

**The Psyching-Up Strategies Utilised by Strength Athletes and Their
Effectiveness in Enhancing Strength Performance**

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ABSTRACT

This thesis examined how psyching-up strategies influence performance in strength tasks. A coherent programme of five studies reviewed existing literature, identified and categorised strategies, examined their application in competition and evaluated their effectiveness through experimental and intervention research. Study 1 systematically reviewed the literature on psyching-up and maximal force production. This review demonstrated that psyching-up enhanced performance in 65% of trials compared with control conditions, while highlighting a limited understanding of how strategies are selected and utilised in applied strength-sport contexts. Addressing this gap, Study 2 adopted a concept mapping design, recruiting experienced practitioners who identified 64 unique psyching-up techniques and grouped them into eight distinct strategies. These comprised “arousal-reducing” strategies (*pre-performance routines; positive thoughts, feelings, images and behaviours; goals and performance accomplishments*) and “arousal-enhancing” strategies (*self-deprecation; negative thoughts, feelings, images and behaviours; stimulation; physical and physiological techniques; aggressive acts*). *Pre-performance routines* was rated as the most effective strategy. Study 3 extended this work into competitive environments by observing the use of psyching-up strategies during strength-sport competitions. Aligning with the findings from Study 2, *pre-performance routines* was selected significantly more frequently than any other strategy ($p < .001$). Study 4 experimentally examined psyching-up effectiveness in 200 competitive strong(wo)man and powerlifting athletes during the deadlift. Deadlift velocity was significantly greater during the psyching-up condition compared to the control. Although no differences were observed between strategies, linear discriminant analysis revealed that higher reward sensitivity, greater trait aggression and lower anxiety sensitivity predicted selection of “arousal-enhancing” strategies ($p = .002$). Finally, Study

5 prescribed personality-matched strategies to athletes reporting ineffective psyching-up, resulting in significant improvements in deadlift velocity following prescription. Collectively, this thesis provides the first systematic and experimental evidence base for psyching-up in strength-sports and supports the value of personalised psychological preparation.

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Publications Arising from This Thesis

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Chapter 1: Introduction

Sport psychology has demonstrated the value of psychological methods in enhancing athletic performance since it emerged as a recognised discipline in the 1970's (Vealey, 2006). Across a wide range of sports, empirical research in sport psychology has identified effective psychological strategies and demonstrated how practitioners can apply them to enhance performance. To establish the robustness of this evidence, a recent meta-analysis of meta-analyses evaluated the overall effectiveness of sport psychology interventions and variables on performance (Lochbaum et al., 2022). Of the interventions examined, mindfulness reported the largest effect. Although its origins lie in contemplative traditions dating back centuries, its integration into modern psychology began with Mindfulness-Based Stress Reduction in 1979 (Singla, 2011). Importantly, mindfulness entered performance psychology not through theoretical invention, but because individuals who engaged in the practice consistently reported benefits that were later formalised into psychological interventions. This can also be noted for various interventions prescribed to athletes, such as pre-performance routines (Cohn, 1990) and self-talk (Hardy et al., 2001), both of which originated from practices athletes were already adopting. One such strategy that has yet to be comprehensively explored is the behaviours often used by strength athletes prior to a maximal lift, commonly referred to as "psyching-up" (Mahoney, 1979). Given the value systematic investigation into psychological strategies has had across various sports, the present thesis sought to provide a thorough exploration of psyching-up to understand what psyching-up entails, assess its effects on performance and determine whether it can be systematically optimised. Although the term psyching-up is retained throughout this thesis, the strategies utilised do not exclusively function to increase activation. Instead, in line with existing literature and strength-sport terminology, psyching-up strategies appear to

influence activation bidirectionally (Tod et al., 2003; Winwood et al., 2019), suggesting that psyching-up is more appropriately understood within a broader framework of arousal regulation.

Sport psychology research has contributed to notable performance enhancements in professional sport. Valuable outcomes have been observed across various contexts, such as Larsen and Henriksen (2015) integrating psychological momentum training within a professional football team, which progressed from narrowly avoiding relegation to securing a silver medal the following season. Additional evidence of performance enhancement through psychological interventions can be found in futsal via mindfulness-based approaches (Vella-Fondacaro & Romano-Smith, 2023), emotional intelligence training in rugby (Campo et al., 2019), psychological skills programmes in volleyball (Zhang et al., 2024) and the application of acceptance and commitment therapy among international chess players (Ruiz & Luciano, 2012). Collectively, these examples demonstrate the breadth and effectiveness of applied sport psychology in elevating athletic performance. The successful integration of evidence-based psychological strategies across a diverse range of sports underscores their adaptability and value within elite environments. Nevertheless, despite the scope of existing research, some sporting domains remain comparatively underrepresented within the applied sport psychology literature. Examples of sports that remain underrepresented within the literature are found in the strength disciplines of powerlifting and strongman and strongwoman (strong(wo)man). Powerlifting is a sport centred on the demonstration of absolute and relative maximal strength, in which athletes are granted three attempts to lift the heaviest possible load for a single repetition across three key lifts: the back squat, bench press and deadlift (Ferland & Comtois, 2019). Strong(wo)man shares some physiological demands with powerlifting, particularly in its emphasis on maximal effort strength but is characterised by greater variability and functional complexity (Winwood et al.,

2011). Each strong(wo)man competition features a distinct set of events designed to assess strength, endurance and cardiovascular capacity (Winwood et al., 2019), often involving multidirectional movement and both unilateral and bilateral loading patterns (Winwood et al., 2014). Common events include carrying heavy frames, kegs and sandbags, as well as vehicle pulls and lifts of heavy stones, logs and oversized dumbbells (Keogh & Winwood, 2017). The recent emergence of strong(wo)man as an organised sport may partly explain the limited research base (Winwood et al., 2012), whereas powerlifting has been contested since 1964 (Alexander et al., 2019) and still suffers from a lack of academic attention, particularly in relation to psychological preparation and intervention (Barnicle & Lepage, 2018). As both sports continue to experience significant growth, it is crucial that sport science research evolves in parallel to support their ongoing development.

Powerlifting has witnessed a remarkable surge in global popularity over the past two decades. In Australia, competition entries rose dramatically from 759 in 1994 to 1,014 in 2011, reaching 6,803 by 2022 (van den Hoek et al., 2024). A similar trend is evident in the United Kingdom. Data from OpenPowerlifting (n.d.), a comprehensive and publicly accessible database of global meet results, show that the number of UK-based competitors in sanctioned events increased from 3,768 in 2017 to 7,267 by 2024. Complementary analysis by PowerliftingInData (2024) highlights an average annual growth rate of 5.9% in global meet participation between 2013 and 2023. Notably, the most substantial increases have occurred among younger age groups, with annual growth rates of 7.1% and 8.8% reported for athletes aged 16-20 and 21-25 years, respectively. Given that around half of all current entries are from individuals aged over 25 years, this upward trend amongst younger lifters suggests a widening participant pipeline that may sustain future growth of the sport.

Strong(wo)man, alongside Powerlifting, has experienced a remarkable growth in popularity over the past decade, evidenced by substantial growth in both participation and spectator engagement. In the UK, the biggest event for British competitors is Giants Live: Britain's Strongest Man. This event showcases the nation's top open-weight athletes to compete for the national title that has been won by widely recognised names such as Geoff Capes, Eddie Hall and Tom Stoltman. Spectator numbers at this event have more than doubled, rising from 3,500 in 2017 to 8,000 in 2024 (Giants Live, n.d.). For athletes outside of the open male division, the most prestigious competition is the Official Strongman Games (OSG) World Final. This is a three-day event where athletes across different weight classes, age groups and sexes compete to be crowned the strongest in the world for their respective category. In 2017, OSG World Final featured 215 athletes, including 130 men and 85 women across nine categories (Beck, 2017). By 2024, this had grown to 346 athletes across 15 categories, with 194 men and 152 women competing (Official Strongman, 2024). Despite this rapid growth in participation, audience size and commercial value, there remains a notable lack of academic research aimed at improving performance within these sports.

While psychological strategies for strong(wo)man and powerlifting athletes remain relatively underexplored, emerging evidence highlights their potential to enhance strength performance. A systematic review examining the effects of cognitive strategies on muscular strength, revealed that techniques such as imagery, goal setting and self-talk were associated with improvements in strength, power and endurance (Tod et al., 2015). While this review provided valuable insight into how psychological interventions may support strength-based performance, none of the included studies recruited participants from either of the aforementioned sports. The limited research within strong(wo)man and powerlifting suggests that anxiety may negatively affect

performance outcomes (Cusimano et al., 2024; Judge et al., 2016), reinforcing the need for sport-specific psychological support. One strategy frequently reported by athletes in these disciplines is the utilisation of “self-directed cognitive strategies immediately prior to or during skill execution to enhance performance”, known as psyching-up (Tod et al., 2003, p. 48). Psyching-up was originally documented amongst Olympic weightlifters (Mahoney, 1979) and later observed in both powerlifting (Tod et al., 2005) and strong(wo)man (Winwood et al., 2019). Despite its widespread use (Winwood et al., 2019), the processes involved in psyching-up and the effectiveness of these methods, remain poorly understood.

Initially, the present thesis adopted the term psyching-up in accordance with the established definition within the existing literature, specifically that proposed by Tod et al. (2003, p. 48) as “self-directed cognitive techniques conducted immediately prior to or during the execution of a skill with the purpose of enhancing performance”. This definition was selected to serve as the eligibility criterion for the systematic review presented in Chapter 2, ensuring alignment with prior experimental research while providing a consistent framework for assessing the suitability of studies included in the aforementioned review. Findings from Chapter 2, however, indicated that restrictions imposed by the rigidity of this definition resulted in the exclusion of numerous strategies previously cited as psyching-up.

Subsequent Chapters within this thesis therefore aimed to more fully explore how athletes’ psych-up. Findings from the exploratory research design in Chapter 3, alongside the observational research conducted within Chapter 4, demonstrated that athletes adopted a broader range of strategies than those typically associated with psyching-up. This included strategies that attempted to increase, regulate and decrease state arousal. Some existing literature differentiated these approaches to arousal management as “psyching-up” and “psyching-down” (Acharya &

Morris, 2014). However, given that prior psyching-up research had encompassed both approaches under the umbrella of psyching-up (Hammoudi-Nassib et al., 2014; McGuigan et al., 2005; Tenenbaum et al., 1995) and that athletes within Chapter 3 explicitly identified these strategies as psyching-up, the present thesis retained the term to reflect its established use within both strength-sport culture and the academic literature.

The working definition of psyching-up was therefore refined within Chapter 3 to “strategies intending to alter activation, or to enhance mental preparedness, immediately prior to or during skill execution”. While the term psyching-up was retained throughout this thesis for pragmatic reasons, it was recognised that many of the strategies examined were more appropriately conceptualised within a broader framework of arousal regulation. From this perspective, these strategies were not limited to unidirectional increases in activation but instead reflected the bidirectional regulation of physiological and psychological states in pursuit of optimal performance. Psyching-up is often used synonymously with enhancing state arousal (Acharya & Morris, 2014). However, as outlined above, this perspective may be overly narrow. To contextualise the role of psyching-up in performance, it is important to first outline the major theoretical models that describe the relationship between arousal and athletic output. Arousal refers to the degree of physiological and psychological activation and individual experiences (Uhm et al., 2020). Elevated levels of arousal are typically accompanied by physiological effects such as increased heart rate, elevated blood pressure and vasoconstriction (Kreibig, 2010). These responses also often occur alongside various negative emotional states, including anger, distress, fear, anxiety, irritation and tension, as well as positive emotional states such as excitement, joy and enthusiasm (Lim, 2016). In a sporting context, physical activity is generally associated with a shift into a sympathetic state (Fisher et al., 2015), which naturally increases arousal. However,

the specific level of arousal required for optimal performance remains uncertain. Several theories have been proposed to better understand this relationship, including Drive Theory (Hull, 1943), the inverted-U hypothesis (Yerkes & Dodson, 1908), individual zone of optimal functioning (IZOF) model (Hanin, 2000), Reversal Theory (Kerr, 1985) and Catastrophe Theory (Hardy & Parfitt, 1991).

Drive theory (Hull, 1943; Spence, 1956) proposes that for well-learned tasks, performance increases in direct proportion to arousal. Conversely, when arousal levels decrease, performance is also expected to decline. As arousal increases, the sympathetic nervous system is activated, leading to elevated heart rate, respiratory rate and blood flow, which enhances oxygen delivery and metabolic readiness (Michael et al., 2017). This heightened physiological state supports increased muscular activation, thereby facilitating physical performance. However, the theory is limited in that it does not consider the influence of specific emotional states, such as anxiety or stress, which may impair performance. It also fails to explain how arousal interacts with these states in more complex or varied contexts.

Multiple theories suggest that the relationship between arousal and performance follows an inverted-U shape. That is, as arousal levels increase, performance also increases up to an optimal point, after which further arousal leads to a decline in performance. This relationship was first proposed in the inverted-U hypothesis by Yerkes and Dodson (1908). Within this model, the optimal arousal level varies according to task complexity. Specifically, simple tasks benefit from higher arousal, while more complex tasks require a more moderate level. Beyond this optimal point, performance is thought to decline due to overstimulation impairing cognitive control. Early development of this principle was initially centred around animal behaviour, before being generalised to human performance, with early evidence supporting the proposal in a sporting

context (Gerdes, 1958; Johnson, 1965). However, the theory has been criticised for its overgeneralisation and simplicity (Oxendine, 1970). Much like Drive Theory, it does not account for individual differences, instead assuming that the same arousal levels are optimal for all individuals.

In response to the limitations of earlier models, particularly the inverted-U hypothesis, Hanin (1978; 2000) developed the IZOF model. This model also describes a curvilinear relationship between arousal and performance; however, IZOF introduced critical distinctions by recognising that the type and subjective perception of arousal both influence performance. Unlike prior theories that treated arousal as a singular, generalised stimulus, IZOF incorporates both hedonic tone, which refers to how pleasant or unpleasant an emotion feels in addition to functionality, which is defined by whether the emotion is perceived to facilitate or hinder performance (Hanin, 2000). These dimensions produce four emotional categories: pleasant and facilitative, unpleasant and facilitative, pleasant and debilitative and unpleasant and debilitative. However, the performance implications of these emotional categories are not uniform, as individuals' zones of optimal functioning can vary substantially in arousal level, hedonic tone and perceived functionality. This framework allows for meaningful individual differences, acknowledging that two athletes experiencing the same emotion at the same arousal level may respond differently depending on how they interpret that state in relation to performance. Additionally, two individuals experiencing the same level of arousal may interpret the emotion similarly yet differ in whether they perceive it as facilitative or debilitative to performance.

The IZOF model gained substantial empirical support by foundational meta-analytic evidence (Jokela & Hanin, 1999). Early research demonstrated that athletes tended to deliver superior performances when their pre-competition emotional states fell within their individually defined

zones of optimal functioning (Hanin & Syrjä, 1995a, 1995b). Subsequent work extended these findings by showing that the valence of emotion alone does not reliably predict performance outcomes. For example, unpleasant emotions such as anger have been reported as both facilitative and debilitating, depending on how athletes interpret their functional significance (Ruiz & Hanin, 2011). Building on these insights, the Multi-Action Plan (MAP) model was developed, integrating IZOF principles into structured routines designed to help athletes regulate and reproduce optimal states (Bortoli et al., 2012). Empirical evidence indicates that adopting the MAP model can enhance sporting performance by supporting the maintenance of optimal states and assisting in the regulation of control when athletes encounter adverse states (Bertollo et al., 2016; Robazza et al., 2016).

Reversal theory (Apter, 1982) similarly recognises the relationship between hedonic tone, arousal and athletic performance. Like IZOF, it emphasises the role of individual interpretation in determining whether a given arousal state enhances or impairs performance. Specifically, if a high-arousal state is perceived as excitement, performance is likely to improve; however, if the same physiological state is experienced as anxiety, performance may deteriorate (Kerr, 1985). Likewise, low arousal can be either facilitative or debilitating, depending on whether it is interpreted as calmness or boredom. As with IZOF, this model offers a compelling account for inter- and intra-individual variability in performance. However, its key distinction lies in the proposition that performance outcomes are driven by the athlete's current motivational state. That is, shifts in perception can occur rapidly and unpredictably, with the effect of arousal on performance determined not by stable zones, but by momentary reversals in how the athlete appraises their experience.

Empirical efforts have produced meaningful findings in support of reversal theory principles. Exploratory studies conducted in naturalistic sporting contexts have documented rapid shifts in emotional and motivational states among both elite athletes (e.g., Grange & Kerr, 2010; Kerr & Males, 2010) and recreational participants (e.g., Bellew & Thatcher, 2022; Frith et al., 2011). Yet the evidence remains inconclusive, with several investigations failing to demonstrate significant differences. For instance, Thatcher et al. (2003) assessed cortisol responses in experienced skydivers immediately before and after a dive and reported no changes in motivation or stress, although pre-dive cortisol was negatively associated with perceived stress. Despite such inconsistencies, a narrative review by Hudson et al. (2016) concluded that, overall, the research base to that point offered support for reversal theory.

The catastrophe model offers an additional theoretical perspective by emphasising the moderating role of anxiety in the relationship between arousal and performance. It proposes that when cognitive anxiety is low, performance follows an inverted-U relationship with arousal (Fazey & Hardy, 1988). However, when cognitive anxiety is high, performance may initially rise with increasing arousal but deteriorates abruptly beyond a critical threshold, resulting in a sudden and marked decline. Similar to the IZOF model and reversal theory, the catastrophe model acknowledges that anxiety plays a crucial role in shaping performance outcomes, highlighting that its influence extends beyond simple increases in arousal. It provides a valuable explanation for the sudden performance breakdowns often observed in high-pressure environments. Although the model offers a more dynamic account of performance under stress, its complexity and limited ease of application have restricted its adoption in applied sport psychology practice (Hardy, 1996).

The validity of the catastrophe model has been frequently contested within the sport psychology literature. Early empirical studies reported support for the model in motor performance contexts, including netball (Edwards & Hardy, 1996), basketball (Hardy & Parfitt, 1991) and golf (Hardy et al., 2004). Building on Hardy (1990) proposition that self-confidence moderates the interaction between cognitive anxiety and physiological arousal, Hardy et al. (2004) demonstrated that golfers with low self-confidence experienced catastrophic performance declines at relatively low levels of somatic anxiety, whereas those with higher self-confidence tolerated greater somatic anxiety before performance deteriorated. This work attracted criticism from Tenenbaum and Becker (2005), who argued that Hardy et al. (2004) conflated somatic anxiety with physiological arousal, relied on a median split to separate high and low self-confidence, increased the risk of type I errors through multiple ANOVAs and shaped their hypotheses post hoc. Woodman and Hardy (2005) responded by clarifying that somatic anxiety can serve as a valid approximation of physiological arousal, that their exploratory use of median splits was designed to flag points of maximum discontinuity, that the multiple ANOVAs were used to identify predicted patterns while acknowledging the increased risk of type I error and by rejecting the claim of post hoc theorising, emphasising that their predictions were grounded in catastrophe theory. Subsequent work sought to strengthen the model, with Hardy et al. (2007) proposing that the asymmetry factor be reconceptualised as perceived effort required by the task. Under this refinement, tasks perceived as highly effortful are more likely to trigger sudden performance breakdowns in anxious athletes, whereas low-effort tasks are less vulnerable to such effects. Empirical studies have since provided support for this revised formulation (e.g., Beattie & Davies, 2010; Woodman & Hardy, 2007).

Collectively, these models demonstrate that the relationship between arousal and performance is not unidirectional but instead reflects a complex and individualised process. While early perspectives suggested that increased arousal enhances performance, subsequent models highlight that optimal performance may require either increases or decreases in activation, depending on factors such as task complexity, skill automaticity and individual differences. As such, performance is not determined by absolute arousal level, but by the extent to which an athlete is able to regulate their psycho-physiological state in a manner conducive to performance (Gould & Udry, 1994). For instance, where individuals may appraise arousal elevating stressors as challenges perceiving this state as positive, eliciting a positive performance output, meanwhile those who appraise the same state as a threat may result in diminished performance outcome (Gomes et al., 2022). Accordingly, the present thesis is situated within a broader arousal regulation perspective, in which psyching-up is interpreted as a strategy used to regulate activation to achieve an optimal performance state, rather than as a method solely intended to increase arousal. From this perspective, psyching-up strategies reflect athletes' attempts to modulate their psycho-physiological state in preparation for performance.

Models such as IZOF, Reversal Theory and the Catastrophe Model all emphasise the role of anxiety in shaping the arousal-performance relationship. While increased arousal can enhance performance, this benefit is limited; beyond an individualised threshold, performance typically declines. Crucially, how arousal is interpreted plays a key role. When perceived as facilitative, arousal may lead to improved outcomes. However, efforts to manipulate arousal can be counterproductive, particularly if they push athletes beyond their optimal zone. Some theories suggest this decline is gradual, while others highlight the potential for abrupt performance breakdowns. Given this complexity, it is important to examine how athletes regulate arousal in

pursuit of performance gains. Accordingly, it remains essential to understand how athletes manage arousal to improve performance. Within this context, psyching-up emerges as a relevant area of investigation. Exploring psyching-up not only deepens our understanding of the psychological techniques used by strength athletes but also contributes to the broader development of performance-enhancement strategies in sport psychology.

Accordingly, this thesis provided a comprehensive investigation of psyching-up within the context of strength-sports. First, it critically evaluated the existing literature on the effectiveness of psyching-up strategies. Second, it explored the specific methods used by strength athletes to psych-up. Third, it examined the prevalence of these strategies during competition. Fourth, it assessed the direct impact of psyching-up strategies on performance in a strength-sport population. Finally, the thesis evaluated whether psyching-up interventions can be systematically tailored to individual psychological profiles to enhance performance. To address these aims, the thesis comprises a literature review, four empirical studies and a general discussion. The aims and study designs for each Chapter are summarised in Table 1.1.

Chapter 2 presents a systematic review examining the efficacy of psyching-up strategies on maximal force production. This review addressed three key research questions: does psyching-up enhance performance in maximal force production tasks; does the existing literature identify a specific strategy as the most effective and do methodological quality and moderating factors influence the reported efficacy of these strategies.

Chapter 3 built on the findings of the systematic review by employing a mixed-methods concept mapping design to identify and evaluate the psyching-up strategies used by experienced strength athletes. In total, 246 experienced strength athletes and coaches contributed statements describing the techniques they use to psych-up. In the second phase of data collection, 112

athletes and coaches grouped these techniques into overarching strategies and rated them based on their perceived effectiveness.

Chapter 4 adopted an observational design to examine the prevalence and effectiveness of the psyching-up strategies identified in Chapter 3. A structured observational framework was employed to record athletes' behaviours during strong(woman) and powerlifting competitions. The study assessed how frequently each strategy is used in a competitive setting and examined athletes' perceptions of their effectiveness in facilitating performance under real-world conditions.

Chapter 5 employed a mixed within- and between-subjects design to investigate the effects of a free-choice psyching-up strategy on deadlift performance. In addition, the study explored whether the specific strategy selected influenced performance outcomes and whether participants' personality profiles are associated with their choice of strategy.

Building on the findings of Chapter 5, Chapter 6 recruited strength-sport athletes who identify their current psyching-up strategies as ineffective. This study employed a within-subjects design with two time points, six weeks apart. At time point one, the effectiveness of each participant's usual psyching-up strategy was assessed. Participants were then prescribed a new strategy tailored to their personality profile. After six weeks of applying the prescribed strategy, its effectiveness was reassessed.

The thesis concludes with a general discussion that summarises the key findings, considers their significance and outlines practical applications. It also reflects on the strengths and limitations of the research and presents an overall conclusion. In doing so, the thesis contributes to a more

individualised understanding of psychological preparation in strength-sports, offering novel insights for both researchers and practitioners.

Table 1.1
Overview of PhD Thesis Structure, Research Aims and Designs

Thesis Chapter	Title	Aims	Study Design
Chapter 2	The Effects of Psyching-Up on Maximal Force Production: A Systematic Review	<ul style="list-style-type: none"> • To evaluate the efficacy of psyching-up strategies on maximal force production • To assess methodological quality and moderating factors influencing outcomes 	Systematic Review
Chapter 3	Identifying The Psyching-Up Strategies Used in Strength-Sports: A Concept Mapping Approach	<ul style="list-style-type: none"> • To identify psyching-up strategies used by strength athletes • To assess athlete and coach perceptions of the strategies' impact on performance • To examine demographic differences in perceived effectiveness of the strategies 	Mixed-methods participatory concept mapping approach
Chapter 4	Observing The Use of Psyching-Up Strategies Within Strength-Sport Competitions	<ul style="list-style-type: none"> • To investigate the prevalence of psyching-up strategies used during competition • To examine strategy-use by classification (“arousal-enhancing” vs. “arousal-reducing”) and differences by sport and sex • To assess whether psyching-up strategies enhance performance in competition • To explore the relationship between perceived strategy effectiveness and actual performance outcomes 	Nomothetic-Point-Unidimensional-Extensive observational design

Chapter 5	The Effects of Psyching-Up on Deadlift Performance in Competitive Strongmen, Strongwomen and Powerlifters	<ul style="list-style-type: none"> • To investigate the effect of psyching-up on deadlift performance in experienced strength athletes • To assess whether the eight psyching-up strategies differ in their impact on performance • To examine whether anxiety sensitivity, reward sensitivity and trait aggression predict strategy selection 	Randomised mixed within- and between-subjects design
Chapter 6	Examining The Effectiveness of Prescribing Psyching-Up Strategies Utilising Personality Profiling	<ul style="list-style-type: none"> • To test whether a personality-matched prescription improves deadlift performance in athletes using ineffective psyching-up strategies 	Within-subjects design with two time points, six weeks apart
Chapter 7	Discussion	<ul style="list-style-type: none"> • To synthesise the findings across the thesis, critically evaluate the contribution of each study to the understanding and application of psyching-up strategies in strength-sports and outline theoretical, practical and future research implications 	Narrative evaluation of the completed studies

Chapter 2: The Effects of Psyching-Up on Maximal Force Production: A Systematic Review

ABSTRACT

A comprehensive examination of psyching-up strategies prior to maximal force production is imperative. Such work allows researchers to evaluate their efficacy, identify beneficial strategies for practitioners and direct future investigations. This systematic review aimed to examine the efficacy of psyching-up strategies on maximal force production. The present review was written in accordance with PRISMA guidelines. A systematic search was carried out in SPORTDiscus, PsychINFO, PsychARTICLES, MEDLINE, Google Scholar and Web of Science. Studies were included if: they used an experimental design, sampled adults, the independent variable included a psyching-up strategy that matched the working definition and the dependent variable measured maximal force production. Twenty-seven independent studies met the inclusion criteria for this review. Of the included trials, 65% reported performance improvements with psyching-up, suggesting a general, though not universal, positive effect on maximal force production. Free-choice psyching-up, motivational self-talk, PETTLEP imagery and prescribed preparatory arousal all consistently enhanced performance. There was also evidence that disparity in the results might be due to the competitive experience of the participants and the type of control condition adopted. The findings suggest that free-choice psyching-up, motivational self-talk, PETTLEP imagery and prescribed preparatory arousal may enhance maximal force production. Future research should recruit experienced athletes to identify and test the efficacy of strategies used by applied practitioners.

2.1: INTRODUCTION

Developing and utilising an athlete's maximal force production is important for optimal performance in many sports (Peterson et al., 2006). Alongside physical training, many athletes and coaches believe psyching-up improves their force production (Shelton & Mahoney, 1978). In practice, these strategies typically aim to alter arousal, focus, efficacy, or confidence to enhance physical and mental activation (Brody et al., 2000). This is achieved through a wide variety of cognitive interventions, such as preparatory arousal (Gould et al., 1980), self-talk (Bahari et al., 2012), emotive-imagery (Murphy et al., 1988), stimulus imagery (Perkins et al., 2001), attention control (Nadzalan et al., 2019) and free-choice (Tod et al., 2005) immediately prior to, or during skill execution. Despite promising evidence supporting psyching-up strategies, it is necessary to thoroughly synthesise research on their efficacy for facilitating maximal force production to clarify inconsistent findings, evaluate research designs and identify gaps for future research.

Currently, psyching-up is defined as "self-directed cognitive techniques that are conducted immediately prior to or during the execution of a skill with the purpose of enhancing performance" (Tod et al., 2003, p. 48). Although psyching-up shares similarities with general cognitive interventions (e.g., Cornwall et al., 1991; De Ruiter et al., 2012), it is distinguished by its acute nature, as it is designed to elicit an immediate effect. At the forefront of current psyching-up research are four primary strategies: preparatory arousal, self-talk, imagery and attentional focus.

Preparatory arousal is a cognitive strategy intending to increase levels of physiological and psychological intensity (Wrisberg, 1994). As outlined in Chapter 1, early accounts such as Drive Theory (Hull, 1943; Spence, 1956) and the Yerkes-Dodson law (Yerkes & Dodson, 1908)

suggested a direct or curvilinear relationship between arousal and performance. Subsequent models, including the IZOF (Hanin, 2000), Reversal Theory (Kerr, 1985) and the Catastrophe Model (Hardy & Parfitt, 1991), highlighted the importance of individual differences, emotional interpretation and anxiety in shaping outcomes. Within this framework, preparatory arousal can be understood as an attempt to increase physiological and psychological activation so that athletes obtain a state most conducive to performance.

Self-talk has been defined as a dynamic and multidimensional process involving verbalisation to oneself (Hardy, 2006). These verbal statements contain interpretive elements related to the task and typically serve one of two functions: instruction or motivation (Hardy, 2006). Instructional self-talk involves the athlete using phrases to direct themselves towards the technical elements of the skill, whereas motivational self-talk involves the athlete utilising phrases to enhance confidence and motivation. The task-matching hypothesis (Hardy et al., 2008) proposes that instructional self-talk is better suited to skill, timing or precision tasks (Boroujeni & Shahbazi, 2011), with motivational self-talk being optimal for strength (Bahari et al., 2012) and endurance tasks (de Matos et al., 2021). Support for this hypothesis has been equivocal, with a meta-analytic review indicating some support (Hatzigeorgiadis et al., 2011), yet a systematic review published in the same year reported limited evidence (Tod et al., 2011).

Imagery is a specific mental process that creates or recreates an experience (Simonsmeier et al., 2021). This strategy is among the most widely applied interventions within sport psychology and has been shown to improve performance, strengthen cognitive skills and support injury rehabilitation (Simonsmeier et al., 2021). Research has advanced the use of imagery interventions, progressing from stimulus-only approaches to the PETTLEP model (Holmes & Collins, 2001). The PETTLEP model comprises seven elements: physical, environment, task,

timing, learning, emotion and perspective. These elements determine how effectively imagery activates the neural regions involved in performance (Janjigian, 2024). Studies comparing PETTLEP with stimulus-only approaches consistently show that PETTLEP imagery produces superior outcomes (e.g., Smith et al., 2007; Wright & Smith, 2009). Imagery has been used to enhance strength performance by targeting neural adaptations, including improved motor unit activation, better coordination and reduced co-contraction of antagonistic muscles (Sidaway & Trzaska, 2005); enhance arousal through emotive-imagery (Murphy et al., 1988); increase self-confidence, self-efficacy and decrease anxiety (Thelwell & Greenlees, 2003).

Attentional focus strategies require the athlete to allocate mental resources to appropriate cues or stimuli (Neumann, 2019). Differences have been proposed in the effectiveness of strategies that direct attention internally compared to those that direct it externally (Nadzalan et al., 2019). Specifically, directing attention internally on movement mechanics or production has been associated with lower performance compared to an external focus of attention on the desired effect or task goal (e.g., Hosseiny et al., 2014; Russell et al., 2014; Sherwood et al., 2020). This difference in performance can be explained by the constrained action hypothesis, which states that when an individual makes a conscious effort to control their own movements, it constrains the motor system interfering with automatic motor control processes that normally regulate the movement (McNevin et al., 2003). Based on this theory, strength performance should be enhanced through an external rather than internal focus of attention (Wulf, 2013).

Although the aforementioned strategies have been used in research and practice, there is some mixed evidence regarding their effectiveness in the context of psyching-up. Despite athletes and coaches believing that performance is enhanced through psyching-up (Shelton & Mahoney, 1978; Tod et al., 2005), empirical evidence has reported positive (Theodorakis et al., 2000; Tod

et al., 2005), null (Brody et al., 2000; McGuigan et al., 2005) and even detrimental effects (Elko & Ostrow, 1992; Murphy et al., 1988) on maximal force production. Accordingly, synthesising the literature can provide a clear summary of empirical evidence on the efficacy of psyching-up. Thus, if the present review concludes that only some psyching-up strategies enhance force production, the findings could enable athletes, coaches and psychologists to better design and implement interventions to improve performance in both training and competition.

The dependent variable in this review is maximal force production. Maximal force production is defined as the maximal voluntary force produced from a muscle group, or group of muscles, producing either maximal strength or explosive power (Takarada & Nozaki, 2021). Many explosive-sport based athletes are required to generate maximum voluntary contractions, such as shot-putters (Schofield et al., 2022), sprinters (Bezodis et al., 2019), powerlifters (Travis, Mujika, et al., 2020) and strong(wo)men (Travis, Ishida, et al., 2020). Thus, if psyching-up strategies improve force production, then utilising effective psyching-up strategies could help optimise athletes' performance across various sports.

Since the origin of psyching-up research (Shelton & Mahoney, 1978) there has been limited reviews of the literature. A 2003 narrative review focused on the effects of psyching-up strategies on muscular strength, endurance and power, concluding that psyching-up enhances strength performance and that preparatory arousal appeared to be the most effective strategy (Tod et al., 2003). Following this, a systematic review in 2015 (Tod et al., 2015) focused on the effect of cognitive strategies on strength performance. The findings suggested that cognitive strategies typically enhanced performance, with 69% of imagery studies, 100% of goal-setting studies, 60% of self-talk studies, 55% of preparatory arousal studies and 63% of free-choice psyching-up reporting significant increases in maximal strength. The previous reviews provided valuable

insight into strategies for force-related performance, but to date no review has systematically collated research specific to psyching-up strategies.

The present review complements and extends the previous literature in three key ways. First, this is the first review to systematically examine psyching-up strategies and their efficacy on maximal force production. Second, it assesses the methodological quality of studies, which could impact on the quality and consistency of evidence. Third, the review focuses on the effects of strategies in relation to passive and/or active control conditions and the experience levels of the participants. Synthesising the current evidence could provide crucial insight into the efficacy of psyching-up strategies, potential reasons for mixed findings and directions and methodological considerations for future research. Additionally, the findings should provide practitioners with greater insight into the potential effectiveness of psyching-up, allowing for more informed decisions to facilitate optimal performance.

The overall purpose of the present Chapter was to review the literature examining the effects of psyching-up on maximal force production, using a transparent systematic approach. The primary aim was to examine the efficacy of psyching-up strategies on maximal force production. The secondary aim was to assess the methodological quality of studies and moderating factors, such as the type of intervention used, the sample and the control condition that might explain any heterogeneity in the evidence-base.

2.2: METHODS

The present review was developed following the guidelines provided by the preferred reporting items for systematic reviews and meta-analyses 2020 (PRISMA 2020).

2.2.1: INFORMATION SOURCES, SEARCH STRATEGY AND SELECTION PROCESS

The search strategy included: (a) an online search conducted on the 16th of December 2022 using the following databases: SPORTDiscus, PsychINFO, PsychARTICLES, MEDLINE, Google Scholar and Web of Science; (b) a manual forward and back search of retrieved articles and (c) a manual review of reference lists of relevant narrative and systematic reviews and meta-analyses. Titles, abstracts and key words were searched online, utilising Boolean operators, using the following string: Psyching OR Arousal AND Strength OR “Weight-lifting task” OR “Force-Production”. The initial search terms were developed, with the aid of my supervisory team (PF; JM) and the departmental librarian (GC). The search results were collated using EndNote, with duplicates automatically deleted by the software followed by a manual deletion by the lead author during the screening process. The studies were then exported to an Excel spreadsheet, containing the author names and titles of all the articles gathered, where titles were screened for eligibility by the lead author. The remaining potentially relevant abstracts and full texts were then screened by the lead author (KC) and a secondary reviewer (JP). One discrepancy was resolved via discussion, with the study being excluded as it contained participants who were under the age of 18.

2.2.2: ELIGIBILITY CRITERIA

Studies were required to meet the following inclusion criteria:

- (a) An experimental design, with counterbalancing or randomisation, comparing psyching-up interventions to a control.

- (b) The independent variable(s) had to meet the definition of psyching-up adopted here for consistency with previous experimental literature, namely Tod et al. (2003, p. 48) definition of “self-directed cognitive techniques conducted immediately prior to or during the execution of a skill with the purpose of enhancing performance”.
- (c) The dependent variable must be a measurable maximal force production output.
- (d) The sample must be healthy adults, aged at least 18 years.
- (e) The retrieved articles must be available in full-text English, or as a full-text translation, prior to the end of the data collection period (December 2022).
- (f) The retrieved articles must also be published in a peer-reviewed journal and demonstrate a moderate or low risk of bias, as assessed using the Cochrane risk of bias tool (Sterne et al., 2019).

2.2.3: ASSESSMENT OF RISK OF BIAS

The present review followed the instructions in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2019) to assess the risk of bias in the included studies using the Risk of Bias 2 Tool (RoB2) (Sterne et al., 2019). The RoB2 has been shown to be a valid tool to assess the methodological quality of randomised trials (Minozzi et al., 2022). Specifically, the following five domains were considered: randomisation process, deviations from the intended interventions, missing outcome data, measurement of the outcome and selection of the reported result. If relevant information was not reported within an article, attempts were made to contact the lead author. Seven authors were contacted and three provided the requested information. In the instances where no response was received, interpretations were made based off the full text, with the options “probably” or “no information” selected.

2.2.4: SYNTHESIS METHODS

The present review extracted data to report into tables. Firstly, for each article we extracted the author/s, study design, participant characteristics (sample size, sex, age and the participant type), type and timing of the intervention, type of control condition, dependent variable and key findings. Next, to analyse the efficacy of each psyching-up strategy, for each independent variable, the number of significant and nonsignificant results were tallied. As psyching-up could inhibit or facilitate performance, we tallied both positive (+) and negative (-) findings, in addition to null (0) findings. Additionally, tallies were calculated for active and passive control conditions in addition to the type of participant. Based on descriptions and interpretations of the full text, participants were classified into the following categories: undergraduate student, novice, weight-trained and athlete. Novice refers to any individual where the report specifies the individuals had no prior, or limited, training experience. Weight-trained refers to individuals who had specified resistance training experience, but no report of competing within sports. Finally, athletes were classified as any participants recruited specifically due to their sporting experience. Lastly, the direct comparisons between the strategies within the articles were extracted and presented using a contingency table showing the number of direct comparisons along the left-hand side of the diagonal line and the right-hand side showing the percentage in which each trial significantly outperformed the other, in addition to nonsignificant findings.

Due to the variety of strategies meeting the criteria of “psyching-up”, the interventions were categorised into six types. Following the initial categorisation, further sub-groups were developed to enable a more nuanced understanding of the efficacy of strategies in facilitating maximal force production. In the occurrence of articles combining multiple strategies, an

additional category was created (category 4). The final categories and sub-groups are listed below:

- 1) Preparatory Arousal
 - a) Prescribed Preparatory Arousal
 - b) Self-Selected Preparatory Arousal
- 2) Self-Talk
 - a) Motivational Self-Talk
 - b) Instructional Self-Talk
- 3) Imagery
 - a) Stimulus-Only Imagery
 - b) PETTLEP Imagery
 - c) Emotive-Imagery
- 4) PETTLEP Imagery & Motivational Self-Talk
- 5) Attentional Focus
 - a) Internal Attentional Focus
 - b) External Attentional Focus
- 6) Relaxation
- 7) Free-Choice Psyching-Up

2.3: RESULTS

The following section presents the results of the systematic review. We begin by outlining the literature search and sifting process, followed by the risk of bias findings for the included

studies. Next, we summarise the main results regarding the overall influence of psyching-up strategies on maximal force production, the efficacy of each specific strategy and direct comparisons between them. Finally, we report the potential moderating effects of the control conditions and the participants' level of competitive experience.

2.3.1: LITERATURE SEARCH

Figure 2.1 displays an overview of the search and screening process. The initial search identified 3,585 potential studies. Following the removal of duplicates and the screening of titles and abstracts, the pool of potential articles was 33. The full text of these 33 articles were screened, which led to the exclusion of a further 12 papers. A further five papers were identified through the manual search processes, giving a total of 26 included articles, containing 27 studies.

Reasons for excluding studies at the full text stage included: the independent variable did not meet the criteria of psyching-up strategies (27% of rejected studies), the dependent variable was not a measure of maximal force production (18%), participants were younger than 18 years (9%), research design (36%) and the article was not published in a peer reviewed journal (18%). All the remaining articles were assessed for risk of bias, with all articles classified as either low or moderate risk of bias. The final articles are summarised in Table 2.1.

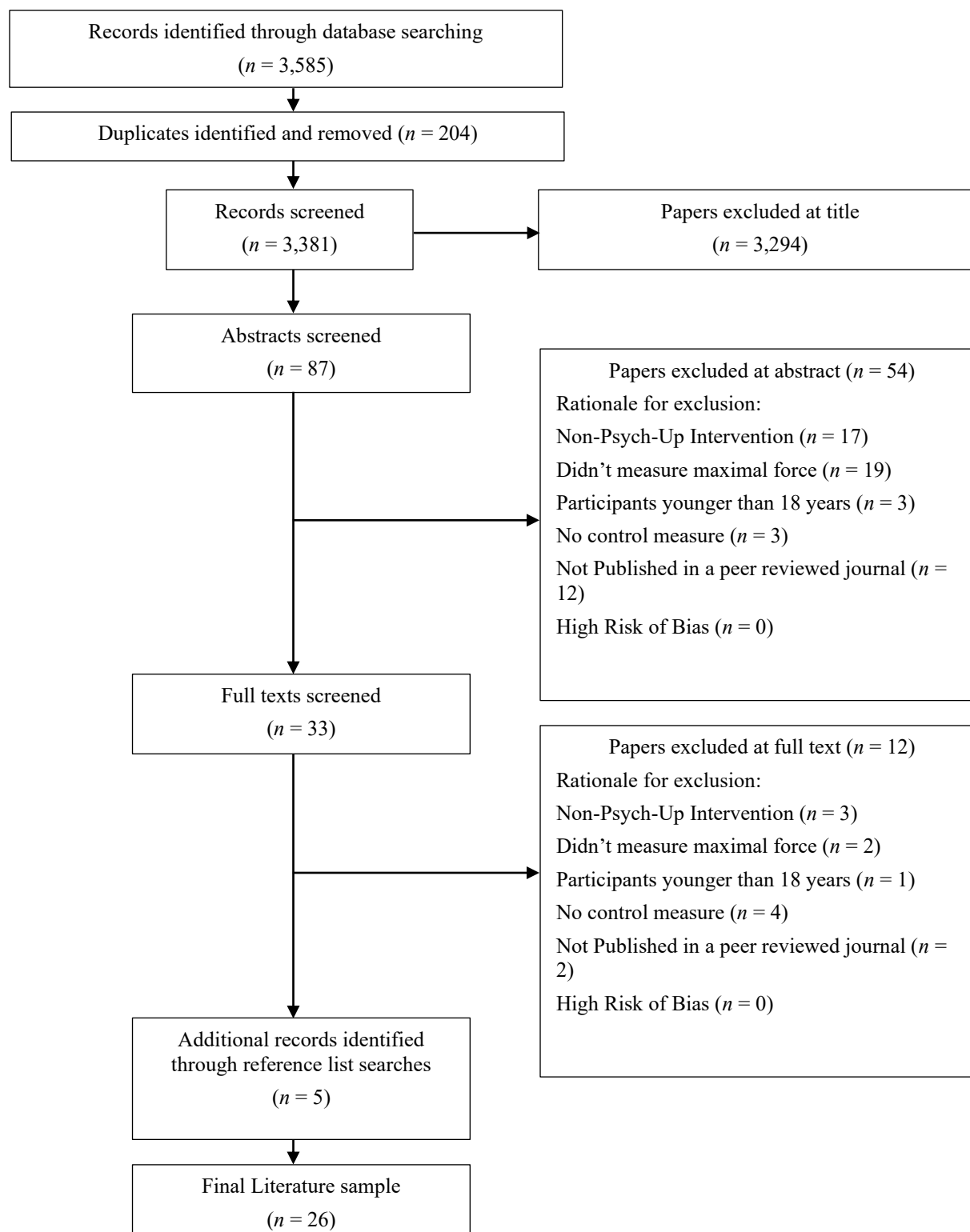


Figure 2.1
PRISMA flowchart illustrating the literature search at each stage.

Table 2.1
Summary of the retrieved articles used within the review

Author	Design	Participants	Interventions		Control	Dependent Variable	Key Findings
			Type	Timing			
Bahari et al. (2012)	Crossover	47 untrained M (22.4 years)	(a) Overt motivational ST (b) Covert motivational ST	Immediately prior	Passive	Grip Strength	No sig. diff interventions, both outperformed the control
Brody et al. (2000)	Crossover	15 strength trained M (23.6 years)	Arousal cues	20s prior	(a) Reading Task (b) Mental Arithmetic	Isometric Elbow Flexion	No sig. effects on dependent variable
Charbaghi (2019)	Crossover	47 untrained M (22.4 years)	Overt motivational ST	Immediately prior	Passive	Grip Strength	ST sig. outperformed control
Di Rienzo et al. (2015)	Crossover	18 M terrestrial sport athletes (19.31 years)	(a) PETTLEP imagery (b) Relaxing imagery	During 60s timed rest	Passive	Elbow Flexion strength	PETTLEP imagery sig. outperformed relaxing and control conditions
Elko and Ostrow (1992)	Mixed 2 (age) x 2 (sex) x 3 (interventions)	(a) 15 M (59.93 years) and 15 F (60.33 years) (b) 15 M (22.14 years) and 15 F (20.96 years) No participant had prior experience in strength training.	(a) Arousal cues (b) stimulus imagery	20s prior	Counting backwards	Grip Strength	Imagery and control sig. outperformed arousal. No sig. difference between control and imagery conditions.
Gould et al. (1980) Study 1	Mixed 2 (sex) x 5 (interventions)	15 M and 15 F undergraduate students	(a) Internal focus (b) Stimulus imagery (c) Arousal Cues	20s prior	(a) Counting backwards (b) passive	Knee Extension Strength	Both imagery and arousal sig. outperformed both controls and focus condition.
Gould et al. (1980) Study 2	RCT 2 (sex) x 3 (interventions)	30 M and 30 F undergraduate students	(a) Stimulus imagery (b) Arousal cues	20s prior	Pre-test passive	Knee Extension Strength	Arousal sig outperformed the control condition, with no other sig. differences found.

Hammoudi-Nassib et al. (2014)	Crossover	16 M sprinters (20.6 years)	PETTLEP imagery	(a) Immediately prior (b) 1 min. prior (c) 2 min. prior (d) 3 mins. prior (e) 5 mins. prior	Counting backwards	Straight Run Sprint (a) Acceleration (0-10m) (b) Overall Sprint (0-30m)	When performed immediately or 1 min or 2 mins prior imagery sig. enhanced performance of both initial acceleration (0-10m) and the overall sprint (0-30m).
Hammoudi-Nassib et al. (2017)	Crossover	16 M sprinters (20.6 years)	(a) PETTLEP imagery (b) Arousal cues	30s prior	Focus on and estimate their own heart rate	Straight Run Sprint (a) Acceleration (0-10m) (b) Overall Sprint (0-30m)	Both imagery and arousal sig. outperformed the control condition for acceleration. For overall sprint, imagery sig. outperformed the control condition. No other sig. effects reported.
McGuigan et al. (2005)	Mixed <i>2 (sex) x 2 (interventions)</i>	10 M (21.6 years) and 10 F (22.4 years) with a minimum of 1 year of weight training experience.	Free-choice PU	30s prior	Counting backwards	Back Squat 1RM	No sig. differences found
Murphy et al. (1988)	Crossover	24 M undergraduate students	(a) Relaxing emotive-imagery (b) Fearful emotive-imagery (c) Anger emotive-imagery	Immediately prior to the trial	Pre and post-test passive	Hand Grip Strength	Pre-test produced sig. greater strength performance, with relaxation scoring the sig. lowest strength performance.
Nadzalan et al. (2019)	RCT	30 M provided with 6 weeks of resistance training.	(a) Internal focus (b) External focus	During the trial	Passive	(a) Back Squat 1RM (b) Deadlift 1RM	External focus sig. outperformed both control and internal focus on both outcome tasks, with no other sig. differences reported.

Perkins et al. (2001)	Crossover	22 M and 6 F elite explosive sport athletes (20.30 years)	1. Respiratory Rate (a) 10 Br.P.M (b) 20 Br. P.M 2. Arousal (a) Para-telic guided imagery (b) Telic guided imagery	Immediately prior	Reading task	(a) Grip Strength	The para-telic condition sig. outperformed both intervention types, with telic sig. outperforming the control task. No sig. effects were found for respiration rate.
Peynircioğlu et al. (2000)	RCT	60 M and 60 F undergraduate students (20.7 years)	(a) Stimulus imagery (b) Arousal cues	Immediately prior	Arithmetic task	Grip Strength	Arousal sig. improved grip strength
Pierce et al. (1993)	Crossover	7 M footballers (18.7 years)	(a) Arousal inducing videos* (b) Relaxation	Immediately prior	Passive	(a) Bench Press 3RM (b) Bench Press 1RM	Arousal and control sig. increased 3RM bench press compared to relaxation, with arousal also sig. outperforming control. Arousal sig. outperformed relaxation and control for the 1RM.
Shelton and Mahoney (1978)	RCT	30 M Olympic weightlifters (23.4 years)	Free-choice PU	10s prior	Counting backwards	Grip Strength	Free-choice PU sig. improved strength performance.
Shukri (2020)	Crossover	45 M with at least 6 months of resistance training experience (21.20 years)	(a) motivational ST (b) Instructional ST	Immediately prior and during the trial	Passive	Bench Press Maximum Repetitions	Motivational ST sig. improved strength performance
Slimani and Chéour (2016)	RCT	44 M striking sport athletes (23.2 years)	10 weeks training learning: (a) PETTLEP imagery only (b) PETTLEP imagery and motivational ST	Immediately prior to and during the trial	Passive	(a) Bench Press 1RM (b) Half Squat 1RM	Imagery and motivational ST condition sig. outperformed the control group in both tasks. No more sig. differences were reported.

