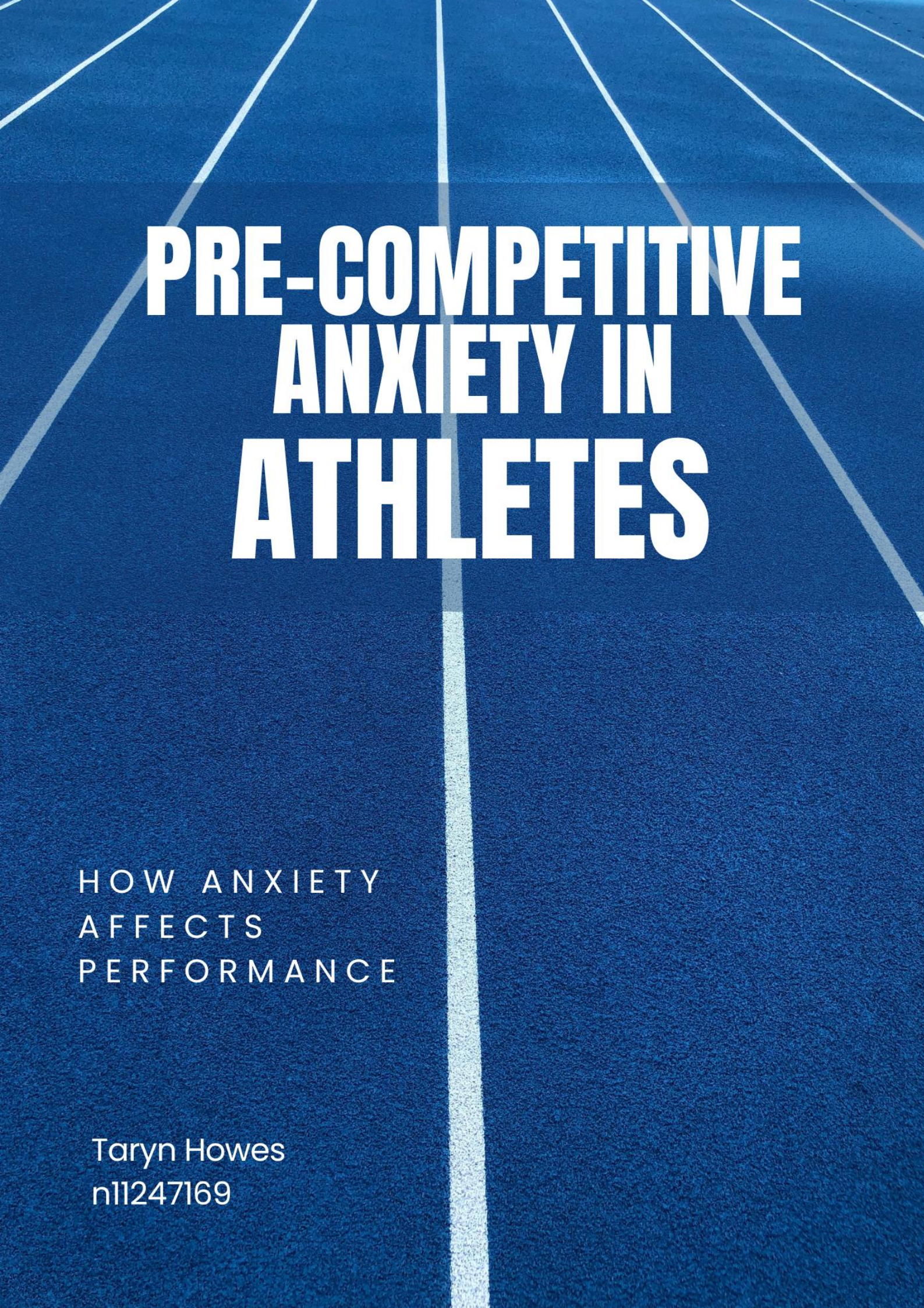

PRE-COMPETITIVE ANXIETY IN ATHLETES

HOW ANXIETY AFFECTS PERFORMANCE

Taryn Howes
n11247169

Authenticity Statement

This is to certify that to the best of my knowledge; the content of this report is my own work. This report has not been submitted for any subject or for other purposes. I certify that the intellectual content of this report is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

I have utilised AI in this report (Otter.ai & Atlas.ti) to assist in various ways. The way I have used AI includes assistance in transcribing and coding interview results. This data was then check and refined if needed.

Taryn Howes

N11247169

6/09/2024

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EXECUTIVE SUMMARY

The aim of this report is to investigate the degree to which pre-competitive anxiety affects athletes' performance when competing. It discusses opportunities for design interventions in the sporting industry, specifically catered to the anxiety of athletes within a sporting context, to enable athletes to perform to the best of their ability. Current anxiety reducing products on the market are not equipped for a sporting context, either being too bulky or not suited to movement. Secondary research within the background highlighted that competitive anxiety is a highly prevalent issue that affects athletes from all levels of competitive, and there is a need for interventions that target this specific issue. An analysis of survey results and two interviews showed that key issues involved: a lack of awareness, access to professional resources and athlete perceptions and mindset. Little design interventions have been developed that address these needs, aiming to address anxiety before it manifests at an intensified level. The design implications will help inform the design of interventions which will aim to reduce anxiety for athletes within different sports, promoting healthy management techniques and strategies, creating supportive environments and overall improving wellbeing and enjoyment of sport.

INTRODUCTION

The aim of this report is to investigate the degree to which pre-competitive anxiety affects athletes' performance when competing. It discusses opportunities for design interventions in the sporting industry, specifically catered to the anxiety of athletes within a sporting context, to enable athletes to perform to the best of their ability. A comprehensive understanding of the underlying factors contributing to increased anxiety will be explored through survey results and professional interviews to quantify data and conclude multiple design implications. The design implications will help inform the design of interventions which will aim to reduce anxiety for athletes within different sports, promoting healthy management techniques and strategies, creating supportive environments and overall improving wellbeing and enjoyment of sport.

BACKGROUND

Anxiety refers to multiple mental and physiological phenomena, it is dynamic and characterised by apprehensive anticipation regarding unpredictable and unavoidable future situations. 17% of Australians experienced an anxiety disorder within the past 12 months, making it a national and global issue (AIHW, 2024). Anxiety can, as a negative emotional state, affect athletes' performance through cognitive and somatic symptoms, leading to many athletes to consider anxiety to be debilitative toward performance. In a competitive scenario, there is a distinction between cognitive and somatic anxiety ((Mercader-Rubio et al., 2023).

Cognitive anxiety relates to adverse anticipations of success or self-evaluation, negative thinking, reduced self-worth, performance worries, and a negative state of mind. Somatic anxiety is linked to physical symptoms such as increased heart rate of muscle tension, contributing to negative sensations like nervousness, muscle strain and breathing difficulties. Research has shown that athletes with elevated anxiety levels often demonstrate poorer performance in competitions in comparison to those with lower anxiety levels. Once a competition is over, however, athletes show lower levels of competitive anxiety than moments prior to the event. Various sports have the potential to cause high levels of stress and anxiety; and it is well established that proper applications of psychological strategies when applied and practiced can be beneficial in anxiety and stress management.

Sports psychologists predict that high levels of competitive state anxiety and trait anxiety before and during competitions are harmful, negatively influencing performance and can lead to expulsion from events. Competitive state anxiety arises when the sport's expectations are greater than abilities perceived by the athletes. Whilst small amount of anxiety before a game gives athletes the drive to compete and perform well, uncontrolled anxiety can damage their performance and perception of self (Bali, 2015).

Past research has demonstrated the impact that competitive anxiety can have on sporting performance, indicating a significant negative effect for cognitive anxiety on sport performance. Additional studies have shown that high anxiety situations cause athletes to engage in excessive error monitoring, reductions in anticipation timing performance and decreased processing efficiency. Competitive anxiety has also been shown to heighten the risk of sport injury, with a study indicating that competitive trait anxiety is a risk factor for musculoskeletal injury in athletes (Hallihan et al, 2022).

Competitive anxiety is a highly prevalent issue that affects athletes from all levels of competitive, and there is a need for interventions that target this specific issue. This would help inform the larger sporting community, such as coaches, managers and sports psychologists, of the effectiveness and viability of psychological interventions, allowing them to make informed decisions on whether to incorporate such interventions in their applied practice. However, it is imperative to consider the impact that physical interventions can make in terms of helping athletes cope with their competitive anxiety, overall enhancing their performance.

BENCHMARKING

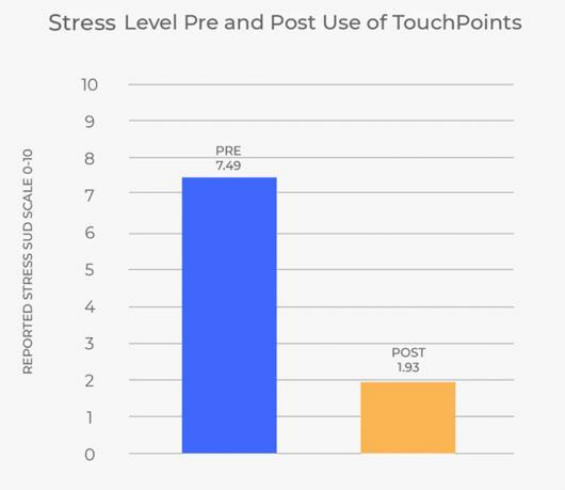
Benchmarking is a process which gives companies' the opportunity to measure the quality and efficiency of their policies, strategies, programs, services, products and processes against competitors within the same market. This process allows for a better understanding of customer needs and wants and ultimately improves business operations and outcomes (Business Victoria, 2022).

Wearable technology is becoming increasingly popular in the health and fitness industry, with brands offering innovative solutions to track and improve physical and mental wellbeing. These brands may encounter some promotional difficulties while educating customers about the benefits and features of their products and appealing to customers' requirements in terms of convenience and style. There is not a specific product within the market to help relieve competitive anxiety within youth and young adults, however there are similar products which relate to anxiety.

The Apollo Neuro wearable was launched in early 2020, it has helped over 100,000 customers sleep, relax and recover through specific vibration frequencies and intensities. The wearable is safe, non-invasive, and easy to use for adults and children alike. Apollo Neuro has been studied in over 1700 research subjects across 7 completed clinical studies. Findings show that 40% of subjects on average felt less feelings of stress and anxiety. The neurodevelopmental paediatrics pilot study shows improvement in mood, behaviour, engagement, and stress reduction in children and adolescents with anxiety and ADHD. Therapists reported that the Apollo device use in therapy significantly increased feelings of calm, eye contact, and functional engagement in the psychotherapy process (Rabin & Siegle, 2018).

