PSYCHOMETRIC PROPERTIES, MOOD PROFILE CLUSTERS, AND PREDICTIVE EFFECTIVENESS OF THE BRUNEL MOOD SCALE IN A SINGAPOREAN CONTEXT

A PhD Thesis by Publication

Submitted by

Christie Sze Yi Han, MSc (Sport & Exercise Psychology)

For the award of Doctor of Philosophy

2020

Abstract

The relationship between affective states and performance has been an enduring area of interest and is well-established in sport and exercise psychology (e.g., Hanin, 1997; Beedie, Terry, & Lane, 2000). However, previous studies in this area did not always provide clear definitions of the mood or emotion construct, which plagued subsequent investigations (Lane, Beedie, & Devonport, 2011). The present research investigated the relationships between mood responses and performance, where mood is defined as "a set of feelings, ephemeral in nature, varying in intensity and duration, and usually involving more than one emotion" (Lane & Terry, 2000, p. 17). In order to assess transient mood states, there is a need to use validated and culturally-relevant psychometric tools. One such instrument is the 24-item Brunel Mood Scale (BRUMS; Terry, Lane, Lane & Keohane, 1999; Terry, Lane, & Fogarty, 2003), a derivative of the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971, 1992), with six mood subscales (i.e., Tension, Depression, Anger, Vigour, Fatigue, and Confusion). The BRUMS has undergone rigorous validity testing using four different samples (Terry, Lane et al., 2003) and has been shown to be a psychometrically robust inventory for assessing mood responses across a range of contexts and cultures (e.g., Terry, Potgieter, & Fogarty, 2003; Terry, Malekshahi, & Delva, 2012; Zhang, Si, Chung, Du, & Terry, 2014).

To date, the BRUMS has not yet been extensively researched in Singapore, which is a multicultural Asian society. Thus, the first aim of the present research was to establish the factorial validity of the BRUMS for use in Singapore, and to develop a set of local norms. The six-factor mood measurement model was tested on a sample of 1,444 English-speaking Singaporean participants aged from 18 to 65 years, including 954 who were involved in sport. Structural equation modelling showed a good fit of the measurement model to the data (CFI = .956, TLI = .950, RMSEA = .052). Multisample analyses supported the invariance of the

measurement model in different subsamples based on gender, age group and sport participation. Concurrent measures correlated with the BRUMS subscale scores, in line with theoretical predictions. Internal consistency and test-retest reliability coefficients were acceptable, supporting the psychometric integrity of the BRUMS for use in Singapore. The second aim was to confirm if previously identified mood profile clusters (see Parsons-Smith, Terry, & Machin, 2017), namely the iceberg profile, inverse Everest profile, inverse iceberg profile, shark fin profile, submerged profile, and surface profile were also present in a Singaporean sample. A seeded *k*-means cluster analysis with a prescribed six-cluster solution was conducted using raw scores cluster centroids derived from Quartiroli, Parsons-Smith, Fogarty, Kuan, and Terry (2018) and the same six mood profile clusters were identified, providing evidence of the cross-cultural generalisability of these mood profiles.

With the locally validated BRUMS and local norms confirmed, the final aim was to examine the relationship between mood and performance among a group of elite pistol shooters. Shooters who performed above average were found to more consistently report a submerged mood profile pre-competition, providing initial evidence of the utility of mood profiling in pistol shooting. In summary, the establishment of the factorial and concurrent validity of the BRUMS, the cross-cultural generalisability of mood profiles in the Singaporean context, and the demonstration of the utility of mood profiling in pistol shooting set the stage for future studies to examine the antecedents, correlates, and behavioural consequences of mood responses among Singaporean samples. This includes examining the utility of mood profiling in clinical and non-clinical settings, across a range of sport, high performance, occupational and health contexts, as a tool for performance prediction, or as an indicator of mental health.

Certification of Thesis

This Thesis is the work of Christie Sze Yi Han, except where otherwise acknowledged. The work is original and has not previously been submitted for any other award, except where acknowledged.

Principal Supervisor: Professor Peter Terry

Associate Supervisor: Professor Gerard Fogarty

Associate Supervisor: Dr Renée Parsons-Smith

Student and supervisors signatures of endorsement are held at the University.

Statements of Contributions

The articles produced in this PhD research project were a joint contribution of the researchers. The details of their scientific contributions are provided below:

Study 1: Psychometric Properties of the Brunel Mood Scale among Athletes and Non-Athletes in Singapore

Article 1: Han, C., Parsons-Smith, R., Fogarty, G., & Terry, P. C. Psychometric properties of the Brunel Mood Scale among athletes and non-Athletes in Singapore, *International Journal of Sport and Exercise Psychology* (under review).

(Quartile-2 ranked; Impact Factor: 2.24; H-Index: 27; SJR = 0.73; SNIP = 0.609; Publisher: Taylor & Francis, ISSN: 1612197X).

The overall contribution of Christie Han was 55% to the concept development, data extraction, analyses, interpretation, drafting and revising the final submission; Professor Peter Terry, Professor Gerard Fogarty, and Dr Renée Parsons-Smith, concept development, editing and providing important technical inputs by 20%, 15% and 10%, respectively.

Study 2: Mood Profiling in Singapore: Cross-Cultural Validation and Potential Applications of Mood Profile Clusters

Article 2: Han, C. S. Y., Parsons-Smith, R. L., & Terry, P. C. (2020). Mood profiling in Singapore: Cross-cultural validation and potential applications of mood profile clusters. *Frontiers in Psychology, 11*, 1–9. https://doi.org/10.3389/fpsyg.2020.00665

(Quartile-1 ranked; Impact Factor: 2.39; H-Index: 95; SJR = 0.914; SNIP = 1.03; Publisher: Frontiers Media S.A., ISSN: 16641078)

The overall contribution of Christie Han was 60% to the concept development, data extraction, analyses, interpretation, drafting and revising the final submission; Dr Renée Parsons-Smith, Professor Peter Terry, and Professor Gerard Fogarty concept development, editing and providing important technical inputs by 20%, 15% and 5%, respectively.

Study 3: Mood and Pistol Shooting Performance

Article 3: Unpublished article. The sensitive nature of data provided by the military personnel who participated in this study precluded publication of this article.

The overall contribution of Christie Han was 70% to the concept development, data extraction, analyses, interpretation, drafting and revising the final submission; Professor Peter Terry, Professor Gerard Fogarty, and Dr Renée Parsons-Smith, concept development, editing and providing important technical inputs by 15%, 10% and 5%, respectively.

Acknowledgements

My supervisors Professor Peter Terry, Professor Gerry Fogarty and Dr. Renée Parsons-Smith have been pivotal in my journey of learning and completion of this work. It has been my fortune and honour to have their guidance and support throughout this journey that has pushed me far. The lessons learnt will continue to serve me well as I embark on the next chapter of my psychology career.

I am grateful for my superiors at work, as their encouragement gave me the courage to embark on this insurmountable journey. I am also thankful to have the blessings and help of my family, friends and colleagues as I took on this tough and lonesome journey. I would have taken much longer to complete this, if not for their faith, belief and generous help rendered. Especially grateful for Wanlin who trudged alongside me in this pursuit of academic knowledge and the betterment of self.

I am also very thankful to have met and worked with the athletes whom I got to meet in the course of my research work. Their talent and generosity allowed me to learn more about their sport, as well as how psychology could be used to enhance their performance and their lives.

To Dr. Emily Ortega and my friends at Singapore Sport Institute whom went out of their way to help me with the study.

My sincere appreciation and gratitude to all of you, for helping me make this work possible. Thank you.

On a final note, the COVID-19 pandemic had upended many people's livelihoods, lifestyles and routines, and a severe mental health crisis looms. I sincerely hope this thesis provides accessible knowledge and tools that increases insight on mood and mental health that may help practitioners, clinicians and policymakers do their work of "helping others" better.

Table of Contents

Abstract ii

Certification of Thesis iv

Statements of Contributions v

Acknowledgments vii

List of Figures xi

List of Tables xiii

List of Abbreviations xv

Chapter 1: Introduction and Literature Review 1

1.1 The Nature of Mood 1

1.2 Conceptual Issues of Mood and Emotion 3

1.2.1 Theoretical Distinctions between Mood and Emotion 3

1.2.2 Conceptual Models of Mood and Emotion 10

1.3 Measurement Issues of Mood and Emotion 13

1.3.1 Mood Assessment Issues 13

1.3.1.1 Types of Measures 15

1.3.1.2 Influence of Demographic and Situational Variables 18

1.3.1.2.1 Personality and Individual Differences 18

1.3.1.2.2 Response Timeframe 20

1.3.1.2.3 Gender 22

1.3.1.2.4 Age 24

1.3.1.2.5 Level of Competition 26

1.3.1.2.6 Situation 28

1.3.1.2.7 Time of Day 30

1.3.1.2.8 Physical Activity and Mental Health 32

1.3.2 Mood Assessment Measures 39

1.3.2.1 The Profile of Mood States (POMS) 39

1.3.2.2 The Brunel Mood Scale (BRUMS) 41

1.4 The Influence of Mood on Sport Performance..... 45

1.4.1 Past Research and its Limitations 45

1.4.2 Conceptual Model of Mood and Performance..... 51

1.5 Mood Profiling, Mood Profile Clusters and its Applications..... 56

1.6 Mood and Emotion Management Strategies 56

1.7 Research Objectives 63

Chapter 2: Study 1 – Psychometric Properties of the Brunel Mood Scale among Athletes and Non-Athletes in Singapore 67

Chapter 3: Study 2 – Mood Profiling in Singapore: Cross-Cultural Validation and Potential Applications of Mood Profile Clusters 99

Chapter 4: Study 3 – Mood and Pistol Shooting Performance 108

Chapter 5: General Discussion and Conclusion 144

5.1 Main Findings..... 144

5.1.1 Factorial Validity of the BRUMS and Generalisability of Mood Profiles in Singapore..... 144

5.1.2 Associations between Demographic Variables and Mood Profile Distribution..... 145

5.1.3 The Utility of Mood Profiling in the Sport of Pistol Shooting 147

5.2 Implications..... 148

5.2.1 The BRUMS as a potential universal measure of mood 148

5.2.2 BRUMS as a potential early detection tool for mental health issues... 149

5.2.3 Mood profiling as a tool to augment mental health literacy and health promotion efforts 149

5.2.4 Expanding the Utility of Mood Profiling in Pistol Shooting 153

5.3 Strengths and Limitations 154

5.4 Future Directions 156

5.5 Conclusions 159

References 160

Appendices 205

List of Figures

Chapter 1

Figure 1. On distinguishing different affective phenomena 7

Figure 2. The circumplex model of mood and emotion 11

Figure 3. A model highlighting two basic biopsychological dimensions of mood 12

Figure 4. The mammalian circadian clock 31

Figure 5. A preliminary taxonomy for enhancing the psychological benefits of exercise..... 36

Figure 6. The iceberg profile 46

Figure 7. Conceptual model of mood and performance with a focus on depression..... 52

Figure 8. Revised conceptual model of mood and performance 55

Figure 9. Mood profiles of successful and unsuccessful athletes 56

Figure 10. Six distinct mood profiles identified via cluster analysis 58

Chapter 2

Figure 1. Normative data for use with Singaporean athletes and non-athletes 98

Chapter 3

Figure 1. Visual representation of the six mood profiles 102

Chapter 4

Figure 1. Six distinct mood profiles identified via cluster analysis 109

Figure 2. Conceptual model of mood and performance with a focus on depression..... 115

Figure 3. Mean mood profile of elite pistol shooters 122

Figure 4. Mood profiles and performance scores of shooter F1 126

Figure 5. Mood profiles and performance scores of shooter F2..... 126

Figure 6. Mood profiles and performance scores of shooter F3..... 127

Figure 7. Mood profiles and performance scores of shooter F4..... 127

Figure 8. Mood profiles and performance scores of shooter F5..... 128

Figure 9. Mood profiles and performance scores of shooter M1 128

Figure 10. Mood profiles and performance scores of shooter M2..... 129

Figure 11. Mood profiles and performance scores of shooter M3..... 129

Figure 12. Mood profiles and performance scores of shooter M4..... 130

Figure 13. Mood profiles and performance scores of shooter M5..... 131

List of Tables

Chapter 1

Table 1. Distinctions between emotions and moods 8

Table 2. BRUMS subscales and its items 43

Table 3. Most popular and effective strategies used to regulate mood dimensions 62

Chapter 2

Table 1. Demographic distribution of the sample (*N* = 1,444) 91

Table 2. Model testing of the BRUMS (*N* = 1,444) 92

Table 3. Standardised factor loadings of the BRUMS (*N* = 1,444) 93

Table 4. Descriptive statistics, reliabilities, and intercorrelations among BRUMS subscales (*N* = 1,444) 94

Table 5. Standard Scores for the BRUMS (*N* = 1,444) 95

Table 6. Descriptive statistics and reliabilities for PANAS and DASS-21 subscales, and correlations with BRUMS subscales (*n* = 243) 96

Table 7. MANOVAs of BRUMS subscale scores by gender, age group, and sport participation 97

Chapter 3

Table 1. Sample demographics (*N* = 1,444) 101

Table 2. Raw score centroids used in cluster analysis 102

Table 3. Descriptive statistics of the 6-cluster solution (*N* = 1,444) 103

Table 4. Discriminant functions (*N* = 1,444) 103

Table 5. Structure matrix (*N* = 1,444) 103

Table 6. Cluster classifications (*N* = 1,444) 103

Table 7. MANOVA of BRUMS subscales by demographic variables 104

Table 8. Distribution of clusters by demographic variables 104

Chapter 4

Table 1. Descriptive statistics of mood and performance scores across six matches 121

Table 2. Mean mood and performance scores across six matches for each shooter..... 122

Table 3. A 2 x 2 contingency table of mood and performance 123

Table 4. Cross-tabulations of mood and performance attained by Fisher's exact test..... 123

Table 5. Distribution of mood profiles across matches..... 124

Table 6. Mean overall mood and mean performance scores of each shooter across six matches 124

Table 7. Non-parametric correlations between mean mood scores and mean performance scores..... 125

List of Abbreviations

AARM – Association of South East Asian (ASEAN) Armies Rifle Meet

AIC – Akaike's Information Criteria

AH – Anger-Hostility

ASEAN – Association of South East Asian Nations

BRUMS – Brunel Mood Scale

CB – Confusion-Bewilderment

CI – Confidence Interval

CFA – Confirmatory Factor Analysis

CFI – Comparative Fit Index

DASS-21 – Depression, Anxiety, and Stress Scales

DD – Depression-Dejection

F1, F2, F3, F4, F5, F6 – Female Shooter 1 to 6

M1, M2, M3, M4, M5, M6 – Male Shooter 1 to 6

MANOVA – Multivariate Analysis of Variance

NA – Negative Affect

FET – Fisher's Exact Test

FI – Fatigue-Inertia

IZOF – Individual Zone of Optimal Functioning

MDD – Major Depressive Disorders

PA – Positive Affect

PANAS – Positive and Negative Affect Schedule

POMS – Profile of Mood States

RMSEA – Root Mean Squared Error of Estimation

STAI – State-Trait Anxiety Inventory

SPSS – Statistical Package for Social Sciences

STAXI – State Anger-Expression Inventory

TA – Tension-Anxiety

TLI – Tucker-Lewis Index

TMD – Total Mood Disturbance

VA – Vigour-Activity

Chapter 1: Introduction and Literature Review

1.1 The Nature of Mood

There is considerable literature demonstrating the essential roles that moods play in human functioning. Mood states influence perception, cognition, and behaviour (Ekman & Davidson, 1994). Moods have been conceptualised as ever-present frames of mind (Morris, 1989), influencing how we interact with the world around us and directing how we behave by providing us with information on the probability of success or failure in our interactions with the environment (Bless, 2001; Brehm, 1999; Gendolla & Krüsken, 2002; Schwarz, 1990). For example, positive moods may indicate that a situation carries little threat while unpleasant moods may indicate that a situation is potentially challenging or threatening (Clore et al., 2001) and that additional resources need to be deployed in order for us to cope and adapt to the environment (Batson, Shaw, & Oleson, 1992; Brehm, 1999; Morris, 1992).

Mood can also determine the enjoyment in our lives (Thayer, 2011) by influencing how we experience energy and tension in daily life, where successful regulation of mood involves behaviours that modulate energy and tension to optimal levels (Thayer, Newman & McClain, 1994). This relates to Thayer's (1978, 1989) theory of mood, which states that mood is closely associated with central states of general bodily arousal with conscious components of *energy* (versus tiredness) and *tension* (versus calmness). Key to Thayer's (1978, 1989) conceptualisation is the focus on "general bodily arousal" where different bodily systems (e.g., cardiovascular, skeletal-muscular, and cognitive) interact in a general or holistic manner with positive and negative moods. Such conceptualisation implies that a change in one system is likely to affect other systems (Thayer et al., 1994). There has indeed been evidence showing that mood can influence the level of arousal in the autonomic and central nervous systems (see Dalgleish, 2004; Iidan et al., 2018; LeDoux, 1992; Thayer, 2001), and the endocrine system (see Graham, Denson, Barnett, Calderwood, & Grisham, 2018; Houser, 2004; Nelson, 2005;

Suchy, 2011; Wieck, 1996). Hence, moods are ever-present and constantly affect our functioning in a multitude of ways, consciously and subconsciously, volitionally or not.

Mood is also likely to affect motivation (e.g., Bowles, Curtis, Davies, Lengerich, & Bugajski, 2019) and performance (e.g., Gendolla, Brinkmann, & Richter, 2007). It has been widely documented that intense emotional responses are elicited when individuals are involved in tasks or events that carry personal importance to them (e.g., major exams; Collins & Onwuegbuzie, 2003; Pekrun, 2017) or competing in major sporting events (e.g., Terry, 1995; Totterdell & Leach, 2001). There is strong anecdotal and scientific evidence that the mood and emotions experienced by athletes prior to and during sport performance can influence the quality of their performances (e.g., Hanin, 2000b; Lane, 2007a). There is also a growing recognition in the past two decades that emotions are fundamental to human striving for achievement (Pekrun, 2017). Emotions are also critical determinants for performance and productivity of individuals, organisations, and cultures (Ashkanasy & Humphrey, 2011; Pekrun & Linnenbrink-Garcia, 2014).

However, the empirical support for mood-performance relationships in sport has been more equivocal than clear cut, even though more than 250 published studies have examined mood responses in sport and exercise settings (LeUnes & Burger, 1998). The equivocality of the mood-performance relationship can be attributed to the lack of clarity or consensus in the sport psychology literature about the nature of the mood construct and its definition (Augustine & Hemenover, 2009; Batson et al., 1992; Lane & Terry, 2000), an inconsistency in the methods used in mood-performance research (e.g., differing response timeframes, see Terry, Stevens, & Lane, 2005), and a dearth of theoretical frameworks to guide research (Beedie et al., 2000).

The following sections serve to address these conceptual, theoretical, and measurement issues of mood so as to facilitate examination of the relationship between mood and performance in this thesis.

1.2 Conceptual Issues of Mood and Emotion

The ability to measure a psychological construct is central to the process of testing theories and investigating hypothesised relationships (Terry, 2003). Before discussions on measurement can proceed, it is necessary to clarify various terminologies in this area of research to provide conceptual clarity (Lane, Beedie, & Devonport, 2011). A lack of conceptual clarity is akin to not having an operational definition for psychological constructs or phenomena, which hinders researchers from creating validated measures of psychological constructs for research or intervention. Having clarity about psychological constructs can also influence the planning and implementation of appropriate interventions and affect the efficacies of these interventions (Terry & Lane, 2011).

This section describes relevant conceptual issues and the different models that have been used to conceptualise mood and emotion. Reviewing the literature on distinctions between mood and emotion sets the stage for the subsequent section of the thesis on the measurement of mood and emotion.

1.2.1 Theoretical Distinctions between Mood, Emotion, and Affect

Most academics regard the concepts of mood, emotion, affect, and feelings as closely related but distinct phenomena (e.g., Ekman, 1994; Frijda, 1993; Watson & Clark, 1994). However, research studies conducted in sport and exercise psychology did not always provide clear definitions of mood or emotion constructs (Lane et al., 2011). A search of the literature revealed that the terms mood, emotion and affect have sometimes been used interchangeably. In some studies, questionnaires like the POMS and its derivatives (McNair et al., 1971, 1992) and the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) were used to assess mood in some studies, emotion in others, and affect in others (see Lane & Terry, 2000; Lane, Beedie, & Stevens, 2005 for reviews). Thus, even though the three common terms are distinct phenomena, the investigations of mood, emotion and affect in the earlier years might not have been separate lines of enquiry. This is not unexpected, given the

general agreement that feeling states, such as anxiety and anger, can occur as either an emotion or a mood. For example, an athlete might feel anxious before a match, but, without additional information, it would be unclear if this were an emotional response to the upcoming competition or a part of a more generalised anxious mood (Terry & Lane, 2011). It is not easy to clearly differentiate them, as affirmed by Lazarus (1984): "moods usually refer to sustained general states, such as sadness and contentment that may or may not be considered emotions depending on theoretical and definitional conventions" (p. 125).