Tenenbaum et al. (1995)	RCT	38 untrained undergraduate students	4 weeks training learning: (a) Motivational ST (b) Relaxation	Immediately prior	Passive	Knee Extension Strength	Control group sig. outperformed both motivational ST and relaxation
Theodorakis et al. (2000)	RCT	27 M and 36 F undergraduate students (20.98 years)	(a) Motivational ST (b) Instructional ST	Immediately prior	Passive	Knee Extension Strength	Both ST groups sig. outperformed the control group
Tod et al. (2005)	Crossover	12 M (27.4 years) and 8 F with a minimum of 1 year experience with the output measure (20.9 years)	Free-choice PU	30s prior to the trial	(a) Focus on and estimate their own heart rate (b) Counting backwards	Bench Press	Free-choice PU sig. outperformed both control conditions
Tynes and McFatter (1987)	Crossover	36 resistance trained M (23.6 years)	(a) Motivational ST (b) Internal focus (c) Arousal Cues	Immediately prior	(a) Counting backwards (b) passive	Knee Extension Strength	All PU strategies sig. outperformed control, with arousal sig. outperforming focus and ST.
Weinberg et al. (1980)	Mixed 2 (sex) x 2 (interventions).	10 M and 10 F undergraduate students	Free-choice PU	Immediately prior	Counting Backwards	Knee Extension Strength	PU sig. outperformed the control
Weinberg et al. (1981)	RCT	40 M and 40 F undergraduate students	Free-choice PU	(a) 15s prior to the trial (b) 30s prior to the trial (c) self-initiated (d) yoked	Passive pre-test	Knee Extension Strength	PU significantly outperformed the control, with no sig. differences found between durations.
Weinberg et al. (1985)	Crossover	24 M recruited from a local weightlifting class (18-28 years)	(a) PETTLEP imagery	30s prior to the trial	Counting Backwards	(a) Broad Jump (b) Pull Ups	All 3 PU conditions outperformed the control condition across the 4

			(b) Arousal cues (c) Free-choice PU			(c) Push Ups (d) Sit Ups	exercises, with no sig. difference being found between the PU conditions.
Whelan et al. (1990)	Mixed 3 (competition experience) x 4 (interventions)	44 M and 42 F undergraduate students (30 high, 26 moderate and 28 low competitive experience) 2 participants removed from data, no mention of sex or competition experience group.	(a) Self-generated arousal (b) Arousal cues	45s prior	Focus on and estimate their own heart rate	Grip Strength	Low demonstrated no sig. performance increases. Moderate gained greatest performance from arousal cues. High gained greatest improvement from self-generated arousal.
Wilkes and Summers (1984)	Mixed 2 (pre-post trials) x 5 (interventions)	60 M undergraduate students	(a) Arousal Cues (b) Internal Focus (c) Stimulus Imagery (d) Motivational ST	20s prior to the trial	Reading task	Unilateral Knee Extension Strength	Arousal sig. outperformed imagery and control, with ST also outperforming the control.

RCT = Randomised Control Trial; M = Male; F = Female; ST = Self-Talk; PU = Psyching-Up; Br.P.M = Breaths Per Minute; Sig. = Significant

*Excluded from synthesis as it does not fit the working definition of psyching-up

2.3.2: ASSESSMENT OF RISK OF BIAS

Overall, the risk of bias was deemed as low or medium in all the items included on the checklist (Figure 2.2). Of the 27 studies, 69% were rated as low risk and 31% as medium risk. The greatest risk was the bias in selection of the reported result, with 27% of the studies rated as medium within this domain. Additionally, 15% of studies were rated as a medium risk of bias from the randomisation process. Bias due to deviations from intended interventions, missing outcome data and measurement of the outcome were all rated as low in all the included studies.

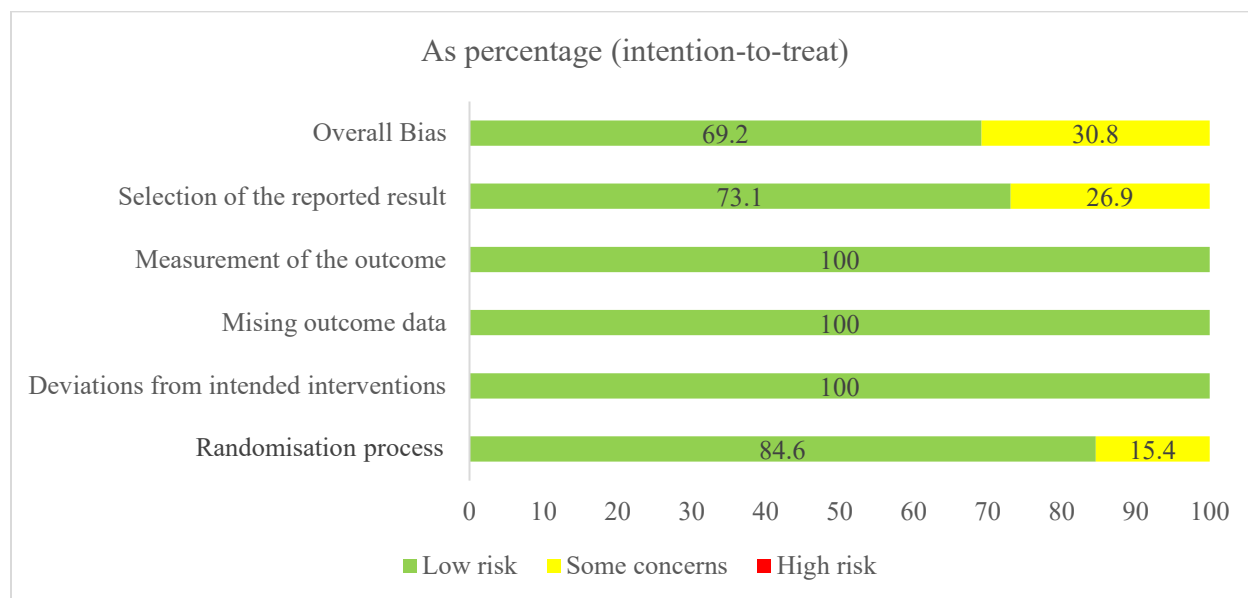


Figure 2.2

Risk of Bias assessment for the retrieved articles collated in the present review

2.3.3: DESCRIPTIVE CHARACTERISTICS OF INCLUDED STUDIES

The present review was based on a total population of 1022 (728 males, 256 females, 38 not specified). As presented in Table 2.2, from the retrieved 27 studies, 55% of samples were male only, with no female only samples. Regarding sample size, 74% of the studies recruited less than 60 participants. Only 26% of the retrieved articles recruited participants with notable competitive experience within sports.

Table 2.2
Sample characteristics of participants employed and control conditions utilised in the reviewed studies

Characteristic	No. of Studies
Sex	
Male only	15
Female only	0
Combined	11
Not Stated	1
Sample Size	
<10	1
10-19	4
20-29	6
30-39	5
40-59	4
60+	7
Participant Label	
Undergraduate Student	10
Novice	4
Weight-Trained	6
Athlete	7
Control Conditions	
Passive	12
Active	13
Both	2

2.3.4: MAIN FINDINGS

2.3.4.1: EFFECTS OF PSYCHING-UP STRATEGIES ON MAXIMAL FORCE PRODUCTION

Table 2.3 presents a summary of the effectiveness of psyching-up strategies on maximal force production. Overall, from the 26 articles, 93 effects were reported that compared an intervention to a control condition. From these comparisons, 60 (65%) reported that psyching-up interventions had positive effects on performance. Twenty-six (28%) of the comparisons indicated that there was no effect of psyching-up and 11 (8%) comparisons reported a negative effect on performance when compared to a control condition.

2.3.4.2: PREPARATORY AROUSAL

The effect of preparatory arousal on maximal force production was examined in 11 studies that collectively reported 26 comparisons against a control condition. As presented in Table 2.3, 69% ($n = 18$) of the effects found that the preparatory arousal condition outperformed the control condition, whereas 4% ($n = 1$) of effects found that the control condition was superior. Further, when the intervention was prescribed, the percentage of comparisons in which the preparatory arousal condition outperformed the control condition was 74% ($n = 17$). Self-selected preparatory arousal techniques only outperformed the control condition in 33% ($n = 1$) of trials, with the remaining trials reporting no difference between the control and intervention conditions. However, one study that used self-selected preparatory arousal strategies explored the moderating effect of competitive experience; it found that in highly experienced competitive athletes, they only outperformed the control condition with a self-prescribed strategy, whereas the participants with moderate competitive experience obtained greater performance

enhancement through prescribed strategies (Whelan et al., 1990).

Table 2.3
Effects of each psyching-up strategy on maximal force production

	K	Number of K's supporting the effect			Sum code (%)
		+	-	0	
Psyching-Up Strategies					
Arousal					
Prescribed	23	17	1	5	74
Self-Selected	3	1	0	2	33
Total	26	18	1	7	69
Self-Talk					
Motivational ST	9	8	1	0	89
Instructional ST	2	1	0	1	50
Total	11	9	1	1	82
Imagery					
Stimulus-Only	6	2	0	4	33
PETTLEP	19	13	0	6	68
Emotive-Imagery	4	0	3	1	0
Total	29	15	3	11	52
PETTLEP Imagery & Motivational ST	2	2	0	0	100
Attentional Focus					
Internal Focus	7	2	0	5	29
External Focus	2	2	0	0	100
Total	9	4	0	5	44
Relaxation	3	0	2	1	0
Free-Choice PU	13	12	0	1	92
Control Condition					
Passive	36	21	6	9	58
Active	57	39	1	17	68
Participant Label					
Undergraduate Student	32	17	5	10	53
Novice	9	5	1	3	56
Weight-Trained	25	21	0	4	84
Athlete	27	17	1	9	63
Total	93	60	7	26	65

K = Number of comparisons with a control condition; + = Indicates positive effects; - = Indicates negative effects; 0 = No effect; ST = Self-Talk; PU = Psyching-Up

2.3.4.3: *SELF-TALK*

The effect of self-talk on maximal force production was examined in six studies that collectively reported 11 comparisons against a control. As presented in Table 2.3, 82% ($n = 9$) of the effects found that the self-talk condition outperformed the control condition, with 9% ($n = 1$) reporting that the control condition was superior. Self-talk strategies were then categorised into the sub-groups of motivational and instructional self-talk. A selection of studies used the terminology ‘self-efficacy’ and after further investigations into the methodologies, these studies were categorised within the motivational self-talk group. Motivational self-talk consistently increased maximal force production, with 89% ($n = 8$) of the nine comparisons reporting that the motivational self-talk condition outperformed the control condition, whereas 11% ($n = 1$) reported negative effects. Conversely, only two studies examined instructional self-talk and 50% ($n = 1$) found that self-talk outperformed the control condition and 50% ($n = 1$) reported no significant difference.

2.3.4.4: *IMAGERY*

The effect of imagery on maximal force production was examined in 10 studies that collectively reported 29 comparisons against a control. As presented in Table 2.3, imagery presented equivocal results with 52% ($n = 15$) of the effects reporting that the imagery condition outperformed the control condition and 10% ($n = 3$) of the effects indicating that the control condition was superior. When the imagery methodology was analysed, the interventions were further subdivided into PETTLEP, stimulus-only and emotive-imagery. PETTLEP imagery outperformed the control condition in 68% ($n = 13$) of the effects, with the remaining 32% ($n = 6$) of effects not being statistically significant. Further, from the effects that were not significant, 67% ($n = 4$) originated from an article that tested how changing the duration between psyching-

up and the output impacted performance, with the trials that were three and five minutes prior to the output finding no significant effects (Hammoudi-Nassib et al., 2014). Stimulus-only imagery only outperformed the control condition in 33% ($n = 2$) of the comparisons, with the remaining 67% ($n = 4$) not statistically significant. None of the emotive-imagery comparisons found that imagery outperformed the control condition, with the control condition significantly outperforming emotive-imagery in 75% ($n = 3$) of the effects.

2.3.4.5: PETTLEP IMAGERY & MOTIVATIONAL SELF-TALK

A combination of PETTLEP imagery and motivational self-talk strategies was investigated in one article (Slimani & Chéour, 2016), which examined an effect on two outcome measures. As presented in Table 2.3, both (100%) of the effects found that the combination of strategies outperformed the control condition.

2.3.4.6: ATTENTIONAL FOCUS

The effect of attentional focus on maximal force production was examined in four studies that collectively reported nine comparisons against a control. As shown in Table 2.3, 44% ($n = 4$) of the effects found that the attentional focus condition outperformed the control condition, with the remaining 56% ($n = 5$) effects not statistically significant. Further subgroup analysis was performed on internal and external focused strategies. An internal focus outperformed the control condition in only 29% ($n = 2$) of the effects, with the remaining 71% ($n = 5$) effects not statistically significant. Conversely, both effects for external focused cues found that the intervention outperformed the control condition.

2.3.4.7: RELAXATION

The effect of relaxation on maximal force production was examined in two studies that collectively reported three comparisons against a control. As presented in Table 2.3, the relaxation condition did not outperform the control condition in any of the trials, with 67% ($n = 2$) of the effects finding that the control condition was superior and 33% ($n = 1$) that the conditions were not significantly different.

2.3.4.8: FREE-CHOICE PSYCHING-UP

The effect of free-choice psyching-up on maximal force production was examined in six studies that collectively reported 13 comparisons against a control condition. As presented in Table 2.3, 92% ($n = 12$) of the effects found that free-choice psyching-up condition outperformed the control condition, whereas 8% ($n = 1$) were not statistically significant. From the six articles, only one (Shelton & Mahoney, 1978) reported the participants' preferred strategy, which was attentional focus.

2.3.4.9: DIRECT COMPARISONS

As presented in Table 2.4, a total of 29 direct comparisons were made between strategies within this review. From these comparisons, only seven significant differences were reported, with preparatory arousal significantly outperforming self-talk ($n = 1$), imagery ($n = 2$) and attentional focus ($n = 2$) and imagery also outperformed preparatory arousal ($n = 2$). The remaining 22 comparisons reported no significant differences between strategies.

Table 2.4
Direct comparisons of each intervention from the retrieved articles

	Arousal	Self-Talk	Imagery	Attentional Focus	Relaxation	Free-Choice
Arousal		A>ST=50% A<ST= 0% A=ST= 50%	A>I= 18% A<I=18% A=I= 64%	A>AF= 67% A<AF= 33% A=AF= 0%	A>R= 0% A<R= 0% A=R= 0%	A>FC=0% A<FC=0% A=FC= 100%
Self-Talk	2		ST>I= 0% ST<I= 0% ST=I= 100%	ST>AF= 0% ST<AF= 0% ST=AF= 100%	ST>R= 0% ST<R= 0% ST=R= 100%	ST>FC= 0% ST<FC= 0% ST=FC= 0%
Imagery	11	1		I>AF= 0% I<AF= 0% I=AF= 100%	I>R= 0% I<R= 0% I=R= 0%	I>FC= 0% I<FC= 0% I=FC= 100%
Attentional Focus	3	2	1		AF>R= 0% AF<R= 0% AF=R= 0%	AF>FC= 0% AF<FC= 0% AF=FC= 0%
Relaxation	0	1	0	0		R>FC= 0% R<FC= 0% R=FC= 0%
Free-Choice	4	0	4	0	0	

Above the diagonal line shows the percentage of the comparisons where an intervention significantly outperformed another intervention, in addition to how often there was not a significant difference. Below the diagonal line is the number of comparisons between the interventions.

A = Arousal; ST = Self-Talk; I = Imagery; AF = Attentional Focus; R = Relaxation; FC = Free-Choice

2.3.4.10: MODERATOR VARIABLES

2.3.4.10.1: CONTROL CONDITION

The effects of psyching-up strategies were examined in 26 articles, across 27 studies, collectively reporting 93 comparisons against a control condition. Of these comparisons, 36 (39%) psyching-up interventions were compared against a passive control condition and 57 (61%) were compared against an active control condition. When interventions were compared against passive control conditions, 58% ($n = 21$) reported positive effects of the intervention. When compared against an active control condition, 68% ($n = 39$) reported positive effects for the intervention.

2.3.4.10.2: PARTICIPANT COMPETITIVE EXPERIENCE

The effect of the participants' competitive experience on the efficacy of the strategies was examined across the 27 studies. Of the 93 comparisons, 32 (34%) used undergraduate students, nine (10%) used novice participants, 25 (27%) used weight-trained individuals and the remaining 27 (29%) used athletes. Just 53% ($n = 17$) of the comparisons that used undergraduates found the psyching-up condition outperformed the control condition and 16% ($n = 5$) found that the control condition was superior. In novice participants, 56% ($n = 5$) of the effects indicated that psyching-up strategies outperformed the control condition, with 11% ($n = 1$) indicating that the control condition was superior. In weight-trained participants, 84% ($n = 21$) of the effects indicated that the psyching-up condition outperformed the control group, with 0% reporting that the control condition was superior. Finally, in athletes, 63% ($n = 17$) of the effects indicated that the psyching-up condition outperformed the control condition and 4% ($n = 1$) indicated that the control condition was superior.

2.3.5: SUMMARY

This review found that psyching-up strategies had a positive effect in the majority of trials. Specifically, prescribed preparatory arousal, motivational self-talk, PETTLEP imagery, external attentional focus and free-choice psyching-up enhanced strength performance in more than two-thirds of the trials in which they were examined. Trials using active control conditions reported positive effects in 68% of cases, compared with 58% under passive control conditions. Finally, trials with weight-trained participants provided the most consistent evidence, with 84% of trials showing performance facilitation, whereas only 53% of trials with undergraduate students reported such effects.

2.4: DISCUSSION

2.4.1: EFFECTS OF PSYCHING-UP STRATEGIES ON MAXIMAL FORCE PRODUCTION

The aims of the present review were to examine the efficacy of psyching-up strategies on maximal force production and to assess the methodological quality of the studies and potential moderating factors. This review found 93 comparisons against control conditions and 29 direct comparisons between interventions, derived from a total of 26 articles that contained 27 experimental studies. The results indicate that psyching-up strategies can facilitate maximal force production, with 65% of the comparisons demonstrating a positive effect. These results are based on research utilising 12 variations of psyching-up strategies across various forms of maximal force production. The use of prescribed preparatory arousal, motivational self-talk, PETTLEP imagery, external attentional focus and free-choice psyching-up all showed consistently positive

effects on performance. Conversely, stimulus-only imagery, internal attentional focus and relaxation typically had either no impact or adverse effects on performance.

2.4.2: PREPARATORY AROUSAL

The findings suggest that the utilisation of preparatory arousal enhances performance across a variety of different maximal force outputs. These findings are consistent with previous attempts to collate the data investigating cognitive strategies on maximal force production (Tod et al., 2015; Tod et al., 2003). Categorising the strategies into subgroups suggests that most researchers have utilised prescribed cues rather than self-selected cues. Only one article investigated the effectiveness of self-selected cues and found that only when the participants had high levels of competitive experience was performance enhanced (Whelan et al., 1990). As outlined in Chapter 1, the major theoretical models of arousal consistently highlight that performance depends on achieving an optimal state rather than simply increasing arousal. The inverted-U hypothesis (Yerkes & Dodson, 1908), the IZOF model (Hanin, 2000), Reversal Theory (Kerr, 1985) and Catastrophe Theory (Hardy & Parfitt, 1991) all recognise that arousal can be facilitative only up to a certain point, after which performance declines either gradually or abruptly, depending on how the state is interpreted and regulated. For inexperienced participants who lack the ability to manage arousal effectively, prescribed cues may therefore push them beyond or leave them short of this optimal zone. This offers a potential explanation for the isolated finding in which the prescribed-arousal condition was significantly outperformed by the control group (Elko & Ostrow, 1992). In this case, novice participants were told to “get mad” before their trial, which may have elevated their arousal past a functional threshold and disrupted performance. Overall, the findings suggest that prescribed preparatory arousal cues can be an effective strategy for

enhancing performance, but further investigation is needed to establish the efficacy of self-selected cues.

2.4.3: *SELF-TALK*

Self-talk demonstrated favourable results, suggesting the strategy is effective for enhancing performance in force-production tasks. More specifically, 89% of the comparisons between motivational self-talk and a control condition reported a positive effect. In contrast, only two effects of instructional self-talk have been reported, with just one of these indicating an advantage over the control condition. The strong support for motivational self-talk and the limited, inconsistent evidence for instructional self-talk align with the task-matching hypothesis (Hardy et al., 2008), which proposes that motivational self-talk is more effective for tasks demanding physical effort and energy expenditure, such as the dependent variables included within this review. Taken together, this suggests that when seeking to maximise force output, athletes are likely to benefit more from motivational self-talk, whereas instructional self-talk appears less applicable to these types of tasks.

2.4.4: *IMAGERY*

Overall, the evidence for the effects of imagery on maximal force production appears mixed. Within this, PETTLEP imagery has generally shown effectiveness, whereas stimulus-only and emotive-imagery have been less effective, though these approaches have received comparatively less investigation. Notably, most of the findings that did not support PETTLEP imagery came from a single study, where the time interval between the imagery script and the performance outcome acted as a moderating factor (Hammoudi-Nassib et al., 2014). The article reported this across two outcome measures, showing that performing the strategy three or five minutes before

the trial did not significantly improve performance. In contrast, when the intervention was administered immediately, one or two minutes prior to the trial, the imagery condition outperformed the control condition. When comparing stimulus-only imagery with PETTLEP imagery, the results indicate that PETTLEP is more effective for enhancing performance, consistent with previous findings (Smith et al., 2007; Wright & Smith, 2009). Additionally, emotive-imagery did not significantly enhance performance in any study and was outperformed by the control condition in 75% of comparisons. Despite the limited body of evidence, we theorise a possible explanation for this. Due to the imagery scripts trial attempting to increase arousal through elevating emotions of fear and anger, athletes may have been driven beyond facilitative levels of arousal. As outlined in Chapter 1, theoretical models of arousal, such as the IZOF model (Hanin, 2000), catastrophe theory (Hardy & Parfitt, 1991) and reversal theory (Kerr, 1985), explain how excessive or negatively appraised arousal can impair performance, either by moving athletes outside their optimal zone, by triggering sudden performance breakdowns, or by shifting high arousal from excitement to anxiety.

2.4.5: FREE-CHOICE PSYCHING-UP

The present results suggest that allowing participants to select their own psyching-up strategy has a positive effect on maximal force production. Across the included studies, 92% of trials using free-choice psyching-up enhanced performance, with only one trial reporting a non-significant effect (McGuigan et al., 2005). Unfortunately, only one article reported the preferred strategies of the participants (Shelton & Mahoney, 1978). In a cohort of competitive weightlifters, attentional focus cues were the favoured strategy while performing a hand dynamometer trial, although it was not reported whether the attentional cues were internally or externally focused. Regardless, the preference of attentional cues might reflect the high

requirement of coordination and technical focus required within Olympic weightlifting (Bishop et al., 2018). Of the trials that examined free-choice psyching-up, 75% involved participants with at least 12 months of weight-training experience. We speculate that participants selected strategies they had previously used, become familiar with and developed strong beliefs in during their own training, which could account for the higher proportion of positive effects compared to other strategies. Unfortunately, the findings of this review cannot provide evidence for this proposal, as the only trials that directly compared free-choice psyching-up with an alternate strategy involved participants with no reported competitive experience, which may account for the null findings observed in these comparisons (Table 2.4).

2.4.6: REMAINING STRATEGIES

Given the limited number of effects within this review for attentional focus, relaxation and strategy combinations, conclusive evidence was not found. The results from the present review found inconsistent effects of attentional focus on maximal force production. Categorising the strategy into internal and external focus sub-groups, however, did indicate a potential trend that is consistent with the constrained action hypothesis (McNevin et al., 2003). The theory proposes that when focus is placed upon internal cues, automatic motor processes that regulate movement are obstructed, thus inhibiting motor performance. Based on the current findings, an external attentional focus appears to be more effective than an internal focus, but more research is required.

When relaxation was utilised as a psyching-up strategy, it was significantly outperformed by the control condition in two of the three trials. Similarly, within the emotive-imagery strategy, a relaxing emotive-imagery condition was also outperformed by the control condition (Murphy et al., 1988). Utilising a relaxation strategy will elicit a parasympathetic state (Chin & Kales, 2019)

which is unlikely to be optimal for enhancing maximal force production. In a parasympathetic state, energy is conserved as heart rate decreases, digestion is prioritised and enzyme and hormone activity regulates blood sugar levels (McCorry, 2007). Conversely, when in a sympathetic state, blood flow towards the working muscles is increased, the uptake of oxygen and the elimination of carbon dioxide is maximised through relaxing the smooth muscles that surround the lungs and greater availability of metabolic energy is provided through increased concentration of glucose and fatty acids in the blood (McCorry, 2007). Thus, being in a sympathetic state is not just optimal for producing maximal force, it is essential. Therefore, future application and research on psyching-up to enhance maximal-force production should consider alternatives to using relaxation strategies.

The use of combined strategies was limited within this review to one article that examined PETTLEP imagery with motivational self-talk (Slimani & Chéour, 2016). The combination of strategies outperformed the control condition in both the half squat and the bench press exercise, whereas PETTLEP imagery with no self-talk did not elicit a significant difference from the control condition. Despite this providing a valuable premise on which to build future research, as the article did not also examine motivational self-talk in isolation, further exploration is required to provide insight on the efficacy of this strategy combination.

2.4.7: DIRECT COMPARISONS

Direct comparisons between intervention strategies produced limited evidence of an optimal strategy. From the retrieved articles, nine studies containing 29 trials directly compared various interventions including preparatory arousal, self-talk, imagery, attentional focus, relaxation and free-choice psyching-up. Only seven comparisons identified significant differences and there was no consistent trend amongst these. Most comparisons (76%) reported null findings. Due to

limited research comparing strategies, in addition some contradictory findings, there is no compelling evidence within this review for an optimal strategy.

2.4.8: MODERATOR VARIABLES

2.4.8.1: CONTROL CONDITIONS

A greater number of comparisons used an active control condition rather than passive. From the trials that utilised active control conditions, 68% of the interventions had positive effects, compared to 58% that used a passive condition (Table 2.3). An active control condition may prevent participants from unintentionally using a cognitive strategy, although providing a risk of inhibiting performance through directing cognitive attention away from the task (Hammoudi-Nassib et al., 2017). Specifically, during active control conditions, participants were asked to complete mental arithmetic (e.g., Brody et al., 2000; Elko & Ostrow, 1992; Gould et al., 1980) and reading tasks (e.g., Brody et al., 2000; Perkins et al., 2001; Wilkes & Summers, 1984), thereby increasing cognitive load on the participants. This increase in cognitive load prior to tasks can decrease strength performance (Graham & Bray, 2015) and increase the risk of injury (McCarren et al., 2023). As such, in comparisons involving active control conditions, the effect observed could, in part, be because the control condition hindered performance, as well as the psyching-up strategy enhancing performance.

2.4.8.2: SAMPLE

The efficacy of psyching-up strategies might vary across different cohorts. Although the efficacy of strategies was higher in athletes compared to undergraduates and novice participants, the most consistent positive effect was found within weight-trained individuals. This might be due to athletes and weight-trained individuals having had previous experience of using psyching-up

strategies through leisure or sport but also could reflect familiarity with the tasks and output measures. All six articles that recruited weight-trained individuals reported the participants had vast prior experience with the output, whereas only two (Hammoudi-Nassib et al., 2014; Hammoudi-Nassib et al., 2017) of the seven articles that recruited athletes used an output measure that was specific to their respective sport. Although athletes' previous experience may have some transferability, the nature of the output could influence the effectiveness of the psyching-up strategy. Accordingly, future research should employ experienced participants, utilising variables specific to their chosen population (Tod et al., 2015).

2.4.9: METHODOLOGICAL QUALITY OF INCLUDED STUDIES

Overall, the body of evidence shows a low level of bias (69%). Failing to report pre-planned analysis and a lack of clarity over concealment and randomisation processes contributed to some articles being rated as a moderate risk of bias. Additionally, 19% of articles relied upon a sample size of less than 20 participants, raising potential risks of the statistical power and reproducibility of the results. Further, males accounted for 74% of the participants across the studies and there were no studies that recruited only female participants. Due to this, it is not clear if the efficacy of psyching-up strategies varies across sexes.

2.4.10: FUTURE RESEARCH DIRECTIONS

Intervention scripts within the articles often lacked specificity and could potentially inhibit performance, particularly when attempting to optimise arousal levels. Directions to the participants included being told to “get emotionally charged up”(Gould et al., 1980, p. 331), “get mad, get pumped up, get charged up” (Elko & Ostrow, 1992, p. 36) and “get[ting] as mad and as charged up as you can”(Wilkes & Summers, 1984, p. 353), often on participants with no reported

competitive experience. This highlights the need to investigate the methods currently used by practitioners, in order to enhance the ecological validity of the literature and support the development of more effective interventions. Additionally, due to the definition emphasising that psyching-up must be self-directed, various strategies currently performed by practitioners and athletes to psych-up may not be considered, such as watching videos (Pierce et al., 1993), listening to music (Ballmann et al., 2021), or using ammonia (Richmond et al., 2014). Although such strategies are commonly seen within sports and considered part of the cognitive preparations of competition day (Winwood et al., 2019), they were not considered within the parameters of this review. Accordingly, future research should focus on identifying the strategies that practitioners and athletes currently use and perceive as beneficial to help bridge the gap between research and practice.

Analysis on strategies such as self-selected arousal cues and attentional focus have received a limited amount of research. Self-selected arousal cues have shown positive effects in participants with higher levels of competitive experience (Whelan et al., 1990), whilst attentional focus was the preferred strategy of competitive weightlifters (Shelton & Mahoney, 1978). Accordingly, research should place greater emphasis on investigating the efficacy of these strategies. In doing so, authors should evaluate the strategies used in practice, allowing practitioners to make more informed decisions regarding optimal strategies and how they are implemented. Additionally, this review found only one article that investigated the effects of combining strategies (Slimani & Chéour, 2016). Although the present review has highlighted limitations within the methodology, the premise of strategy combination is one that should be further explored.

Analysis of the samples in the retrieved articles highlighted various potential nuances in the efficacy of the strategies. Despite the appealing nature of recruiting undergraduate students for

accessibility, the current findings demonstrate disparity in the efficacy of the strategies compared to athletes and in particular weight-trained individuals. As previously stated, we theorise the higher efficacy in weight-trained individuals might be due to prior experience with the output measure and the interventions. Further, although 56% of the articles sampled only males, there was no article with a specific focus on females and no studies compared the efficacy of the intervention between the two sexes. Therefore, future research should focus on recruiting participants, preferably athletes, with equal numbers of males and females and use an output measure specific to their sport. In doing so, analysis should be conducted to highlight any potential variation across males and females, which could provide insight to allow researchers and practitioners to prescribe the most effective strategy to an individual.

Investigation of the methods and research designs within the articles highlighted that there were more positive effects in studies that used an active control condition (68%) compared to a passive control condition (58%). Future research should utilise passive control conditions, or a combination of active and passive control conditions, to prevent false positive effects being reported due to any potentially adverse influence of active control conditions. Additionally, despite 93 comparisons between intervention strategies and control conditions within this review, there was only 29 comparisons between different strategies. Further research that directly compares strategies is important to progress the understanding of psyching-up and identify if there is an optimal strategy.

2.4.11: PRACTICAL IMPLICATIONS

The present findings suggest that psyching-up strategies can have positive effects upon maximal force production. Based upon current results, preparatory arousal, motivational self-talk, PETTLEP imagery, or a free-choice psyching-up strategy should be used immediately prior to

the task to maximise performance. There was also some support for the use of an external attentional focus. Although the present review did not identify one optimal strategy, it has indicated some interventions that should potentially be avoided: Stimulus-only imagery, emotive-imagery, internal attentional focus and relaxation. The number of effects within this review, however, prevents definitive recommendations.

The findings suggest that experienced athletes might benefit from having autonomy over the strategy they utilise for psyching-up. However, conversations with coaches should take place to maximise the effectiveness of the strategy. For example, one should consider content and timing, such as using PETTELP rather than stimulus-only imagery and within 2 minutes of performance (Hammoudi-Nassib et al., 2014). Finally, practitioners should ensure that if they are prescribing preparatory arousal strategies to inexperienced athletes, to do so with clear instruction to facilitate athletes achieving an optimal state.

2.4.12: LIMITATIONS

Despite following the PRISMA 2020 guidelines, some limitations should be acknowledged in the current review. First, the categorisation of strategies involved potential crossover between interventions. For example, emotive-imagery could be classified as either preparatory arousal or relaxation. To address this, when categorising interventions and collating sample characteristics, we followed the terminology used by the authors of the primary studies for our classifications. Second, the current review excluded non-English studies, which could have influenced the findings. However, a previous review on plyometric training reported that fewer than 0.5% of studies were published in other languages, suggesting that the impact of this exclusion is likely minimal (Ramirez-Campillo et al., 2018). Third, grey literature was not included in this review so the results may be subject to publication bias, where articles which fail to report significant or

report null findings do not get published. Therefore, there is a possibility that the present article over-represents the value of psyching-up strategies. However, the publication process often ensures ethical and transparent research methodology, giving greater confidence that the included articles within this research have produced valid results. An additional limitation is that the present review relied primarily on the reporting of p-values. As effect sizes were not consistently available across the included studies, this limits the interpretation of the practical magnitude and applied relevance of psyching-up strategies, given that statistical significance may not necessarily reflect meaningful performance improvements. Accordingly, future research should aim to report effect sizes more consistently to allow for clearer interpretation of the practical impact of psychological interventions. Finally, due to the heterogeneity of the methodologies used within the retrieved articles, a meta-analysis could not be performed. Though a meta-analysis would provide more precise findings, a review is inherently limited by the primary studies. Despite this, through our data extraction, we have collated and presented the findings in the most appropriate way for the existing literature on psyching-up strategies.

2.5: CONCLUSIONS

The present review was the first to systematically examine the efficacy of psyching-up strategies on maximal force production while also assessing methodological quality and potential moderating factors. The findings indicate that psyching-up can positively influence maximal force production, with the strongest and most consistent evidence supporting preparatory arousal, motivational self-talk, PETTLEP imagery and free-choice psyching-up strategies. Future work should investigate the approaches currently used by practitioners and athletes, as well as examining athletes in tasks and outcomes that are specific to their sport. For applied practice,

experienced athletes should be given autonomy to select their preferred strategy, while practitioners should provide guidance towards those strategies identified in this review as consistently effective.

Chapter 3: Identifying The Psyching-Up Strategies Used in Strength-Sports: A Concept Mapping Approach

ABSTRACT

It has frequently been reported that strength athletes use psyching-up strategies to enhance performance. Despite numerous investigations into their efficacy, there has not yet been a thorough examination of the specific techniques' athletes use to psych-up. The present study aimed to identify the psyching-up strategies used by strength-sport athletes and to assess their perceived effectiveness for performance. Using a concept mapping approach, 246 strength-sport athletes and coaches took part in an initial statement (technique) generation phase and 112 participants sorted the techniques into clusters (strategies) and rated their effectiveness for enhancing maximal strength performance. In the generation stage, 64 individual psyching-up techniques were identified. Similarity matrix generation, multidimensional scaling and hierarchical cluster analysis were then used to produce visual cluster maps, which identified eight clusters of psyching-up strategies: *pre-performance routines*; *positive thoughts, feelings, images and behaviours*; *goals and performance accomplishments*; *self-deprecation*; *negative thoughts, feelings, images and behaviours*; *stimulation*; *physical and physiological techniques* and *aggressive acts*. Based on their outcomes, the strategies were further classified as "arousal-reducing" (Strategies 1-3) or "arousal-enhancing" (Strategies 4-8). Participants ranked *pre-performance routines* as the most effective strategy, with males reporting significantly higher ratings for *self-deprecation*; *negative thoughts, feelings, images and behaviours*; *stimulation* and *aggressive acts*. The findings demonstrate a wider range of psyching-up techniques than those typically investigated in the literature. Accordingly, we suggest a revised definition of psyching-up strategies in the context of strength-sports: 'strategies intending to alter activation, or to enhance mental preparedness, immediately prior or during skill execution'.

3.1: INTRODUCTION

Competitive strength athletes commonly use psyching-up strategies to enhance performance in training and competitions (Tod et al., 2005). These are defined as “self-directed cognitive strategies that are used immediately before or during the execution of a skill to enhance performance” (Tod et al., 2003, p. 48). Many athletes and coaches believe that psyching-up is pivotal in enhancing strength performance (Shelton & Mahoney, 1978), yet limited research has examined the specific techniques that athletes employ. The systematic review presented in Chapter 2 found that although psyching-up strategies can facilitate strength performance, only a relatively limited number of strategies have been examined (see Section 2.4.10). Without a thorough assessment of the methods used by athletes to psych-up, examinations may be limited by failing to utilise unexplored strategies. Accordingly, the present study used a concept mapping approach to identify and categorise the breadth of strategies utilised by strength coaches and athletes to psych-up and the perceived effectiveness of these strategies.

Interviews with competitive weightlifters revealed that athletes use psyching-up strategies during competition (Mahoney, 1979). Building on these reports, Shelton and Mahoney (1978) conducted the first study to examine the efficacy of psyching-up strategies on maximal strength performance. Specifically, competitive Olympic weightlifters were instructed to psych-up in their own way, prior to performing a hand dynamometer task. Grip strength performance was greater following use of a psyching-up strategy compared to a control condition. Follow-up interviews revealed that the participants implemented one of four strategies: self-talk, attentional focus, preparatory arousal or imagery. Of these strategies, attentional focus was the most used within the cohort.

The systematic review within Chapter 2 found that 82% of the studies primarily focused on the four strategies identified by Shelton and Mahoney (1978) (see Table 2.1). In addition to these strategies, studies have also investigated the effects of relaxation (e.g., Pierce et al., 1993) and free-choice (e.g., McGuigan et al., 2005). Although there is evidence that using psyching-up strategies can enhance strength performance, the findings have been inconsistent. For example, studies have reported positive (Theodorakis et al., 2000; Tod et al., 2005), null (Brody et al., 2000; McGuigan et al., 2005) and even detrimental (Elko & Ostrow, 1992; Murphy et al., 1988) effects of psyching-up strategies on physical performance. As discussed in Section 2.4.10, some potential explanations for this lack of consistency include, but are not limited to: the skill level of the participants, the interventions used and the rigidity of what constitutes a psyching-up strategy based on previous definitions. It was also found that the efficacy of psyching-up strategies had the greatest consistency when an experienced participant was given the autonomy to choose their own strategy (see Table 2.4). Specifically, free-choice psyching-up demonstrated the greatest level of consistency in significantly enhancing maximal force production compared to the other strategies. Notably, 75% of the articles within the systematic review that utilised free-choice interventions sampled experienced participants, suggesting that athlete experience may play an important role in the efficacy of psyching-up. Despite the efficacy of free-choice strategies (e.g., Tod et al., 2005; Weinberg et al., 1980; Weinberg et al., 1985), no article since Shelton and Mahoney (1978) has reported the strategies chosen by the participants in experiments. Additionally, limited attempts have been made to examine the strategies used by athletes in training and competition.

The psyching-up strategies prescribed in some studies have been vague and lacking clear direction. For example, as highlighted in Section 2.4.10, verbal instructions provided to

inexperienced participants have included: “get emotionally charged up” (Gould et al., 1980, p. 331); “get mad, get pumped up, get charged up” (Elko & Ostrow, 1992, p. 36) and “get[ting] as mad and as charged up as you can” (Wilkes & Summers, 1984, p. 353). Although interesting, these examples present three potential flaws within existing research. First, the instructions focus on the outcome rather than the process of achieving the desired state. Second, the participants in those studies had no reported experience in using psyching-up strategies, so it was not clear whether they had the required skills, knowledge, or experience to elicit the desired response. Third, as outlined in Chapter 1, theoretical models of arousal suggest that there is an optimal level of arousal for performance (Martens et al., 1990; Yerkes & Dodson, 1908) and that failing to meet or exceed this level of arousal can negatively impact performance. Therefore, an examination of the strategies used by coaches and athletes can provide important insight into the techniques currently being used to optimise performance, to provide more appropriate intervention scripts for future investigations.

Consistent with the current definition of psyching-up (Tod et al., 2003), empirical studies have typically focused on self-directed interventions. This definition was also used for the inclusion criteria of the systematic review within Chapter 2, resulting in the exclusion of articles examining the effects of external stimuli, such as music (Ballmann et al., 2021), watching videos (Pierce et al., 1993) and inhaling ammonia (Bartolomei et al., 2018). Contrary to this, however, it has been reported that athletes engage in behaviours such as listening to music (Winwood et al., 2019) and inhaling ammonia (Rogers et al., 2023) during competition to psych-up. The exclusion of these strategies illustrates a potential disconnect between the scientific literature and the practice of psyching-up strategies in competitive environments.

The development of empirical research into psyching-up intended to test the effects of the strategies used by athletes (Shelton & Mahoney, 1978). Yet, since the origin of this literature, there have been limited efforts to identify the psyching-up strategies that athletes use. Without first examining the strategies athletes use to psych-up, the efficacy of psyching-up cannot be fully understood. Therefore, using a concept mapping approach (Trochim, 1989), the aim of the present study was to identify the psyching-up strategies used by strength-sport athletes and to examine their perceived impact on performance according to both athletes and coaches in these sports. Additionally, we aimed to investigate demographic differences in the perceived assessments of the strategies. Given the exploratory nature of concept mapping, no specific hypotheses were proposed for the study.

3.2: METHODS

3.2.1: STUDY DESIGN

To investigate the psyching-up strategies used by strength athletes, a mixed-methods participatory concept mapping approach was used (Trochim, 1989). Concept mapping is a structured method that organises and represents ideas from a specific population on a topic of interest (Trochim & Kane, 2005; Trochim, 1989). Concept mapping has been demonstrated to have both good internal representation validity and sorting reliability (Rosas & Kane, 2012) and has been used in a multitude of settings, including healthcare (Hargett et al., 2017), education (Martí-Parreño et al., 2021) and agricultural technology (Moretti et al., 2023). In sport, concept mapping has been used to investigate barriers to implementing sports injury prevention programmes (Donaldson et al., 2018), barriers faced by women within basketball (Marshall et

al., 2022), the educational needs of parenting youth athletes (Gjaka et al., 2021) and factors in the recovery from lower back pain in elite athletes (Trease et al., 2023).

The concept mapping process comprises six stages (Trochim, 1989). First, the preparation stage involves the researcher identifying the focus and participants required for the concept mapping process. Second, the statement generation stage involves the participants providing statements representing the focus of the study (i.e., psyching-up strategies). Third, the structuring stage involves participants sorting and rating the statements from the preceding stage. Fourth, the representing stage involves analysing the data and developing maps. Fifth, the interpretation stage involves interpreting the maps. Finally, the utilising stage requires using the maps for future research and interventions.

3.2.2: PARTICIPANTS

Concept mapping should aim to include a wide variety of relevant people (Trochim, 1989). The inclusion criteria for this study were that the participants were at least 18 years old and to have competed or coached a client to a minimum regional level competition (defined as participation in an event that serves as a qualifier for national competition) within a strength-sport. For the statement generation stage, we recruited 246 (Male = 143; Female = 103; Mean Age = 35.96 years \pm 11.08) participants, comprised of 2 coaches, 201 athletes and 43 identifying as both. The sports of the participants were strong(wo)man ($n = 105$), powerlifting ($n = 117$), Olympic weightlifting ($n = 19$) and “other” ($n = 5$). The highest competitive level of participants was regional ($n = 53$), national ($n = 92$) and international ($n = 101$) level.

For the sorting and rating stage, we recruited 112 (Male = 75; Female = 37 Mean Age = 33.45 years \pm 8.73) participants, comprised of 1 coach, 89 athletes and 22 identifying as both.

Participants were strong(wo)men (n = 68), powerlifters (n = 39) and Olympic weightlifters (n = 5). The highest competitive level of this sample was regional (n = 23), national (n = 48) and international (n = 41) level competitors/coaches.

3.2.3: PROCEDURES

Before data were collected, ethical approval was granted by an institutional review committee (ETH2223-2315). Purposive sampling was used with participants recruited through advertisement on social media pages related to strength-sports and emailing coaches and athletes within strength-sports. The recruitment materials provided brief information about the study and a link to an online survey (Qualtrics, Provo, UT, USA). The online survey was used to ensure a greater reach of participants across geographical locations, to enable them to share their psyching-up techniques anonymously and include participants who may refrain from in-person data collection (Braun et al., 2021). The survey initially presented the information about the study, before obtaining consent to participate. The information sheet included details of an incentive offered to boost recruitment (i.e., participants who completed both phases of the study could choose to be entered into a raffle to win a six-month membership to the MST Systems mobile application). Participants then provided the following demographic information: sex, age, their predominant sport, their role in the sport (coach/athlete/both) and the highest level of competition they had reached as a coach or an athlete. The statement generation process then commenced where the participants were initially presented with a definition of psyching-up: “self-directed cognitive strategies used immediately prior to or during skill execution that are designed to enhance physical performance” (Tod et al., 2003, p. 48). Participants were then asked to list as many psyching-up techniques as possible. Following this, participants were given details of a second stage of data collection and asked to provide an email address should they

wish to participate in the succeeding stage. Data were gathered for phase one over a period of 10 days during October 2023.

After the first phase of data collection was complete, the statements (psyching-up techniques) were analysed by the lead researcher. Specifically, Kane and Trochim (2007) recommended that if the statement generation process receives more than 100 statements, researchers should conduct a preliminary sort/synthesis. The synthesis involved: analysing each technique provided and ensuring they represent a singular technique, that each technique was relevant to the research and removing duplicates or unclear techniques.

Following the synthesis of the psyching-up techniques, emails were sent to all those who initially consented to be contacted for phase two of data collection: the structuring stage. Further, we also sought to recruit participants who did not engage in the first phase through advertising on social media and directly contacting coaches and athletes. Participants completed an online survey (Qualtrics, Provo, UT, USA), which initially provided information about this stage of the research before obtaining consent for participation and gathering demographic information. Participants were then presented with the list of psyching-up techniques that were generated during the statement generation stage. Each participant was asked to sort the techniques into groups. The instructions for this grouping process were to sort the techniques based on what techniques they believed would be used together or produce the same outcome. If participants were not able to put any techniques into a meaningful group, they were asked to place all of these into a miscellaneous group. After grouping the techniques, participants were asked to name each group. Finally, participants were asked to rate how effective they perceived each individual technique to be at enhancing maximal strength, on a 5-point scale ranging from 0 (not at all

effective) to 4 (extremely effective). Data were gathered for phase two over a period of 20 days during December 2023 and January 2024.

3.2.4: STATISTICAL ANALYSES

Consistent with previous concept mapping research (Kane & Trochim, 2007; Rosas & Kane, 2012), we used three analyses on the data generated in phase two: similarity matrix generation, multidimensional scaling analysis and hierarchical cluster analysis, to create the maps. Initially, the data were exported into Microsoft Excel. A sift removed the miscellaneous groups from the data set for each participant and then a binary square similarity matrix was created for each technique. Within a matrix, if a participant had grouped two techniques together a 1 was added and if the techniques were not grouped together a 0 was added. The 64 separate matrices were then compiled to create the final binary square similarity matrix. A greater number of technique combinations indicated a greater number of participants compiling the techniques together.

The overall binary matrix was subsequently exported into SPSS V.28. To visualise the similarities between the techniques, a multidimensional scaling analysis was then implemented locating the techniques onto an x-y spatial 'point map'. A hierarchical cluster analysis was conducted using Ward's algorithm on the dimensions created from the multidimensional scaling. In doing this, the techniques were partitioned into clusters, with clusters representing different groups of techniques that had the greatest similarity scores.

To evaluate the perceived effectiveness of the grouped strategies, mean scores from the Likert scales were calculated. First, the mean scores for each individual technique were calculated and then the mean score for each clustered group was derived. A one-way repeated measures ANOVA was conducted to examine whether perceived effectiveness ratings differed between the eight

psyching-up clusters. In addition, three one-way MANOVAs were conducted to investigate demographic differences in perceived effectiveness as a function of sex, sport and competitive level.

3.3: RESULTS

3.3.1: PARTICIPANTS

Two-hundred and forty-six participants contributed to the statement generation in phase one of data collection and 112 participants engaged in the sorting and rating stage during phase two.

The characteristics of the participants in each phase are summarised in Table 3.1.

Table 3.1
Participant characteristics by phase

Characteristic	Statement Generation	Statement Sorting and Rating
Sex		
Male	143	75
Female	103	37
Age Range		
18-24	29	13
25-34	103	54
35-44	59	31
45+	55	14
Role		
Athlete	201	89
Coach	2	1
Both	43	22
Sport		
Strong(wo)men	105	68
Powerlifters	117	39
Olympic Weightlifters	19	5
Others	5	0
Competitive Level		
Regional	53	23
National	92	48
International	101	41

3.3.2: STATEMENT GENERATION

Nine hundred and one techniques were reported. Due to the high number of psyching-up techniques, an initial synthesis was conducted to remove duplicates and unclear or irrelevant statements (Kane & Trochim, 2007). This resulted in 64 unique techniques that were used in the next phase (Table 3.2). The three most reported techniques were: Listening to music that makes you feel aggressive (n = 109), visualising performing the lift successfully prior to execution (n = 91) and inhaling sniffing salts (n = 71).

3.3.3: STATEMENT SORTING

The participants sorted the 64 techniques into a mean 8.55 groups (SD = 4.18; range 2-18 groups). Each group was then named by the participants.

3.3.4: STATEMENT RATING

Participants rated all 64 techniques on perceived effectiveness (Table 3.2). Overall, the mean score of all the techniques was 1.69 out of 4 (SD = 0.68). The three techniques that were perceived to be most effective were technique 10, '*Visualising performing the lift successfully prior to execution*' (M = 3.08 ± 0.95), technique 8: '*Sticking to your set routine prior to the lift (e.g. the order you put your kit on)*' (M = 2.81 ± 1.18) and technique 4: '*Clearing your mind*' (M = 2.71 ± 1.15). The three techniques that were perceived to be the least effective were: technique 15, '*Thinking about ancestors/religious persons suffering*' (M = 0.38 ± 0.82), technique 35 '*Listening to music that makes you feel sad*' (M = 0.38 ± 0.76) and technique 61: '*Visualising a thrilling experience (e.g. being on a rollercoaster)*' (M = 0.41 ± 0.81).