Apollo Neuro was also tested regarding improving recovery and performance in elite athletes over the age of 18. Results showed that the wearable enhanced the consistency of sustaining peak performance during intense workouts. The Apollo wearable delivers low-frequency vibrations, Apollo Vibes, that significantly improved HRV and brought athletes back to a state of recovery faster after physical, mental, or emotional strain. (Hallihan & Siegle, 2022).

A key competitor is Sensate, which also utilises specific vibrations to calm the Vagus nerve, calming the brain medulla responsible for stress and anxiety. Additionally, over 65% with anxiety disorder and over 50% with a depressive disorder noted an improvement in their condition when using the device (Sensate, 2024). Both Apollo and Sensate target the Vagus nerve, however sensate has not been utilised within a sporting context. Compared to the Apollo design, the Sensate has a larger and bulkier form. It can be attached to a lanyard to hang around the neck; however, lacks discreetness which consumers may not find attractive.



A more discreet design is TouchPoints, which offers similar services to Apollo and Sensate, but at a reduced price. TouchPoints also offers a variety of different ways consumers can wear and use the product, not limited to one part of the body. TouchPoints work by altering the body's stress response with scientifically proven BLAST (Bi-lateral Alternating Stimulation Tactile) technology. However, it doesn't have any of the tracking features Apollo Neuro offers and has far fewer vibration modes to choose from.

A limitation of these devices is that they predominantly focus on reducing stress, not anxiety. It was challenging to search for a product that catered towards anxiety, and even more so for competitive and sports anxiety.

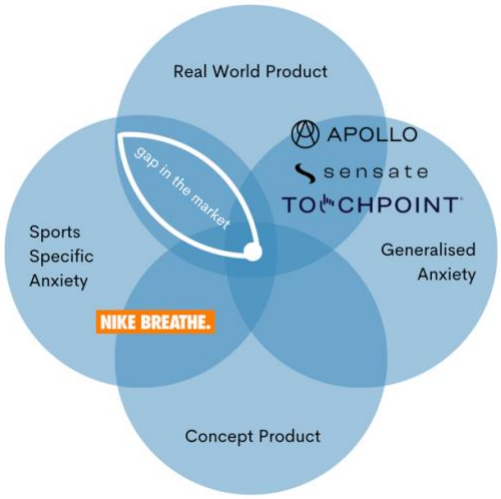
Nike Breathe – an anxiety kit/product design for footballers by Varun Anand explores reducing athlete anxiety levels to improve performance. Instead of offering calming vibrations, the design includes multiple components to help alleviate anxiety (Anand, 2023). This includes a shiatsu massage, positive messaging, tactile fidget buttons and storage for mints and gum. It is ergonomically designed to fit into the users' hand, it features a non-slip strap so it can be used during training. Anand recognised a gap in the market for products that aim to improve the performance of the user, hence providing scope for growth and development of the solution.

The Nike Breathe concept product includes more active user engagement and fits within a sporting context. The design is also cost-effective as it does not use technological features and does not need to be charged and thus would be more affordable, improving accessibility.

These products all leverage sensory stimulation to modulate the nervous system, aiming to provide a non-invasive solution to anxiety management. As seen in the comparison chart, Nike Breathe is the only product that is sports specific.

Comparison Chart

Features	APOLLO	SENSATE	TOUCHPOINTS	NIKE BREATHE
Reduces Anxiety	✓	✓	✓	✓
Sports-specific				✓
Ease of Use	✓	✓	✓	✓
Affordability			✓	✓
Aesthetic and Sensory Considerations	✓		✓	✓
User Interaction	✓	✓	✓	✓



As seen in this graphic, there is a clear gap in the market for sports specific anxiety relieving products. Whilst conducting research, the only sports specific product, was a concept, not a real-world product or brand.

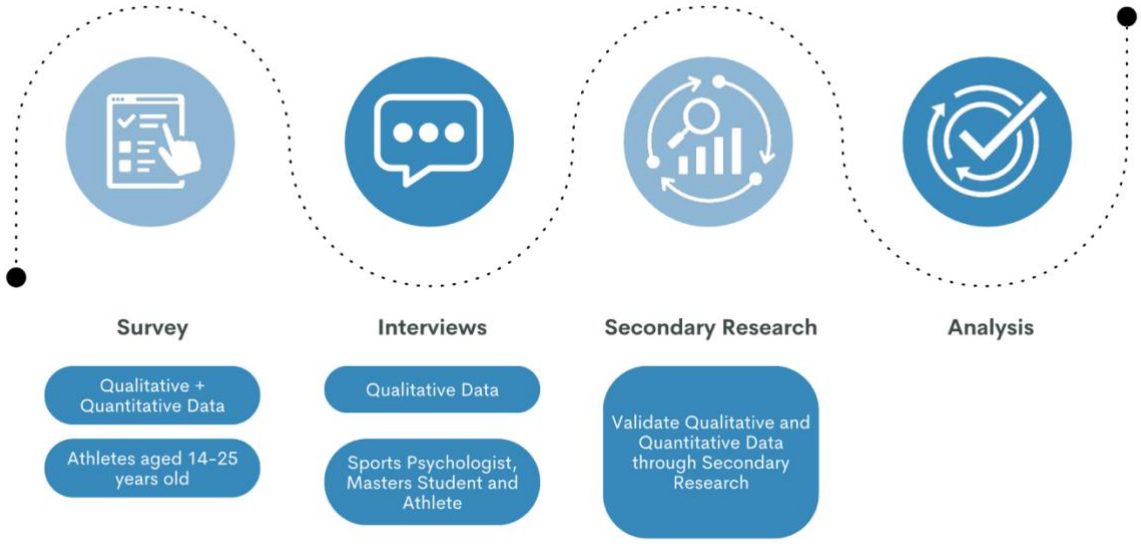
Thus, there is a need to provide a product catered specifically towards athletes as there is a clear gap in the market for this area. Current products do not serve the needs of athletes, aiming to reduce pre-competitive anxiety.

RESEARCH DESIGN

Design research is essential because it provides a foundation of insights that guide the creative process, ensuring that designs are user-centred, functional, and relevant. By understanding user needs, behaviours, and contextual factors, designers can create solutions that effectively address real-world problems, leading to more successful and impactful outcomes. This section of the report details findings from interviews and surveys. The interview participants gave their consent by signing consent forms, agreeing to the anonymous recording of their responses, which will be used to inform the outcomes of this research.

One of the strengths of qualitative research is its ability to explain processes and patterns of human behaviour that can be difficult to quantify. Experiences, attitudes, and behaviours can be complex to capture accurately and quantitatively.

The key objective of the research is to identify pain points and barriers for users, and what coping strategies they utilise to reduce feelings of anxiety. This will help inform the direction that the design takes.



Structure of Primary Research

Raw data was collected in the form of surveys, sent out to athletes between the ages of 14-25 which is a key age group who suffer from pre-competitive anxiety. In research it was deduced that pre-competitive anxiety increases as athletes become older, thus informing the age group for the surveys. Surveys were sent out via an Instagram story and a LinkedIn post (See Appendix 1). This enabled for qualitative and quantitative data to be collected. The surveys utilised nominal, categorical and short answer questions. Nominal data was used to organise responses to closed-ended and open-ended questions, helping the researcher understand user demographics. Categorical data was used to determine whether there was a statistically significant association between two categorical variables.

Mixed methods combine quantitative and qualitative research approaches in getting research questions answered, while triangulation describes how the researcher makes use of all the multiple approaches in

the study to extract the required information as well as critically analysing findings (Social Sciences Research Laboratories,2018); thus, establishing validity and credibility.

Triangulation can help ensure that fundamental biases that arise from the use of a single method are overcome. It helps explore and explain complex human behaviour using a variety of methods to offer a more balanced explanation of the data. It enables validation and credibility and can be used for both quantitative and qualitative studies (Noble & Heale, 2019).

Survey Design

A single survey was conducted to collect user data, utilising a mix of nominal, categorical and short answer questions. The survey was released and distributed through an Instagram story and a LinkedIn post (See Appendix 1), marketed towards a younger age group.

The first section of the survey focussed on user demographics, these individuals were between the ages of 14 to 25 and had competed in different sports at varying levels. Their sporting history was also asked, for example, how long they had competed in the sport. The second half of the survey aimed to determine the intensity of anxiety felt before competitions compared to after competing. Questions revolving around physical anxiety symptoms and possible causes of intensified anxiety were included.

Key survey questions included:

- On a scale of 1 to 5, with one being the lowest, how much anxiety did you experience before competing?
- On a scale of 1 to 5, how much of an impact did your anxiety have on your performance?
- What tools or strategies have you used to manage your anxiety before a competition?
- How long have you been competing in these events? If possible, please specify at what age you started

Survey data was collected using google forms and excel was utilised to display information.

Interview Design

Interviews were conducted following a semi-structured format following a series of pre-planned questions. The semi-structured nature of the interview questions enabled the acquisition of responses to key queries. It also provided the opportunity for follow-up questions, allowing the exploration of new ideas that emerged during the interview, thereby fostering a more comprehensive understanding for the researcher.

Questions were altered based on the participants' profession and experience, for example an elite athlete and performance psychologist. The interview with the elite athlete mainly centered around their experience competing with pre-competitive anxiety and how their performance was affected. Whilst speaking with the performance psychologist revolved around more psychological and coping technique-based questions.

The interviewees were contacted formally via email (See Appendix 2) and a specific date and time was decided to conduct an interview via video chat. Consent forms were sent to the participants and collected before conducting the interview (See Appendix 3). The interviews were timed to not exceed 30 minutes maximum. Interview transcripts can be seen in Appendix 5 and 6.

Examples of interview questions are listed below.

Elite Athlete	Performance Psychologist
Have you found that this anxiety intensifies as athletes get older? How do you think pre-competitive, and sports anxiety differs from generalised anxiety?	What psychological techniques have proven most effective in reducing pre-competitive anxiety in youth sports? What are the most common psychological barriers that young athletes face before competitions?

Interviews were transcribed using Otter.io and Atlas.ti was utilised to discover themes and codes within the transcriptions. Using AI to transcribe and code has limitations due to inaccuracy and reliability, thus additional codes were made manually. By doing this, the interviews could be coded into themes and codes, thus helping in the discovery of the relationships and patterns between different insights and interviews. These themes also aided in the creation of the design implication criteria.

