

## The Effects of Coping Interventions on Ability to Perform Under Pressure

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### Abstract

The ability to perform under pressure is necessary to achieve goals in various domains of life. We conducted a systematic review to synthesise findings from applied studies that focus on interventions developed to enhance an individual's ability to cope under performance pressure. Following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines, a comprehensive search of five electronic databases was conducted. This yielded 66,618 records, of which 23 peer review papers met inclusion criteria of containing an intervention that targeted coping skills for performing under pressure. Using the Standard Quality Assessment for evaluation of primary research papers (Kmet et al., 2004) to assess quality, included studies performed well on reporting research objectives, research design, and statistical procedures. Sixteen studies showed poor quality in controlling for potentially confounding factors and small sample sizes. A narrative aggregate synthesis identified intervention studies that provided an educational focus ( $n=9$ ), consultancy sessions ( $n=6$ ), simulation training ( $n=5$ ) and emotion regulation strategies ( $n=3$ ). Findings highlight a need to; 1) establish a contextualized pressure task which will generate high levels of ecological validity for participants. Having established a suitable pressure task, 2) research should assess the effects of pressure by evaluating conscious and nonconscious effects and associated coping mechanisms, which should inform the subsequent development of interventions, and 3) assess interventions to enhance understanding of the ways in which they improve coping with pressure, or may fail, and the mechanisms which may explain these outcomes.

**Key words:** Pressure, stress, anxiety, emotion, mental toughness, achievement.

### Introduction

Across different domains in life, an individual may be confronted with situations, where the outcome hinges on one pressured moment. For example, a medic attending an emergency, a child in an examination, a footballer taking a penalty kick, or a soldier in combat. Performing in professional environments can often require individuals to make split-second decisions, maintain fine motor control under physical and mental fatigue—underpinned by the knowledge that the performance outcome can result in consequences of risk or reward (Anderson and Gustafsson, 2016).

A known requirement in producing excellence is the ability for an individual to execute vital self-regulatory processes under pressure (Baumeister, 1984; Jordet, 2009). Pressure is defined as “the presence of situational incen-

tives for optimal, maximal, or superior performance” (Baumeister and Showers, 1986, p. 362). These processes enable an individual to regulate physiological and psychological states to help movement and decision-making that help goal achievement (Vickers and Lewinski, 2012). Individuals who are unable to employ effective coping skills to regulate physiological and psychological states affected by pressure may underperform, relative to their skill level (DeCaro et al., 2011). Coping strategies that help an individual regulate perceived demands in an important moment could enhance an individual's ability to attend, concentrate, and perform effectively under pressure (Jensen and Wrisberg, 2014). An individual's capacity to perform under pressure may be improved by developing availability of coping strategies, increasing coping flexibility, developing knowledge of when to utilise different strategies, and enhancing confidence in their application (Duhachek and Kelting, 2009). This would enable individuals to maintain performance in contexts that require optimal or superior performance (Adler et al., 2015). Consequently, researchers and practitioners have strived to better understand what interventions may be most efficacious and effective in helping individuals develop the coping skills and strategies to withstand – or even thrive on – the pressure they experience (Sarkar and Fletcher, 2014).

Conceptual clarity is important for theory testing and consequently it is important for researchers to define the constructs under examination (Lane and Terry, 2000). Conceptual confusion has been evidenced in differentiating stress and pressure, where at times these terms are used interchangeably (e.g., Nibbeling et al., 2014). Stress is defined as “the process that involves the perception of a substantial imbalance between environmental demands and response capability, under conditions where failure to meet demand is perceived as having important consequences it is responded to with increased levels of state anxiety” (Martens, 1977, p. 9). Lazarus and Folkman (1984) emphasize how stress results from a transaction between the person and environment, whereby an appraisal of the significance of stimuli within that environment may have valence for well-being, rather than optimal performance. By contrast, pressure is characterized by the presence of incentives that result in an appraisal that the execution of a performance calls for an optimal outcome, improved performance, or enhanced functioning (Baumeister, 1984; Hill et al., 2011). Appraisal of the significance of stimuli within the environment is focussed on valence for optimal performance rather than well-being (Baumeister, 1984). Situational incentives may appear singly or in combination, and might include the contingency of rewards or punishments

on level of performance, the presence of an evaluative audience, the presence of comparison or competition, the extent to which performance reflects on important features of the self (i.e., ego relevance), and the likelihood that one will not have a second chance (Baumeister and Showers, 1986). An inability to cope with pressure can result in a critical deterioration in skill execution, leading to sub-standard performance at a time when a successful outcome is normally attainable (Hill et al., 2011).

In order to synthesise existing knowledge on coping interventions intended to help individuals perform under pressure, and identify future research directions, the authors undertook a systematic review of relevant published intervention literature. The choice of a systematic review was prompted because a meta-analysis of the literature would not be suitable, as a “Meta-analysis is only properly applicable if the data summarised are homogenous” (Eysenck, 1995, p. 70). The large discrepancy anticipated when examining studies from different areas of application (e.g. variety of participant sample sizes, data collection methods and interventions) would pay no attention to the fact that an intervention may be appropriate for one context but may not apply to another. The resultant effect size could be misleading, and thus unhelpful for practitioners and researchers alike (Eysenck, 1995).

The aims were to; (a) examine the influence of coping interventions on performance under pressure, and (b) offer a critique of the extant literature and offer recommendations intended to enhance future pressure intervention research.

## Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Higgins and Green, 2009; Petticrew and Roberts, 2005) were used. The review was registered on PROSPERO (CRD42015027916) and aims, inclusion criteria, data extraction and data quality evaluation were specified at the outset. The rationale for using this method is that it is a commonly agreed approach and that ensures methodological rigour, objectivity and replicability.

### Literature search

A systematic search was undertaken using the databases Business Source Complete, Education Course Complete, PsycINFO, MEDLINE, and SPORTDiscus. Search terms described coping, performance, and intervention. The term “pressure” was not included as a search term as scoping searches identified this as “physical pressure” and not relevant to the present review. In adhering to the inclusion criteria, the authors included only those intervention studies that explicitly aimed to enhance coping with performance ‘pressure’ (incentives for optimal, superior or optimal performance; Baumeister, 1986) and not stressors (e.g., reference to stress and well-being, with no mention of optimal, superior or maximal performance, Lazarus and Folkman, 1984). Pressure was therefore defined by pooling descriptors of “coping,” and “performance,” and the term “intervention” was used to delimit to studies that intended to help manage pressure (see Appendix A). No delimiters

on the time frame of searches were imposed, with literature dating from November 1901 to 23rd November 2016 included within the search. The search was delimited to peer-reviewed articles, “human only” studies (for MEDLINE), and English language. No other restrictions were applied to ensure that the search was comprehensive and that no articles were missed.