Table 3.2
Statements by clusters

Cluster Statement	N	Mean Rating 0 - 4 (SD)
Cluster 1: Pre-Performance Routines		2.30 (0.61)
40 Giving yourself a countdown prior to execution (e.g. 3 - 2 - 1 lift it).	1	1.63 (1.24)
42 Hyper-focusing your attention on a certain spot/person/thing in the room.	8	2.05 (1.24)
49* Blocking out the environment (e.g. turning the speakers up, using headphones).	13	2.32 (1.30)
60* Technical verbal instructions, from somebody else (e.g. friend/coach).	3	2.36 (1.13)
63* Wearing the same clothing/footwear which you have associated with successful previous lifts.	1	2.21 (1.40)
51 Thinking about cues outside of the body (e.g. punching the bar away, the floor is lava).	4	1.95 (1.26)
22* Watching videos of yourself doing the event/lift successfully.	5	2.15 (1.27)
8 Sticking to your set routine prior to the lift (e.g. the order you put your kit on).	28	2.81 (1.18)
20 Isolating yourself in the moments prior to execution.	9	2.37 (1.12)
26 Slow deep breaths.	55	2.19 (1.23)
11 Repeating a positive word internally (e.g. repeatedly saying "yes" in your head).	3	2.43 (1.13)
43 Using a small body motion (e.g. head-nod, twitch) prior or during the execution.	3	1.79 (1.38)
25* Thinking about instructional cues inside your body (e.g. engaging a muscle group).	13	2.54 (1.09)
46 Focusing on your mental cue checklist.	13	2.29 (1.08)
4 Clearing your mind.	27	2.71 (1.15)
10 Visualising performing the lift successfully prior to execution.	91	3.08 (0.95)
Cluster 2: Positive thoughts, feelings, images and behaviours		1.45 (0.64)
57* Verbal Encouragement from somebody else (coach/friend, etc.).	5	2.55 (1.15)
62 Presenting yourself in a power stance.	1	1.38 (1.34)
18* Listening to music that makes you feel upbeat/happy.	13	2.02 (1.23)
58* Listening to music that makes you feel chilled/relaxed.	2	1.10 (1.15)
41 Stating a motivational statement prior or during the execution of a lift (e.g. I can do this).	24	1.94 (1.20)
39 Visualising being given divine/superhuman powers prior to execution.	1	0.84 (1.19)
61 Visualising a thrilling experience (e.g. being on a rollercoaster).	1	0.41 (0.81)
54 Saying a self-affirmation (e.g. telling yourself you are the best in the world).	24	1.73 (1.30)
64 Dismissing/downplaying the magnitude of the lift.	1	1.12 (1.11)

27*	Watching videos of other athletes who you draw inspiration/motivation from.	3	1.48 (1.15)
53	Visualising being in front of a crowd (in training).	1	1.41 (1.27)
Cluster 3: Goals and performance accomplishments			1.57 (0.83)
52	Focusing about how much you want to achieve your goals.	9	1.98 (1.20)
56	Thinking about previous successful lifts.	6	2.25 (1.28)
16	Thinking about the work/commitment has gone into training	9	1.51 (1.13)
17	Thinking about your desire to leave a legacy, locally (family, friendship group) or globally (worldwide).	3	1.24 (1.18)
47*	Watching scenes/speeches from films.	4	0.89 (1.12)
31	Reminding yourself of previous challenges that you have overcome.	5	1.79 (1.27)
34	Thinking about how much you love the sport.	1	1.59 (1.36)
23	Thinking of making loved ones proud.	2	1.68 (1.25)
45*	Listening to motivational videos/speakers/podcasts.	4	1.23 (1.18)
Cluster 4: Self-deprecation			0.87 (0.74)
38	Visualising that the equipment is insulting you.	1	0.46 (0.92)
55	Explicitly insulting yourself (e.g. you're a piece of sh*t).	5	0.68 (1.24)
2*	Pre-agreed verbal statement from somebody else, with the goal of evoking anger.	2	1.46 (1.12)
Cluster 5: Negative thoughts, feelings and images and behaviours			0.75 (0.77)
1	Visualising a scenario where the lift can save a loved one from danger.	13	1.48 (1.43)
35*	Listening to music that makes you feel sad.	6	0.38 (0.76)
50	Thinking about 'haters' and proving them wrong.	2	0.91 (1.28)
15	Thinking about ancestors/religious persons suffering.	2	0.38 (0.82)
48	Focusing on the fear or shame of failing.	7	0.63 (1.12)
30	Thinking about negative events currently going on in your life.	7	0.68 (1.17)
33	Thinking about historic negative events that you have experienced.	15	0.83 (1.24)
9*	Listening to music that you associate with grief.	1	0.75 (1.07)
Cluster 6: Stimulation			2.02 (0.80)
32*	Listening to music that makes you feel arrogant/confident.	3	2.12 (1.31)
37*	Creating an atmosphere/crowd to provide loud encouragement while you execute the lift.	14	2.31 (1.32)
21	Internally stating an explicit motivational statement (e.g. saying "let's f**king go" in your head before execution).	3	2.31 (1.27)
28*	Taking stimulants (e.g. caffeine tablets/pre-workouts).	13	2.64 (1.18)
44*	Pinching your earlobes.	4	0.72 (1.07)
Cluster 7: Physical and physiological techniques			1.86 (0.80)
3*	Bouncing/Jumping/Spinning before the lift.	15	1.80 (1.04)

7*	Pacing.	10	2.06 (1.21)
5	Fast, short breaths.	36	2.03 (1.23)
19*	Clamping down on a mouthpiece.	3	1.54 (1.26)
Cluster 8: Aggressive Acts			1.90 (0.92)
12*	Inhaling Sniffing salts.	71	2.29 (1.29)
14	Screaming/yelling an explicit motivational statement out loud (e.g. screaming “let’s f**king go” out loud before execution).	13	2.04 (1.29)
6	Screaming/Loud Grunting.	37	2.11 (1.26)
13	Screaming/yelling a positive statement out loud (e.g. screaming “yes” out loud before execution).	7	2.06 (1.16)
24*	Listening to music that makes you feel aggressive (e.g. metal, heavy rock etc.).	109	2.55 (1.37)
29*	Being slapped (by yourself, or a training partner/coach).	56	1.71 (1.36)
59*	Shaking/attacking the bar.	5	1.53 (1.36)
36*	Headbutting something.	13	0.90 (1.15)

N= The number of participants who reported this technique during the statement generation process

**= Techniques that would not meet the previous definitions of psyching-up.*

3.3.5: CONCEPT MAPS

Multidimensional scaling produced a point-cluster map, which visually represents the similarities between the psyching-up techniques based on participants' sorting data (Figure 3.1). The stress value was .09, which reflects a good representation (Kruskal, 1964). Indeed, Kane and Trochim (2007) found that the average stress value in concept mapping research is 0.29. Following the guidance from Kane and Trochim (2007), twelve participants reviewed the dendrogram and considered the mean number of groups generated during the sorting process (8.55) to determine how to partition the clusters. Following this process, an eight-cluster map was chosen. These were labelled through conducting discussions with eight respected strength-sport coaches and five researchers (three sport psychologists and two strength and conditioning researchers) within the author's institution, regarding the techniques comprising each strategy and the labels provided by the participants. The eight clusters were labelled as: Cluster 1: *pre-performance routines*; Cluster 2: *positive thoughts, feelings, images and behaviours*; Cluster 3: *goals and performance accomplishments*; Cluster 4: *self-deprecation*; Cluster 5: *negative thoughts, feelings, images and behaviours*; Cluster 6: *stimulation*; Cluster 7: *physical and physiological techniques*; Cluster 8: *aggressive acts* (Figure 3.2). *Pre-performance routines* had the highest mean effectiveness rating (2.30) of the clusters and *negative thoughts, feelings, images and behaviours* had the lowest mean effectiveness rating (0.75).

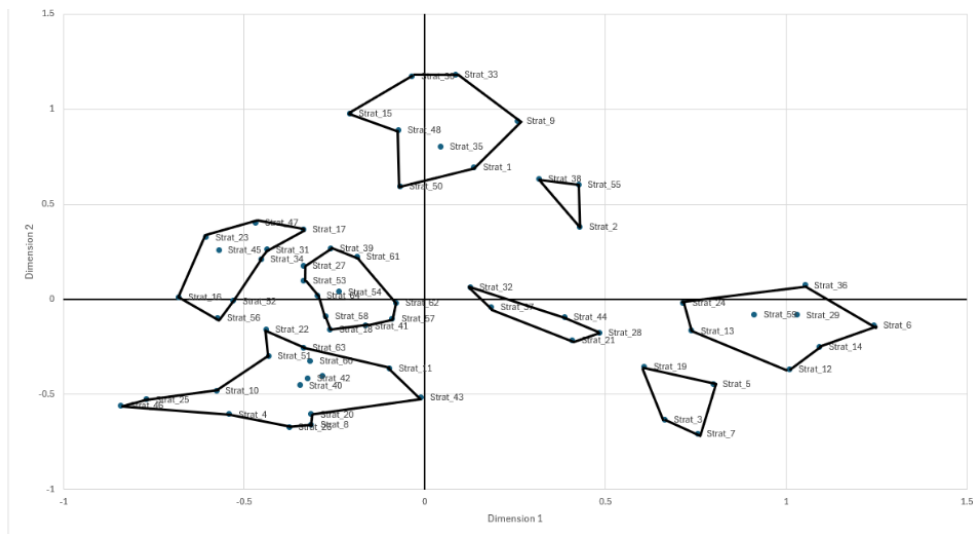


Figure 3.1
Cluster Map of psyching-up strategies with position of each technique

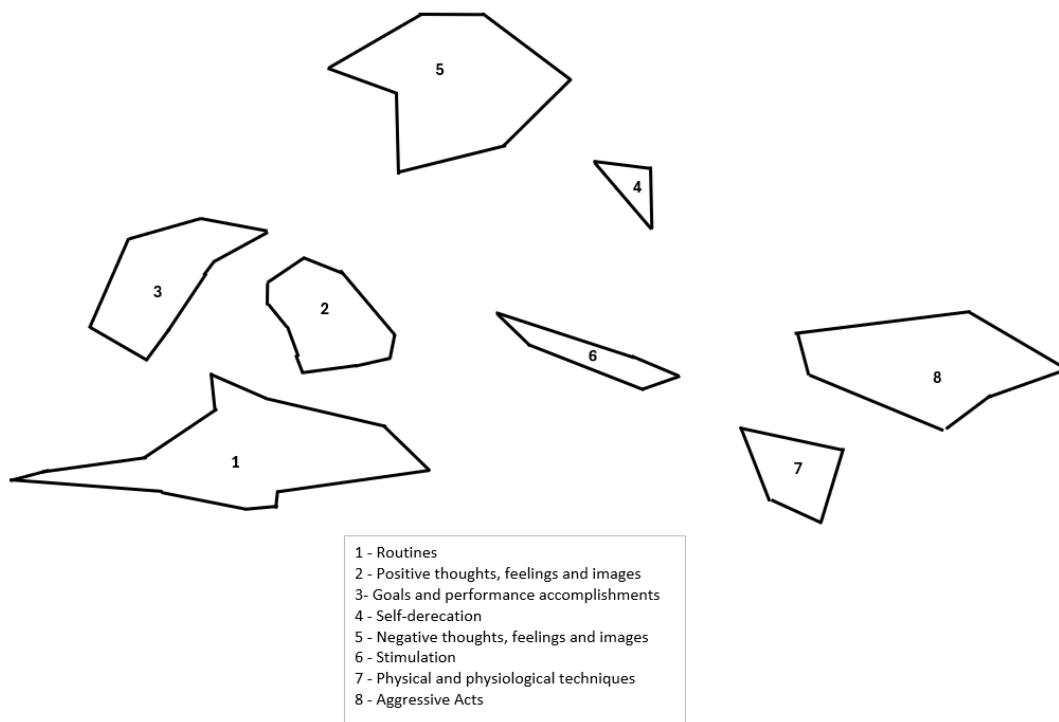


Figure 3.2
Cluster map of psyching-up strategies with cluster labels

3.3.6: SUPPLEMENTARY ANALYSIS

As shown in Table 3.2, *pre-performance routines* had the highest perceived effectiveness rating and *goals and performance accomplishments* were rated lowest. To test whether these differences were statistically significant, a one-way repeated measures ANOVA was conducted. Mauchly's test indicated that the assumption of sphericity was violated, $W = .196$, $\chi^2(27) = 176.99$, $p < .001$; therefore, Greenhouse-Geisser corrected values were used ($\epsilon = .682$). A large statistically significant effect of cluster was found, $F(4.77, 49.46) = 104.60$, $p < .001$, $\eta^2 = .49$. Pairwise comparisons with Bonferroni adjustment indicated that *pre-performance routines* were rated significantly more effective than all other clusters (all $p < .001$) and that *physical and physiological techniques* were rated significantly more effective than *positive thoughts, feelings, images and behaviours* ($p < .001$), *self-deprecation* ($p < .001$), *negative thoughts, feelings, images and behaviours* ($p < .001$), *stimulation* ($p = .002$) and *goals and performance accomplishments* ($p < .001$). No other significant differences were identified.

To consider the effect that sex, sport and competitive level had on perceived effectiveness of the clusters, three one-way multivariate analyses of variance (MANOVA) were conducted. No significant differences in perceived effectiveness were identified between the preferred sports (Wilks' Lambda = 0.89, $F(15, 91) = 1.503$, $p = .166$, $d = .35$) or competitive level (Wilks' Lambda = .845, $F(23, 88) = 1.117$, $p = .341$, $d = .30$). The MANOVA examining the differences in perceived effectiveness as a function of sex found a medium statistically significant difference between males and females, Wilks' Lambda = 0.80, $F(15, 96) = 3.210$, $p = .003$, $d = .50$.

Follow up univariate MANOVA revealed significant differences between males and females on the perceived effectiveness on four clusters. There was a medium effect size for Cluster 4, with males ($M = 1.00 \pm 0.77$) rating *Self-deprecation* as more effective than females ($M = 0.59 \pm$

0.57) $F(1, 100) = 8.508, p = .004, d = .59$. A medium effect for Cluster 5 was revealed, with males ($M = 0.90 \pm 0.80$) rating *Negative thoughts, feelings, images and behaviours* as more effective than females ($M = 0.45 \pm 0.58$) $F(1, 100) = 9.148, p = .003, d = .61$. A medium effect for Cluster 6: was revealed, with males ($M = 2.15 \pm 0.76$) rating *Stimulation* as more effective than females ($M = 1.76 \pm 0.82$) $F(1, 100) = 6.087, p = .015, d = .50$. A large effect for Cluster 8 was revealed, with males ($M = 2.14 \pm 0.84$) rating *Aggressive Acts* as more effective than females ($M = 1.42 \pm 0.88$) $F(1, 100) = 17.859, p < .001, d = .85$.

3.4: DISCUSSION

The aim of the present study was to identify the psyching-up strategies used by athletes within strength-sports and to assess strength-sport athletes' and coaches' perceptions of the impact that the strategies have on performance. Through utilising a concept mapping approach, the present study identified a number of psyching-up techniques that are currently un-tested within strength-sport research. A total of 64 unique techniques were identified during the initial statement generation process, which were then grouped into eight separate strategies: *pre-performance routines; positive thoughts, feelings, images and behaviours; goals and performance accomplishments; self-deprecation; negative thoughts, feelings, images and behaviours; stimulation; physical and physiological techniques* and *aggressive acts*. Participants perceived that *pre-performance routines* were the most effective strategy for enhancing strength performance, whereas *negative thoughts, feelings, images and behaviours* was perceived to be least effective. Additionally, the present study aimed to investigate if there were any demographic differences in the perceived assessments of the strategies. No significant differences were reported between the preferred sport, or competitive level, however there were differences found between the sexes.

Specifically, males perceived the following strategies as more effective: *self-deprecation; negative thoughts, feelings, images and behaviours; stimulation* and *aggressive acts* than females.

A key finding of the present study was that the various psyching-up techniques used by strength athletes and coaches converged upon eight distinct strategies (clusters). As outlined within Chapter 2 (see Table 2.1), typically, research has focused on just four psyching-up strategies: preparatory arousal, imagery, self-talk and attentional focus. The 64 techniques reported in the statement generation stage of the current study did incorporate the four aforementioned interventions, but the athletes and coaches grouped the techniques into various different strategies (clusters). For example, “explicitly insulting yourself” (Technique: 55) reflects a form of motivational self-talk and was classified as *self-deprecation*, whereas “saying a self-affirmation” (Technique: 54), which also reflects motivational self-talk, was grouped in *positive thoughts, feelings, images and behaviours*. Further, the reported techniques included the use of imagery (Technique: 39; 61; 53; 38; 1), self-talk (Technique: 11; 41; 54; 21; 14; 13) and attentional focus techniques (Technique: 42; 51; 25; 46). Moreover, various techniques (e.g., Technique: 2; 48; 30; 33; 21; 28) appear to have the intention to enhance psycho-physiological arousal. Granted, the aforementioned four strategies are still present within the eight clusters, the current findings may suggest that they are typically recruited concurrently rather than in isolation.

A number of techniques identified in the present research do not meet the current definition of psyching-up (Tod et al., 2003). For example, the most reported psyching-up technique within this study was listening to aggressive music ($n = 109$). Additionally, this technique was perceived as one of the most effective for enhancing strength performance ($M = 2.55$), as were inhaling sniffing salts ($n = 71$; $M = 2.29$), ingesting caffeinated drinks ($n = 13$; $M = 2.64$) and blocking out

the environment with headphones ($n = 13$; $M = 2.32$). Overall, 26 of the 64 techniques identified by participants are not self-directed cognitive strategies. These 26 techniques amassed 391 individual reports from participants, indicating that the existing definition (Tod et al., 2003) may not be an accurate representation of what psyching-up strategies entail to athletes and coaches. These findings highlight that psyching-up extends beyond the narrow cognitive-based definition adopted in Chapter 2, supporting the need for a broader working definition that reflects applied practice. Consequently, we propose that psyching-up strategies in strength-sports should be defined as: *'strategies intending to alter activation, or to enhance mental preparedness, immediately prior or during skill execution'*.

Participants perceived that the most effective strategy for enhancing strength performance was *pre-performance routines*. Similarly, a recent meta-analysis covering 15 sports found that pre-performance routines are effective for enhancing performance (Rupprecht et al., 2021). A pre-performance routine is characterised as a sequence of task-relevant thoughts and actions that an athlete engages in systematically prior to the execution of their task (Moran, 1996). Through the incorporation of pre-performance routines, athletes can elicit an optimal emotional, high self-expectant, confident and focused state immediately prior to and during execution (Singer, 2002). The *pre-performance routines* cluster comprised techniques with ritualistic properties, such as giving oneself a countdown prior to execution (Technique: 40), wearing the same clothing/footwear which one has associated with previous successful performance (Technique: 63), sticking to one's set routine (Technique: 8) and using a small body motion prior to or during execution (Technique: 43). Various techniques (e.g., Technique: 4; 10; 26) within this cluster mirror elements of pre-performance routines utilised in other sports such as golf (Swann et al., 2015), artistic gymnastics (Clowes & Knowles, 2013) and cricket (Miles et al., 2016). Given the

high regard the participants placed on this strategy, in addition to the positive findings in other sports, we would advise that strength athletes should develop a routine to perform before skill execution.

There were demographic differences in the perceived effectiveness of four strategies. Compared to females, males perceived the following strategies as more effective: *self-deprecation; negative thoughts, feelings, images and behaviours; stimulation* and *aggressive acts*. Examination of the techniques contained within these strategies suggest that the aim is to increase psycho-physiological arousal through using adverse emotions, stimulation and aggression. An explanation for some of these sex differences in perceived effectiveness may be linked with anxiety and telic and paratelic states. During elevated states of arousal, an individual will perceive this psycho-physiological response as exciting or exhilarating whilst in a paratelic state and anxiety whilst in a telic state (Hudson et al., 2016). It has previously been proposed that telic-dominant individuals' preference for low arousal states (Kerr et al., 2006), may be due to possessing greater sensitivities to their biological anxiety systems (Howard, 1986). Indeed, previous research has indicated that greater levels of sensitivity to anxiety has a negative effect on performance in strength athletes (Cusimano et al., 2024), with females consistently being reported as presenting greater levels of sensitivity than males (e.g., Eriksson et al., 2023; Gray et al., 2016). Additionally, a recent meta-analysis has also reported that female athletes experience greater levels of anxiety than males (Rice et al., 2019). In the context of psyching-up, therefore, individuals who are telic dominant may perceive strategies that increase psycho-physiological arousal as anxiety inducing, resulting in poorer performance.

Another explanation for these sex differences may arise from individual differences in biological reward systems (Gray, 1990), with males typically reporting as having greater levels of reward

sensitivity (Gray et al., 2016; Vermeersch et al., 2009). Individuals participating in high-risk sports typically report greater levels of reward sensitivity (Maher et al., 2015; Thomson & Carlson, 2014). This may be explained by findings that when an individual faces a situation perceived as both threatening and exhilarating, those with greater reward sensitivity interpret the stimulus as appetitive rather than anxiety-inducing (Berkman et al., 2009). Accordingly, when approaching a heavy lift or competition, athletes with higher reward sensitivity are likely to perceive this state as pleasant and facilitative, thus strategies that increase psychophysiological arousal can facilitate their performance, as outlined in the IZOF model (Hanin, 2000).

The largest difference in perceived effectiveness between males and females identified in this study was for *Aggressive Acts*. Beyond the previous explanations, we also propose that this difference in perceived effectiveness may be characterised by individual differences in trait aggression. It is well documented that males present greater direct aggression than females (e.g., Archer & Coyne, 2005; Côté, 2007; Hyde, 2005). Therefore, the large sex differences reported for *Aggressive Acts* may reflect the differences in trait aggression possessed by the participants, as opposed to being specifically related to sex. That is, should a female possess greater aggressive traits, they may obtain performance enhancement from utilising these strategies. The proposal that sex differences in perceived strategy effectiveness may reflect underlying individual trait differences is further supported within the sport psychology literature.

Specifically, given the highly individualised and idiographic nature of optimal functioning, assigning strategies based on an athlete's emotional profile has been shown to produce beneficial performance outcomes. For example, this approach has been associated with reduced avoidance tendencies and increased optimal pleasant emotions in student team sport athletes (Robazza &

Bortoli, 2005), as well as improved emotional regulation into optimal performance zones in gymnasts and hockey players (Robazza et al., 2004).

Building on these findings, the eight identified strategies can also be distinguished according to their intended psycho-physiological outcomes. Examination of the techniques comprising each strategy (see Table 3.2) suggests a higher-order categorisation of psyching-up strategies into two sub-groups: “arousal-enhancing” (*self-deprecation; negative thoughts, feelings, images and behaviours; stimulation; physical and physiological techniques and aggressive acts*) and “arousal-reducing” (*pre-performance routines; positive thoughts, feelings, images and behaviours and goals and performance accomplishments*). Importantly, these classifications reflect dominant functional tendencies, consistent with established sport psychology literature, rather than fixed or universal effects. Just as was the case for the initial eight clusters, the higher-order classification was derived from the hierarchical cluster analysis, specifically the first partition of the dendrogram. The labelling of these clusters as “arousal-enhancing” or “arousal-reducing” was therefore based on the interpreted functional characteristics of the techniques within each group. However, the regulatory direction of individual techniques may vary depending on athlete interpretation, intent and situational context. This separation aligns with the structure of the dendrogram, in which the first partition of the hierarchical cluster analysis separated Clusters 1-3 from Clusters 4-8 (Figure 3.3). As highlighted in the preceding section, the sex differences observed in perceived effectiveness align with this categorisation, as it reflects theoretical accounts of how elevated arousal can be appraised differently. The exception to this pattern was the *physical and physiological techniques* strategy, which did not differ between sexes. A likely explanation is that the techniques within this cluster act directly on the body to elevate state arousal (e.g., Technique 5: fast short breaths (Van de Borne et al., 2000);

Technique 7: pacing (Zouhal et al., 2008); Technique 3: bouncing or jumping (Brown et al., 2010)). Rather than relying on negative emotional states such as anger, shame, or sadness to induce arousal, as appears to be the case with other strategies in this group, these strategies act directly on the body, with the heightened physiological activation subsequently being registered as arousal (Critchley & Garfinkel, 2017). Conversely, the strategies categorised as “arousal-reducing” align with established approaches in the sport psychology literature that are specifically designed to manage anxiety and regulate arousal (e.g., Technique 26: slow deep breaths (Merlin et al., 2024); Technique 58: listening to music that you feel chilled/relaxed (Kuan, 2023); Technique 56: Thinking about previous successful lifts (Hanton et al., 2009).

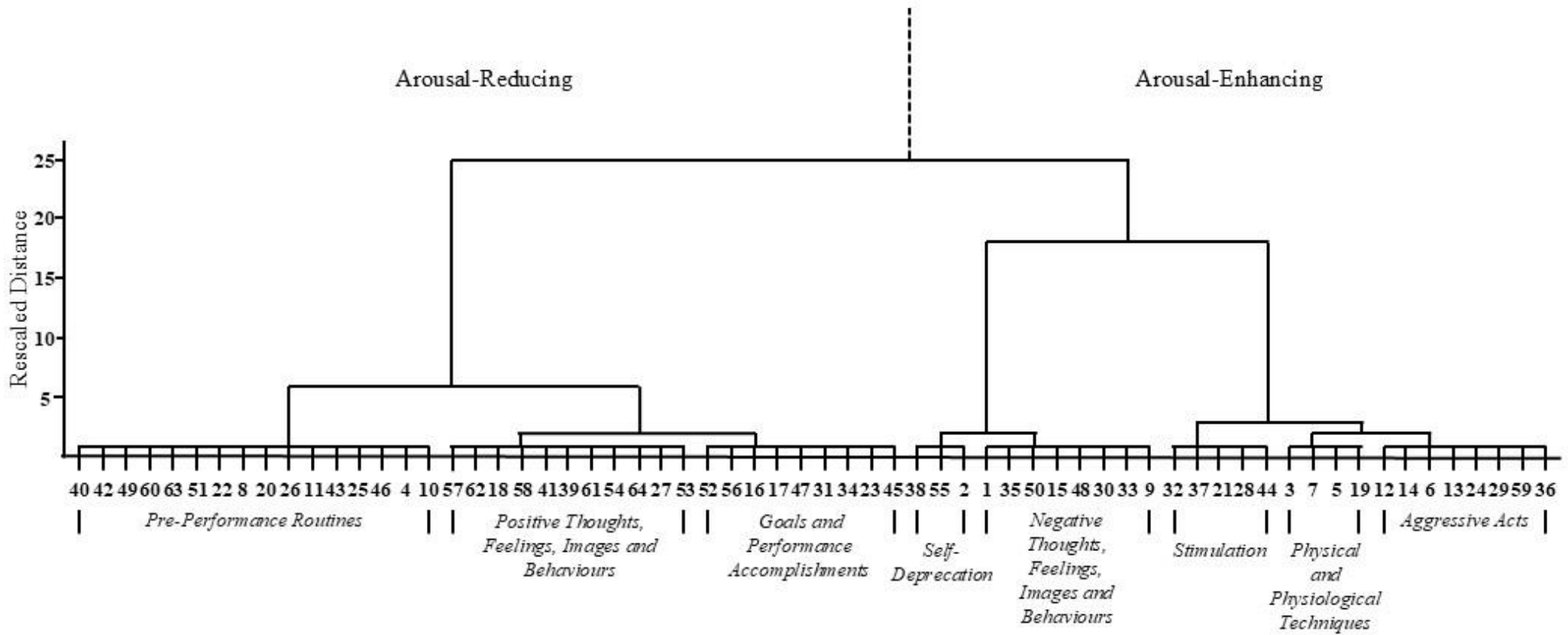


Figure 3.3
Dendrogram illustrating the distinction between “arousal-reducing” and “arousal-enhancing” psyching-up strategies. Strategy classifications are labelled according to their most commonly reported regulatory direction in the literature; however, individual responses may vary.

Note: Numbers along the x-axis correspond to the technique numbers as presented in Table 3.2.

Despite the novel findings, the present study is not without limitations. First, participants rated the perceived effectiveness of each technique on a Likert scale. Although this presents valuable information regarding athletes' perceptions, it does not provide an objective measure of which techniques, if any, exert the greatest benefit for performance. Second, the present study asked the participants to rate every technique, regardless of whether the participant had experienced the technique. Given that there were 64 techniques, it is unlikely that each participant had used each one, thus potentially resulting in an inaccurate assessment of effectiveness. Finally, the present study calculated the perceived effectiveness of each strategy as the mean score of all techniques within a cluster. Consequently, this may not produce the most accurate representation of the participants' perceptions of an overall strategy.

To better understand the use and effectiveness of psyching-up strategies, it is important that future research adopts a range of research designs and contexts. For example, investigating how psyching-up strategies are used in a natural setting (e.g., competition) will provide a greater insight into the methods used to enhance performance and their relative effectiveness. Further, examining the efficacy of strategies in experimental design will provide more control and strengthen causal inferences. Finally, to investigate our propositions regarding anxiety and reward sensitivities and trait aggression, participants should complete personality measures prior to examining the efficacy of psyching-up strategies within a controlled environment to understand if these variables influence the efficacy of psyching-up strategies. Based on the present findings, we suggest athletes adopt a pre-performance routine prior to execution. Pre-performance routines have previously been shown to enhance performance in a wide variety of sports (Rupprecht et al., 2021), in addition to being ranked as the most effective psyching-up strategy within our sample of experienced strength athletes and coaches. Athletes could utilise

one or more of the techniques highlighted by our participants within the *pre-performance routines* cluster. Further, should an athlete wish to increase their psycho-physiological state, techniques identified in the *stimulation, physical and physiological techniques* or *aggressive acts* strategies should be considered, rather than those contained within *self-deprecation* and *negative thoughts, feelings, images and behaviours*.

3.5 CONCLUSIONS

Understanding the methods used by athletes and strength-sport practitioners to psych-up is paramount in examining and developing these strategies. Using a concept mapping approach, the present study identified 64 separate individual techniques that converge into eight psyching-up strategies. Further, we highlight several key points. First, *pre-performance routines* was perceived to be the most effective strategy for enhancing strength performance and *negative thoughts, feelings, images and behaviours* was perceived to be the least effective. Second, a large proportion of the techniques identified within the statement generation stage did not meet the previous definition of psyching-up (Tod et al., 2003). We propose that psyching-up strategies in the context of strength-sports, should now be defined as ‘strategies intending to alter activation, or to enhance mental preparedness, immediately prior or during skill execution’. Finally, the present article found that males typically perceived strategies that increased psycho-physiological arousal as more effective than females. Overall, the study has identified a diverse range of strategies that strength athletes could use to psych-up and provided important insight into their perceived effectiveness on performance.

Chapter 4: Observing The Use of Psyching-Up Strategies Within Strength-Sport Competitions

ABSTRACT

Psyching-up strategies are often recruited within strength-sport competitions. Despite this, limited empirical investigations have explored how they are applied in competition or whether they improve performance in real-world contexts. Building on the eight strategy clusters identified in Chapter 3, this study employed an observational design to examine their prevalence, sex-based differences and effectiveness of psyching-up strategies during strength-sport competitions. Ninety-nine competitive athletes (54 male, 45 female; mean age = 32.10 \pm 7.00) were recruited from two strong(wo)man competitions and one powerlifting meet. Prior to competition, athletes reported their intended psyching-up strategy from the eight clusters. Observations during maximal lift events recorded actual strategy use, which was confirmed through post-competition self-report. Competition performance was compared to projected one-repetition maximums (1RM) estimated using the Lombardi formula, with also athletes providing perceived ratings for strategy effectiveness. Chi-square tests and paired-samples t-tests examined prevalence, sex differences and relationships between perceived and actual effectiveness. *Pre-performance routines* was most frequently selected, $\chi^2(7) = 138.01$, $p < .001$, aligning with athletes' perceptions in Chapter 3. A significant association was found between sex and strategy type, $\chi^2(1, N = 98) = 9.01$, $p = .003$, with 78.60% of those selecting "arousal-enhancing" strategies being male and 54.90% of those selecting "arousal-reducing" strategies being female. Psyching-up was not associated with enhanced performance, as competition performance ($M = 170.01 \text{ kg} \pm 83.49$) was lower than projected 1RM ($M = 175.68 \text{ kg} \pm 88.13$), $t(98) = 5.05$, $p < .001$, 95% CI [3.38, 7.77]. Perceived effectiveness showed a weak relationship with performance outcomes. This study provides the first observational evidence of psyching-up in competition, highlighting strategy prevalence, sex differences and a relationship between perceived and actual effectiveness.

4.1: INTRODUCTION

Psyching-up strategies are a fundamental component of strength athletes' competition preparations (Winwood et al., 2019). Reports of athletes using these psychological techniques to enhance performance in strength-based sports began to emerge in the 1970s (Genov, 1970; Mahoney, 1979). Early research led to psyching-up strategies being classified into four categories: preparatory arousal, imagery, attentional focus and self-talk (Shelton & Mahoney, 1978). Subsequently within Chapter 2 these strategies were greatly investigated in isolation, highlighting disconnect between research and applied practice (see Section 2.4.10). Leading on from this, a cluster mapping methodology was adopted in Chapter 3, recruiting high-level strength athletes. This approach identified a broader range of psyching-up techniques leading to the development of eight distinct strategies (see Section 3.3.5). These strategies were subsequently categorised according to their intended function: either to reduce and maintain arousal or to enhance it (see Section 3.4).

Of the eight strategies identified within Chapter 3, three of these strategies were classified as aiming to reduce or regulate state arousal (Figure 3.3). Specifically, these strategies were identified as *pre-performance routines; positive thoughts, feelings, images and behaviours* and *goals and performance accomplishments*. In contrast, the remaining five strategies: *self-deprecation; negative thoughts, feelings, images and behaviours; stimulation; physical and physiological techniques* and *aggressive acts*, were categorised as intending to enhance arousal levels. Although the four original strategies proposed by Shelton and Mahoney (1978) continue to hold relevance as foundational elements within contemporary psyching-up approaches, they are generally embedded across the eight clusters (see Table 3.2). Accordingly, within Chapter 3 (see Section 3.4) we suggested that athletes might apply them in combination rather than in isolation. Considering this broader and more integrated

perspective, the definition of psyching-up was refined to reflect its practical use in performance settings: "strategies intending to alter activation or to enhance mental preparedness, immediately prior to or during skill execution."

Within the eight strategies identified in Chapter 3, a number of psychological skills commonly cited within the sport psychology literature are present across multiple strategies and arousal classifications. As discussed in Section 3.4, psychological skills such as imagery and self-talk appear within several classifications (see Table 3.2). Specifically, imagery is present within the "arousal-reducing" strategies *pre-performance routines* (Technique: 10) and *positive thoughts, feelings, images and behaviours* (Technique: 39, 53, 61), as well as within the "arousal-enhancing" strategies *self-deprecation* (Technique: 38) and *negative thoughts, feelings, images and behaviours* (Technique: 1). Similarly, self-talk techniques are identified within the "arousal-reducing" strategies *pre-performance routines* (Technique: 25) and *positive thoughts, feelings, images and behaviours* (Technique: 41, 54), while also appearing within the "arousal-enhancing" strategies *self-deprecation* (Technique: 55), *stimulation* (Technique: 21) and *aggressive acts* (Technique: 13). These findings demonstrate that, rather than serving a singular purpose, such psychological skills are multifunctional and may contribute to a range of psycho-physiological outcomes. When embedded within a pre-performance routine, their function may shift from influencing activation to facilitating attentional control and emotional stability. As such, the regulatory outcome of a given psychological technique is likely to depend more on the athlete's intent than on the technique itself. Accordingly, the arousal classifications derived from the dendrogram in Chapter 3 (see Figure 3.3) were based on the interpreted intent of each strategy, rather than the inherent properties of the techniques in isolation.

In Chapter 3, it was identified that *pre-performance routines* are perceived by athletes as the most effective strategy, which may help explain their potential prominence in competitive

settings. This strategy was comprised of techniques such as Technique 40: “giving yourself a countdown before execution”, Technique 8: “sticking to your set routine before the lift” and Technique 26: “slow deep breaths” (see Table 3.2). These approaches are consistent with established elements of pre-performance routines (Moran, 2016), which have shown to enhance sporting performance and to be effective in decreasing somatic anxiety (Hazell et al., 2014). Although such findings provide a valuable foundation for understanding the potential effectiveness of pre-performance routines, a clearer understanding of how these strategies are applied in real-world settings requires an investigation into their actual prevalence during competition. Winwood et al. (2019) offered relevant insight, reporting that over 60% of strength athletes in their sample used attentional focus, goal setting, mental imagery and preparatory arousal techniques prior to competitive events. However, given the more recent identification of eight distinct psyching-up strategies, further clarification is needed to determine which of these are most frequently employed by experienced strength athletes. Establishing the prevalence of these strategies will provide critical insight into their perceived utility and may help guide both future research and applied sport psychology practice.

To better interpret the use and selection of psyching-up strategies in competition, it is important to consider how athletes respond to and regulate arousal. Strategies designed to reduce arousal may work either by lowering current arousal levels or by preventing them from increasing further. These approaches are particularly relevant in the context of strength-sports, where signals of elevated physiological arousal, such as increased heart rate (Movahedi et al., 2007), gastrointestinal sensations (Kaplánová, 2021) and excessive perspiration (Ellaway et al., 2010), can often be interpreted as anxiety (Patel et al., 2010). Reversal theory offers a useful framework for understanding this interpretation, as it proposes that identical physiological states can be experienced as either facilitative or debilitating depending on the athlete’s appraisal of how those states will affect their performance

(Hudson et al., 2016). Furthermore, the IZOF model suggests that optimal arousal levels vary between individuals, with some athletes requiring heightened arousal for peak performance, while others perform best under calmer conditions (Hanin, 2000). Previous findings reflect this variability. Winwood et al. (2019) reported that 56% of strong(wo)man competitors aim to increase state arousal before competition events, while a further 36% aim to maintain it. Their study did not examine whether such preferences were influenced by the athlete's sex, yet our findings from Chapter 3 suggest this may be an important factor, as four of the five strategies intended to elevate arousal were rated significantly lower by female athletes compared to males (see Section 3.3.6). Interestingly, no significant differences in perceived effectiveness were found between powerlifters and strong(wo)man competitors, implying that sex, rather than sport-specific demands, underlie these differences. By observing the strategy selection of high-level competitive athletes, we can begin to understand whether these perceived sex-based differences are reflected in the actual choices made in competitive settings.

Empirical evidence suggests that psyching-up strategies can enhance strength performance. Specifically, within Chapter 2 it was revealed that performance improvements have been associated with strategies intended to increase arousal, including self-talk, PETTLEP imagery and an external focus of attention (see Section 2.3). It was further reported that the current literature indicates that approximately 65% of psyching-up trials result in improved performance compared to control conditions, with free-choice strategies emerging as the most effective (Table 2.3). However, much of the existing literature has typically recruited undergraduate students, or individuals' that engage with resistance training recreationally, with a notable absence of specialised strength athletes, which limits the generalisability of these results (see Section 2.4.8.2). To date, only one study has investigated free-choice psyching-up strategies within a strength-sport population, sampling Olympic weightlifters to

perform hand dynamometer tasks (Shelton & Mahoney, 1978). Considering the recent identification of eight distinct psyching-up strategies, it is increasingly important to understand how these approaches influence performance. Furthermore, no research to date has employed an observational design to examine their effectiveness within the context of competition. To address these gaps, the present study investigates whether the psyching-up strategies identified within Chapter 3 enhance performance in real-world competitive settings.

Much of the early research on psyching-up strategies was prompted by strength athletes' belief that such strategies enhance performance. For example Mahoney (1979), documented athletes' use of psyching-up techniques, which laid the groundwork for subsequent experimental trials testing their actual effects on performance (e.g., McGuigan et al., 2005; Tod et al., 2005). To follow this, within Chapter 3, an evaluation of strategy effectiveness has also been shaped by these same subjective reports. However, it is well established that athletes can be susceptible to placebo effects. Within controlled research settings, placebos have consistently demonstrated performance-enhancing effects in sport (Hurst et al., 2020). Beyond the laboratory, high-profile cases such as the use of holographic wristbands (Brice et al., 2011) and nasal dilator strips (Dinardi et al., 2021) highlight how elite athletes may adopt performance aids based on belief, despite limited or no empirical support. Although previous studies have reported benefits associated with psyching-up, as outlined in Chapter 2, the evidence is far from conclusive, with approximately 35 percent of trials reporting either no effect or a detrimental effect on performance (see Section 2.3.4.1). Therefore, it is important to examine whether these perceptions align with actual performance outcomes. Doing so may provide critical insight into the validity of athletes' beliefs and the extent to which perceived benefits reflect genuine performance enhancement or whether they are shaped by placebo effects.

The present study had four primary aims. First, it sought to investigate the prevalence of psyching-up strategies employed by strength-sport athletes during competition. Second, it aimed to explore the classification-level use of these strategies, with particular attention to whether athletes tended to favour “arousal-enhancing” or “arousal-reducing” approaches and whether such preferences varied across sex. Third, the study examined whether the application of psyching-up strategies enhanced performance in competitive settings. Finally, it assessed whether athletes’ perceptions of strategy effectiveness were related to their actual performance outcomes.

On the basis of these aims, four hypotheses were formulated. It was hypothesised that *pre-performance routines* would emerge as the most frequently selected strategy overall (H1). Furthermore, male athletes were expected to be more likely to employ “arousal-enhancing” strategies, whereas female athletes would show a preference for “arousal-reducing” approaches (H2). In addition, the use of psyching-up strategies was predicted to enhance competition performance (H3). Finally, it was hypothesised that there would be a positive relationship between athletes’ perceived strategy effectiveness and their actual performance, measured as a percentage of their projected 1RM (H4).

4.2: METHODS

4.2.1: STUDY DESIGN

To investigate the effectiveness and application of psyching-up strategies during strength competitions, the present study employed an observational design. Observational methods are well established in sport science and psychology for examining behaviours in natural contexts without disrupting performance, with applications ranging from children's attitudes toward disability (Ottononi et al., 2017), the relationship between physical activity and health-related quality of life (Moeijes et al., 2019), psychosocial well-being (Moeijes et al., 2018), athletes' appraisals of pressure in rowing (Cumming et al., 2017) and norm-breaking behaviours in junior tennis (Hanegby & Tenenbaum, 2001). This design ensured ecological validity (Osborne-Crowley, 2020) by documenting psyching-up strategies as they occurred naturally in competition, addressing concerns that experimental interventions may not reflect real-world practice (see Section 2.4.10) and recognising the broader range of strategies recently identified in Chapter 3. The study followed the Guidelines for Reporting Evaluations based on Observational Methodology (GREOM) framework (Portell Vidal et al., 2015), adopting a Nomothetic-Point-Unidimensional-Extensive (Symmetric) design. Specifically, multiple athletes were observed (nomothetic), at single competition events (point), with a focus on one behavioural dimension of psyching-up (unidimensional) and under conditions that ensured comparable observations across participants (extensive/symmetric).

4.2.2: PARTICIPANTS

An a priori power analysis was conducted using G*Power 3.1 to determine the minimum required sample size for the study. The analysis was based on a one-tailed independent-samples t-test, with $\alpha = .05$, power = .80 and a moderate expected effect size of $d = 0.50$. This

indicated that a minimum total sample size of 102 participants was required, with 51 participants per group.

Ninety-nine participants (Male = 54; Female= 45; Mean Age = 32.10 years \pm 7.00) were recruited from three elite strength competitions. More specifically two strong(wo)man competitions (Male = 35; Female = 35; Mean Age = 32.20 years \pm 7.00) and one powerlifting meet (Male = 19; Female = 10; Mean Age = 31.86 years \pm 7.22). The inclusion criteria for this study were that the participants must be over the age of 18 years old, be able to fully consent to the study and be actively competing in one of the observed competitions.

Participant characteristics are summarised in Table 4.1.

Table 4.1.
Participant Demographic Characteristics

Characteristic	Total
Sex	
Male	54
Female	45
Age Group	
18-24	13
25-30	32
31-35	28
36-40	12
41-45	10
46+	4
Sport	
Strongman	70
Powerlifting	29
Competition	
European Pro Show	26
UK Natural Strongman Britain's Strongest	44
A/BPU Powerlifting Qualifier	29

4.2.3: PROCEDURES

Prior to data collection, ethical approval was granted by the University of Essex Ethics Committee 2 (ETH2324-0773). Participants were initially recruited indirectly through competition-related social media platforms, as well as directly via competition organisers who contacted athletes registered for their events. Data collection began two weeks prior to each competition. Athletes completed an online questionnaire hosted on Qualtrics (Provo, UT, USA). The survey began with an informed consent form, followed by questions regarding basic demographic information including age, sex and full name. Participant names were collected solely for identification purposes during the competition and were deleted immediately after data collection was completed. Participants were then asked to indicate which competition they would be attending. Next, they were presented with the eight psyching-up strategy clusters (Figure 4.1), each containing the 64 techniques identified within Chapter 3 and asked to select the strategy that best represented how they intended to psych-up for each maximal lift during competition.

Following this, participants were asked to report the heaviest weight (kg) they had lifted for two to five repetitions in the previous six-weeks in preparation for the competition, specific to the exercise(s) that had a 1RM within their competition. These values were used to calculate an estimated 1RM using the Lombardi (1989) formula. As the number of 1RM events varied across competitions, only those in which the 1RM was scheduled as the opening discipline were included in the analysis to minimise the influence of fatigue. Within the present study, the following lifts were assessed: 1RM deadlift during the Euro Pro Show, 1RM axle clean and press from the UK Natural Strongman British Final and 1RM back squat within the A/BPU Qualifier.

During each competition, the researcher was positioned in the spectator area to avoid influencing athlete behaviour. The researcher used a strategy tracking sheet, which listed each participant's selected psyching-up strategy. Athlete behaviours were observed and compared with their previously disclosed strategies to determine whether their visual behaviours matched the chosen method. The weights lifted were also recorded for later comparison with the projected 1RMs calculated using the Lombardi (1989) formula.

At the conclusion of the competition, consent was re-obtained from participants. Each athlete was shown the strategy they had initially selected, along with the full list of strategies and techniques and asked to indicate whether they had used their original strategy or changed it on the day. Should the participant have reported a change in their psyching-up strategy, these adjustments were manually updated. Following this, participants were asked: "Regardless of your competition performance, how effective did you find the strategy you used in preparing you and enhancing your performance during your 1RM attempt?" Responses were provided on a Likert scale ranging from 0 (Extremely Ineffective) to 4 (Extremely Effective). Once all responses were collected, participants were thanked and debriefed.

From our previous study, 8 different groups of psyching-up strategies were identified. Below is a summary of each group. The processes for each group are listed below:

Which strategy/group of techniques **best** resembles how you intend to psych-up for your 1RM attempt? (please note, you do not have to use all of the techniques listed)

STRATEGY 1: Pre-Performance Routines

- Giving yourself a countdown prior to execution (e.g. 3 - 2 - 1 lift it).
- Hyper-focusing your attention on a certain spot/person/thing in the room.
- Blocking out the environment (e.g. turning the speakers up, using headphones).
- Technical verbal instructions, from somebody else (e.g. friend/coach).
- Wearing the same clothing/footwear which you have associated with successful previous lifts.
- Thinking about cues outside of the body (e.g. punching the bar away, the floor is lava).
- Watching videos of yourself doing the event/lift successfully.
- Sticking to your set routine prior to the lift (e.g. the order you put your kit on).
- Isolating yourself in the moments prior to execution. Slow deep breaths.
- Repeating a positive word internally (e.g. repeatedly saying “yes” in your head).
- Using a small body motion (e.g. head-nod, twitch) prior or during the execution.
- Thinking about instructional cues inside your body (e.g. engaging a muscle group).
- Focussing on your mental cue checklist.
- Clearing your mind.

- Visualising performing the lift successfully prior to execution.

STRATEGY 2: Positive thoughts, feelings, images and behaviours

- Verbal Encouragement from somebody else (coach/friend, etc).
- Presenting yourself in a power stance.
- Listening to music that makes you feel upbeat/happy.
- Listening to music that makes you feel chilled/relaxed.
- Stating a motivational statement prior or during the execution of a lift (e.g. I can do this).
- Visualising being given divine/superhuman powers prior to execution.
- Visualising a thrilling experience (e.g. being on a rollercoaster).
- Saying a self-affirmation (e.g. telling yourself you are the best in the world).
- Dismissing/downplaying the magnitude of the lift.
- Watching videos of other athletes who you draw inspiration/motivation from.

- Visualising being in front of a crowd (in training).

STRATEGY 3: Goals and performance accomplishment

STRATEGY 4: Self-deprecation

- Visualising that the equipment is insulting you.
 - Explicitly insulting yourself (e.g. you’re a piece of sh*t).
 - Pre-agreed verbal statement from somebody else, with the goal of evoking anger.
- #### **STRATEGY 5: Negative thoughts, feelings, images and behaviours**
- Visualising a scenario where the lift can save a loved one from danger.
 - Listening to music that makes you feel sad.
 - Thinking about ‘haters’ and proving them wrong.
 - Thinking about ancestors/religious persons suffering.
 - Focussing on the fear or shame of failing.

- Thinking about negative events currently going on in your life.
- Thinking about historic negative events that you have experienced.
- Listening to music that you associate with grief.

STRATEGY 6: Stimulation

- Listening to music that makes you feel arrogant/confident.
- Creating an atmosphere/crowd to provide loud encouragement while you execute the lift.
- Internally stating an explicit motivational statement (e.g. saying “let’s f**king go” in your head before execution).
- Taking stimulants (e.g. caffeine tablets/pre-workouts).
- Pinching your earlobes.

STRATEGY 7: Physical and physiological techniques

- Bouncing/Jumping/Spinning before the lift.
- Pacing.
- Fast, short breaths.
- Clamping down on a mouth piece.

STRATEGY 8: Aggressive Acts

- Inhaling Sniffing salts.
- Screaming/yelling an explicit motivational statement out loud (e.g. screaming “let’s f**king go” out loud before execution).
- Screaming/Loud Grunting.
- Screaming/yelling a positive statement out loud (e.g. screaming “yes” out loud before execution).

- Focusing about how much you want to achieve your goals.
- Thinking about previous successful lifts.
- Thinking about the work/commitment has gone into training
- Thinking about your desire to leave a legacy, locally (family, friendship group) or globally (worldwide).
- Watching scenes/speeches from films.
- Reminding yourself of previous challenges that you have overcome.
- Thinking about how much you love the sport.
- Thinking of making loved ones proud.
- Listening to motivational videos/speakers/podcasts.
- Listening to music that makes you feel aggressive (e.g. metal, heavy rock etc.).
- Being slapped (by yourself, or a training partner/coach).
- Shaking/attacking the bar. Headbutting something.

Figure 4.1.

List of Psyching-Up Strategies and their associated techniques presented to participants (Adapted from Chapter 3)

4.2.4: STATISTICAL ANALYSIS

To test H1, a series of chi-square goodness-of-fit analyses was conducted using SPSS (Version 28). A chi-square test was selected because the analyses were exploratory, aiming to identify whether strategy selections occurred in unequal proportions rather than testing a specific predicted pattern. An initial analysis was conducted to investigate whether the frequency of psyching-up strategy use differed significantly from a uniform distribution. For this purpose, null frequencies were calculated based on equal probability across categories, providing the reference values against which the observed data were compared. Strategies were then grouped into two broader categories: “arousal-reducing” (*pre-performance routines; positive thoughts, feelings, images and behaviours and goals and performance accomplishments*) and “arousal-enhancing” (*self-deprecation; negative thoughts, feelings images and behaviours; stimulation; physical and physiological techniques and aggressive acts*). A subsequent chi-square goodness-of-fit test was conducted to examine differences in the overall use of “arousal-reducing” versus “arousal-enhancing” strategies.

To test H2, chi-square tests of independence were performed using IBM SPSS Statistics (Version 28). A chi-squared test was utilised due to the exploratory nature of the research, to

investigate whether the strategy selections were selected unequally. These analyses examined whether the distribution of strategy classification differed as a function of sex. Assumptions for the chi-square test of independence were met, with all expected cell frequencies exceeding the minimum threshold of five and no violations reported.

To test H3, a paired samples t-test was conducted using SPSS (Version 28). Within this test, the participants projected 1RM according to the Lombardi (1989) formula was compared to the actual lift performed during competition. The estimated 1RM was calculated in Microsoft Excel, with actual competition lifts manually recorded by the researcher. Assumption checks confirmed normality of the difference scores (Shapiro-Wilk $p = .303$), with no extreme outliers identified. Four mild outliers were detected based on the percentage of projected 1RM lifted; however, these values were considered plausible within the context of inter-individual variability in strength performance and were retained in the analysis.

To test H4, a Spearman's rank-order correlation was conducted to examine the relationship between reported perceived strategy effectiveness and the percentage of projected 1RM lifted in competition. This non-parametric test was selected due to the ordinal nature of the perceived effectiveness variable, which was measured using a Likert scale. The percentage of the projected 1RM lifted was calculated by dividing the competition lift by the projected 1RM and multiplying by 100. A visual inspection of the scatterplot confirmed a monotonic relationship between the two variables and no extreme outliers were identified.