RESEARCH FINDINGS

The following section will discuss methods of analysis undertaken and key findings. The raw survey data can be seen in Appendix 4.

SURVEY FINDINGS

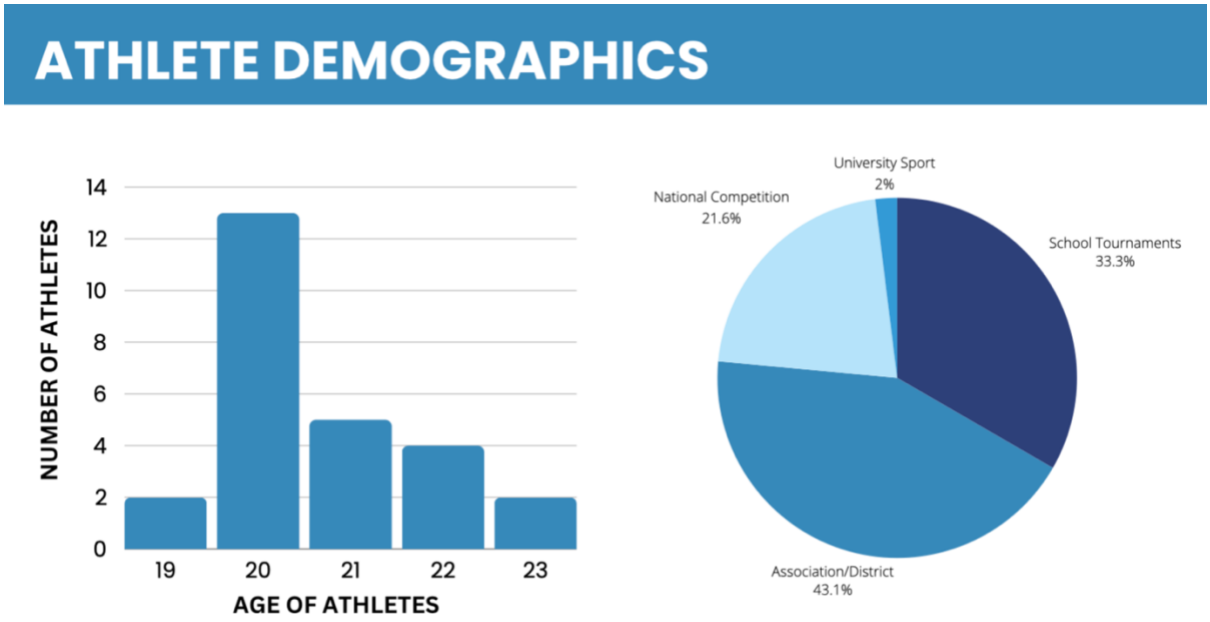


Figure 1 – Bar Chart detailing age of athletes, Pie chart detailing level of competition

As seen above in the bar chart, the predominant age of athletes was 20 years old. The survey was open to ages 14-25 years old, and the results were skewed towards the older half of the user group. The majority of athletes competed at association/district levels at 43.1%. The second highest level was school tournaments at 33.3%.

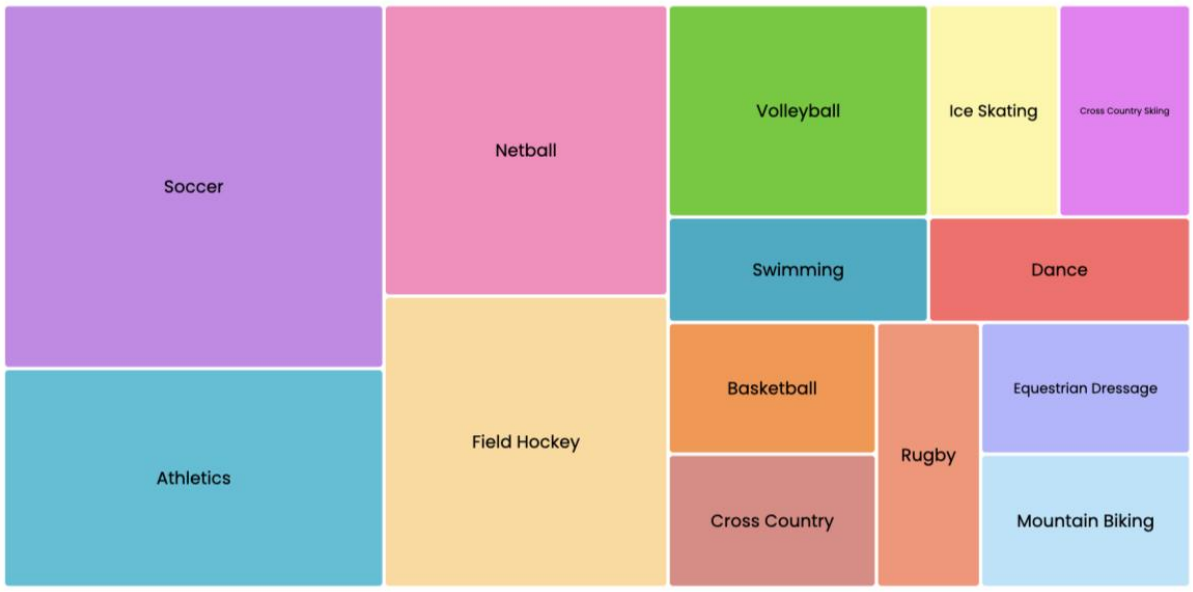


Figure 2 – Tree Map of sports athletes participate in

The tree map shows that most athletes competed in team sports such as soccer, netball and field hockey. Less participants competed in individual sports such as Cross Country and Equestrian Dressage. The results show a wide range of sports varying between team and individual levels, requiring different skill sets and measures of performance. Understanding which sports participants competed in, provides insights into the type of sports where athletes face higher amounts of pre-competitive anxiety.

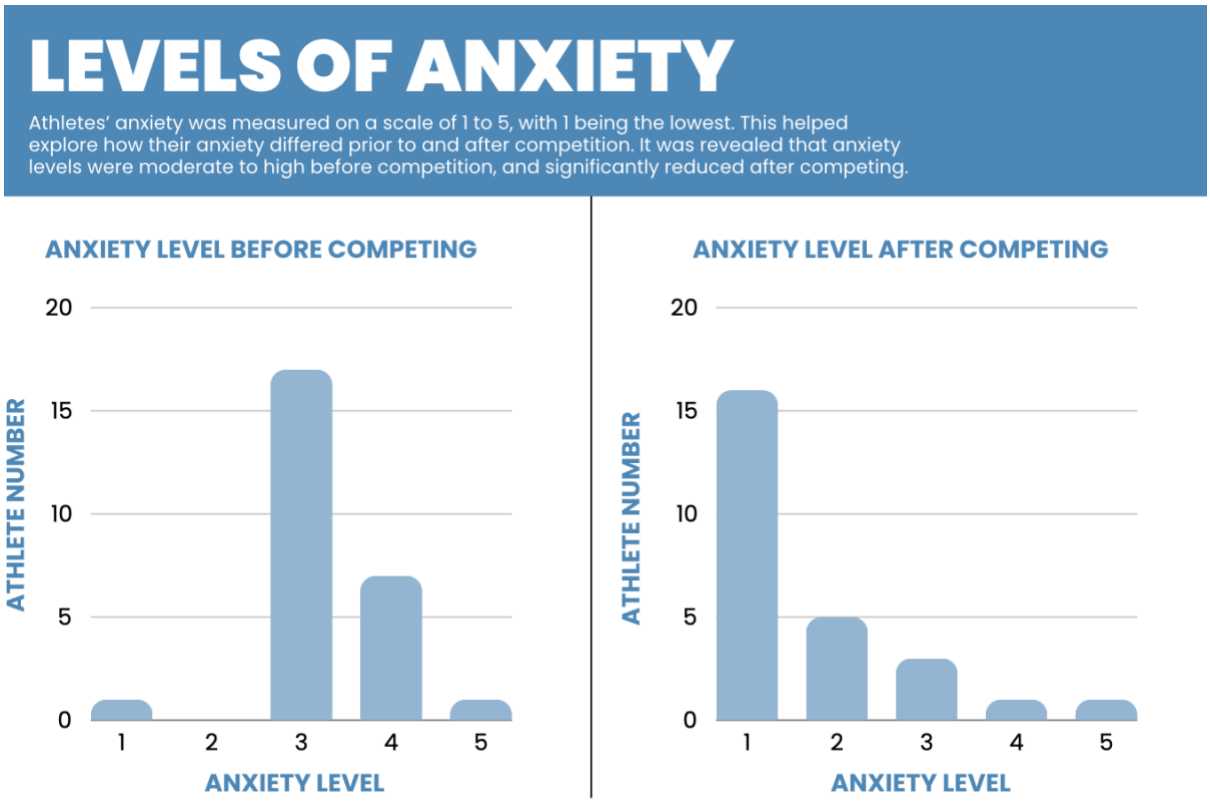
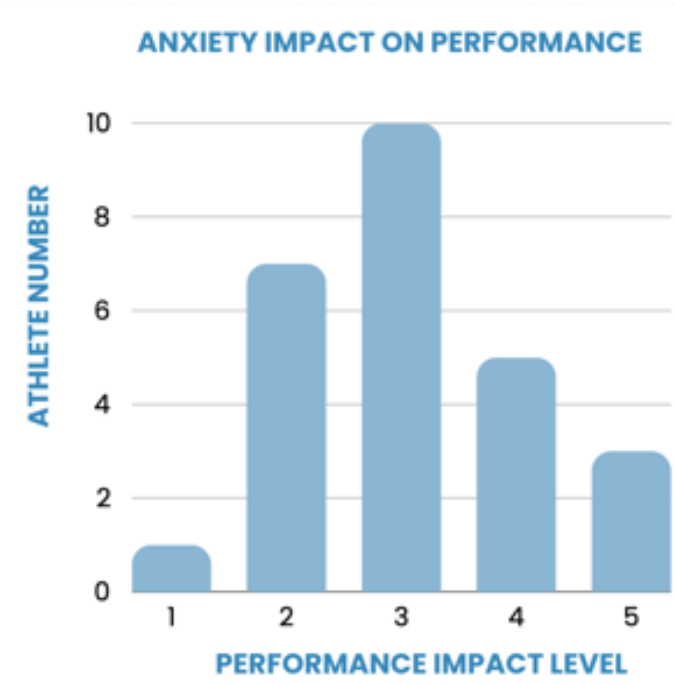