### Searches

Reference management software was used to organise citations (Endnote X7). This search yielded 66,618 records, of which 60,725 remained following de-duplication. The titles were independently screened by three reviewers to identify studies that facilitated or manipulated coping skills with the intention of facilitating optimal performance of a task of perceived importance. Where there was disagreement, the full text manuscript was consulted by two reviewers to reach agreement. For a study to be included, there had to be consensus that the following criteria were met:

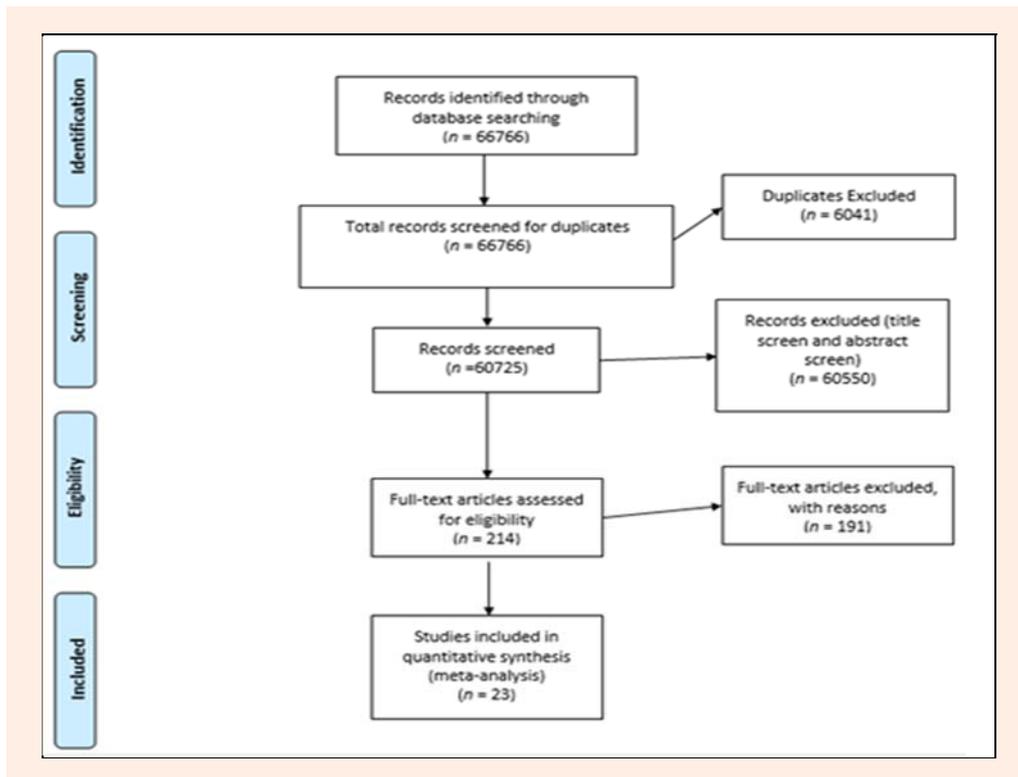
### Inclusion

- Papers must be empirical and peer reviewed (i.e., no reviews, letters, book reviews, theses, non-peer reviewed articles, or magazine editorials);
- Participants must be exposed to a performance context that presents situational incentives for perceived optimal, superior or maximal performance (Baumeister and Showers, 1986)
- The study must include an intervention where the aim was to facilitate or manipulate coping skills with the intention to improve performance under pressure;
- All studies must be in the English language;
- There must be an inclusion of a quantitative outcome measure (e.g., performance scores, inventory scores);
- Studies must only include a non-clinical population.

Following title screening, 60,550 were excluded and the full text from 214 studies were further assessed for eligibility. A further 191 papers were excluded at this stage. These included; papers without a specific aim of delivering a coping intervention to facilitate performing under pressure ( $n = 52$ ), papers with no measurement of the intervention upon performance ( $n = 38$ ), intervention intended to support skill acquisition (e.g., reading) ( $n = 26$ ), theoretical papers which described but did not deliver an intervention ( $n = 25$ ), unpublished theses ( $n = 14$ ), review papers ( $n = 13$ ), papers which aimed to develop decision-making ( $n = 7$ ), papers with a medical population ( $n = 7$ ), papers not reported in English ( $n = 4$ ), papers which developed coping inventories ( $n = 3$ ), and conference presentations ( $n = 2$ ). Following full inclusion assessment, 23 papers were included in the present review (Figure 1).

### Data quality

The quality of included papers was assessed using the standard quality assessment criteria for evaluating primary research papers (Kmet et al., 2004). The 20 criteria produced by Kmet et al. (2004) cover research design, sampling, methodology, analysis, results, and conclusions. For each criterion, papers are scored 2 (good), 1 (partial



**Figure 1.** Process of screening for selection of studies for inclusion in review.

fulfilment), 0 (not fulfilled) or X (not relevant) (Kmet et al., 2004). A mean score was calculated for each paper to give an overall rating of quality. The mean score across all papers for each of the 20 criterion was calculated to indicate methodological or design strengths and limitations of the included studies.

## Results

### Characteristics of the included studies

Included papers (see Table 1) delivered coping under pressure interventions across a range of psychological contexts namely; Sport ( $n = 15$ ), Medical ( $n = 2$ ), Educational ( $n = 2$ ), Occupational ( $n = 2$ ), Forensic ( $n = 1$ ), and Military ( $n = 1$ ). Intervention duration ranged from a 10-minute single intervention (Hunziker et al., 2013) to a three-year simulation programme (Beauchamp et al., 2012). Interventions were described as being delivered by researchers with no mention of psychology qualifications or experience of delivering interventions ( $n = 6$ ), psychologists with reported experience of delivering interventions ( $n = 8$ ), therapists professionally trained to deliver an intervention ( $n = 2$ ), video or computer simulation ( $n = 2$ ), or not reported ( $n = 5$ ).

The number of participants ranged from 1 to 209 ( $M = 42.8$ ;  $SD = 58.6$ ), with the reported age ranging from 15.9 to 45.6 years ( $M = 24.6$ ;  $SD = 3.9$ ). Studies were largely from Western countries, namely; UK ( $n = 6$ ), USA ( $n = 6$ ), Australia ( $n = 4$ ), Canada ( $n = 2$ ), Finland ( $n = 1$ ), Holland ( $n = 1$ ), Japan ( $n = 1$ ), Spain ( $n = 1$ ), and Switzerland ( $n = 1$ ). Studies were conducted with a predominantly male sample ( $M = 71\%$ ; all male samples studies = 5).

Interventions were delivered using either an A-B ( $n$

= 13), A-B-A ( $n = 8$ ), or A-B-A-B experimental design ( $n = 2$ ). An A-B experimental design incorporates a baseline condition (e.g., pre-intervention performance score under pressure) (A), followed by the introduction of a coping intervention with the aim of improving performance under pressure (B). An A-B-A research design involves participants being monitored at a baseline condition (A), thereafter receiving a coping intervention (B), after which they return to the baseline condition (A). As part of an A-B-A-B research design participants are monitored twice at a baseline condition (no pressure manipulations) (A), receiving a monitored coping with pressure intervention on two occasions (B). The two B conditions vary in their degree of pressure, with the first B condition being low pressure, and the second being high pressure (Mesagno et al., 2008; 2009).

The majority ( $n = 9$ ) of A-B interventions employed a comparison/control group which provided performance results of a pressurized task without intervention (e.g., emotion regulation technique) to allow for estimates of intervention effects and causality to be inferred (Chambless and Ollendick, 2001) (See Table 2). For example, receiving neutral instructions (Moore et al., 2015) or no instructions after the pressure performance (Hunziker et al., 2013).