4.3: RESULTS

Table 4.2 summarises the frequency with which each psyching-up strategy was selected, disaggregated by sex and sport, alongside mean ratings of perceived effectiveness and actual competition performance relative to projected 1RM.

4.3.1: STRATEGY PREVALENCE

4.3.1.1: OVERALL STRATEGY PREVALENCE

A chi-square goodness-of-fit test indicated a significant difference in the frequency of psyching-up strategy use, $\chi^2(7) = 138.01, p < .001$, suggesting that strategies were not selected in equal proportions. *Pre-performance routines* were chosen far more frequently than the null frequency of 12.4, with 50 athletes selecting this strategy.

4.3.1.2: AROUSAL CLASSIFICATION COMPARISONS

A chi-square goodness-of-fit test was conducted to compare the observed frequency of “arousal-reducing” ($n = 71$) and “arousal-enhancing” ($n = 28$) psyching-up strategies used in competition. The result was statistically significant, $\chi^2(1) = 18.68, p < .001$, indicating that these two categories were not selected in equal proportions.

4.3.1.3: SEX COMPARISONS

A chi-square test of independence was conducted to examine the association between sex and the selection of “arousal-reducing” or “arousal-enhancing” psyching-up strategies. The association was statistically significant, $\chi^2(1, N = 98) = 9.01, p = .003$, indicating that males and females differed in their choice of strategy type. Of those who selected “arousal-enhancing” strategies, 78.6% were male. Of those who selected “arousal-reducing” strategies, 54.9% were female.

Table 4.2.

A table summarising the frequency of participants selecting each strategy and the mean scores for perceived effectiveness and competition performance.

Strategy	Participant Type	Number of participants (% of population)	Mean Perceived Effectiveness (0 - 4) (SD)	Competition Performance (% of Projected 1RM) (SD)	
Pre-Performance Routines	Sex	Male	20 (37.00)	3.30 (0.66)	97.90 (5.57)
		Female	30 (66.67)	3.17 (0.99)	95.85 (7.32)
	Sport	Strong(wo)man	37 (52.86)	3.22 (0.92)	95.94 (6.99)
		Powerlifting	13 (44.83)	3.23 (0.73)	98.76 (5.46)
		Total	50 (50.51)	3.22 (0.86)	96.67 (6.69)
Positive Thoughts, Feelings, Images and Behaviours	Sex	Male	4 (40.00)	3.50 (1.00)	96.07 (5.09)
		Female	6 (60.00)	3.17 (1.17)	97.19 (8.58)
	Sport	Strong(wo)man	7 (70.00)	3.14 (1.22)	95.27 (5.42)
		Powerlifting	3 (30.00)	3.67 (0.58)	100.18 (10.52)
		Total	10 (10.01)	3.30 (1.06)	96.74 (7.06)
Goals and Performance Accomplishment	Sex	Male	8 (72.73)	3.50 (0.76)	95.96 (4.41)
		Female	3 (27.27)	3.67 (0.58)	101.10 (5.79)
	Sport	Strong(wo)man	9 (81.82)	3.67 (0.71)	97.23 (5.52)
		Powerlifting	2 (18.18)	3.00 (0.00)	97.94 (4.01)
		Total	11 (11.11)	3.55 (0.69)	97.36 (5.11)
Self-Deprecation	Sex	Male	3 (100.00)	2.67 (1.53)	94.86 (1.60)
		Female	0 (0.00)	-	-
	Sport	Strong(wo)man	2 (66.67)	3.50 (0.71)	95.49 (1.67)
		Powerlifting	1 (33.33)	1.00 (0.00)	93.61 (0.00)
		Total	3 (3.03)	2.67 (1.53)	94.86 (1.60)
Negative Thoughts, Feelings, Images and Behaviours	Sex	Male	3 (100.00)	3.33 (0.58)	97.70 (2.06)
		Female	0 (0.00)	-	-
	Sport	Strong(wo)man	1 (66.67)	4.00 (0.00)	96.03 (0.00)
		Powerlifting	2 (33.33)	3.00 (0.00)	98.53 (2.07)
		Total	3 (3.03)	3.33 (0.58)	97.70 (2.06)
Stimulation	Sex	Male	6 (75.00)	3.67 (0.52)	96.86 (8.14)
		Female	2 (25.00)	3.00 (0.00)	97.59 (16.10)
	Sport	Strong(wo)man	5 (62.50)	3.40 (0.55)	96.77 (11.05)
		Powerlifting	3 (37.50)	3.67 (0.58)	97.49 (7.14)
		Total	8 (8.08)	3.50 (0.54)	97.04 (9.19)
Physical and Physiological Techniques	Sex	Male	2 (66.67)	2.50 (0.71)	98.13 (4.42)
		Female	1 (33.33)	4.00 (0.00)	107.31 (0.00)
	Sport	Strong(wo)man	2 (66.67)	3.00 (1.41)	101.16 (8.71)
		Powerlifting	1 (33.33)	3.00 (0.00)	101.25 (0.00)
		Total	3 (3.03)	3.00 (1.00)	101.19 (6.16)
Aggressive Acts	Sex	Male	8 (72.73)	3.38 (0.52)	95.62 (6.00)
		Female	3 (27.27)	3.33 (0.58)	97.38 (3.80)
	Sport	Strong(wo)man	7 (87.50)	3.29 (0.49)	93.45 (4.52)
		Powerlifting	4 (36.36)	3.50 (0.58)	100.75 (3.12)
		Total	11 (11.11)	3.36 (0.51)	96.10 (5.36)
Total	Sex	Male	54 (54.55)	3.33 (0.73)	96.85 (5.28)
		Female	45 (45.45)	3.39 (0.93)	96.81 (7.49)
	Sport	Strong(wo)man	70 (70.71)	3.30 (0.86)	95.99 (6.58)
		Powerlifting	29 (29.29)	3.24 (0.74)	98.89 (5.31)
		Total	99 (100.00)	3.28 (0.82)	96.84 (6.35)

4.3.1.4: SPORT COMPARISONS

A chi-square test of independence was conducted to examine the association between sport type and the selection of “arousal-reducing” and “arousal-enhancing” psyching-up strategies. The result was not statistically significant, $\chi^2(1, N = 98) = 1.88, p = .170$, indicating that strong(woman) and powerlifting athletes did not differ significantly in their choice of strategy type.

4.3.2: STRATEGY EFFECTIVENESS

A paired-samples t-test was conducted to examine whether performance during competition, differed from athletes' projected 1RMs based on recent training history. Results indicated that actual competition performance ($M = 170.01 \text{ kg} \pm 83.49$) was significantly lower than projected 1RM ($M = 175.68 \text{ kg} \pm 88.13$), $t(98) = 5.05, p < .001, 95\% \text{ CI } [3.38, 7.77]$.

4.3.3: RELATIONSHIP BETWEEN PERCEIVED EFFECTIVENESS AND ACTUAL EFFECTIVENESS

A Spearman's rank-order correlation was conducted to assess the relationship between perceived strategy effectiveness and the percentage of projected 1RM lifted in competition. A significant positive correlation was found, $\rho(99) = .370, p < .001$, indicating that greater perceived effectiveness was associated with better relative performance.

4.4: DISCUSSION

This study investigated the use and effectiveness of psyching-up strategies in strength-sport competition. It focused on four areas: the prevalence of each strategy, sex differences in the preference for “arousal-enhancing” or “arousal-reducing” approaches, the extent to which these strategies improve competitive performance and the relationship between perceived effectiveness and actual outcomes. H1 was supported, with *pre-performance routines* being the most frequently selected strategy. Consistent with H2, males typically favoured “arousal-enhancing” strategies, while females preferred “arousal-reducing” approaches. H3 was not supported as athletes lifted significantly less in competition than predicted using the Lombardi (1989) formula. Finally, H4 was supported, with a significant positive relationship observed between perceived strategy effectiveness and actual performance.

A chi-squared goodness-of-fit test indicated that *pre-performance routines* were selected significantly more often than any of the other seven strategies. This strategy was chosen by 50 participants, more than four times the null frequency for each strategy (12.4). As shown in Figure 4.1, the *pre-performance routines* strategy was selected more frequently than all other strategies combined. These findings are broadly consistent with the findings within Chapter 3, which ranked *pre-performance routines* as the most effective strategy. While not as apparent, the following most selected strategies were *goals and performance accomplishments; stimulation and aggressive acts* which were rated highly within Chapter 3 (see Section 3.3.4). In contrast, *self-deprecation and negative thoughts, feelings, images and behaviours* were ranked or utilised lowest in both datasets. The only notable divergence was in the use of *physical and physiological techniques*, which were rated highly by the strength athletes recruited within Chapter 3, but adopted by just three participants in this cohort. Nevertheless, the strong preference for *pre-performance routines* may reflect the benefits

such strategies offer in reducing anxiety (Hazell et al., 2014). They may also provide athletes with structure and a sense of control in high-pressure environments (Hill et al., 2010).

Additionally, *pre-performance routines* have been associated with flow state (Cotterill, 2010), which has been shown to enhance performance while minimising negative self-talk and self-evaluation (Ulrich et al., 2016).

Further analysis examined the selection of “arousal-reducing” and “arousal-enhancing” strategies. A chi-square goodness-of-fit test indicated a clear preference for “arousal-reducing” strategies, largely due to the high number of participants selecting *pre-performance routines*. Follow-up chi-square tests of independence explored whether sex influenced strategy selection. This analysis revealed a significant association, that being that males chose “arousal-enhancing” strategies at a greater rate, whereas females favoured “arousal-reducing” strategies. This supports our previous findings from Chapter 3 that males’ rate “arousal-enhancing” strategies as more effective than females’. We propose that the competitive environment contributed to elevated physiological arousal, with many participants aiming for qualification, podium finishes, or record-breaking lifts. Competing in such settings naturally increases arousal (Cintineo & Arent, 2019) and under pressure this may be appraised as threatening (Henderson et al., 2024), increasing the risk of somatic anxiety (Seery, 2011), which can impair performance (Parnabas et al., 2015). Given that women typically show greater anxiety sensitivity than men (Panno et al., 2018), their preference for “arousal-reducing” strategies may reflect attempts to regulate arousal-related performance decrements. In contrast, men tend to display greater reward sensitivity (Gray et al., 2016) and may perceive high-arousal, high-pressure situations as energising (Breivik et al., 1998). We suggest these psychological differences underpin the sex-based patterns observed in strategy selection.

Performance during competition utilising psyching-up strategies was significantly lower than predicted by the 1RM formula. Although this appears to contradict athlete perceptions (Mahoney, 1979; McGuigan et al., 2005) and previous findings suggesting psyching-up improves performance (see Section 2.3.4), contextual factors likely explain this result. All three competitions used weight classes and most athletes underwent extreme weight cuts to qualify for their category. Common weight-cutting methods include dehydration (Wilson et al., 2014), use of diuretics (Kinningham & Gorenflo, 2001) and heated training rooms (Artioli et al., 2010). These practices are frequently reported in various disciplines such as combat sports (Alderman et al., 2004), rowing (Slater et al., 2014) and horse racing (Moore et al., 2002), but are also commonplace within strength-sports (Nolan et al., 2022). These practices pose health risks (Lakicevic et al., 2021) and can impair performance (Franchini et al., 2012). Within the present study, one participant had used a sweat-enhancing gel to reduce bodyweight, which led to severe cramps, convulsions and vomiting after weigh-in. Such cases suggest that the observed reduction in performance may be a consequence of the physiological strain caused by these weight-loss methods, rather than a reflection of the psyching-up strategies themselves. Additional competition factors, such as inconsistent rest periods, stricter judging and limited warm-up opportunities, may also have contributed. Further, given that athletes often use psyching-up techniques in both training and competition (Tod et al., 2003), the present findings may rather reflect the demands of the competitive setting more than the strategy effectiveness.

To build on the findings from Chapter 3, which assessed psyching-up strategy effectiveness based on athlete perception, we examined whether perceived effectiveness was associated with actual performance in competition. Specifically, the analysis explored whether a relationship existed between athletes' self-reported effectiveness ratings and the percentage of their projected one-repetition maximum achieved during competition. The results indicated a

positive association, with higher perceived effectiveness corresponding to stronger performance outcomes. Given that current evaluations of psyching-up strategies from Chapter 3 relied on self-report, it was important to assess whether these perceptions align with objective measures of effectiveness. While this analysis does not establish a causal relationship, the observed correlation suggests that athletes' perceptions may, to some extent, reflect performance-relevant processes.

This study represents the first observational investigation into the use of psyching-up strategies within strength-sports. By recruiting experienced and actively competing athletes, we gained rare insight into how these psychological strategies are employed in authentic, high-pressure environments. Unlike laboratory-based research, this approach allowed for the capture of data in real-world competitive settings, enhancing the ecological validity of the findings. In particular, the study contributes to our understanding of how psyching-up strategies are naturally selected and implemented by athletes without experimental interference. This offers valuable contextual information that complements and extends our findings from Chapter 3, which relied primarily on general perceptions of strategy effectiveness. Our data not only reinforced the trend that *pre-performance routines* are the most frequently used strategies but also highlighted meaningful sex-based differences in the use of “arousal-enhancing” and “arousal-reducing” strategies. These findings add nuance to the current literature and provide an empirical foundation for future work aiming to tailor psyching-up interventions to individual athlete profiles in competitive strength-sports.

Despite the novel contributions of this study, several limitations must be acknowledged. First, although the findings may suggest that psyching-up strategies were ineffective in enhancing performance, it is more likely that the discrepancy between projected and actual 1RM was influenced by external competition-related factors. These include common practices such as weight cutting, as well as situational elements such as stricter judging and restricted warm-up

access, which may have impaired performance regardless of the psychological strategy used. Additionally, projected 1RM values were based on training lifts, but no data were collected on whether or how psyching-up strategies were used during those sessions. This omission limits the ability to determine whether competition strategies represented a departure from, or continuation of, typical preparation routines and reduces the clarity of the performance comparison. As such, the analysis may not fully reflect a true baseline, which constrains the strength of conclusions about strategy effectiveness. Future research should adopt experimental designs that systematically manipulate psyching-up strategies and include non-intervention control conditions to allow for more rigorous evaluation. Furthermore, while a moderate correlation was observed between perceived strategy effectiveness and actual performance, it is likely that participants' knowledge of their performance influenced their ratings. Despite being instructed to evaluate the strategy itself, outcome awareness may have shaped their perceptions. To more accurately assess the reliability of perceived effectiveness, future studies could employ a blinded design, using methods such as isometric strength tests where performance feedback is withheld. This would allow researchers to better isolate the effects of psyching-up strategies on both subjective experience and objective performance.

The present findings may offer invaluable insight into the practical applicability for strength-sports. Most notably, the results provide real-world evidence that *pre-performance routines* are not only perceived as highly effective but are also the most frequently selected strategy by athletes in competition. This strengthens the applied relevance of our prior concept mapping work within Chapter 3, suggesting that athletes' subjective evaluations of strategy effectiveness meaningfully reflect their actual practice. The positive correlation between perceived effectiveness and competitive performance further supports the validity of athlete self-report as a basis for strategy selection. Strength-sport practitioners should therefore feel more confident incorporating athlete preferences into psychological preparation, particularly

when designing psyching-up interventions tailored to individual needs. The clear sex-based differences observed in the selection of arousal classification strategies also have practical relevance. Athletes and coaches within strength-sports intending to enhance performance using psyching-up may consider assessing personality traits and anxiety sensitivity to help athletes identify which strategies are most compatible with their arousal profiles. Together, these findings support a more athlete-centred and evidence-informed approach to psyching-up in competitive strength settings.

4.5: CONCLUSIONS

The present study aimed to investigate the prevalence of psyching-up strategy selection within competitions and whether this was influenced by sex. Additionally, it also intended to explore the effectiveness of psyching-up within a strength-sport competition and whether there was a relationship between athletes' perception of psyching-up effectiveness and performance outcomes. The findings revealed that *pre-performance routines* were selected more often than any other strategy, highlighting their perceived value among high-level athletes. Analyses also revealed that males were more likely to adopt "arousal-enhancing" strategies, whereas females typically preferred "arousal-reducing" approaches. Additionally, the present findings also suggested that psyching-up may not enhance performance during competition, although this may be due more to the demands of the competitive environment than to the ineffectiveness of the strategies themselves. Finally, a weak positive correlation was observed between athletes perceived effectiveness of their chosen strategy and their performance, suggesting that athlete perceptions could offer invaluable insight into the validity of these strategies. Together, these findings offer valuable insight into how psyching-up strategies are applied in real-world settings and can inform more tailored recommendations for athletes seeking to optimise their competitive performance. In doing so,

this study contributes to a more ecologically valid understanding of how psyching-up strategies are naturally selected and perceived in competitive strength-sports, complementing the conceptual investigations presented in Chapter 3 of this thesis.

Chapter 5: The Effects of Psyching-Up on Deadlift Performance in Competitive Strongmen, Strongwomen and Powerlifters

ABSTRACT

This study investigated the effect of psyching-up on deadlift performance in experienced strength athletes. Further it examined whether individual differences in anxiety sensitivity, reward sensitivity and trait aggression influence strategy selection. A total of 200 competitive strength athletes completed the BIS/BAS Likert scale and the Buss-Perry Aggression Questionnaire. Participants then performed a deadlift under two conditions: a free-choice psyching-up intervention and a passive control. Barbell velocity was measured using a *GymAware RS* linear position transducer. Results showed that deadlift velocity was significantly greater during the psyching-up condition ($M = 0.39 \text{ m/s} \pm 0.11$) compared to the control ($M = 0.34 \text{ m/s} \pm 0.10$), representing an 18.58% increase in performance ($p < .001$). This improvement in bar speed corresponds to an estimated 4.3% increase in predicted 1RM. A Welch ANOVA found no significant differences in performance across the eight psyching-up strategies ($p = .16$). However, discriminant analysis revealed that higher reward sensitivity, greater trait aggression and lower anxiety sensitivity significantly predicted the selection of “arousal-enhancing” strategies ($p = .002$). These findings indicate that psyching-up can support deadlift performance in strength athletes and that personality traits may influence their choice of strategy. While no single strategy was found to be more effective than others, the data suggests that athletes tend to select strategies that reflect their individual personality traits. This study also presents a discriminant function that may help practitioners and coaches recommend appropriate psyching-up approaches based on an athlete’s personality profile, contributing to more effective and individualised psychological preparation in strength-sports.

5.1: INTRODUCTION

The previous Chapters have outlined how psyching-up strategies are commonly employed by strength athletes to enhance performance. Specifically, athletes do this with the belief that psyching-up will enhance maximal strength, muscular endurance and power (Tod et al., 2003). These strategies are frequently used by powerlifters (Tod et al., 2005), Olympic weightlifters (Mahoney, 1979) and competitive strong(wo)men (Winwood et al., 2019). Despite their widespread use, only one study (Shelton & Mahoney, 1978) has recruited strength athletes specifically to test the effectiveness of psyching-up in a controlled setting, indicating psyching-up enhanced performance. In the absence of robust outcome-focused research within this population, Chapter 3 examined the psyching-up strategies strength athletes commonly employ, while Chapter 4 explored their use and prevalence within competition settings. This research has offered an invaluable understanding of the processes involved in psyching-up; however, there remains a need to investigate how these strategies function in practice and the factors that may shape their effectiveness. This study therefore examines whether psyching-up can enhance deadlift performance and explores how these strategies operate within an applied strength-sport context, specifically in preparing for maximal lifts in sports such as powerlifting and strong(wo)man.

As outlined in Section 2.4.8.2 previous research in this area has predominantly involved inexperienced participants. Specifically, participants were often required to implement unfamiliar, researcher-prescribed psyching-up interventions during performance tasks that have limited relevance to the complex, multi-joint, sport-specific movements athletes typically aim to improve. While this has provided a useful foundation, a deeper understanding of these strategies requires investigation among experienced strength athletes who have developed and refined their own methods over time. Despite evidence that psyching-up is commonly used in

powerlifting (Alexander et al., 2019) and strong(wo)man competitions (Winwood et al., 2019), no study has directly examined its effectiveness in athletes with this level of sport-specific expertise, whose refined use of such strategies may offer invaluable insight. Moreover, psyching-up has traditionally been defined as “self-directed cognitive strategies that are used immediately before or during the execution of a skill to enhance performance” (Tod et al., 2003, p. 48). Based on this definition, techniques such as listening to music or inhaling ammonia have typically been excluded from empirical investigation (see Section 2.4.10). However, the mixed-method study of experienced strength athletes within Chapter 3 reported these two techniques as among the most used by these populations. Additionally, this Chapter further presented that 40% of the identified techniques did not align with the traditional definition of psyching-up (see Section 3.4).

Within Chapter 3, 64 individual psyching-up techniques were identified, comprised into eight individual strategies. Specifically, the strategies reported were *pre-performance routines*; *positive thoughts, feelings, images and behaviours*; *goals and performance accomplishments*; *self-deprecation*; *negative thoughts, feelings, images and behaviours*; *stimulation*; *physical and physiological techniques* and *aggressive acts*. In the present Chapter, these strategies are formally defined in Table 5.1, derived from the techniques identified in Chapter 3 and their observed use in Chapter 4. Based on the content of these techniques, a higher-order categorisation was identified, with Strategies 1-3 classified as “arousal-reducing” and Strategies 4-8 classified as “arousal-enhancing” (see Figure 3.3). As a result, the definition of psyching-up was adapted to: "strategies intended to alter activation or enhance mental preparedness immediately prior to or during skill execution." While the processes adopted by strength athletes are now better understood, it remains crucial to evaluate the effectiveness of these strategies in practice.

Table 5.1.
Classification, Definitions and Mean Ratings of Psyching-Up Strategies Identified in Strength Athletes

Strategy Name	Arousal- Classification	Definition	Mean Rating (0-4) \pm SD
Pre-performance routines	arousal-reducing	A sequence of consistent, personally meaningful behaviours or cues performed immediately prior to a lift to promote readiness and focus. These routines often include visualisation, equipment rituals, internal countdowns or physical cues (e.g., a head nod) designed to establish control and confidence.	2.30 \pm 0.61
Positive thoughts, feelings, images and behaviours	arousal-reducing	Cognitive and emotional techniques aimed at generating optimism, motivation or calmness before performance. These include affirmations, recalling previous achievements, visualising success, or using music and media that induce positive affect or self-belief.	1.45 \pm 0.64
Goals and performance accomplishments	arousal-reducing	Focusing on personal goals or past successes to increase commitment and drive. This includes techniques such as focusing on personal goals, remembering the sacrifices made during training or reflecting on previous successful lifts.	1.57 \pm 0.83
Self-deprecation	arousal-enhancing	The deliberate use of negative self-directed language or imagery to provoke feelings of anger. This may involve internal or verbal insults or pre-agreed deprecative comments delivered by a third party.	0.87 \pm 0.74
Negative thoughts, feelings, images and behaviours	arousal-enhancing	Drawing on emotionally intense or distressing content to elevate arousal. Techniques may include negative visualisation, focusing on fear of failure, grief or recalling past or present traumas, either self-directed or elicited through external stimuli, to provoke a strong adverse emotional response prior to performance.	0.75 \pm 0.77
Stimulation	arousal-enhancing	Efforts to heighten arousal through environmental, auditory or chemical stimuli. Examples include using loud music, motivational statements or ingesting stimulants like caffeine. These techniques are intended to elevate energy and neural activation.	2.02 \pm 0.80
Physical and physiological techniques	arousal-enhancing	Bodily actions used to provoke physiological readiness, such as pacing, jumping, fast breathing or clamping down on a mouthpiece. These techniques are used to further activate the sympathetic nervous system, elevating physiological arousal and preparing the body for maximal effort.	1.86 \pm 0.80
Aggressive acts	arousal-enhancing	Overt, intense behaviours intended to generate maximal arousal and focus through aggression. These are typically employed immediately before maximal efforts, elevating arousal levels through intense feelings of aggression.	1.90 \pm 0.92

Strategy names, arousal classifications and mean ratings presented here are consistent with those reported in Chapter 3 and the actions and behaviours from athletes within Chapter 4. Within this Chapter, the accompanying definitions have been developed based on the techniques identified in each cluster.

Across the eight strategies, it is important to recognise that many of the techniques reflect commonly utilised psychological skills within the sport psychology literature. As discussed in Sections 3.4 and 4.1, strategies such as imagery and self-talk are evident within both “arousal-reducing” and “arousal-enhancing” classifications, with their application varying in a manner that can elicit contrasting effects. As demonstrated in Chapter 3 (see Table 3.2), these skills are not confined to a single strategy or arousal classification, indicating that they do not serve a fixed functional role, but rather may fulfil multiple purposes depending on how they are applied. Furthermore, when embedded within broader strategies such as *pre-performance routines*, their function may extend beyond influencing activation, instead facilitating attentional control, supporting emotional stability and contributing to the regulation of arousal. As such, the regulatory outcome of a given psychological technique is likely to depend more on the athlete’s intent than on the technique itself. Accordingly, the classifications adopted within the present thesis reflect the interpreted function of the strategy, rather than the inherent properties of the individual techniques in isolation.

Across the two preceding Chapters, strength athletes perceived *pre-performance routines* as the most effective strategy, rating them highest in Chapter 3 and selecting them most frequently in a competition setting in Chapter 4. As defined in Table 5.1, this cluster includes techniques such as mentally rehearsing the lift (e.g., Technique: 10), using cue words (e.g., Technique: 25; 51; 60) and engaging in consistent physical behaviours immediately before execution (Technique: 8; 40; 43; 63). Indeed, some of the techniques within this strategy (see Table 3.2) have been used in previous psyching-up research, such as Technique 11: "repeating a positive word/phrase internally" (Bahari et al., 2012) and Technique 10: "visualising performing the lift successfully prior to execution" (Di Rienzo et al., 2019). Additionally, these techniques have also been commonly used in pre-performance routines in applied settings within other sports, such as golf (Cotterill et al., 2010) and soccer (Hazell et al., 2014). Inspection of the other

techniques within this cluster parallels various techniques used in alternative pre-performance routines (e.g., Technique: 4 “clearing your mind”; Technique 43: “using small body motions, such as a head-nod or twitch, before or during execution”; (Rabinovitch et al., 2025)). Despite Chapter 3 reporting that this cluster received the highest perceived effectiveness rating from participants, it has yet to be tested or considered as a psyching-up strategy within the current empirical research (see Section 2.4.10). Chapter 4 attempted to examine the effectiveness of these strategies; however, the observational design, combined with reliance on projected 1RM comparisons, introduced limitations that may have led to invalid performance measurements (see Section 4.4). Given that initial investigations into the effects of psyching-up on strength performance were driven by interest in the strategies employed by experienced strength athletes during competitions (Mahoney, 1979), it is crucial to ensure that the strategies tested align with those performed by athletes to accurately assess their effectiveness in literature.

Sex-based differences in the perceived effectiveness of psyching-up strategies may reflect broader psychological and behavioural tendencies (see Section 3.4). For example, males rated strategies such as *self-deprecation*, *negative thoughts*, *feelings*, *images and behaviours*, *stimulation* and *aggressive acts* as more effective than females (see Section 3.3.6) and they also showed a greater tendency to select “arousal-enhancing” strategies (see Section 4.3.1.3). One possible explanation for this disparity is that females typically experience higher levels of state anxiety (Panno et al., 2018; Rosenblum & Elimelech, 2021) and anxiety sensitivity (Gray et al., 2016; Wright et al., 2009), which may influence their preference for lower-arousal approaches. Differences in aggression levels may also play a role, as the strategies more strongly endorsed by males tend to involve aggressive elements. This is particularly evident in the *aggressive acts* cluster, which not only showed the greatest sex-based difference in perceived effectiveness but also contained the most overtly aggressive techniques. Males generally have higher aggression levels (Sher et al., 2019; Tremblay & Ewart, 2005) which

may partly account for these findings. Additionally, research has shown that males display greater sensitivity to reward (Gray et al., 2016; Vermeersch et al., 2009), a trait linked to the pursuit of high-arousal states (Balconi et al., 2009; Black et al., 2014). In sport, heightened reward sensitivity has been associated with participation in extreme and high-risk activities (Maher et al., 2015; Thomson & Carlson, 2014) which may further clarify why certain psyching-up strategies are perceived as more effective by males.

Psyching-up strategies can be employed to either increase, maintain or decrease arousal. As outlined in Chapter 1, several theories have been proposed to explain the relationship between arousal and sporting performance. A common perspective is that performance improves with increasing arousal up to an optimal point, beyond which performance declines and may manifest as anxiety (Hardy & Parfitt, 1991; Yerkes & Dodson, 1908). Furthermore, it has been proposed that individuals possess their own unique optimal threshold of arousal for performance (Hanin, 2000). Therefore, it was suggested that the first three strategies aimed to reduce or regulate psychophysiological arousal. The consistent perceived effectiveness of these first three strategies across sexes, alongside evidence that females typically report higher anxiety sensitivity than males, suggests that such strategies may be particularly beneficial for individuals who negatively appraise elevated arousal. For those with greater sensitivity to anxiety, strategies aimed at promoting regulation and controlling arousal may help maintain performance within an optimal zone. In contrast “arousal-enhancing” strategies, such as *stimulation* or *aggressive acts*, may increase the risk of exceeding an individual’s optimal arousal threshold, potentially impairing performance.

The present study has three major aims. The first aim was to investigate the effect of psyching-up on deadlift performance in experienced strength athletes. The second aim was to examine whether the eight strategies had differential effects on performance. Finally, the third aim was

to investigate whether individual sensitivity to anxiety, reward and trait aggression can predict strategy selection.

Consistent with the empirical findings presented in the systematic review in Chapter 2, we hypothesised that psyching-up would enhance deadlift performance (H1). Drawing on the perceptions of strength athletes reported in Chapter 3 and the prevalence of strategies selected in Chapter 4, we further hypothesised that *pre-performance routines* would be the most effective strategy (H2). Finally, for group classification, we hypothesised that higher levels of trait aggression and reward sensitivity in addition to lower sensitivity to anxiety, would be associated with the selection of “arousal-enhancing” strategies (H3).

5.2: METHODS

5.2.1: STUDY DESIGN

The present study adopted a mixed within- and between-subjects design, prescribing each participant a “free-choice” psyching-up intervention and a passive control condition. Strategies then selected by the participants will be compared, allowing for further investigations to be conducted into the efficacy of the selected strategy. Individual differences in anxiety sensitivity, reward sensitivity and trait aggression were also examined as predictors of strategy selection. Competitive strength athletes, with a minimum requirement of competing at a regional level competition within their respective sport, performed one deadlift under each condition (psyching-up, control) during the same session. Prior to each deadlift participants engaged in one of two conditions: a “free-choice” psyching-up intervention and a passive control condition. The conditions were randomised with a coin toss to avoid any order effect.

5.2.2: PARTICIPANTS

An a priori power analysis was conducted using G*Power 3.1 to determine the minimum required sample size for the study. The analysis was based on a one-way ANOVA, with $\alpha = .05$, power = .80 and a medium expected effect size of $f = 0.25$. Assuming eight groups, this indicated that a minimum total sample size of 240 participants was required.

Participants were recruited from specialist strongman or powerlifting facilities across England and Scotland. The inclusion criteria for the present study were that participants must be over 18 years of age and to have competed to a minimum regional level (defined as participation in an event that serves as a qualifier for national competition) of competition in powerlifting or

strong(wo)man. Overall, 200 competitive strength athletes were recruited (mean age: 32.4 years \pm 7.8). The sample consisted of 127 males (mean age: 31.7 years \pm 7.5) and 73 females (mean age: 33.6 years \pm 8.1). Sample characteristics are summarised in Table 5.2.

Table 5.2.
Sample Demographic Characteristics Table

Characteristic	Male	Female	Total
Age Group			
18-24	20	8	28
25-30	43	19	62
31-40	49	32	81
41-50	14	10	24
51+	1	4	5
Sport			
Strong(wo)man	102	45	147
Powerlifting	25	28	53
Competitive Level			
Regional	59	38	97
National	38	13	51
International	30	22	52

5.2.3: MEASURES

5.2.3.1: DEADLIFT VELOCITY

Deadlift velocity was used as the dependent measure in this study. The deadlift was selected for two key reasons. First, as a concentric starting movement, the deadlift reduces the likelihood of performance being affected by external factors, such as squat depth or bar path during the eccentric phase. Second, the deadlift is a primary exercise in both powerlifting and strongman competitions, making it an exercise in which participants are highly skilled and experienced. This expertise ensures the participants are familiar with the technical demands of the exercise and are likely to have prior experience psyching-up specifically for the deadlift. Barbell velocity was selected as the dependent variable as it provides a safe and practical outcome measure

compared with testing maximal loads. Measuring deadlift velocity allows for a sensitive and objective assessment of performance while substantially reducing the injury risk associated with repeated maximal testing. Additionally, to provide a more applied interpretation, the change in velocity can be translated into relative load using a validated load-velocity equation specific to mean velocity in the deadlift (Benavides-Ubric et al., 2020). This allows the observed differences to be expressed as changes in percentage of one-repetition maximum, offering a clearer and more practical understanding of performance improvements within a maximal-strength context.

Adopting this method also accommodates the training demands of competitive strength athletes, who would be unlikely to undertake two maximal deadlifts within a short period due to the considerable recovery required. In this study, the deadlift was performed using the *Strength Shop Bastard Deadlift Bar*. Deadlift velocity was measured using a *GymAware RS velocity tracker*, a linear position transducer (LPT) that demonstrated excellent levels of accuracy and reliability (Weakley et al., 2021).

5.2.3.2: PERSONALITY MEASURES

To explore how individual differences in personality might influence selection of psyching-up strategies, two self-report questionnaires were utilised.

The BIS/BAS Scale (Carver & White, 1994) is a 24-item self-report measure designed to assess individual differences in sensitivity to punishment and reward. It comprises four subscales: the Behavioural Inhibition System (BIS; 7 items) and three components of the Behavioural Activation System (BAS): Drive (4 items), Fun Seeking (4 items) and Reward Responsiveness (5 items). Items are rated on a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Example items include “I worry about making mistakes” (BIS) and “When I see an opportunity for something I like, I get excited right away” (BAS). The original validation study

reported acceptable to good internal consistency (BIS $\alpha = .74$; BAS Drive $\alpha = .76$; BAS Fun Seeking $\alpha = .66$; BAS Reward Responsiveness $\alpha = .73$; (Carver & White, 1994)). The BIS/BAS Scale was selected due to its theoretical grounding in reinforcement sensitivity theory (Gray, 1990). This framework aligns with the rationale that psyching-up strategy selection reflects individual differences in approach and avoidance motivations (see Section 3.4; Section 4.4). Alternative sport-specific measures of anxiety were considered, such as the Competitive State Anxiety Inventory-2 (CSAI-2). Yet the selection of the BIS/BAS was predominantly because the CSAI-2 assess transient competitive states rather than stable personality traits. Furthermore, their inclusion would necessitate an additional measure to capture reward sensitivity, increasing participant burden. In the present study, aggregate BIS and BAS scores were utilised to reflect overall sensitivity to punishment and reward, consistent with the study's focus on broader approach and avoidance tendencies.

The Buss-Perry Aggression Questionnaire (BPAQ) (Buss & Perry, 1992) is a 29-item instrument designed to measure trait aggression. It includes four subscales: Physical Aggression, Verbal Aggression, Anger and Hostility. Items are rated on a 5-point Likert scale ranging from 1 (extremely uncharacteristic of me) to 5 (extremely characteristic of me). Example items include "I have threatened people I know" (Physical Aggression) and "At times I feel I have gotten a raw deal out of life" (Hostility). The original validation study demonstrated strong internal consistency (Physical Aggression $\alpha = .85$; Verbal Aggression $\alpha = .72$; Anger $\alpha = .83$; Hostility $\alpha = .77$; Buss & Perry, 1992). The BPAQ was selected due to its comprehensive assessment of trait aggression, capturing a broad range of aggressive predispositions. This aligns with the conceptualisation of psyching-up strategies within the present thesis, whereby strategy selection is considered to reflect stable personality traits, with this broader assessment accommodating

both externally expressed behaviours and internal emotional and cognitive processes (see Table 3.2). While sport-specific measures such as the Sport Aggression Scale (SAS) (Makarowski, 2013) and the Competitive Aggressiveness and Anger Scale (CAAS) (Maxwell & Moores, 2007) may offer greater contextual relevance, they primarily assess aggression within sporting situations and are often oriented towards observable behaviours. Similarly, the State-Trait Anger Expression Inventory-2 (STAXI-2) (Spielberger, 1999) provides a detailed assessment of anger and its expression, but is centred specifically on anger experience, expression and control (Borteyrou et al., 2008). In contrast, the BPAQ captures a broader range of aggressive tendencies and was therefore considered more appropriate for assessing general predispositions that may influence strategy selection.

5.2.4: PROCEDURES

Prior to data collection, ethical approval for the study was granted by the University of Essex Ethics Committee 2 (ETH2324-1384). All participants were fully informed about the study procedures and provided informed consent before data collection commenced. Initial contact was made with managers of strength-sport-specific facilities across England and Scotland to assess their interest in hosting the trial and assisting with participant recruitment. Once agreements were reached regarding the locations for the trials, further purposive sampling was conducted via social media platforms dedicated to strength-sports. These platforms were used to share information about the study, including the trial locations and dates.

The trial commenced with participants completing an online survey administered in person via Qualtrics (Provo, UT, USA) to collect demographic data and assess sensitivity to anxiety, reward and aggression. The survey first provided participants with a description of the study and obtained informed consent to participate. Participants were then asked to provide the following

demographic information: sex, age, predominant sport and the highest level of competition they had competed in. Participants were also asked to report the heaviest deadlift (kg) they had completed in the past six weeks for a set of two to five repetitions. This information was used to estimate their 1RM using the Lombardi (1989) formula. Following this, participants were presented with the psyching-up clusters and their associated techniques, as identified from Chapter 3 and were asked to identify the strategy that most closely resembled their own approach to psyching-up. This was the strategy participants were requested to use during the psyching-up condition later in the experiment.

The next section of the survey, the participants completed two questionnaires: the BIS/BAS Likert Scale (Carver & White, 1994) and the BPAQ (Buss & Perry, 1992). Once the surveys were completed, participants were instructed to approach the researcher to confirm their working load (kg) and proceed with their usual warm-up routine for the deadlift.

During this interaction, participants were reminded of the study's requirements and a coin flip was performed to randomly assign them to one of the two experimental conditions. If the coin landed on heads, participants performed the psyching-up condition first; if it landed on tails, they began with the control condition. Following this, participants were informed of their working load (kg), which was set at 90% of their estimated 1RM (based on the Lombardi (1989) formula). Additionally, participants were given an option to adjust their working load by up to 10% prior to the trial, allowing for minimal disruption to their usual training regimes.

Throughout the warm-up, a qualified strength and conditioning practitioner observed the participants' deadlift to ensure they maintained safe technique. Participants were also asked if they experienced any discomfort or pain during the warm-up. If unsafe technique was observed, or if the participants reported pain, they were immediately asked to withdraw from the study.

Following the warm-up, the *GymAware RS* velocity tracker was attached to the collar of the *Strength Shop Bastard Deadlift Bar* to measure barbell velocity. Participants were familiarised with the velocity tracker to ensure it did not interfere with their performance. When participants reached their working load, they performed one repetition under both the psyching-up and control conditions. In both conditions, participants were instructed to perform the deadlift as quickly as possible to maximise barbell velocity.

During the trial, barbell velocity was recorded using the *GymAware RS* system. Between the two conditions, participants were instructed that the barbell was ready whenever they felt prepared to begin the lift, with no time constraints imposed. This approach was intended to allow participants adequate time to prepare mentally and physically for each condition. Since individual work capacities and rest needs vary, participants were permitted to determine their own rest intervals between lifts, enhancing the ecological validity of the study.

5.2.4.1: PSYCHING-UP CONDITIONS

5.2.4.1.1: FREE-CHOICE PSYCHING-UP CONDITION

A free-choice psyching-up condition was chosen based on the systematic review within Chapter 2 (see Section 2.3.4.8) suggesting that psyching-up strategies are most effective when individuals with experience in the outcome measure are given the autonomy to select their own strategy. To ensure that participants could replicate their usual methods, they were provided with the following instruction:

“Pull this deadlift as fast as possible, using the same strategies you would use prior to approaching a 1RM deadlift attempt.”

Since several techniques identified within Chapter 3 involved assistance from a third party, participants were also asked if they required any support during the lift to facilitate their mental strategies. If support was requested, the researcher aided as instructed by the participant, which typically involved music selection, specific verbal cues, or general vocal encouragement.

5.2.4.1.2: CONTROL CONDITION

A passive control condition was selected to avoid potential interference with the primary intervention, as active control conditions may confound the results and lead to false positive outcomes (see Section 2.3.4.10.1). Prior to the control condition, facility music was turned off to ensure that all psyching-up techniques were controlled. This decision was informed by the findings within Chapter 3, in which participants reported using music as a psyching-up technique on 119 occasions, spanning four distinct strategy categories (Table 3.2). Reported music types ranged from grief-associated to relaxing, happy and aggressive selections, illustrating how music, of any genre, may inadvertently serve as a means of psyching-up. Participants were then given the following instructions:

“Pull this deadlift as fast as possible, while refraining from using any psyching-up or mental strategies. Approach this lift with the same mentality you would use to lift your gym bag.”

To minimise the risk of participants unintentionally engaging in psyching-up strategies during the control condition, a clear analogy was provided during the pre-trial briefing. Specifically, participants were instructed to approach the control lift as if they were lifting a gym bag, an everyday action that does not typically involve any preparatory mental strategies. This example was chosen to help distinguish the control condition from Technique 4 “clearing your mind” from the *pre-performance routines* strategy and to reduce any misinterpretation of the control

trial as a “calm” or preparatory phase. The analogy aimed to ensure that the control condition was understood as a neutral baseline, free from deliberate psyching-up.

5.2.5: STATISTICAL ANALYSIS

A paired-samples t-test was conducted to test H1, comparing mean bar velocity (m/s) between the psyching-up condition and the passive control condition. To address H2, a new variable was computed to quantify the percentage change in performance relative to the control. This was calculated by subtracting bar velocity in the control condition from that in the psyching-up condition, dividing by the control value and multiplying by 100. This percentage difference served as the dependent variable in a one-way between-subjects ANOVA, used to assess whether strategy effectiveness differed across the eight psyching-up strategies. Normality of residuals showed minor deviations (Shapiro-Wilk, $p < .001$), though inspection of Q-Q plots indicated an approximately normal distribution. Homogeneity of variance was violated (Levene’s test, $p = .010$), therefore the Welch correction was applied as it provides a more robust alternative under conditions of unequal variances and group sizes (Blanca et al., 2018; Tomarken & Serlin, 1986).

To test H3, the eight psyching-up strategies were categorised into two groups: “arousal-reducing” (Strategies 1-3) and “arousal-enhancing” (Strategies 4-8). A linear discriminant analysis was conducted to examine whether anxiety sensitivity, reward sensitivity and trait aggression predicted psyching-up strategy selection.

Additional supplementary analysis was conducted to examine whether competitive level influenced the effectiveness of psyching-up. To address this, a one-way ANOVA was performed with competitive level (regional; national; international) as the between-subjects factor. The dependent variable for this analysis was the percentage performance difference between the

psyching-up and control conditions. Prior to analysis, assumptions were assessed. Normality of residuals showed minor deviations (Shapiro-Wilk, $p < .001$), though Q-Q plots indicated an approximately normal distribution, and homogeneity of variance was met (Levene's test, $p = .067$). This analysis examined whether the magnitude of the psyching-up effect differed across athletes of varying competitive levels. Where differences were detected, Bonferroni-adjusted post-hoc comparisons were used to identify which competitive levels significantly differed from one another.

5.3: RESULTS

5.3.1: MAIN FINDINGS

Table 5.3 summarises the mean scores for the three personality measures, the working deadlift load and the velocity of the psyching-up trial, control condition and the percentage difference. Internal consistency was assessed using Cronbach's alpha. The total BAS score demonstrated acceptable reliability ($\alpha = .78$), the BIS score showed good internal consistency ($\alpha = .88$) and the total aggression score from the BPAQ demonstrated excellent reliability ($\alpha = .91$). Table 4 summarises the scores for each personality measure for each strategy in addition to the percentage difference.

Table 5.3

The mean values reported for personality traits, deadlift load, condition velocities and difference in velocity as a percentage

Measure	Mean \pm SD		
	Male	Female	Total
Total BAS	41.80 \pm 4.74	40.64 \pm 4.52	41.38 \pm 4.69
Total BIS	18.72 \pm 4.94	23.27 \pm 4.15	20.38 \pm 5.15
Total BPAQ	83.37 \pm 19.50	74.88 \pm 20.38	80.87 \pm 19.57
Deadlift Load	217.66kg \pm 43.76	137.26kg \pm 32.05	188.32kg \pm 55.59
Control Velocity	0.36m/s \pm 0.10	0.31m/s \pm 0.09	0.34m/s \pm 0.10
Psyching-Up Velocity	0.42m/s \pm 0.12	0.35m/s \pm 0.09	0.39 m/s \pm 0.11
% Difference in Velocity	18.94% \pm 26.57	17.94% \pm 20.59	18.58% \pm 24.51

A paired samples t-test indicated a significant difference in deadlift velocity between the psych-up and control conditions, $t(199) = 11.10$, $p < .001$. The mean difference was 0.05 m/s (95% CI [0.04, 0.06]), representing a medium effect size $d_z = 0.78$ (Cohen, 1988).

Strategies with fewer than 20 participants were excluded prior to analysis due to insufficient sample size for meaningful comparison, which resulted in the removal of *self-deprecation*;

negative thoughts, feelings, images and behaviours and physical and physiological techniques.

Following these exclusions, assumptions of normality of residuals and homogeneity of variance were examined. Levene's test indicated that the assumption of homogeneity of variance was violated. Therefore, a Welch ANOVA was conducted. The analysis indicated no significant effect of psyching-up strategy on percentage change in deadlift velocity relative to the control condition, $F(4, 67.71) = 1.69, p = .16$.

A linear discriminant analysis found that BIS, BAS and trait aggression significantly predicted psyching-up strategy classification ("arousal-reducing" vs. "arousal-enhancing"), Wilks' Lambda = 0.518, $\chi^2(3) = 130.09, p = .002$. The model accounted for 48.2% of the variance (canonical correlation = 0.694) and correctly classified 82.5% of participants.

Participants who selected "arousal-enhancing" strategies had significantly higher BAS scores ($p = .006$), greater trait aggression ($p = .025$) and lower BIS scores ($p = .025$) than those selecting "arousal-reducing" strategies. The resulting discriminant function was:

$$D = -5.366 + 0.133(\text{BAS}) - 0.097(\text{BIS}) + 0.023(\text{BPAQ})$$

A classification threshold of 0.0275 was applied, with scores above the cut-off classified as "arousal-enhancing" strategy users and scores below classified as "arousal-reducing".

5.3.2: SUPPLEMENTARY ANALYSIS

A one-way between-subjects ANOVA showed a significant effect of competitive level on psyching-up performance, $F(2, 199) = 5.33, p = .006$. Bonferroni-adjusted post-hoc comparisons indicated that International participants ($M = 25.72\% \pm 27.77$) demonstrated significantly greater improvements than Regional participants ($M = 13.06\% \pm 23.58$), $p = .007$. National participants

($M = 21.80\% \pm 20.34$) did not differ significantly from either Regional or International competitors (all $p > .109$).

5.4: DISCUSSION

This study investigated whether psyching-up enhances deadlift performance in experienced strength athletes and whether the eight strategies had differential effects on performance. It also explored how personality traits, specifically anxiety sensitivity, reward sensitivity and trait aggression, predict strategy selection. Specifically, it was hypothesised that psyching-up would enhance deadlift performance (H1), that *pre-performance routines* would be the most effective strategy (H2) and that athletes with higher levels of trait aggression, reward sensitivity and lower anxiety sensitivity, would be more likely to adopt “arousal-enhancing” strategies (H3).

Consistent with H1, participants produced significantly greater barbell velocity following the psyching-up intervention compared to the passive control condition. Contrary to H2, there were no effects in performance enhancement across the strategies. Finally, H3 was supported, as athletes who selected “arousal-enhancing” strategies scored higher on reward sensitivity and aggression and lower on anxiety sensitivity.

A paired-samples t-test indicated that psyching-up significantly enhanced deadlift velocity in this cohort of experienced strength athletes. This finding is consistent with the previous research, showing psyching-up improved performance in 65% of psyching-up trials and in 92% of trials under a free-choice protocol (see Section 2.3.4). In the present study, psyching-up increased mean deadlift velocity by 18.58%, with all eight strategy types showing performance improvements (see Table 5.4). While this exceeds the 12% average improvement summarised by Tod et al. (2003) in their review of earlier studies, the increase observed here may reflect the

applied setting, the use of experienced strength athletes, or the flexibility afforded by the free-choice design. Although the observed difference in bar velocity ($M = 0.39$ m/s vs. 0.34 m/s) yielded a medium effect size (Cohen's $d_z = 0.78$), further interpretation using Benavides-Ubric et al. (2020) general load-velocity equation for mean velocity in the deadlift ($\text{Load } [\%1RM] = -80.188 \times \text{Mean Velocity } [m/s] + 124.929$) provides additional insight. This analysis suggests that the working load assigned during the trial was lifted at approximately 97.7% intensity during the control condition (0.34 m/s) and at approximately 93.7% intensity during the psyching-up condition (0.39 m/s). This shift in relative intensity equates to an estimated 4.3% improvement in predicted one-repetition maximum, with the psyching-up condition associated with a faster and more efficient lift. This increase in performance represents a substantial relative gain, particularly within the context of competitive strength-sports. Although psyching-up improved barbell velocity, the mechanisms underlying this effect cannot be definitively determined. While the present findings are interpreted within an arousal regulation framework, the performance improvements reported may also reflect increased activation, enhanced emotional control, improved attentional focus or greater readiness prior to lifting (Brody et al., 2000). For example, psyching-up strategies may increase neural drive and physiological activation prior to movement, narrow attentional focus toward task-relevant cues, reduce disruptive cognitions or enhance motivational readiness to exert maximal effort. These mechanisms are not mutually exclusive and may operate concurrently in applied strength settings. Additionally, as the present study did not directly assess physiological arousal or attentional processes, it is not possible to conclusively determine whether the observed improvements were driven specifically by optimal arousal regulation. Nevertheless, the interpretation adopted throughout this thesis is grounded in arousal-based theory. The psyching-up strategies were conceptualised according to their intended

influence on activation. The personality traits examined were also selected due to their established links with anxiety sensitivity, reward responsiveness and aggression, which are associated with individual differences in arousal responses (e.g., Balconi et al., 2009; Howard, 1986). Accordingly, although alternative mechanisms may contribute to the observed improvements, interpreting the findings within an arousal regulation framework remains theoretically justified. Therefore, psyching-up is best viewed as influencing performance through multiple, potentially overlapping mechanisms, with arousal regulation representing a central, but not exclusive, explanatory pathway.

The one-way between-subjects ANOVA did not identify a clearly superior strategy. Variation in participant numbers across strategy groups limited the ability to robustly evaluate the effectiveness of each approach. It was hypothesised that *pre-performance routines* would demonstrate greater performance enhancement comparative to the alternative strategies due to the athlete perception scores in Chapter 3 and strategy selections in Chapter 4, yet this was not supported by the data. Although no significant performance differences were observed between the strategies, consistent with the findings within Chapter 4, *pre-performance routines* were selected by 62 participants, which was 28 more than the next most chosen strategy, *Stimulation* (see Figure 5.1). This suggests that while participants who selected *pre-performance routines* did not outperform those in other strategy groups, the high selection rate (31%) reflects a strong perception of its effectiveness among strength athletes. It is possible that the free-choice design enabled participants, particularly those with greater experience, to select strategies they perceived as personally effective. As such, the distribution of selections may reflect underlying athlete intuition or prior familiarity, which could partially account for the absence of between-group differences.