Even though several definitions of mood have been proposed, the underlying mood-emotion conundrum remains unresolved (Beedie et al., 2005). For example, Lane and Terry (2000) defined mood as "a set of feelings, ephemeral in nature, varying in intensity and duration, and usually involving more than one emotion" (p. 17). This definition has been criticised as being limited, because emotion and mood were defined by each other, hence it does not fully explicate the distinction between a mood and an emotion (Mellalieu, 2003; Beedie et al., 2005). However, others have argued that this definition is noteworthy because it shows that mood and emotion each play a contributing role to the experiential sensation (Lane & Terry, 2000; Suchy, 2011), in the same way that hours, minutes and seconds all give rise to time. Parkinson, Totterdell, Briner, and Reynolds (1996) proposed that "mood reflects changing non-specific psychological dispositions to evaluate, interpret, and act on past, current, or future concerns in certain patterned ways" (p. 216). A mood can be described as a set of constantly changing feelings that vary in terms of strength and duration. Our moods usually involve more than one emotion and furthermore, as described by Karageorghis and Terry (2010), "there is a reciprocal, or two-way, relationship between moods and emotions, in that mood shapes the emotional reaction to a particular situation, and the emotional experience that follows contributes to mood" (p. 120).

The complexity of clarifying the conceptual differences between these psychological constructs should not be underestimated (Terry & Lane, 2011). To date, none of the above

proposed distinctions have been supported by published data (Schimmack & Siemer, 1998). Several measures of either emotion or mood have been published (see Matthews, Jones, & Chamberlain, 1990; Power, 2006; Watson et al., 1988), but not all of them distinguished between the two constructs (Beedie et al., 2011). There is also no accepted methodology for use in investigating the conundrum (Beedie et al., 2005). Previous approaches have also focused on *structural distinctions*, such as contrasting the brief intensity of an emotion with the more enduring and diffused nature of a mood (Watson & Clark, 1997); that emotions are considered to be immediate responses to specific stimuli, characterised by a relatively short duration and high intensity (Ekkekakis & Petruzello, 2002), while mood is defined as a set of feelings considered as lacking a specific target and generally thought of as being less intense and longer lasting than emotions (Parkinson et al., 1996). It is further proposed that the consequences of emotion are mostly behavioural, whereas those of mood are mostly cognitive (Ekman & Davidson, 1994).

Furthermore, a number of dynamic transactional relationships between mood and emotion have also been hypothesised. For example, Ekman (1994) suggested that mood interacts with emotion, altering the emotion threshold (i.e., the point at which an emotion is experienced), while Stevens (2007) argued that mood influences emotional reactions in contextual situations, with the consequential feelings then contributing to mood. Similarly, Parkinson and colleagues (1996) posited that emotions contribute to more enduring moods, and are cognitively interpreted depending on the mood state. In summary, the transactional nature of the process suggests that mood influences cognition, whereas emotional responses to specific situations continue to reinforce or modify the intensity of the underlying mood. Others have also argued that mood and emotion interact, and potentially overlap (Reed, 2005). For example, in everyday speech, feeling states such as anxiety can be described as either an emotion or a mood, whereby individuals can experience the emotion of anxiety or be in an anxious mood. Therefore, from the perspective of the person experiencing them, the emotion

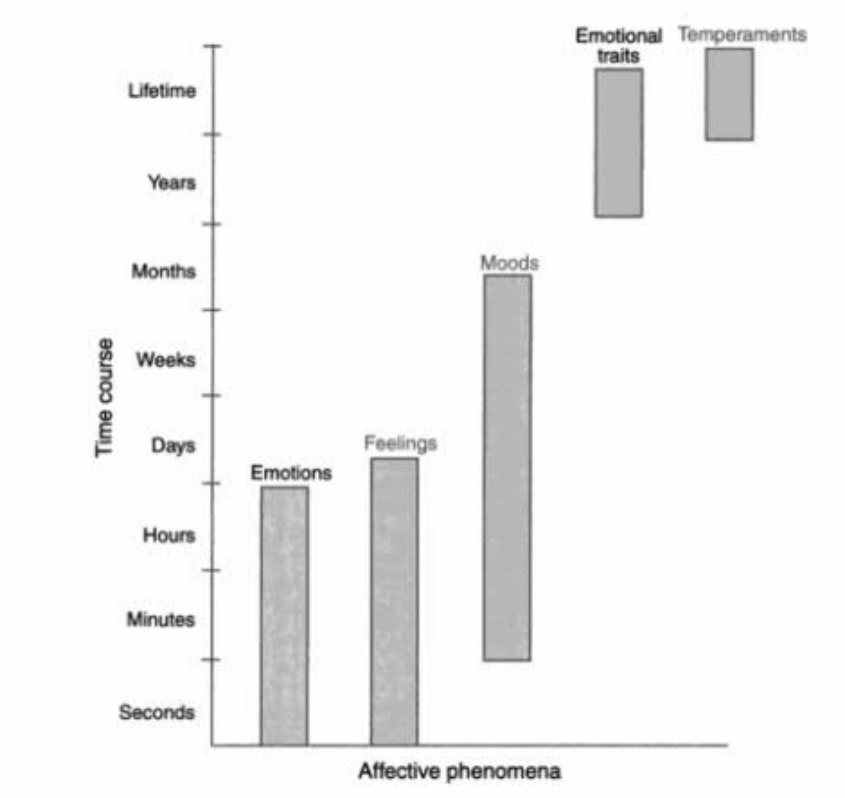
of anxiety and an anxious mood may feel identical (Watson, 2000). Watson and Clark (1994) proposed that emotion refers to a sudden reaction to a specific event leading to physiological, experiential, and behavioural changes; feelings more specifically reflect the subjective experience of emotion and mood, without physiological or behavioural changes; and emotions may involve physiological and behavioural changes because they represent a stronger affective state than mood and feelings.

Given the transient nature of mood and the transactional relationship between mood and emotion, it may be hard for respondents to distinguish current mood from mood experienced in previous situations stored as memory (Beedie, et al, 2011) unless questionnaires are specific in addressing the subjective context in which an individual experiences affective responses, so that they are aware of the antecedents, focus, and likely consequences (Beedie et al., 2005) and can distinguish if those feelings felt are mood or emotion (Beedie, 2007).

The transient nature of mood and the transactional relationship between mood and emotion is best summarised by Vallerand and Blanchard (2000): “the complex and varied concept of emotion includes the related constructs of feelings, mood and affect, which researchers have measured in various ways.” This is depicted in Figure 1, which shows how emotions (minutes or hours), feelings (minutes, hours, and days), moods (hours, days, weeks, and months), emotional traits (years) and temperaments (lifetime) differ on a temporal basis. For example, the tendency to experience sadness and the negative mood may stem from the emotional trait of negative affect (Tellegen, 1985, 1991) and negative affect may in turn stem from the broader, inborn temperament of neuroticism (McCrae & Costa, 1987).

Figure 1

On Distinguishing Different Affective Phenomena (Taken from Oatley & Jenkins, 1996)



In an effort to provide a clear summary of scientific distinctions between mood and emotion, Beedie and colleagues (2005) conducted a content analysis of the academic literature, including 65 published works from sport and exercise psychology, general psychology, psychiatry and philosophy literature that attempted to distinguish mood from emotion. Qualitative techniques were also used to explore differences between emotion and mood from a sample of 106 participants that included several Olympic medallists. Inductive content analysis showed that among the 65 contributions to the academic literature, eight themes emerged from the definitions provided, including *duration* (62%), *intentionality* (41%), *cause* (31%), *consequences* (31%) and *function* (18%). Sixteen themes were identified among 106 non-academic participants, with the most frequently cited being *cause* (65%), *duration* (40%), *control* (25%), *experience* (15%), and *consequences* (14%). When the eight themes cited by both academic authors and non-academic participants were rank ordered, an

agreement rate of 60% was found (see Table 1). The authors also noted that 'affect' was not mentioned by any of the participants, and attributed this to the notion that the term is used almost exclusively by psychologists who may wish to avoid defining whether the construct is a mood or emotion (Beedie et al., 2005). Both mood and emotion are considered affective states and affect is often described as positive or negative (American Psychological Association Dictionary of Psychology, n.d.). Affect has been defined as subjective physiological experiences that include short-term targeted emotions and longer-term, less targeted moods, as well as enduring dispositions (Quinn, 2007).

Table 1

Distinctions between Emotions and Moods (Taken from Beedie et al., 2005)

Criterion	*Emotion*	*Mood*
Anatomy	Related to the heart	Related to the mind
Awareness of cause	Individual is aware of cause	Individual may be unaware of cause
Cause	Caused by a specific event or object	Cause is less well defined
Clarity	Clearly defined	Nebulous
Consequences	Largely behavioural and expressive	Largely cognitive
Control	Not controllable	Controllable
Display	Displayed	Not displayed
Duration	Brief	Enduring
Experience	Felt	Thought
Intensity	Intense	Mild
Intentionality	About something	Not about anything in particular
Physiology	Distinct physiological patterning	No distinct physiological patterning
Stability	Fleeting and volatile	Stable
Timing	Rises and dissipates quickly	Rises and dissipates slowly

Having a clear distinction between mood and emotion is also important when determining the appropriateness of interventions (Terry & Lane, 2011). For example, if emotion biases behaviour but mood biases cognition (see Ekman & Davidson, 1994), strategies to regulate emotions might focus on changing behavioural responses to the stressors, for example, to withdraw from stressful situations versus dealing with them; while strategies to regulate mood might target cognitive processes, such as encouraging positive rather than

negative self-talk. Similarly, if emotions have specific causes but moods do not (Ekman, 1999), an effective strategy to regulate emotion may be to identify and reappraise the cause; while an effective strategy to regulate mood-regulation may be to tune down the negative feelings or tune up positive feelings by, for example, listening to music or engaging in physical exercise (Thayer, 1997).

Terry (2003) used the analogy of '*climate'* and '*weather* to help readers grasp the mood-emotion conundrum more simply. Temperament (i.e., emotional disposition) is said to be analogous to the climate of a place (i.e., weather patterns that repeat over the years), just as a climate may include hot, dry summers and cool, wet winters. Thus, an athlete's temperament might predispose him to be confident and happy in most contexts, but such disposition may be subjected to changes in mood, and mood is analogous to prevailing weather front (i.e., changes in weather that may last a few hours or a few days that may or may not be consistent with the normal climate). The example provided that relates to changes in mood (weather) was: "just as a summer storm may blow in, so the normally upbeat mood of an athlete may darken, and feelings of anger, tension, and unhappiness may prevail temporarily" (p. 1). Summarising this analogy, emotions are characterised by brief changes to the weather (i.e., mood) such as a sudden gust of wind, or a light shower of rain. Similarly, an upbeat mood may be susceptible to brief but intense emotional responses to specific incidents (e.g., an athlete angered by an opponent's action); and these brief emotional episodes may not necessarily lead to a decline in one's mood unless they happen frequently and intensely, which might signal a new weather front (mood), in the same way that increasing cloud cover and frequent showers does.

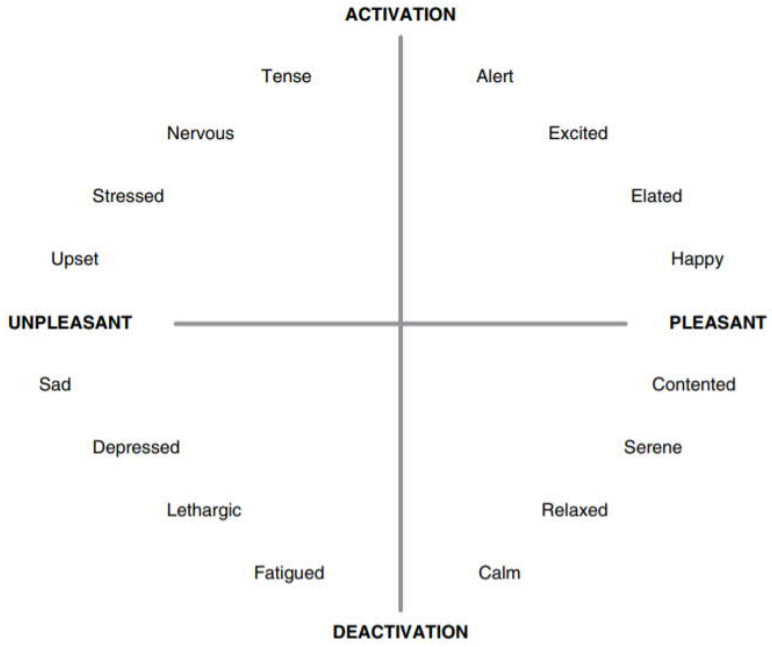
In short, the core features that distinguish mood from emotion may be that mood is less intense, more diffused, and global, and often not attributable to a specific cause or event (Terry & Lane, 2000; Siemer, 2009). This lack of a clear object is the reason why transient mood states have a pervasive and global influence on cognition and action (e.g., Clore et al., 2001; Morris, 1989).

1.2.2 Conceptual Models of Mood and Emotion

There is currently no universally accepted model to represent the structure of mood and emotions. Much of the research has proposed two-dimensional, bio-psychological models, where the constructs of emotion, mood or affect are organised on two orthogonal dimensions, with various authors using different labels. For example, Larsen and Diener (1992) proposed the dimensions of *pleasant-unpleasant* and *high-low activation*. Thayer (1989, 1997) proposed *energy-tiredness* and *tension-calmness* (see Figure 2). Russell (1980) *proposed pleasure-misery* and *arousal-sleep*. These models have labels that vary more in expression than their fundamental nature. Usually, these two-dimensional models are presented as a *circumplex*, wherein emotions are usually arranged around the perimeter of a circle, though not always (Remington, Fabrigar, & Visser, 2000) (see Figure 3). Although circumplex models have been pervasive in the literature (e.g., Russell & Feldman Barrett, 1999**;** Watson, Wiese, Vaidya, & Tellegen, 1999; Yik, Russell, & Feldman Barrett, 1999), there is no consensus about where particular emotions should be positioned on the circumplex. However, circumplex models (see Figure 2) are hardly used in the domains of sport and exercise research, where most mood and emotion research is based on models with *unipolar dimensions* like tension, depression, anger, fatigue, and confusion, and positive mood factors such as vigour and happiness (McNair et al., 1971, 1992**;** Terry et al, 1999) or bipolar opposites like relaxed-tense and happy-sad (e.g., Lorr & McNair, 1988), or orthogonal dimensions like positive and negative affect (Watson & Tellegen, 1985).

Figure 2

The Circumplex Model of Mood and Emotion (taken from Karageorghis & Terry, 2010)

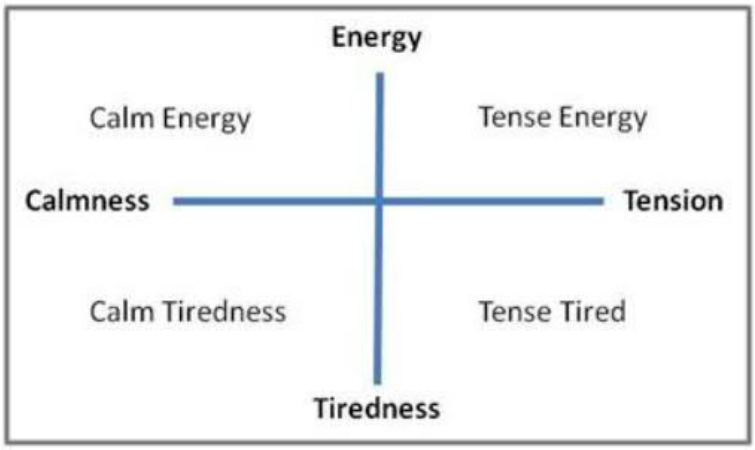


In Thayer's (1978, 1989) biopsychological model of mood (see Figure 3), it is proposed that diverse systems of the body give rise to what humans experience as mood. Moods are a barometer of body states that involve arousal including fear, anxiety, and a whole host of psychological reactions, and some are conscious while some are not (Thayer, 1997). Two biopsychological dimensions of mood were identified, namely *energetic arousal* and *tense arousal* (i.e., energy and tension, respectively) which are key to understanding mood (Thayer, 2001). The two dimensions interact under different activating conditions to form four complex moods ranging from *calm energy* (i.e., pleasurable mood associated with full attentional focus, happiness, optimism, favourable athletic performance, and self-control) to *tense tiredness* (i.e., bad mood associated with depression, negative perception of problems, yielding to unwanted urges such as sugar snacking or smoking; Ryan & Thayer, 2012). Two other complex moods include *tense energy*, consisting moderately positive state with vigour and moderate tension, and *calm tiredness* which is ideal for restful sleep (Ryan & Thayer, 2012). Energetic and tense arousal have been associated with various motivational processes

including different strategies of self-regulation (e.g., a combination of relaxation techniques, exercise, and cognitive control). Imperative to these moods are the natural processes like health, sleep, diet, diurnal energy cycles, exercise, and stress. These moods are mediated by general bodily arousal states. According to Thayer (1997), *good moods* comprise a high level of energy and a low level of tension (i.e., calm energy), while *bad moods* tend towards a low level of energy combined with a high level of tension (i.e., tense tiredness). Further, calm energy is associated with pleasure and happiness, while tense tiredness is associated with despair.

Figure 3

A Model Highlighting Two Basic Biopsychological Dimensions of Mood (i.e., energy and tension; taken from Thayer, 2001)



Despite their limitations, various forms of evidence have been found for the utility of the different models. For example, Ekkekakis (2008) highlighted that the utility of the circumplex model is that it could explain the psychological complexities of the exercise experience, while at the same time highlighting some of their limitations. With regards to unipolar dimensions, this approach has become popular with mood researchers through the use of validated psychometric instruments with unipolar dimensions (such as POMS, PANAS, BRUMS), where mood is assessed using self-report via a process called mood profiling, with the intent of examining mood and performance relationships. Therefore, compelling

arguments can be made to support the different models. Watson, Wiese, Vaidya, and Tellegen (1999) urged future researchers to utilise different approaches in their quest to understand this extraordinarily complex domain.

Lane and Terry (2000) also developed a conceptual model of mood and performance that emphasised the pivotal role of the depression component of mood in an attempt to provide theoretical explanations for mood-performance relationships. This will be discussed further in section 1.4.

1.3 Measurement Issues of Mood and Emotion

1.3.1 Mood Assessment Issues

In psychology, the measurement or assessment of any construct is especially difficult because what we want to measure may not always be directly observable (Fried & Flake, 2018). Thus, the measurement of any psychological construct relies heavily on the use of psychologically validated measures. Of greatest importance in the validation process is *construct validity*, which is now generally viewed as a unifying form of validity for psychological measurements, subsuming both content and criterion validity (Strauss & Smith, 2009). Construct validity is defined as the "degree to which a test or instrument is capable of measuring a concept, trait, or other theoretical entity" (American Psychological Association Dictionary of Psychology, n.d.). It is generally seen as the 'gold standard' of questionnaire validity in the trait-related approach to psychometrics (Rust & Golombok, 1999). Kline (1994) suggested that construct validity is demonstrated by accumulating evidence that the construct a measure purports to measure is related to other constructs in ways that are consistent with theoretical predictions. Therefore, researchers generally attempt to demonstrate the construct validity of a measure by correlating it with other measures and justify that the pattern of correlations among variables occurs in theoretically predictable ways (Westen & Rosenthal, 2003). However, if a psychological test lacks construct validity, it will make it impossible to

make sense or interpret the results obtained using the test or measure (Westen & Rosenthal, 2003).

Next, it is important to ascertain the equivalence of research instruments across different cultural or ethnic groups, in order to confirm that theoretical frameworks and psychometric measures are indeed generalisable (Sue, 1999). Duda and Allison (1990) argued that culture and ethnicity are important variables that may be illuminating in psychological theories of cognitions, affect, and behaviours in the sport and exercise domain. Ballard (2002) described human cultures as *cognitive structures* that provide a vehicle for communication and are best understood as the set of ideas, values, and understandings that people within a specific network of social relationships use to order their interpersonal interactions and hence generate ties of reciprocity between themselves, and in so doing provide the key basis on which human beings give meaning and purpose to their lives. Various human cultures in turn gives rise to diverse cultural worldviews, which can affect a range of psychological processes such as perceptual, cognitive, personality, and social processes (Halloran, 2007). Another term that is often used alongside culture is *ethnicity***,** which describes *cultural identity* – the practices, values, and beliefs of a group, which may include shared language, religion, and traditions, among other commonalities, based on biological or physical similarities of a group (Little, 2016). Ethnicity is also used to refer to the fact of belonging to a particular race or culture, or to a group of people with a common cultural or national identity (Oxford Learner's Dictionaries, n.d.). Thus, ethnicity can be considered as a derivative of culture.