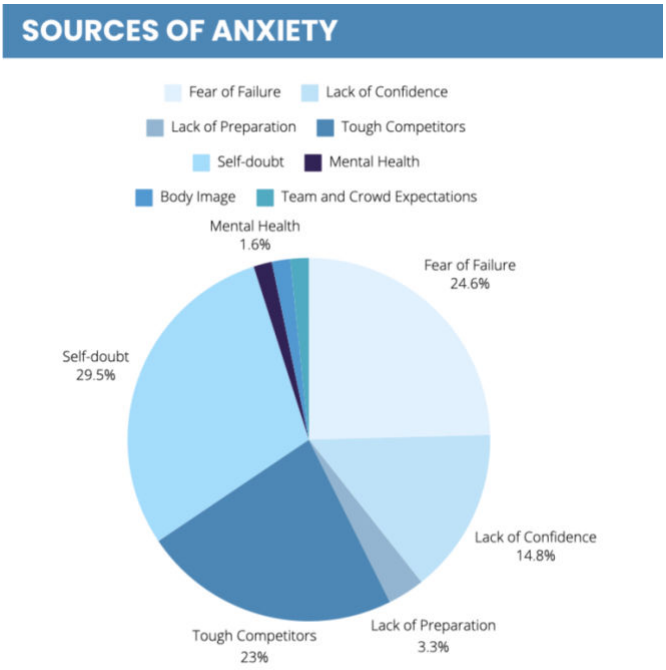
Figure 3 – Bar Chart

The results showed that pre-competitive anxiety levels were at a moderate to high level before competing. Post-competition anxiety levels were low and skewed to the left. There is a clear difference between pre and post competition anxiety levels. Athletes experienced low levels of anxiety post-competition, however there are two outliers of two athletes being at levels 4 and 5. Pre competition, an outlier was the athlete who had a low level of anxiety. This could be attributed to their mental preparation and experience with anxiety as well as personal factors such as wellbeing.



This bar chart displays to what extent athletes perceived their pre-competitive anxiety had an impact on their performance. The data is skewed towards the right, indicating a moderate to high impact on performance. It can be deduced that the higher levels of anxiety felt before competing, the higher impact anxiety had on performance. This can be contributed to athlete perceptions.

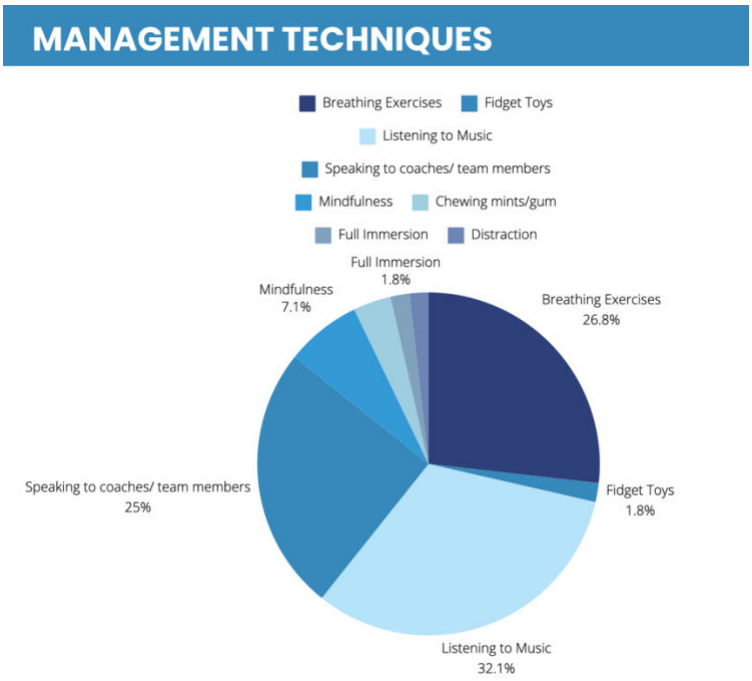
Figure 4 – Anxiety Impact on Performance



Key sources of anxiety included cognitive symptoms such as self-doubt and fear of failure. Athletes' perceptions of self and mental state were the most significant causes of anxiety when competing. This relates to research on cognitive anxiety, relating to adverse anticipations of success or self-evaluation.

Additionally external and non-controllable factors included tough competitors and peer pressure.

Figure 5 – Key Sources of Anxiety within Athletes

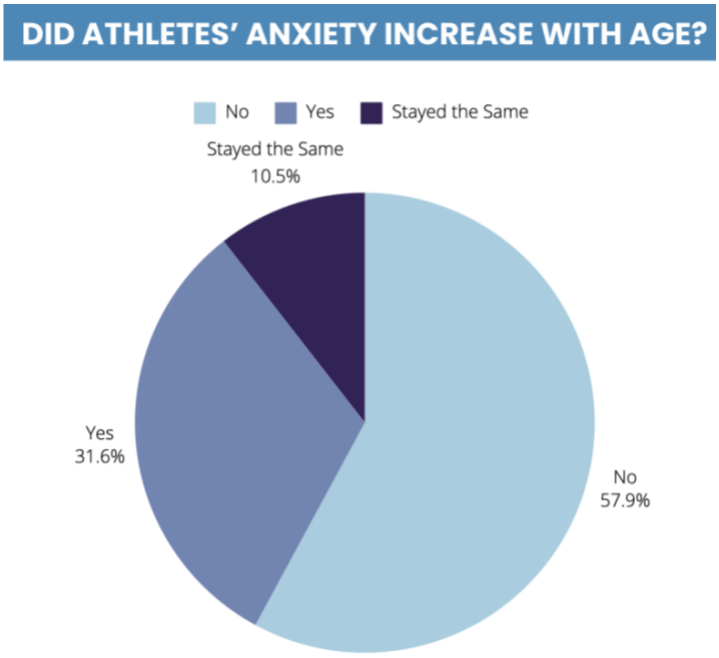


Key management techniques utilised by athletes included listening to music, breathing exercises and speaking to coaches and team members. These techniques helped athletes distract themselves from their anxiety to achieve balance, enhancing their preparation for competition.

Additionally, 23.1% of respondents had seen a practitioner/psychologist regarding their anxiety.

Figure 6 – Anxiety Management Techniques used by Athletes

One respondent stated that "coping strategies such as looking at things one step at a time [helped], normally when I get very anxious, I think of the entire picture of a situation and overthink which causes a lot of stress, but I have learnt to look at things one step at a time to calm me down." Multiple respondents shared similar insights with a key theme of putting their performance and competition into perspective to help alleviate their anxiety.



Contrary to findings in the background research, most respondents said their competitive anxiety did not increase with age. Among multiple researchers, it was deduced that anxiety increased with the age of athletes.

However, the athletes surveyed reported that the anxiety had decreased said that having a supportive environment, change in mentality and increase in experience helped reduce their pre-competitive anxiety levels. For example, one athlete said "No, it's gotten better as I realise it's all in my head, but it was difficult to realise that and I still struggle sometimes."

Figure 7 – Did Athletes' pre-competitive anxiety increase as they got older?

Figure 8 – Usefulness of a product that monitors anxiety levels

In accordance to the benchmarking section, which introduced multiple products which measured and mitigated anxiety, athletes were asked if they would find it useful to have a product that monitors their anxiety.

The majority of results said that a product like this would be somewhat useful (38.5%), whilst 38.5% stated that it would be very useful. One respondent commented that it may exacerbate feelings of anxiety as an athlete now has a quantifiable measure of it?

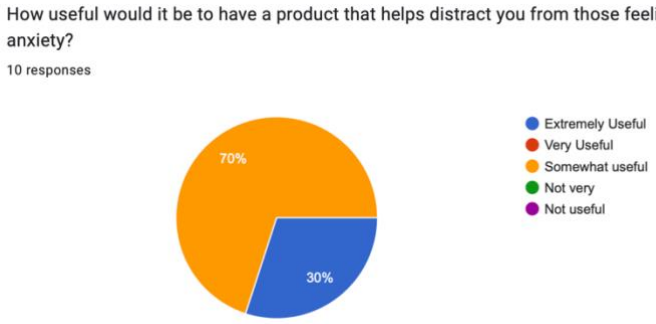


Figure 9 – Usefulness of a product that provides momentary distraction

In terms of a product that enables momentary distraction from their anxiety, athletes stated that it would somewhat useful (70%) to very useful (30%).

INTERVIEW FINDINGS

The interviews provided deeper insights into pre-competitive anxiety within athletes, with professional perspectives.

INTERVIEW ONE

Emily is an elite athlete who struggled with pre-competitive anxiety throughout their sporting career. She competed in the 2020 Tokyo Olympics for Group Rhythmic Gymnastics. She discussed the challenges of managing anxiety, particularly in high-pressure environments like rhythmic gymnastics, and the benefits of sports psychology techniques such as mindfulness and visualisation. Emily, in her final semester of a Masters in developmental psychology, specialising in disability, shared her journey from sports psychology to supporting individuals with disabilities. Emily emphasised the importance of a holistic approach to mental health and the need for effective strategies to manage both sports-related and generalised anxiety.

Emily loved competing in rhythmic gymnastics because she "liked performing and doing tricky things. It help[ed] get rid of [her] hyperactivity."

Emily started experiencing feelings of pre-competitive anxiety from the age of 14, she said the anxiety peaked when she "started placing or doing well at a national or state level". In terms of her mentality, she said it "felt like the world was on [her] shoulders". At 16 she started performing worse, because she "felt so much pressure before [she] went on the floor and wanted to keep doing well and placing".

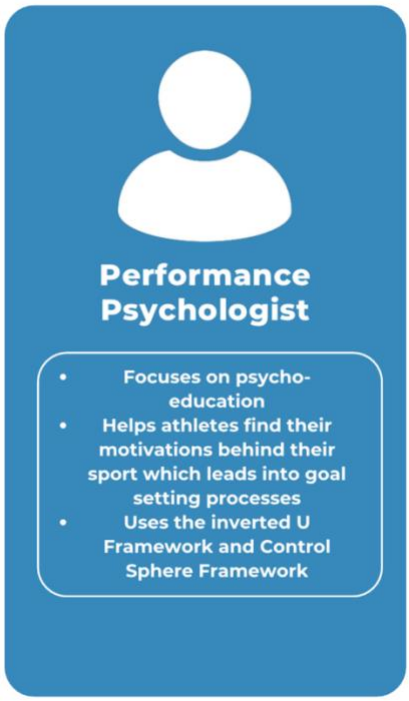
To help manage her anxiety and improve her performance, Emily started seeing a sports psychologist which taught her how to use that anxiety and relax the body before she performed. She stated that "to know that you can't really control anything, takes the power out of [the anxiety] as well.".