Table 5.4.

A table summarising the mean scores for each personality measure and percentage difference in condition velocity reported by each strategy.

Strategy	Participants (n = 200)	Total BIS Score (Range: 7- 28)	Total BPAQ Score (Range: 29- 145)	Total BAS Score (Range: 13- 52)	Average % Difference
Pre-performance routines	62	20.63 ± 5.60	77.05 ± 20.50	40.11 ± 3.81	12.94 ± 16.71
Positive thoughts, feelings, images and behaviours	26	22.27 ± 4.60	78.54 ± 21.96	41.69 ± 5.40	18.69 ± 16.32
Goals and performance accomplishments	22	21.14 ± 3.94	77.00 ± 12.95	40.45 ± 6.30	20.18 ± 17.38
Self-deprecation	5	21.80 ± 7.12	78.20 ± 18.50	38.80 ± 4.15	28.96 ± 86.56
Negative thoughts, feelings, images and behaviours	12	20.92 ± 3.78	83.17 ± 21.11	42.17 ± 3.97	27.55 ± 20.31
Stimulation	34	18.26 ± 4.71	86.88 ± 17.35	43.09 ± 4.52	20.06 ± 26.42
Physical and physiological techniques	9	19.11 ± 5.42	81.22 ± 20.50	43.22 ± 5.12	10.60 ± 14.69
Aggressive acts	30	20.00 ± 5.52	82.23 ± 24.73	42.03 ± 4.11	24.36 ± 29.40
Total	200	20.38 ± 5.15	80.27 ± 20.20	41.38 ± 4.70	18.58 ± 24.51

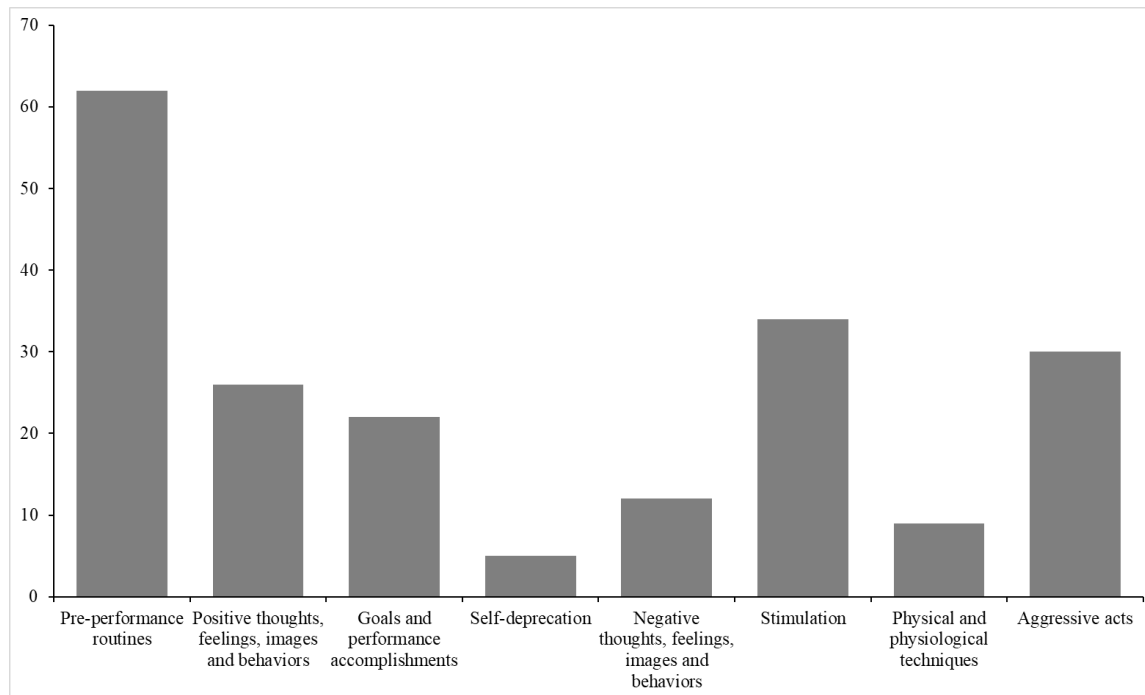


Figure 5.1

A bar chart of the distribution of participants selection across the eight psyching-up strategies

The discriminant analysis indicated that scores on the BIS, BAS and BPAQ scales could predict whether a participants would select an “arousal-reducing” or an “arousal-enhancing” strategy. Specifically, higher BAS and BPAQ scores, combined with lower BIS scores, were associated with the selection of strategies intended to increase activation. Given that state anxiety has been shown to impair sporting performance (Kang & Jang, 2021) and that anxiety sensitivity increases vulnerability to such effects (Balle et al., 2013; Markarian et al., 2013), this may explain why individuals with higher BIS scores favoured strategies associated with controlling arousal. Strategies one to three in the “arousal-reducing” cluster include techniques (see Table 3.2) commonly used to reduce performance-related anxiety and improve outcomes (Kuan et al., 2018; Wadey & Hanton, 2008). In contrast, participants with greater BAS sensitivity were more likely to select “arousal-enhancing” strategies. Previous research has linked high BAS sensitivity with

increased engagement in high-risk activities, both in sport (Thomson & Carlson, 2014) and other contexts (Scott-Parker & Weston, 2017). While psyching-up does not necessarily constitute high-risk behaviour, it is possible that the physiological stimulation sought by these athletes shares features with the arousal associated with extreme sports (Celsi et al., 1993). Techniques classified within the “arousal-enhancing” clusters (see Table 3.2), such as “headbutting something” (Technique: 36), “inhaling smelling salts” (Technique: 12), or “taking stimulants” (Technique: 28), are likely used to evoke intense sympathetic activation, mirroring the heightened arousal seen in thrill-seeking contexts (Breivik et al., 1998). Participants who selected “arousal-enhancing” strategies also reported higher BPAQ scores, indicating greater trait aggression. This aligns with the nature of several “arousal-enhancing” methods (see Table 3.2), which include physically aggressive or emotionally charged behaviours such as “shaking/attacking the bar” (Technique: 59), “screaming/yelling explicit motivational statements out loud” (Technique: 14), or “Pre-agreed verbal statement from somebody else, with the goal of evoking anger” (Technique: 2). These strategies may be more appealing to individuals with elevated aggression levels, potentially serving as a functional outlet in preparation for performance.

This study is the first to recruit a large sample of high-level strong(wo)men and powerlifters to examine the impact of psyching-up strategies on performance. The sample of 200 participants represents a substantial increase in scale compared to prior research, with the closest comparable study involving 120 psychology undergraduate students, with no reported training experience (Peynircioğlu et al., 2000). The findings support existing evidence that psyching-up can enhance performance and, in doing so, also shed light on the types of strategies more commonly selected by strength athletes. Although exploring strategy preferences was not a core objective, the

pattern of selections offers additional insight into the strategies that athletes tend to favour in practice, whilst providing further support for the findings reported within Chapter 3 and 4. While the study did not identify significant performance differences between the various strategies, this may reflect the self-directed nature of selection, whereby experienced athletes are likely to choose approaches that align with their individual needs and prior experience. A further novel contribution of the present study is the development of a discriminant function based on personality measures, which identifies the traits associated with athletes who tend to favour and respond well to high-arousal strategies. These findings not only add to the evidence base for the performance benefits of psyching-up but also enhance our understanding of how individual characteristics may inform the effectiveness and selection of specific strategies.

Despite the novel findings, the present study has some limitations. First, while efforts were made to ensure a robust research design, the use of a passive control condition introduces certain limitations. Although all participants were provided with the same script, it is difficult to ensure complete consistency in what each participant is doing during this condition. Although this limitation exists, the findings from the systematic review within Chapter 2 indicates that previous psyching-up literature has shown that trials using an active control condition produce positive findings 10% more often than passive control conditions (see Section 2.4.8.2), while also presenting additional concerns of health and safety risks associated with active controls (McCarren et al., 2023). Therefore, we concluded that using passive control conditions was the most viable option approach. Second, this study did not involve a maximal lift or a competition context, meaning that the anxiety associated with performing a maximal deadlift may not have been present. This is particularly relevant if the strategy is aimed at managing or reducing symptoms of anxiety. Future research could replicate this design, recruiting participants to test

their 1RM. A further limitation relates to the selection of personality measures. While the BIS/BAS Scale and BPAQ were chosen to assess stable individual differences aligned with the study's theoretical framework, they are general trait measures and may not fully capture context-specific experiences within competitive sport. For example, sport-specific instruments such as the CSAI-2 (Martens et al., 1990), the SAS (Makarowski, 2013) and the CAAS (Maxwell & Moores, 2007) may offer greater ecological sensitivity. However, the present study prioritised broader predispositions, as psyching-up strategy selection was conceptualised as reflecting stable approach, avoidance and aggression-related tendencies across contexts. Additionally, the uneven distribution of participants across strategies (see Figure 5.1) limited the analysis, restricting the ability to determine whether any single approach was superior. Although this may have impacted on the present findings, future research could adopt a crossover design in which each participant performs under all conditions: one control and each of the eight psyching-up strategies. By ensuring that all athletes have prior experience with the performance task (e.g., the deadlift) but are initially unfamiliar with the specific strategies, this design would enable within-subject comparisons while minimising bias from prior strategy preferences. Such an approach may not only clarify which strategies are most effective but also provide more detailed insights into how BIS, BAS and BPAQ scores influence individual responses to psyching-up techniques.

The findings of this study suggest that psyching-up strategies can meaningfully support deadlift performance in experienced strength athletes. On average, participants demonstrated an 18.58% improvement in bar velocity when using a psyching-up strategy compared to their performance under a passive control condition. When interpreted using velocity-based models, this improvement corresponds to an estimated 4.3% increase in predicted 1RM. Coaches and athletes aiming to maximise strength performance should therefore consider incorporating a psyching-up

strategy into their psychological preparation. These findings, however, reflect experienced athletes and further research is needed before extending them to less experienced populations. Accordingly, to optimise performance enhancement, it is important that athletes are given time to familiarise themselves with the selected strategy during training, as the benefits are unlikely to be realised without adequate exposure and practice.

This study also presents a discriminant function that can guide initial selection between “arousal-enhancing” and “arousal-reducing” strategies, based on an athlete’s personality profile (reward sensitivity, anxiety sensitivity and trait aggression). The absence of significant differences in performance between strategies likely reflects the experienced nature of the sample, who may have already gravitated toward strategies that best suit their individual profiles. In this context, the discriminant function provides practitioners with a useful tool for identifying the general strategy type that aligns with an athlete’s dispositional traits. Following this, athletes should be offered autonomy to select from the available options within the recommended arousal category, informed by both their experience and the contextual demands of their performance setting.

5.5: CONCLUSIONS

The present study examined the impact of psyching-up strategies on deadlift performance and explored how individual personality traits influence strategy selection. While no single strategy was found to be more effective than others, the comparison between conditions indicated that deadlift velocity was significantly greater following the use of a psyching-up strategy relative to passive control. Although the specific strategy used was not assigned by the researchers, the structured comparison between conditions suggests that the psyching-up intervention contributed meaningfully to the observed performance enhancement. Additionally, strategy selection was

systematically related to personality traits: higher BAS and BPAQ scores, alongside lower BIS scores, were associated with a preference for high-arousal strategies. These findings highlight the potential for using personality profiles to inform psyching-up strategy selection and support the use of the discriminant function as a practical guide for individualised preparation.

**Chapter 6: Effects of Personality-Matched
Psyching-Up Interventions on Deadlift
Performance in Competitive Strength
Athletes**

ABSTRACT

The present study examined the effectiveness of tailored psyching-up strategies on deadlift performance in athletes whose previous strategies had been ineffective. The new strategies were tailored to match athletes' personality profiles. A within-subjects design was used to assess the effects of a six-week tailored strategy prescription on deadlift performance. At Baseline, 35 competitive strength athletes who identified as struggling with their psyching-up performance completed the BIS/BAS Scale and the BPAQ. Participants then performed a deadlift under two randomised conditions (free-choice psyching-up and a passive control), while mean barbell velocity was recorded using a *GymAware RS linear position transducer*. Those who demonstrated a meaningful improvement in the psyching-up condition ($n = 17$) were deemed ineligible for the intervention phase. The remaining participants ($n = 18$) were prescribed a psyching-up strategy based on their questionnaire responses with instruction to apply this strategy before every deadlift session across a six-week period. Thirteen participants completed Follow-Up Testing. A significant interaction between condition and time showed no difference in deadlift velocity at Baseline (psyching-up: $M = 0.41 \text{ m/s} \pm 0.12$; control: $M = 0.40 \text{ m/s} \pm 0.11$), but significantly greater velocity for the psyching-up condition at Follow-Up Testing ($M = 0.43 \text{ m/s} \pm 0.14$ vs. $M = 0.34 \text{ m/s} \pm 0.11$). However, this interaction was driven by a significant decline between time-points in control-condition performance ($MD = 0.06, p = .018$), with no significant change observed in the psyching-up conditions ($MD = 0.02, p = .343$). These findings may indicate that prescribing psyching-up strategies based on individual personality profiles can meaningfully enhance strength performance in athletes whose existing approaches are ineffective, with potential explanations for the decline observed in the control condition explored in the discussion.

6.1: INTRODUCTION

Psychological interventions are widely recognised for addressing a range of performance-related challenges in sport (Reinebo et al., 2024). Research has shown that they can reduce both trait and state anxiety (Niering et al., 2023), enhance self-efficacy (Huang et al., 2025) and promote optimal performance states such as flow (Liu et al., 2021). Collectively, these findings align with meta-analytic evidence demonstrating a positive, moderate relationship between psychological interventions and sport performance (Brown & Fletcher, 2017). These outcomes are typically achieved through established techniques including mindfulness (Mehrsafar et al., 2021), imagery (Yahya et al., 2016) and motivational self-talk (Kanniyan, 2015). Among strength athletes, one particularly relevant approach is psyching-up, an acute mental preparation comprising eight distinct strategies that are generally classified as either “arousal-reducing” or “arousal-enhancing”, depending on the intended outcome (see Figure 3.3). Although research has demonstrated that psyching-up can improve strength performance (see Section 2.3.4.1), its potential as a targeted, personalised intervention remains unexplored, particularly amongst athletes who do not experience optimal performance enhancement from their current strategies. This gap is notable given the established role of personality traits in shaping both the effectiveness and appropriateness of psychological interventions (Allen & Laborde, 2014; Kaiseler et al., 2012). Accordingly, the present study intended to address this gap by examining whether prescribing psyching-up strategies based on personality profiles can enhance strength performance in strength-athletes.

Psyching-up, as defined in Section 3.4, refers to “strategies intending to alter activation or to enhance mental preparedness, immediately prior to or during skill execution”. These strategies were categorised based upon the intended goal to either reduce or regulate state arousal (“arousal-reducing”), or to increase levels of state arousal (“arousal-enhancing”) (see

Figure 3.3). “Arousal-reducing” strategies include *pre-performance routines; positive thoughts, feelings, images and behaviours* and *goals and performance accomplishments*. The techniques reported within these strategies have been shown to improve sporting performance in throwing accuracy (Perry & Katz, 2015), gymnastics (Santos-Rosa et al., 2022) and running performance (Barwood et al., 2009). The “arousal-enhancing” strategies comprised: *self-deprecation; negative thoughts, feelings, images and behaviours; stimulation; physical and physiological techniques* and *aggressive acts*. The techniques identified within these strategies have been associated with improved performance in explosive movements such as sprinting (Hammoudi-Nassib et al., 2017) and broad jumps (Weinberg et al., 1985), but these effects are not always consistently replicated (Tod et al., 2015). Despite the intention of psyching-up being to enhance performance, the aforementioned strategies indicate that athletes rely on polarising techniques to achieve an optimal performance state.

The contrasting psyching-up strategies adopted by athletes can be accounted for by the IZOF model (Hanin, 2000). IZOF proposes that each athlete has a unique optimal zone of arousal, shaped by their emotional experience and their interpretation of whether that state facilitates or hinders performance. Given the central role of individual hedonic tone in this model, IZOF may help explain the disparity in perceived effectiveness between males and females in four of the five “arousal-enhancing” strategies reported (see Section 3.3.6). While some individuals rely on “arousal-enhancing” techniques because they require higher activation to experience a functional emotional state, others may exceed their optimal zone when using these techniques, which leads to dysfunctional emotional responses that are more likely to be perceived as anxiety. This is consistent with the fact that many “arousal-enhancing” techniques are closely linked to anxiety-related responses, including caffeine consumption (e.g., Technique: 28) (Silver, 2001), rapid breathing (e.g., Technique: 5) (Fincham et al., 2023) and listening to aggressive music such as the heavy metal genre (e.g., Technique: 24)

(Olsen et al., 2023). Conversely, many techniques classified as “arousal-reducing” are commonly used to regulate or lower activation and have been shown to reduce symptoms of state anxiety (Balban et al., 2023). These include imagery (e.g., Technique: 10) (Wadey & Hanton, 2008), controlled breathing (e.g., Technique: 26) (Migliaccio et al., 2023) and calming music (e.g., Technique: 58) (Kuan et al., 2018). The contrasting patterns within these two groups suggest that athletes’ optimal zone of functioning vary considerably between individuals, consistent with the IZOF framework. To better understand how these strategies can be applied, it is important to consider how techniques can be matched to an individual’s hedonic tone and functional interpretation of their emotional state.

Tailoring psyching-up interventions to an athlete’s personality profile may better position them within their individual zone of optimal functioning. For example, the Five-Factor Personality Inventory (Costa Jr, 1992) has been used to identify individuals more likely to adopt maladaptive coping strategies, offering insight into how subtle personality differences shape coping styles (Allen et al., 2011). These screening practises have revealed that athletes with higher levels of neuroticism tend to benefit less from mindfulness-based approaches, whereas those scoring high in openness often report greater effectiveness from such strategies (Goisbault et al., 2022). Similarly, individuals with elevated aggression levels appear to respond more positively to direct, action-oriented techniques (Donohue et al., 2021). Further, traits such as neuroticism and conscientiousness have been shown to predict competitive anxiety, demonstrating that personality assessments can help identify those at greater risk of maladaptive responses and inform early intervention (Lim & Kee, 2022). Together, these findings suggest that both the effectiveness and suitability of psychological strategies can be anticipated through personality profiling. Despite this, sport psychology interventions are still frequently delivered in the absence of a formal evidence-based assessment of athletes’ personality attributes. Moreover, efforts to understand moderating influences often centre on

broad demographic variables such as sex (e.g., Brown & Fletcher, 2017), age (e.g., Lochbaum & Gottardy, 2015) or competitive experience (e.g., Ong & Chua, 2021). Investigations into such factors do offer valuable context, however, adopting a tailored approach based on personality measures may lead to highly accessible and effective interventions in applied settings, with greater relevance to the recipient, resulting in large improvements in athletic performance. Extending this personalised approach, previous research showed that publicly available self-report measures of trait anxiety, reward sensitivity and aggression can predict the selection of “arousal-reducing” or “arousal-enhancing” strategies in strength athletes (see Section 5.3.1). Consequently, the reported discriminant function may offer a viable method for aligning psyching-up strategies with an athlete’s individual zone of optimal functioning.

Anxiety is an important psychological factor in strength performance (Haischer et al., 2021). Elevated trait anxiety has been negatively associated with bench press and deadlift performance in competitive powerlifters (Judge et al., 2016). Similarly, heightened sensitivity to anxiety has been correlated with lower performance among competitive strong(wo)men and powerlifters (Cusimano et al., 2024). When examining anxiety, it is important to distinguish between trait anxiety and state anxiety. Trait anxiety refers to a stable personality characteristic that reflects a person’s general tendency to respond to perceived threats with anxiety (Knowles & Olatunji, 2020). In contrast, state anxiety describes a temporary emotional condition marked by subjective feelings of tension and increased physiological arousal (Spielberger et al., 1971). Individuals with higher levels of trait anxiety are more likely to experience elevated state anxiety, which can be detrimental to performance compared to those with lower trait anxiety (Horikawa & Yagi, 2012). In such instances, performance declines because individuals high in trait anxiety are more prone to experiencing

intense emotional and physiological responses to perceived stressors, leading to them exceeding their optimal zone of functionality.

In contrast to trait anxiety, trait reward sensitivity may be linked to more adaptive outcomes in sporting contexts (Kuśnierz et al., 2024). Trait reward sensitivity is a self-reported predisposition to seek rewarding substances and experiences (Wyngaarden et al., 2024). Comparative to individuals with low, or moderate levels of reward sensitivity, individuals high in this trait tend to notice and pursue appetitive and rewarding substances and experiences at a greater rate (Loxton, 2018). Individuals with higher levels of reward sensitivity demonstrate increased activation in the left frontal cortex of the brain in response to positive cues (Balconi et al., 2009). This region is associated with approach-related behaviours, including motivation (Harmon-Jones & Gable, 2018), goal pursuit (Spielberg et al., 2013) and the processing of positive emotions (Davidson, 2004). In contrast, increased activation in the right frontal cortex is linked to avoidance-related behaviours such as anxiety, threat detection and the processing of negative emotions (Balconi et al., 2009). In situations involving approach-avoidance conflict, where a stimulus simultaneously evokes both positive and threatening cues, those with heightened reward sensitivity are more likely to interpret the stimulus in an approach-oriented manner (Berkman et al., 2009). In such cases, the anticipation of thrill can outweigh the avoidance response associated with anxiety, resulting in approach behaviour. This response may help explain why some individuals engage in risk-taking behaviours, such as drug experimentation (O'Connor et al., 2009) or participation in extreme sports (Thomson & Carlson, 2014), despite experiencing both fear and thrill (Buckley, 2016). In the context of psyching-up, the effectiveness of a strategy may therefore depend on an individual's reward sensitivity. During high-pressure scenarios, such as testing 1RM lifts, athletes typically experience elevated physiological arousal (Lovell et al., 2011). During these states, individuals with greater reward sensitivity are likely to interpret this

response as exciting or energising enhancing performance (Balconi et al., 2009; Davidson, 2004), whereas those with heightened trait anxiety may experience debilitating performance due to appraising the same state as threatening (Cusimano et al., 2024; Judge et al., 2016).

The final trait reported in the discriminant function that may influence the effectiveness of psyching-up is trait aggression. Trait aggression refers to enduring and stable individual differences in hostile thoughts, angry emotions and behaviours intended to cause harm (Webster et al., 2014). Resistance training can have cathartic effects for individuals with high levels of trait aggression, providing an outlet for the expression of aggressive impulses (Wagner et al., 1999). In this context, psyching-up strategies such as *aggressive acts* or *negative thoughts, feelings, images and behaviours* may function as extensions of this emotional release, allowing individuals to channel aggression in a controlled and goal-directed manner. Neurophysiological evidence indicates that aggression is positively associated with activation of approach-motivated neural systems (Harmon-Jones & Sigelman, 2001). Individuals with heightened trait aggression show greater activation within the BAS when experiencing aggressive emotions (Harmon-Jones, 2007), making them more likely to act upon the situation rather than withdraw from it. Given that a state of aggression elevates arousal (Patrick & Verona, 2007) and that trait-aggressive individuals are predisposed to respond with action rather than inhibition, it is plausible that adopting “arousal-enhancing” strategies within a psyching-up context may facilitate performance in these individuals.

Building on these findings, the present study assigned psyching-up strategies according to individual differences in trait anxiety, trait reward sensitivity and trait aggression. This will be achieved through the discriminant function reported within Section 5.3 of this thesis, which classifies whether an athlete should adopt an “arousal-reducing” or “arousal-enhancing” strategy based on their psychological profile. To ensure meaningful applied insight, the study focused on athletes whose existing psyching-up strategies were identified as ineffective, as

these individuals stand to benefit most from a personality-matched prescription. By applying this function in an experimental performance setting, the study aimed to determine whether prescribing psyching-up strategies in a personality-matched manner can enhance deadlift performance in competitive strength athletes. It was hypothesised that deadlift performance would improve following the six-week intervention in which athletes adopted a psyching-up strategy aligned with their psychological profile of anxiety sensitivity, reward sensitivity and trait aggression.

6.2: METHODS

6.2.1: STUDY DESIGN

This study employed a within-subjects design with two testing sessions conducted six weeks apart. The sequence of procedures is illustrated in Figure 6.1. At each session, participants completed two deadlift trials at an estimated 90% of their 1RM, calculated using the Lombardi (1989) formula. One trial followed a psyching-up condition and the other served as a control. At Baseline, the order of these conditions was randomised for each participant using a coin flip and this same order was maintained at Follow-Up Testing to ensure consistency.

During Baseline, the participants first completed the BIS/BAS scale (Carver & White, 1994) and the BPAQ (Buss & Perry, 1992) to establish their levels of trait anxiety, reward sensitivity and aggression. During testing, participants used their existing free-choice psyching-up strategy, referring to the approach they typically employ during training or competition (e.g., McGuigan et al., 2005; Shelton & Mahoney, 1978; Tod et al., 2005). A baseline measure of their strategies effectiveness was established through comparing it to a controlled condition. The participants' baseline measures were compared against predefined eligibility thresholds established specifically for this study. These thresholds were derived

from the data collected within Chapter 5 and adjusted for competitive level (regional, national, international). Participants whose performance enhancement surpassed their corresponding threshold were excluded from Follow-Up Testing, as their existing strategy was already considered effective.

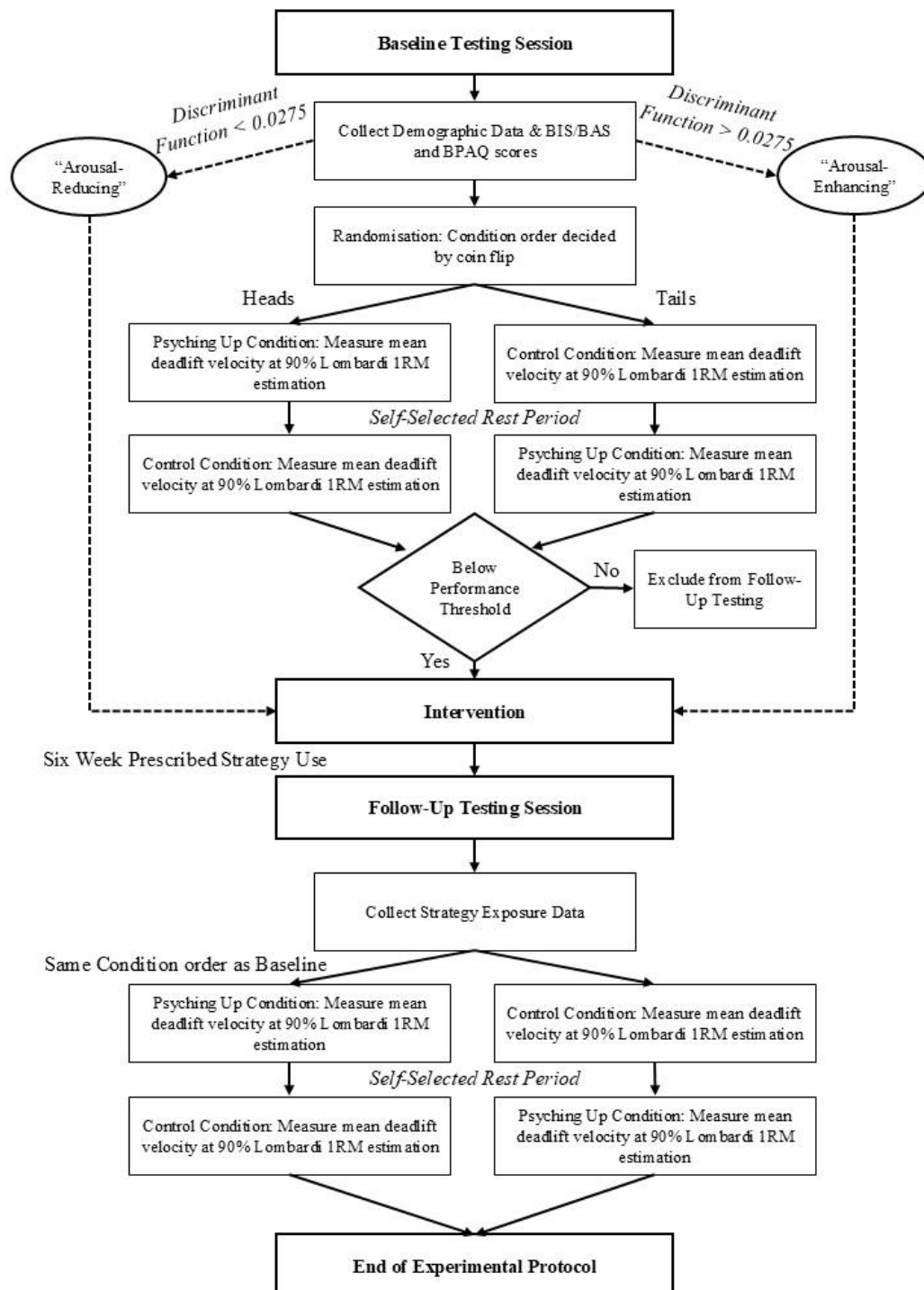


Figure 6.1.
A Flow diagram summarising the study design from Baseline to Follow-Up Testing

Eligible participants were then provided with a tailored psyching-up strategy determined by their individual profiles of anxiety sensitivity, reward sensitivity and trait aggression. They were instructed to use this strategy prior to all deadlift training sessions for six weeks. At Follow-Up Testing, participants again completed both control and psyching-up conditions, following the same order as at Baseline, with the psyching-up trial now incorporating the prescribed strategy. Deadlift velocity was recorded for all trials to assess changes in performance across time points.

6.2.2: PARTICIPANTS

An a priori power analysis was conducted using G*Power 3.1 to determine the minimum required sample size for the study. The analysis was based on a one-tailed paired-samples *t*-test, with $\alpha = .05$, power = .80 and a moderate expected effect size of $d = 0.50$. This indicated that a minimum total sample size of 27 participants was required.

Participant characteristics are summarised in Table 6.1. Participants were recruited from specialist strength-sport facilities across England. Inclusion criteria required participants to be aged 18 years or older, to have competed at least at the regional level in powerlifting or strongman/strongwoman competition (defined as participation in an event that serves as a qualifier for national competition) and to report using a psyching-up strategy they perceived as ineffective. Additionally, only athletes whose psyching-up strategies were deemed ineffective, based on pre-specified performance thresholds, were included in the final analysis. An initial 35 participants participated within the Baseline. Seventeen of these were excluded due to performance improvements that exceeded the cut-off values for their competitive level. A further five participants did not attend the second testing session, due to injury ($n = 2$) or scheduling conflicts ($n = 3$). The final sample consisted of 13 competitive strength athletes (mean age: 36.54 ± 7.56 years), including 7 males (mean age: 36.86 ± 9.79) and 6 females (mean age: 36.17 ± 4.67).

Table 6.1.
Participant Characteristics

Characteristic	Male	Female	All
	<i>Baseline</i>		
Mean Age	34.33 ± 7.36	35.43 ± 4.33	34.85 ± 6.35
Sport			
Strong(wo)man	16	12	28
Powerlifting	5	2	7
Competitive Level			
Regional	10	7	17
National	5	4	9
International	6	3	9
Personality Profile			
Mean BIS Score	19.76 ± 4.55	21.57 ± 3.41	20.49 ± 4.18
Mean BAS Score	40.38 ± 5.44	43.43 ± 5.33	41.60 ± 5.53
Mean BPAQ Score	91.05 ± 23.30	72.14 ± 15.34	83.49 ± 22.31
Discriminant Function Score*	0.182 ± 0.983	-0.023 ± 0.876	-0.099 ± 0.934
Mean Deadlift Load (kg)	218.93 ± 41.84	118.39 ± 25.56	178.71 ± 61.45
	<i>Follow-Up Testing</i>		
Mean Age	36.86 ± 9.79	36.17 ± 4.67	36.54 ± 7.56
Sport			
Strong(wo)man	7	5	12
Powerlifting	0	1	1
Competitive Level			
Regional	4	4	8
National	1	1	2
International	2	1	3
Personality Profile			
Mean BIS Score	18.57 ± 4.43	22.67 ± 4.18	20.46 ± 4.65
Mean BAS Score	37.57 ± 6.02	42.00 ± 7.48	39.62 ± 6.84
Mean BPAQ Score	87.71 ± 26.69	70.00 ± 15.07	79.54 ± 23.14
Discriminant Function Score*	-0.153 ± 1.138	-0.369 ± 1.133	-0.253 ± 1.093
Mean Deadlift Load	196.43 ± 29.54	116.67 ± 24.43	159.62 ± 48.97

* >0.025 = "Arousal-Enhancing"; <0.025 = "Arousal-Reducing"

6.2.3: MEASURES

6.2.3.1: DEADLIFT VELOCITY

Deadlift velocity (m/s) served as the dependent variable in this study. The deadlift was chosen for its suitability in assessing strength performance under controlled conditions. As a concentric-only lift, it minimises confounding factors associated with eccentric phases, such as bar path variability, inconsistent depth and the stretch-reflex rebound effect which are more common in lifts like the back squat. Additionally, the deadlift is a fundamental event in

both powerlifting and strongman competitions, meaning participants were highly familiar with its technical demands and likely to have established psyching-up routines specific to this lift. All deadlifts were performed using a *Strength Shop Bastard Deadlift Bar*. Mean concentric barbell velocity was recorded using a *GymAware RS LPT*, which was attached to the sleeve of the barbell. The device transmitted data via Bluetooth to a tablet running the *GymAware* application. The *GymAware RS LPT* system has demonstrated excellent validity and reliability for monitoring resistance training performance (Weakley et al., 2021) and moderate-to-excellent test-retest reliability for mean velocity during the deadlift (ICC = 0.63-0.99; SEM = 0.03-0.05 m/s; CV = 2.2 - 10.6%) (Grgic et al., 2020).

6.2.3.2: PERFORMANCE THRESHOLD CALCULATION

A threshold calculation was developed to identify participants whose psyching-up strategy was not producing optimal performance enhancement. The mean percentage improvement in deadlift velocity between the free-choice psyching-up and control conditions was extracted from data collected in Chapter 5. As this Chapter demonstrated that more experienced athletes typically achieve greater performance enhancement from psyching-up (see Section 5.3.2), the mean values and standard deviations specific to each competitive level were obtained. Informed by Cohen (1988) guideline for a small effect size, experience-specific thresholds equivalent to 0.2 standard deviations below the mean improvement were used as a pragmatic cutoff to identify athletes whose psyching-up strategies were deemed ineffective. Accordingly, participants were excluded if their psyching-up condition produced a performance enhancement of 8.34% or greater at the Regional level, 17.73% or greater at the National level, or 20.17% or greater at the International level. This approach ensured that only participants who did not currently experience meaningful performance enhancement from their psyching-up strategies were retained for intervention.

6.2.3.3: *DISCRIMINANT FUNCTION*

To prescribe psyching-up strategies based on psychological traits, this study utilised the discriminant function reported in Chapter 5 (see Section 5.3.1). The function was derived by examining how participants' scores on the BIS/BAS Scale (Carver and White, 1994) and the BPAQ (Buss & Perry, 1992) predicted their self-selected psyching-up strategy classification. Strategies were classified as either “arousal-reducing” or “arousal-enhancing” and discriminant analysis was used to generate a function that distinguished between these two categories.

The BIS/BAS Scale is a 24-item self-report measure assessing sensitivity to punishment and reward. It comprises four subscales: BIS, BAS Drive, BAS Fun Seeking and BAS Reward Responsiveness. Chapter 5 (see Section 5.3.1) reported good internal consistency for total BIS ($\alpha = .88$) and acceptable for total BAS ($\alpha = .78$) in strength-sport athlete populations. The BPAQ is a 29-item measure of trait aggression, comprising four subscales: Physical Aggression, Verbal Aggression, Anger and Hostility. The total aggression score for the BPAQ demonstrated excellent internal reliability ($\alpha = .91$) in competitive strong(wo)men and powerlifters (see Section 5.3.1).

Scores from these scales were input into the following linear discriminant function:

$$D = -5.366 + 0.133(\text{BAS}) - 0.097(\text{BIS}) + 0.023(\text{BPAQ})$$

Participants scoring above the classification threshold of 0.0275 were assigned a choice of an “arousal-enhancing” strategy, whereas those scoring below were assigned an “arousal-reducing” strategy. The function demonstrated strong predictive validity (see Section 5.3.1), correctly classifying 82.5% of participants and accounting for 48.2% of the variance.

6.2.4: PROCEDURES

Ethical approval for the study was obtained from the University of Essex Ethics Committee 2 (ETH2425-1044) prior to data collection. To recruit suitable testing sites, the lead author contacted managers of strength-sport facilities across England through their professional network. Facility managers were provided with full details of the study and asked whether they would be willing to host testing sessions. Once agreements were secured, purposive sampling was conducted via social media advertisements and facility managers were encouraged to circulate the information to their members and clients. These advertisements included details about the study's aims, trial dates and testing locations.

6.2.4.1: BASELINE

Participants first completed an online survey hosted on Qualtrics (Provo, UT, USA), which included an overview of the study and a digital consent form. After providing consent, participants reported their age, sex, primary sport and highest level of competitive experience. They were then presented with the eight psyching-up strategies and the techniques comprising each strategy, as identified in Chapter 3 (see Table 3.2). Participants were then instructed to select the psyching-up strategy that most closely reflected the approach they typically use to psych-up.

Participants reported the heaviest deadlift completed for two to five repetitions within the previous six weeks of training. This value was converted to an estimated 1RM using the Lombardi (1989) formula: $1RM = Weight \times (Repetitions ^ 0.10)$, which has demonstrated excellent validity and reliability for estimating maximal strength across 10 resistance-training exercises ($R = 1.00$; $ICC = 0.98$; $NMAE = 5.8$) (Simonsen et al., 2025). Ninety percent of the estimated 1RM was set as the working load for testing, with participants permitted a $\pm 10\%$ adjustment to minimise disruption to their ongoing training.

Participants then completed the BIS/BAS scale (Carver & White, 1994) and the BPAQ (Buss & Perry, 1992). Scores were automatically calculated and input into the discriminant function, which assigned each participant to one of two groups: Category A (“arousal-reducing” strategy) or Category B (“arousal-enhancing” strategy). To maintain blinding, the platform displayed only the category code, without disclosing its meaning. Participants were reminded of their working load and allowed to adjust it by up to 10% if desired.

A coin toss determined the order of conditions. Participants received the following instructions:

1. Free-Choice Psyching-Up: *“In your own time, psych-up for this lift and pull it as fast as possible.”*
2. Passive Control: *“Pull this deadlift as fast as possible, while refraining from using any psyching-up or mental strategies. Approach this lift with the same mentality you would use to lift your gym bag.”*

An applied example was used to help minimise the likelihood that participants deliberately adopted cognitive strategies within the passive control condition. Participants confirmed they understood the instructions and completed a self-selected warm-up. They were instructed to prepare as they normally would for the prescribed working load, including any preferred mobility, activation, or warm-up exercises, followed by their usual progression of sets and repetitions performed at their own pace to replicate their typical training routine. During this time, a *GymAware RS* velocity tracker was attached to the Deadlift Bar to allow participants to familiarise themselves with its presence and confirm that it did not affect bar balance or movement characteristics. No data were recorded until the working load was reached.

Once participants had completed their self-selected warm-up and worked up to their designated load, they performed the first working deadlift. A self-determined rest period was

then taken before the second deadlift to preserve ecological validity and accommodate individual differences in recovery and work capacity, reflecting applied training practices. The *GymAware RS* recorded mean deadlift velocity in metres per second (m/s) during each working-load trial.

A total of 17 participants did not proceed to the intervention phase due to demonstrating a meaningful benefit from their existing psyching-up strategy, based on the experience-specific performance thresholds as described in Section 6.2.3.2. Participants whose psyching-up condition exceeded the relevant threshold were thanked for their participation, while those below the threshold progressed to the intervention phase.

Discussions were held with all eligible participants to refine or develop their psyching-up strategies in line with their prescribed arousal-classification. Conversations initiated with asking the participant to describe the detailed procedures they used while psyching-up. Where a participant's current strategy did not match their profile, a new strategy was introduced. Strategy selection was informed by each participant's psychological profile, the emotional states they perceived as facilitative and the techniques they felt comfortable using (e.g., covert or overt techniques). Each strategy was prescribed following discussion with the participant and developed using the techniques reported in Table 3.2, in conjunction with relevant psychological frameworks (e.g., IZOF). For "arousal-enhancing" strategies, participants were guided through options that could evoke an enhanced facilitative psychophysiological response. Specifically, they were presented with the techniques within each "arousal-enhancing" strategy and informed about the purpose of the techniques and how the participant could utilise or adapt these techniques within their own strategy. Further inspection of their personality profile was used to indicate a strategy they may seem best suited, with those with greater scores on the BPAQ being suggested that the *aggressive acts* strategy may best facilitate their performance. For "arousal-reducing" strategies, participants

were first informed of the purpose of these approaches in regulating or lowering state arousal and why this could be advantageous for their performance. The specific techniques within each strategy were then discussed and a final strategy was developed collaboratively between the participant and the researcher.

For those participants who's existing, but ineffective, strategy already aligned with their classification, discussions focused on refining their approach to better facilitate performance. These discussions revealed that, although their chosen strategies were theoretically appropriate, they were often applied inconsistently. Two common themes emerged. First, while participants selected the strategy that most closely reflected their typical psyching-up strategy, they frequently combined techniques characteristic of both "arousal-reducing" and "arousal-enhancing" strategies. Second, although they maintained the overarching goal or framework of their chosen strategy, they often varied the specific techniques used between sessions. In such cases, the prescribed intervention focused on promoting consistent use of techniques aligned with their arousal classification.

Participants spent approximately 30 minutes learning how to apply their new strategy effectively. The familiarisation session involved the researcher guiding the participant on recognising appropriate physiological states prior to lifting (e.g., a clear and focused mindset, or physiological indicators of elevated arousal such as "butterflies"). This education was followed by practice trials with researcher feedback to ensure correct application, alongside individual adaptations to suit each participant's personal style. Before leaving the facility, participants were instructed to use this strategy before every working deadlift set over the next six weeks and were informed that they would receive weekly follow-up contact to monitor progress. This follow-up contact consisted of a weekly text message, asking the participant if they had any questions or issues with their strategy. In most cases, this contact consisted of providing additional clarification regarding the strategy's purpose, implementing

minor adjustments to accommodate participants' preferences, or the participant confirming that the strategy was perceived as performance-enhancing.

6.2.4.2: FOLLOW-UP TESTING

Six weeks later, participants returned to the same facility for Follow-Up Testing. They completed a brief Qualtrics survey, which included a reminder of the trial aims, renewed consent and a prompt to enter their unique ID code for data matching.

Participants reported how many deadlift sessions they had completed since Baseline, the estimated the total number of working sets performed and their consistency in using the prescribed strategy. Consistency was assessed using a nominal scale (“all”, “most”, “half”, “hardly”, “none”), which was later converted into percentage values (0%, 25%, 50%, 75%, 100%) to quantify adherence. They were once again then shown the eight strategies as detailed in Table 3.2 and asked to identify which one they had been prescribed.

Working load, condition order, velocity measurement protocols, rest periods and all methodological procedures were held consistent with the baseline assessment. Participants were reminded of the following instructions:

1. Prescribed Psyching-Up: *“In your own time, using the prescribed psyching-up strategy from the last trial, lift and pull this deadlift as fast as possible.”*
2. Passive Control: *“Pull this deadlift as fast as possible, while refraining from using any psyching-up or mental strategies. Approach this lift with the same mentality you would use to lift your gym bag.”*

6.2.5: STATISTICAL ANALYSIS

To assess whether prescribing psyching-up strategies based on personality profiles enhanced performance, a 2 x 2 repeated-measures ANCOVA was conducted, with Condition (psyching-up vs control) and Time (pre- vs post-intervention) as within-subject factors. The number of

deadlift working sets was multiplied by the percentage of strategy adherence to compute a strategy engagement variable, which was entered as a continuous covariate. Mean barbell velocity (m/s) served as the dependent variable. This analysis examined the main effects of condition and time in addition to the interaction between condition and time, while adjusting for individual differences in strategy engagement. Significant interactions were followed by Bonferroni-adjusted pairwise comparisons.

6.3: RESULTS

Table 6.1 presents descriptive statistics for participant age, sport, competitive level, personality measures, discriminant function score and deadlift load. Internal consistency was assessed using Cronbach's alpha for the personality measures. The total BIS score showed good internal consistency ($\alpha = .83$), the total BAS score demonstrated good reliability ($\alpha = .84$) and the total aggression score from the BPAQ demonstrated excellent reliability ($\alpha = .93$).

Table 6.2 reports the deadlift velocity within all conditions and their strategy exposure during the intervention period.

Table 6.2.***Participant strategies deadlift velocities under psyching-up and control conditions at Baseline and Follow-up Testing and strategy exposure***

	Initial Strategy	Baseline Deadlift Velocity (m/s)		Prescribed Strategy	Training Exposure and Strategy Adherence Variables			Follow-Up Testing Deadlift Velocity (m/s)	
		Psyching-Up Condition	Control Condition		Deadlift Sessions	Working sets	Strategy Adherence (%)	Psyching-Up Condition	Control Condition
Participant 1	Stimulation**	0.41	0.35	Pre-performance Routines	14	80	100	0.44	0.26
Participant 2	Pre-performance Routines*	0.50	0.43	Pre-performance Routines	6	20	50	0.49	0.37
Participant 3	Stimulation*	0.20	0.19	Physical and Physiological Techniques	3	15	75	0.22	0.17
Participant 4	Pre-performance Routines**	0.48	0.46	Physical and Physiological Techniques	4	22	75	0.66	0.54
Participant 5	Pre-performance Routines*	0.49	0.48	Pre-performance Routines	6	90	75	0.49	0.44
Participant 6	Pre-performance Routines*	0.37	0.40	Goals and Performance Accomplishments	3	6	75	0.30	0.25
Participant 7	Goals and Performance Accomplishments*	0.56	0.53	Pre-performance Routines	7	28	75	0.44	0.35
Participant 8	Stimulation*	0.42	0.41	Physical and Physiological Techniques	5	5	50	0.44	0.33
Participant 9	Pre-performance Routines*	0.36	0.34	Positive thoughts, feelings, images and behaviours	5	26	50	0.33	0.25
Participant 10	Positive thoughts, feelings, images and behaviours**	0.64	0.62	Aggressive Acts	5	20	75	0.71	0.54
Participant 11	Pre-performance Routines*	0.27	0.29	Pre-performance Routines	5	55	75	0.32	0.28
Participant 12	Aggressive Acts*	0.29	0.28	Aggressive Acts	1	3	100	0.42	0.30
Participant 13	Negative thoughts Feelings and Images**	0.35	0.36	Pre-performance Routines	6	25	100	0.37	0.34

* Strategy matched function classification ** Strategy did not match function classification

A 2 x 2 repeated-measures ANCOVA examined the effects of Condition (psyching-up vs control) and Time (Baseline vs Follow-Up Testing) on mean deadlift velocity (m/s), while adjusting for individual differences in strategy engagement. There was a significant main effect of Condition, $F(1, 11) = 11.42, p = .006, \eta^2 = .51$ and a non-significant main effect of Time, $F(1, 11) = 0.28, p = .611, \eta^2 = .02$. A significant interaction between Condition and Time was also observed, $F(1, 11) = 29.70, p < .001, \eta^2 = .73$. Strategy engagement did not significantly predict mean velocity, $F(1, 11) = 0.003, p = .958, \eta^2 = .00$, nor did it interact with Condition ($p = .614$), Time ($p = .958$), or the Condition and Time interaction ($p = .872$).

Within-Time post-hoc comparisons with Bonferroni adjustment indicated that at Baseline, mean deadlift velocity did not significantly differ between the psyching-up ($M = 0.41 \text{ m/s} \pm 0.12$) and control ($M = 0.40 \text{ m/s} \pm 0.11$) conditions, $MD = 0.02 \text{ m/s}, d_z = 0.12, SE = 0.01, 95\% \text{ CI } [-0.00, 0.03], p = .076$. At Follow-Up Testing, the psyching-up condition ($M = 0.43 \text{ m/s} \pm 0.14$) produced higher velocity than the control condition ($M = 0.34 \text{ m/s} \pm 0.11$), $MD = 0.09 \text{ m/s}, d_z = 0.74, SE = 0.01, 95\% \text{ CI } [0.06, 0.12], p < .001$.

Within-Condition comparisons showed no significant change in mean velocity from Baseline to Follow-Up Testing in the psyching-up condition, $MD = 0.02 \text{ m/s}, d_z = 0.18, SE = 0.02, 95\% \text{ CI } [0.00, 0.07], p = .343$. In the control condition, mean velocity decreased significantly from Baseline to Follow-Up Testing, $MD = 0.06 \text{ m/s}, d_z = 0.46, SE = 0.02, 95\% \text{ CI } [0.01, 0.10], p = .018$.

6.4: DISCUSSION

The present study aimed to determine whether prescribing psyching-up strategies in a personality-matched manner can enhance deadlift performance in competitive strength athletes. To achieve this, the study applied the discriminant function reported within Section 5.3.1, to identify an appropriate psyching-up strategy for participants who had previously demonstrated ineffective performance enhancement from their existing approach. The findings offer partial support for the hypothesis that deadlift performance would improve following the personality-matched intervention, with the significant interaction indicating that the relative difference in performance between the psyching-up and control conditions increased across the six-week intervention. However, this effect was predominantly driven by a decline in performance within the control condition rather than a substantial improvement in the prescribed psyching-up condition.

The findings of the present study may suggest that, following a six-week intervention, prescribed psyching-up strategies enhanced deadlift performance. Specifically, the mean difference in barbell velocity between conditions increased by 0.08 m/s from Baseline to Follow-Up Testing. This corresponded to an approximate 19.88% divergence between conditions across time, reflecting a substantial relative difference in performance. Using the Benavides-Ubric et al. (2020) formula to convert velocity to relative load (%1RM), psyching-up corresponded to an estimated 0.8% increase in 1RM strength compared to the control condition at Baseline and a 7.22% increase at Follow-Up Testing. These gains are particularly meaningful given that the current sample comprised individuals who had previously shown sub-optimal performance responses to psyching-up. Collectively, these findings strengthen existing evidence supporting

the effectiveness of psyching-up interventions (see Section 2.3.4), while also providing a plausible explanation for the null or adverse effects reported in some previous studies (e.g., Brody et al., 2000; Elko & Ostrow, 1992; McGuigan et al., 2005). We propose that psyching-up may fail to enhance strength performance when the strategy employed does not align with an individual's personality profile, which, if correct, would further emphasise the value of a personality-matched-prescription approach.