Given the potential influence of culture and ethnicity, the robustness of the psychometric properties of any psychometric instrument must be demonstrated across different cultural settings, before it can be deemed as a valid instrument. This process is known as cross-cultural validation, where psychological constructs that were originally generated in a single culture are examined to see if they are also applicable, meaningful, and thus equivalent in another culture (Matsumoto, 2003). Cross-cultural validation has been

applied mainly in psychological studies to adapt self-report measures for use in languages other than the source language (Beaton, Bombardier, Guillemin, & Ferraz, 2000). In addition, researchers should see the process of validation as ongoing, and that the validity of a chosen measure should be evaluated each time a measure is chosen (Anastasi & Urbina, 1997). Beedie and colleagues (2011) contended that as psychological science works towards more rigorous methods of validation, psychologists should work on "demonstrating validity process in action", that is to re-validate well-used scales.

Besides construct validity and cross-cultural validity, researchers are also urged to give due consideration at the start of their research to the measures to be used (Ekkekakis, 2013). For example, when studying mood, researchers should pay attention to the types of measures of mood available for use based on the construct of interest, choose the appropriate one based on their purpose (see Ekkekakis, 2013), understand how response timeframe can influence the results attained in a study (see Beedie et al., 2000), and also examine the effects of demographic and situational variables on mood (see Parsons-Smith, Terry, & Machin, 2017). The following sections will consider the types of mood assessment measures and the influence of demographic and situational variables on mood assessment.

1.3.1.1 Type of Measures

Self-report measurement, which involves asking people directly for information relating to a particular construct, is extremely prevalent in most areas of the social sciences, including psychology (Anastasi & Urbina, 1997; Schwarz, 1999). In general, self-report inventories are designed to measure and gain insight into memories, anticipations, or general emotional dispositions (Jacobs, Fehres, & Campbell, 2012). Self-reports are also commonly used for the assessment of mood where respondents are presented with a series of Likert-type or analogue scales and asked to rate the extent to which they feel particular emotions or mood descriptors (Terry & Lane, 2011). When working with athletes, the purpose of mood assessment is for psychologists to assess the psychological states of their client as they work

together to improve performance and/or well-being (Terry & Lane, 2011). Self-reports offer the most direct access to what a person feels, where the richness of information can only be attained by the self who has the unique opportunity to perceive a wide range of feelings and behaviours over time, especially those that typically occur in private and are unobservable (Paulhus & Vazire, 2007). Thus, the distinct value of self-report is that it can be used to measure unobservable phenomena (Robinson & Clore, 2002). Self-reports are also easy to administer, relatively low cost, and minimally invasive when used appropriately (Terry & Lane, 2011). They are very practical as they require only the cooperation of the target respondent, and do not rely on any others, compared to the collection of observer ratings which can be more cumbersome (Paulhus & Vazire, 2007). The relative ease and convenience of the self-report method thus generates a large sample quickly, without requiring the presence of the researcher (Thomas & Christiansen, 2011), unlike other research methods (e.g., focus groups, ethnography). Beyond these advantages, researchers have argued that self-reports are essential as they may be the only method available and appropriate for some constructs (Paulhus & Vazire, 2007). An example is self-efficacy, which is a construct that must be obtain via self-report (Ozer & Reise, 1994).

On the other hand, there are disadvantages when choosing self-reports as various measures of psychological states may vary in their scientific rigour, psychometric integrity and degree of invasiveness, and therefore suitability for use in various contexts (e.g., sporting contexts; Terry & Lane, 2011). Firstly, self-reports are prone to social desirability effects, experimenter effects, “faking good or bad” by respondents, disinterest from respondents, respondents’ inability to comprehend the questions, or poor self-awareness in general (see Terry & Lane, 2011; McDonald, 2008). In order to minimise the potential pitfalls arising from the use of self-report measures, the researcher or practitioner must be cognisant of the context and select the appropriate self-report tool (e.g., a brief but valid questionnaire that can be completed quickly pre-competition to minimise invasiveness) that works for the intended

purpose with the athlete's best interests at heart (Lane, 2012). Saw, Kellmann, Main, and Gastin (2017) discussed the need to create a supportive culture where there is a mutual understanding amongst stakeholders, and transparency with regards to the intended and potential data use. Thus, practitioners should also plan to inform and educate athletes and their coaches about the purpose and benefits of such measurements, to get their buy-in and mentally prepare them, so as to minimise any possible negative impact and maximise the effectiveness of the intended outcome from such interventions.

Besides self-report, several alternative types of measures have been proposed, including the use of physiological markers like heart rate, galvanic skin response, blood pressure or eye movements (see Wagner & Manstead, 1989), as well as neuropsychological measures like EEG (see Fulmer & Frijters, 2009). There are limitations with these alternatives as they do not always provide an accurate measure of the psychological state of interest. For example, a person reports unpleasant thoughts and is said to be feeling anxious, with a corresponding increase in physiological arousal indices and may display certain behaviours. However, excitement shares similar physiological and behavioural characteristics, but excitement is associated with pleasant thoughts, therefore it can be difficult to differentiate between anxiety and excitement if researchers use physiological assessment alone (Lane, 2012). Hence researchers should consider if it is appropriate to use several different measures jointly in their research, such as using self-report together with relevant physiological or neurophysiological measures. When these measures are interpreted together, researchers and practitioners are better able to corroborate and understand the associations between psychological and physiological indicators, furthering their understanding of the unique condition that each individual respondent experiences. As such, self-report may play an essential role in the measurement process as it can help distinguish thought patterns associated with various physiological states (Lane, 2012).

In short, Lane (2012) recommended that researchers and practitioners should first be clear about what exactly needs to be assessed (e.g., mood or emotion) so as to meet the intent of their research and then select the most appropriate measure for that need by considering the psychometric rigour applied to the development of the measure. Researchers and practitioners should also keep in mind that self-report scales are ultimately just an estimate and should use them as a guide to learn about an individual's mindset, while at the same time search for information to confirm or disprove this estimate via observations and conversations with their client and perhaps also their support network (e.g., coaches, team mates).

1.3.1.2 Influence of Demographic and Situational Variables on Mood Assessment

In the assessment of mood, it is important to consider demographic and situational variables that may potentially influence mood responses among respondents. Previous studies have identified some factors that appear to influence the intensity of mood responses, such as personality (e.g., McFatter, 1994; Prapavessis & Grove, 1994), training volume (e.g., Morgan, Brown, Raglin, O'Connor, & Ellickson, 1988; Raglin, Eksten, & Garl, 1995), situational factors (e.g., Mischel, 1990), and response timeframes (e.g., Terry et al., 2005). Studies have also explored the influence of other variables on mood, such as gender (e.g., Terry & Lane, 2000), age (e.g., McNeil, Stone, Kozma, & Andres, 1994), level of competition (e.g., LeUnes & Burger, 1998), situation or context (e.g., Lane, Thelwell, & Devonport, 2009), time of day (e.g., Atkinson & Reilly, 1996), and exercise participation (e.g., Berger & Motl, 2000). The influence of these variables on mood will be discussed in the sub-sections below.

1.3.1.2.1 Personality and Individual Differences. Personality refers to individual differences in characteristic patterns of thinking, feeling and behaving, which relate to an individual's unique adjustment to life, including major traits, interests, drives, values, self-concept, abilities, and emotional patterns. Personality is generally viewed as a complex and dynamic integration of multiple forces such as hereditary and environmental factors (American Psychological Association Dictionary of Psychology, n.d.). Hence, individual

differences in personality and therefore temperament clearly makes the experience of mood unique for each person. Such differences are well-documented in terms of absolute differences between individuals (e.g., Terry & Lane, 2000), the pattern of mood variability within individuals (e.g., Penner, Shiffman, Paty, & Fritzsche, 1994) as well as individual differences in mood variability over time (e.g., Larsen & Diener, 1987). Thus, even though different individuals report very different moods, and the degree of mood change varies greatly, there is still a certain degree of consistency to which moods are stable or prone to change (Terry & Lane, 2011).

Several studies have examined the relationship between moods and personality traits. For example, the personality trait of extraversion was found to be associated with positive mood and cognition (e.g., Stafford, Ng, Moore, & Bard, 2010). Individuals with higher neuroticism scores were found to be more susceptible to negative mood inductions (e.g., Rusting & Larsen, 1997).

Studies have found that individuals with negative perceptions of their individual ability to regulate mood encountered greater disruption to their exam performance compared to those with stronger beliefs (Catanzaro, 1996). Totterdell and Leach (2001) found that athletes who believed that they had the capability to change the way they feel to how they would like to feel had better performance, and reported more positive moods during competition. This suggests that an individual's belief about their mood regulation ability may play a part in how successful they manage to regulate their moods prior to and during competition in a way that enhances performance. A possible explanation is that those who believe emotions are fixed tend to accept their feelings and make little effort to change while those who believe that emotions are changeable are more likely to put in effort to self-regulate using different strategies (see Tamir, John, Srivastava, & Gross, 2007).

Finally, other researchers have found a link between emotional intelligence and effective mood regulation. For example, Lane and Wilson (2007) found that athletes with

higher scores on emotional intelligence were better at managing unpleasant feelings, such as depressed mood and confusion. Lane and colleagues (2009) showed that emotionally intelligent athletes can effectively regulate their emotions to optimal levels across different situations.

The evidence above provides some useful insights for practitioners. Firstly, practitioners must be able to understand the typical pattern of moods for each athlete they work with, how stable or volatile it is, and the extent to which the individual athlete perceives mood and emotions as changeable within their locus of control (Terry & Lane, 2011). The practitioner could attain this information by regularly assessing mood at appropriate times pre-competition so as to collect sufficient data to determine the usual mood profile of each athlete, and help them derive their "ideal" pre-competition mood profile. The practitioner should also consider assessing athletes' emotional intelligence and emotion regulation beliefs so as to have a holistic insight into each athlete which will be useful in the planning and implementation of interventions (Terry & Lane, 2011).

1.3.1.2.2 Response Timeframe. The reference period called the 'response timeframe' that is stated in the instructions to respondents is an important consideration in mood assessment (Terry et al., 2005). The response timeframe varies across different psychometric instruments, ranging from 'How do you feel right now?', 'How do you feel today?', 'How have you felt over the past week including today?' and 'How do you feel generally?' All of these timeframes have been used with the POMS (McNair et al., 1971) and its derivatives like the BRUMS (Terry et al., 1999; Terry, Lane et al., 2003), as well as the PANAS (Watson et al., 1988). Whereas previous studies have made known the influence of response timeframe on the outcome of psychometric assessment (see Nisbett & DeCamp Wilson, 1977), there is limited literature examining the impact of response timeframe on mood (Terry et al., 2005). Terry and colleagues (2005) found that the ''right now'' response timeframe yielded high inter-correlations amongst dimensions and low test-retest coefficients, suggesting the

assessment of person-environment interactions at the time of testing. Terry (1995) pointed out that many previous studies did not state the response set used, which can influence the mood-performance relationship and how the results were eventually interpreted.

In addition, Winkielman, Knauper, and Schwarz (1998) found that response timeframe influenced the intensity of moods reported. Participants reported less intense experiences when the longer response timeframe "Have you felt angry this week?" was used, compared to a shorter response time like "Have you felt angry today?" This may be due to respondents inferring that researchers were looking for more intense experiences within the longer timeframe. This perception was found to grow stronger with longer response timeframes, suggesting that mood responses collected using longer timeframes are more predisposed to being influenced by relatively short but intense feelings, leading to an assessment that is not as accurate as desired.

Rasmussen, Jeffrey, Willingham, and Glover (1994) found that an "over time" assessment of mood for a period of three days was significantly different from the mean of 18 "right now" assessments collected during the same time period. This was replicated by Terry and colleagues (2005) when they examined the association between mood responses collected using two timeframes of "right now" and "in the past week including today" and found that the "past week" mood assessments had higher scores than multiple "right now" assessments. Terry and colleagues (2005) also found that higher scores were associated with the mood experienced at the time of recall, specifically for the dimensions of confusion, depression, and vigour.

Hence, the evidence to date on the influence of response timeframe seems to highlight that retrospective measurement of mood has its limitations. Retrospective recall relies on memory retrieval which is prone to inaccuracies caused by memory decay, wrong or incomplete encoding, or distorted recall (Smith, Leffingwell, & Ptacek, 1999). Previous research has shown that memories are more readily accessible if the mood at the time of recall

is similar to mood at the time of encoding (Blaney, 1986). As such, the recall of mood over time is problematic as it can be influenced by mood-congruent effects (Blaney, 1986) and ambient mood (i.e., mood at the time of recall; Terry et al., 2005). Thus, the retrospective measures of mood should not be seen as comparable to measures taken with more temporal proximity to the experience of interest.

Nevertheless, Terry and colleagues (2005) highlighted a potential limitation when using the "right now" response timeframe. Given how the concept of mood and emotion can be quite difficult to differentiate using psychometric measures, respondents may mistakenly report fleeting or transient emotions rather than underlying mood (Lane et al., 2011), even though mood and emotion *can* be defined using differentiating theoretical and definitional conventions. Terry and colleagues (2005) suggested collecting multiple "right now" responses when examining mood profiles over time to minimise potential sources of bias.

From a measurement standpoint, if the focus of research is to understand how the athlete's mindset prior to competition is related to their performance, then the "right now" response set is the most appropriate for assessing relationships between pre-performance mood and the quality of a single performance given its sensitivity to acute stressors such as competition (McNair et al., 1971, 1992; Terry, 1995; Watson, 1988). From an applied perspective, a sport psychologist will be able to assess the need for intervention and its effects based on an assessment of current mood versus a summary of moods experienced over time (Terry & Lane, 2000). In summary, it appears the "right now" response timeframe is most appropriate for mood research to capture the mood states experienced before competition.

1.3.1.2.3 Gender. Most social scientists view sex and gender as conceptually distinct. Sex refers to the biological characteristics differentiating males and females, while gender denotes social and cultural characteristics of masculine and feminine behaviour. Individuals who strongly identify with the opposing gender are considered transgendered. While the biological differences between males and females are relatively straightforward, the social and

cultural aspects of being a man or woman are more complex (Little, 2016). In addition, the dichotomous view of gender, in which one is either male or female, may apply only to certain cultures and is not universal as some cultures view gender as fluid (Little, 2016).

A famous case of contention that can illustrate the complexity of sex and gender issues in the sporting world involved Caster Semenya, a South African track-and-field athlete who won the 800-meter world championship in 2009. Officials from the International Association of Athletics Foundation (IAAF) had initially questioned the huge improvements over her previously recorded timings, suspecting her of steroid use but later on decided to put Semenya through humiliating sex-determination tests due to her masculine build and dominant performance (Clarey, 2009). The IAAF alleged that Semenya was biologically male no matter what gender she identified with.

Keeping in mind the complexities of sex versus gender, the research evidence so far has shown limited differences in reported mood between genders when looking at individual mood dimensions in general, though it is not entirely clear if studies had explicitly asked respondents to indicate their sex or their gender. In the original validation studies of the POMS (see McNair et al., 1971), no differences in mood responses between males and females were found. In a sport-specific study, Fuchs and Zaichowsky (1983) did not find any differences between male and female body builders.

However, studies that evaluated distributions of mood profiles have found a gender difference. Parsons-Smith and colleagues (2017) found that females were significantly over-represented for the inverse iceberg profile and shark fin profile in two samples, while males were significantly over-represented for the iceberg profile. In a similar study on mood profiles, males were found to be significantly over-represented for the iceberg profile, while females were significantly over-represented for the more negative inverse Everest and shark fin profiles (Quartiroli et al., 2018). Therefore, it may be that gender differences on the individual mood dimensions of the various profiles are weak or non-existent, but with the six mood

dimensions presented as a whole mood profile, emergent properties reveal gender differences. Quartiroli and colleagues (2018) encouraged more studies to look further into the gender differences in mood profiles.

1.3.1.2.4 Age. Several studies looking at age-related differences in the experience of mood and affect found that older adults report more positive affective experience (Carstensen et al., 2011) and are likely to be quicker in regulating out of negative mood states (Larcom & Isaacowitz, 2009), compared to younger people. Several theories have been postulated to explain these age differences. A possible mechanism is that older adults may have more experience in managing their moods (Blanchard-Fields, 2007). One of the most prominent theories postulated is the *socioemotional selectivity theory* (SST; Carstensen, Isaacowitz, & Charles, 1999) which posits that as people age, they place greater value on emotionally meaningful goals or hedonic goals, therefore invest more cognitive and social resources to obtain them. Accompanying this shift in motivation toward emotional goals is better emotion regulation, where older adults were found to display "positivity effects" in their attention and memory, focusing more on positive and less on negative material so as to achieve their hedonic goals (Cartensen & Mikels, 2005). Older people were found to attend to, hold in mind, and remember emotionally positive information more than they do for negative and neutral information (Cartensen & Mikels, 2005). Recent studies have shown that these age-related positivity effects in attention and memory had served to help older adults regulate their affective states (Isaacowitz & Blanchard-Fields, 2012). However, it is important to note that the SST does not imply that the older people are uniformly happier. Instead, older adults' preference to invest in meaningful activities under time-limited conditions may give rise to richer and more complex emotional experiences; for example, gratitude accompanied by a sense of fragility, or happiness tinged with sadness (Carstensen et al., 2011). Such an experience in mixed emotions had been referred to as poignancy (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). For example, older people were found to be less reactive than

younger adults to daily events, regardless of whether they were good or bad, and maintained a relatively stable mix of emotions regardless of positive or negative events (Roecke, Li, & Smith, 2009).

In contrast, studies have found that younger adults were likely to process negative information more thoroughly than positive information, as well as place more weight on negative information during impression formation, memory, and decision making (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Previous experiments conducted found that older adults recalled positive images relatively better than negative images (Charles, Mather, & Carstensen, 2003). This age-related difference was also documented at the neural level where older adults were found to show significantly greater activation in their amygdala for positive images than for negative ones, compared to younger adults, providing further evidence that age may bias positive over negative material (Mather et al., 2004; Carstensen & Mikels, 2005). Finally, studies have also found that the memories of old adults are biased as they tend to reconstruct the past in a way as that highlights the positives, which may reflect better emotion regulation among older adults (Fernandes, Ross, Wiegand, & Schryer, 2008). In the context of sport and exercise, older athletes were found to report lower levels of depression and anxiety, specifically in master-category runners aged 50 years old on average (Ungerleider, Golding, Porter, & Foster, 1989). The authors explained that the masters' long commitment to training and competition taught them the value of patience in attaining success, which may carry over to other areas of their life and career. In another study of swimmers, Riddick (1984) reported that varsity adult swimmers reported more positive moods than age group junior swimmers.

The above evidence of age effects on mood seem to coincide with the few mood profiling studies conducted thus far (Parsons-Smith et al., 2017; Quartiroli et al., 2018). Respondents in the younger age group (18–24 years) were significantly under-represented in the more positive iceberg profile, but significantly over-represented in the negative shark fin

profile, and the more subtle surface profile. However, those in the older age groups of 36–45 and 56–65 years were significantly over represented in the more positive iceberg profile, which is associated with higher vigour and more positive moods. However, these findings should be treated with caution due to small sample sizes in each age group.

In summary, age may influence our experience of mood and emotion due to the possible differences in neural activation, information processing, attention and memory, socialisation and life experience between younger and older adults. Future studies should continue to explore how and why age may influence the distribution of the six identified mood profiles.

1.3.1.2.5 Level of Competition. Research on the relationship between level of competition or achievement and mood responses can be traced to the work of Morgan and his colleagues studying the association of mood profiles and athletic success (e.g., Morgan, 1974; Morgan & Johnson, 1978; Morgan & Pollock, 1977; Nagle, Morgan, Hellickson, Serfass, & Alexander, 1975). Morgan and colleagues found that the mood profiles of elite athletes, when compared to population norms, were characterised by above average vigour scores and below average scores for tension, depression, anger, fatigue, and confusion. This pattern of mood responses became known as the iceberg profile and it was proposed to be reflective of positive mental health (Morgan, 1980, 1985a), which also led to the iceberg profile being proclaimed as the “test of champions” (Morgan, 1980).