Four studies did not incorporate a control group (Beauchamp et al., 2012; Meyers and Schleser, 1980; Olusoga et al., 2014; Prapavessis et al., 1992), and explained that this was due to either financial, temporal, or practical constraints (e.g., case study methodology). All A-B-A interventions used a control group which received no intervention. A-B-A-B interventions did not present a control group because of the difficulty in recruiting participants who met

**Table 1. Selection of studies for inclusion in review.**

Author	Title	Design / Sample	Type of Intervention	Pressure manipulation	Control Condition	Measures	Outcome
Abbott et al. (2009)	The impact of online resilience training for sales managers on wellbeing and performance.	A-B-A Occupational	Cognitive-behavioral workshop	Natural experiment- number of sales by managers.	The control group consisted of a randomly allocated sample of (occupational) sales managers from an Australian industrial organization based in home-offices. Control group participants continued their usual sales job with no intervention.	Depression Anxiety and Stress Scales (DASS21; Lovibond and Lovibond, 1995) Pre-intervention (prior to starting the program), post-intervention and at follow-up (10-weeks after the end of the program). Work performance statistics (meeting sales targets).	Both groups (experimental and control) met more of their target gross margin after the intervention than at baseline, but there were no differences in work performance between groups. No significant difference between intervention and control groups on depression, anxiety, stress or quality of life measures.
Balk et al. (2013)	Coping under pressure: Employing emotion regulation strategies to enhance performance under pressure.	A-B Sport	Emotional regulation strategy during pressurized task	Laboratory study- Golf putting task with additional pressure variables (videotaping participants and financial incentive).	Self-selecting participants from a golf club and then randomly assigned to the control group. Control participants were given no emotional regulation strategy, only to feel their emotions freely.	Pressure/ tension subscale from the Intrinsic Motivation Inventory (Deci and Ryan, 1994). The number of successfully holed putts (range 0–10). Heart Rate (HR). Arousal and anxiety scale (Fisk and Warr, 1996) The number of successfully holed putts (range 0–10).	The use of distraction, had improved performance under pressure. Reappraisal maintained performance under pressure  Distraction condition reported higher levels of arousal.
Beauchamp et al. (2012)	An integrated biofeedback and psychological skills training program for Canada’s Olympic short-track speed skating team.	A-B Sport	Simulation	Field experiment- simulation training of short-track speed skating performance with additional pressure variables (crowd noise, picture of the performance venue).	No control condition	Heart rate, respiration, muscle activity, skin temperature, Ottawa Mental Skills Assessment Test (OMSAT-3) (Durand-Bush et al., 2001), Cognitive-State-Anxiety- Inventory- 2 (CSAI-2) (Martens et al., 1990), Recovery-Stress Questionnaire (RESTQ-Sport) (Kellmann and Kallus, 2001). Test of Attentional and Interpersonal Style (TAIS) (included a performance under pressure element and confidence) (Nideffer, 1976). Interviews.	The short-track speed skating team achieved their medal target of two gold medals, two silver medals, and one bronze medal.
Bell et al.(2013)	Enhancing mental toughness and performance under pressure in elite young cricketers: A 2-year longitudinal intervention.	A-B Sport	Simulation	Field experiment- cricket training drills with additional pressure variables (punishments for not meeting performance standards).	Players that were not selected as a future potential for the England program were asked to join a comparison control group. Continued usual training program.	Mental Toughness Inventory, Performance, (Woodman and Hardy, 2001) Cricket performance on batting, bowling and fitness tests.	Punishments, and more specifically the threat of punishment enhanced performance under pressure. Importance of transformational leadership and coping support in facilitating this intervention.

**Table 1. Continued .....**

Author	Title	Design / Sample	Type of Intervention	Pressure manipulation	Control Condition	Measures	Outcome
Björkstrand et al. (2013)	Evaluation of an imagery intervention to improve penalty taking ability in soccer: A study of two junior girls teams.	A-B Sport	Cognitive-behavioral workshop	<b>Laboratory experiment-</b> Penalty soccer kick with additional pressure variables (competitive comparison, publishing data, psychologists observing performance).	Two soccer teams took part. Both teams were randomly assigned into a control or intervention group. Control group were 'Active' and given a stretching routine rather than a psychological intervention.	The Finnish Athletic Coping Skills Inventory-28 (Peaking under pressure) (Smith et al., 1995) Bespoke self-efficacy and situational anxiety scale. Number of goals scored.	No significant difference in performance between intervention and the control group Players who scored high on a scale measuring ability to peak under pressure showed significant improvement in penalty taking ability.
Breso et al. (2009)	Can a self-efficacy-based intervention decrease burnout, increase engagement, and enhance performance? A quasi-experimental study.	A-B-A Educational	Psychological consultancy session	<b>Natural experiment-</b> the number of exams passed over the school year.	Control group were volunteers that participated in the academic stress and anxiety workshop but chose to not receive the one-on-one intervention program.	Academic self-efficacy (Midgley et al., 2000), Academic assessment and academic burnout (Schaufeli et al., 2002). Exams passed	The intervened group presented higher levels of performance.  The intervened group presented higher levels of self-efficacy and task engagement.
Crocker et al. (1988)	Cognitive-affective stress management training with high performance youth volleyball players: Effects on affect, cognition, and performance.	A-B Sport	Cognitive-behavioral workshop	<b>Field experiment-</b> volleyball serving drill (delivered to North region of Canada volleyball team) during a training session.	Those from the southern region of Canada comprised of the control group, which received no intervention.	Performance scores. SCAT (Sport Competition Anxiety Test) (Martens, 1977), CSAI-2 (Martens et al., 1990) and thought listing procedure Volleyball serving drill performance.	Improved performance compared to the control group. No significant difference in trait or state anxiety.
Griffiths et al. (1985)	The effects of relaxation and cognitive rehearsal on the anxiety levels and performance of scuba students.	A-B Sport	Cognitive-behavioral workshop	<b>Natural experiment-</b> Scuba diving performance	Control group consisted of enrolled novice SCUBA divers receiving basic SCUBA diving training with no relaxation/cognitive rehearsal intervention.	Respiration rate, state-trait anxiety inventory general trait (Spielberger et al., 1983). Bespoke measures of anxiety.	Pre-dive anxiety reduced before the task, however lack of transference when performing the actual pressurized task. Significant improved performance for the experimental group in comparison to the control group perform the underwater task.
Hunziker et al. (2013)	Impact of a stress coping strategy on perceived stress levels and performance during a simulated cardiopulmonary resuscitation: a randomized controlled trial.	A-B Medical	Cognitive-behavioural workshop	<b>Laboratory experiment-</b> simulated medical emergency (cardiac arrest)	Students were randomly allocated into the control group and took part in a video training session and a baseline test.	Bespoke measures of stress (post intervention).	A significant benefit in terms of reducing perceived levels of stress/overload. No statistically significant improvement in performance was observed.

