoto, N., van der Kamp, J., Morya, E., Ranvaud, R., & Savelsbergh, G. J. (2012). The effects of high pressure on the point of no return in simulated penalty kicks. *Journal of Sport and Exercise Psychology*, *34*(1), 83–101. https://doi.org/10.1123/jsep.34.1.83

Otte, F. W., Millar, S. K., & Klatt, S. (2021). What do you hear? The effect of stadium noise on football players passing performances. *European journal of sport science*, *21*(7), 1035–1044. https://doi.org/10.1080/17461391.2020.1809714

Oudejans, R. R., & Pijpers, J. R. (2010). Training with mild anxiety may prevent choking under higher levels of anxiety. *Psychology of Sport and Exercise*, *11*(1), 44–50. https://doi.org/10.1016/j.psychsport.2009.05.002

Park, S. H., Uiga, L., & Masters, R. S. W. (2022). Crowd reception influences avoidance behavior during football penalty-kicks, but you wouldn't know it: A retrospective analysis of professional games. *Psychology of Sport and Exercise*, *61*, 102169. https://doi.org/10.1016/j.psychsport.2022.102169

Parnabas, V. A., Mahamood, Y., Parnabas, J., & Abdullah, N. M. (2014). The relationship between relaxation techniques and sport performance. *Universal Journal of Psychology*, *2*(3), 108–112. https://doi.org/10.13189/ujp.2014.020302

Pocock, C., Dicks, M., Thelwell, R. C., Chapman, M., & Barker, J. B. (2019). Using an imagery intervention to train visual exploratory activity in elite academy football players. *Journal of Applied Sport Psychology*, *31*(2), 218–234. https://doi.org/10.1080/10413200.2017.1395929

Ratcliff, R., & Smith, P. L. (2010). Perceptual discrimination in static and dynamic noise: The temporal relation between perceptual encoding and decision making. *Journal of Experimental Psychology: General*, *139*(1), 70–94. https://doi.org/10.1037/a0018128

Roberts, L. J., Jackson, M. S., & Grundy, I. H. (2019). Choking under pressure: Illuminating the role of distraction and self-focus. *International Review of Sport and Exercise Psychology*, *12*(1), 49–69. https://doi.org/10.1080/1750984X.2017.1374432

Sadeghi, H., Omar-Fauzee, M. S., Jamalis, M., Ab-Latif, R., & Cheric, M. C. (2010). The mental skills training of university soccer players. *International Education Studies*, *3*(2), 81–90. https://doi.org/10.5539/ies.v3n2p81

Shimizu, Y., Umeda, M., Mano, H., Aoki, I., Higuchi, T., & Tanaka, C. (2007). Neuronal response to Shepard's tones. An auditory fMRI study using multifractal analysis. *Brain Research*, *1186*, 113–123. https://doi.org/10.1016/j.brainres.2007.09.097

Simonsmeier, B. A., Andronie, M., Buecker, S., & Frank, C. (2021). The effects of imagery interventions in sports: A meta-analysis. *International Review of Sport and Exercise Psychology*, *14*(1), 186–207. https://doi.org/10.1080/1750984X.2020.1780627

Stanton, T., & Spence, C. (2020). The influence of auditory cues on bodily and movement perception. *Frontiers In Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.03001

Stradomska, M. (2021). Emotional control and burnout in sportsmen on the example of football players. *Journal of Modern Science*, *47*(2), 409–430. https://doi.org/10.13166/jms/143306

Szalma, J. L., & Hancock, P. A. (2011). Noise effects on human performance: A meta-analytic synthesis. *Psychological Bulletin*, *137*(4), 682–707. https://doi.org/10.1037/a0023987

Toth, A. J., McNeill, E., Hayes, K., Moran, A. P., & Campbell, M. (2020). Does mental practice still enhance performance? A 24 Year follow-up and meta-analytic replication and extension. *Psychology of Sport and Exercise*, *48*, 101672. https://doi.org/10.1016/j.psychsport.2020.101672

Wadey, R., & Hanton, S. (2008). Basic psychological skills usage and competitive anxiety responses: Perceived underlying mechanisms. *Research Quarterly for Exercise and Sport*, *79*(3), 363–373. https://doi.org/10.1080/02701367.2008.10599500

Williams, S. E., & Cumming, J. (2012). Athletes' ease of imaging predicts their imagery and observational learning use. *Psychology of Sport and Exercise*, *13*(4), 363–370. https://doi.org/10.1016/j.psychsport.2012.01.010

Wilson, M. R., Wood, G., & Vine, S. J. (2009). Anxiety, attentional control, and performance impairment in penalty kicks. *Journal of Sport and Exercise Psychology*, *31*(6), 761-775. https://doi.org/10.1123/jsep.31.6.761