Several external factors also increased her competitive anxiety. Since group rhythmic is a team sport, anyone could be taken out of the team at any moment, and thus it was a competitive environment. Emily said “we went through a period of 11 months testing. So, each day we were being tested, and I just remember, this was the year before Tokyo. My anxiety was through the roof, and I, like, couldn't concentrate, and I was stressing the whole time.”.

A word art diagram was created using wordart.com to help visualise the key words found in Emily’s interview. There is a predominant use of negative wording such as failure, shock and tense. All these words combined describes an athlete’s negative experience with pre-competitive anxiety.

Figure 10 – Word Art Diagram of Key Words from Interview

INTERVIEW TWO



Kat is a Performance Psychologist and specialises in helping young athletes with their performance anxiety. Performance psychology is commonly associated with sporting and performing arts, but also branches into business and corporations. Kat stated that “the performance side of it is the skills that we're teaching, the strategies that we're implementing are based around trying to help them either manage symptoms of anxiety or stress and things like that, or to increase their performance from where it is currently.”

Kat’s interview focussed predominantly on the technical side of management strategies and techniques, providing insights into effective frameworks and processes. At the start of her sessions, Kat helps her clients find motivational factors that drive her clients to keep playing the sports that they play. Then, she explores the inverted U theory, proposes that sporting performance improves as arousal levels increase but that there is a threshold point. Any increase in arousal beyond the threshold point will worsen performance.

Kat stated that “a lot of it, like often, will come down to the overthinking. So, then it's, how do we begin to minimise the amount of overthinking?”, indicating that the cognitive side of anxiety is one of the most complex to address.

In terms of management strategies, on the topic of fidget toys, which help relieve anxiety, Kat said that “Yeah, a lot of coaches are like, put that away. Like, that's a distraction. Like, you need to be getting ready. And not a lot are informed, that it might be something that's helping them”. Kat highlighted the need for coaches to be more aware and educated on different techniques for relief from anxiety, rather than becoming a barrier to an athlete achieving the relief they need.

Qualitative coding provides organisation and structure to the data, allowing results to be examined in a systemic way to increase the validity of analysis (Dawood Salmana et al., 2021).

The code distribution view can be seen in Appendix xxx.

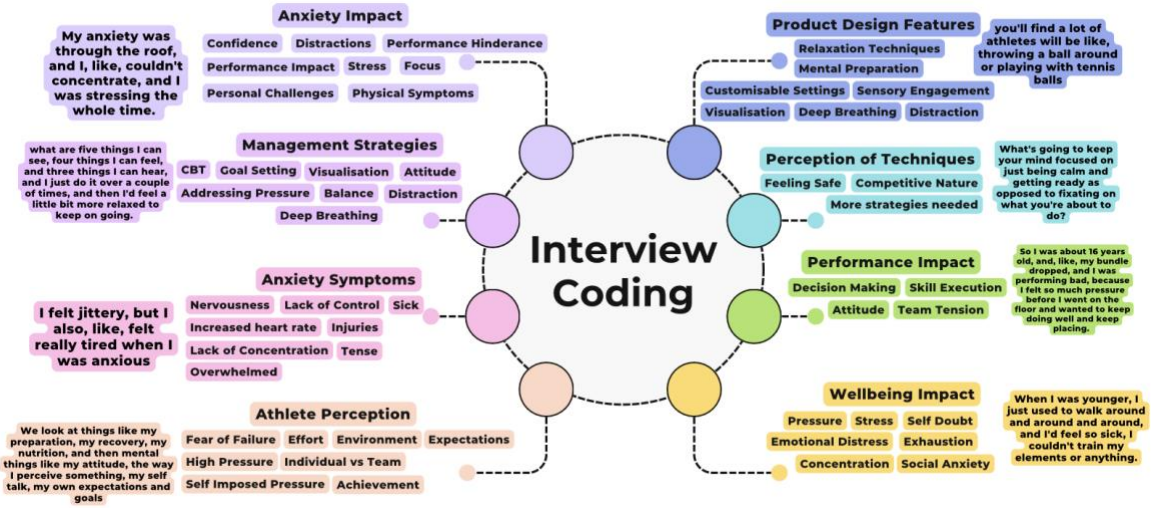


Figure 11 – Visualisation of Key Themes and Codes in the Interviews

The mind map above creates a surface level visualisation of the key themes and topics discussed in the interviews. The mind map features some repetition as codes and sub-codes can be applied to multiple themes. The coding helps visualise the main pain points, barriers, and enablers identified. Each code helps understand at a deeper level, athletes experience when competing and the reasons behind why some athletes may experience anxiety at a higher rate than others.

The table below displays a more comprehensive example of the coding technique.

Theme	Code	Sub-code	Example
Increasing Anxiety	Environment	Competitiveness Pressure	Emily: "But the tricky thing with doing group rhythmic gymnastics is there was always someone could be taken out of the team." Kat: "We find the older you get; the more people drop out" Kat: "So, there's that pressure of, I need to be achieving, I need to be performing to even stay in the sport." Emily: "Family stuff affected my anxiety in general. So I remember some comps, if I was having, like, a bad family week, it would really affect my performance."
	Somatic and Cognitive Symptoms	Nervousness Lack of Control Pressure Difficulty Breathing	Emily: "When I was younger, I just used to walk around and around and around, and I'd feel so sick" "I'd always a lot of the time I'd second guess myself being like, Oh no, I'm going to drop" Emily: "The most anxiety before comps was, like, team based in my final years, like those things, like comments from peers and like the potential of being kicked out was always and,

			like, being on the floor and you drop it, and you'd be like, oh my god, what is going to happen to me now?" Kat: So the physical symptoms I like, similar to traditional anxiety, heart racing, clammy, like the elevated breathing rate, feeling sick to your stomach, not being able to eat, and then the cognitive symptoms. For most of them, it's like, it's like an overthinking, so just lots of noise going on in the head
	External Factors	Family	Emily: "So the anxiety was always about, am I going to be good enough? Will I hit my mark? Will I hit? This was very performance based, whereas the stuff in my family life was very family based, so I had to focus a lot on"
Decreasing Anxiety	Support System	Positive Environment	Emily: "And when I moved to somewhere that was more welcoming and like wanted me to do well and that kind of thing, my performance kept going."
	Distractions		Emily: "And right before I went on the floor, I'd do something where I'd always feel really anxious in my chest, like it's tense, and hold it for about 10 seconds and let go." Kat: "you'll find a lot of athletes will be like, throwing a ball around or playing with tennis balls, yeah, just like lots of little things to kind of keep themselves occupied"
Management Strategies	Physical Techniques		Emily: "I was able to relax parts of my body that were really tense, so that when I got the floor, I wasn't tense and didn't have my shoulders up."
	Compartmentalisation		Emily: "that was always like, kind of affecting the way I was, like present in the gym or present before competitions. So, I felt like that's what was missing, was like a little bit more of a holistic thing, which sports psychs aren't so much trained in"
	Preparation Activities		Kat: "if you're high up on this, on the right side, in the stress zone, then we're looking at things like relaxation, breathing, progressive muscle relaxation, distraction, different types of music and designing your environment, and then if you're on the other side, it's more like energizing activities, gotcha." Kat: "we look at things like my preparation, my recovery, my nutrition, and then mental things like my attitude, the way I perceive something, my self-talk, my own expectations and goals"

Figure 12 – Comprehensive table of Interview Coding

ANALYSIS AND DISCUSSION

Based on primary and secondary research techniques conducted, various insights and findings were identified. The analysis and discussion section will examine the similarities and differences between the data, as well as highlight any limitations in research methods and data.

The findings show that pre-competitive anxiety is common, especially among older athletes competing at higher levels. As athletes progress, they face greater pressure, which heightens anxiety. This anxiety negatively impacts performance, aligning with the Yerkes-Dodson Law, where too much stress leads to decreased performance. The relationship between anxiety and performance highlights the need for psychological preparation, particularly in team sports where peer judgment plays a significant role.

Cognitive symptoms, such as self-doubt and fear of failure, are key sources of anxiety, with external pressures like tough competitors exacerbating the stress. Post-competition anxiety significantly decreases, emphasising the anticipatory nature of the anxiety athletes feel before competing.

Athletes use various management strategies, such as breathing exercises, cognitive reframing, and mental preparation, to cope with anxiety. The fact that 23.1% sought help from professionals suggests that mental health support is becoming increasingly important in sports. Techniques like breaking tasks into smaller steps help athletes manage overwhelming situations, reducing stress.

It is noted that survey respondents did not utilise tangible products to aid in anxiety relief, but rather techniques and easily accessible sources like music. No specific product was mentioned in responses, which also highlights a gap in the market for the sporting industry and maintaining athlete wellbeing and performance.

In conclusion, pre-competitive anxiety affects athletes' performance, especially at higher competition levels. However, effective management strategies and psychological support can mitigate its impact, highlighting the importance of mental resilience training in athletic development.

Section 1: Anxiety in the Competitive Sphere

As highlighted in Figure 3, athletes faced moderate to high levels of anxiety before competing. This mirrors research that athletes with elevated anxiety levels often demonstrate poorer performance in competitions in comparison to those with lower anxiety levels. Once a competition is over, however, athletes show lower levels of competitive anxiety than moments prior to the event. Figure 3 showed a decrease in anxiety post-competition; thus, it is imperative to examine the pre-competitive mind and body state to identify areas of anxiety and tension.

Sport makes up a large proportion of an athletes' identity, and thus performing lowly could have drastic impacts on their mental wellbeing and idea of self-worth. In an interview with Emily, who competed in the 2020 Tokyo Olympics for Rhythmic Gymnastics, she placed an emphasis on the importance of sport in shaping her identity. Emily experienced pre-competitive anxiety from the age of 14 as her gymnastics level increased and thus was competing in higher level events. Emily said that it was like "the world was on [her] shoulders" when competing, placing high amounts of pressure on herself to perform well.