**Table 1. Continued .....**

Author	Title	Design / Sample	Type of Intervention	Pressure manipulation	Control Condition	Measures	Outcome
McClernon et al. (2011)	Stress training improves performance during a stressful flight.	A-B Military	Simulation	<b>Laboratory experiment-</b> Simulation of piloting an aircraft.	Control participants were recruited from the Naval Post-graduate School and randomly allocated to received identical flight skill acquisition training but without 'psychological' training.	Bespoke measures of stress. Performance of flight. (post intervention)	Flight simulation training enhanced performance (telemetry data, certified flight instructor evaluations) than control participants. Significant reduction in perceived stress.
Meyers & Schleser (1980)	A cognitive behaviour intervention for improving basketball performance.	A-B Sport	Psychological consultancy session	<b>Natural experiment-</b> basketball match performance for each game of the athlete's 28-game basketball season.	No control condition	Performance statistics (minutes played, field goals attempted, field goals made, foul shots attempted, foul shots made, and total points scored) (pre and post intervention)	Measured effectiveness from global performance scores only. Points per game increased significantly after intervention.
Moore et al. (2015)	Reappraising Threat-How to Optimize Performance Under Threat	A-B Sport	Emotion regulation strategy	<b>Laboratory study-</b> Reward. Performance comparison. Video. 'non-contingent' feedback. Negative	Participants were randomly assigned to a reappraisal or control group. Control group received neutral instructions that informed the participants about a nondemanding cognitive task in which they had to think about capital cities for one minute.	Challenge and threat states after the pressure and reappraisal/control instructions (computed by converting each participant's cardiac output and total peripheral resistance residualized change scores into z-scores).  Performance statistics (the distance the ball finished from the hole in centimetres).	Despite performing similarly at baseline, the reappraisal group outperformed the control group during the pressurized task.
Olusoga et al. (2014)	Coaching under pressure: Mental skills training for sports coaches.	A-B Sport	Psychological consultancy session	<b>Natural experiment-</b> Intervention delivered to sports coaches to cope with competition demands during the competitive season.	No control condition	Mental Skills Questionnaire (MSQ; Bull et al., 1996) Social Validation Questionnaire (SVQ) (Thelwell & Greenlees, 2003 (Did the coping under pressure intervention help?) MCOPE (Crocker et al., 1995) CSAI-2 (Martens et al., 1990) Qualitative interviews. Subjective coaching performance.	Coaches rated their ability to perform under pressure; positive changes in perceived ability to cope. Reduced perceived intensity of somatic anxiety. Sharing experiences building self-confidence, and developing the ability to physically relax.
Page et al. (2015)	Brief mental skills training improves memory and performance in high stress police cadet training.	A-B Forensic	Cognitive-behavioral workshop	<b>Laboratory experiment-</b> police officers replicating a defensive spray incident.	The control group comprised of police cadets undergoing OC (oleoresin capsicum) spray training. Control participants were randomly selected and then moved to a different classroom and attended a 75-minute lecture on cardiovascular physiology.	Bespoke confidence, level of stress, and pain. Heart rate (HR) and hemoglobin-oxygen saturation (SpO2) Recall of information (memory) from the defensive spray incident.	No difference in heart rate or SpO2 values post intervention. Cadets that reported being more confident had better memories. Significant difference in performance- police officer's ability to recall more salient aspects of the scenario.

**Table 1. Continued .....**

Author	Title	Design / Sample	Type of Intervention	Pressure manipulation	Control Condition	Measures	Outcome	
Prapavessis et al. (1992)	Self-regulation training, state anxiety, and sport performance: A psychophysiological case study.	A-B Sport	Sport	Psychological consultancy session	<b>Natural experiment-</b> shooting performance for a competitive rifle shooter	No control condition	CSAI-2 (Martens et al., 1990). Electromyogram. Heart Rate. Urine testing for catecholamine (i.e., noradrenaline and adrenaline). behavioral state anxiety (movement of gun) was measured using accelerometer. Performance scores (3 rounds of 20 shots).	Intervention was effective in improving shooting performance. Effective in reducing state anxiety and enhancing confidence which was perceived to be beneficial for the performer.
Kimura et al. (2015)	Effect of a brief training program based on cognitive behavioral therapy in improving work performance: A randomized controlled trial.	A-B-A Occupational	Cognitive-behavioral workshop	<b>Natural experiment-</b> number of sales from employees.	Control participants were randomly allocated to receive no intervention and continued work performance tasks.	Researcher designed cognitive flexibility scale and self-evaluation of stress.	Subjective performance scores indicated an improved performance.  No significant difference in dysfunctional thinking patterns in comparison to baseline.	
Lorains et al. (2013)	An above real time training intervention for sport decision making.	A-B-A Sport	Simulation	<b>Laboratory experiment-</b> video simulation of Australian rules football with additional time pressure.	Participants were randomly allocated into the control group where they received no training or practice for the pressure task.	Global performance scores of reaction times and decision-making.	Decision-making accuracy was increased by training in above real-time simulations, on the computer-based task, compared to normal speed training or no training at all	
Wetzel et al. (2011)	Stress management training for surgeons- a randomized, controlled, intervention study.	A-B-A Medical	Simulation	<b>Laboratory experiment-</b> simulation of a surgical operation.	Surgeons were randomly assigned into a control group and completed the pressurized task at baseline, but then received no treatment before re-test.	Heart rate/ Heart rate variability, salivary cortisol. State-Trait-Anxiety-Inventory (STAI; Marteau and Becker, 1992). Bespoke stress and confidence scale.  Surgical decision making (DM)—observer rating of the surgeon's decision process.	The experience of a simulated surgical crisis was regarded as beneficial for enhancing performance. In addition, surgeons reported an increase in practicing technical skills decision making under pressure and confidence. Enhanced observational teamwork. Reduced heart rate variability during simulated surgery.	
Wood & Wilson (2012)	Quiet-eye (QE) training, perceived control and performing under pressure.	A-B-A Sport	Cognitive-behavioural workshop	<b>Lab Experiment-</b> Soccer penalty kick task with additional pressure variables (Only one kick, financial incentive, random order, different goalkeeper was used in contrast to the training conditions.	Participants were randomly allocated to a control group which practiced taking penalties and received basic information on taking penalties. They were instructed to score as many goals as possible.	Gaze control, Control beliefs (Jordet et al., 2006) Mental Readiness Form-3 (MRF-3; Krane, 1994)  Shooting accuracy	QE training was successful in optimizing aiming behavior; encouraging participants to aim for the optimal area of the target facilitating optimum performance under pressure. Positive impact upon the control beliefs of the performer. Control beliefs appeared to be related to intensity of state anxiety and the way in which the penalty taker approached the shot.	

**Table 1. Continued .....**

Author	Title	Design / Sample	Type of Intervention	Pressure manipulation	Control Condition	Measures	Outcome
Mesagno et al. (2008)	A pre-performance routine to alleviate choking in "choking-susceptible" athletes.	A-B-A-B Sport	Cognitive-behavioural workshop	<b>Field experiment-</b> ten-pin bowling performance with pressure variables (videotaping all shots, audience presence, money).	No control condition	Self-Consciousness (Fenigstein et al., 1975). Sport Anxiety Scale (Smith et al., 1990) Coping Style Inventory (Anshel and Kaissidis, 1997). CSAI-2 (Martens et al., 1990) Performance error, from center of the target to center of the ball. Qualitative interviews	In a sample of 'choking susceptible participants' performance of ten pin bowling significantly improved. Reduction in self-awareness and provided a method of maintaining task-relevant cues, especially after an unsuccessful shot. Pre-performance routine useful in reducing negative self-talk and help maintain task-related focus.
Mesagno et al. (2009)	Alleviating choking: The sounds of distraction.	A-B-A-B Sport	Emotion regulation strategy	<b>Field experiment-</b> performing a basketball task with pressure variables (videotaping all shots, audience presence and money).	No control condition	Self-Consciousness (Fenigstein et al., 1975). Sport Anxiety Scale (Smith et al., 1990) Coping Style Inventory (Anshel and Kaissidis, 1997). CSAI-2 (Martens, 1990) Free-throw shooting percentage (total successful free throws in each trial block) Qualitative interviews	Reduction in the intensity of somatic anxiety. Audience/ fear of underperforming was biggest perceived pressure.

**Table 2. Data quality table of included studies.**

Item	Indicator of quality	Mean	(SD)
12	Data analyses in accordance to treatment	2	0.29
2	Description of study design	1.91	0.49
1	Hypothesis	1.91	0.39
19	Description of main findings	1.91	0.51
15	Estimates of Variance	1.91	0.38
10	Description of trial components	1.86	0.48
3	Description of outcome measures	1.82	0.44
14	Description of methods for analysis	1.77	0.46
13	Reliable and valid measures	1.64	0.58
5	Recruitment selection	1.60	0.65
6	Description of sample characteristics	1.60	0.58
9	Randomisation of participants	1.39	0.59
8	Sample size	1.37	0.86
20	Conclusion	1.37	0.46
4	Timing between study components	1	0.91
18	Adjusting for follow up time	0.9	0.89
7	Adjusting for participants lost	0.67	0.75
11	Randomisation of participants	0.67	0.75
17	Randomisation concealed	0.29	0.70
16	Control over confounding variables	0.27	0.44

the inclusion criteria for the study (Mesagno et al., 2008; 2009).