The identification of the iceberg profile then led to a surge in studies looking for patterns of mood responses that may distinguish athletes at various levels of competition or achievement, such as international, club, or novice levels (see LeUnes & Burger, 1998). Some other studies explored whether the iceberg profile was related to athletic success (see Rowley, Landers, Kyllo, & Etnier, 1995). However, the legitimacy of the POMS and the significance of the iceberg mood profile in predicting performance came to be challenged. For example, Terry (1995) proposed that individual differences in skill and conditioning make it “entirely

unreasonable" (p. 310) to expect mood to predict athletic achievement. Similarly, Renger (1993) cast doubt on the use of mood profiles to predict athletic achievement, critiquing Morgan's work for its methodological shortcomings, thus rendering Morgan's conceptualisation to be less valid than first reported. Specifically, Renger (1993) argued that the earlier studies by Morgan and colleagues (see Morgan & Pollock, 1977) had failed to report the statistical results and descriptive statistics needed to interpret the data clearly. Renger (1993) concluded that studies which attempted to use the POMS in differentiating athletes of differing levels of ability have been "misdirected" (p. 82) and called on researchers to "abandon the POMS" (p. 83) in research on successful and unsuccessful athletes. Next, a meta-analysis of pertinent studies by Rowley and colleagues (1995) concluded that the iceberg profile accounted for less than 1% of the variance in athletic success and that the "utility of the POMS in predicting athletic success is questionable" (p. 185).

Given that most preceding studies had plotted mood data of athletes against the psychiatric outpatient or student norms (see McNair et al., 1971), it is unsurprising that athletes typically report an iceberg profile regardless of their level of competition. Even though an iceberg profile may be desirable based on research evidence, its significance is likely to be overstated and any link between athletic achievement and mood responses is probably more subtle and complex than can be explained readily by the iceberg profile (Terry & Lane, 2011).

In a later meta-analyses conducted on published findings related to mood and performance, Beedie and colleagues (2000) looked at the findings of 13 published studies examining if mood responses can differentiate athletes of varying degrees of achievement, and 16 published studies examining if mood responses can differentiate performance outcomes amongst athletes of similar ability. They concluded that mood responses have substantial utility in the prediction of performance outcome but not level of achievement and argued that there was no valid rationale for continuing the research on whether mood responses could

predict level of achievements or competition. Terry and Lane (2011) reasoned that normal populations other than elite athletes can also experience positive moods, and given that mood states are transient in nature, there is no compelling reason why mood profiles should distinguish between performers at different levels of achievement. Nonetheless it is still viable to investigate the relationship between mood and performance amongst athletes of similar ability in order to identify the ideal pre-competition mood state that produces optimal performance for each athlete.

1.3.1.2.6 Situation. Situational characteristics can influence the mood responses of athletes as the individual interacts with the environmental forces from situation to situation (Terry & Lane, 2011). For example, mood states have been shown to fluctuate before and after competition (Terry, 1992, 1993) as well as away from the competition environment (Hall & Terry, 1995). In a cross-sectional study of the mood responses of more than 2,000 athletes assessed either before competition, after competition, or away from the competition environment, Terry and Lane (2000) found that athletes reported higher tension, depression, anger, and confusion prior to competition than at the post-competition stage. However, when athletes were not in the competition environment, their moods were at levels midway between the pre- and post-competition situations. Since the research evidence points to the potential of pre-competition mood responses in the prediction of performance quality (see Beedie et al., 2000), practitioners should consider carefully when and how to collect mood responses, such that they are able to attain sufficient data collected at appropriate time points that can help establish the pre-competition mood states that are optimal for good performance.

Mood assessment could also play a part in revealing the impact of situational factors on an athlete's mood which can be crucial prior to big competitions. For example, Terry (2010) shared how mood assessment leading up to the 1998 Winter Olympics had revealed that athletes with whom he was working were affected by situational factors like travel fatigue, jet lag, the high stress Olympic environment, and family-related concerns. One

particular athlete's profile had shown substantial mood disturbance, evidenced by uncharacteristically low levels of vigour, high levels of anger and depression, and the general volatility of mood responses. The regular mood assessment leading up to the competition allowed the practitioner and athlete to identify and address issues early on, and eventually the athlete's mood profile returned to his ideal pre-competition state on the day of competition when medals were decided.

Outside of the competition context, Pedlar and colleagues (2007) had used mood assessment with an athlete on a long solo expedition to the South Pole. As the expedition went on, the athlete's mood scores showed a gradual reduction in vigour and an increase in fatigue. However, Pedlar and colleagues (2007) reported that the mood scores did not appear to have a distinct relationship with performance, which was defined as the distance covered each day. The researchers explained that this may be due to the athlete's highly developed mood regulation skills and awareness of negative mood dimensions that may debilitate performance. For example, the athlete would focus on what needed to be done, rather than how she was feeling, seeing those feelings as a distraction. This case study provided evidence that mood assessment helped athletes gain awareness of their mood states, and learnt how to effectively regulate them so that performance could be sustained. Thus, on top of mood assessment, Pedlar and colleagues (2007) suggested that practitioners should also work with athletes to evaluate their beliefs about mood management strategies, evaluate their current strategies and their efficacies in mood regulation, with the intent of exposing them to more effective strategies.

Finally, Lane and colleagues (2009) found that mood differences between optimal and poor performance were more evident for sport performance than university examinations, reinforcing the notion that the link between mood and performance is situation-specific. Specifically, when comparing optimal and poor performance, the differences in reported depression, fatigue, and vigour were significantly greater in sport than academic settings. This

study provides evidence that sport performance may be more mood-dependent than performance in examinations.

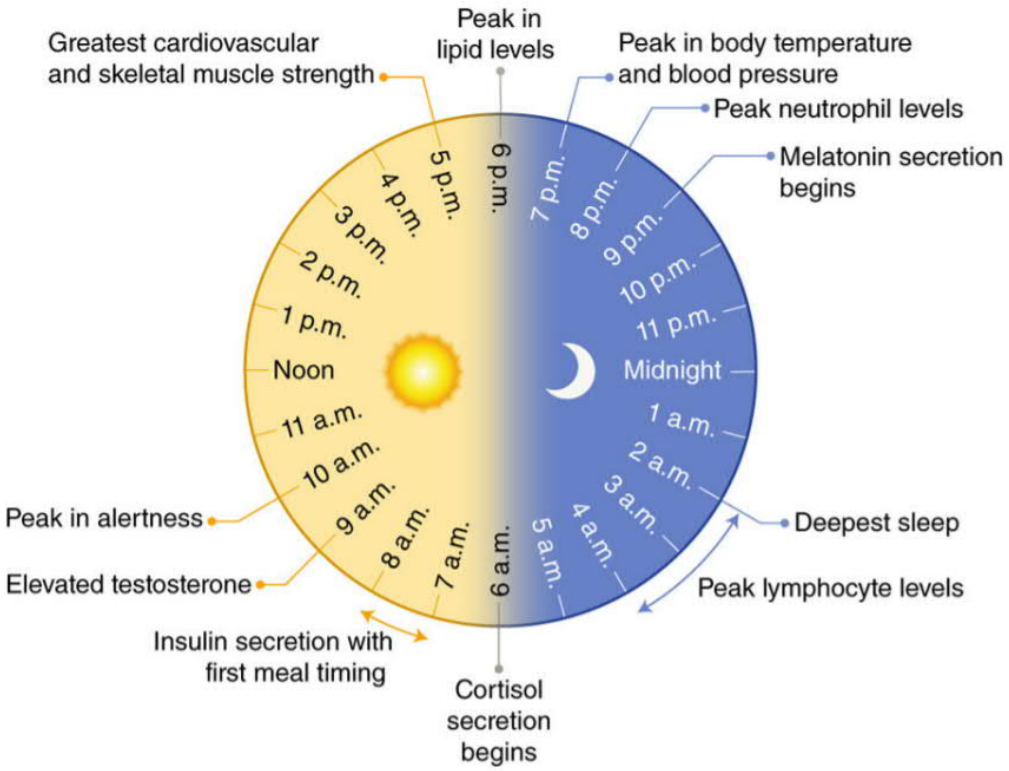
In summary, a practitioner should always take into account how the situation can possibly affect mood responses during mood assessment so as to help the athlete gain the most out of the mood assessment process, be it through pre-competition preparation or learning various strategies that are effective for self-regulation across the various situations and stressors that athletes commonly face.

1.3.1.2.7 Time of Day. Human activity is associated with circadian rhythms (see Figure 4), which is the 24-hour cycle that influences physiological, psychological and behavioural rhythms like sleeping, mood and performance efficiency (Conroy & Mills, 1970). The diurnal (i.e., time of day) effects in mood have been well documented (see Atkinson & Reilly, 1996; Clark, Watson, & Leeka, 1989; McNeil et al. 1994), where mood was found to improve from early morning to mid-day, followed by a dip after lunch, and then improvement later in the afternoon or early evening. Aside from these regular patterns of mood changes through the day, there also seems to be individual differences in circadian rhythms as reflected in the chronotype, which describes people as either typically Morning-types (M-types, or 'larks') and Evening-types (E-types, or 'owls'), while the majority of the population belongs to neither category (N-types, often labelled Intermediate-types, or I-types; Adan et al., 2012). Horne and Östberg (1976) showed that acrophases (i.e., peaks or crests) in the circadian rhythms occur earlier in M-types than in E-types. Relating to affective functioning, M-types are in a better mood in the morning than evening, while, the opposite pattern appears for E-types (Jankowski & Ciarkowska, 2008). Other studies also pointed to an important chronobiological distinction between positive affect (PA) and negative affect (NA; see Clark et al., 1989; Murray, Allen, & Trinder, 2002). Murray and colleagues (2002) showed that PA presented a circadian rhythm, closely tied to the individual's internal biological clock, fluctuating according to the 24-hour cycle, although this was not observed for NA. This

contrast between the variation in PA and NA with the circadian rhythm can be explained from the evolutionary perspective, where the variation in PA is important given that humans are diurnal and the rise in affect is related to social activity during the day (Murray et al. 2002); while NA tends to remain low when there is no apparent threat but can quickly increase with the emergence of potential danger (Watson et al., 1999). The NA system is therefore related to unpredicted situations where they may be a demand for more energy (Murray et al., 2002).

Figure 4

The Mammalian Circadian Clock (Taken from Masri & Sassone-Corsi, 2018)



Diurnal variation in mood has been related to depression, with the key features of early-morning worsening followed by an afternoon slump or worsening in the evening (Wirz-Justice, 2008). Thus, the E-types chronotype may be a risk factor for depression (Gaspar-Barba et al., 2009). Murray (2007) proposed that having a clearer understanding of how mood varies in non-clinical populations can help advance our understanding of circadian processes which may play a part in affective disorders. In the context of sport and exercise, a study by

Karageorghis, Dimitriou, and Terry (1999) assessed the mood of 58 athletes on four occasions during a rest day, and mood was found to be most positive at noon and least positive early in the morning.

The findings presented above suggests that it is important for researchers assessing mood to take into account the diurnal effects on mood as this can impact how the researcher interprets the findings. In order to control for diurnal fluctuations in mood, researchers should consider measuring mood responses about the same time each day (Terry & Lane, 2011).

1.3.1.2.8 Physical Activity and Mental Health. For the last 40 years, many reviews have been published and the vast majority have concluded that exercise reduces self-reported anxiety and depression (see Asmundson et al., 2013; Biddle, 2000; Jayakody, Gunadasa, & Hosker, 2014; Schuch et al., 2016). The International Society for Sport Psychology (1991) released a position statement outlining the psychological benefits related to physical activity, and concluded that exercise was associated with desirable changes in mood. In earlier reviews of exercise and mental health research that examined experimental research on exercise and mental disorders, evidence for the anti-depressive properties of exercise and its ability to increase positive mood-related attributes was also found (Byrne & Byrne, 1993). Exercise has also been prescribed as an alternative treatment for mental disorders, such as clinical depression, anxiety and mood disorders, due to its multiple global health benefits (Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; Goodwin, 2003; Otto et al., 2007). Moderate physical activity was found to be associated with a decrease in negative affect including depression, anger, tension and confusion, regardless of age or gender (Berger & Motl, 2000). In a meta-analysis by Reed and Ones (2006), 156 studies were examined and similar findings were found, where an episode of acute aerobic exercise produced an increase in self-reported positive affect while a decrease occurred in the control conditions.

Berger and Motl (2000) found in their review that chronic mood changes (as measured using the POMS) were also related to exercise in healthy populations. However, these chronic

mood effects of exercise in healthy populations have been more equivocal than acute changes. This may be because mood is transient and fluctuating (McNair et al., 1971, 1992) and it may not be easy to make sense of the meaning of the chronic mood changes in exercise settings for those who are not depressed or anxious.

Physical activity has also been found to be one of the most effective strategies for self-regulation of moods in normal populations (Berger & Motl, 2000; Thayer et al., 1994). In addition, exercise "was self-rated as the most successful at changing a bad mood, fourth most successful at raising energy, and third or fourth most successful at tension reduction" (Thayer et al., 1994; p. 921). Psychotherapists also assessed active mood management, which included exercise, as the most effective technique for changing a bad mood (Thayer et al., 1994). In a recent meta-analysis, White and colleagues (2017) found that the promotion of physical activity during leisure time is likely to be the most effective method to prevent poor mental health, compared to household physical activity and participation in physical education, where no association was found for mental health or mental ill-health. Several studies have investigated the effect of sedentary behaviour or a lack of physical activity on various mental health outcomes. Associations of sedentary behaviour with depression, anxiety and low self-esteem have typically been reported (e.g., Edwards & Loprinzi, 2016; Proper, Singh, van Mechelen, Chinapaw, 2011; Teychenne, Costigan, & Parket, 2015; Thyfault, Du, Kraus, Levine, & Booth, 2015).

A number of psychological and physiological mechanisms may explain the relationship between physical activity and improved mood or reduction in depression or anxiety symptoms. The psychological mechanisms proposed include: (i) the *distraction hypothesis,* where exercise can distract us from unpleasant stimuli of daily life, leading to improved mood state after exercise (Leith, 1994; Paluska & Schwenk, 2000); (ii) the *self-efficacy theory,* where an increase in confidence in the ability to exercise and maintain a regular schedule may translate to improved self-confidence in the ability to manage the

challenges to personal mental health (Gauvin & Spence, 1996; North, McCullagh, & Train, 1990); (iii) the *mastery hypothesis*, where mastery of exercise techniques and the completion of workouts can bring about feelings of independence and success, which can positively influence other areas of life (Greist et al., 1979; Simon, McGowan, Epstein, Kupfer, & Robertson, 1985); and (iv) the *social interaction* hypothesis, where social relationships and mutual support from others during exercise can have a positive effect on mental health (Treiber et al., 1991).

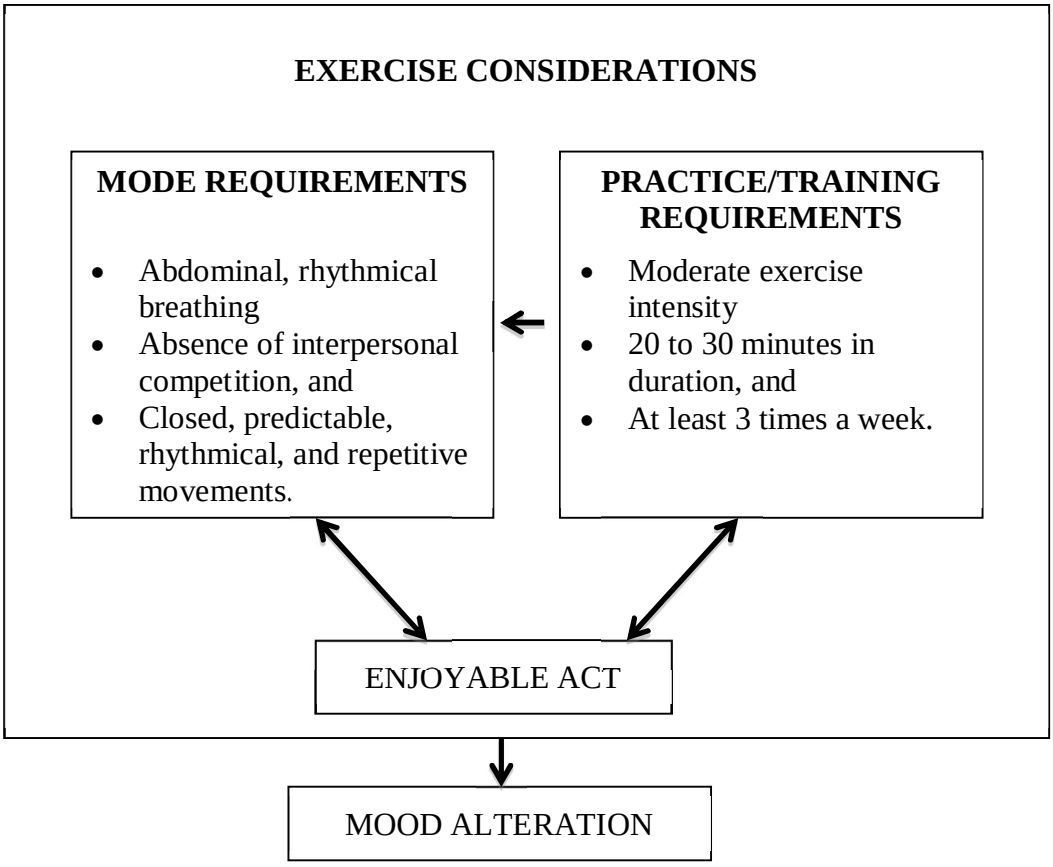
The physiological mechanisms proposed include: (i) the *monoamine hypothesis*, where exercise improves the brain's aminergic synaptic transmission, affecting monoamines such as noradrenaline, dopamine, and serotonin, all of which have been implicated in depressive disorders (Dunn & Dishman, 1991; Ransford, 1982); (ii) the *endorphin hypothesis*, where endorphins released due to exercise can help to reduce pain and induce a state of euphoria (Morgan, 1985b; North et al., 1990); (iii) the *thermogenic hypothesis*, where elevated body temperature due to exercise may bring about improved mood (Horne & Staff, 1983); and finally, (iv) exercise can increase perceived control and hence improve resistance against stress-related psychiatric disorders such as depression (Babyak et al., 2000).

While many different psychological and physiological mechanisms have been proposed, the mechanisms mediating the anxiolytic effects of physical activity remains unclear (Mohammadi-Nezhad, 2011). Insufficient research and studies in the form of randomised controlled interventions have been conducted to provide evidence that can pinpoint any prominent mechanism (Paluska & Schwenk, 2000). However, it appears that the shift to positive affect after exercise is likely a result of interaction between various factors including personal preference, familiarity with exercise, the mode of exercise, the duration of exercise, as well as the conditions of the exercise environment (Berger & Motl, 2000; Daley & Maynard, 2003; Lane et al., 2005; Solanki & Lane, 2010; Thayer et al., 1994).

Berger and Motl (2000) proposed a preliminary taxonomy containing enjoyment, mode and training guidelines that may help maximise mood benefits associated with physical activity (see Figure 5). There are two parts to the proposed model, namely (i) *mode requirements*, which describes the different types of physical activity, and (ii) *practice or training requirements*, which describes the intensity, duration, and frequency of exercise. The key feature of this taxonomy is that exercise or physical activity can provide enjoyment which shifts mood positively. Berger and Motl (2000) proposed that engaging in an enjoyable activity is likely to produce greater positive effects than engaging in a less enjoyable one. In addition, the exercise mode requirements include abdominal and rhythmic breathing, non-competition, predictability, rhythmic and repetitive movements. The practice and training requirements look at the intensity, duration, and frequency of exercise. Berger and Motl (2000) suggested that the duration of exercise sessions should be at least 20 to 30 minutes each time, and scheduled at least three times per week. They also proposed that competitive environments may reduce overall enjoyment, which then negates mood improvements. For example, previous studies have partially supported this notion as participants' cognitive focus switched from enjoyment to winning during competition (Motl, Berger, & Leuschen, 2000).

Figure 5

A Preliminary Taxonomy for Enhancing the Psychological Benefits of Exercise (Taken from Berger & Motl, 2000)



The above framework is further supported by the finding that predictable and repetitive activities do bring about positive mood changes (see Berger, 1994, 1996; Berger & McInman, 1993). For example, both yoga (Narasimhan, Nagarathna, & Nagendra, 2011) and tai chi (Wang et al., 2010) meet the mode requirements in terms of Berger and Motl's (2000) framework, and the opportunity for self-reflection and free-association during these two types of exercise have also been linked to mood improvements.

Relating to mode of exercise, both aerobic and anaerobic modes of exercise have been found to reduce depressive states, while also positively influencing specific mood dimensions (Tsang, 2011). For example, in a study by Rokka, Mavridis, and Kouli (2010), participants' mood was assessed pre- and post-exercise session, which was either a high-intensity or

moderate-intensity aerobic dance session. The authors found a statistically significant decrease in tension, depression, aggressiveness, and confusion scores, together with an increase in energy and no change in fatigue identified, and concluded that both high- and moderate-intensity exercise programmes had positively influenced mood.