This is an experience supported by performance psychologist, Kat, who added that by the time athletes are 15, 16, 17, there's a small pool. There is pressure for athletes believing "there's that pressure of, I need to be achieving, I need to be performing to even stay in the sport.", which over all reduces their enjoyment and motivational factors to keep competing in the sport. This is supported by a study which investigated gender and age influence in pre- competitive and post-competitive anxiety in young tennis players. The results showed that younger players showed lower trait anxiety, lower pre-match state

anxiety, and lower pre-match somatic anxiety as compared to their older counterparts (Gallego et al, 2022). This indicates that there is a gap in the transition into higher level sports for mental wellbeing to enhance performance.

The coded table shown in Figure 12 demonstrates how athletes face increasing anxiety due to competitive pressure, somatic and cognitive symptoms, and external factors. However, a supportive environment, distraction techniques, and various management strategies, such as relaxation techniques and preparation activities, help decrease and manage anxiety, enabling athletes to perform better. The insights suggest a need for more holistic approaches, such as compartmentalisation, to manage the multifaceted nature of anxiety in sports. This is mirrored in the survey results wherein supportive environments, such as support from team members, distractions such as listening to music and practicing breathing exercises, and support from psychologists enabled athletes to perform at a higher level.

Section 2: Management Techniques

Key strategies identified in the coded interviews were preparation, compartmentalisation, and physical techniques. Popular management techniques detailed from respondents revealed that athletes preferred listening to music to calm their pre-competitive anxiety. This may be due to the neurochemical effects of music which include increased levels of endogenous opioids and dopamine. There is also strong evidence to suggest that may be due to music's ability to reduce cortisol in a natural setting, as well as preventing cortisol increases and in some cases reducing cortisol in stressful situations (Mallik & Russo, 2022).

Additionally, breathing exercises and distraction techniques are important. Emily recounted using the 54321 techniques in which the individual is required to identify things around them appealing to the senses, for example, what are five things I can see? Emily utilised a pre-performance routine, which refers to "a set of task-relevant thoughts and actions an athlete systematically engages in prior to performance execution." (Rupprecht et al., 2021). A study analysing the effectiveness of pre-performance routines on performance concluded that both extensive and stand-alone routines are effective in optimising sport performance (Rupprecht et al., 2021).

Kat's use of the inverted U theory and sphere of control helps athletes put their performance into perspective. It is imperative that interventions motivate athletes to compete in their sport and continue to utilise motivational factors to drive their performance.

From an industrial design perspective, users were more inclined towards a product that distracted them from their feelings of anxiety, rather than having a quantifiable measure to monitor it. This demonstrates athletes' perceptions towards their anxiety, and that they need a distraction from their anxiety to calm and ground themselves. Emily stated different distraction techniques which helped her manage her anxiety.

One limitation within the study was that all participants came from an Australian context, thus an international perspective was not researched and inspected. Additionally, the short time frames and low participant numbers would have affected data collected as only particular perspectives were analysed and explored.

DESIGN IMPLICATIONS

Based on background research, surveys, and interviews, followed by an analysis and discussion of findings, design implications have been identified. These have been identified through design criteria and opportunity areas found by theme coding. Based on these areas criteria have been listed that are important to consider in design iterations. There is an obvious gap in the market for athlete specific anxiety management tools and future design should provide individual or multiple opportunity areas.

There is a clear gap for tangible products that specifically cater towards anxiety within athletes. Current designs are not built for the sporting context and lack a combination of anxiety management techniques. The majority of research and data collected indicated the significance of somatic and cognitive anxiety and how addressing these symptoms can help decrease feelings of anxiety. Four main design implications were identified based on data collected.

Integration with sports psychologists or mental health professionals could make the intervention more credible and effective. Athletes will have access to validated, expert-driven content, which can improve their confidence in using the intervention as a reliable tool for managing stress.

Addressing cognitive-behavioural factors will influence athletes' thought processes, helping to reframe negative thinking and reduce anxiety. This will directly impact performance, as athletes will have better control over their mental state, leading to fewer mental distractions and more focus during competition. Primary interventions could be introduced, ensuring that pre-competitive anxiety does not increase as athletes age as secondary and primary research revealed that athletes' anxiety increased with age.

Customisable features will lead to a highly individualised user experience, ensuring that the intervention caters to the specific needs of each athlete. This adaptability can increase the intervention's effectiveness, as athletes will be more likely to engage with a tool that feels tailored to their personal anxiety triggers and coping mechanisms. Furthermore, taking the sporting context into consideration, designs will need to adapt to different sporting fields. Designs viewed in the benchmarking section, such as Apollo Neuro and Sensate, are not discreet and could make a player's anxiety stand out even more on

the field. A design like Nike Breathe, not only fits the sporting aesthetic, but incorporates multiple anxiety relieving techniques in one product. Having a design that users will not feel embarrassed to use in front of others is also an important factor. Survey respondents stated that they don't want to add emphasis onto their anxiety, they want to distract themselves from it. Whilst distraction techniques are effective, it is also imperative that athletes understand the source of their anxiety and set goals and measures of improvement to help tackle their anxiety.

In addition to alleviating pre-competitive anxiety, the intervention should be designed to actively enhance performance by focusing on optimising mental and physical readiness. By integrating cognitive training tools like visualisation exercises and positive self-talk, athletes can sharpen their focus and boost confidence, helping them enter competitions with a clear and resilient mindset. These implications reflect how each design feature will shape the overall effectiveness, user engagement, and long-term impact of the intervention on athletes' ability to manage pre-competitive anxiety.

CONCLUSION

In conclusion, there is an obvious gap in the market for athlete specific anxiety management tools and future design should provide individual or multiple opportunity areas. The market proposes highly expensive and non-adaptable designs which are not suited to the competition space. Without the education of management techniques such as deep breathing exercises and professional support, athletes' mental wellbeing is put at risk, and ultimately their performance. Sporting anxiety, to an extent, can drive athletes to perform better, but too much puts the athlete at risk of worsening their performance. Young athletes may not recognise the extent of their anxiety due to a lack of education, thus awareness of pre-competitive anxiety is needed.

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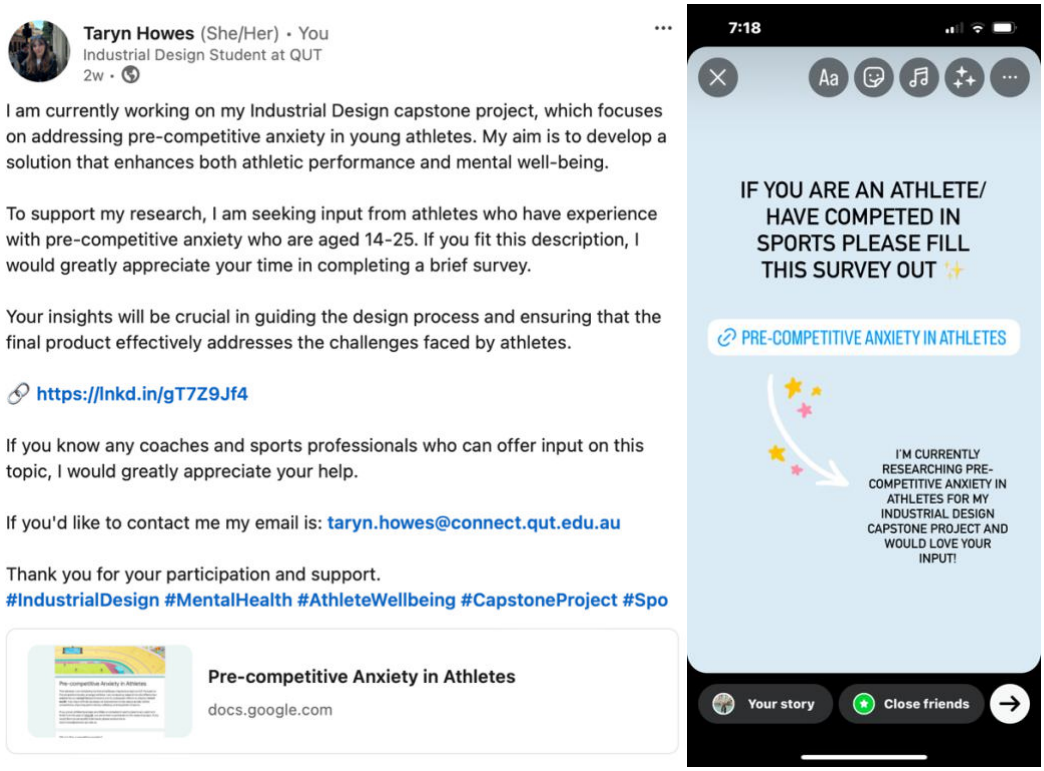
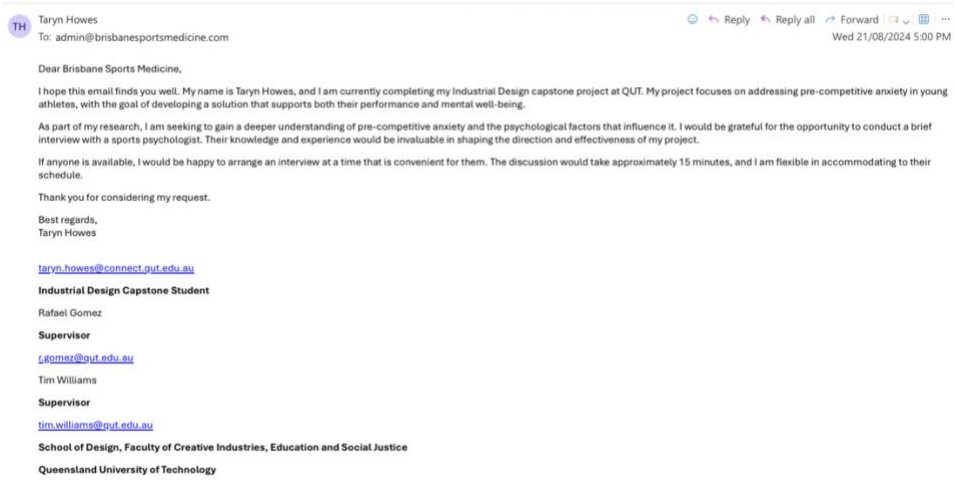
APPENDIX



Appendix 1 Formal and Informal Distribution of Survey



Appendix 2 - Sample Email for Interview Request

PARTICIPANT INFORMATION FOR CAPSTONE RESEARCH PROJECT
– Interview / Focus Group / Observations–

Investigating pre-competitive anxiety in athletes

Research team Please list all members and organisations in this section

Principal Researcher:	Taryn Howes	Student
Unit Coordinator(s):	Rafael Gomez	Unit Coordinator
	Tim Williams	Unit Coordinator

School of Design/Faculty of Creative Industries, Education and Social Justice
Queensland University of Technology (QUT)

Why is the study being conducted?