Various measures were used as indicators of coping intervention effectiveness including; points scored on a task; ( $n = 13$ ; e.g., exam marks), psychological inventories ( $n = 25$ ; most often [ $n = 6$ ] the Competitive Anxiety Inventory-2; Martens et al., 1990), physiological variability/ biofeedback measurements ( $n = 6$ ; heart rate most used  $n = 3$ ), coded verbal statements such as leadership statements or thoughts in response to a stressor ( $n = 3$ ), or perception of performance by an organisational leader/coach ( $n = 2$ ).

Interventions delivered across the 23 studies included cognitive-behavioral workshops (CBW;  $n = 9$ ), psychology consultancy sessions ( $n = 6$ ), emotional regulation strategies ( $n = 3$ ), and simulation tasks ( $n = 5$ ). CBW workshops were classroom-based education sessions focused on mental preparation principles and the development of psychological skills. Psychology consultancy sessions were delivered with the aim of establishing a therapeutic environment (e.g., genuine compassion, empathetic understanding) placing emphasis on a person-centred approach. Emotional regulation strategies were brief interventions provided to a performer before competing in a pressurized, single-trial, motor task. Finally, simulation tasks involved practice of the performance task/skill in an environment replicating the pressure-conditioned stimuli an individual would experience (Jones and Hardy, 1990).

### Data quality

The possible range of scores on quality assessment was 0–2, with a higher score indicating better quality (Kmet et al., 2004). The mean scores and standard deviation (SD) for the 20

criterion of study quality are presented in Table 2. Across included studies, the mean score for quality was 1.41 (SD = 0.23), with scores ranging from 0.94 (SD = 0.82; Meyers and Schleser, 1980) to 1.83 (SD = 0.39; Hunziker et al., 2013). Nine studies scored more than one standard deviation below the sample mean (Abbott et al., 2009; Beauchamp et al., 2012; Crocker et al., 1988; Griffiths et al., 1985; Mesagno et al., 2008; 2009; Meyers and Schleser, 1980; Moore et al., 2015; Wetzel et al., 2011). These studies were included within the review as they contribute towards a useful critique of existing pressure intervention literature, however their findings should be interpreted with caution.

Overall, studies performed well on reporting the objective of the research process, with the research design being easily identifiable and appropriate to address the study question. Studies also used a variety of statistical procedures to help establish credibility/trustworthiness of the data. However, studies underperformed on attempting to control, or consider the control of potentially confounding variables, and also on use of inadequate sample sizes.

## Discussion

### Pressure manipulation

Pressure was manipulated via laboratory experiments ( $n = 9$ ), natural experiments ( $n = 9$ ), and field experiments ( $n = 5$ ). Laboratory experiments created an artificial environment enabling high levels of control and manipulation of pressure variables, thus establishing scenarios that would otherwise be difficult to replicate, such as critical surgical operations (Wetzel et al., 2011) or cardiopulmonary resuscitation (Hunziker et al., 2013).

Natural experiments measured the effectiveness of interventions on an individual's ability to cope using naturally occurring pressure variables found within the environment. There was no attempt to manipulate pressure, or include additional pressure variables. For example, Keogh et al. (2006, p. 340) used GCSE (General Certificate of Secondary Education) examinations due to 'the high importance of these results for employment known to cause mental strain and worry.'

Field experiments attempted to simulate a common performance climate, but also incorporate artificial pressure variables. Artificial pressure variables were additional factors included within the 'B' condition of laboratory experiments and field experiments. These included; financial reward for successful performance ( $n = 5$ ), the publishing of results ( $n = 4$ ), filming the performance task ( $n = 4$ ), performing in the presence of an audience or crowd noise ( $n = 5$ ), random task order whereby participants did not know when they were performing a task ( $n = 1$ ), non-contingent feedback ( $n = 1$ ), punishment-conditioned stimuli ( $n = 1$ ) and only one opportunity to perform the task ( $n = 1$ ).

With regards to pressure manipulation, it is important to ensure that a performance task recreates the characteristics of pressure, such as a meaningful task, incentives for good performance, under constraints such as time, or a single performance opportunity. For example, the use of GCSE examinations as a pressure task (Keogh et al.,

2006) could be argued to facilitate results high in ecological validity, however, pressure has a 'subjective component' and only deemed pressure if an individual is aware of the incentives for optimal performance, but also values them (Baumeister and Showers, 1986, p. 373). For example, getting a good grade in an exam may not be an incentive where someone has a job to walk into. According to drive theories (Blascovich, 2008), should a performance situation not generate appraisals of demand or importance, there will not be a pressure response. As some people sit exams with no expectation of passing, or lack desired outcomes for passing, this presents a questionable pressure task for these individuals as they may not perceive pressure. However, it is important to consider the 'successful' use of cognitive reappraisal and how the individual may reframe the relevance of situation as a function of their 'successful' self-regulation. In this instance it would be advisable to include individuals who require a set grade, and deem this target to be challenging but attainable in order to achieve something worthwhile (e.g., a University place) and does in fact create pressure pre-intervention by piloting the task. This recommended practice was evident in Balk (2013, p. 413) who incorporated a pilot study to ensure that the pressure task (golf putting) successfully induced a 'classic choking under pressure effect' (subjective arousal, objective arousal, and decline in performance).

To establish that conditions are attained in research settings whereby an individual is performing under pressure, the pressure task should be contextualised. Key personnel from the context where the study is being conducted should inform pressure task development to ensure it attains task meaningfulness, goal valence, and task importance (Baumeister et al., 2007). We argue that the validation of a task in controlled conditions that exposes participants to meaningful pressure, should be the first stage of research seeking to examine the effects of pressure on performance. Such pressure manipulation data provides a means of establishing if the performance task was meaningful enough to evoke coping efforts.

Where all known characteristics of pressure are included within the performance setting, should participants report experiencing negligible pressure, this does not necessarily indicate an absence of pressure in the experimental condition. Drive theories contend that the demand/resource evaluation process is more unconscious and automatic than conscious and deliberate (Richter et al., 2016). Therefore, in line with the contention of drive theories (e.g., social facilitation theory; Zajonc, 1965), individuals who have the resources and efficacy to effectively cope with pressure conditions would not perceive/report felt pressure (Blascovich et al., 2000; Seery, 2011). This is not a research failing, as the focus of pressure interventions is to help individuals cope with pressure, via an efficacious use of coping strategies such as reappraisal and resource accumulation (Taylor and Morgan, 2014). However, an alternative explanation for a reported absence of perceived pressure is that the measures used to ascertain perceived pressure may be inadequate to detect subtle changes as discussed below.

### Pressure manipulation evaluation

When developing pressure interventions, evaluations of pressure are necessary to help determine if the chosen performance task(s) can help validate intervention effectiveness, and also evaluate the efficacy of interventions. Three studies included a pressure manipulation check to assess participants' subjective experience of pressure. Balk et al. (2013) administered the 7-item 'pressure/ tension' subscale of the Intrinsic Motivation Inventory (obtained by administering questionnaires right before putting in the low- and high-pressure phases) (IMI; Deci and Ryan, 1994). Beauchamp et al. (2012) administered (but did not report data from or reveal when self-report was administered) the Test of Attentional and Interpersonal Style (TAIS) using the 'drive and confidence over time' subscale to establish an individual's ability to perform under pressure. A single-item from the Finnish Athletic Coping Skills Inventory-28 (Liukkonen and Jaakkola, 2003) was utilised by Bjorkstrand and Jern (2013) to assess pressure: 'How nervous were you during the penalty shoot-out?' (recorded only in the pre-intervention condition).