Within the present study the performance in the control condition significantly decreased from Baseline to Follow-Up Testing. The inclusion of a passive control condition was intended to provide an objective benchmark against which intervention-related changes could be evaluated while accounting for uncontrollable influences associated with high-level strength-sport. However, these findings may be susceptible to bias due to the absence of blinding, which is a recognised limitation within psychology research (Juul et al., 2021). Given that the purpose of the intervention was transparent, participants may have intentionally or unintentionally underperformed in the control condition during Follow-Up Testing. However, the observed decline is consistent with well-established external variables that naturally cause fluctuations in strength performance, including accumulated fatigue (Tosovic et al., 2016), shifts in periodisation structure (Schoenfeld et al., 2017) and hormone changes associated with altered performance-enhancing drug cycles (Weatherby et al., 2002), which are commonplace in strong(wo)man and powerlifting populations particularly in untested federations where such substances are not prohibited (Jokipalo & Khudayarov, 2021). This is particularly relevant as five participants in the present study competed during the six-week intervention period (Participants: 1, 2, 6, 7 and 9), which inevitably altered training load, fatigue, tapering, recovery and physiological status. Additionally, Participant 12 began a general physical preparedness phase

that prioritises high volume and movement variation over maximal strength expression (Issurin, 2010) and is known to temporarily reduce peak force output (Kiely, 2012). Furthermore, the reduction in control-condition performance could reflect a perceived dependency on psyching-up strategies, as previous research indicates that omitting a psychological routine or ritual can trigger expectancy driven decrements (Moradi, 2020; Schippers & Van Lange, 2006). However, the addition of the strategy engagement as covariate within the ANCOVA demonstrated that strategy exposure did not predict strategy performance, suggesting that belief-driven dependency was unlikely to be the primary explanation. Taken together, the pattern of results appears most plausibly attributable to the real-world training schedules, competitive demands and physiological fluctuations experienced by the participants during the intervention period rather than expectancy-related impairment.

The present study demonstrated performance enhancement when participants were provided with psyching-up strategies tailored to their levels of trait anxiety, trait reward sensitivity and trait aggression. These findings reinforce the perspective that the effectiveness of psychological interventions depends on their alignment with individual personality characteristics rather than the quality of the intervention alone (Connor-Smith & Flachsbart, 2007; Roberts & Woodman, 2015). Personality traits shape how individuals appraise and regulate their physiological and emotional states (Hughes et al., 2020), highlighting the importance of aligning psychological interventions with the dispositional tendencies of the recipient (Bucher et al., 2019). In the context of the present study, we suggest that elevated arousal may be appraised as facilitative among individuals with greater reward sensitivity or heightened trait aggression, as these traits predispose individuals to adopt approach-oriented responses during approach-avoidance conflicts (Berkman et al., 2009; Harmon-Jones, 2007). Conversely, those with higher trait anxiety may be

more likely to appraise elevated arousal as threatening, experiencing it as debilitating and subsequently demonstrating impaired performance (Horikawa & Yagi, 2012). These findings add further empirical support to research advocating for the use of personality profiling to inform psychological interventions (e.g., Burnell et al., 2023; Contreras et al., 2023; Stieger et al., 2020). Comparable benefits have also been highlighted in applied practice, where practitioners implementing personality-matched approaches in sport settings have reported enhanced performance and self-regulation (e.g., Cotterill, 2012; Shambrook, 2009). Although a substantial proportion of participants were already using a psyching-up strategy aligned with their classification (see Table 6.2), their performance benefits appeared limited by inconsistent application, as noted in the procedures. Once these individuals were guided to apply their strategy consistently and to use techniques that more closely matched their personality profile, notable improvements in deadlift performance were observed. These findings suggest that personality-matched prescriptions can enhance strength performance when supported by consistent and structured implementation.

The present findings align with the IZOF model (Hanin, 2000). This model suggests that performance enhancement depends not only on arousal intensity but on how that arousal is interpreted. According to IZOF, each athlete has an optimal activation zone shaped by whether physiological and emotional states are perceived as pleasant or unpleasant and as facilitative or debilitating to performance. This interpretation is consistent with previous applications of IZOF in sport, which have shown that interventions aligned with an athlete's individual activation and affective preferences can enhance performance (e.g., Cohen et al., 2006; Robazza et al., 2004). The present data extend this body of work by demonstrating that matching psyching-up strategies to personality profiles in anxiety sensitivity, reward sensitivity and trait aggression was

associated with significant performance gains. Existing evidence indicates that perceiving elevated arousal as pleasant and performance-enhancing is characteristic of individuals high in reward sensitivity (Chat et al., 2022) and trait aggression (Carré et al., 2010), who tend to use activation to generate energy and focus. Conversely, athletes high in anxiety sensitivity are more likely to interpret heightened physiological sensations as threatening and unpleasant (Bernstein et al., 2009), leading to avoidance and rigid coping responses that can suppress optimal performance. Indeed, the present study did not assess athletes' subjective interpretations of arousal, yet the pattern of results suggests that aligning strategy type with personality characteristics may help to optimise arousal intensity in ways consistent with the directional and emotional dimensions proposed within the IZOF framework. Future research should examine this process directly to clarify the mechanisms underlying these effects.

The present study was the first to match psyching-up interventions based on psychometric screening, providing further support for the notion that psychological interventions in sport are most effective when personalised according to individual personality traits (Allen et al., 2011; Burnell et al., 2023). It also offers empirical support for findings in Chapter 5, through demonstrating that psyching-up strategies can be effectively prescribed using the discriminant function reported in that study (see Section 5.3.1). A further strength of the study lies in the recruitment of experienced competitive athletes who presented with ineffective psyching-up strategies. Focusing on individuals with a genuine need for intervention increases the applied relevance and transferability of the findings, ensuring that the outcomes reflect challenges encountered in real-world performance settings. As such, the present results offer practitioners a meaningful and evidence-based resource for improving acute mental preparation in strength-sports.

Despite the novel findings, the present study is not without limitations. Foremost, the absence of blinding may have introduced demand characteristics. Although all participants were instructed to lift with maximal velocity at every testing point, their awareness of the study's aims may have led some to intentionally or unintentionally underperform in the control condition, which could account for the significant differences observed in deadlift velocity between conditions despite no change within the psyching-up condition. As discussed previously, the pattern observed is likely attributable to uncontrollable external factors; however, it remains important that future research seeks to reduce this potential source of bias. Future research should aim to minimise this through approaches such as incorporating a placebo intervention to less experienced participants. In addition to these considerations, further limitations relate to the evaluation of the discriminant function. Although prescribing psyching-up strategies informed by the function produced significant performance enhancement, the present design did not provide a direct test of the function's effectiveness. All participants received strategies that matched their personality profile, meaning the study did not assess whether mismatched prescriptions would produce comparable or inferior outcomes. Such a comparison is necessary to establish the validity of the function. However, given the competitive level of the recruited athletes and the emotional and financial value they place on performance, assigning potentially inhibitory mismatched strategies would have raised ethical concerns. Future research should therefore examine the reliability and validity of this prescription model in inexperienced or non-competitive samples, ideally through a crossover design in which each participant completes both a matched and an unmatched strategy in separate testing sessions.

A final limitation concerns the control condition. Efforts were made to implement a passive control condition, as informed by the findings in Chapter 2 (see Section 2.3.4.10.1). However,

instructing participants to refrain from thinking about psyching-up may have inadvertently induced ironic processing (Wegner, 1994). According to ironic process theory, attempts to suppress a thought can increase its cognitive accessibility, making the thought more likely to occur. As such, participants in the control condition may have still engaged in elements of psyching-up despite instructions not to do so, potentially reducing the contrast between conditions and attenuating the observed effects. Additionally, the analogy used to support this instruction, “approach this lift with the same mentality you would use to lift your gym bag”, may have influenced lifting mechanics for some participants. Although this risk is likely minimal given the experience level of the recruited athletes, it remains an important consideration. Future research should ensure that maximal force production is held constant while only the psychological preparation strategy varies. Where less experienced participants are recruited, particular care should be taken, as such analogies may inadvertently alter movement execution and, consequently, performance outcomes.

The present findings indicate that prescribing psyching-up strategies based on an athlete’s psychological profile can meaningfully enhance strength performance in experienced strength athletes. Practitioners and athletes seeking acute psychological enhancement should begin by assessing trait anxiety and reward sensitivity using the BIS/BAS scales (Carver & White, 1994) and trait aggression using the BPAQ (Buss & Perry, 1992). These scores can then be entered into the discriminant function, which classifies individuals as requiring either an “arousal-reducing” strategy (*pre-performance routines; positive thoughts, feelings, images and behaviours and goals and performance accomplishments*) or an “arousal-enhancing” strategy (*self-deprecation; negative thoughts, feelings, images and behaviours; stimulation; physical and physiological techniques and aggressive acts*). Once the appropriate category is identified, athletes should

review the specific techniques within the assigned strategies and select those that feel most engaging and natural to perform. It is recommended that athletes complete a six-week familiarisation phase with the strategy to build efficacy and competence with the strategy. This period allows the strategy to be refined, promote flow states and become fully integrated into pre-lift routines before expecting substantial performance benefits.

6.5: CONCLUSIONS

The present study examined the effectiveness of prescribing psyching-up strategies for competitive strength athletes who initially demonstrated sub-optimal strategy effectiveness. Deadlift velocity was assessed against a control condition both before and after a six-week intervention, during which each participant was prescribed a psyching-up strategy matched to their trait anxiety, trait reward sensitivity and trait aggression. Following the intervention, difference in barbell velocity between the psyching-up condition and control condition were substantially greater than those observed during the Baseline. These findings suggest that tailoring psyching-up strategies to individual personality profiles can meaningfully aid strength performance in experienced athletes who present with sub-optimal psyching-up strategies.

Chapter 7: General Discussion

7.1: INTRODUCTION

Within this Chapter, the findings from the present thesis are synthesised. The overarching aim of this thesis was to evaluate the effects of psyching-up on strength performance. To address this aim, this thesis synthesised existing literature on the effectiveness of psyching-up strategies, identified the specific psyching-up techniques and strategies used by strength athletes, examined the prevalence and perceived effectiveness of psyching-up strategies within competitive contexts in relation to performance outcomes, assessed their direct impact on performance and determined whether psyching-up interventions can be systematically tailored to individual psychological profiles to enhance performance. A summary of the thesis structure, research aims, study designs and key findings for each Chapter is presented in Table 7.1. The following sections will first summarise the key findings of the thesis, before discussing their broader significance, how this research can be conceptualised to current theoretical models and applied implications. Subsequently, the strengths and limitations of the research will be evaluated, followed by recommendations for future research directions and a concluding synthesis.

Table 7.1
Overview of PhD Thesis Structure, research aims, designs and key findings

Thesis Chapter	Title	Aims	Study Design	Key Findings
Chapter 2	The Effects of Psyching-Up on Maximal Force Production: A Systematic Review	<ul style="list-style-type: none"> To evaluate the efficacy of psyching-up strategies on maximal force production To assess methodological quality and moderating factors influencing outcomes 	Systematic Review	<ul style="list-style-type: none"> 65% of studies assessing psyching-up reported performance enhancement relative to control conditions Greater performance gains were observed among more experienced athletes. Psyching-up demonstrated higher effectiveness when compared to active, rather than passive, control conditions
Chapter 3	Identifying The Psyching-Up Strategies Used in Strength-Sports: A Concept Mapping Approach	<ul style="list-style-type: none"> To identify psyching-up strategies used by strength athletes To assess athlete and coach perceptions of the strategies' impact on performance To examine demographic differences in perceived effectiveness of the strategies 	Mixed-methods participatory concept mapping approach	<ul style="list-style-type: none"> Eight psyching-up strategies identified, grouped into “arousal-reducing” and “arousal-enhancing” categories <i>Pre-performance routines</i> rated as the most effective overall strategy Male athletes rated four of the five “arousal-enhancing” strategies as more effective than female athletes
Chapter 4	Observing The Use of Psyching-Up Strategies Within Strength-Sport Competitions	<ul style="list-style-type: none"> To investigate the prevalence of psyching-up strategies used during competition To examine strategy-use by classification (arousal-enhancing vs. reducing) and differences by sport and sex 	Nomothetic-Point-Unidimensional-Extensive observational design	<ul style="list-style-type: none"> <i>Pre-performance routines</i> were selected more frequently than all other strategies Male athletes selected “arousal-enhancing” strategies at higher rates than female athletes

		<ul style="list-style-type: none"> • To assess whether psyching-up strategies enhance performance in competition • To explore the relationship between perceived strategy effectiveness and actual performance outcomes 		<ul style="list-style-type: none"> • Competition performance was significantly lower than predicted performance based on training lifts • A weak positive relationship was observed between perceived psyching-up effectiveness and actual competition performance
Chapter 5	The Effects of Psyching-Up on Deadlift Performance in Competitive Strongmen, Strongwomen and Powerlifters	<ul style="list-style-type: none"> • To investigate the effect of psyching-up on deadlift performance in experienced strength athletes • To assess whether the eight psyching-up strategies differ in their impact on performance • To examine whether anxiety sensitivity, reward sensitivity and trait aggression predict strategy selection 	Randomized mixed within- and between-subjects design	<ul style="list-style-type: none"> • The psyching-up condition significantly outperformed the passive control condition • No significant performance differences were found between individual psyching-up strategies. • Selection of “arousal-reducing” or “arousal-enhancing” strategies was associated with trait anxiety, reward sensitivity and aggression.
Chapter 6	Examining The Effectiveness of Prescribing Psyching-Up Strategies Utilising Personality Profiling	<ul style="list-style-type: none"> • To test whether a personality-matched prescription improves deadlift performance in athletes using ineffective psyching-up strategies 	Within-subjects design with two time points, six-weeks apart	<ul style="list-style-type: none"> • Performance relative to the control condition significantly improved following the six-week intervention among participants with ineffective psyching-up at pre-test

7.2: SUMMARY OF KEY FINDINGS

7.2.1: EVIDENCE FOR EFFICACY AND THE NEED FOR CONCEPTUAL EXPANSION

The first study of this thesis involved a systematic review of the existing literature examining psyching-up strategies. Overall, the findings indicated that psyching-up can enhance maximal force production, with 65% of trials reporting improved performance following its use. These results provided support for the general efficacy of psyching-up, yet the evidence was not conclusive. Specifically, 27.5% of trials reported no effect and 7.5% reported detrimental effects from psyching-up on performance. Further scrutiny of the findings indicated that prescribed preparatory arousal, motivational self-talk, PETTLEP imagery and free-choice psyching-up strategies produced the most consistent improvements in strength performance. In contrast, emotive-imagery, stimulus-only imagery, internal focus of attention and relaxation techniques showed little evidence of effectiveness when attempting to enhance strength performance. Additional findings indicated that psyching-up tended to be more effective among participants with greater competitive and resistance training experience. The type of control condition also appeared to moderate these outcomes. Trials using an active control reported positive psyching-up effects in 68% of trials, whereas those using a passive control reported positive effects in 58% of trials. Finally, an examination of the methodologies used across the included studies revealed notable discrepancies between real-world practice and research approaches to psyching-up, underscoring the need for further investigation into psyching-up strategies.

7.2.2: CLASSIFICATION OF PSYCHING-UP STRATEGIES

The present thesis identified the psyching-up strategies used by strength athletes and examined how effective these strategies were perceived to be within this population. Chapter 3 adopted a concept-mapping design to identify the psyching-up strategies used by strength athletes. An

initial 901 psyching-up techniques were reported, which were refined through a sifting process to 64 individual techniques. These were subsequently grouped into eight strategies: *pre-performance routines*; *positive thoughts, feelings, images and behaviours*; *goals and performance accomplishments*; *self-deprecation*; *negative thoughts, feelings, images and behaviours*; *stimulation*; *physical and physiological techniques* and *aggressive acts* (see Figure 3.1). These strategies could be further classified through their overarching goal of manipulating arousal, with *pre-performance routines*; *positive thoughts, feelings, images and behaviours* and *goals and performance accomplishments* being classified as “arousal-reducing” and *self-deprecation*; *negative thoughts, feelings, images and behaviours*; *stimulation*; *physical and physiological techniques* and *aggressive acts* being classified as “arousal-enhancing” (see Figure 3.3). Within Chapter 3 participants rated *pre-performance routines* as the most effective strategy. This perception was further reflected in subsequent Chapters, with *pre-performance routines* being selected most frequently both in a competitive context (see Table 4.2) and within a free-choice psyching-up experimental design (see Figure 5.1). Additionally, findings indicated that male athletes typically perceived *self-deprecation*; *negative thoughts, feelings, images and behaviours*; *stimulation* and *aggressive acts* as more effective than did female athletes, as reflected in both their ratings in Chapter 3 (see Section 3.3.6) and their strategy selections in Chapter 4 (see Table 4.2). Although Chapter 4 attempted to measure strategy effectiveness, the absence of an appropriate baseline measure limited the ability to determine whether these strategies objectively enhanced performance. Consequently, further investigation was required to examine how psyching-up strategies influence performance.

7.2.3: PSYCHING-UP EFFECTIVENESS AND THE INFLUENCE OF PERSONALITY TRAITS

The thesis demonstrated that psyching-up strategies and interventions can enhance strength performance and it identified that personality traits may influence both strategy selection and the effectiveness of psyching-up. Chapter 5 investigated the effect of psyching-up strategies on deadlift performance relative to a passive control condition. Participants identified which strategy they used within training and competition contexts prior to data collection, before using this same strategy as the independent variable. Deadlift performance significantly increased following a psyching-up ($M = 0.39 \text{ m/s} \pm 0.11$) comparative to a passive control condition ($M = 0.34 \text{ m/s} \pm 0.10$). Subsequently, follow up analysis was conducted to investigate whether any strategy reported as being superior, with no significant difference reported between the strategies. However, discriminant analysis indicated that strategy selection was influenced by personality traits. Specifically, high levels of trait reward sensitivity and trait aggression in addition to lower levels of trait anxiety predicted the selection of “arousal-enhancing” strategies. Informed by this function, Chapter 6 provided psyching-up interventions to participants who presented as having ineffective psyching-up strategies. The findings from this Chapter reported that performance enhancement significantly increased following a six-week intervention for those who initially presented with sub-optimal performance from their pre-existing psyching-up strategy. This suggests that adopting a psyching-up intervention, informed by personality traits, can be used to meaningfully enhance performance for those presenting with psych-up strategies that are ineffective.

7.3: SIGNIFICANCE OF THE PRESENT FINDINGS

7.3.1: EVIDENCE FOR EFFICACY AND THE NEED FOR CONCEPTUAL EXPANSION

The first study of the present thesis was a systematic review that evaluated the effectiveness of psyching-up strategies on maximal force production. The review demonstrated that psyching-up generally produced favourable outcomes, while also identifying a range of methodological and conceptual factors that may have limited the strength of the evidence. It was the first systematic synthesis to quantify the effectiveness of psyching-up and to highlight key sources of inconsistency within the literature, such as restrictive definitions, poorly defined intervention scripts and variation in participant experience (see Section 2.4). This review therefore provided an essential foundation for the development of psyching-up research, evidencing its potential to facilitate performance while revealing methodological weaknesses that have hindered progress in the field. Several factors were identified as potential explanations for these discrepancies, including the type of control condition employed, the competitive experience of the participants and the specific methods used within intervention scripts (see Table 2.3). These findings not only clarified several of the inconsistencies observed within the existing psyching-up literature but also offered methodological insight that may be generalised to wider sport psychology research. Specifically, the findings suggest that the active control conditions recruited may hinder, as opposed to control performance (Graham & Bray, 2015) and highlighted the importance of recruiting experienced athletes in sport science research (Mitchell et al., 2024).

The thesis also highlighted a lack of thorough exploration of the full range of psyching-up techniques used by strength athletes (see Section 2.4). Several commonly used methods, such as inhaling ammonia (Bartolomei et al., 2018) or listening to music (Kuan et al., 2018), were

excluded because previous definitions of psyching-up restricted the concept to cognitive or internally generated strategies. This limitation can be traced back to an earlier investigation of athletes' psyching-up techniques (Shelton & Mahoney, 1978), which defined psyching-up solely in terms of imagery, self-talk, attentional focus and preparatory arousal. Accordingly, Chapter 2 emphasised the importance of examining the full range of techniques athletes use to psych-up and understanding how these techniques can be categorised. By identifying these gaps, the Chapter established the need for a broader and more inclusive understanding of psyching-up that integrates cognitive, behavioural and physiological components. These insights directly informed the subsequent concept-mapping investigation, which examined how experienced strength athletes naturally perform and categorise psyching-up strategies in practice.

7.3.2: CLASSIFICATION OF PSYCHING-UP STRATEGIES

This thesis provided a comprehensive examination of the psyching-up strategies used in strength-sports and explored how athletes perceive the effectiveness of these strategies. By identifying the specific techniques employed and categorising them into distinct strategies, it offered valuable insight into the psychological preparation methods adopted by experienced athletes. This process advanced current knowledge by highlighting numerous techniques that athletes believe enhance performance but had previously been overlooked in the literature. The distinction between “arousal-reducing” and “arousal-enhancing” strategies further clarified the nuanced ways in which individuals seek to elicit a desired psycho-physiological state. Techniques within the “arousal-reducing” group typically aligned with established sport psychology approaches used to regulate or decrease cognitive and somatic anxiety (see Section 3.4). In contrast, existing research attempting to examine preparatory arousal has often relied on evoking aversive emotions, such as anger (Brody et al., 2000), fear (Murphy et al., 1988) or aggression

(Peynircioğlu et al., 2000). However, arousal is a multidimensional construct and many theoretical models propose that emotional state mediates its impact on performance. Therefore, the techniques identified within the “arousal-enhancing” category provide alternative routes through which athletes may elevate arousal, creating opportunities to examine how different strategies may influence performance across individuals. Overall, the classification of strategies into “arousal-enhancing” and “arousal-reducing” represents an important theoretical development that reflects the natural ways athletes regulate activation states to optimise performance.

Previously, psyching-up strategies had been grouped according to the characteristics of the intervention (e.g., self-talk, imagery or attentional focus) (Tod et al., 2003). However, the present findings indicated that these techniques are often used in combination and serve different purposes depending on whether the athlete seeks to increase or decrease arousal and vary on their preferred methods to elicit this psych-physiological response. For example, whereas previous research treated imagery as a single, isolated strategy, the present findings show that athletes use it in several distinct forms that align with broader sport psychology literature. These include task-specific imagery (Wright & Smith, 2009) (Technique: 10), pleasant emotive-imagery (Mellalieu et al., 2009) (Technique: 61), unpleasant emotive-imagery (Murphy et al., 1988) (Technique: 1; 38) and energising imagery (Stanley & Cumming, 2010) (Technique: 39; 53). This identification highlighted how previous investigations into psyching-up had adopted a restrictive approach that failed to account for the nuanced differences in strategy use. In response and informed by the arousal-based classification, a revised definition of psyching-up was proposed to better capture this broader variation. This updated definition extends the concept to

include cognitive, behavioural and physiological processes, providing a more comprehensive framework for examining psyching-up within both applied and experimental contexts.

In addition to identifying these strategies, the present research examined how they were perceived and adopted by athletes. These investigations revealed consistent meaningful differences between sexes across three separate studies. Specifically, across Chapters 3 to 5, male athletes consistently rated and selected *self-deprecation, negative thoughts, feelings, images and behaviours; stimulation and aggressive acts* as more effective, or at greater rates than female athletes. These findings suggest that psyching-up preferences may be shaped by underlying psychological or motivational factors, such as differences in arousal interpretation or sensitivity to anxiety, aligning with established arousal theories (e.g., IZOF; Reversal Theory; Catastrophe Theory). This represents an important direction for future research, which should investigate the mechanisms underlying these sex-based differences to better understand how individual characteristics influence the use and effectiveness of psyching-up strategies.

7.3.3: PSYCHING-UP EFFECTIVENESS AND THE INFLUENCE OF PERSONALITY TRAITS

The findings from Chapters 5 and 6 provide further support for the wider body of research reviewed in Chapter 2, demonstrating that psyching-up enhances performance. In Chapter 5, experienced lifters who selected their preferred psyching-up strategy showed improved performance compared to a passive control condition. In Chapter 6, athletes who initially reported and displayed ineffective psyching-up strategies exhibited significant performance improvements following a six-week intervention designed to optimise their psychological approach to training. These studies collectively provided the first empirical examination of the strategies identified in Chapter 3 and were the first to recruit competitive strength athletes,

offering strong ecological validity. Together, these findings demonstrated that when psyching-up strategies are applied in ways consistent with real-world strength-sport practice, they can meaningfully enhance performance. This also helps to explain inconsistencies in earlier research, where narrow methodologies or non-athlete samples may have limited observed effects. Overall, these findings offer valuable guidance for practitioners seeking to facilitate performance enhancement through the structured use of psyching-up techniques. Future research should aim to replicate and extend these findings to test their validity and generalisability across different sports and performance settings.

The present thesis also provided evidence that psyching-up strategies may be influenced by individual differences in personality traits. Within this thesis, differences in perceived effectiveness were reported between males and females for four of the five “arousal-enhancing” strategies (see Section 3.3.6). These differences were further reflected within Chapter 4 with males selecting “arousal-enhancing” strategies at a much greater rate than females (see Section 4.3.1.3). These findings resulted in theorising these sex differences may reflect differences in trait reward sensitivity, trait anxiety sensitivity and trait aggression (see Section 4.4).

Accordingly, these traits were assessed using established personality measures. Within this thesis, the BIS/BAS Scale (Carver & White, 1994) was selected to measure reward and anxiety sensitivity, while the BPAQ (Buss & Perry, 1992) was used to assess trait aggression. Although alternative measures may have offered a more nuanced or context-specific assessment, the selection of these instruments was considered appropriate for the aims of the thesis. For example, a sport-specific measure of anxiety such as the CSAI-2 (Martens et al., 1990) may have provided greater contextual insight. Similarly, the RST-PQ (Corr & Cooper, 2015) offers a more detailed personality-based assessment of both anxiety and reward sensitivity. However, the inclusion of

the CSAI-2 would have required an additional measure to capture reward sensitivity, while the RST-PQ comprises 84 items, increasing participant burden. In contrast, the BIS/BAS scale provides a concise format of 24 items while still demonstrating validity (e.g., Diego et al., 2001) and aligning with the aims of the thesis. To assess trait aggression, the STAXI-2 (Spielberger, 1999) may have provided greater context-specific insight into anger expression. However, given the research questions within this thesis, the BPAQ offered a more comprehensive assessment of general trait aggression, capturing multiple dimensions including physical aggression, verbal aggression, anger and hostility.

Accordingly, subsequent investigation in Chapter 5 demonstrated that trait anxiety, trait reward sensitivity and trait aggression can predict the selection of “arousal-reducing” or “arousal-enhancing” strategies (see Section 5.3.1) while later also using these traits to inform strategy selection for an intervention (see Figure 6.1). This intervention was guided by a discriminant function identified in Chapter 5, which, if shown to be reliable and valid through future research, holds considerable potential for practitioners and researchers. Should the function demonstrate good validity and reliability it would enable personality-matched prescription of psyching-up strategies as a practical means of improving strength performance, with direct benefits for strength athletes and possible indirect benefits for athletes in other sports. Specifically, it offers a personality-matched approach to prescribing psyching-up strategies, allowing for more precise and individualised applications. Importantly, these findings may help explain the equivocal results reported in previous psyching-up research (see Section 2.4), as prior interventions may have been mismatched to participants’ underlying traits. They also provide a novel theoretical contribution, suggesting that individual differences in sensitivity to anxiety and reward in addition to trait aggression may influence how athletes experience and respond to arousal. This

offers a potential explanation for why individuals can exhibit different performance outcomes under similar levels of physiological activation. Future research should therefore examine the reliability and validity of the discriminant function and explore whether the relationships between the aforementioned traits and arousal generalise across other sports and performance contexts, further aligning with and refining existing arousal-based theoretical models.

7.4: THEORETICAL IMPLICATIONS AND CONCEPTUAL INTEGRATION

Given that the primary function of psyching-up is to modify an athlete's state arousal (see Section 3.4), the following section interprets the present findings in relation to established theoretical models of arousal. This thesis did not test these theoretical models directly but positions them as interpretive frameworks that help contextualise the findings. Although the present thesis did not measure state arousal directly, interpretations are informed by the psychophysiological effects associated with the techniques identified within the "arousal-enhancing" and "arousal-reducing" strategies (see Section 3.4). Further interpretations are made, where appropriate, regarding perceived facilitation and strategy use. In studies where these perceptions were not directly measured, it is assumed that athletes selected strategies they believed would facilitate their performance. Specifically, the discussion will examine how the results align with three dominant frameworks within sport psychology: the IZOF model, reversal theory and the catastrophe model, before evaluating which of these appears to receive the greatest empirical support from the present work.

7.4.1 THE IZOF MODEL

The IZOF model proposes a curvilinear relationship between arousal and performance (Hanin, 2000). Specifically, performance improves as arousal increases, but only up to a critical "optimal

zone,” beyond which further increments in arousal lead to performance decrements. The model emphasises that these optimal zones are unique to each individual and are influenced not only by the intensity of arousal but also by how the individual interprets that state, including whether it is experienced as pleasant or unpleasant and whether it is perceived as facilitative or debilitating to performance (Hanin, 2000). As a result, two athletes experiencing similar levels of physiological arousal may display very different performance outcomes depending on their subjective interpretation of that state.

The present findings provide meaningful evidence supportive of the IZOF model. Across Chapters 3 to 6, consistent evidence emerged that athletes adopt markedly different approaches to manage and regulate arousal, even when competing at comparable levels. Athletes of similar experience often selected contrasting psyching-up strategies to achieve optimal performance. Moreover, both demographic and personality differences were shown to influence perceptions of strategy effectiveness, particularly between “arousal-reducing” and “arousal-enhancing” strategies. This variability reflects the IZOF model’s core proposition that individual differences in the perception and regulation of arousal determine performance outcomes. Further support for the IZOF framework can be drawn from the patterns observed within each arousal-based classification. For instance, within the “arousal-reducing” group, strategies such as *self-deprecation* and *negative thoughts, feelings, images and behaviours* rely on unpleasant emotional thoughts to elicit a psychophysiological response (see Table 3.2). These athletes may therefore experience unpleasant emotions yet appraise them as facilitative, enabling optimal performance within their individual zone of functioning. In contrast, the *physical and physiological techniques* strategy appears to generate comparable increases in arousal through overt bodily actions rather than negative affect (see Section 3.4), suggesting that some athletes elevate arousal to achieve

optimal activation absent of unpleasant emotions. These interpretations are further supported by the observed relationships between personality traits and strategy selection. Athletes high in trait anxiety were less likely to select an “arousal-enhancing” strategy, specifically if they did not present with high levels of reward sensitivity or trait aggression. Athletes displaying high levels of either reward sensitivity or trait aggression may possess sufficient approach motivation to override the threat appraisal typically associated with high trait anxiety (e.g., Berkman et al., 2009; Harmon-Jones & Sigelman, 2001). For those high in reward sensitivity, heightened arousal may be reinterpreted as thrilling or exciting (Buckley, 2016), while those high in trait aggression may channel this activation toward assertive or confrontational behaviour, perceiving it as energising and goal-directed rather than threatening (Harmon-Jones, 2007). Conversely, in the absence of these strong approach-oriented traits, individuals with high sensitivity to their anxiety systems are more likely to interpret increased arousal as debilitating and unpleasant (Horikawa & Yagi, 2012), thus favouring “arousal-reducing” strategies. This collective pattern may help explain why athletes with low reward sensitivity and aggression, when coupled with elevated anxiety sensitivity, tend to function optimally at lower levels of arousal, consistent with the predictions of the IZOF model.

Support for the IZOF model is evident but constrained by missing data. While several findings within the present thesis align with the model’s principles, this interpretation is limited by the absence of information on athletes perceived hedonic states and their appraisal of arousal functionality. Although Chapters 3 and 4 collected detailed data on athletes’ perceptions of their psyching-up strategies and Chapter 5 and 6 measured their effects on deadlift performance, no measures captured whether these strategies were experienced as pleasant or unpleasant. As a result, it is not possible to determine conclusively whether the present findings fully align with

the IZOF model's assumptions. Nevertheless, if future research confirms the inferences proposed in this thesis regarding athletes' hedonic experiences and perceived functionality of their chosen strategies, the present work may extend the IZOF framework. Specifically, it highlights the potential role of personality traits in shaping individual zones of optimal functioning, offering meaningful implications for applied sport psychology and performance enhancement across a range of disciplines.

Overall, the present thesis provides partial support for the IZOF model. Clear disparities were observed between "arousal-reducing" and "arousal-enhancing" strategies, with personality traits appearing to influence these preferences. Additional inferences within each arousal classification suggest potential differences in the hedonic states sought by athletes (see Table 3.2). If these inferences are confirmed, the findings would not only reinforce the IZOF model but also extend it by identifying personality traits that may shape individual optimal zones. However, the absence of direct data on the hedonic states elicited by psyching-up strategies, along with limited information on perceived functionality, constrains the extent to which the present thesis can conclusively support the model.

7.4.2 REVERSAL THEORY

Reversal theory describes a dynamic relationship between arousal and performance, governed by reversals between opposing motivational and hedonic states (Apter, 1982). Specifically, when a high-arousal state is interpreted as excitement, performance is likely to improve, whereas perceiving the same state as threatening may lead to deterioration (Kerr, 1985). Likewise, low-arousal states can be either facilitative or debilitating depending on whether they are experienced as calmness or boredom, respectively (Bellew & Thatcher, 2002). These perceptions are not

fixed but can be “reversed” at any moment according to the athlete’s prevailing motivational state (Kerr, 1985).

The present thesis found some evidence for the reversal theory. Comparisons of athletes’ perception ratings for the techniques and strategies identified in Chapter 3 (see Table 3.2) revealed differences in the perceived facilitative nature of these strategies, with subsequent findings in Chapter 5 (see Section 5.3.1) suggesting that such differences are partly influenced by trait anxiety. As Chapter 5 used strategy selection as the dependent variable, it can be inferred that athletes perceived their chosen strategies as facilitative to performance. This pattern aligns with reversal theory, which proposes that individuals who interpret high-arousal states as anxiety are likely to experience performance decrements, thereby preferring techniques designed to lower or regulate arousal, as reported within Cluster 1 - 3 in Table 3.2 (e.g., Technique: 26 (Luo et al., 2025); Technique: 4 (Chin et al., 2024); Technique: 56 (Williams & Cumming, 2016)). The author speculates that this behavioural preference may reflect previous experiences of high-arousal states being perceived as debilitating. Conversely, athletes who favoured high-arousal strategies may have developed positive associations with these states, perceiving them as energising or thrilling. These facilitative interpretations of arousal may be driven by stronger approach orientations, which promote engagement with challenging or threatening situations and are often associated with higher levels of trait reward sensitivity (Spielberg et al., 2013) or trait aggression (Harmon-Jones, 2007).

A key feature of reversal theory is the rapid and often unpredictable switching between motivational states (Kerr, 1985). In an instant, an individual may shift from perceiving arousal as excitement to anxiety, or from calmness to boredom, resulting in impaired performance (Shepherd et al., 2006). However, the findings from this thesis did not provide any indication that

athletes underwent the unpredictable motivational state switches outlined in reversal theory. It must be acknowledged that the methodologies used were not specifically designed to examine rapid motivational reversals, yet the available data did not indicate any evidence of such changes. Conversely, the findings within the present thesis would indicate consistent effect of psyching-up, showing few indications of switching between approaches. Moreover, those who displayed sub-optimal performance in Chapter 6 were primarily limited by inconsistency in applying their chosen strategy (see Section 6.4), rather than by reversals in motivational state. Additionally, participants reported consistently positive perceptions of their strategy use in competition (see Table 4.2). On a scale from 0 to 4, the 99 competitors rated their chosen strategy as highly effective, with a mean of 3.28 and a standard deviation of 0.82. If reversal theory were strongly influencing strategy effectiveness in this context, one might expect greater fluctuation in these ratings, particularly given the competitive intensity of the events and the sample size. Frequent shifts in motivational state should lead to more variable experiences and interpretations of psyching-up. The relatively stable perceptions observed here therefore raise questions about the extent to which reversal theory accounts for psyching-up experiences in strength-sports.

Overall, the present thesis does not provide compelling evidence in support of reversal theory. While some observations suggest that differences in personality profiles may influence behavioural responses and help explain athletes' consistent selection of psyching-up strategies, there was no indication of unstable or rapidly shifting responses to arousal states driven by motivational factors. Although the studies within this thesis were not specifically designed to test reversal theory, if its principles had been operating strongly, evidence of such reversals would likely have emerged, particularly within the competition data presented in Chapter 4.

7.4.3 CATASTROPHE MODEL

The catastrophe model proposes a curvilinear relationship between arousal and performance that is moderated by cognitive anxiety (Fazey & Hardy, 1988). Specifically, when cognitive anxiety is low, performance tends to increase with arousal up to an optimal point, beyond which it gradually declines. However, when cognitive anxiety is high, performance will also increase with arousal until reaching a critical threshold, after which a sudden and dramatic (“catastrophic”) drop in performance is expected.

The observed patterns within the present thesis show only limited correspondence with the predictions of the catastrophe model. Across several Chapters, evidence was observed suggesting that anxiety sensitivity can influence psyching-up strategy selection (see Section 5.4). This pattern aligns with the model’s core premise that the interaction between arousal and cognitive anxiety can produce non-linear performance outcomes. Given that experienced athletes should typically select strategies they have previously found to enhance performance, it is plausible that cognitive anxiety shaped whether they chose “arousal-reducing” or “arousal-enhancing” approaches. Specifically, athletes who had previously attempted “arousal-enhancing” strategies but experienced performance decrements consistent with a catastrophic drop may have subsequently adopted “arousal-reducing” methods to avoid repeating such outcomes. Conversely, athletes with lower trait anxiety, who are less likely to experience intense cognitive anxiety alongside heightened arousal states (Horikawa & Yagi, 2012), appeared to favour “arousal-enhancing” strategies. For these individuals, increased arousal may have facilitated performance up to an optimal threshold, beyond which performance declined gradually rather than catastrophically. Collectively, these findings provide tentative support for the catastrophe model, with inferences suggesting that individuals with greater trait anxiety sensitivity,

experience greater cognitive anxiety which may inhibit performance under high-arousal conditions.

The present thesis did not provide definitive evidence to support the catastrophe model. No reports indicated that athletes experienced a catastrophic drop in performance. This absence may, in part, reflect the lack of exploratory investigation into why athletes selected their strategies or whether they had previously experienced symptoms indicative of such performance collapses. Consistent with the observations discussed in the reversal theory section, the data from the observational study in Chapter 4 revealed no evidence of abrupt performance deterioration, a finding further supported by the stable perceived effectiveness ratings of psyching-up strategies reported in Table 3.2. Although the findings suggest that trait anxiety influences how athletes regulate arousal through psyching-up, there was no direct measure to determine whether this relationship was driven by cognitive anxiety specifically, or whether a catastrophic decline in performance occurred as cognitive anxiety increased. Further research is therefore required to examine how psyching-up might operate within the framework of the catastrophe model. The limited support presented here likely reflects the nature of the research design rather than a complete incompatibility between the model and the phenomena studied.

Overall, the present thesis provides limited support for the catastrophe model. While the findings suggest that anxiety may influence the selection and effectiveness of psyching-up strategies, there was no evidence of the abrupt performance declines characteristic of a catastrophic response. The results are therefore only partially consistent with the model's assumptions, indicating that increases in arousal and anxiety may impair performance in a more gradual and controllable manner than the model predicts. The absence of direct measures of cognitive anxiety further limits the extent to which these findings can substantiate the model. Consequently,

although the catastrophe model offers a useful framework for understanding the interaction between arousal and psyching-up, it appears less applicable to the stable performance patterns demonstrated by the strength-sport athletes recruited in the present thesis.

7.4.4 SUMMARY

The preceding sections explored how the present findings correspond with the frameworks of the IZOF model, reversal theory and the catastrophe model. Collectively, these discussions indicated that while each theory offers some explanatory value, the degree of support from the current work varied across models. Among the three, the findings most strongly align with the IZOF model. Each framework proposes that arousal and performance are influenced by anxiety, typically resulting in performance decrements when poorly regulated. This pattern was reflected in the present data, as trait anxiety partly predicted the selection of psyching-up strategies and informed the prescription of strategies used in the intervention. However, the mechanisms proposed by reversal theory, which suggest that performance is moderated by rapid motivational reversals and those central to the catastrophe model, which predict a sudden decline in performance under high cognitive anxiety, were not observed in the present research. In contrast, the stability of strategy use and the perceived effectiveness reported by athletes appear more consistent with the IZOF framework. It may therefore be inferred that athletes tended to select strategies they perceived as facilitative, even when these involved either pleasant or unpleasant emotional states, supporting the model's emphasis on individualised optimal zones. Furthermore, the findings may add nuance to the IZOF model by suggesting that personality traits influence how athletes interpret and regulate their emotional states. Individuals with higher levels of reward sensitivity and trait aggression, combined with lower levels of trait anxiety sensitivity, may be more likely to perceive heightened arousal as facilitative rather than debilitating.

However, further research that directly examines perceptions and arousal in relation to IZOF is required before definitive conclusions can be drawn.

A final conceptual consideration relates to the terminology adopted throughout this thesis. As outlined in Chapter 1, the term psyching-up is often interpreted as reflecting attempts to enhance state arousal (Acharya & Morris, 2014). Additionally, some perspectives have distinguished between psyching-up and psyching-down (Steyn et al., 2016), with the latter referring to strategies aimed at reducing activation. While this distinction provides conceptual clarity, the present thesis retained the broader term psyching-up to maintain consistency with both the existing literature and strength sport culture (e.g., Hammoudi-Nassib et al., 2017; Tod et al., 2003; Winwood et al., 2019). Findings across the present research indicate that athletes do not necessarily differentiate between these processes in practice. Specifically, when asked to report how they psych-up, athletes identified a wide range of techniques, including those clearly intended to reduce activation (see Table 3.2). This suggests that, within a strength-sport context, psyching-up reflects a bidirectional process involving both the enhancement and reduction of arousal. However, the lack of consistency in how these terms are used introduces potential ambiguity in their interpretation. Accordingly, it may be argued that arousal regulation provides a more conceptually precise descriptor of the underlying processes identified within this thesis. Nevertheless, the continued use of the term psyching-up remains appropriate within applied contexts, given its widespread recognition and relevance within strength-sport populations, as well as its historical grounding within the strength-sports (Mahoney, 1979).

7.5: APPLIED IMPLICATIONS

The findings from the present thesis offer valuable insights that can inform applied practice within sport. Given the importance of research-led practice in sport psychology, it is essential that empirical evidence contributes directly to guiding practitioners toward effective methods. All four studies recruited experienced strength athletes, which enhance the ecological validity of the work and ensures that the findings are directly applicable to those who train and compete at a high level. This also means the outcomes can more confidently inform the practice of experienced practitioners, who require evidence that reflects the demands of high-performance sport. This subsection outlines how the current findings can support practice within strength-sports and how these principles may be applied more broadly across other sporting contexts.

The discriminant function reported in Chapter 5 offers practitioners an invaluable tool for guiding the selection of psyching-up strategies (see Section 5.3.1). As psyching-up primarily involves the regulation of physiological arousal (see Section 3.4), adopting strategies aligned with established models of arousal is essential. The findings from this thesis indicate that an individual's optimal level of functional arousal is influenced by differences in trait anxiety sensitivity, reward sensitivity and aggression (see Section 5.3.1). Accordingly, practitioners seeking to prescribe or recommend an appropriate psyching-up strategy can utilise psychometric assessments such as the BIS/BAS scales (Carver & White, 1994) and the BPAQ (Buss & Perry, 1992), inputting the total scores into the function outlined in Section 5.3. The results of this function can then be interpreted to guide strategy selection. For example, if an athlete is classified within the "arousal-enhancing" category, their total BPAQ score may further inform the most suitable strategy. Individuals with higher levels of trait aggression, who typically display increased activation in approach motivation regions of the brain (Harmon-Jones &

Sigelman, 2001), may respond particularly well to more aggressive psyching-up strategies, such as those involving controlled expressions of aggression. To further inform the decision, practitioners may also draw upon the perceived effectiveness ratings reported by athletes within this thesis. Table 3.2 presents the mean ratings for each strategy and technique, derived from 112 experienced strength athletes. Additional insight can be gained by examining the strategies selected during both competition (see Table 4.2) and controlled laboratory settings (see Table 5.4). Across these Chapters, a consistent trend emerged, with *pre-performance routines* rated as the most effective and most frequently selected strategy overall. This suggests that practitioners working with athletes classified as suiting “arousal-reducing” strategies may find *pre-performance routines* a reliable and well-tolerated option. In contrast, for those classified as requiring “arousal-enhancing” strategies, *stimulation* was rated highest within Chapter 3 and was the most frequently selected “arousal-enhancing” approach within Chapter 5. For further refinement, Table 5.4 details the average performance enhancement associated with each strategy; however, these findings should be interpreted cautiously given the limited statistical power arising from unequal strategy selection frequencies. Ultimately, while matching strategy type to personality profile is an important step, this process should be collaborative. Practitioners are encouraged to engage athletes in the selection and refinement of their chosen strategy to ensure it aligns with their preferences and feels both natural and sustainable in practice.

Within any sporting context, providing athletes with autonomy is imperative (Occhino et al., 2014). Autonomy-supportive approaches have been shown to enhance intrinsic motivation (Mageau & Vallerand, 2003) and promote positive performance outcomes across a range of sports (e.g., judo (Gillet et al., 2010); volleyball (Perlman, 2014); golf (McKay & Ste-Marie, 2020)). The importance of autonomy in strategy selection was consistently evident throughout

the studies within the present thesis. As identified in Chapter 2 (see Section 2.4.5), existing empirical evidence indicated that free-choice psyching-up strategies were the most effective broad approach to facilitating performance. Similarly, the extensive range of techniques identified in Chapter 3 ($n = 901$) demonstrated the diversity of methods used by strength athletes to psych up. Although these were refined and categorised into 64 distinct techniques, each could still be performed in various ways, reflecting a high degree of personalisation and flexibility in how athletes engage with their psyching-up process. Practitioners should therefore aim to facilitate and inform, rather than prescribe set methodologies, allowing athletes to exercise autonomy when developing their strategies. The discriminant function reported in Chapter 5 further supports this approach, as personality traits were found to predict whether an athlete would benefit more from “arousal-reducing” or “arousal-enhancing” strategies. This enables athletes to be actively involved in constructing their own personalised psyching-up approach, informed by evidence-based guidance yet adaptable to individual preference. This philosophy was implemented within the intervention study reported in Chapter 6, where collaboration between researcher and athlete was central. Strategies were developed in partnership, refined through ongoing feedback and adjustment, ensuring each athlete could develop an approach that was both effective and personally meaningful.

Once a strategy has been identified and techniques selected, it is imperative to maintain flexibility within these choices. The techniques adopted should reflect behaviours that are appropriate and comfortable for the individual engaging with the strategy. For example, if an athlete feels uncomfortable performing highly disruptive behaviours within a gym setting, selected techniques should prioritise covert methods, regardless of their classification. Each strategy contains a range of techniques that can be aligned with personal preferences and

modified to suit the individual. Ensuring that the athlete feels comfortable with their behaviours within the context of their environment can help to reduce anxiety (Dehkordi & Chtourou, 2023) and promote the emergence of flow (Jackson, 1995), both of which are associated with optimal performance (Koehn, 2017; Miruna & Laura, 2023). This applies irrespective of whether the athlete's goal is to reduce or enhance arousal. Once the strategy has been collaboratively developed, it is recommended that practitioners allocate a familiarisation period. This phase allows the athlete to conduct a "dress rehearsal" of their strategy to understand the sequence and purpose of each technique, while also serving an educational function. Specifically, practitioners should explain the underlying rationale for the selected techniques and the overarching strategy (see Table 5.1), including the typical cognitive and somatic sensations that may arise. For athletes adopting "arousal-enhancing strategies", these sensations may include butterflies (Lai et al., 2023), increased heart rate (McCorry, 2007) or trembling (Pohjavaara et al., 2003). Conversely, athletes employing "arousal-reducing" strategies may experience a reduction in the aforementioned effects, accompanied by feelings of calmness, control, or satisfaction (Wells et al., 2012). Educating athletes about the potential benefits of these sensations can enhance perceived competence and confidence in their chosen strategy (Neil et al., 2006). Following the familiarisation phase, it is important that both the practitioner and athlete recognise that the development of a psyching-up strategy is an evolving and adaptive process. As such, ongoing reflection and adjustment should be encouraged to ensure the strategy continues to meet the needs of the athlete and remains consistent with the aforementioned principles of autonomy and individualisation.

During the intervention period, it is important that practitioners maintain regular communication with athletes to monitor their experiences and perceptions of the strategy. Following strategy

development, a six-week familiarisation and implementation period is recommended prior to any major competition or formal testing of effectiveness. Although Chapter 6 indicated that training volume, frequency, or prevalence of strategy use did not influence effectiveness (see Section 6.3), each participant incorporated their prescribed strategy within their regular training for six weeks. Future research may explore whether integrating mental rehearsal as a supplementary cognitive practice undertaken independently of performance could further strengthen learning and consolidation. In this context, PETTLEP-based imagery can be utilised as a form of mental rehearsal, which has demonstrated effectiveness in developing physical skills (Afrouzeh et al., 2015) and emotional regulation (Ramsey et al., 2010), suggesting that similar mechanisms may support the longer-term development of psychological strategies such as psyching-up. However, as the present findings did not examine this approach, the six-week period outlined in Chapter 6 is recommended for applied practice. Throughout this phase, maintaining collaboration with the athlete is essential to ensure understanding of the strategy's purpose, expected sensations and intended psychological effects (see Section 6.4). Within this study, continued communication allowed the researcher to further educate the athlete based on their experiences and to refine the strategy in line with their preferences. This process helped to build the athlete's confidence and clarified the psycho-physiological responses they should expect from the strategy. By revisiting the aims of the strategy and exploring their psycho-physiological responses, such as experiencing a clear mind or calmness, practitioners can help athletes recognise these sensations as desirable outcomes consistent with optimal functioning for their personality profile. Educating athletes about these responses enhances their understanding of the strategy, increases perceived competence and confidence and ultimately facilitates greater performance enhancement.

7.6: STRENGTHS AND LIMITATIONS

7.6.1 STRENGTHS OF THE PRESENT RESEARCH

One prominent strength of the present thesis lies in its programmatic and progressive research design. The research was intentionally structured to progress systematically from theoretical exploration to applied intervention. Beginning with a systematic review that synthesised existing evidence and identified key gaps in the psyching-up literature, subsequent studies then examined how psyching-up strategies are defined, categorised and applied within competitive settings. Building on these findings, the later experimental studies tested the effectiveness of these strategies, identifying the personality traits that influence strategy selection and psyching-up effectiveness. These insights informed the development and testing of a tailored psyching-up intervention in the final study. Accordingly, each study was deliberately designed to build upon the preceding one, enabling theoretical refinement, methodological advancement and the accumulation of a coherent body of knowledge. This sequential approach strengthened the internal consistency of the thesis and ensured that the later investigations were empirically informed, resulting in a theoretically grounded and practically applicable framework for psyching-up in strength-sports.