This research project is being undertaken as part of an Industrial Design Capstone project for Taryn Howes

The purpose of this project is to investigate pre-competitive anxiety within athletes and its effect on performance, sports injury, and mental wellbeing. At the conclusion of the project, a product/service will be designed aimed at reducing anxiety levels prior to competitions.

You are invited to participate in this research project because you are an expert in this field and your insights will provide significant information for the researcher.

What does participation involve?

Your participation will involve an audio recorded interview that will take approximately 15 minutes of your time.

Questions will include:

- What psychological strategies or interventions are commonly used to help athletes manage pre-competitive anxiety?
- How do you think pre-competitive, and sports anxiety differs from generalised anxiety?
- Based on your knowledge, what considerations should I keep in mind when designing a product aimed at reducing pre-competitive anxiety in young athletes?

Your participation in this research project is entirely voluntary. If you do agree to participate you can withdraw from the research project without comment or penalty. You can withdraw anytime during the interview. If you withdraw after your interview, on request any information already obtained that can be linked to you will be destroyed. Your decision to participate or not participate will in no way impact upon your current or future relationship with QUT.

You will be able to review a transcript of your responses after the interview.

What are the possible benefits for me if I take part?

It is expected that this research project may benefit you directly. The outcomes of the research, however, may benefit athletes. You can request a brief summary of the outcomes of the study by

emailing the principal researcher

What are the possible risks for me if I take part?

There are no risks beyond normal day-to-day living associated with your participation in this research project.

What about privacy and confidentiality?

All comments and responses are coded i.e. it be possible to re-identify you. A re-identifying code stored separately to personal information (e.g. name, address), will only be accessible to the research team, and the code plus identifying information will be destroyed at the end of the semester.

Any personal information that could potentially identify you will be removed or changed before the summary of results are disseminated or these data are shared with other researchers. The information that will be removed includes names, initials, place of work, education.

Any data collected as part of this research project will be stored securely on personal computers or password protected cloud storage systems (not on public storage systems). Data will be deleted once the project is complete at the end of the semester.

If the research project involves audio or video recording, information should also be included to inform participants. Delete/amend as necessary:
As the research project involves an audio recording:

- You will have the opportunity to verify your comments and responses prior to final inclusion.
- The recording will not be used for any other purpose.
- Only the named researchers will have access to the recording.
- It is possible to participate in the research project without being recorded.

Every effort will be made to ensure that the data you provide cannot be traced back to you in reports, publications and other forms of presentation. You can choose to have your comments attributed to you by name, or you can choose to be cited anonymously. For example, we will only include the relevant part of a quote, we will not use any names, or names will be changed, and/or details such as dates and specific circumstances will be excluded. Due to your expertise, you will be introduced as an expert (e.g. Sports Psychologist). Nevertheless, while unlikely, it is possible that if you are quoted directly your identity may become known.

How do I give my consent to participate?

You can provide consent by confirming that you have read and understood the consent information via email.

What if I have questions about the research project?

If you have any questions or require further information, please contact one of the listed researchers:

Taryn Howes taryn.howes@connect.qut.edu.au 0452560405

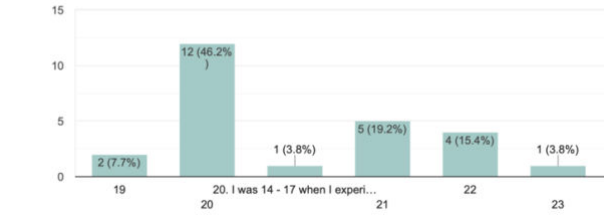
What if I have a concern or complaint regarding the conduct of the research project?

The researcher is committed to research integrity and the ethical conduct of research projects. If you wish to discuss the study with someone not directly involved, particularly in relation to matters concerning policies, information or complaints about the conduct of the study or your rights as a

Appendix 3 Participant Consent Forms

What is your age?

26 responses



What sport/s do you compete in? Were they at an individual or team level?

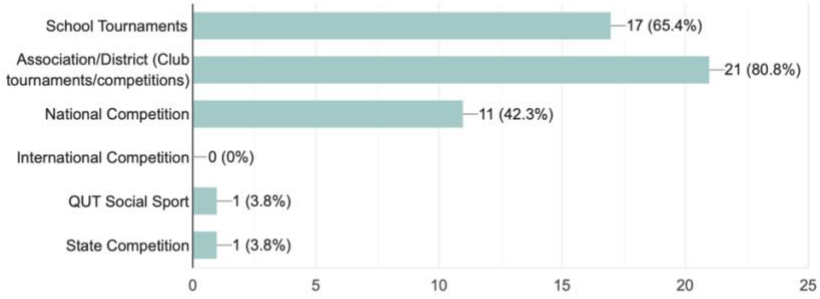
26 responses

Volleyball at team level
Hockey
Volleyball, team level
Mountain biking - individual
Netball, team level
Hockey (team)
athletics / track
Field hockey at a team level
Equestrian dressage. Both individually and team

At what level/s do you compete in the sport?

Copy

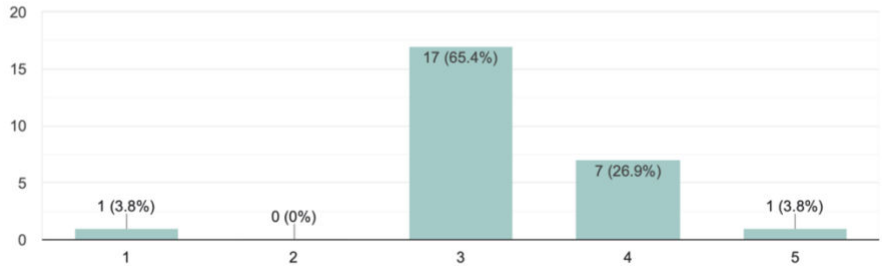
26 responses



On a scale of 1 to 5, with 1 being the lowest, how anxious were you before a competition?

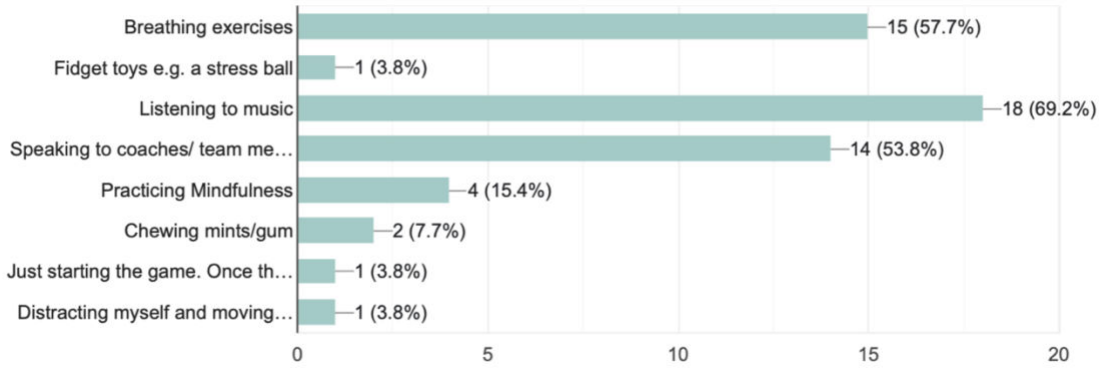
Copy

26 responses



What tools or strategies have you used to manage your anxiety before a competition? Copy

26 responses



Has this competitive anxiety increased as you have gotten older?

26 responses

no

Yes it has as I have expectations for myself and my performance

I feel that it has increased in different ways. When I was younger I was more anxious about winning the prize and that was my only focus, whereas as I had gotten older I felt more anxious about how other people perceived me and how I thought of myself with my performance.

Yes, more expectation on myself as I was becoming more higher ranked.

No, it has gotten better due to no longer playing competitively under abusive coaches.

No, it decreased. I kind of "cured" it after I did as many races as possible in a year and anesthetized myself against it, essentially

No, it's gotten better as I realise it's all in my head but it was difficult to realise that and I still struggle sometimes

Yes, due to playing in more competitive leagues

Have you felt relieved from this anxiety after competing? Why/ why not?

25 responses

Yes because of my performance and my team's performance exceeding expectations, competing well, and working together.

Yes, the pressure is over.

Yes - once the game started it would go.

Not really, new anxiety about performance after it is over, anxiety only relieved after a coach summary talk

depending on the result. if I do badly then the anxiety remains and I've kind of proved my pre-competition anxiety right

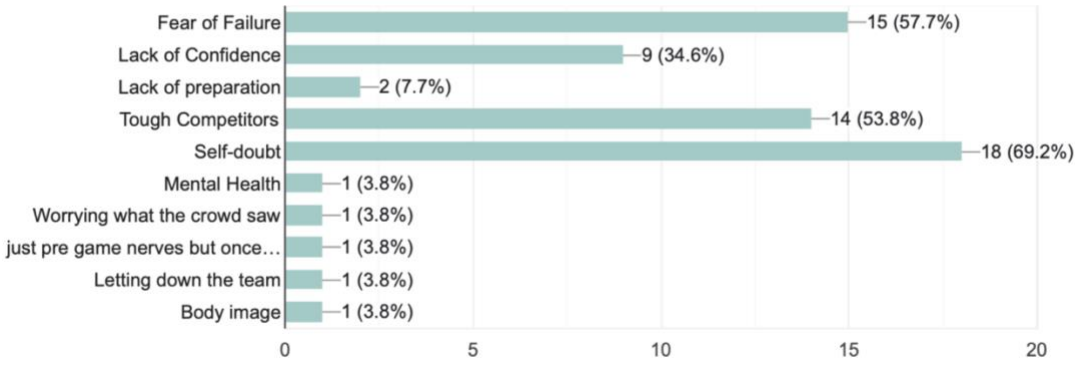
I think if you experience anxiety when you're competing it might actually be adrenaline cause the two can often get confused when competing. So generally after a game the adrenaline wears off and then you come back to reality. So I don't necessarily think that relieved is something that I personally would experience after a game

No as waiting for scores etc, as still anxious

If you felt anxious before a match, what was the main reason?