Three studies (Mesagno et al., 2008, 2009; Olusoga et al., 2014) undertook interviews asking participants to self-report the degree of pressure experienced during the focal task. In both Mesagno et al. (2008, 2009) studies participants were screened for their susceptibility to 'choke' under pressure before A-B-A-B experimentation began. Interviews explored the participants perceptions of the intervention and captured detailed accounts of resultant perceptions. Mesagno et al. (2008) was the only paper to exclude participants from further study as they did not experience choking in the 'first pressure' phase. Using self-report methods, Mesagno et al. (2008; 2009) determined whether a psychological intervention would alleviate the likelihood of choking, thus, the researchers perceived it was necessary to purposively recruit choking-susceptible participants (Mesagno et al., 2008; 2009). However, such self-report measures only provide a measure of conscious pressure, as the demand/resource evaluation process is relatively unconscious and automatic, individuals may subconsciously activate coping strategies to manage pressure, and thus not consciously perceive or report these pressure evaluations (Seery, 2011). For such individuals, their self-reported perceptions of pressure may not truly reflect the pressure characteristics of a task. In addressing these limitations, retrospective evaluations of pressure interventions that encourage participants to reflect on pressure and coping may provide an opportunity for researchers to tap into the non-conscious and habitual methods people have for evaluating and coping with pressure. Furthermore, task valence and importance of goal achievement would be appropriate measures to help validate if a task may enhance the perception of pressure (Baumeister et al., 2007; Lane et al., 2016; Lazarus, 1999).

Seventeen studies did not specifically measure the perception of pressure, instead measuring variables argued to be indicative of pressure. Seven studies included psychophysiological measure including; heart rate ( $n = 6$ ), respiration rate ( $n = 2$ ), cardiac output ( $n = 1$ ), cortisol ( $n = 1$ ), gaze control ( $n = 1$ ), haemoglobin and oxygen saturation ( $n = 1$ ), muscle activity ( $n = 1$ ), skin temperature ( $n = 1$ ) and total peripheral resistance ( $n = 1$ ).

Seven studies administered stress Likert scales with five studies administering a bespoke single-item stress Likert following a pressurised task asking, 'How stressed did you feel?'. This highlights interesting findings about how authors may blur the concepts between stress and pressure. Two studies used validated scales namely; Depression Anxiety and Stress Scales (DASS21; Lovibond and Lovibond, 1995), Recovery-Stress Questionnaire (RESTQ-Sport; Kellmann and Kallus, 2001). Fourteen studies measured anxiety using validated psychometric scales, typically the Competitive State Anxiety Inventory- 2 (CSAI-2) (Martens et al., 1990;  $n = 5$ ), the most commonly used measure of anxiety in sport. The cognitive anxiety scale on CSAI-2 has been questioned as a measure of anxiety, with researchers suggesting phrasing anxiety around the term concern assessed task importance rather than anxiety (Lane et al., 1999). As such, use of the revised version is recommended (Cox et al., 2003). Two of the stress scales (Hunziker et al., 2013; McClernon et al., 2011) and one of the anxiety scales (Wetzel et al., 2011) were completed post-intervention only and intended to test the effects of the pressure task. All other stress and anxiety measures were completed pre- and post-intervention in order to test the effects of an intervention.

A limitation of interpreting high anxiety scores, or psychophysiological measures of high anxiety as indicative of pressure, is that some individuals interpret high anxiety as signal of being ready to perform, and so they will make themselves feel more anxious as part of mental preparation (Hanton et al., 2004; Hanin, 2000; Lane et al., 2016). As highlighted by the Individual Zone of optimal Functioning (IZOF; Hanin, 2000) and Survival, Evasion, Resistance, and Extraction (SERE; Wagstaff and Leach, 2015) perspectives, the experience of anxiety and associated physiological responses, can be task facilitative or debilitating. This is dependent on the individual's perception of anxiety, or use of the resultant energy mobilization for different performance tasks. For example, a surgeon experiencing high levels of anxiety is more likely to experience deleterious performance effects due to associated outcomes such as feeling shaky and clumsy (Wetzel et al., 2006). In contrast, a rugby player experiencing high anxiety may benefit from associated increases in cardiac output, effort, masked fatigue and maintained alertness (Robazza and Bortoli, 2007). Intensity and interpretations of anxiety (somatic and cognitive) have also been related to confidence. Specifically, Hanton et al. (2004) reported that under conditions of high self-confidence, increases in anxiety symptoms were reported to lead to positive perceptions of control and of benefit to sports performance.

Ten studies included measures of confidence, including self-confidence scales taken from the Ottawa Mental Skills Assessment Test (OMSAT-3; Durand-Bush et al., 2001) ( $n = 1$ ), Test of Attentional and Interpersonal Style (TAIS; Nideffer, 1976) ( $n = 1$ ), Mental Skills Questionnaire (MSQ; Bull et al., 1996) ( $n = 1$ ) and the CSAI- 2 (Martens et al., 1990) ( $n = 4$ ). Alternatively, the Academic Self-Efficacy Scale (Midgley et al., 2000) or bespoke measures of confidence (e.g., 'how many penalties do you believe you could successfully convert?' Bjorkstrand and Jern, 2013) were used. Beauchamp et al. (2012) did not

report confidence results for the TAIS (Nideffer, 1976) and CSAI-2 (Martens et al., 1990). However, four studies identified a post-intervention increase in self-confidence (Breso et al., 2011; Olusoga et al., 2014; Page et al., 2015; Prapavessis et al., 1992; Wood and Wilson, 2012).

It is important to consider the use and type of a control group when planning pressure manipulation evaluations. A control group is argued to help support researchers to contrast performances under pressure of those receiving interventions and those who are not and establish causation (control condition). However, within ( $n = 6$ ) studies 'control' groups included general instructional/ educational training ( $n = 5$ ) or intervention at physical support for the pressure task ( $n = 1$ ). The instructional training or physical support may provide participants with enhanced confidence or control of performing a pressure task and therefore undermine the validity of the comparison between the psychological intervention proposed and the control condition. A concern regarding research for performance under pressure is that it is difficult to control for desensitization to pressure as a confounding variable when collecting baseline data (e.g., via practice or familiarization; Wood and Wilson, 2012). Therefore, the simple repeated exposure to a pressure situation might serve as a coping intervention, if the type of situation and/ or pressure is new to the participant. Counterbalancing is one method used to control for such effects. For example, Bjorkstrand and Jern (2013) recruited participants of a similar demographic to both control and experimental conditions (female football players of a similar age and skill level) allowing differences in performance to be attributed to intervention with greater confidence. However, as noted by Page et al. (2015), such comparison with the control group can be compromised if participants are not screened for confounding variables. In their study, they noted that law enforcement academy cadets may have already been exposed to techniques used in the intervention provided, and this was argued to have diminished group differences. Therefore, it is important to consider the significant differences found in the studies when assessing the validity of the control groups.

Four of the fourteen A-B studies did not incorporate a control group (Beauchamp et al., 2012; Meyers and Schleser, 1980; Olusoga et al., 2014; Prapavessis ET AL., 1992), and explained that this was due to either financial, temporal, or practical constraints (e.g., case study methodology). All seven A-B-A studies included a control group. Both A-B-A-B interventions did not present a control group because of the difficulty in recruiting participants who met the inclusion criteria for the study (Mesagno et al., 2008; 2009). The absence of a control group from study design necessitates caution in interpreting the outcomes of pressure-interventions. This becomes particularly pertinent when participants are aware of the project aims, and may respond differently to measures indicative of pressure. However, the benefits of an A-B-A-B design are that it allows researchers to observe what happens when a treatment is removed, and also what happens when the treatment is introduced a second time.