A further strength of the thesis lies in the adoption of a mixed-methods concept mapping design in Chapter 3. This approach provided a comprehensive and ecologically grounded understanding of how psyching-up is conceptualised and applied by athletes and coaches in real-world settings. The design revealed major discrepancies between the controlled and reductionist methods commonly employed in empirical research (see Chapter 2) and the multifaceted ways in which athletes implement psyching-up strategies in practice. Specifically, it demonstrated that the psychological techniques typically examined in isolation within experimental studies are often

used concurrently and interactively in applied environments, with only one previous study ((Slimani & Chéour, 2016); see Section 2.4.6) recognising this overlap. The findings also highlighted the frequent use of external stimuli such as music, environmental factors or interpersonal cues as integral components of psyching-up routines, which has been largely overlooked in existing literature. Through this process, eight overarching strategy clusters were identified, extending and refining the original four strategies proposed by Shelton and Mahoney (1978). These findings demonstrated that strategies are better differentiated by the desired outcome they seek to produce and the distinct mechanisms through which they achieve this effect, rather than categorising them by the psychological skill themselves (i.e., self-talk, preparatory arousal, imagery and attentional focus). This study therefore represented both a methodological and conceptual advancement, bridging the gap between laboratory-based research and applied practice and providing a more ecologically valid foundation for the empirical testing conducted in Chapters 5 and 6.

Finally, a major strength of the thesis lies in the recruitment of experienced and high-level strength athletes across all studies. Sport science research frequently relies on student or recreational samples, with limited representation of elite or competitive athletes (Burke & Peeling, 2018). This limitation is particularly evident within sport psychology (Lochbaum et al., 2022). Consequently, a considerable gap has emerged between empirical research and applied practice, leading many practitioners and researchers to question the generalisability of scientific findings to competitive settings (Mitchell et al., 2024). By recruiting experienced athletes, the present thesis directly addressed this gap and enhanced both the ecological validity and applied relevance of its findings. The inclusion of these athletes enabled a more detailed examination of how psyching-up strategies are used, why they are adopted and how they align with existing

theoretical models of arousal. Observing these strategies in authentic competition settings provided valuable insight into how seemingly contrasting methods can each facilitate performance when applied appropriately. Allowing experienced athletes to perform their chosen strategies within controlled experimental conditions offered empirical support for their effectiveness, while the final intervention study demonstrated that modifying or tailoring these strategies can meaningfully enhance performance among athletes whose existing approaches were ineffective. Collectively, the recruitment of experienced strength athletes strengthened the methodological rigour, ecological validity and applied impact of the thesis.

7.6.2 LIMITATIONS OF THE PRESENT RESEARCH

Despite the meaningful contributions of the present thesis, several limitations should be acknowledged. First, the findings from Chapters 5 and 6 may have been influenced by the absence of participant blinding. This is a common challenge within psychology research, as interventions are often overtly delivered and cannot easily be disguised from participants (Juul et al., 2021). Because the purpose of the study was transparent, participants were likely aware of the desired outcome, which may have elicited demand characteristics. Specifically, in Chapter 5, participants may have intentionally or unintentionally underperformed in control conditions to demonstrate that psyching-up strategies enhance performance. This tendency could have been reinforced in Chapter 6, as participants recognised that the intervention phase was explicitly designed to improve performance. The potential for bias may have been heightened by the experience level of the participants, particularly in Chapter 5. Having developed their own psyching-up strategies over many years, these athletes may have displayed a self-serving bias, performing in ways that supported their personal belief in the effectiveness of their preferred techniques. Although a sham condition could potentially minimise such expectancy and self-

serving effects, this was not feasible in the current design. Participants in Chapter 5 were instructed to use self-selected strategies, meaning a sham would not address the motivational bias to excel in their chosen approach. Similarly, in Chapter 6, introducing a sham would have required participants to repeatedly practice both real and placebo strategies, which could have disrupted training or competition preparation and raised ethical concerns.

A further limitation concerns the performance context. The experimental tasks in Chapters 5 and 6 were conducted under controlled settings, where participants performed submaximal deadlifts that they were confident they could lift. This differs from typical competitive or maximal-effort scenarios that naturally induce higher arousal levels. Because the functionality of arousal is often considered to operate within an optimal zone, these controlled conditions may have constrained the true effectiveness of psyching-up strategies. Participants performing under low-arousal conditions may not have reached the levels of activation required for their strategies to exert maximal influence. This issue is particularly relevant for athletes employing “arousal-reducing” strategies, who may have already been operating at or below their optimal arousal level, thereby further reducing activation. Conversely, “arousal-enhancing” strategies may also have been limited in effect, as participants were not exposed to arousal-inducing stimuli that typically accompany maximal or competitive performance. However, given the high level of experience among participants, it is plausible that many were able to self-regulate arousal to near-optimal levels even within a controlled environment.

The absence of quantitative measures of arousal represents a limitation in the interpretation of the present findings. The higher-order classification of strategies as “arousal-reducing” and “arousal-enhancing” was therefore based on inference, grounded in the techniques identified in Chapter 3 (see Table 3.2), rather than direct physiological assessment. While these classifications

were theoretically informed, a more comprehensive evaluation of psychophysiological activation would be required to draw definitive conclusions regarding the mechanisms underpinning performance changes. Future research could address this limitation through the inclusion of objective physiological measures. For example, indices such as heart rate (Wascher, 2021), heart rate variability (Mohammadpoor Faskhodi et al., 2023) and blood pressure (Andrade et al., 2019) may provide accessible markers of changes in physiological state. More direct measures, including electrodermal activity (Kettunen et al., 1998), salivary cortisol (McGuigan et al., 2005) and alpha-amylase (Lim, 2018), may offer further insight into autonomic and endocrine responses to psyching-up strategies. The inclusion of such measures would allow for a more robust examination of whether the proposed distinctions between “arousal-reducing” and “arousal-enhancing” strategies are reflected in measurable changes in activation and may also help to identify the extent to which participants engaged in psyching-up during the control condition. It is acknowledged that the inclusion of these measures would have strengthened the rigour and theoretical grounding of the present thesis. However, their omission was primarily due to practical constraints associated with the scale and design of the research, including data collection across multiple training environments and a large sample of competitive athletes. Given that the primary aim of the thesis was to examine the effects of psyching-up strategies on performance, rather than to directly test models of physiological arousal, the chosen approach was considered appropriate. Nonetheless, future research should seek to integrate objective physiological measures to further examine the mechanisms through which psyching-up strategies influence performance.

A final limitation of the present thesis concerns the absence of a more explorative qualitative research design. Given that the thesis primarily investigated previously unexplored strategies,

identified only within Chapter 3, incorporating either mixed-method or qualitative approaches could have provided a richer understanding of psyching-up. Specifically, Chapters 4 and 5 could have benefited from a qualitative design that explored the underlying processes, purposes and outcomes associated with the strategies examined. In these studies, experienced participants were recruited to demonstrate the effectiveness of their chosen strategies; therefore, follow-up or pre-study interviews could have offered valuable insight into how these strategies were applied and perceived. The greatest potential value of a qualitative approach, however, would have been within Chapter 6. During the initial discussions with participants being prescribed a strategy, it became evident that these conversations revealed information which may have explained why some individuals were unable to elicit optimal performance. For example, several participants described inconsistencies within their strategy execution, such as using different techniques each time or combining elements from multiple strategies. These discussions also provided insight into how their physiological symptoms manifested and why they aligned with their arousal classification, such as reporting symptoms of performance anxiety or experiencing a sense of under activation. Incorporating a qualitative component could therefore have offered readers a more comprehensive understanding of the potential adverse implications of psyching-up, while also deepening insight into how strategies might be more effectively assigned. Moreover, such an approach would have been strengthened by qualitative data gathered within the preceding Chapters, as this would have contextualised why athletes selected particular strategies and demonstrated how the matching process implemented in Chapter 6 was developed.

7.7: DIRECTIONS FOR FUTURE RESEARCH

To establish the efficacy of tailoring psyching-up strategies to individual personality profiles, future research should evaluate the reliability and validity of prescriptions derived from the discriminant function identified in Chapter 5. Despite the present findings demonstrating that the function can be used to inform strategy selection and enhance performance, its efficacy has not yet been tested against mis-matched prescriptions. Future studies should therefore compare performance outcomes between strategies that are matched and those that are mis-matched to an individual's psychological profile. Such work would clarify whether the observed performance enhancement is specifically attributable to the alignment between strategy and personality traits, or merely a general effect of consistent strategy use. Establishing this distinction will provide stronger empirical support for the discriminant function, advancing both theoretical understanding of arousal-performance relationships and its practical application as a valid tool for athletes and practitioners seeking to optimise psyching-up interventions in strength contexts.

Future research should build upon the findings of Chapter 6 by extending the investigation to assess the long-term effects of psyching-up interventions. The present intervention specifically targeted individuals who demonstrated limited performance enhancement from their existing psyching-up strategies and future work should first seek to replicate these findings before evaluating their persistence across an extended period. A valuable next step would involve tracking athletes' performance throughout a competitive season or training year to determine whether the initial benefits of the intervention translate into sustained performance improvements. Within both strong(wo)man and powerlifting, longitudinal data can be collected using publicly available competition results from platforms such as Strength Register and Open Powerlifting. This approach would allow the comparison of pre- and post-intervention

performances, as well as the monitoring of progression trends across multiple competitions. Maintaining semi-regular communication with participants would also provide insight into how these strategies influence training outcomes and competition preparation over time. Powerlifting may serve as an especially appropriate model for this research due to its standardised event structure and consistent performance markers. Establishing whether the improvements observed in Chapter 6 can be maintained or amplified across a season would provide valuable evidence regarding the long-term efficacy and practical value of psyching-up strategies within strength-sport performance.

Once the full extent of psyching-up strategies on strength-sport performance has been explored and understood, future research should examine the potential transferability of these strategies to other sports. While the immediate adoption of psyching-up may hold limited value in fast-paced, continuously changing sporting environments, its application within strength and conditioning contexts could produce meaningful physical adaptations that enhance overall sporting performance. A substantial body of evidence has shown that improvements in strength can positively influence key determinants of athletic success, including speed (Comfort et al., 2014), agility (Hammami et al., 2018) and vertical jump performance (da Rocha et al., 2017). Therefore, if psyching-up strategies are shown to facilitate strength enhancement during training, the resulting adaptations could indirectly contribute to performance improvements in sport-specific contexts. Future research could therefore implement psyching-up interventions within different sporting populations, assessing both strength-related outcomes and sport-relevant performance measures at regular intervals throughout a competitive season.

7.8: CONCLUSIONS

The present thesis provided a comprehensive examination of psyching-up within strength-sports. It began by synthesising existing evidence, demonstrating overall support for psyching-up while highlighting methodological limitations and the need for conceptual expansion. The following studies identified the specific strategies used by strength athletes, grouping them into eight clusters that were classified as either “arousal-enhancing” or “arousal-reducing” and revealed differences in perceived effectiveness between sexes. Subsequent experimental work showed that psyching-up enhanced deadlift performance when athletes used their preferred strategy, with personality traits predicting strategy selection. Finally, an intervention informed by these traits improved performance among those previously exhibiting ineffective psyching-up. Collectively, these findings confirm the efficacy of psyching-up, extend theoretical understanding of arousal regulation through personality-matched differences and provide valuable practical guidance for athletes and practitioners seeking to optimise strength performance.

REFERENCES

- Acharya, J., & Morris, T. (2014). Psyching up and psyching down. In A. G. Papaioannou & D. Hackfort (Eds.), *Routledge companion to sport and exercise psychology* (pp. 386–401). Routledge. <https://doi.org/https://doi.org/10.4324/9781315880198>
- Afrouzeh, M., Sohrabi, E., Haghkhan, A., Rowshani, F., & Goharrokhi, S. (2015). Effectiveness of PETTLEP imagery on performance of passing skill in volleyball. *The Journal of sports medicine and physical fitness*, 55(1-2), 30–36.
- Alderman, B. L., Landers, D. M., Carlson, J., & Scott, J. R. (2004). Factors related to rapid weight loss practices among international-style wrestlers. *Medicine & Science in Sports & Exercise*, 36(2), 249–252.
<https://doi.org/https://doi.org/10.1249/01.mss.0000113668.03443.66>
- Alexander, D. M., Hutt, E. A., Lefebvre, J. S., & Bloom, G. A. (2019). Using imagery to enhance performance in powerlifting: a review of theory, research, and practice. *Strength & Conditioning Journal*, 41(6), 102–109.
<https://doi.org/https://doi.org/10.1519/ssc.0000000000000490>
- Allen, M. S., Greenlees, I., & Jones, M. (2011). An investigation of the five-factor model of personality and coping behaviour in sport. *Journal of sports sciences*, 29(8), 841–850.
<https://doi.org/https://doi.org/10.1080/02640414.2011.565064>
- Allen, M. S., & Laborde, S. (2014). The role of personality in sport and physical activity. *Current directions in psychological science*, 23(6), 460–465.
<https://doi.org/https://doi.org/10.1177/0963721414550705>

- Andrade, D. d. M., Amaral, J. F., Trevizan, P. F., Toschi-Dias, E., Silva, L. P. d., Laterza, M. C., & Martinez, D. G. (2019). Anxiety increases the blood pressure response during exercise. *Motriz: Revista de Educação Física*, 25(3), e101948.
- Apter, M. J. (1982). *The Experience of Motivation: The Theory of Psychological Reversals*. Academic Press.
- Archer, J., & Coyne, S. M. (2005). An integrated review of indirect, relational, and social aggression. *Personality and social psychology review*, 9(3), 212–230.
https://doi.org/https://doi.org/10.1207/s15327957pspr0903_2
- Artioli, G. G., Gualano, B., Franchini, E., Scagliusi, F. B., Takesian, M., Fuchs, M., & Lancha Jr, A. H. (2010). Prevalence, magnitude, and methods of rapid weight loss among judo competitors. *Medicine & Science in Sports & Exercise*, 42(3), 436–442.
<https://doi.org/https://doi.org/10.1249/mss.0b013e3181ba8055>
- Bahari, S. M., Shojaei, M., & Mokhtari, P. (2012). The effect of overt and covert self-talk on the performance of force-production task. *European Journal of Experimental Biology*, 2(4), 1200–1203.
- Balban, M. Y., Neri, E., Kogon, M. M., Weed, L., Nouriani, B., Jo, B., Holl, G., Zeitzer, J. M., Spiegel, D., & Huberman, A. D. (2023). Brief structured respiration practices enhance mood and reduce physiological arousal. *Cell Reports Medicine*, 4(1).
<https://doi.org/https://doi.org/10.1016/j.xcrm.2022.100895>
- Balconi, M., Brambilla, E., & Falbo, L. (2009). BIS/BAS, cortical oscillations and coherence in response to emotional cues. *Brain research bulletin*, 80(3), 151–157.
<https://doi.org/https://doi.org/10.1016/j.brainresbull.2009.07.001>

- Balle, M., Tortella-Feliu, M., & Bornas, X. (2013). Distinguishing youths at risk for anxiety disorders from self-reported BIS sensitivity and its psychophysiological concomitants. *International Journal of Psychology, 48*(5), 964–977.
<https://doi.org/https://doi.org/10.1080/00207594.2012.723804>
- Ballmann, C. G., McCullum, M. J., Rogers, R. R., Marshall, M. R., & Williams, T. D. (2021). Effects of preferred vs. nonpreferred music on resistance exercise performance. *The Journal of Strength & Conditioning Research, 35*(6), 1650–1655.
<https://doi.org/https://doi.org/10.1519/JSC.0000000000002981>
- Barnicle, S., & Lepage, M. (2018). Lifting the mind: A case study of applied sport psychology in powerlifting. *International Journal of Physical Education, Fitness and Sports, 7*(1), 1–5.
<https://doi.org/https://doi.org/10.26524/ijpefs1811>
- Bartolomei, S., Nigro, F., Gubellini, L., Semprini, G., Ciacci, S., Hoffman, J. R., & Merni, F. (2018). Acute effects of ammonia inhalants on strength and power performance in trained men. *The Journal of Strength & Conditioning Research, 32*(1), 244–247.
<https://doi.org/https://doi.org/10.1519/jsc.0000000000002171>
- Barwood, M., Weston, N., Thelwell, R., & Page, J. (2009). A motivational music and video intervention improves time trial performance in warm conditions. *Journal of Sports Science and Medicine, 8*(3), 435–442.
- Beattie, S., & Davies, M. (2010). A test of engagement versus disengagement in catastrophe models. *British journal of psychology, 101*(2), 361–371.
<https://doi.org/https://doi.org/10.1348/000712609x467891>

- Beck, K. (2017). *2017 Official Strongman Games LiveStream & Results*. . Starting Strongman. Retrieved June 6 from <https://startingstrongman.com/2017/12/15/2017-official-strongman-games-livestream/>
- Bellew, E., & Thatcher, J. (2002). Metamotivational state reversals in competitive sport. *Social Behavior and Personality: an international journal*, *30*(6), 613–623. <https://doi.org/https://doi.org/10.2224/sbp.2002.30.6.613>
- Benavides-Ubric, A., Díez-Fernández, D. M., Rodríguez-Pérez, M. A., Ortega-Becerra, M., & Pareja-Blanco, F. (2020). Analysis of the load-velocity relationship in deadlift exercise. *Journal of Sports Science & Medicine*, *19*(3), 452.
- Berkman, E. T., Lieberman, M. D., & Gable, S. L. (2009). BIS, BAS, and response conflict: Testing predictions of the revised reinforcement sensitivity theory. *Personality and Individual Differences*, *46*(5-6), 586–591. <https://doi.org/https://doi.org/10.1016/j.paid.2008.12.015>
- Bernstein, A., Zvolensky, M. J., Vujanovic, A. A., & Moos, R. (2009). Integrating anxiety sensitivity, distress tolerance, and discomfort intolerance: A hierarchical model of affect sensitivity and tolerance. *Behavior therapy*, *40*(3), 291–301. <https://doi.org/https://doi.org/10.1016/j.beth.2008.08.001>
- Bertollo, M., di Fronso, S., Conforto, S., Schmid, M., Bortoli, L., Comani, S., & Robazza, C. (2016). Proficient brain for optimal performance: the MAP model perspective. *PeerJ*, *4*, e2082. <https://doi.org/https://doi.org/10.7717/peerj.2082>
- Bezodis, N. E., Willwacher, S., & Salo, A. I. T. (2019). The biomechanics of the track and field sprint start: a narrative review. *Sports Medicine*, *49*(9), 1345–1364. <https://doi.org/10.1007/s40279-019-01138-1>

- Bishop, C., Chavda, S., & Turner, A. (2018). Exercise technique: the push press. *Strength & Conditioning Journal*, 40(3), 104–108.
<https://doi.org/https://doi.org/10.1519/ssc.0000000000000321>
- Black, C. L., Goldstein, K. E., LaBelle, D. R., Brown, C. W., Harmon-Jones, E., Abramson, L. Y., & Alloy, L. B. (2014). Behavioral approach system sensitivity and risk taking interact to predict left-frontal EEG asymmetry. *Behavior therapy*, 45(5), 640–650.
<https://doi.org/https://doi.org/10.1016/j.beth.2014.01.006>
- Blanca, M. J., Alarcón, R., Arnau, J., Bono, R., & Bendayan, R. (2018). Effect of variance ratio on ANOVA robustness: Might 1.5 be the limit? *Behavior research methods*, 50(3), 937–962.
- Boroujeni, S. T., & Shahbazi, M. (2011). The effect of instructional and motivational self-talk on performance of basketball's motor skill. *Procedia-Social and Behavioral Sciences*, 15, 3113–3117. <https://doi.org/https://doi.org/10.1016/j.sbspro.2011.04.255>
- Borteyrou, X., Bruchon-Schweitzer, M., & Spielberger, C. (2008). The French adaptation of the STAXI-2, CD Spielberger's State-trait anger expression inventory. *L'Encephale*, 34(3), 249–255.
- Bortoli, L., Bertollo, M., Hanin, Y., & Robazza, C. (2012). Striving for excellence: A multi-action plan intervention model for shooters. *Psychology of Sport and Exercise*, 13(5), 693–701. <https://doi.org/https://doi.org/10.1016/j.psychsport.2012.04.006>
- Braun, V., Clarke, V., Boulton, E., Davey, L., & McEvoy, C. (2021). The online survey as a qualitative research tool. *International journal of social research methodology*, 24(6), 641–654. <https://doi.org/https://doi.org/10.1080/13645579.2020.1805550>

- Breivik, G., Roth, W. T., & Jørgensen, P. E. (1998). Personality, psychological states and heart rate in novice and expert parachutists. *Personality and Individual Differences*, 25(2), 365–380. [https://doi.org/https://doi.org/10.1016/s0191-8869\(98\)00058-0](https://doi.org/https://doi.org/10.1016/s0191-8869(98)00058-0)
- Brice, S. R., Jarosz, B. S., Ames, R. A., Baglin, J., & Da Costa, C. (2011). The effect of close proximity holographic wristbands on human balance and limits of stability: A randomised, placebo-controlled trial. *Journal of Bodywork and Movement Therapies*, 15(3), 298–303. <https://doi.org/https://doi.org/10.1016/j.jbmt.2011.01.020>
- Brody, E. B., Hatfield, B. D., Spalding, T. W., Frazer, M. B., & Caherty, F. J. (2000). The effect of a psyching strategy on neuromuscular activation and force production in strength-trained men. *Research quarterly for exercise and sport*, 71(2), 162–170. <https://doi.org/https://doi.org/10.1080/02701367.2000.10608894>
- Brown, D. J., & Fletcher, D. (2017). Effects of psychological and psychosocial interventions on sport performance: A meta-analysis. *Sports Medicine*, 47, 77–99. <https://doi.org/https://doi.org/10.1007/s40279-016-0552-7>
- Brown, G. A., Ray, M. W., Abbey, B. M., Shaw, B. S., & Shaw, I. (2010). Oxygen consumption, heart rate, and blood lactate responses to an acute bout of plyometric depth jumps in college-aged men and women. *The Journal of Strength & Conditioning Research*, 24(9), 2475–2482. <https://doi.org/https://doi.org/10.1519/jsc.0b013e3181b22b63>
- Bucher, M. A., Suzuki, T., & Samuel, D. B. (2019). A meta-analytic review of personality traits and their associations with mental health treatment outcomes. *Clinical psychology review*, 70, 51–63. <https://doi.org/https://doi.org/10.1016/j.cpr.2019.04.002>
- Buckley, R. C. (2016). Qualitative analysis of emotions: Fear and thrill. *Frontiers in psychology*, 7, 1187. <https://doi.org/https://doi.org/10.3389/fpsyg.2016.01187>

- Burke, L. M., & Peeling, P. (2018). Methodologies for investigating performance changes with supplement use. *International journal of sport nutrition and exercise metabolism*, 28(2), 159–169. <https://doi.org/https://doi.org/10.1123/ijsnem.2017-0325>
- Burnell, L., Ong, C. W., Pitt, T., Butt, J., & Eubank, M. R. (2023). Exploring the perceived benefits of engaging with Spotlight personality profiling in performance domains. *Sport and Exercise Psychology Review*, 18(1), 76–95. <https://doi.org/https://doi.org/10.53841/bpssepr.2023.18.1.76>
- Buss, A. H., & Perry, M. (1992). The aggression questionnaire. *Journal of personality and social psychology*, 63(3), 452. <https://doi.org/https://doi.org/10.1037//0022-3514.63.3.452>
- Campo, M., Laborde, S., Martinent, G., Louvet, B., & Nicolas, M. (2019). Emotional intelligence (EI) training adapted to the international preparation constraints in rugby: Influence of EI trainer status on EI training effectiveness. *Frontiers in psychology*, 10, 1939. <https://doi.org/https://doi.org/10.3389/fpsyg.2019.01939>
- Carré, J. M., Gilchrist, J. D., Morrissey, M. D., & McCormick, C. M. (2010). Motivational and situational factors and the relationship between testosterone dynamics and human aggression during competition. *Biological psychology*, 84(2), 346–353. <https://doi.org/https://doi.org/10.1016/j.biopsycho.2010.04.001>
- Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: the BIS/BAS scales. *Journal of personality and social psychology*, 67(2), 319. <https://doi.org/https://doi.org/10.1037//0022-3514.67.2.319>

Celsi, R. L., Rose, R. L., & Leigh, T. W. (1993). An exploration of high-risk leisure consumption through skydiving. *Journal of consumer research*, 20(1), 1–23.

<https://doi.org/https://doi.org/10.1086/209330>

Charbaghi, Z. (2019). The Effect of Motivational Self-Talk on Arousal and Performance in a Force Production Task. *Journal of Applied Psychology & Behavioral Science*, Vol., 4 (1), 8–10. <https://doi.org/https://doi.org/10.1016/j.psychsport.2008.07.009>

Chat, I. K.-Y., Dunning, E. E., Bart, C. P., Carroll, A. L., Grehl, M. M., Damme, K. S., Abramson, L. Y., Nusslock, R., & Alloy, L. B. (2022). The interplay between reward-relevant life events and trait reward sensitivity in neural responses to reward cues. *Clinical Psychological Science*, 10(5), 869–884.

<https://doi.org/https://doi.org/10.1177/21677026211056627>

Chin, M. S., & Kales, S. N. (2019). Understanding mind–body disciplines: A pilot study of paced breathing and dynamic muscle contraction on autonomic nervous system reactivity. *Stress and Health*, 35(4), 542–548. <https://doi.org/https://doi.org/10.1002/smi.2887>

Chin, P., Gorman, F., Beck, F., Russell, B. R., Stephan, K. E., & Harrison, O. K. (2024). A systematic review of brief respiratory, embodiment, cognitive, and mindfulness interventions to reduce state anxiety. *Frontiers in psychology*, 15, 1412928.

<https://doi.org/https://doi.org/10.3389/fpsyg.2024.1412928>

Cintineo, H. P., & Arent, S. M. (2019). Anticipatory salivary cortisol and state anxiety before competition predict match outcome in division I collegiate wrestlers. *The Journal of Strength & Conditioning Research*, 33(11), 2905–2908.

<https://doi.org/https://doi.org/10.1519/jsc.0000000000003376>

- Clowes, H., & Knowles, Z. (2013). Exploring the effectiveness of pre-performance routines in elite artistic gymnasts: a mixed method investigation. *Science of Gymnastics Journal*, 5(2). <https://doi.org/https://doi.org/10.52165/sgj.5.2.27-40>
- Cohen, A. B., Tenenbaum, G., & English, R. W. (2006). Emotions and golf performance: An IZOF-based applied sport psychology case study. *Behavior modification*, 30(3), 259–280. <https://doi.org/https://doi.org/10.1177/0145445503261174>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed. ed.). <https://doi.org/https://doi.org/10.4324/9780203771587>
- Cohn, P. J. (1990). Preperformance routines in sport: Theoretical support and practical applications. *The Sport Psychologist*, 4(3), 301–312. <https://doi.org/https://doi.org/10.1123/tsp.4.3.301>
- Comfort, P., Stewart, A., Bloom, L., & Clarkson, B. (2014). Relationships between strength, sprint, and jump performance in well-trained youth soccer players. *The Journal of Strength & Conditioning Research*, 28(1), 173–177. <https://doi.org/https://doi.org/10.1519/jsc.0b013e318291b8c7>
- Connor-Smith, J. K., & Flachsbart, C. (2007). Relations between personality and coping: a meta-analysis. *Journal of personality and social psychology*, 93(6), 1080. <https://doi.org/https://doi.org/10.1037/0022-3514.93.6.1080>
- Contreras, D. W., Granquist, M. D., & Martin, L. A. (2023). Stress, sport anxiety, neuroticism, and coping in student-athletes: implications for patient mental health. *Journal of athletic training*, 58(9), 733–739. <https://doi.org/https://doi.org/10.4085/1062-6050-0527.22>

- Cornwall, M. W., Bruscatto, M. P., & Barry, S. (1991). Effect of mental practice on isometric muscular strength. *Journal of Orthopaedic & Sports Physical Therapy*, *13*(5), 231–234.
<https://doi.org/https://doi.org/10.2519/jospt.1991.13.5.231>
- Corr, P. J., & Cooper, A. (2015). The reinforcement sensitivity theory personality questionnaire (RST–PQ). *Development and validation*.
- Costa Jr, P. T. (1992). Revised NEO personality inventory and NEO five-factor inventory. *Professional manual*.
- Côté, S. M. (2007). Sex differences in physical and indirect aggression: A developmental perspective. *European Journal on Criminal Policy and Research*, *13*, 183–200.
<https://doi.org/https://doi.org/10.1007/s10610-007-9046-3>
- Cotterill, S. (2010). Pre-performance routines in sport: Current understanding and future directions. *International review of sport and exercise psychology*, *3*(2), 132–153.
<https://doi.org/https://doi.org/10.1080/1750984x.2010.488269>
- Cotterill, S. (2012). Experience of working in an elite sports academy: A case study in professional cricket. *Sport & Exercise Psychology Review*, *8*(1).
<https://doi.org/https://doi.org/10.53841/bpssepr.2012.8.1.45>
- Cotterill, S. T., Sanders, R., & Collins, D. (2010). Developing effective pre-performance routines in golf: Why don't we ask the golfer? *Journal of Applied Sport Psychology*, *22*(1), 51–64.
<https://doi.org/https://doi.org/10.1080/10413200903403216>
- Critchley, H. D., & Garfinkel, S. N. (2017). Interoception and emotion. *Current opinion in psychology*, *17*, 7–14. <https://doi.org/https://doi.org/10.1016/j.copsy.2017.04.020>
- Cumming, S. J., Turner, M. J., & Jones, M. (2017). Longitudinal changes in elite rowers' challenge and threat appraisals of pressure situations: A season-long observational study.

The Sport Psychologist, 31(3), 217–226. <https://doi.org/https://doi.org/10.1123/tsp.2016-0087>

Cusimano, K., Freeman, P., Moran, J., & Yamaguchi, M. (2024). Differences in Approach and Avoidance Motivation Sensitivities Predicting Participation and Performance in Strength Sport. *The Journal of Strength & Conditioning Research*, 38(1), 180–184.
<https://doi.org/https://doi.org/10.1519/jsc.0000000000004710>

da Rocha, J. A., da Silva, R. A. D., Oliveira, M. P., Szmuchrowski, L. A., Couto, B. P., & Drummond, M. D. M. (2017). Chronic effect of strength training on vertical jump performance in parkour practitioners. *Archives of Budo Science of Martial Arts and Extreme Sports*.

Davidson, R. J. (2004). What does the prefrontal cortex “do” in affect: perspectives on frontal EEG asymmetry research. *Biological psychology*, 67(1-2), 219–234.
<https://doi.org/https://doi.org/10.1016/j.biopsycho.2004.03.008>

de Matos, L. F., Bertollo, M., Stefanello, J. M. F., Pires, F. O., da Silva, C. K., Nakamura, F. Y., & Pereira, G. (2021). Motivational self-talk improves time-trial swimming endurance performance in amateur triathletes. *International Journal of Sport and Exercise Psychology*, 19(3), 446–459.
<https://doi.org/https://doi.org/10.1080/1612197x.2020.1717576>

De Ruiter, C. J., Hutter, V., Icke, C., Groen, B., Gemmink, A., Smilde, H., & De Haan, A. (2012). The effects of imagery training on fast isometric knee extensor torque development. *Journal of sports sciences*, 30(2), 166–174.
<https://doi.org/https://doi.org/10.1080/02640414.2011.627369>

- Dehkordi, A. M. A., & Chtourou, H. (2023). Managing Athlete Anxiety: A Comprehensive Review of Psychological Interventions in Sports Psychology. *Health Nexus*, 1(4), 48–53. <https://doi.org/https://doi.org/10.61838/kman.hn.1.4.6>
- Di Rienzo, F., Blache, Y., Kanthack, T. F. D., Monteil, K., Collet, C., & Guillot, A. (2015). Short-term effects of integrated motor imagery practice on muscle activation and force performance. *Neuroscience*, 305, 146–156. <https://doi.org/https://doi.org/10.1016/j.neuroscience.2015.07.080>
- Di Rienzo, F., Joassy, P., Kanthack, T., Macintyre, T. E., Debarnot, U., Blache, Y., Hautier, C., Collet, C., & Guillot, A. (2019). Effects of action observation and action observation combined with motor imagery on maximal isometric strength. *Neuroscience*, 418, 82–95. <https://doi.org/https://doi.org/10.1016/j.neuroscience.2019.08.025>
- Diego, M. A., Field, T., & Hernandez-Reif, M. (2001). BIS/BAS scores are correlated with frontal EEG asymmetry in intrusive and withdrawn depressed mothers. *Infant Mental Health Journal: Official Publication of the World Association for Infant Mental Health*, 22(6), 665–675.
- Dinardi, R. R., Ferreira, C. H. S., Silveira, G. S., de Araújo Silva, V. E., da Cunha Ibiapina, C., & de Andrade, C. R. (2021). Does the external nasal dilator strip help in sports activity? A systematic review and meta-analysis. *European Archives of Oto-Rhino-Laryngology*, 278, 1307–1320. <https://doi.org/https://doi.org/10.1007/s00405-020-06202-5>
- Donaldson, A., Callaghan, A., Bizzini, M., Jowett, A., Keyzer, P., & Nicholson, M. (2018). A concept mapping approach to identifying the barriers to implementing an evidence-based sports injury prevention programme. *Injury prevention*. <https://doi.org/https://doi.org/10.1136/injuryprev-2017-042639>

- Donohue, B., Gavrilova, E., Danlag, A., Perry, J., Kuhn, C., Allen, D. N., & Benning, S. D. (2021). A comprehensive examination of factors impacting collegiate athletes' utilization of psychological assessment and intervention services. *Psychology in the Schools, 58*(3), 458–474. <https://doi.org/https://doi.org/10.1002/pits.22458>
- Edwards, T., & Hardy, L. (1996). The interactive effects of intensity and direction of cognitive and somatic anxiety and self-confidence upon performance. *Journal of Sport and Exercise Psychology, 18*(3), 296–312. <https://doi.org/https://doi.org/10.1123/jsep.18.3.296>
- Elko, K., & Ostrow, A. C. (1992). The effects of three mental preparation strategies on strength performance of young and older adults. *Journal of Sport Behavior, 15*(1), 34.
- Ellaway, P. H., Kuppuswamy, A., Nicotra, A., & Mathias, C. J. (2010). Sweat production and the sympathetic skin response: Improving the clinical assessment of autonomic function. *Autonomic Neuroscience, 155*(1-2), 109–114. <https://doi.org/https://doi.org/10.1016/j.autneu.2010.01.008>
- Eriksson, L. J., Sundin, Ö., & Jansson, B. (2023). Exploring Response Inhibition, the Behavioral Inhibition System and Possible Sex Differences in Athletes and Non-Athletes. *International Journal of Environmental Research and Public Health, 20*(14), 6340. <https://doi.org/https://doi.org/10.3390/ijerph20146340>
- Fazey, J., & Hardy, L. (1988). *The inverted-U hypothesis: A catastrophe for sport psychology*. British Association of Sports Sciences and the National Coaching Foundation.
- Ferland, P.-M., & Comtois, A. S. (2019). Classic powerlifting performance: A systematic review. *The Journal of Strength & Conditioning Research, 33*, S194–S201. <https://doi.org/https://doi.org/10.1519/jsc.0000000000003099>

- Fincham, G. W., Strauss, C., Montero-Marin, J., & Cavanagh, K. (2023). Effect of breathwork on stress and mental health: A meta-analysis of randomised-controlled trials. *Scientific Reports*, 13(1), 432. <https://doi.org/https://doi.org/10.1038/s41598-022-27247-y>
- Fisher, J. P., Young, C. N., & Fadel, P. J. (2015). Autonomic adjustments to exercise in humans. *Comprehensive physiology*, 5(2), 475–512. <https://doi.org/https://doi.org/10.1002/cphy.c140022>
- Franchini, E., Brito, C. J., & Artioli, G. G. (2012). Weight loss in combat sports: physiological, psychological and performance effects. *Journal of the international society of sports nutrition*, 9(1), 52. <https://doi.org/https://doi.org/10.1186/1550-2783-9-52>
- Genov, F. (1970). The nature of the mobilization readiness of the sportsman and the influence of different factors upon its formation. In G. S. a. G. Kenyon, T. M. (Ed.), *Contemporary psychology of sport*. International Society of Sport Psychology; sold by Athletic Institute.
- Giants Live. (n.d.). *News*. Giants Live. Retrieved June 6 from <https://giants-live.com/news/>
- Gillet, N., Vallerand, R. J., Amoura, S., & Baldes, B. (2010). Influence of coaches' autonomy support on athletes' motivation and sport performance: A test of the hierarchical model of intrinsic and extrinsic motivation. *Psychology of Sport and Exercise*, 11(2), 155–161. <https://doi.org/https://doi.org/10.1016/j.psychsport.2009.10.004>
- Gjaka, M., Tessitore, A., Blondel, L., Bozzano, E., Burlot, F., Debois, N., Delon, D., Figueiredo, A., Foerster, J., & Gonçalves, C. (2021). Understanding the educational needs of parenting athletes involved in sport and education: The parents' view. *PloS one*, 16(1), e0243354. <https://doi.org/https://doi.org/10.1371/journal.pone.0243354>
- Goisbault, M., Lienhart, N., Martinent, G., & Doron, J. (2022). An integrated mindfulness and acceptance-based program for young elite female basketball players: Exploratory study of

- how it works and for whom it works best. *Psychology of Sport and Exercise*, 60, 102157.
<https://doi.org/https://doi.org/10.1016/j.psychsport.2022.102157>
- Gomes, A. R., Simões, C., Morais, C., & Cunha, R. (2022). Adaptation to stress in football athletes: The importance of cognitive appraisal. *Frontiers in psychology*, 13, 939840.
- Gould, D., & Udry, E. (1994). Psychological skills for enhancing performance: Arousal regulation strategies. *Medicine & Science in Sports & Exercise*, 26(4), 478–485.
- Gould, D., Weinberg, R., & Jackson, A. (1980). Mental preparation strategies, cognitions, and strength performance. *Journal of Sport Psychology*, 2(4).
<https://doi.org/https://doi.org/10.1123/jsp.2.4.329>
- Graham, J. D., & Bray, S. R. (2015). Self-control strength depletion reduces self-efficacy and impairs exercise performance. *Journal of Sport and Exercise Psychology*, 37(5), 477–488. <https://doi.org/https://doi.org/10.1123/jsep.2015-0064>
- Gray, J. A. (1990). Brain systems that mediate both emotion and cognition. *Cognition & emotion*, 4(3), 269–288. <https://doi.org/https://doi.org/10.1080/02699939008410799>
- Gray, J. D., Hanna, D., Gillen, A., & Rushe, T. (2016). A closer look at Carver and White's BIS/BAS scales: Factor analysis and age group differences. *Personality and Individual Differences*, 95, 20–24. <https://doi.org/https://doi.org/10.1016/j.paid.2016.02.022>
- Grgic, J., Scapec, B., Pedisic, Z., & Mikulic, P. (2020). Test-retest reliability of velocity and power in the deadlift and squat exercises assessed by the GymAware PowerTool system. *Frontiers in physiology*, 11, 561682.
<https://doi.org/https://doi.org/10.3389/fphys.2020.561682>
- Haischer, M. H., Cooke, D. M., Carzoli, J. P., Johnson, T. K., Shipherd, A. M., Zoeller, R. F., Whitehurst, M., & Zourdos, M. C. (2021). Impact of cognitive measures and sleep on

acute squat strength performance and perceptual responses among well-trained men and women. *The Journal of Strength & Conditioning Research*, 35, S16–S22.

<https://doi.org/https://doi.org/10.1519/jsc.0000000000003202>

Hammami, M., Negra, Y., Billaut, F., Hermassi, S., Shephard, R. J., & Chelly, M. S. (2018).

Effects of lower-limb strength training on agility, repeated sprinting with changes of direction, leg peak power, and neuromuscular adaptations of soccer players. *The Journal of Strength & Conditioning Research*, 32(1), 37–47.

<https://doi.org/https://doi.org/10.1519/jsc.0000000000001813>

Hammoudi-Nassib, S., Chtara, M., Nassib, S., Briki, W., Hammoudi-Riahi, S., Tod, D., &

Chamari, K. (2014). Time interval moderates the relationship between psyching-up and actual sprint performance. *Journal of strength and conditioning research*, 28(11), 3245–

3254. <https://doi.org/10.1519/JSC.0000000000000530>

Hammoudi-Nassib, S., Nassib, S., Chtara, M., Briki, W., Chaouachi, A., Tod, D., & Chamari, K.

(2017). Effects of Psyching-Up on Sprint Performance. *Journal of strength and conditioning research*, 31(8), 2066–2074.

<https://doi.org/10.1519/JSC.0000000000000373>

Hanegby, R., & Tenenbaum, G. (2001). Blame it on the racket: norm-breaking behaviours among

junior tennis players. *Psychology of Sport and Exercise*, 2(2), 117–134.

[https://doi.org/https://doi.org/10.1016/s1469-0292\(00\)00017-0](https://doi.org/https://doi.org/10.1016/s1469-0292(00)00017-0)

Hanin, Y., & Syrjä, P. (1995a). Performance affect in junior ice hockey players: An application of

the individual zones of optimal functioning model. *The Sport Psychologist*, 9(2), 169–

187. <https://doi.org/https://doi.org/10.1123/tsp.9.2.169>

- Hanin, Y., & Syrjä, P. (1995b). Performance affect in soccer players: An application of the IZOF model. *International Journal of Sports Medicine*, 16(04), 260–265.
<https://doi.org/https://doi.org/10.1055/s-2007-973002>
- Hanin, Y. L. (2000). Individual Zones of Optimal Functioning (IZOF) Model: Emotion-performance relationship in sport. In *Emotions in sport* (pp. 65–89). Human Kinetics.
<https://doi.org/https://doi.org/10.5040/9781492596233.ch-003>
- Hanton, S., Cropley, B., & Lee, S. (2009). Reflective practice, experience, and the interpretation of anxiety symptoms. *Journal of sports sciences*, 27(5), 517–533.
<https://doi.org/https://doi.org/10.1080/02640410802668668>
- Hardy, J. (2006). Speaking clearly: A critical review of the self-talk literature. *Psychology of Sport and Exercise*, 7(1), 81–97.
<https://doi.org/https://doi.org/10.1016/j.psychsport.2005.04.002>
- Hardy, J., Gammage, K., & Hall, C. (2001). A descriptive study of athlete self-talk. *The Sport Psychologist*, 15(3), 306–318. <https://doi.org/https://doi.org/10.1123/tsp.15.3.306>
- Hardy, J., Oliver, E., & Tod, D. (2008). A framework for the study and application of self-talk within sport. In *Advances in applied sport psychology* (pp. 47–84). Routledge.
- Hardy, L. (1990). A catastrophe model of anxiety and performance. In J. G. a. H. Jones, L. (Ed.), *Stress and performance in sport* (pp. 81–106). Wiley.
- Hardy, L. (1996). Testing the predictions of the cusp catastrophe model of anxiety and performance. *The Sport Psychologist*, 10(2), 140–156.
<https://doi.org/https://doi.org/10.1123/tsp.10.2.140>

- Hardy, L., Beattie, S., & Woodman, T. (2007). Anxiety-induced performance catastrophes: Investigating effort required as an asymmetry factor. *British journal of psychology*, 98(1), 15–31. <https://doi.org/https://doi.org/10.1348/000712606x103428>
- Hardy, L., & Parfitt, G. (1991). A catastrophe model of anxiety and performance. *British journal of psychology*, 82(2), 163–178. <https://doi.org/https://doi.org/10.1111/j.2044-8295.1991.tb02391.x>
- Hardy, L., Woodman, T., & Carrington, S. (2004). Is self-confidence a bias factor in higher-order catastrophe models? An exploratory analysis. *Journal of Sport and Exercise Psychology*, 26(3), 359–368. <https://doi.org/https://doi.org/10.1123/jsep.26.3.359>
- Hargett, C. W., Doty, J. P., Hauck, J. N., Webb, A. M., Cook, S. H., Tsipis, N. E., Neumann, J. A., Andolsek, K. M., & Taylor, D. C. (2017). Developing a model for effective leadership in healthcare: a concept mapping approach. *Journal of healthcare leadership*, 69–78. <https://doi.org/https://doi.org/10.2147/jhl.s141664>
- Harmon-Jones, E. (2007). Trait anger predicts relative left frontal cortical activation to anger-inducing stimuli. *International Journal of Psychophysiology*, 66(2), 154–160. <https://doi.org/https://doi.org/10.1016/j.ijpsycho.2007.03.020>
- Harmon-Jones, E., & Sigelman, J. (2001). State anger and prefrontal brain activity: evidence that insult-related relative left-prefrontal activation is associated with experienced anger and aggression. *Journal of personality and social psychology*, 80(5), 797. <https://doi.org/https://doi.org/10.1037//0022-3514.80.5.797>
- Harmon-Jones, E., & Gable, P. A. (2018). On the role of asymmetric frontal cortical activity in approach and withdrawal motivation: An updated review of the evidence. *Psychophysiology*, 55(1), e12879. <https://doi.org/https://doi.org/10.1111/psyp.12879>

- Hatzigeorgiadis, A., Zourbanos, N., Galanis, E., & Theodorakis, Y. (2011). Self-talk and sports performance: A meta-analysis. *Perspectives on Psychological Science*, 6(4), 348–356. <https://doi.org/https://doi.org/10.1177/1745691611413136>
- Hazell, J., Cotterill, S. T., & Hill, D. M. (2014). An exploration of pre-performance routines, self-efficacy, anxiety and performance in semi-professional soccer. *European journal of sport science*, 14(6), 603–610. <https://doi.org/https://doi.org/10.1080/17461391.2014.888484>
- Henderson, J., Kavussanu, M., Cooke, A., & Ring, C. (2024). Some pressures are more equal than others: Effects of isolated pressure on performance. *Psychology of Sport and Exercise*, 72, 102592. <https://doi.org/https://doi.org/10.1016/j.psychsport.2024.102592>
- Higgins, J., & Green, S. (2019). Cochrane Handbook for Systematic Review. *Cochrane Collaboration*. Retrieved from www.cochrane-handbook.org.
- Hill, D. M., Hanton, S., Matthews, N., & Fleming, S. (2010). A qualitative exploration of choking in elite golf. *Journal of clinical sport psychology*, 4(3), 221–240. <https://doi.org/https://doi.org/10.1123/jcsp.4.3.221>
- 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/https://doi.org/10.1080/104132001753155958>
- Horikawa, M., & Yagi, A. (2012). The relationships among trait anxiety, state anxiety and the goal performance of penalty shoot-out by university soccer players. *PloS one*, 7(4), e35727. <https://doi.org/https://doi.org/10.1371/journal.pone.0035727>
- Hosseiny, S. H., Ghasemi, A., & Shakeri, N. (2014). Comparing the effects of internal, external and prefer focus of attention on the elite shooters' performance. *Advances in Environmental Biology*, 8(5), 1245–1250.