Copy

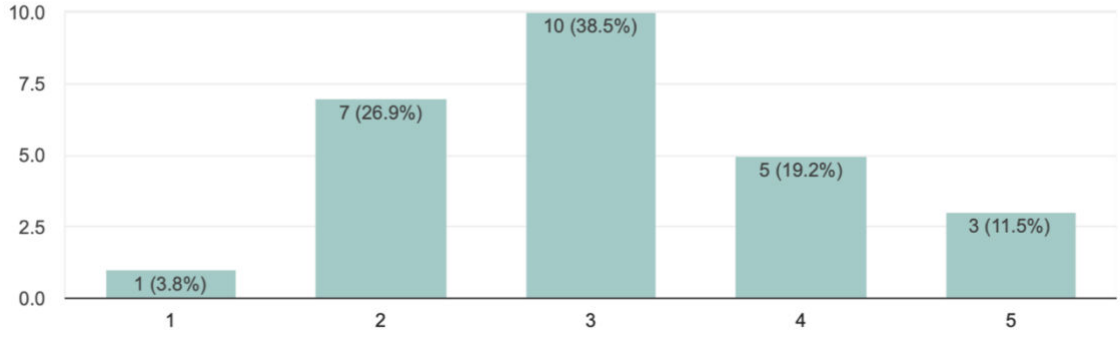
26 responses



On a scale of 1 to 5, how much of an impact did your anxiety have on your performance?

Copy

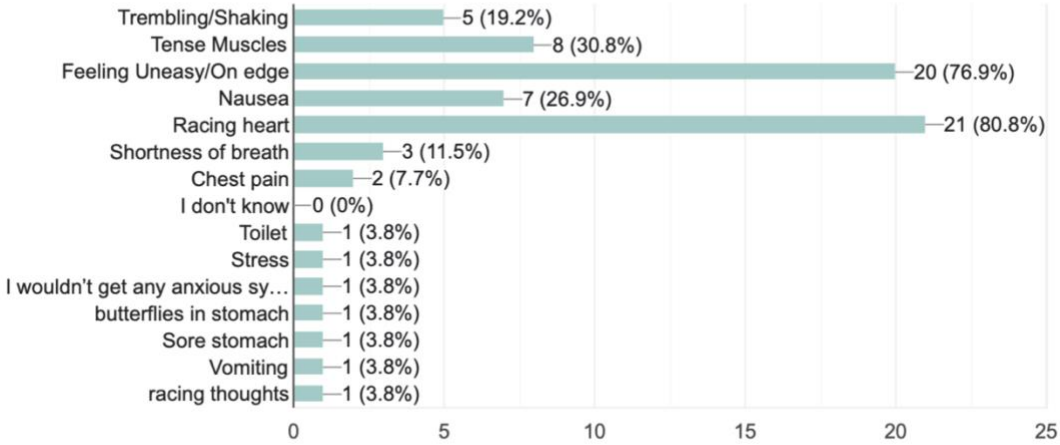
26 responses



What physical symptoms of anxiety would you experience? Please select all that apply

Copy

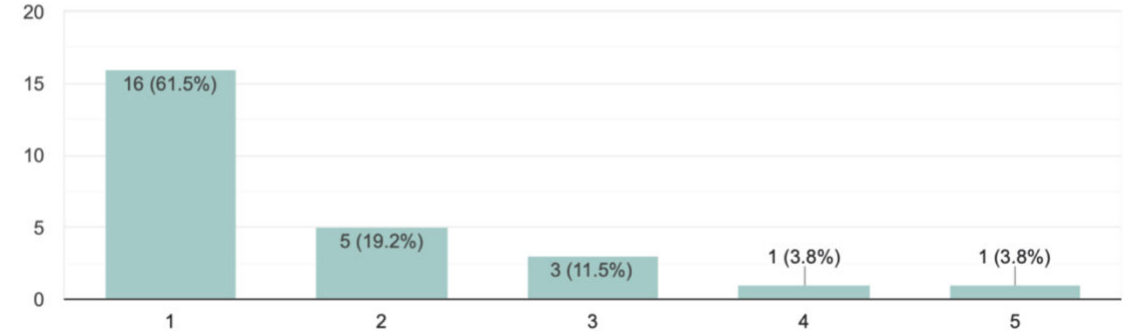
26 responses



On a scale of 1 to 5, how anxious do you feel after competing?

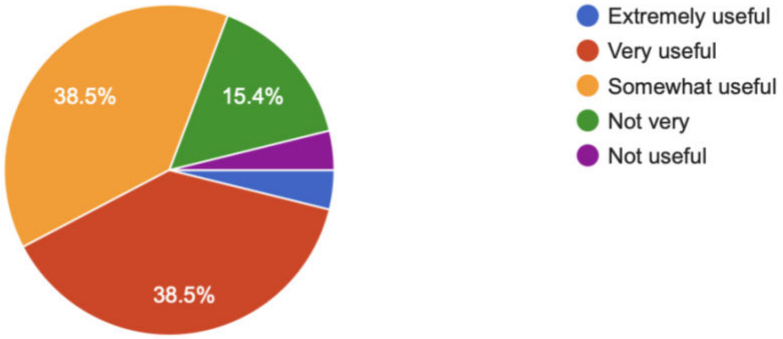
Copy

26 responses



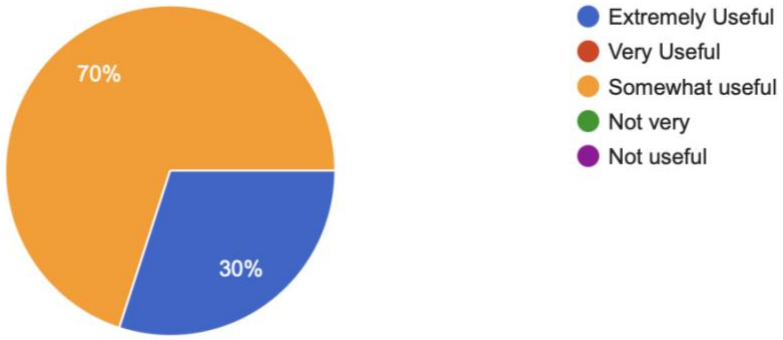
How useful would it be to have a product that monitors your anxiety levels, helping you understand and manage your pre-competition anxiety?

26 responses

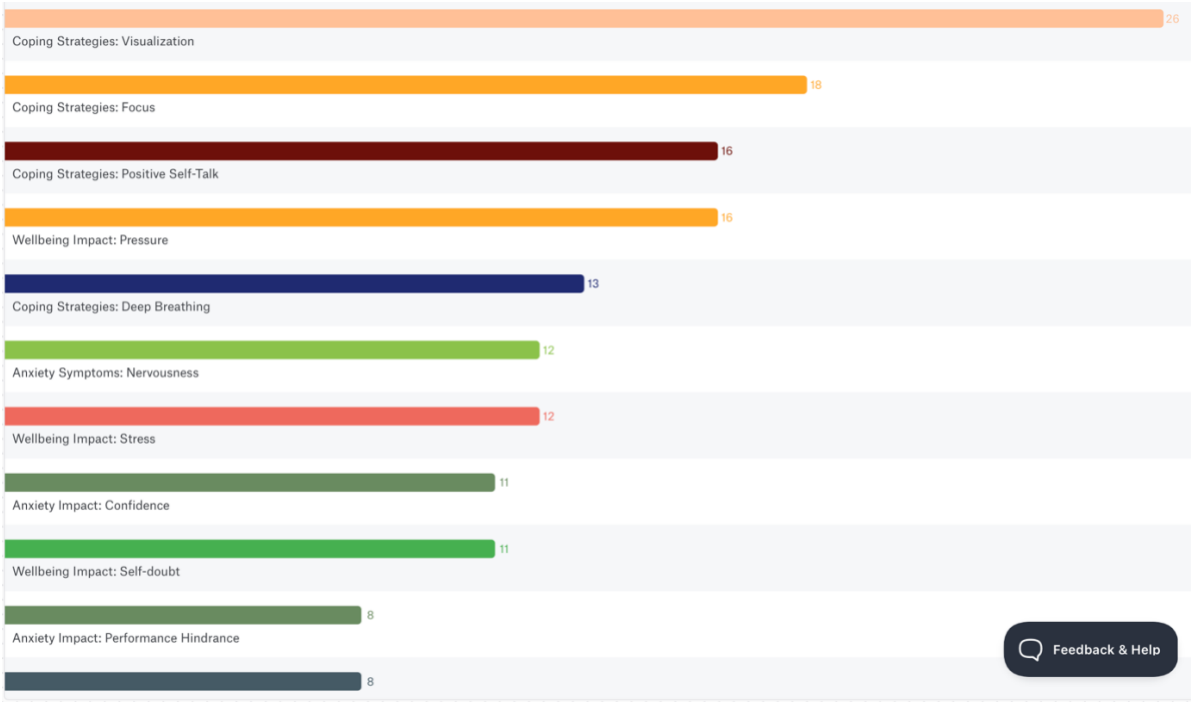


How useful would it be to have a product that helps distract you from those feelings of anxiety?

10 responses



Appendix 4 Raw Data from Survey



Taryn:

What kind of like techniques and strategies have like been most effective in reducing the performance anxiety in like athletes?

Kat ：

So, I typically start with like psycho education. So, in the session, I always do this ride up like a little mind map of why they play the sport that they play, essentially, and we're looking for, I guess that helps us look for motivational factors so why they're still invested, and why they're still playing that sport. And then also, like sports or pressure that will usually identify as well. Yeah. And then, depending on what comes up, like in that initial kind of activity and session, we go into things like the inverted U theory, so arousal control, a bit of education around that, like, where do you sit on the scale, and then techniques that you can bring in. So, when you're talking about arousal techniques, we're looking mostly at the body symptoms, yeah, gotcha. So obviously, like, if you're high up on this, on the right side, in the stress zone, then we're looking at things like relaxation, breathing, progressive muscle relaxation, distraction, different types of music and designing your environment, and then if you're on the other side, it's more like energizing activities, gotcha.

Appendix 5 – Transcript of Interview with Kat

Emily:

My anxiety was through the roof, and I, like, couldn't concentrate, and I was stressing the whole time. So yeah, I think the secret to it was just having a sport psych in my pocket since, I think the final five years I worked on and off with sports psychology.

Taryn:

Yeah, that's amazing, especially because, um, what kind of like techniques or like strategies did you learn from the sports psychs that, like, helped you?

Emily:

Do you know, 5432?

Appendix 6– Transcript of Interview with Emily