However, it has been difficult to quantify the intensity of exercise that leads to the greatest improvements in mood due to the inconsistencies in definitions in previous studies (Yeung, 1996), even though the literature generally suggests that cardiovascular exercise produces the greatest enhancements (Ekkekakis, Hall, VanLanduyt, & Petruzzello, 2000; Hassmén, Koivula, & Uutela, 2000; Yeung, 1996).

Relating to duration of exercise required for positive mood benefits, different studies have proposed different time durations. For example, Hansen, Stevens, and Coast (2001) suggested that healthy adults should do moderate physical exercise daily for a total of 30 minutes, accumulated in short bouts to experience positive fitness, health and mood benefits. Ekkekakis and colleagues (2000) suggested that a 10- to 15-minute walk could improve mood, while Thayer and associates concluded that a brisk 10-minute walk was sufficient to increase energy and reduce tension (Thayer, 1987, 2001). A more recent study using randomised control intervention evaluating the effects of acute exercise on depression and mood, assessed by the POMS (Jaffery, Edwards, & Loprinzi, 2017), demonstrated that a five-minute bout of walking improved overall mood profile. Depression scores were lowered and the authors were able to replicate this treatment (exercise condition) effect. The authors further suggested that their study showed that mood-related benefits of the five-minute exercise bout is likely to occur due to the self- selected walking pace which may positively influence an individual's confidence in their ability to sustain activity and therefore positively impact the anticipated enjoyment of the physical activity. These findings above appear to relate back to the taxonomy of enjoyment proposed by Berger and Motl (2000) and the self-efficacy theory as described above (Gauvin & Spence, 1996; North et al., 1990), that physical activity has positive benefits

on mood as long as it is perceived as enjoyable and promotes self-confidence and a sense of control. In a recently concluded study, Chan and colleagues (2019) found that the relationship between exercise duration and mood change is non-linear and that a 10- to 30-minute bout of exercise is good enough to improve mood. Overall, it appears that physical activity has the potential to evoke profound positive mood changes that may persist for up to 24 hours (Maroulakis & Zervas, 1993), even though different findings on recommended durations have been found.

In summary, participation in moderate intensity exercises over a period of 5 to 75 minutes has been found to relate to a reduction in depression, tension, anger, and confusion, regardless of age and gender (Berger & Motl, 2000), with evidence on shorter durations and self-selected intensities recently found (e.g., Jaffery et al., 2017). Next, there is also evidence that regular exercisers are characterised by a less intense physiological and psychological response to stress (Dishman et al., 2000). In addition, some studies have also shown that the change in mood as a result of participating in a long-term physical exercise programme is persistent (Brown et al., 1995). Given that there is considerable evidence of the maladaptive effects of increased sedentary behaviours (e.g., Edwards & Loprinzi, 2016; Proper et al., 2011; Teychenne et al., 2015; Thyfault et al., 2015), practitioners and clinicians could consider how to promote physical activity to inactive clients, and to encourage the maintenance of physical activity in active clients especially the injured active individuals to consider finding another outlet of physical activity to reduce the effects of any depressive or negative mood symptoms that they already experience from sustaining various injuries (Edwards & Loprinzi, 2016).

Finally, since physical activity has been shown to have positive influence on mood, practitioners could then consider how mood assessment and mood profiles can be used to identify the type of physical activity that may be suitable to promote physical and mental well-being of their clients.

1.3.2 Mood Assessment Measures

In this section, two popular measures used in the assessment of mood are described, namely the Profile of Mood Scales (POMS; McNair et al., 1971, 1992) and the Brunel Mood Scale (BRUMS; Terry et al., 1999; Terry, Lane et al., 2003), which are both self-report measures. The 24-item BRUMS is a derivative of the POMS, with six mood subscales (i.e., Tension, Depression, Anger, Vigour, Fatigue, and Confusion). It is important to understand these two measures as they are key to the measurement of mood in this research project. Both measures have been well validated across different contexts. Specifically, the BRUMS has undergone rigorous validity testing using four different samples (Terry, Lane et al., 2003) and has been shown to be a psychometrically robust inventory for assessing mood responses across a range of contexts and cultures (e.g., Terry, Potgieter et al., 2003; Terry et al., 2012; Zhang et al., 2014). However, the BRUMS had not yet been researched extensively or validated in Singapore, which was the central aim of this research project.

1.3.2.1 The Profile of Mood States (POMS). Developed by McNair and colleagues (1971, 1992), the original POMS is a 65-item self-report questionnaire which assesses six underlying dimensions of the mood construct namely *Anger*, *Confusion*, *Depression*, *Fatigue*, *Tension* and *Vigour*. It is one of the most frequently used measures of mood in sport research. Respondents are asked to rate using the five-point Likert scale of 0 (*not at all*) to 4 (*extremely*) how they feel in relation to the descriptive adjectives based on a timeframe of 'right now', 'today', 'in the last week', or 'in the last 3 minutes' (LeUnes & Burger, 2000). Scores for each of the underlying dimensions of anger-hostility (AH), confusion-bewilderment (CB), depression-dejection (DD), fatigue-inertia (FI), tension-anxiety (TA), and vigour-activity (VA) are provided (Curran, Andrykowski, & Studts, 1995; LeUnes & Burger, 2000). An example of the items from each subscale include annoyed and angry (from the AH subscale), mixed up and uncertain (from CB subscale), miserable and downhearted (from the DD

subscale), tired and exhausted (from the FI subscale), nervous and anxious (from the TA subscale), and alert and energetic (from the VA subscale; Lane, Hewston, Redding, & Whyte, 2003). A 'Total Mood Disturbance' (TMD) score can be calculated by summing the negative mood states and subtracting the positive mood state of VA, using the following formula: TMD = [(AH + CB + DD + FI + TA) - VA)] (Heuchert & McNair, 2012).

The POMS was initially developed in 1971 to assess psychological distress among psychiatric populations. However, its administration took up to 20 minutes for psychiatric populations and up to seven minutes for psychologically healthy individuals (Bourgeois, LeUnes, & Meyer, 2010; LeUnes & Burger, 2000), placing "undue burden" on the patients (Curran et al., 1995, p. 80). This led to the development of several abbreviated versions including the 11-item Brief POMS (Cella et al., 1987), the 6-item Incredibly Short POMS (ISP; Dean, Whelan & Mayers, 1990), the 30-item POMS (Curran et al., 1995; Bourgeois et al., 2010), the 27-item POMS-C (Terry, Keohane, & Lane, 1996), and the 24-item BRUMS (formally known as the POMS-Adolescents [POMS-A]; Terry et al., 1999; Terry, Lane, et al., 2003).

Even though the POMS was originally developed for use with non-sporting population, validation procedures reported by McNair and colleagues (1971) were considered rigorous at the time of publication. Since sport psychology researchers did not have an abundance of sport-specific measures available, they would borrow previously validated measures as one way to initiate research. The POMS was used to predict performance, popularised by Morgan (1980), who was the first to suggest that successful sport performance is associated with an iceberg mood profile, which is typified by above-average scores for vigour and below-average anger, confusion, depression, fatigue and tension scores. This finding set the path for research from 1980 onwards to use the POMS to predict sport performance or achievements. However, subsequent research showed that an iceberg profile is the norm for athletes (Terry & Lane, 2000) and so it should not be surprising that many

studies had found that athletes reported this profile. In addition, findings from meta-analyses provided clear evidence that scores on the POMS do not distinguish athletes by level of competition (Beedie et al., 2000; Renger, 1993; Rowley et al., 1995). This led researchers to argue that subsequent research should move beyond focusing just on iceberg mood profile and performance (Terry, 2000). The meta-analyses by Beedie and colleagues (2000) demonstrated that the POMS is useful in the prediction of performance amongst athletes of similar standards.

Tests of the reliability and validity of the POMS had mixed results (Bourgeois et al., 2010). Original psychometric data reported internal consistency ranging from .84 to .95, with 8 of the 12 alpha coefficients reported at .90 or above (LeUnes & Burger, 2000). Additionally, LeUnes and Burger (2000) noted that six factor analytic replications supported the factorial validity of the scale. Other studies provided at least partial support for construct validity (see Boyle, 1987, 1988; Morris & Salmon, 1994; Reddon, Marceau, & Holden, 1985). However, some other studies found little support for the six subscales (see Fernandez, Fernandez, & Pesqueira, 2000; Lindgren, Masten, Tiburzi, Ford, & Bleeker, 1999). On the other hand, predictive and construct validity involving controlled outpatient drug trials, emotion-inducing studies, and studies on concurrent validity coefficients together strengthen the reliability and validity of the POMS (LeUnes & Burger, 2000). More recent versions of the POMS have established clinical and research utility using large normative samples, with the full-length versions including a measure of ‘friendliness’ (Heuchert & McNair, 2012). Level of friendliness is scored separately, and does not contribute to the Total Mood Disturbance (TMD) score.

1.3.2.2 The Brunel Mood Scale (BRUMS). The importance of having brief but valid measures when assessing psychological states of athletes in sport scenarios cannot be overemphasised (Lane, 2007b), especially if the timing of opportunity for assessment occurs before competitions, where time is precious and athletes’ preparation should not be disrupted

by long questionnaires (Terry, 1995). As such, several truncated versions of the relatively lengthy POMS were developed. The BRUMS is one of the few shortened variations of the POMS that has undergone rigorous validity testing (Terry et al., 1999; Terry, Lane, et al., 2003). It was developed by Terry and colleagues (1999) who sought to validate a 24-item measure of the POMS factors and named it the Brunel Mood Scale, partly because the development of the scale was completed at Brunel University (London) and also to clearly differentiate it from the original POMS at the request of McNair and colleagues. Confirmatory factor analysis was conducted to test the extent to which a reduced set of items supported the six-factor measurement model proposed by McNair and colleagues (1971). After removing weak loading items, a 24-item measure of mood with six subscales was attained.

The BRUMS is made up of six subscales namely *Anger*, *Confusion*, *Depression*, *Fatigue*, *Tension*, and *Vigour*, with each subscale containing four items (see Table 2). A standard response timeframe of "How you feel right now?" is used, where respondents are asked to rate their responses on a 5-point Likert scale of 0 = *Not at all*, 1 = *A little*, 2 = *Moderately*, 3 = *Quite a bit*, and 4 = *Extremely* (Terry & Lane, 2010). Total subscale scores may range from zero to 16. The completion time for the BRUMS is about two minutes. Alternative timeframes can also be used (e.g., 'How you have felt during the past week including today?', 'How have you felt over the past month?', and/or 'How do you normally feel?'), thus providing flexibility in assessment.

Table 2

BRUMS Subscales and its Items (Terry et al., 1999; Terry, Lane et al., 2003)

BRUMS Subscales	**Items**
Anger	annoyed, bitter, angry, bad tempered
Confusion	confused, mixed up, muddled, uncertain
Depression	depressed, downhearted, unhappy, miserable
Fatigue	worn out, exhausted, sleepy, tired
Tension	panicky, anxious, worried, nervous
Vigour	lively, energetic, active, alert

These six subscales were validated via multi-sample confirmatory factor analysis, using four different samples: adult students (n = 656), adult athletes (n = 1,984), young athletes (n = 676), and schoolchildren (n = 596; Terry & Lane, 2010; Terry, Lane et al., 2003). Comprehensive tables of normative data are available for each of the abovementioned four populations.

In terms of psychometric properties, Terry and colleagues (2003) reported evidence of criterion validity where results for correlations between BRUMS and PANAS scores (Watson et al., 1988) and the State Anger-Expression Inventory (STAXI: Spielberger, 1991) were found to be consistent with theoretical predictions. The BRUMS has also demonstrated high internal consistency, with Cronbach coefficient alphas ranging from .74 to .90 for each of the six subscales (Terry et al., 1999). Test-retest reliability coefficients ranging from .26 to .53 over a one-week period have been reported, which was proposed to be appropriate for a measure of transient psychological states. The concurrent validity of the BRUMS has also been supported (Terry, Lane et al., 2003), where a strong positive correlation was found between the BRUMS Vigour subscale and the PANAS PA scale (Watson et al., 1988), with

only a minimum correlation found with the other BRUMS subscales. Correlations between the BRUMS subscales of Anger, Confusion, Depression, Fatigue, and Tension were also found with the PANAS NA scale (Watson et al., 1988). In addition, a strong correlation was found between the State-Trait Anger Expression Inventory (STAXI; Spielberger, 1991) and the BRUMS Anger subscale (Terry et al., 1999; Terry, Lane et al., 2003), and a moderate correlation was found between the BRUMS Depression subscale and the depression scale of the Hospital Anxiety and Depression Scale (HADS; Terry, Lane et al., 2003; Zigmond & Snaith, 1983).

In terms of generalisability, researchers have found evidence for the validity of BRUMS by conducting factor analytic studies with diverse populations such as adolescents with intellectual disability (Argus, Terry, Bramston, & Dinsdale, 2004) and water-skiers (Fazackerley, Lane and Mahoney, 2003). In addition, the BRUMS has also undergone rigorous cross-cultural validation, included translation and validation in various languages and cultures. As of today, the BRUMS is available for use in the following languages: Afrikaans (Terry, Potgieter et al., 2003), Chinese (Zhang et al., 2014), Farsi (Terry, et al., 2012), French (Rouveix, Duclos, Gouarne, Beauvieux, & Filaire, 2006), Hungarian (Lane, Soos, Leibinger, Karsai, & Hamar, 2007), Italian (Lane et al., 2007), Japanese (Yokoyama, Araki, Kawakami, & Tkakeshita, 1990), Malay (Hashim, Zulkifli, & Yusof, 2010), Portuguese (Rohlfs et al., 2008), Serbian (Rajkovic, 2014), and Spanish (Cañadas, García, Sanchis, Fargueta, & Herráiz, 2017). Even though some of these validation studies have removed or added items into their version of the mood scale after doing either a confirmatory factor analysis or exploratory factor analysis, the six-factor structure as found in the BRUMS is retained.

Overall, there is strong evidence to support the psychometric integrity and robustness of the BRUMS across the diverse populations and cultures in which it has been validated in (Terry et al., 1999; Terry, Lane et al., 2003). Its brevity makes it easy to administer and user-friendly and it is available for use free of charge with permission sought. The current PhD

research aimed to establish the factorial validity of the BRUMS for use in a Singaporean context (Study 1).

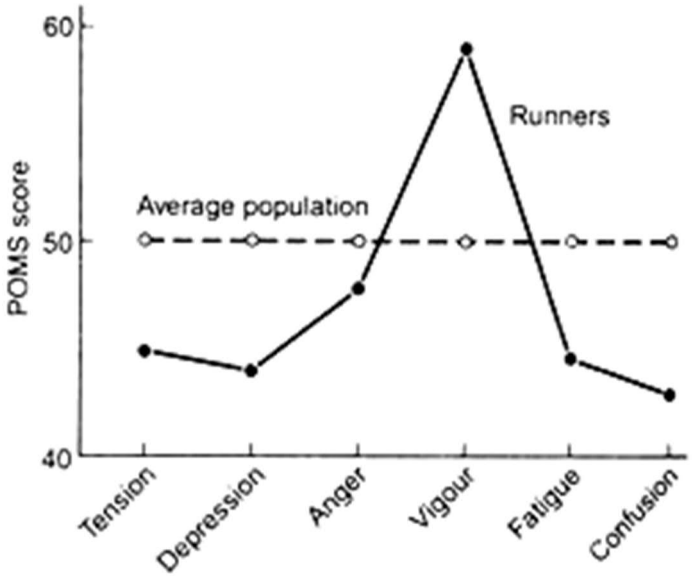
1.4 The Influence of Mood on Sport Performance

1.4.1 Past Research and its Limitations

The intuitive link between mood states and performance has provided a catalyst for psychologists to investigate this relationship (Lane & Terry 2000), which has been researched extensively over the past 40 years (see LeUnes & Burger, 1998; Renger, 1993; Rowley et al., 1995; Terry, 1995). The role of mood in predicting performance in the context of sport has been well documented (Beedie et al., 2000; Hanin, 1997; Terry, Janover, & Diment, 2004). Sport psychology researchers have relied almost exclusively on the POMS (McNair et al., 1971) and its derivatives as the measure of mood when examining its relationship with sport performance. The use of the POMS in sport was pioneered by Morgan and colleagues (e.g., Morgan, 1974; Morgan & Johnson, 1978; Morgan & Pollock, 1977; Nagle et al., 1975) who demonstrated that the mood profiles of athletes particularly those at the elite level, when compared to population norms, were characterised by above average vigour scores and below average scores for tension, depression, anger, fatigue, and confusion. This pattern of mood responses was termed an ‘iceberg profile’ (Morgan, 1980; see Figure 6), which was proposed to reflect positive mental health as described by Morgan (1985) in the mental health model. The model states that positive mental health enhances the likelihood of success in sport, whereas psychopathology is associated with a greater incidence of failure (p. 79).

Figure 6

The Iceberg Profile with Low Scores on the Negative Mood Dimensions, together with a High Score on the Positive Mood Dimension Vigour (Morgan, 1980, 1985)



Although more than 250 published studies have examined mood responses in sport and exercise settings, the empirical support for mood-performance relationships in sport has been equivocal (LeUnes & Burger, 1998). Researchers have not always been able to articulate in detail the "ideal mood" for best performance (Terry & Lane, 2011). The current state of the research literature in mood and performance suggest that much of the equivocal findings can be explained by methodological factors (Terry, 1995; Lane, 2007a), which are elaborated below.

Although Morgan (1985) reported impressive figures for performance prediction, various researchers in the 1990s started to point out the apparent equivocality in the mood-performance research (see Renger, 1993; Rowley et al., 1995), downplaying the predictive effectiveness of mood. For example, Rowley et al. (1995) showed that although successful athletes reported a mood profile that resembled more of an iceberg than unsuccessful athletes, POMS could explain only 1% of the variance in performance. They concluded that researchers should abandon mood profiling and look for other variables to predict performance. By

contrast, Terry (1995), in a review which predominantly comprised the same studies, proposed that the POMS was an effective predictor of performance if certain conditions are met, and concluded that Renger (1993) and Rowley et al.'s (1995) proposal that mood is a poor predictor of performance were based on studies where mood-performance relationships were weak due to methodological limitations.

In 2000, Beedie and colleagues completed two meta-analyses of all studies on mood and performance conducted and concluded that studies that examined the relationship between pre-competition mood and subsequent performance were more productive and logical, compared to those looking at how mood differs between athletes or non-athletes, or elite versus non-elite athletes. It was also discovered that when studies investigating level of achievement and studies using inappropriate methods were excluded, the mean effect of mood on performance was small-to-moderate (Cohen's d = .31). Effects were moderate for vigour, confusion, and depression, small for anger and tension, and very small for fatigue. All these effects were in the direction predicted by Morgan's (1985) mental health model. Notably, the meta-analyses found that the effects of mood on performance were larger in sports of short duration, in closed-skill sports, and when performance was judged using self-referenced criteria, like achievement of performance goals or percentage of personal best (Beedie et al., 2000). These findings were similar to what Terry (1995) had proposed, to consider how other potential moderating variables related to a particular sport (e.g., task characteristics, complexity, and number of co-acting performers), as well as personal characteristics (e.g., skill and conditioning), can influence performance and thus has to be controlled or taken into consideration in order for the effects of mood to be identified. All these moderating variables are potential confounds that previous researchers had generally overlooked (Terry & Lane, 2011) which may have contributed to the equivocal findings of the mood-performance literature. Next, the way in which performance is operationalised and measured is also critical when investigating mood-performance relationships. It appears that the use of objective

performance indicators like win-loss record or selection to a national team that are insensitive to the relative quality of performance for a particular athlete, may have often masked the effects of pre-performance mood (Terry, 1995). Instead, Terry (1995) proposed that a self-referenced performance criterion, such as percentage of personal best or the achievement of performance goals, would be a more sensitive measure of the quality of performance than objective criteria.

Past research had not always sufficiently distinguished between the level of performer and level of performance (Terry & Lane, 2011). As mood is transient, it is not obvious how and why mood profiles would distinguish between performers with different levels of achievement, because elite athletes do not have a monopoly on positive moods (Terry & Lane, 2011) and are potentially affected by negative moods too. In reality, athletes may deviate from the iceberg profile, following injury, loss, tough training or stressful events and may experience a certain degree of disturbed mood during such periods (Terry, 1995). It is also very important to note that there is no mood profile that is ideal for everybody. Different athletes perform best with different mood profiles. The transient nature of moods itself is suggestive of a link with performance, where an individual is more likely to perform well when in their "ideal" mood than any other mood. The results of Beedie and colleagues (2000) had also clearly demonstrated that mood responses do not reliably differentiate between athletes at different levels of achievement, producing similar findings as Rowley and colleagues (1995), concluding that the line of research looking at whether mood could predict levels of achievement was questionable.