- Howard, R. (1986). Psychopathy: A psychobiological perspective. *Personality and Individual Differences*, 7(6), 795–806. [https://doi.org/https://doi.org/10.1016/0191-8869\(86\)90078-4](https://doi.org/https://doi.org/10.1016/0191-8869(86)90078-4)
- Huang, D., Wang, H., Tang, Y., Lei, H., & Koh, D. (2025). Enhancing athlete performance under pressure: the role of attribution training in mitigating choking. *Frontiers in psychology*, 16, 1435374. <https://doi.org/https://doi.org/10.3389/fpsyg.2025.1435374>
- Hudson, J., Males, J. R., & Kerr, J. H. (2016). Reversal theory-based sport and exercise research: A systematic/narrative review. *Psychology of Sport and Exercise*, 27, 168–179. <https://doi.org/https://doi.org/10.1016/j.psychsport.2016.08.008>
- Hughes, D. J., Kratsiotis, I. K., Niven, K., & Holman, D. (2020). Personality traits and emotion regulation: A targeted review and recommendations. *Emotion*, 20(1), 63. <https://doi.org/https://doi.org/10.1037/emo0000644>
- Hull, C. L. (1943). *Principles of behavior: An introduction to behavior theory*. Appleton-Century-Crofts. <https://doi.org/https://doi.org/10.2307/2019960>
- Hurst, P., Schipof-Godart, L., Szabo, A., Raglin, J., Hettinga, F., Roelands, B., Lane, A., Foad, A., Coleman, D., & Beedie, C. (2020). The placebo and nocebo effect on sports performance: a systematic review. *European journal of sport science*, 20(3), 279–292. <https://doi.org/https://doi.org/10.1080/17461391.2019.1655098>
- Hyde, J. S. (2005). The gender similarities hypothesis. *American psychologist*, 60(6), 581. <https://doi.org/https://doi.org/10.1037/0003-066x.60.6.581>
- Issurin, V. B. (2010). New horizons for the methodology and physiology of training periodization. *Sports Medicine*, 40(3), 189–206. <https://doi.org/https://doi.org/10.2165/11319770-000000000-00000>

- Jackson, S. A. (1995). Factors influencing the occurrence of flow state in elite athletes. *Journal of Applied Sport Psychology*, 7(2), 138–166.
<https://doi.org/https://doi.org/10.1080/10413209508406962>
- Janjigian, K. (2024). Picture perfect: the science behind mental imagery for peak performance & best practices for mental imagery protocols in sport. *Journal of Imagery Research in Sport and Physical Activity*, 19(s1), 20230027.
<https://doi.org/https://doi.org/10.1515/jirspa-2023-0027>
- Jokela, M., & Hanin, Y. L. (1999). Does the individual zones of optimal functioning model discriminate between successful and less successful athletes? A meta-analysis. *Journal of sports sciences*, 17(11), 873–887.
<https://doi.org/https://doi.org/10.1080/026404199365434>
- Jokipalo, I., & Khudayarov, A. (2021). A netnography and a survey on doping use among competitive doping-untested strength-sport athletes. *International Journal of Sports Medicine*, 42(07), 645–650. <https://doi.org/https://doi.org/10.1055/a-1342-7312>
- Judge, L. W., Urbina, L. J., Hoover, D. L., Craig, B. W., Judge, L. M., Leitzelar, B. M., Pearson, D. R., Holtzclaw, K. A., & Bellar, D. M. (2016). The impact of competitive trait anxiety on collegiate powerlifting performance. *The Journal of Strength & Conditioning Research*, 30(9), 2399–2405.
<https://doi.org/https://doi.org/10.1519/jsc.0000000000001363>
- Juul, S., Gluud, C., Simonsen, S., Frandsen, F. W., Kirsch, I., & Jakobsen, J. C. (2021). Blinding in randomised clinical trials of psychological interventions: a retrospective study of published trial reports. *BMJ evidence-based medicine*, 26(3), 109–109.
<https://doi.org/https://doi.org/10.1136/bmjebm-2020-111407>

- Kaiseler, M., Polman, R. C., & Nicholls, A. R. (2012). Effects of the Big Five personality dimensions on appraisal coping, and coping effectiveness in sport. *European journal of sport science*, 12(1), 62–72.
<https://doi.org/https://doi.org/10.1080/17461391.2010.551410>
- Kane, M., & Trochim, W. M. (2007). *Concept mapping for planning and evaluation*. Sage Publications, Inc. <https://doi.org/https://doi.org/10.4135/9781412983730>
- Kang, H., & Jang, S. (2021). Self and relative effects of competitive state anxiety on perceived performance in middle and high school taekwondo athletes: An actor and partner interdependence model analysis. *Iranian Journal of Public Health*, 50(6), 1167.
<https://doi.org/https://doi.org/10.18502/ijph.v50i6.6415>
- Kanniyan, A. (2015). Competitive state anxiety: impact of positive self talk training on junior level football players. *Sport Mont Journal*, 13(43-44-45), 42–49.
- Kaplánová, A. (2021). Competitive anxiety, and guilt and shame proneness from perspective type D and non-type D football players. *Frontiers in psychology*, 12, 601812.
<https://doi.org/https://doi.org/10.3389/fpsyg.2021.601812>
- Keogh, J. W., & Winwood, P. W. (2017). The epidemiology of injuries across the weight-training sports. *Sports Medicine*, 47(3), 479–501. <https://doi.org/https://doi.org/10.1007/s40279-016-0575-0>
- Kerr, J. (1985). The experience of arousal: A new basis for studying arousal effects in sport. *Journal of sports sciences*, 3(3), 169–179.
<https://doi.org/https://doi.org/10.1080/02640418508729749>
- Kerr, J. H., Wilson, G. V., Svebak, S., & Kirkcaldy, B. D. (2006). Matches and mismatches between telic dominance and type of sport: Changes in emotions and stress pre-to post-

- performance. *Personality and Individual Differences*, 40(8), 1557–1567.
<https://doi.org/https://doi.org/10.1016/j.paid.2005.10.024>
- Kettunen, J., Ravaja, N., Näätänen, P., Keskivaara, P., & Keltikangas-Järvinen, L. (1998). The synchronization of electrodermal activity and heart rate and its relationship to energetic arousal: A time series approach. *Biological psychology*, 48(3), 209–225.
- Kiely, J. (2012). Periodization paradigms in the 21st century: evidence-led or tradition-driven? *International journal of sports physiology and performance*, 7(3), 242–250.
<https://doi.org/https://doi.org/10.1123/ijsp.7.3.242>
- Kinningham, R. B., & Gorenflo, D. W. (2001). Weight loss methods of high school wrestlers. *Medicine and science in sports and exercise*, 33(5), 810–813.
<https://doi.org/https://doi.org/10.1097/00005768-200105000-00021>
- Knowles, K. A., & Olatunji, B. O. (2020). Specificity of trait anxiety in anxiety and depression: Meta-analysis of the State-Trait Anxiety Inventory. *Clinical psychology review*, 82, 101928. <https://doi.org/https://doi.org/10.1016/j.cpr.2020.101928>
- Koehn, S. (2017). Flow state and performance patterns in tennis competition. *Psychology and Behavioral Science International Journal*, 7(3).
<https://doi.org/https://doi.org/10.19080/pbsij.2017.07.555715>
- Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: A review. *Biological psychology*, 84(3), 394–421.
<https://doi.org/https://doi.org/10.1016/j.biopsycho.2010.03.010>
- Kruskal, J. B. (1964). Multidimensional scaling by optimizing goodness of fit to a nonmetric hypothesis. *Psychometrika*, 29(1), 1–27.
<https://doi.org/https://doi.org/10.1007/bf02289565>

- Kuan, G. (2023). The effect of music listening on athletes' anxiety, depression, and pain: A mini review. *The Asian Journal of Kinesiology*, 25(2), 19–25.
<https://doi.org/https://doi.org/10.15758/ajk.2023.25.2.19>
- Kuan, G., Morris, T., Kueh, Y. C., & Terry, P. C. (2018). Effects of relaxing and arousing music during imagery training on dart-throwing performance, physiological arousal indices, and competitive state anxiety. *Frontiers in psychology*, 9, 14.
<https://doi.org/https://doi.org/10.3389/fpsyg.2018.00014>
- Kuśnierz, C., Rogowska, A. M., Görner, K., & Wosinek, P. (2024). Sensitivity to rewards and punishments in karate athletes: an examination of the temperamental characteristics and profile of karate competitors according to the revised reinforcement sensitivity theory. *BMC Sports Science, Medicine and Rehabilitation*, 16(1), 178.
<https://doi.org/https://doi.org/10.1186/s13102-024-00971-w>
- Lai, T.-T., Liou, C.-W., Tsai, Y.-H., Lin, Y.-Y., & Wu, W.-L. (2023). Butterflies in the gut: the interplay between intestinal microbiota and stress. *Journal of biomedical science*, 30(1), 92. <https://doi.org/https://doi.org/10.1186/s12929-023-00984-6>
- Lakicevic, N., Paoli, A., Roklicer, R., Trivic, T., Korovljev, D., Ostojic, S. M., Proia, P., Bianco, A., & Drid, P. (2021). Effects of rapid weight loss on kidney function in combat sport athletes. *Medicina*, 57(6), 551. <https://doi.org/https://doi.org/10.3390/medicina57060551>
- Larsen, C. H., & Henriksen, K. (2015). Psychological momentum in team sport: An intervention program in professional soccer. *Sport Science Review*, 24(1-2), 27–39.
<https://doi.org/https://doi.org/10.1515/ssr-2015-0007>

- Lim, I.-S. (2018). Comparative analysis of the correlation between anxiety, salivary alpha amylase, cortisol levels, and athletes' performance in archery competitions. *Journal of exercise nutrition & biochemistry*, 22(4), 69.
- Lim, K. J. Y., & Kee, K. M. (2022). Relationship of Personality Traits and Competitive Trait Anxiety in Recreational Individual Event Sports. International Conference on Movement, Health and Exercise,
- Lim, N. (2016). Cultural differences in emotion: differences in emotional arousal level between the East and the West. *Integrative medicine research*, 5(2), 105–109.
<https://doi.org/https://doi.org/10.1016/j.imr.2016.03.004>
- Liu, F., Zhang, Z., Liu, S., & Zhang, N. (2021). Examining the effects of brief mindfulness training on athletes' flow: the mediating role of resilience. *Evidence-Based Complementary and Alternative Medicine*, 2021(1), 6633658.
<https://doi.org/https://doi.org/10.1155/2021/6633658>
- Lochbaum, M., & Gottardy, J. (2015). A meta-analytic review of the approach-avoidance achievement goals and performance relationships in the sport psychology literature. *Journal of Sport and Health Science*, 4(2), 164–173.
<https://doi.org/https://doi.org/10.1016/j.jshs.2013.12.004>
- Lochbaum, M., Stoner, E., Hefner, T., Cooper, S., Lane, A. M., & Terry, P. C. (2022). Sport psychology and performance meta-analyses: A systematic review of the literature. *PloS one*, 17(2), e0263408. <https://doi.org/https://doi.org/10.1371/journal.pone.0263408>
- Lombardi, V. P. (1989). Appendix F: Predicting maximum lifts. In *Beginning weight training: the safe and effective way* (pp. 201). Wm. C. Brown Publishers.

- Lovell, D. I., Cuneo, R., & Gass, G. C. (2011). The blood pressure response of older men to maximum and sub-maximum strength testing. *Journal of Science and Medicine in Sport*, *14*(3), 254–258. <https://doi.org/https://doi.org/10.1016/j.jsams.2010.12.005>
- Loxton, N. J. (2018). The role of reward sensitivity and impulsivity in overeating and food addiction. *Current Addiction Reports*, *5*(2), 212–222. <https://doi.org/https://doi.org/10.1007/s40429-018-0206-y>
- Luo, Q., Li, X., Zhao, J., Jiang, Q., & Wei, D. (2025). The effect of slow breathing in regulating anxiety. *Scientific Reports*, *15*(1), 8417. <https://doi.org/https://doi.org/10.1038/s41598-025-92017-5>
- Mageau, G. A., & Vallerand, R. J. (2003). The coach–athlete relationship: A motivational model. *Journal of sports science*, *21*(11), 883–904. <https://doi.org/https://doi.org/10.1080/0264041031000140374>
- Maher, A. M., Thomson, C. J., & Carlson, S. R. (2015). Risk-taking and impulsive personality traits in proficient downhill sports enthusiasts. *Personality and Individual Differences*, *79*, 20–24. <https://doi.org/https://doi.org/10.1016/j.paid.2015.01.041>
- Mahoney, M. J. (1979). Cognitive skills and athletic performance. In P. C. a. H. Kendall, S.D. (Ed.), *Cognitive-Behavioural Interventions* (pp. 423–444). Academic Press. <https://doi.org/https://doi.org/10.1016/b978-0-12-404480-7.50019-8>
- Makarowski, R. (2013). Aggressiveness in sport–measurement method. *Journal of Physical Education and Sport*, *13*(3), 278–282.
- Markarian, S. A., Pickett, S. M., Deveson, D. F., & Kanona, B. B. (2013). A model of BIS/BAS sensitivity, emotion regulation difficulties, and depression, anxiety, and stress symptoms

in relation to sleep quality. *Psychiatry research*, 210(1), 281–286.

<https://doi.org/https://doi.org/10.1016/j.psychres.2013.06.004>

Marshall, S., McNeil, N., Seal, E.-L., Nicholson, M., & Donaldson, A. (2022). The professionalization tension in women's sport: the case of women's basketball in Australia. *European Sport Management Quarterly*, 1–23.

<https://doi.org/https://doi.org/10.1080/16184742.2022.2145332>

Martens, R., Vealey, R. S., & Burton, D. (1990). Competitive anxiety in sport.

Martí-Parreño, J., Galbis-Córdova, A., & Currás-Pérez, R. (2021). Teachers' beliefs about gamification and competencies development: A concept mapping approach. *Innovations in education and teaching international*, 58(1), 84–94.

<https://doi.org/https://doi.org/10.1080/14703297.2019.1683464>

Maxwell, J. P., & Moores, E. (2007). The development of a short scale measuring aggressiveness and anger in competitive athletes. *Psychology of Sport and Exercise*, 8(2), 179–193.

McCarren, G., Chaput, M., Grooms, D. R., Criss, C. R., Buckley, S., Brazalovich, P., Yom, J., & Simon, J. E. (2023). Cognitive load influences drop jump landing mechanics during cognitive-motor-simulated shooting. *Military medicine*, 188(7-8), e2102–e2108.

<https://doi.org/https://doi.org/10.1093/milmed/usad003>

McCorry, L. K. (2007). Physiology of the autonomic nervous system. *American journal of pharmaceutical education*, 71(4). <https://doi.org/https://doi.org/10.5688/aj710478>

McGuigan, M. R., Ghiagiarelli, J., & Tod, D. (2005). Maximal strength and cortisol responses to psyching-up during the squat exercise. *Journal of sports sciences*, 23(7), 687–692.

<https://doi.org/https://doi.org/10.1080/02640410400021401>

- McKay, B., & Ste-Marie, D. M. (2020). Autonomy support and reduced feedback frequency have trivial effects on learning and performance of a golf putting task. *Human Movement Science, 71*, 102612. <https://doi.org/https://doi.org/10.1016/j.humov.2020.102612>
- McNevin, N. H., Shea, C. H., & Wulf, G. (2003). Increasing the distance of an external focus of attention enhances learning. *Psychological research, 67*, 22–29. <https://doi.org/https://doi.org/10.1007/s00426-002-0093-6>
- Mehrsafar, A. H., Moghadam Zadeh, A., Gazerani, P., Jaenes Sanchez, J. C., Nejat, M., Rajabian Tabesh, M., & Abolhasani, M. (2021). Mental health status, life satisfaction, and mood state of elite athletes during the COVID-19 pandemic: a follow-up study in the phases of home confinement, reopening, and semi-lockdown condition. *Frontiers in psychology, 12*, 630414. <https://doi.org/https://doi.org/10.3389/fpsyg.2021.630414>
- Mellalieu, S. D., Hanton, S., & Thomas, O. (2009). The effects of a motivational general-arousal imagery intervention upon preperformance symptoms in male rugby union players. *Psychology of Sport and Exercise, 10*(1), 175–185. <https://doi.org/https://doi.org/10.1016/j.psychsport.2008.07.003>
- Merlin, Q., Vacher, P., Mourot, L., Levillain, G., Martinent, G., & Nicolas, M. (2024). Psychophysiological effects of slow-paced breathing on adolescent swimmers' subjective performance, recovery states, and control perception. *Journal of Functional Morphology and Kinesiology, 9*(1), 23. <https://doi.org/https://doi.org/10.3390/jfmk9010023>
- Michael, S., Graham, K. S., & Davis, G. M. (2017). Cardiac autonomic responses during exercise and post-exercise recovery using heart rate variability and systolic time intervals—a review. *Frontiers in physiology, 8*, 301. <https://doi.org/https://doi.org/10.3389/fphys.2017.00301>

- Migliaccio, G. M., Russo, L., Maric, M., & Padulo, J. (2023). Sports performance and breathing rate: What is the connection? A narrative review on breathing strategies. *Sports, 11*(5), 103. <https://doi.org/https://doi.org/10.3390/sports11050103>
- Miles, A. J., Neil, R., & Barker, J. (2016). Preparing to take the field: A temporal exploration of stress, emotion, and coping in elite cricket. *The Sport Psychologist, 30*(2), 101–112. <https://doi.org/https://doi.org/10.1123/tsp.2014-0142>
- Minozzi, S., Dwan, K., Borrelli, F., & Filippini, G. (2022). Reliability of the revised Cochrane risk-of-bias tool for randomised trials (RoB2) improved with the use of implementation instruction. *Journal of clinical epidemiology, 141*, 99–105. <https://doi.org/https://doi.org/10.1016/j.jclinepi.2021.09.021>
- Miruna, M., & Laura, L. P. P. (2023). The level of anxiety as a facilitating or inhibiting factor in sports performance. *BlackSea Journal of Psychology, 14*(3), 158–165. <https://doi.org/https://doi.org/10.47577/bspsychology.bsjop.v14i3.253>
- Mitchell, L., Ratcliff, J., Burke, L. M., & Forsyth, A. (2024). Engaging athletes as research participants. A document analysis of published sport science literature. *European journal of sport science, 24*(10), 1442–1451. <https://doi.org/https://doi.org/10.1002/ejsc.12198>
- Moeijes, J., van Busschbach, J. T., Bosscher, R. J., & Twisk, J. W. (2018). Sports participation and psychosocial health: a longitudinal observational study in children. *BMC public health, 18*, 1–11. <https://doi.org/https://doi.org/10.1186/s12889-018-5624-1>
- Moeijes, J., van Busschbach, J. T., Bosscher, R. J., & Twisk, J. W. (2019). Sports participation and health-related quality of life: a longitudinal observational study in children. *Quality of life research, 28*, 2453–2469. <https://doi.org/https://doi.org/10.1007/s11136-019-02219-4>

- Mohammadpoor Faskhodi, M., Fernández-Chimeno, M., & García-González, M. A. (2023). Arousal detection by using ultra-short-term heart rate variability (HRV) analysis. *Frontiers in Medical Engineering, 1*, 1209252.
- Moore, J. M., Timperio, A. F., Crawford, D. A., Burns, C. M., & Cameron-Smith, D. (2002). Weight management and weight loss strategies of professional jockeys. *International journal of sport nutrition and exercise metabolism, 12*(1), 1–13.
<https://doi.org/https://doi.org/10.1123/ijsnem.12.1.1>
- Moradi, J. (2020). Benefits of a guided motor-mental preperformance routine on learning the basketball free throw. *Perceptual and Motor Skills, 127*(1), 248–262.
<https://doi.org/https://doi.org/10.1177/0031512519870648>
- Moran, A. P. (1996). *The Psychology of Concentration in Sport Performers: A Cognitive Analysis*. Psychology Press.
- Moran, A. P. (2016). *The psychology of concentration in sport performers: A cognitive analysis*. Psychology Press. <https://doi.org/https://doi.org/10.4324/9781315784946>
- Moretti, D. M., Baum, C. M., Ehlers, M.-H., Finger, R., & Bröring, S. (2023). Exploring actors' perceptions of the precision agriculture innovation system—A Group Concept Mapping approach in Germany and Switzerland. *Technological Forecasting and Social Change, 189*, 122270. <https://doi.org/https://doi.org/10.1016/j.techfore.2022.122270>
- Movahedi, A., Sheikh, M., Bagherzadeh, F., Hemayattalab, R., & Ashayeri, H. (2007). A practice-specificity-based model of arousal for achieving peak performance. *Journal of motor behavior, 39*(6), 457–462. <https://doi.org/https://doi.org/10.3200/jmbr.39.6.457-462>

- Murphy, S. M., Woolfolk, R. L., & Budney, A. J. (1988). The effects of emotive imagery on strength performance. *Journal of Sport and Exercise Psychology, 10*(3), 334–345.
<https://doi.org/https://doi.org/10.1123/jsep.10.3.334>
- Nadzalan, A. M., Lee, J. L. F., Azzfar, M. S., Muhammad, N. S., Shukri, E. W. M. C., & Mohamad, N. I. (2019). The effects of resistance training with different focus attention on muscular strength: Application to teaching methods in physical conditioning class. *Age (years), 21*, 1.00.
- Neil, R., Mellalieu, S. D., & Hanton, S. (2006). Psychological skills usage and the competitive anxiety response as a function of skill level in rugby union. *Journal of Sports Science & Medicine, 5*(3), 415.
- Neumann, D. L. (2019). A systematic review of attentional focus strategies in weightlifting. *Frontiers in Sports and Active Living, 1*, 7.
<https://doi.org/https://doi.org/10.3389/fspor.2019.00007>
- Niering, M., Monsberger, T., Seifert, J., & Muehlbauer, T. (2023). Effects of psychological interventions on performance anxiety in performing artists and athletes: A systematic review with meta-analysis. *Behavioral Sciences, 13*(11), 910.
<https://doi.org/https://doi.org/10.3390/bs13110910>
- Nolan, D., Lynch, A. E., & Egan, B. (2022). Self-reported prevalence, magnitude, and methods of rapid weight loss in male and female competitive powerlifters. *The Journal of Strength & Conditioning Research, 36*(2), 405–410.
<https://doi.org/https://doi.org/10.1519/jsc.0000000000003488>

- O'Connor, R. M., Stewart, S. H., & Watt, M. C. (2009). Distinguishing BAS risk for university students' drinking, smoking, and gambling behaviors. *Personality and Individual Differences, 46*(4), 514–519. <https://doi.org/https://doi.org/10.1016/j.paid.2008.12.002>
- Occhino, J. L., Mallett, C. J., Rynne, S. B., & Carlisle, K. N. (2014). Autonomy-supportive pedagogical approach to sports coaching: Research, challenges and opportunities. *International Journal of Sports Science & Coaching, 9*(2), 401–415. <https://doi.org/https://doi.org/10.1260/1747-9541.9.2.401>
- Official Strongman. (2024, 2024). *OSG World Final 2024 – Day 1 [Video]*. Official Strongman. Retrieved June 6 from <https://officialstrongman.com/videos/osg-world-final-2024-day-1>
- Olsen, K. N., Terry, J., & Thompson, W. F. (2023). Psychosocial risks and benefits of exposure to heavy metal music with aggressive themes: Current theory and evidence. *Current Psychology, 42*(24), 21133–21150. <https://doi.org/https://doi.org/10.1007/s12144-022-03108-9>
- Ong, N. C., & Chua, J. H. (2021). Effects of psychological interventions on competitive anxiety in sport: A meta-analysis. *Psychology of Sport and Exercise, 52*, 101836. <https://doi.org/https://doi.org/10.1016/j.psychsport.2020.101836>
- OpenPowerlifting. (n.d.). *OpenPowerlifting Database*. OpenPowerlifting. Retrieved April 14 from <https://www.openpowerlifting.org/>
- Osborne-Crowley, K. (2020). Social cognition in the real world: Reconnecting the study of social cognition with social reality. *Review of General Psychology, 24*(2), 144–158. <https://doi.org/https://doi.org/10.1177/1089268020906483>

- Ottoboni, G., Milani, M., Setti, A., Ceciliani, A., Chattat, R., & Tessari, A. (2017). An observational study on sport-induced modulation of negative attitude towards disability. *PloS one*, *12*(11), e0187043. <https://doi.org/https://doi.org/10.1371/journal.pone.0187043>
- Panno, A., Donati, M. A., Milioni, M., Chiesi, F., & Primi, C. (2018). Why women take fewer risk than men do: the mediating role of state anxiety. *Sex Roles*, *78*, 286–294. <https://doi.org/https://doi.org/10.1007/s11199-017-0781-8>
- Parnabas, V., Parnabas, J., & Parnabas, A. M. (2015). The relationship between somatic anxiety and sport performance on running athletes. *European Academic Research*, *2*(11), 14769–14775.
- Patel, D. R., Omar, H., & Terry, M. (2010). Sport-related performance anxiety in young female athletes. *Journal of pediatric and adolescent gynecology*, *23*(6), 325–335. <https://doi.org/https://doi.org/10.1016/j.jpag.2010.04.004>
- Patrick, C. J., & Verona, E. (2007). The Psychophysiology of Aggression: Autonomic, Electro-cortical, and Neuro-Imaging. In D. J. Flannery, Vazsonyi, A. T. and Waldman, I. D. (Ed.), *The Cambridge handbook of violent behavior and aggression* (pp. 111–150). Cambridge University Press. <https://doi.org/https://doi.org/10.1017/cbo9780511816840.007>
- Perkins, D., Wilson, G. V., & Kerr, J. H. (2001). The effects of elevated arousal and mood on maximal strength performance in athletes. *Journal of Applied Sport Psychology*, *13*(3), 239–259. <https://doi.org/https://doi.org/10.1080/104132001753144392>
- Perlman, D. (2014). Self-Determination Theory and teacher instruction: A positive partnership for student performance and involvement.

- Perry, I. S., & Katz, Y. J. (2015). Pre-performance routines, accuracy in athletic performance and self-control. *Athens Journal of Sports*, 2(3), 137–152.
<https://doi.org/https://doi.org/10.30958/ajspo.2-3-1>
- Peterson, M. D., Alvar, B. A., & Rhea, M. R. (2006). The contribution of maximal force production to explosive movement among young collegiate athletes. *The Journal of Strength & Conditioning Research*, 20(4), 867–873.
<https://doi.org/https://doi.org/10.1519/r-18695.1>
- Peynircioğlu, Z. F., Thompson, J. L., & Tanielian, T. B. (2000). Improvement strategies in free-throw shooting and grip-strength tasks. *The Journal of general psychology*, 127(2), 145–156. <https://doi.org/https://doi.org/10.1080/00221300009598574>
- Pierce, E. F., McGowan, R. W., Eastman, N. W., Aaron, J. G., & Lynn, T. D. (1993). Effects of progressive relaxation on maximal muscle strength and power. *The Journal of Strength & Conditioning Research*, 7(4), 216–218. <https://doi.org/https://doi.org/10.1519/00124278-199311000-00005>
- Pohjavaara, P., Telaranta, T., & Väisänen, E. (2003). The role of the sympathetic nervous system in anxiety: Is it possible to relieve anxiety with endoscopic sympathetic block? *Nordic journal of psychiatry*, 57(1), 55–60.
<https://doi.org/https://doi.org/10.1080/08039480310000266>
- Portell Vidal, M., Anguera Argilaga, M. T., Chacón Moscoso, S., & Sanduvete Chaves, S. (2015). Guidelines for reporting evaluations based on observational methodology. *Psicothema*, 2015, vol. 27, num. 3, p. 283-289.
<https://doi.org/https://doi.org/10.7334/psicothema2014.276>

PowerliftingInData. (2024). *Ten-year growth: The highest totals keep getting higher.*

PowerliftingInData. Retrieved April 14 from

<https://powerliftingindata.com/posts/2024/12/01/ten-year-growth-highest-totals.html>

Rabinovitch, H., Johnston, K., Patelia, S., Cattle, A., Wojtowicz, M., & Baker, J. (2025). Playoff beards and unwashed uniforms: a scoping review on athletes' superstitions and rituals.

International review of sport and exercise psychology, 1–20.

<https://doi.org/https://doi.org/10.1080/1750984X.2025.2521776>

Ramirez-Campillo, R., Álvarez, C., García-Hermoso, A., Ramírez-Vélez, R., Gentil, P., Asadi, A., Chaabene, H., Moran, J., Meylan, C., & García-de-Alcaraz, A. (2018).

Methodological characteristics and future directions for plyometric jump training research: a scoping review. *Sports Medicine*, 48(5), 1059–1081.

<https://doi.org/https://doi.org/10.1007/s40279-018-0870-z>

Ramsey, R., Cumming, J., Edwards, M. G., Williams, S., & Brunning, C. (2010). Examining the emotion aspect of PETTLEP-based imagery with penalty taking in soccer. *Journal of Sport Behavior*, 33(3), 295.

Reinebo, G., Alfonsso, S., Jansson-Fröjmark, M., Rozental, A., & Lundgren, T. (2024). Effects of psychological interventions to enhance athletic performance: A systematic review and meta-analysis. *Sports Medicine*, 54(2), 347–373.

<https://doi.org/https://doi.org/10.1007/s40279-023-01931-z>

Rice, S. M., Gwyther, K., Santesteban-Echarri, O., Baron, D., Gorczynski, P., Gouttebauge, V., Reardon, C. L., Hitchcock, M. E., Hainline, B., & Purcell, R. (2019). Determinants of anxiety in elite athletes: a systematic review and meta-analysis. *British Journal of Sports Medicine*, 53(11), 722–730. <https://doi.org/https://doi.org/10.1136/bjsports-2019-100620>

- Richmond, S. R., Potts, A. C., & Sherman, J. R. (2014). The impact of ammonia inhalants on strength performance in resistance trained males. *J Exerc Physiol Online*, *17*, 60–66.
- Robazza, C., Bertollo, M., Filho, E., Hanin, Y., & Bortoli, L. (2016). Perceived control and hedonic tone dynamics during performance in elite shooters. *Research quarterly for exercise and sport*, *87*(3), 284–294.
<https://doi.org/https://doi.org/10.1080/02701367.2016.1185081>
- Robazza, C., & Bortoli, L. (2005). Changing students' attitudes towards risky motor tasks: an application of the IZOF model. *Journal of sports sciences*, *23*(10), 1075–1088.
- Robazza, C., Pellizzari, M., & Hanin, Y. (2004). Emotion self-regulation and athletic performance: An application of the IZOF model. *Psychology of Sport and Exercise*, *5*(4), 379–404. [https://doi.org/https://doi.org/10.1016/s1469-0292\(03\)00034-7](https://doi.org/https://doi.org/10.1016/s1469-0292(03)00034-7)
- Roberts, R., & Woodman, T. (2015). Contemporary personality perspectives in sport psychology. In S. D. Mellalieu & S. Hanton (Eds.), *Contemporary advances in sport psychology: A review* (pp. 1–27). Routledge/Taylor & Francis Group.
- Rogers, R. R., Beardsley, K. G., Cumbie, P. E., & Ballmann, C. G. (2023). Ammonia inhalants enhance psychophysiological responses and performance during repeated high intensity exercise. *Research quarterly for exercise and sport*, *94*(4), 1035–1041.
<https://doi.org/https://doi.org/10.1080/02701367.2022.2104447>
- Rosas, S. R., & Kane, M. (2012). Quality and rigor of the concept mapping methodology: a pooled study analysis. *Evaluation and program planning*, *35*(2), 236–245.
<https://doi.org/https://doi.org/10.1016/j.evalprogplan.2011.10.003>

- Rosenblum, S., & Elimelech, O. C. (2021). Gender differences in state anxiety related to daily function among older adults during the COVID-19 pandemic: questionnaire study. *JMIR aging*, 4(2), e25876. <https://doi.org/https://doi.org/10.2196/25876>
- Ruiz, F. J., & Luciano, C. (2012). Improving international-level chess players' performance with an acceptance-based protocol: Preliminary findings. *The Psychological Record*, 62(3), 447–462. <https://doi.org/https://doi.org/10.1007/bf03395813>
- Ruiz, M. C., & Hanin, Y. L. (2011). Perceived impact of anger on performance of skilled karate athletes. *Psychology of Sport and Exercise*, 12(3), 242–249. <https://doi.org/https://doi.org/10.1016/j.psychsport.2011.01.005>
- Rupprecht, A. G., Tran, U. S., & Gröpel, P. (2021). The effectiveness of pre-performance routines in sports: a meta-analysis. *International review of sport and exercise psychology*, 1–26. <https://doi.org/https://doi.org/10.1080/1750984x.2021.1944271>
- Russell, R., Porter, J., & Campbell, O. (2014). An external skill focus is necessary to enhance performance. *Journal of Motor Learning and Development*, 2(2), 37–46. <https://doi.org/https://doi.org/10.1123/jmld.2014-0038>
- Santos-Rosa, F. J., Montero-Carretero, C., Gómez-Landero, L. A., Torregrossa, M., & Cervelló, E. (2022). Positive and negative spontaneous self-talk and performance in gymnastics: The role of contextual, personal and situational factors. *PloS one*, 17(3), e0265809. <https://doi.org/https://doi.org/10.1371/journal.pone.0265809>
- Schippers, M. C., & Van Lange, P. A. (2006). The psychological benefits of superstitious rituals in top sport: a study among top sportspersons 1. *Journal of Applied Social Psychology*, 36(10), 2532–2553. <https://doi.org/https://doi.org/10.1111/j.0021-9029.2006.00116.x>

- Schoenfeld, B. J., Grgic, J., Ogborn, D., & Krieger, J. W. (2017). Strength and hypertrophy adaptations between low-vs. high-load resistance training: a systematic review and meta-analysis. *The Journal of Strength & Conditioning Research*, *31*(12), 3508–3523.
<https://doi.org/https://doi.org/10.1519/jsc.0000000000002200>
- Schofield, M., Cronin, J. B., Macadam, P., & Hébert-Losier, K. (2022). Rotational shot put: a phase analysis of current kinematic knowledge. *Sports biomechanics*, *21*(3), 278–296.
<https://doi.org/https://doi.org/10.1080/14763141.2019.1636130>
- Scott-Parker, B., & Weston, L. (2017). Sensitivity to reward and risky driving, risky decision making, and risky health behaviour: A literature review. *Transportation research part F: traffic psychology and behaviour*, *49*, 93–109.
<https://doi.org/https://doi.org/10.1016/j.trf.2017.05.008>
- Seery, M. D. (2011). Challenge or threat? Cardiovascular indexes of resilience and vulnerability to potential stress in humans. *Neuroscience & Biobehavioral Reviews*, *35*(7), 1603–1610.
<https://doi.org/https://doi.org/10.1016/j.neubiorev.2011.03.003>
- Shambrook, C. (2009). Delivering sport psychology to Olympic rowers: Beyond psychological skills training. *Applied sport psychology: A case-based approach*, 111–138.
- Shelton, T. O., & Mahoney, M. J. (1978). The content and effect of “psyching-up” strategies in weight lifters. *Cognitive Therapy and Research*, *2*, 275–284.
<https://doi.org/https://doi.org/10.1007/bf01185789>
- Shepherd, D. J., Lee, B., & Kerr, J. H. (2006). Reversal theory: A suggested way forward for an improved understanding of interpersonal relationships in sport. *Psychology of Sport and Exercise*, *7*(2), 143–157. <https://doi.org/https://doi.org/10.1016/j.psychsport.2005.08.003>

Sher, L., Rutter, S. B., New, A. S., Siever, L. J., & Hazlett, E. A. (2019). Gender differences and similarities in aggression, suicidal behaviour, and psychiatric comorbidity in borderline personality disorder. *Acta Psychiatrica Scandinavica*, *139*(2), 145–153.

<https://doi.org/https://doi.org/10.1111/acps.12981>

Sherwood, D. E., Lohse, K. R., & Healy, A. F. (2020). The effect of an external and internal focus of attention on dual-task performance. *Journal of Experimental Psychology: Human Perception and Performance*, *46*(1), 91.

<https://doi.org/https://doi.org/10.1037/xhp0000698>

Shukri, N. S. M. (2020). Electromyographical analysis and performance during bench press exercise: The influence of self-talk. *International Journal of Recent Technology and Engineering*, *8*(1), 1279–1281.

Sidaway, B., & Trzaska, A. (2005). Can mental practice increase ankle dorsiflexor torque? *Physical therapy*, *85*(10), 1053–1060.

<https://doi.org/https://doi.org/10.1093/ptj/85.10.1053>

Silver, M. D. (2001). Use of ergogenic aids by athletes. *JAAOS-Journal of the American Academy of Orthopaedic Surgeons*, *9*(1), 61–70.

<https://doi.org/https://doi.org/10.5435/00124635-200101000-00007>

Simonsen, M. B., Jolas, E., Pedersen, S. R., Jensen, J. G., Faarup, M., Jakobsen, R. T., Andersen, M. S., & Kristiansen, M. (2025). Analyzing one-repetition-max predictions: load-velocity relationship vs. repetition to failure equation in ten lower extremity exercises. *Sport Sciences for Health*, *21*(1), 343–353. [https://doi.org/https://doi.org/10.1007/s11332-024-](https://doi.org/https://doi.org/10.1007/s11332-024-01264-y)

[01264-y](https://doi.org/https://doi.org/10.1007/s11332-024-01264-y)

- 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/https://doi.org/10.1080/1750984x.2020.1780627>
- Singer, R. N. (2002). Preperformance state, routines, and automaticity: What does it take to realize expertise in self-paced events? *Journal of Sport and Exercise Psychology, 24*(4), 359–375. <https://doi.org/https://doi.org/10.1123/jsep.24.4.359>
- Singla, R. (2011). Origins of mindfulness & meditation interplay of eastern & western psychology. *Psyke & Logos, 32*(1), 20.
<https://doi.org/https://doi.org/10.7146/pl.v32i1.8802>
- Slater, G., Rice, A., Jenkins, D., & Hahn, A. (2014). Body mass management of lightweight rowers: nutritional strategies and performance implications. *British Journal of Sports Medicine, 48*(21), 1529–1533. <https://doi.org/https://doi.org/10.1136/bjsports-2014-093918>
- Slimani, M., & Chéour, F. (2016). Effects of cognitive training strategies on muscular force and psychological skills in healthy striking combat sports practitioners. *Sport Sciences for Health, 12*(2), 141–149. <https://doi.org/https://doi.org/10.1007/s11332-016-0267-z>
- Smith, D., Wright, C., Allsopp, A., & Westhead, H. (2007). It's all in the mind: PETTLEP-based imagery and sports performance. *Journal of Applied Sport Psychology, 19*(1), 80–92.
<https://doi.org/https://doi.org/10.1080/10413200600944132>
- Spence, K. W. (1956). *Behavior theory and conditioning*. Yale University Press.
<https://doi.org/https://doi.org/10.1037/10029-000>

- Spielberg, J. M., Heller, W., & Miller, G. A. (2013). Hierarchical brain networks active in approach and avoidance goal pursuit. *Frontiers in human neuroscience*, 7, 284.
<https://doi.org/https://doi.org/10.3389/fnhum.2013.00284>
- Spielberger, C. D. (1999). *Professional manual for the State-Trait Anger Expression Inventory-2 (STAXI-2)*. Psychological Assessment Resources.
- Spielberger, C. D., Gonzalez-Reigosa, F., Martinez-Urrutia, A., Natalicio, L. F., & Natalicio, D. S. (1971). The state-trait anxiety inventory. *Revista Interamericana de Psicología/Interamerican journal of psychology*, 5(3 & 4).
- Stanley, D. M., & Cumming, J. (2010). Are we having fun yet? Testing the effects of imagery use on the affective and enjoyment responses to acute moderate exercise. *Psychology of Sport and Exercise*, 11(6), 582–590.
<https://doi.org/https://doi.org/10.1016/j.psychsport.2010.06.010>
- Sterne, J. A., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M. S., & Eldridge, S. M. (2019). RoB 2: a revised tool for assessing risk of bias in randomised trials. *bmj*, 366.
<https://doi.org/https://doi.org/10.1136/bmj.l4898>
- Steyn, B. J., Steyn, M. H., Maree, D. J., & Panebianco-Warrens, C. (2016). Psychological skills and mindfulness training effects on the psychological wellbeing of undergraduate music students: An exploratory study. *Journal of Psychology in Africa*, 26(2), 167–171.
- Stieger, M., Robinson, S. A., Bisson, A. N., & Lachman, M. E. (2020). The relationship of personality and behavior change in a physical activity intervention: The role of conscientiousness and healthy neuroticism. *Personality and Individual Differences*, 166, 110224. <https://doi.org/https://doi.org/10.1016/j.paid.2020.110224>

- Swann, C., Piggott, D., Crust, L., Keegan, R., & Hemmings, B. (2015). Exploring the interactions underlying flow states: A connecting analysis of flow occurrence in European Tour golfers. *Psychology of Sport and Exercise, 16*, 60–69.
<https://doi.org/https://doi.org/10.1016/j.psychsport.2014.09.007>
- Takarada, Y., & Nozaki, D. (2021). Shouting strengthens maximal voluntary force and is associated with augmented pupillary dilation. *Scientific Reports, 11*(1), 1–11.
<https://doi.org/https://doi.org/10.1038/s41598-021-97949-2>
- Tenenbaum, G., Bar-Eli, M., Hoffman, J. R., Jablonovski, R., Sade, S., & Shitrit, D. (1995). The effect of cognitive and somatic psyching-up techniques on isokinetic leg strength performance. *Journal of Strength & Conditioning Research (Allen Press Publishing Services Inc.), 9*(1), 3–7. <https://doi.org/https://doi.org/10.1519/00124278-199502000-00001>
- Tenenbaum, G., & Becker, B. (2005). Is self-confidence a bias factor in higher-order catastrophe models? An exploratory analysis—A critique. *Journal of Sport and Exercise Psychology, 27*(3), 375–381. <https://doi.org/https://doi.org/10.1123/jsep.27.3.375>
- Thelwell, R. C., & Greenlees, I. A. (2003). Developing competitive endurance performance using mental skills training. *The Sport Psychologist, 17*(3), 318–337.
<https://doi.org/https://doi.org/10.1123/tsp.17.3.318>
- Theodorakis, Y., Weinberg, R., Natsis, P., Douma, I., & Kazakas, P. (2000). The effects of motivational versus instructional self-talk on improving motor performance. *The Sport Psychologist, 14*(3), 253–271. <https://doi.org/https://doi.org/10.1123/tsp.14.3.253>

- Thomson, C. J., & Carlson, S. R. (2014). Personality and risky downhill sports: Associations with impulsivity dimensions. *Personality and Individual Differences, 60*, 67–72. <https://doi.org/https://doi.org/10.1016/j.paid.2013.12.022>
- Tod, D., Edwards, C., McGuigan, M., & Lovell, G. (2015). A systematic review of the effect of cognitive strategies on strength performance. *Sports Medicine, 45*, 1589–1602. <https://doi.org/https://doi.org/10.1007/s40279-015-0356-1>
- Tod, D., Hardy, J., & Oliver, E. (2011). Effects of self-talk: A systematic review. *Journal of Sport and Exercise Psychology, 33*(5), 666–687. <https://doi.org/https://doi.org/10.1123/jsep.33.5.666>
- Tod, D., Iredale, F., & Gill, N. (2003). ‘Psyching-up’ and muscular force production. *Sports Medicine, 33*, 47–58. <https://doi.org/https://doi.org/10.2165/00007256-200333010-00004>
- Tod, D. A., Iredale, K. F., McGuigan, M. R., Strange, D. E., & Gill, N. (2005). “Psyching-up” enhances force production during the bench press exercise. *The Journal of Strength & Conditioning Research, 19*(3), 599–603. <https://doi.org/https://doi.org/10.1519/14263.1>
- Tomarken, A. J., & Serlin, R. C. (1986). Comparison of ANOVA alternatives under variance heterogeneity and specific noncentrality structures. *Psychological Bulletin, 99*(1), 90.
- Tosovic, D., Than, C., & Brown, J. (2016). The effects of accumulated muscle fatigue on the mechanomyographic waveform: implications for injury prediction. *European journal of applied physiology, 116*(8), 1485–1494. <https://doi.org/https://doi.org/10.1007/s00421-016-3398-7>
- Travis, S. K., Ishida, A., Taber, C. B., Fry, A. C., & Stone, M. H. (2020). Emphasizing task-specific hypertrophy to enhance sequential strength and power performance. *Journal of*

Functional Morphology and Kinesiology, 5(4), 76.

<https://doi.org/https://doi.org/10.3390/jfmk5040076>

Travis, S. K., Mujika, I., Gentles, J. A., Stone, M. H., & Bazyler, C. D. (2020). Tapering and peaking maximal strength for powerlifting performance: a review. *Sports*, 8(9), 125.

<https://doi.org/https://doi.org/10.3390/sports8090125>

Trease, L., Mosler, A. B., Donaldson, A., Hancock, M. J., Makdissi, M., Wilkie, K., & Kemp, J. (2023). What Factors Do Clinicians, Coaches, and Athletes Perceive Are Associated With Recovery From Low Back Pain in Elite Athletes? A Concept Mapping Study. *Journal of Orthopaedic & Sports Physical Therapy*, 53(10), 610–625.

<https://doi.org/https://doi.org/10.2519/jospt.2023.11982>

Tremblay, P. F., & Ewart, L. A. (2005). The Buss and Perry Aggression Questionnaire and its relations to values, the Big Five, provoking hypothetical situations, alcohol consumption patterns, and alcohol expectancies. *Personality and Individual Differences*, 38(2), 337–

346. <https://doi.org/https://doi.org/10.1016/j.paid.2004.04.012>

Trochim, W., & Kane, M. (2005). Concept mapping: an introduction to structured conceptualization in health care. *International journal for quality in health care*, 17(3),

187–191. <https://doi.org/https://doi.org/10.1093/intqhc/mzi038>

Trochim, W. M. (1989). An introduction to concept mapping for planning and evaluation.

Evaluation and program planning, 12(1), 1–16.

[https://doi.org/https://doi.org/10.1016/0149-7189\(89\)90016-5](https://doi.org/https://doi.org/10.1016/0149-7189(89)90016-5)

Tynes, L. L., & McFatter, R. M. (1987). The efficacy of 'psyching' strategies on a weight-lifting task. *Cognitive Therapy and Research*, 11(3), 327–336.

<https://doi.org/https://doi.org/10.1007/bf01186283>

- Uhm, J.-P., Lee, H.-W., & Han, J.-W. (2020). Creating sense of presence in a virtual reality experience: Impact on neurophysiological arousal and attitude towards a winter sport. *Sport Management Review*, 23(4), 588–600.
<https://doi.org/https://doi.org/10.1016/j.smr.2019.10.003>
- Ulrich, M., Keller, J., & Grön, G. (2016). Neural signatures of experimentally induced flow experiences identified in a typical fMRI block design with BOLD imaging. *Social cognitive and affective neuroscience*, 11(3), 496–507.
<https://doi.org/https://doi.org/10.1093/scan/nsv133>
- Van de Borne, P., Mezzetti, S., Montano, N., Narkiewicz, K., Degaute, J. P., & Somers, V. K. (2000). Hyperventilation alters arterial baroreflex control of heart rate and muscle sympathetic nerve activity. *American Journal of Physiology-Heart and Circulatory Physiology*, 279(2), H536–H541.
<https://doi.org/https://doi.org/10.1152/ajpheart.2000.279.2.h536>
- van den Hoek, D. J., Mallard, A., Garrett, J. M., Beaumont, P. L., Howells, R. J., Spathis, J. G., Pearson, J., & Latella, C. (2024). Powerlifting participation and engagement across all ages: A retrospective, longitudinal, population analysis with comparison to community strength norms. *International Journal of Sports Science & Coaching*, 19(5), 2199–2209.
<https://doi.org/https://doi.org/10.1177/17479541241244481>
- Vealey, R. S. (2006). Smocks and jocks outside the box: The paradigmatic evolution of sport and exercise psychology. *Quest*, 58(1), 128–159.
<https://doi.org/https://doi.org/10.1080/00336297.2006.10491876>
- Vella-Fondacaro, D., & Romano-Smith, S. (2023). The impact of a psychological skills training and mindfulness-based intervention on the mental toughness, competitive anxiety, and

- coping skills of futsal players—a longitudinal convergent mixed-methods design. *Sports*, *11*(9), 162. <https://doi.org/https://doi.org/10.3390/sports11090162>
- Vermeersch, H., T'Sjoen, G., Kaufman, J.-M., & Vincke, J. (2009). The relationship between sex steroid hormones and behavioural inhibition (BIS) and behavioural activation (BAS) in adolescent boys and girls. *Personality and Individual Differences*, *47*(1), 3–7. <https://doi.org/https://doi.org/10.1016/j.paid.2009.01.034>
- 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/https://doi.org/10.5641/193250308x13086832906030>
- Wagner, M., McBride, R. E., & Crouse, S. F. (1999). The effects of weight-training exercise on aggression variables in adult male inmates. *The Prison Journal*, *79*(1), 72–89. <https://doi.org/https://doi.org/10.1177/0032885599079001005>
- Wascher, C. A. (2021). Heart rate as a measure of emotional arousal in evolutionary biology. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *376*(1831).
- Weakley, J., Morrison, M., García-Ramos, A., Johnston, R., James, L., & Cole, M. H. (2021). The validity and reliability of commercially available resistance training monitoring devices: a systematic review. *Sports Medicine*, *51*, 443–502. <https://doi.org/https://doi.org/10.1007/s40279-020-01382-w>
- Weatherby, R. P., Giorgi, A., & Kazlauskas, R. (2002). Retention of performance gains following testosterone enanthate administration. *Medicine & Science in Sports & Exercise*, *34*(5), 90. <https://doi.org/https://doi.org/10.1097/00005768-200205001-01788>
- Webster, G. D., DeWall, C. N., Pond Jr, R. S., Deckman, T., Jonason, P. K., Le, B. M., Nichols, A. L., Schember, T. O., Crysel, L. C., & Crosier, B. S. (2014). The brief aggression

questionnaire: Psychometric and behavioral evidence for an efficient measure of trait aggression. *Aggressive behavior*, 40(2), 120–139.

<https://doi.org/https://doi.org/10.1002/ab.21507>

Wegner, D. M. (1994). Ironic processes of mental control. *Psychological review*, 101(1), 34.

Weinberg, R., Gould, D., & Jackson, A. (1980). Cognition and motor performance: Effect of psyching-up strategies on three motor tasks. *Cognitive Therapy and Research*.

<https://doi.org/https://doi.org/10.1007/bf01173655>

Weinberg, R., Gould, D., & Jackson, A. (1981). Relationship between the duration of the psych-up interval and strength performance. *Journal of Sport Psychology*.

<https://doi.org/https://doi.org/10.1123/jsp.3.2.166>

Weinberg, R., Jackson, A., & Seaboune, T. (1985). The effects of specific vs nonspecific mental preparation strategies on strength and endurance performance. *Journal of Sport Behavior*, 8(4), 175–180.

Wells, R., Outhred, T., Heathers, J. A., Quintana, D. S., & Kemp, A. H. (2012). Matter over mind: a randomised-controlled trial of single-session biofeedback training on performance anxiety and heart rate variability in musicians.

<https://doi.org/https://doi.org/10.1371/journal.pone.0046597>

Whelan, J. P., Epkins, C. C., & Meyers, A. W. (1990). Arousal interventions for athletic performance: Influence of mental preparation and competitive experience. *Anxiety Research*, 2(4), 293–307.

<https://doi.org/10.1080/08917779008248735>

Wilkes, R., & Summers, J. (1984). Cognitions, mediating variables, and strength performance. *Journal of Sport Psychology*, 6(3), 351–359.

<https://doi.org/https://doi.org/10.1123/jsp.6.3.351>

- Williams, S. E., & Cumming, J. (2016). Athlete imagery ability: A predictor of confidence and anxiety intensity and direction. *International Journal of Sport and Exercise Psychology*, 14(3), 268–280. <https://doi.org/https://doi.org/10.1080/1612197x.2015.1025809>
- Wilson, G., Drust, B., Morton, J. P., & Close, G. L. (2014). Weight-making strategies in professional jockeys: implications for physical and mental health and well-being. *Sports Medicine*, 44, 785–796. <https://doi.org/https://doi.org/10.1007/s40279-014-0169-7>
- Winwood, P. W., Cronin, J. B., Brown, S. R., & Keogh, J. W. (2014). A biomechanical analysis of the farmers walk, and comparison with the deadlift and unloaded walk. *International Journal of Sports Science & Coaching*, 9(5), 1127–1143. <https://doi.org/https://doi.org/10.1260/1747-9541.9.5.1127>
- Winwood, P. W., Keogh, J. W., & Harris, N. K. (2011). The strength and conditioning practices of strongman competitors. *The Journal of Strength & Conditioning Research*, 25(11), 3118–3128. <https://doi.org/https://doi.org/10.1519/jsc.0b013e318212daea>
- Winwood, P. W., Keogh, J. W., & Harris, N. K. (2012). Interrelationships between strength, anthropometrics, and strongman performance in novice strongman athletes. *The Journal of Strength & Conditioning Research*, 26(2), 513–522. <https://doi.org/https://doi.org/10.1519/jsc.0b013e318220db1a>
- Winwood, P. W., Pritchard, H. J., Wilson, D., Dudson, M., & Keogh, J. W. (2019). The competition-day preparation strategies of strongman athletes. *The Journal of Strength & Conditioning Research*, 33(9), 2308–2320. <https://doi.org/https://doi.org/10.1519/jsc.000000000003267>

- Woodman, T., & Hardy, L. (2005). Tenenbaum and Becker's critique: Much ado about nothing. *Journal of Sport and Exercise Psychology*, 27(3), 382–392.
<https://doi.org/https://doi.org/10.1123/jsep.27.3.382>
- Woodman, T., & Hardy, L. (2007). Dynamic systems, catastrophe models, and performance. *Movement & Sport Sciences*, 60(1), 63–67.
<https://doi.org/https://doi.org/10.3917/sm.060.0063>
- Wright, C. J., & Smith, D. (2009). The effect of PETTLEP imagery on strength performance. *International Journal of Sport and Exercise Psychology*, 7(1), 18–31.
<https://doi.org/https://doi.org/10.1080/1612197x.2009.9671890>
- Wright, L., Hardie, S. M., & Wilson, K. (2009). Handedness and behavioural inhibition: left-handed females show most inhibition as measured by BIS/BAS self-report. *Personality and Individual Differences*, 46(1), 20–24.
<https://doi.org/https://doi.org/10.1016/j.paid.2008.08.019>
- Wrisberg, C. A. (1994). The arousal–performance relationship. *Quest*, 46(1), 60–77.
<https://doi.org/https://doi.org/10.1080/00336297.1994.10484110>
- Wulf, G. (2013). Attentional focus and motor learning: a review of 15 years. *International review of sport and exercise psychology*, 6(1), 77–104.
<https://doi.org/https://doi.org/10.1080/1750984x.2012.723728>
- Wynngaarden, J. B., Johnston, C. R., Sazhin, D., Dennison, J. B., Zaff, O., Fareri, D., McCloskey, M., Alloy, L. B., Smith, D. V., & Jarcho, J. M. (2024). Corticostriatal responses to social reward are linked to trait reward sensitivity and subclinical substance use in young adults. *Social cognitive and affective neuroscience*, 19(1).
<https://doi.org/https://doi.org/10.1101/2023.01.17.524305>

- Yahya, M. F., Ismail, M., & Amer, A. (2016). The idea of using practice in mind training program for rugby players to improve anxiety and kicking performance. *Int J Sports Sci*, 6(2), 70–75. <https://doi.org/https://doi.org/10.5923/j.sports.20160602.09>
- Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of comparative neurology and psychology*, 18(5), 459–482. <https://doi.org/https://doi.org/10.1002/cne.920180503>
- Zhang, X., Rogers, M., & Werthner, P. (2024). Exploring a practitioner-athlete relationship and facilitated learning throughout a psychological skills training program. *Frontiers in psychology*, 15, 1354129. <https://doi.org/https://doi.org/10.3389/fpsyg.2024.1354129>
- Zouhal, H., Jacob, C., Delamarche, P., & Gratas-Delamarche, A. (2008). Catecholamines and the effects of exercise, training and gender. *Sports Medicine*, 38(5), 401–423. <https://doi.org/https://doi.org/10.2165/00007256-200838050-00004>