### Effects of coping interventions on performing under pressure

**Cognitive-behavioral workshops:** The most commonly used intervention, found in eight of the included studies ( $5 = A-B, 2 = A-B-A, 1 = A-B-A-B$ ), comprised of Cognitive-Behavioral Workshops (CBW). CBW interventions using an A-B design included activities such as developing strategies for acceptance and gaining control ( $n = 2$ ), understanding emotion-performance relationships ( $n = 2$ ), developing problem-focused coping strategies ( $n = 2$ ), confidence - reducing false or self-defeating beliefs ( $n = 2$ ), and enhancing gaze/attentional control ( $n = 1$ ). CBW interventions were delivered by a researcher ( $n = 3$ ), tape ( $n = 1$ ) or video ( $n = 1$ ). Interventions ranged from a single 10-minute educational workshop (Hunziker et al., 2013) to an eight-week coping skills programme (Crocker et al., 1988).

Three A-B CBW studies evidenced significant performance improvements from A to B conditions following intervention, whilst two did not. Two studies measured confidence and found that individuals reporting higher levels of confidence performed better than individuals reporting lower levels of confidence (Bjorkstrand and Jern, 2013; Page et al. 2015). Four studies measured state anxiety using the CSAI-2 (Martens et al., 1990), of these, three indicated that interventions intended to reduce the intensity of anxiety symptoms did not influence performance under pressure (Abbott et al., 2009 Crocker et al., 1988; Griffiths et al., 1985). However, as previously noted, reducing anxiety may not necessarily offer performance benefits to participants (Hanton et al., 2004; Robazza and Bortoli, 2007).

Two CBW interventions used an A-B-A design that aimed to educate individuals on cognitive flexibility strategies (Kimura et al., 2015), or control visual attention and beliefs (Wood and Wilson, 2012). In the case of both studies, whilst improvements in performance were found, these were not statistically significant when comparing to those of the control groups. It would be important to identify that the procedures used for control groups expose participants to repeating the pressure task. For example, Wood and Wilson (2012) identified that the intervention and control group both identified a significant increase in perceptions of control and competence. Arguably, the first pressure testing condition may act as an intervention due to a perceived increase in confidence and expectations for perceived chances of success when repeating the pressure test. Mesagno et al. (2009) stated it is virtually impossible to control for pressure desensitization, therefore researchers should take into account significant statistical differences between intervention conditions and control conditions, or the use of qualitative feedback when assessing performance under pressure. Finally, Mesagno et al. (2008) used an A-B-A-B design to deliver a CBW workshop focussed on pre-performance routines. This intervention aimed to educate individuals on optimal arousal levels, attentional control, and cue words. The experimental design enabled the participants to use their developed performance routine (A) in a pressurized task (B), to be educated on how to refine this skill (A), to then perform again under pressure (B). This intervention was found to significantly improve performance under pressure. However, with no comparisons to a control group it is challenging to establish if the pressure context might have naturally improved participants' perception of pressure and performance or the intervention.

Four of the eight CBW studies identified a significant difference in either perceived (Kimura et al., 2015) or objective (Crocker et al., 1988; Mesagno et al., 2008; Page et al., 2015) performance post intervention. In line with distraction theories (e.g., attentional control theory - ACT; Eysenck et al., 2007) whilst feeling nervous or anxious may produce distracting thoughts and worries (Eysenck and Calvo, 1992), among performers who possess confidence in their ability to control both themselves and the environment, they are more likely to report facilitative interpretations of anxiety (Jones, 1995). Such feelings can prompt compensatory coping efforts that draw upon additional processing resources (e.g., increased effort) or strategies (e.g., seeking social support) that may maintain performance quality, motivation, and effectiveness (Eysenck et al., 2007; Eysenck and Calvo, 1992; Wilson, 2008).

**Psychology consultancy sessions:** Psychology consultancy sessions were offered as the intervention in six studies (3 = A-B, 3 = A-B-A). A structured cognitive mental skills programme delivered by psychologist ( $n = 4$ ) or therapist ( $n = 2$ ) was provided during consultancy sessions. Largely, interventions were developed to aid performance under pressure within sport contexts ( $n = 4$ ), and delivered on a one-to-one basis ( $n = 4$ ). Two studies delivered mental skills consultancy sessions as a group consultancy intervention package ( $n = 2$ ). Intervention duration ranged from seven sessions over three-weeks (Meyers and Schlessler, 1980) to 12 sessions over six-weeks (Prapavessis et al., 1992).

A-B interventions focused on teaching relaxation techniques ( $n = 3$ ), imagery ( $n = 3$ ), confidence ( $n = 3$ ), thought-stopping ( $n = 2$ ), challenging irrational thoughts ( $n = 2$ ) and developing performance routines ( $n = 2$ ). The two A-B consultancy sessions delivered to participants on an individual basis both produced significant performance improvements following pressure intervention (Meyers and Schlessler, 1980; Prapavessis et al., 1992). The group A-B consultancy intervention found soccer coaches to perceive an increased ability to coach effectively under pressure post intervention (Olusoga et al., 2014). However, without a control group, it is difficult to say that results were solely due to the efficacy of the mental skills programme or coaches may have developed their psychological skills naturally through the process of engaging with their teams, athletes, and colleagues over the time of the intervention.

A-B-A consultancy interventions were structured around a variety of cognitive- behavioral strategies namely; anxiety reappraisal ( $n = 3$ ), problem-focused coping ( $n = 2$ ), self-talk ( $n = 2$ ), re-framing techniques ( $n = 2$ ), attentional focus ( $n = 1$ ) and confidence ( $n = 1$ ). Intervention delivery ranged from once-a-week for ten-weeks (Keogh et al., 2006) to 16 sessions for eight-months (Kerr and Leith, 1993). All three A-B-A interventions identified a significantly improved ability to perform under pressure following intervention.

Of the six consultancy based interventions, three (Breso et al., 2011; Olosuga et al., 2014; Prapavessis et al., 1992) demonstrated post intervention increases in confidence that participants perceived as important in supporting their performance under pressure. Olusoga et al. (2014)

and Prapavessis et al. (1992) also reported a significant reduction in symptoms of anxiety and stress. Confidence is a central to the appraisal of pressure, and contributes to the cognitive and somatic response patterns that are either facilitative or debilitating to performance (Blascovich et al., 2003). These findings suggest that the development and implementation of interventions that manage factors argued to disrupt performance (e.g., debilitating anxiety, low confidence) enable individuals to perform at their best (Lazarus, 2000).

**Simulation interventions:** Five studies (A-B = 3, A-B-A = 2) provided simulation interventions to replicate as closely as possible the experiences of a pressurized task. Three A-B simulation interventions (Beauchamp et al., 2012; Bell et al., 2013; McClernon et al., 2011) incorporated consultancy sessions alongside pressure training delivered by a psychologist. A-B interventions ( $n = 3$ ) ranged from a ten-minute flight simulation session (McClernon et al., 2011) to a seven-phase multifaceted intervention conducted over three-years (Beauchamp et al., 2012). The interventions provided participants with educational support on relaxation skills ( $n = 2$ ), attention strategies ( $n = 1$ ), and individual coping strategies ( $n = 1$ ). Participants were asked to apply these skills during simulation. McClernon et al. (2011) delivered interventions on a one-to-one basis, whilst Beauchamp et al. (2012) and Bell et al. (2013) delivered interventions to teams working alongside key individuals that may influence the training environment and effectiveness of the intervention. Both McClernon et al. (2011) and Bell et al. (2013) identified a significant improvement in performance following intervention. Beauchamp et al. (2012) did not present specific performance results, but concluded that the intervention was successful as athletes achieved their performance goals as set by their national governing body.