Overall, the findings from Beedie and colleagues (2000) supported that mood profiles taken at the pre-performance stage are significant predictors of subsequent performance when certain conditions are met. It was concluded that much of the equivocality in mood-performance literature in sport were related to methodological factors (Beedie et al., 2000; Terry & Lane, 2011), which leads us back to the root of the issue, in which a lack of theory in

mood and sport performance to underpin research questions could have contributed to some questionable research intents and study designs (Terry, 2003; Terry & Lane, 2011).

On another note, other researchers have proposed that it may be more insightful and meaningful using an idiographic, rather than a nomothetic, approach to unravel the complexities of the effects of human emotions on performance (e.g., Hanin, 1997; Prapavessis, 2000). While the results of more than 300 cross-sectional studies conducted in this area have offered many insights into the mood-performance link, it is likely that models emphasising an intra-individual focus, like the individual zone of optimal functioning (IZOF) model (Hanin, 1997) can help improve our understanding of the mood-performance relationship. To illustrate this, a few studies have investigated mood-performance relationships using both cross-sectional and intra-individual designs. For example, Lane and Chappell (2001) assessed mood and performance for 11 basketball players competing at the world student games and found that pre-performance mood scores accounted for 9% of performance variance in cross-sectional analyses, whereas intra-individually performance was significantly related to mood for six players, accounting for up to 40% of variance, although mood and performance were unrelated for the other five players. Similarly, Terry and colleagues (2004), who investigated mood-performance relationships among 702 junior swimmers, showed that, for the group as a whole, pre-race mood accounted for 24% of performance variance. However, intra-individual analyses on 24 of the swimmers showed that pre-race mood accounted between 1% and 86% of performance variance. These two findings confirmed that the strength of mood-performance relationships differs between individuals. In other words, performances can be extremely mood-dependent for some athletes but less so for other athletes (Totterdell, 1999; Lane & Chappell, 2001). Thus, the utility of mood profiling for predicting performance may rely on the individualised assessment of idiosyncratic mood-performance relationships (Terry, 1995).

Hence, models that emphasise an intra-individual focus such the Individual Zone of Optimal Functioning (IZOF; Hanin, 1997) may offer great potential to refine our understanding of the relationship between mood, emotion and performance. This line of individual-oriented research originated from Hanin's applied work with top-level athletes, which began looking at anxiety using the State-Trait Anxiety Inventory (STAI; Spielberger, et al., 1970) and how it could affect an individual athlete's performance, since the presence of pre-competition anxiety was well-known and coaches, athletes and sport practitioners were interested to better understand its effects (Ruiz, Raglin, & Hanin, 2017). The main emphasis of the IZOF is on real (within-individual) experiences rather than pre-conceived ideas coming from group-oriented models prevalent in the past (Hanin, 1993; Jokela & Hanin, 1999) which may have minimised individual differences, leading to equivocal findings (Krane, 1992; Raglin, 1992). In summary, through the continued research and application of the IZOF model by various researchers and applied practitioners worldwide on real-life case studies, the IZOF model continues to be fruitful in the examination of the basic and applied problems in sport psychology, with the underlying goal of facilitating athletes to gather personal insight as to how their individual mental processes and psychobiosocial states can help them attain optimal performances and reach their potential (Ruiz et al., 2017). A key lesson that can be drawn from the success of the IZOF model worldwide by various practitioners might be that the idiographic approach may indeed be the way ahead for research on mood states and performance.

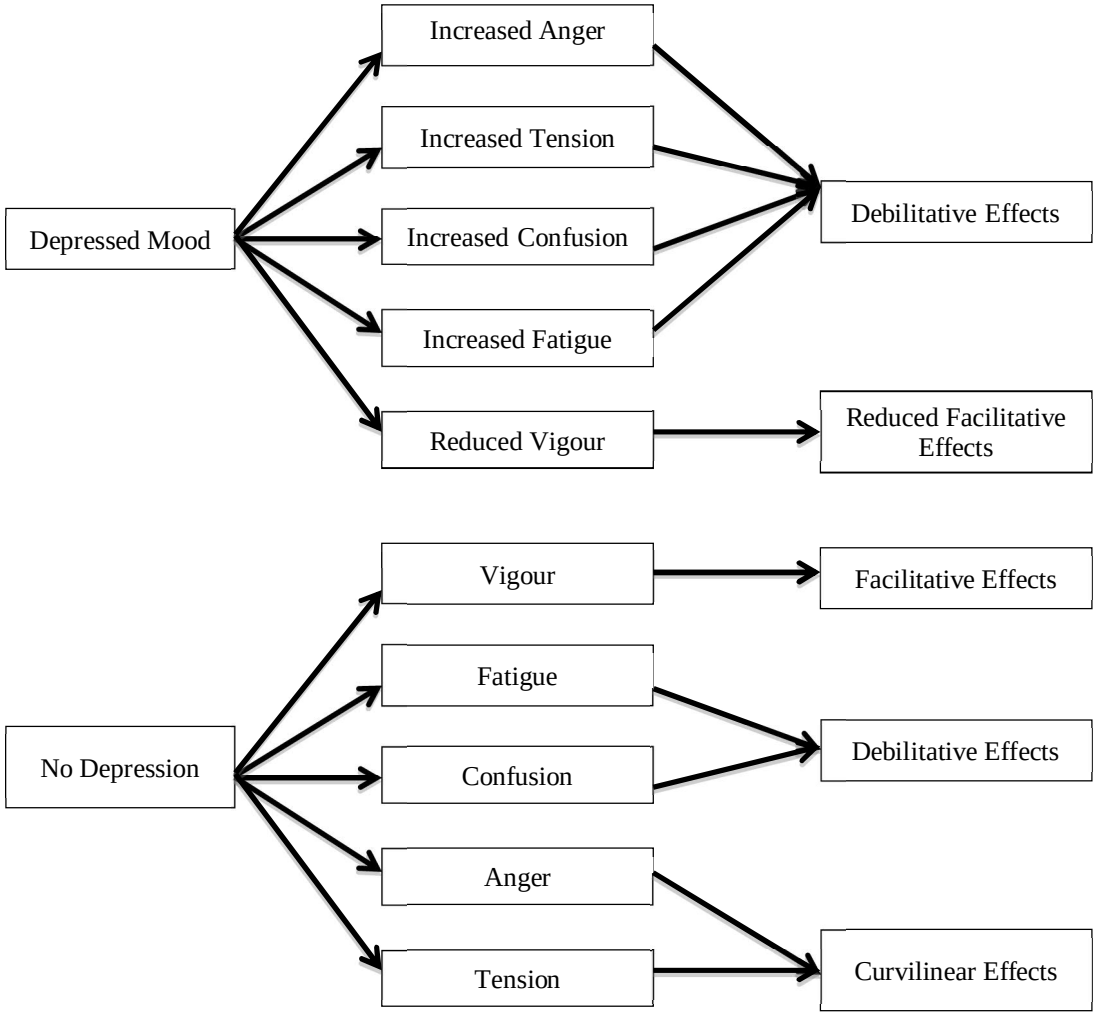
Besides recognising the value and importance of idiographic approaches in mood-performance research, it is also of crucial importance to have a theoretical framework that can explain mood-performance relationships. The conceptual model of mood and performance developed by Lane and Terry (2000), is discussed in the next section.

1.4.2 Conceptual Model of Mood and Performance

As mentioned previously, the study of mood in sport and exercise has been hampered by a lack of theory to underpin research questions (Terry, 2003; Terry & Lane, 2011). In an attempt to address the conceptual gap and to enhance the understanding of why and how mood states could predict performance, Lane and Terry (2000) developed a conceptual model, based on the POMS (McNair et al., 1971) or its derivatives (e.g., BRUMS), to explain the relationship between mood and performance (see Figure 7). Lane and Terry (2000) argued that mood-performance relationships should be investigated using discrete mood dimensions, rather than broad constructs such as positive or negative affect. Lane (2007a) wrote that people experience a combination of mood states in real life, and it is the interaction among these mood states that influences how we act, and ultimately influence performance. Thus the six dimensions of mood of the POMS, namely anger, confusion, depression, fatigue, tension, and vigour are included in the conceptual model. It is also important to consider the interaction between these discrete mood states.

Figure 7

Conceptual Model of Mood and Performance with a Focus on Depression (Taken from Lane & Terry, 2000, p. 24)



Central to this model is the role of depressed mood, which influences the intensity of other mood states, and determines the functional impact of anger and tension on performance. It is proposed that the negative cognitive generalisations that accompany depressed moods are pervasive and act as a catalyst for other unpleasant mood dimensions. Depressed moods also promote a focus on past negative experiences, which may diminish self-confidence and ability to cope (Rokke, 1993), and may require more regulation than other moods, thus reducing capacity for alternative types of regulation such as physical performance (Muraven, Tice, &

Baumeister, 1998). To affirm the central role of depression in this model, Lane and Terry (1999) also tested if anxiety exerted a similar influence. They found that anxiety did not associate with large differences in other mood dimensions, thus supporting the notion that depression is a key variable when examining mood-performance relationships. Furthermore, depression should have the strongest influence on sport performance as it is the "antithesis of a mindset needed to bring about optimal performance" (Lane, 2015, p. 29).

However, the meta-analysis by Beedie and colleagues (2000) showed a weak relationship between depression and performance, which prompted Lane and Terry (2000) to re-analyse the same studies as Beedie et al. (2000), focusing on the depression scores. Lane and Terry (2000) found that approximately half of the athletes reported a zero score for depression scores, hence depressed mood data has limited variance, contributing to a weak relationship between depression and performance. This led to Lane and Terry (2000) suggesting that participants should be grouped into depressed mood and no-depression groups, on the basis of their answers to the four depression items on BRUMS, which helped to uncover the influential role of depressed mood on performance.

The meta-analysis by Beedie and colleagues (2000) also identified inconsistent results for the anger-performance and tension-performance relationships. Lane and Terry (2000) hypothesised that anger and tension be either facilitative or debilitative of performance, depending on their interaction with depressed mood. Indeed when the conceptual model was tested, findings on the dimensions of anger and tension suggested that they can either debilitate or facilitate performance, depending on the co-existence or absence of depressed mood (Lane & Terry, 2000).

In the presence of depressed mood, anger-related thoughts tend either to be supressed or directed to the self (inwards; Spielberger, 1991), while tension may bring about feelings of threat or worry, both of which can debilitate performance. In the absence of depressed mood,

anger may play a signalling role to prime an individual for positive action, while tension may be interpreted as the readiness to perform.

The distinction between suppressed and expressed anger is important for sport performance. According to Spielberger (1991), the self-blame element of suppressed anger may intensify feelings of hopelessness, leading to poorly motivated behaviour and debilitated performance. In addition, the tendency to suppress anger is closely related to the simultaneous experience of depressed mood. Expressed anger tends to be directed at the source of the original frustration, or towards another object or person, which may improve performance if the athlete is able to channel anger productively into determination to succeed, with this more likely to happen in the absence of depressed mood.

Tension, like anger, is associated with heightened arousal (Lane, 2015), thus tension may serve a functional role by signaling whether conditions warrant action (Schwarz & Bless, 1991). Experiencing tension pre-performance may signal the possibility of a poor performance unless some action is taken, such as increased effort or improved concentration. In this instance, in the absence of depressed mood, tension may provide a motivating effect if performance outcome is perceived as important by the individual. However, in the presence of depressed mood, tension may be directed toward negative self-thoughts which can bring about a demotivating effect (Lane, 2015).

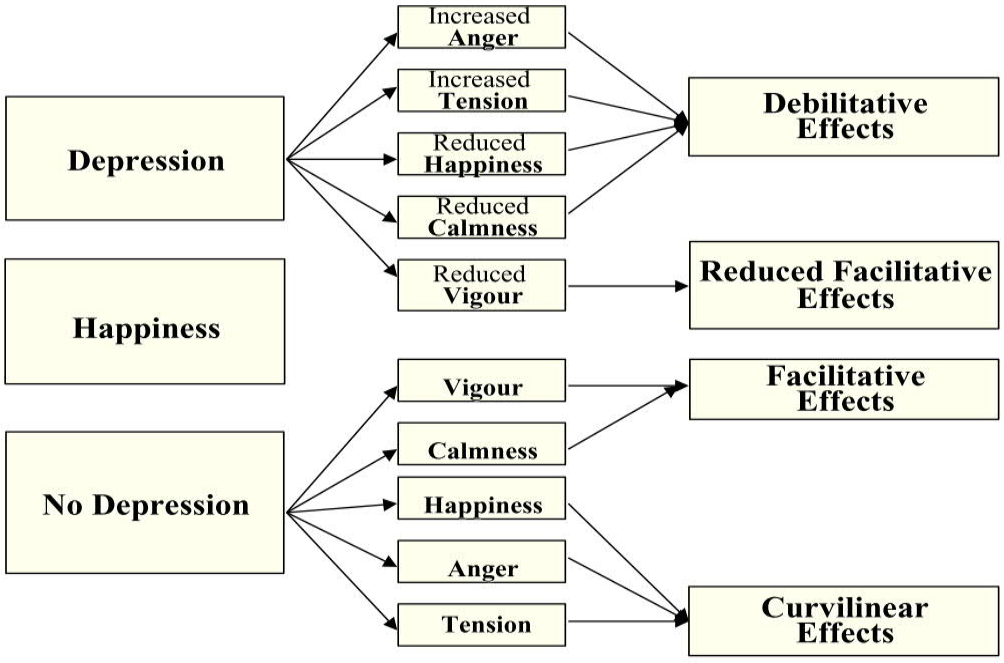
This switching effect was significant for both anger and tension, but was greater for anger (Lane, 2015). Vigour showed a moderate positive relationship with performance in both groups, whereas confusion and fatigue showed weak negative relationships. These findings provide general support that depressed mood moderates mood-performance relationships for anger and tension, but not for confusion, fatigue, and vigour (Lane & Terry, 2000).

Multiple studies have tested Lane and Terry's model and reasonable support was found for the central hypotheses (e.g., Lane, Terry, Beedie, & Stevens, 2004; Owens, Lane, & Terry, 2000). To address one of the perceived shortcomings that the POMS assesses only a limited

range of mood states (see Lane et al., 2005), Lane (2007a) proposed a revised model (see Figure 8). Confusion was removed because it was more a cognitive state than a mood state. “Calmness” and “happiness”, which are positive mood states, were added, stemming from the applied work of Lane, Whyte, Godfrey, and Pedlar (2003) with a team of biathletes training at altitude. The research team was vigilant at detecting the presence of depressed mood, given the evidence supporting the conceptual model. They found that the addition of Happiness as a measure came to provide an early sign to symptoms of depressed mood as it was found that symptoms of depressed mood usually occurs following a period of reduced scores on the Happiness scale gradually over time (Lane, 2007a). Calmness was also included and proposed to provide insight into the nature of tension and anger experienced in the absence of depressed mood. Therefore if an athlete uses anger and tension to motivate behaviour in a controlled manner, it is likely that the athlete should report feeling, calm, angry and tense (Lane, 2007a).

Figure 8

Revised Conceptual Model of Mood and Performance (Taken from Lane, 2007a, p. 22)



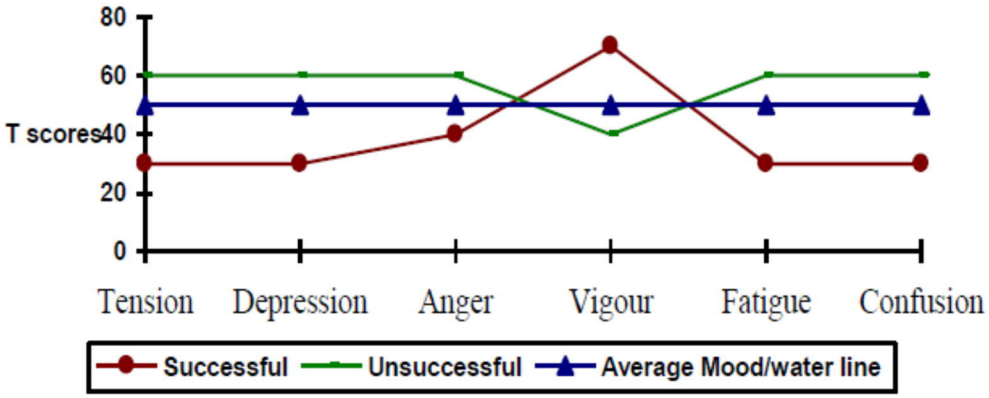
In summary, the conceptual model of mood and performance by Lane and Terry (2000) may provide a plausible theoretical explanation for the contradictory findings found previously in the mood-performance research. The model also provides testable hypotheses relevant to the POMS and its derivatives (Terry & Lane, 2011).

1.5 Mood Profiling and Mood Profile Clusters and its Applications

Research on mood has had a strong focus on psychometric testing, commonly referred to as mood profiling (e.g., Terry et al., 1999, Terry, Lane et al., 2003). Mood profiling first became popular in sport when Morgan (1980) proposed a link between athletic success and an *iceberg* mood profile, based on the Profile of Mood States (POMS) (McNair et al., 1971), which combines above average scores for vigour and below average scores for tension, depression, anger, fatigue and confusion (see Figure 9). Qualitative reviews of the literature (LeUnes, Haywood, & Daiss, 1998; Renger, 1993; Vanden Auweele, De Cuyper, Van Mele, & Rzewnicki, 1993) have demonstrated that athletes typically report iceberg profiles, which by definition vary from population norms derived largely from non-athletes. Subsequently, published normative data based on the mood responses of 2,086 participants in sport and exercise confirmed that an iceberg profile is “normal” for athletes (Terry & Lane, 2000).

Figure 9

Mood Profiles of Successful and Unsuccessful Athletes as Proposed by Morgan (1980)



Prior to 2000, sport psychology researchers relied almost exclusively upon the POMS as the measure of mood when examining links with athletic performance (Beedie, et al., 2000). Other self-report questionnaires validated in general psychology were also used in this context, such as the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). However, construct validity was an issue as some scales had insufficient population-specific normative data for them to be confidently generalised across populations. For instance, the POMS was initially developed in 1971 to assess psychological distress among psychiatric populations. In addition, the administration of the 65-item POMS took up to 20 minutes (LeUnes & Burger, 2000; Bourgeois et al., 2010), placing a burden on respondents (Curran et al., 1995, p. 80). The length of the POMS gave rise to the development of several truncated versions, such as a 37-item POMS-Short Form (Shacham, 1983), a 30-item abbreviated POMS (Curran et al., 1995; Bourgeois et al., 2010), and the 24-item Brunel Mood Scale (BRUMS) (Terry et al., 1999, Terry, Lane et al., 2003).

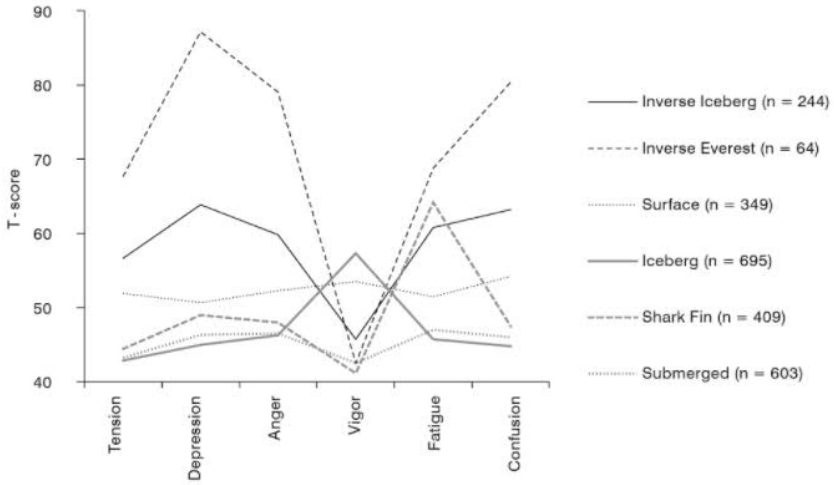
As mentioned above in section 1.3.2.2, the BRUMS is the only variation of the original to have undergone extensive validation with various adolescent and adult populations (Terry et al., 1999, Terry, Lane et al., 2003). The BRUMS has been translated and revalidated in several languages and has been shown to be a psychometrically robust inventory for assessing mood responses of adolescents and adults across a range of contexts.

Seven distinct mood profiles have been identified in the literature, referred to as the (1) *iceberg profile* (Morgan, 1980), (2) *Everest profile* (Terry, 1995), (3) *inverse iceberg profile* (Terry, 2004), and the more recently identified profiles of (4) *inverse Everest*, (5) *surface profile*, (6) *shark fin* and (7) *submerged* profiles (Parsons-Smith et al., 2017). Besides the iceberg profile, there has not been much research on the other mood profiles. Researchers have not yet investigated if and how these other mood profiles are related to sporting performance, though there has been some evidence that the inverse Everest and shark fin profiles are associated with debilitated performance, measured in terms of adherence to safety

behaviours in high-risk vocations (Parsons-Smith, 2015). Figure 10 below illustrates the six distinct mood profiles identified by Parsons-Smith et al. (2017) in terms of their scores on the six mood dimensions of tension, depression, anger, vigour, fatigue and confusion.

Figure 10

Six Distinct Mood Profiles Identified via Cluster Analysis (N = 2,364; Parsons-Smith et al., 2017)



As mentioned previously, the *iceberg* profile is characterised by above average scores for vigour and below average scores for tension, depression, anger, fatigue and confusion, and has been reported to indicate positive mental health (Morgan, 1980) and associate with superior performance (Raglin, 2001). The *Everest* profile, which is not shown in Figure 10, is characterised by high scores on vigour (*T* score of 60 or more) and low scores on the remaining factors (*T* score of 40 or below), and is associated with superior performance (Terry, 1995). The *inverse Everest* profile is characterised by a low score for vigour, high scores for tension and fatigue, and very high scores for depression, anger, and confusion, which may be indicative of clinical mood disorders (Lane & Terry, 2016). In 2013, van Wijk, Martin, and Hans-Arendse demonstrated that BRUMS has utility as a screening tool for clinical conditions, although Lane and Terry (2016) cautioned that BRUMS should not be used as a diagnostic tool. The *inverse iceberg* profile is characterised by a low vigour score,

and high scores for tension, depression, anger, fatigue, and confusion. The *shark fin* profile is characterised by below average scores for tension, depression, anger, vigour, and confusion, together with a high score for fatigue. The *surface* profile is characterised by slightly above average scores for each mood dimension. Finally, the *submerged* profile is characterised by below average scores for all mood dimensions (Parsons-Smith et al., 2017). The extent to which the six mood profiles generalise to other cultural contexts has been shown by Quartiroli and colleagues (2018) in an Italian sample, while the impact on performance of the four novel mood profiles identified by Parsons-Smith and colleagues (2017) has not yet been tested. The current PhD research project aimed to investigate the cross-cultural generalisability of these six previously identified mood profiles, to examine if they are also present in the Singaporean context (Study 2).

Mood profiling has many potential applications beyond predicting performance in sport. Research has consistently shown significant mood effects on performance in diverse areas including work (Lee & Allen, 2002), academics and creativity (Grawitch, Munz, & Kramer, 2003). Mood profiling has also been used to screen combat troops for post-traumatic stress risk (van Wijk et al., 2013), assessing safety-related mood disturbance in high-risk industries (Parsons-Smith, 2015), screening for risk of youth suicide (Gould et al., 2005), and to monitor cardiac rehabilitation patients (Sties et al., 2014). The current research aimed to investigate the utility of mood profiling amongst a group of elite pistol shooters (Study 3).

1.6 Mood and Emotion Management Strategies

As mentioned above, our moods usually involve more than one emotion and furthermore, as aptly summarised by Karageorghis and Terry (2010): “there is a reciprocal, or two-way, relationship between moods and emotions, in that mood shapes the emotional reaction to a particular situation, and the emotional experience that follows contributes to mood” (p. 120). It was shown in past research studies on mood and emotion regulation (e.g., Terry et al., 2006) that athletes actively use a variety of strategies in an attempt to regulate

their mood and emotions, but the effectiveness of these strategies is not well understood, especially in terms of how each strategy regulates a particular mood or emotion. Thus, researchers and practitioners studying the relationship between mood and performance would benefit from an understanding of the available mood and emotional regulation strategies and the mechanisms by which they work, which will in turn facilitate the planned interventions to enhance the mood and performance of their athletes.

Among the general population, Thayer and colleagues (1994) looked at the frequency and the effectiveness of various strategies of affect regulation and found that the most common strategies to reduce nervousness, tension, or anxiety in the short term were affiliative-communicative behaviors such as calling, talking to, or being with someone, exercise, relaxation techniques, rest, music, and food; while the most common strategies for enhancing the energy component of mood were to control thoughts via self-talk, to listen to music, take a shower, exercise, take a nap, keep busy, eat something, or have a caffeinated beverage.

Amongst athletes, Stevens and Lane (2000) found that the most commonly used mood regulation strategies were listening to music, controlling thoughts, talking to or having someone else around, and exercising. Another study by Terry and colleagues (2006) investigated the effectiveness of mood regulation behaviours used before competition, and also found that athletes engaged in various strategies in order to regulate the different mood dimensions (i.e., anger, confusion, depression, fatigue, tension, and vigour). Terry and colleagues (2006) proposed a strong case for instructing athletes in the use of strategies, such as relaxation, imagery, and music as they were rated as particularly effective. However, they also found that the strategies most commonly chosen were not always the most effective. As pointed out by Totterdell and Parkinson (1999): “some strategies might be used a lot because they are considered effective, whereas in practice they may not actually improve mood” (p. 219). Fazackerly, Lane and Mahoney (2007) tested these principles in a study that developed

and evaluated individualised mood regulation interventions for athletes, which was based on previously identified differences in mood responses between best and worst performances. Fazackerly and colleagues (2007) implemented positive imagery and self-talk with athletes who reported that depressed mood debilitated their performance, used attentional control training with athletes whose performance was impaired by confusion, and used activation training with athletes whose high fatigue and low vigour were associated with poor performance. Following these interventions, the study found enhanced mood responses and improved performance, with the mood dimension of fatigue and vigour most inclined to change (Fazackerly et al., 2007).

These three studies showed that some strategies may be favoured over others but it is not always obvious which techniques are actually effective in alleviating negative mood states, hence the practitioner could play an important role in helping athletes identify how mood or emotion influenced their performance, and the most effective strategies to use in order to optimise their performance. For example, Terry and colleagues (2006) found that the most popular strategies employed to regulate feelings of anger were (a) letting the feeling out, (b) spending time alone, (c) confiding in someone about the feelings, (d) dealing with the cause of the feelings, (e) using humour, and (f) trying to put the feelings into perspective. However, the most effective strategies reported were (a) dealing with the cause of the feelings, (b) using relaxation techniques, (c) spending time alone, (d) focusing on competition strategies, (e) trying to place feelings into perspective, and (f) avoiding the cause of the feelings (Terry et al., 2006). Terry and colleagues (2006) summarised in their study the most popular and effective strategies for regulating each of the six dimensions of mood according to the BRUMS (see Table 3).

Table 3

Most Popular and Effective Strategies used to Regulate Mood Dimensions (adapted from Terry et al., 2006)

Mood Dimension	Most Popular	Most Effective
Tension	Physical activity Focus on competition strategies Relaxation techniques Give myself a pep talk Talk with others to distract myself Spend time alone	Relaxation techniques Sport-related imagery Physical activity Superstitious things Positive thinking Deal with the cause of the feelings
Depression	Spend time alone Talk to someone about my feelings Talk with others to distract myself Seek physical affection Use humour Think about something else	Think positively Deal with the cause of the feelings Talk to someone about my feelings Put feelings into perspective Seek physical affection Think about something else
Anger	Let the feeling out Spend time alone Talk to someone about my feelings Deal with the cause of the feeling Use humour Try to put my feelings into perspective	Deal with the cause of the feelings Use relaxation techniques Spend time alone Focus on competition strategies Try to put my feelings into perspective Avoid the cause of the feelings
Vigour	Physical activity Fast, upbeat music Use humour Sport-related imagery Focus on competition strategies Give myself a pep talk	Physical activity Think positively Sport-related imagery Fast, upbeat music Focus on competition strategies Put feelings into perspective
Fatigue	Take a shower Rest, take a nap or sleep Splash face with cold water Eat something Physical activity Focus on competition strategies	Relaxation techniques Take a shower Rest, take a nap or sleep Put feelings into perspective Have a massage Deal with the cause of the feelings
Confusion	Talk to someone about my feelings Give myself a pep talk Use humour Spend time alone Talk with others to distract myself Engage in physical activities	Focus on competition strategies Positive thinking Deal with the cause of the feelings Talk to someone about my feelings Mentally switch off Avoid the cause of the feelings

The various mood regulation strategies and their potential efficacy for regulating mood dimensions provide insights for athletes, coaches and applied practitioners on the various means and effectiveness of emotional regulations. However, it is important for them to work out which strategies work best for individual athletes, through a process of assessment, implementation and evaluation. Future studies could evaluate the mechanisms through which the various strategies work, and examine how their use is associated with improved performance. In relation to mood profiling, the various mood regulation strategies could be tested for their efficacy in terms of how they could be used to either attain or maintain a certain mood profile that is optimal for performance (e.g., iceberg profile, submerged profile), or to self-regulate to reduce negative symptoms of less positive mood profiles (e.g., inverse iceberg profile, shark fin profile).

1.7 Research Objectives

Taking into account the current state of research in mood and its relationship to performance, this programme of research aimed to examine several research questions in a series of three studies. These three studies were planned on the premise that mood profiling has not been extensively used nor researched in Singapore, which is an island nation home to about 5.7 million people from multi-ethnic and cultural groups. The main ethnic groups are Chinese, Malay, Indian, with all other races categorised under “others” (Singapore Department of Statistics, 2018). It is important to note that there were no prior published studies on mood or emotion amongst the general population in Singapore, hence this PhD research represents the first attempt to investigate mood assessment and mood profiling in Singapore, and how mood relates to performance.

Each study was built on the findings of the previous studies in this project. In Study 1, the objective was to confirm if the Brunel Mood Scale (BRUMS; Terry et al., 1999), which has been shown to be a psychometrically robust inventory for assessing mood responses across adolescents and adults across a range of contexts, is also a valid and reliable measure of

mood in Singapore. The BRUMS is one of the derivatives of the more prominent Profile of Mood States (POMS; McNair et al., 1971) and had undergone cross-cultural validation in various countries. The BRUMS has not been validated in Singapore, which is a multi-cultural Asian society, with English as its first language. Hence in Study 1, the factorial validity of the BRUMS was examined to establish whether it had the psychometric integrity and cross-cultural validity for use with Singaporean athletes and non-athletes. Finding evidence that the BRUMS is valid and reliable for use in the Singaporean population would further strengthen its generalisability as a psychometric instrument for the measure of mood. A set of local norms was developed, which will facilitate the use of the BRUMS by practitioners within the local population. This also sets the ground for further opportunities to examine the antecedents, correlates and behavioural consequences of mood responses among athletes and non-athletes in Singapore.

In Study 2, cluster analysis was used to analyse the data collected from Study 1 to establish if the mood profile clusters previously identified (Parsons-Smith et al., 2017; Quartiroli et al., 2018) are also present in a Singaporean context. Study 2 also examined differences in mood profiles and their distribution among those who participated in sport and those who did not. Identifying the same six mood profile clusters would provide further evidence of the stability and cross-cultural replicability of mood profile clusters in English-speaking sport and non-sport samples in Singapore. Findings from Study 2 will also provide researchers and practitioners with greater confidence that it is worth exploring the meaning and practical applications of mood profile clusters and mood profiling (e.g., as a catalyst for conversation, to assist the design of interventions, to monitor psychological health, or perhaps to complement large scale mental health awareness programmes).

Finally, in Study 3, the aim was to explore the relationship between mood and performance amongst a group of elite pistol shooters, to test the utility of mood profiling in an applied setting. Study 3 serves as a culminating point where the knowledge and information

gained from Study 1 and 2 will be applied and examined. An idiographic approach was used to examine if individual fluctuations in pre-competition mood were related to fluctuations in shooting performance. The research objectives were to identify if and how pre-performance mood is related to pistol shooting performance; what is the relationship between individual mood dimensions and shooting performance; if an idiographic approach to the study of mood-performance relationships would yield any insights; and if an ideal pre-performance mood profile for pistol shooters can be identified. Findings from Study 3 will provide insights for pistol shooting athletes and practitioners on how mood relates to performance, the utility of mood profiles in competition preparation and prediction of performance, and offers a reference of the individual interventions that may be suitable for athletes based on their ideal mood profiles. Findings from Study 3 also serve to inform us about the utility of mood profiling in a sporting context in Singapore, providing greater impetus to future researchers to investigate how mood profile clusters and mood profiling may be applied in a range of sport, occupational and health contexts, as well as the advantages or limitations of doing so.

In summary, these three studies were aimed at firstly establishing the factorial validity of the BRUMS for use in a Singaporean context with the production of local norms. Secondly, the present research identified the mood profile clusters present in the local population and the potential meaning and applications of mood profiling in Singapore. Finally, the present research explored the relationship between mood and performance in a group of elite pistol shooters, and explored the applied value of mood profiling for the sport of shooting and how it could be used to enhance pistol shooting performance. The methods, results and discussion of each study are further elaborated in the thesis in the next three chapters.

Overall, these three studies served to extend research in the mood and performance literature. At the time of submission of this thesis, Study 1 has been submitted for publication in the *International Journal Sport and Exercise Psychology* and is undergoing the review process. Study 2 has been published in the *Frontiers in Psychology* in April 2020 (Han,

Parsons-Smith, & Terry, 2020). Study 3 will be written in the format ready for publication though it will not be published in any journal to respect the restrictions within the organisation in which Study 3 was conducted. All raw data collected as part of this PhD project have been archived by the candidate and is available upon request.

Chapter 2: Study 1 – Psychometric Properties of the Brunel Mood Scale among Athletes and Non-Athletes in Singapore

Abstract

Researchers in sport and exercise psychology have shown an enduring interest in mood responses, the study of which relies on well-validated and culturally relevant measures. The current study was a cross-cultural validation of the 24-item Brunel Mood Scale (BRUMS: Terry, Lane, Lane, & Keohane, 1999) in a Singaporean context. The six-factor measurement model was tested among a sample of 1,444 English-speaking Singaporean participants (440 females) aged from 18–65 years, including 954 who were involved in sport. Structural equation modelling showed a good fit of the measurement model to the data (CFI = .956, TLI = .950, RMSEA = .052). Multisample analyses supported the invariance of the measurement model in different subsamples based on gender, age group, and sport participation. Concurrent measures correlated with subscale scores in line with theoretical predictions. Internal consistency and test–retest reliability were acceptable. Mood responses varied predictably by gender, age group, and sport participation. Findings supported the psychometric integrity of the BRUMS, providing opportunities to examine the antecedents, correlates, and behavioural consequences of mood responses among Singaporean samples.

Keywords: affect, emotion, cross-cultural validation, psychometric, PANAS, DASS-21

Introduction

The investigation of mood dimensions has long been a popular area of research in the field of sport and exercise psychology (see LeUnes, 2000), and such research relies heavily on valid measures of the mood construct. Lane and Terry (2000) defined mood as "a set of feelings, ephemeral in nature, varying in intensity and duration, and usually involving more than one emotion" (p. 17). The Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) has been a prominent measure of mood in sport and exercise contexts for several decades (LeUnes & Burger, 1998). Prior to 2000, researchers relied almost exclusively on the POMS to investigate links between various mood dimensions and athletic performance (Beedie, Terry, & Lane, 2000). However, the 65-item POMS requires a relatively lengthy administration time, placing "undue burden" on respondents (Curran, Andrykowski, & Studts, 1995, p. 80). To ameliorate this issue, several truncated versions of the scale were developed. One such derivative of the POMS is the 24-item Brunel Mood Scale (BRUMS; Terry et al., 1999). The BRUMS retained the original multidimensional measurement structure of the POMS, comprising the six subscales of Anger, Confusion, Depression, Fatigue, Tension, and Vigour. Due to its reduced completion time and robust psychometric characteristics, the BRUMS has been applied extensively in the sport and exercise domains for diverse purposes. More specifically, uses in sport include prediction of performance; monitoring athlete mindset; assessing mood responses to poor performance, training load, injury or long haul travel; screening for risk of overtraining, eating disorders and other pathogenic conditions; and finally, as a general catalyst for discussion between athlete and sport psychologist (see Terry & Lane, 2011 for a review). Uses of the BRUMS in the exercise domain include assessment of mood responses to various types of exercise modalities and intensities (e.g., Brandt et al., 2016; Lane, Crone-Grant, & Lane, 2002), and monitoring mood responses to music (e.g., Terry, Karageorghis, Saha, & D'Auria, 2012).

Beyond sport and exercise domains, the BRUMS has been used to screen for post-traumatic stress disorder (van Wijk, Martin, & Hans-Arendse, 2013), monitor the psychological well-being of cardiac rehabilitation patients (Sties et al., 2014), and assess adolescents with elevated suicide risk (Gould et al., 2005). Thus, there is much evidence to support the utility of the BRUMS in applied and clinical settings. The BRUMS has been extensively validated, with tables of normative data available for a variety of populations (e.g., schoolchildren, young athletes, adult athletes, and adult students; Terry, Lane, & Fogarty, 2003; Terry & Lane, 2010).

Furthermore, the BRUMS is one of the few measures of mood to have been translated into several languages and undergone cross-cultural validation. The scale has been validated in Afrikaans (Terry, Potgieter, & Fogarty, 2003), Brazilian Portuguese (Rohlfs et al., 2008), Chinese (Zhang, Si, Chung, Du, & Terry, 2014), Farsi (Terry, Malekshahi, & Delva, 2012), Hungarian (Lane, Soos, Leibinger, Karsai, & Hamar, 2007), Italian (Quartiroli, Terry, & Fogarty, 2017), Malay (Lan, Lane, Roy, & Hanin, 2012), and Spanish (Cañadas, Monleón, Sanchis, Fargueta, & Blasco, 2017).

To date, the scale has not been validated for use in a Singaporean context. According to the island nation's Prime Minister, Lee Hsien Loong, Singapore is "a society where each race is encouraged to preserve its unique culture and traditions, and appreciate and respect those of others" (Salleh, 2017). As 97% of the Singaporean population fall into one of three ethnic groups (Chinese, Malay, Indian), the country represents a unique cultural mix, which may influence how mood is conceptualised and expressed. Given that English is the first language of most Singaporeans, translation of the BRUMS was unnecessary. Therefore, the aim of the current research was to conduct a cross-cultural validation of the BRUMS in its original format to evaluate the psychometric integrity of the measure for use with Singaporean athletes and non-athletes.

Method

Participants

A heterogeneous sample was recruited (N = 1,444; see Table1) with all participants being Singaporean residents. Sixty-nine percent of the respondents (n = 991) identified as male, 31% as female (n = 440), and < 1% as neither (n = 13). The age range of participants was 18–65 years, with a large proportion of the sample (76%) aged between 18 and 30 years. The ethnic distribution of the sample approximated the Singaporean population (Chinese: 81% vs. 74%, Malay: 8% vs. 13%, Indian: 8% vs. 9%, and other: 2% vs. 3%; respectively), as outlined by the Singapore Department of Statistics (2018). The highest education level attained by participants was diverse, ranging from primary school (< 1%) to postgraduate (6%), with 61% having a post-secondary qualification (Junior College, International Baccalaureate, Polytechnic Diploma, or Institute of Technical Education Certification) and 32% having a university or postgraduate qualification.

A total of 65% of respondents participated in sport either for recreation (n = 514) or competitively (n = 431) at an international, regional, inter-scholastic and/or inter-club level. Participants engaged in a wide range of sports, including running, swimming, tennis, volleyball, dragon boat, rugby, cycling, taekwondo, golf, basketball, and powerlifting. A total of 48% (n = 695) of the sample completed an online version of the BRUMS, while the remaining 52% (n = 749) used a paper-and-pen version. Braekman et al. (2018) showed that web-based modes provide, in general, equal responses to paper-and-pen modes for health-related measures. All participants could read and write in English. Table 1 shows the demographic distribution of the sample.

Insert Table 1 about here

Measures

Brunel Mood Scale (BRUMS)

The BRUMS is a 24-item scale comprising basic mood descriptors rated on a 5-point Likert-type scale (0 = *not at all*, 1 = *a little*, 2 = *moderately*, 3 = *quite a bit*, and 4 = *extremely*; Terry et al., 1999; Terry & Lane, 2010). Participants responded using the standard response timeframe of "How do you feel right now?" The measure has six subscales (i.e., Anger, Confusion, Depression, Fatigue, Tension, and Vigour) with each containing four items. Total subscale scores range from 0 to 16. The BRUMS has demonstrated good internal consistency, with Cronbach alpha coefficients ranging from .74 to .90 for each subscale (Terry et al., 1999).

Positive and Negative Affect Schedule (PANAS)

The PANAS (Watson, Clark, & Tellegen, 1988) is a 20-item self-report measure with 10 positive and 10 negative affective descriptors rated on a 5-point Likert-type scale (1 = *not at all*, 2 = *a little*, 3 = *moderately*, 4 = *quite a bit*, 5 = *extremely*). Participants responded using the "How do you feel at the moment?" timeframe. Both positive affect (PA) and negative affect (NA) scores can range from 10 to 50, with higher scores representing higher levels of positive or negative affectivity. The internal consistency coefficients for PA and NA are .87 and .88, respectively, while the 8-week test–retest coefficients are .68 and .71, respectively (Watson et al., 1988).