A-B-A simulation studies ( $n = 2$ ) included a one-day simulated surgical crisis intervention (Wetzel et al., 2011) and a six-week computerized decision making-accuracy programme (Lorains et al., 2013). Both interventions concluded that simulation had significant beneficial effects for improving the speed and effectiveness of decision making under pressure in comparison to the control group. Surgeons within the Wetzel et al. (2011) study also noted that the stress management strategies provided helped them control physiological responses perceived as influencing performance under pressure.

All five simulation interventions enhanced performance under pressure, with three simulation studies including control groups. Whilst simulation interventions incorporated educational support (e.g., Bell et al., 2013; workshops focused on mental preparation principles) the emphasis was on individuals developing, refining, and building a repertoire of coping strategies via application under conditions which simulated the pressurized task (Bouchard et al., 2010). In reviewing the interventions provided, simulation training consistently provided a means of effectively transferring mental skills to the pressure task. However, only Wetzel et al. (2011) included a (bespoke) perceived 'realism' scale to assess the ecological validity of the simulation, and none of the simulation studies evalu-

ated the impact of the intervention on real pressure performance data. Simulation intervention research would benefit from investigating individuals' perceptions of the transferability of coping strategies developed during simulation, to the real pressurized scenarios.

**Emotion regulation interventions:** Emotion regulation interventions (A-B = 2, A-B-A-B = 1) instructed participants to engage in a distraction ( $n = 2$ ) and/or a reappraisal ( $n = 2$ ) strategy. Interventions were brief 'one-off' interventions intended to aid the performance of a golf putting task (Balk et al., 2013; Moore et al., 2015) or a basketball shooting task (Mesagno et al., 2009). Using an A-B design, Balk et al. (2013) intervention comprised of two self-administered (reading and following the implementation) reappraisal strategies, and one distraction strategy. The reappraisal strategy focused on reinterpreting 'pressure' in a way that is facilitative. This type of strategy was explicitly underpinned by distraction theories that suggest debilitating thoughts and worries impair performance (e.g., process efficiency theory; PET; Eysenck and Calvo, 1992). Consequently, the intervention instructed participants to think about the positive aspects of what they were experiencing to alter its potential impact upon performance. The distraction strategy required the participant to engage in another neutral thought or taking thoughts or memories in mind that were unrelated to the pressurized task. Moore et al. (2015) provided an A-B intervention arousal reappraisal intended to help participants view pressure-induced emotions as a resource that could aid performance. Reappraisal instructions took '60 seconds to deliver', which would suggest this was researcher-led. The A-B-A-B intervention delivered by a researcher in Mesagno et al. (2009) study was also intended to distract participants from symptoms of somatic anxiety through engaging in a distraction strategy during the pressurized task. There were no significant differences in performance post intervention for Mesagno et al. (2009). Both reappraisal interventions (Balk et al., 2013; Moore et al., 2015) and along with the distraction intervention (Balk et al., 2013) produced significant improvements to performance under pressure. Whilst there is insufficient evidence to conclude that one strategy is more efficacious than the other, it was suggested that reappraisal allows performers to re-evaluate symptoms of anxiety to be facilitative of performance (Moore et al., 2015).

## Conclusions

Pressure interventions offered in the included studies most often ( $n = 9$ ) adopted cognitive-behavioral approaches in order to address the appraisal of pressure (e.g., Crocker et al., 1988). Relaxation and re-appraisal techniques (e.g., positive self-talk) were the most commonly used intervention strategies. These were suggested to reduce "unhelpful" aspects of embodied stress responses such as excessive tension and nausea (e.g., Keogh et al., 2006), enable emotion regulation (Olusoga et al., 2014), and divert attention from negative physiological symptoms of anxiety (Page et al., 2015). Distraction theories propose that high-pressure situations cause performance to decrease due to working memory becoming over-loaded with task-irrelevant stim-

uli. Task irrelevant stimuli, such as worries about consequences, disrupt what was once an automatic skill/performance (Anderson and Gustafsson, 2016). Evidence suggests that pressure interventions delivered via cognitive-behavioral workshops, individual consultation sessions, emotional regulation strategies, and simulation training may all offer, at least to a small degree performance enhancement by improving an individual's ability to execute self-regulatory processes that support performance under pressure. However, improvements in performance related variables within control groups may suggest that performance related variables improved, but not because of the interventions but the repetitive exposure to the pressure tasks. Some control groups also provided educational or physical interventions that may enhance the perceived confidence or control over performance which may have contributed to an increase in performance within the control conditions.

Simulation studies that exposed individuals to 'pressure' settings produced the most consistent improvements to performance, in comparison to a control group. Researchers concluded that simulation of performance under pressure provides greater opportunity for an individual to demonstrate competence, therefore enhancing an individual's context specific confidence that they can perform the pressure task (e.g., Wetzel et al., 2011). Simulation interventions also provide the opportunity to develop coping skills in a controlled environment, incremented at a pace that encouraged the individual to utilize their coping techniques, develop resilience, and enhance both physical and cognitive functioning (e.g., Bell et al., 2013).

A common theme in reviewing the outcomes of pressure interventions was the influence of appraisals, particularly with regards anxiety and arousal in pressurized performance settings. Researchers commonly reported that individuals who perceived themselves as having the resources and efficacy to cope with pressure conditions were more likely to perceive anxiety as facilitative of performance (Blascovich et al., 2000; Seery, 2011).

This systematic review highlights limitations with the design, execution, and evaluation of pressure interventions. Notably, there is a clear need to better consider the approach used to generate meaningful performance pressures. By identifying pertinent incentives, pressure training can be more effectively contextualized and bespoke to the performance and contextual needs for individuals. As such, it is suggested that future research should better attend to the reliability and ecological validity of the methods used for generating pressure. Specialized samples that require coping skills to facilitate performance under pressure may be particularly pertinent to generate an understanding of the types of meaningful incentives to be incorporated into pressure tasks. However, the opportunity to conduct research with 'hard to reach' groups (e.g., elite athletes) means that researchers are likely to have a small sample size and a control group that maybe affected by confounding variables (e.g., 'lower-skilled' cricket players that may not receive as many hours of training; Bell et al., 2013). Although this may mean that the results should be interpreted with a degree of caution this should not stop re-

searchers from investigating such a unique sample, especially when the investigation focuses on enhancing performance under pressure. Researchers may adopt a phenomenological approach to the study of developing an intervention to aid coping under pressure, especially in light of the fact that pressure is a subjective experience and can be influenced by context. In view of the limitations noted by this systematic review, we suggest that future pressure research should; 1) establish a contextualised task which will generate pressure for participant. Having established a suitable pressure task, research should 2) assess the consequences of pressure by evaluating conscious and non-conscious effects and coping mechanisms, and 3) assess mechanisms through which coping with pressure might be improved. Future research should seek to address these limitations with greater theoretical emphasis to allow advances in both theory in practice.

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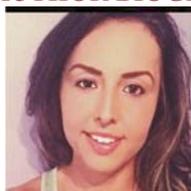
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## Key points

- Simulation studies that exposed individuals to 'pressure' settings produced the most consistent improvements to performance, in comparison to a control group.
- This systematic review highlights limitations with the design, execution, and evaluation of pressure interventions.
- Future research should attempt to better consider the approach used to generate meaningful performance pressures and assess the consequences of pressure by evaluating conscious and non-conscious effects and coping mechanisms through which coping with pressure might be improved.

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