Depression Anxiety Stress Scales-21 (DASS-21)

The DASS-21 (Henry & Crawford, 2005) is a 21-item scale used in clinical and research settings to assess depression, anxiety, and stress, with items rated on a 4-point Likert-type scale (0 = *did not apply to me at all*, 1 = *applied to some degree, or some of the time*, 2 = *applied to me a considerable degree, or a good part of the time*, 3 = *applied to me very much, or most of the time*). Participants responded to how they have felt "over the past week" (Lovibond & Lovibond, 1995). Each subscale has seven items, with scores ranging from 0 to

21. The factor structure of the DASS-21 was supported for use in six Asian cultures, including Singapore, although the stress subscale included three cross-loading items (Oei, Sawang, Goh, & Mukhtar, 2013).

Procedure

The study was conducted in accordance with the Australian Code for the Responsible Conduct of Research. The protocol was approved by the University of Southern Queensland's Human Research Ethics Committee (approval number: H17REA143). There were two modes of data collection. First, a group of participants recruited from local organisations (e.g., schools and workplaces) completed a paper-and-pen version of the BRUMS. Second, a link to an online version of the BRUMS, hosted on the university's eResearch Survey System, was distributed to a sample of Singapore residents using snowball sampling and assistance from the Singapore Sport Institute. All potential respondents were informed that this was a research study of mood in Singapore. Informed consent was provided by all participants prior to data collection, immediately after they had been introduced to the study and given the option of participating or withdrawing.

Next, to assess test–retest reliability, a random selection of online participants completed the BRUMS on a second occasion. An email requesting a second completion of the BRUMS was sent one week after the first completion, with a reminder email sent a week later, where necessary. To assess concurrent validity, a separate random sample of participants completed all three scales: the BRUMS, PANAS, and DASS-21 on the same occasion. Demographic data (i.e., gender, ethnicity, age group, level of education, sport participation, and level of participation) were also collected.

Data Analysis

A confirmatory factor analysis (CFA) in Amos 25 (Arbuckle, 2017) was used to assess the factorial validity of the BRUMS. CFA is a theory-driven method that uses a collection of estimation techniques and measurement fit indices to test how well the hypothesised model

fits the sample covariance matrix. Good-fitting models tend to produce consistent results on different measures of model fit (Tabachnick & Fidell, 2019). Population parameter estimates were calculated using the maximum likelihood (ML) method, which specified that items were related to their hypothesised factor with the variance of the latent factor fixed at 1. ML is less sensitive to distribution misspecification (Hu & Bentler, 1998) and performs well over other normal-theory-based methods for large samples (Tabachnick & Fidell, 2019). In line with the validation process used by Terry, Lane, and colleagues (1999, 2003), the latent factors of Anger, Confusion, Depression, Fatigue, and Tension, were allowed to inter-correlate positively, and to correlate negatively with Vigour.

To evaluate model adequacy, several fit indices were used. Initially, the popular ratio of χ^2 to degrees of freedom (where a ratio of < 3 represents acceptable fit; Kline, 2015) was considered. However, given that the asymptotic test is a reasonable measure of fit only for models with 75 to 200 cases, and is *always* statistically significant for models with ≥ 400 cases, it was not considered a reliable guide for a sample of this size (Kline, 2015). Consequently, two incremental fit indices were given priority; namely, the comparative fit index (CFI; Bentler, 1990) and the non-normed fit index or Tucker-Lewis index (TLI; Tucker & Lewis, 1973), where values ≥ .90 indicate an acceptable fit. The final index used was the root mean square error of approximation (RMSEA; Steiger, 1990), which indicates the mean discrepancy between the observed covariances and those implied by the model per degree of freedom, where values of .05 or lower indicate a good fit and values up to .08 indicate an acceptable fit (Browne & Cudeck, 1993).

To establish a preliminary table of normative data for use in Singaporean contexts, raw scores on each BRUMS subscale were converted to T-scores, using the standard formula T = 50 + 10z (Tabachnick & Fidell, 2019).

Results

Data Screening

Thirteen cases with missing values were detected and deleted. Data were screened for compliance with the assumptions of univariate and multivariate normality. In common with previous BRUMS datasets (e.g., Parsons-Smith, Terry, & Machin, 2017), significant univariate non-normality was found in some subscales (e.g., Depression, Anger, and Tension) being consistent with typical mood subscale distributions. Negative mood scores tend towards higher numbers at the lower end, and lower numbers at the upper end (Terry et al., 1999). Previous studies involving the BRUMS (e.g., Terry et al., 2003) had also observed non-normality and achieved good model fit without transforming the data. Thus, to ensure comparability with previous validation studies, our data were not transformed prior to analysis.

A total of 45 multivariate outliers were identified using a Mahalanobis distance test ($p < .001$), although a case-by-case inspection found no examples of response bias in the form of acquiescent, extreme, or straight line responding (Leiner, 2019; Meisenberg & Williams, 2008). Hence, all outliers were retained, and a final sample of 1,444 cases was included in the analyses.

Confirmatory Factor Analysis

Results of the CFA to evaluate the original measurement model (i.e., six factors of four items each) indicated an acceptable fit to the data [CFI = .937, TLI = .927, RMSEA = .062], whereas a competing single-factor model (i.e., one factor of 24 items) showed a poor fit [CFI = .609, TLI = .572, RMSEA = .150]. Akaike's information criterion (AIC; Akaike, 1974) reinforced the superiority of the six-factor model (AIC = 1,686.58) over the single-factor model (AIC = 8,574.10) and hence all subsequent analyses were based on the original measurement model.

Modification indices showed that the fit of the original measurement model would improve significantly if the error terms for depressed and downhearted (indicator items of Depression), and sleepy and tired (indicator items of Fatigue) were allowed to co-vary, which was consistent with previous studies (Terry, Lane et al., 2003; Terry, Potgieter et al., 2003). Table 2 shows the resulting improved fit indices: CFI = .956, TLI = .949, RMSEA = .052 [90% CI = .049, .055] and Table 3 shows the standardised factor loadings. All items loaded on target factors and all loadings were above .50, supporting the measurement model. Table 4 shows the descriptive statistics and correlations among the six BRUMS subscales. All subscales with a negative orientation were inter-correlated, as expected, and Vigour scores correlated inversely with all subscales except Tension. Cronbach alpha coefficients for the six subscales were all above .80, exceeding the threshold of acceptability (Nunnally, 1994).

Insert Tables 2, 3, 4, about here

Multisample Analysis

Multisample CFA is a rigorous procedure used to test the generalisability of a measurement model. Its purpose is to assess the extent to which data support hypothesised relationships specified in an *a priori* model across different samples or subsamples simultaneously (Bentler, 1995; Tabachnick & Fidell, 2019). Thus, to test factorial invariance, multisample modelling was conducted on various subsamples, for (1) male vs. female participants, (2) younger (≤ 25 years) vs. older (26+ years) participants, and (3) sport vs. non-sport participants. Grouping participants into younger vs. older using 25 years as the cut-off resulted in approximately equal subsamples (see Table 1). The variance of the latent variables was set to 1, with regression weights of all other pathways left free to vary. Fit statistics for the subsample analyses (see Table 2) showed a good fit of the measurement model to the data, thus supporting factorial validity across subsamples that varied by gender, age group, and

sport participation. Given this evidence of factorial invariance of the BRUMS in the current sample, a preliminary table of raw scores and normative data (see Table 5) was generated from the overall sample to act as a guide for researchers and practitioners using the BRUMS in Singapore. A BRUMS mood profile sheet is also included to facilitate the interpretation of mood scores (see Figure 1).

_____

Insert Table 5 about here

_____

_____

Insert Figure 1 about here

_____

Concurrent Validity and Test–retest Reliability

To assess concurrent validity, a random sample of participants (n = 243) completed all three questionnaires (BRUMS, PANAS, and DASS-21). Relationships among the six subscales of the BRUMS (i.e., Anger, Confusion, Depression, Fatigue, Tension, and Vigour), the two subscales of the PANAS (i.e., PA and NA), and the three subscales of the DASS-21 (i.e., Depression, Stress, and Anxiety) were assessed. Observed relationships were consistent with theoretical predictions (see Table 6).

Effect sizes (Cohen, 1992) were large (i.e., correlations above .50) between the Confusion and Depression subscales of the BRUMS and all three subscales of the DASS-21. A large correlation also emerged between the BRUMS Anger subscale and the DASS-21 Depression subscale, and between the BRUMS Tension subscale and the DASS-21 subscales of Stress and Anxiety. Further, large effects were evident between the Anger, Confusion, Depression, and Tension subscales of the BRUMS and the PANAS NA subscale, and between the PANAS PA subscale and the BRUMS Vigour subscale. These large correlations observed between constructs that were expected to be correlated, represents evidence of convergent validity. The

weak, nonsignificant relationships observed between constructs where no correlation was expected represents evidence of discriminant validity.

Insert Table 6 about here

To assess test–retest reliability of the BRUMS, a random sample of respondents (n = 141) completed the measure twice, with an intervening time period of one to two weeks. Test–retest coefficients for the six subscales of the BRUMS ranged from .44 to .64, which were similar to those reported previously (e.g., Terry et al., 1999) and were judged to be appropriate for a measure of transient feeling states.

Between-Group Comparisons

A series of MANOVAs was performed to test for differences in mood responses when participants were grouped by gender, age group, and sport participation (see Table 7). Males reported more positive moods than females [Hotelling's T = .074, $F(6, 1424) = 17.52$, $p < .001$], with higher Vigour scores coupled with lower Anger, Confusion, Depression, Fatigue, and Tension scores, accounting for 6.9% of the variance. Significant differences in mood responses were also identified for age group [Hotelling's T = .049, $F(6, 1423) = 11.54$, $p < .001$], accounting for 4.6% of the variance. Participants aged ≤ 25 reported higher scores for Confusion, Fatigue, and Tension compared with participants aged 26 and above. Sport participants reported more positive moods than non-participants [Hotelling's T = .037, $F(6, 1423) = 8.86$, $p < .001$], accounting for 3.6% of variance.

Insert Table 7 about here

Discussion

The present study evaluated the factorial validity, concurrent validity, and internal consistency of the BRUMS using an English-speaking Singaporean sample, which included sport and non-sport participants. The six-factor measurement model was clearly identified and fit indices provided evidence of model fit (see Table 2). Further, multisample CFAs showed measurement invariance for the sample grouped by gender, age group, and sport participation. Factor inter-correlations reflected theoretical predictions (see Table 4). Depression was correlated positively with Anger, Confusion, Fatigue, and Tension, while Vigour was correlated inversely with all other BRUMS subscales, except Tension. The absence of a strong negative correlation between Vigour and Tension scores is consistent with the findings of Terry and colleagues (1999). As the partial eta-squared values (see Table 7) were low throughout, this suggests small mean differences between groups and hence one set of norms may be sufficient.

Gender differences in mood responses were identified, wherein males reported moods that were more positive than females, with lower scores for Anger, Confusion, Depression, Fatigue, and Tension, and higher scores for Vigour. This result is consistent with the findings of Cañadas et al. (2017). Mood regulation strategies have been shown to vary by gender, with females more likely to ruminate than males (Nolen-Hoeksema & Jackson, 2001). This may increase the probability of negative mood reports, and indeed females do report feeling depressed, sad, anxious, or nervous more often than males (American Psychological Association, 2012). In addition, the results of Parsons-Smith et al. (2017) showed that males were more likely than females to report an *iceberg* profile (characterised by high Vigour scores together with low scores for Anger, Confusion, Depression, Fatigue, and Tension; Morgan, 1980); whereas females were more likely than males to report an *inverse iceberg* profile (characterised by low Vigour scores together with high scores for Anger, Confusion, Depression, Fatigue, and Tension; Terry, 1995).

In a Singaporean context, women, particularly those aged 18 to 34, have been found to be more prone to depression than men, with a 7.2% lifetime prevalence of major depressive disorder compared with 4.3% among men (Subramaniam et al., 2012). Explanations for this difference offered by Subramaniam and colleagues included hormonal mechanisms, women being more likely to seek help, and social and cultural influences, such as the dual roles that many women occupy at home and at work. The lower prevalence of depression among males was explained by a reluctance of men to discuss personal issues and therefore not presenting for diagnosis.

Lee (2017) summarised how Singaporean society plays a role in shaping coping mechanisms differently for males and females: “the different ways that girls and boys are brought up, the way that our society views the sexes, the powerful influence of media in portraying men and women, and the effect of national service” (p. 1). National service is a key feature of Singaporean society, wherein all male Singaporeans are liable by law from the age of 18 to serve as a full-time national serviceman for a maximum of two years (Singapore Statutes Online, 2020). Leong, Yang, and Ho (2013) found that 97% of respondents agreed with the statement that “national service makes a person more resilient” (p. 13) suggesting that Singaporean men’s experience of national service helped them to develop effective coping skills.

With this understanding of the different life experiences between men and women in Singaporean society, the gender differences in the experience of mood may warrant further cross-cultural comparison. For example, future research could explore if the mood profile clusters previously found in a Western population by Parsons-Smith et al. (2017) are also evident in the Singaporean population. These include the abovementioned *iceberg* (Morgan, 1980) and *inverse iceberg* profiles (Terry, 1995), as well as the more recently identified and theoretically meaningful *inverse Everest*, *shark fin*, *submerged*, and *surface* profiles (Parsons-Smith et al., 2017).

In relation to age, older participants in our study reported lower Confusion, Fatigue, and Tension scores than younger participants. This finding is similar to trends previously reported in investigations of the age-related prevalence of mood profile clusters (Parsons-Smith et al., 2017; Quartiroli et al., 2018). It has been shown that younger adults tend to process negative information more thoroughly than positive information, and place more weight on negative information during impression formation, memory, and decision-making (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001), which may influence their reported mood. Further, in a recent study of mental health in Singapore (Subramaniam et al., 2020), the 18 to 34 age group showed the highest incidence of mental health disorders, which the study authors viewed as reflective of lower stigma and better knowledge of mental health issues among younger adults. These age-related trends in mood responses are worthy of further investigation in a Singaporean context.

Finally, our results showed that participants involved in sport reported more positive moods than those not involved in sport, with significant differences evident on all six subscales. This is consistent with previous literature involving athletic samples (e.g., Terry & Lane, 2000). A meta-analysis by Reed and Ones (2006), summarising 156 studies, demonstrated that aerobic exercise increased positive mood, and Brown et al. (1995) showed that mood enhancements as a result of participating in long-term physical exercise are persistent. From an applied practitioner perspective, a mood measure validated among a Singaporean population supports diverse applications, including (a) monitoring athletes' mood responses to training load, acclimatisation, and injury, (b) as an indicator of general well-being, (c) as a catalyst for discussion (Terry, 1995); and (d) as a self-monitoring tool to reduce risk of overtraining (Lovell, 2004; Rohlfs et al., 2008). For example, considering the maladaptive psychological effects of sedentary behaviours (e.g., Proper, Singh, van Mechelen, & Chinapaw, 2011; Teychenne, Costigan, & Parker, 2015), practitioners and clinicians might consider ways to promote physical activity to inactive clients, and to encourage the

maintenance of physical activity among active clients. From a research perspective, future research could investigate how mood responses and mood regulation strategies compare between exercisers and non-exercisers, and the potential positive and negative effects of mood states on performance. Further, the BRUMS is an easy-to-administer mood assessment in time-limited environments (e.g., during the pre-competition or competition phase at sport events), and the information obtained can be used as part of an individualised intervention to promote optimal performance.

It should be acknowledged that the POMS, the measure upon which the BRUMS is based, has been criticised by some researchers. LeUnes and Burger (2000), for example, argued that the POMS is limited because it considers primarily negative mood states, largely ignoring the role of positive mood states other than vigour. Ekkekakis (2012) similarly expressed concern that the POMS was a limited measure of the global domain of mood. However, self-report measures of moods, including the POMS and the BRUMS, have been shown to be more sensitive indicators of well-being than objective physiological measures (Saw, Main, & Gastin, 2016). Also, several studies have shown the negative mood dimensions assessed by the BRUMS to be significant predictors of athletic performance (see Beedie et al., 2000) and athletic injury (Galambos, Terry, Moyle, & Locke, 2005). It is evident that the BRUMS is a useful measure of a specific set of mood dimensions despite limitations as a measure of the global domain of mood.

Conceptual and methodological concerns have also been expressed about the PANAS (see Ekkekakis, 2013) and a recent article by Lee, Hartono, Yong, Koh, and Leung (2020), published since our study was conducted, identified measurement noninvariance associated with the PANAS in a Singaporean context, meaning that the two-factor measurement model (PA and NA) was unstable. Hence, future studies should consider using an alternative to PANAS in order to establish concurrent validity.

Overall, our findings provide support for the factorial validity of the BRUMS for use in a Singaporean context. The psychometric integrity of the scale provides opportunities for further investigation of the antecedents, correlates, and behavioural consequences of mood responses among athletes and non-athletes in Singapore.

Acknowledgements

The authors thank the Singapore Sport Institute and Dr. Emily Ortega for assistance with data collection.

References

Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control, 19,* 716–723. doi:10.1109/TAC.1974.1100705

American Psychological Association (2012). *Stress by gender*. Retrieved from https://www.apa.org/news/press/releases/stress/2012/gender-report.pdf

Arbuckle, J. L. (2017). Amos (Version 25.0) [Computer Program]. Chicago, IL: IBM SPSS.

Baumeister, R., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology, 5,* 323–370. doi:10.1037/1089-2680.5.4.323

Beedie, C. J., Terry, P. C., & Lane, A. M. (2000). The profile of mood states and athletic performance: Two meta-analyses. *Journal of Applied Sport Psychology, 12,* 49–68. doi:10.1080/10413200008404213

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107,* 238–246. doi:10.1037/0033-2909.107.2.238

Bentler, P. M. (1995). *EQS structural equation program manual*. Los Angeles, CA: BMDP Statistical Software.

Braekman, E., Berete, F., Charafeddine, R., Demarest, S., Drieskens, S., Gisle, L., … & Van Hal, G. (2018). Measurement agreement of the self-administered questionnaire of the Belgian Health Interview Survey: Paper-and-pencil versus web-based mode. *PLoS ONE, 13,* e0197434. doi:10.1371/journal.pone.0197434

Brandt, R., Herrero, D., Massetti, T., Crocetta, T. B., Guarnieri, R., de Mello Monteiro, C. B., ... & Andrade, A. (2016). The Brunel Mood Scale rating in mental health for physically active and apparently healthy populations. *Health, 8,* 125–132. doi:10.4236/health.2016.82015

Brown, D. R., Wang, Y., Ward, A., Ebbeling, C. B., Fortlage, L., Puleo, E., … & Rippe, J. M. (1995). Chronic psychological effects of exercise and exercise plus cognitive strategies. *Medicine & Science in Sports & Exercise, 27,* 765–775.

doi:10.1249/00005768-199505000-00021

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 132–162). Newbury Park, CA: Sage.

Cañadas, E., Monleón, C., Sanchis, C., Fargueta, M., & Blasco, E. (2017). Spanish validation of BRUMS in sporting and non-sporting populations. *European Journal of Human Movement, 38,* 105–117. Retrieved from http://www.eurjhm.com/index.php/eurjhm/article/view/413/608

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155–159. doi:10.1037/0033-2909.112.1.155

Curran, S. L., Andrykowski, M. A., & Studts, J. L. (1995). Short form of the Profile of Mood States (POMS-SF): Psychometric information. *Psychological Assessment, 7,* 80–83. Retrieved from https://psycnet.apa.org/buy/1995-27722-001

Ekkekakis, P. (2012). The measurement of affect, mood, and emotion in exercise psychology. In G. Tenenbaum, R. C. Eklund, & A. Kamata (Eds.), *Measurement in sport and exercise psychology* (pp. 321–332). Champaign, IL: Human Kinetics.

Ekkekakis, P. (2013). *The measurement of affect, mood, and emotion: A guide for health-behavioral research*. New York, NY: Cambridge University Press.

Galambos, S. A., Terry, P. C., Moyle, G. M., & Locke, S. A. (2005). Psychological predictors of injury among elite athletes. *British Journal of Sports Medicine, 39,* 351–354. doi:10.1136/bjsm.2005.018440

Gould, M. S., Marrocco, F. A., Kleinman, M., Thomas, J. G., Mostkoff, K., Côté, J., & Davies, M. (2005). Evaluating iatrogenic risk of youth suicide screening programs: A randomized controlled trial. *Journal of the American Medical Association, 29,* 1635–1643. doi:10.1001/jama.293.13.1635

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 44,* 227–239. doi:10.1348/014466505X29657

Hu, L. T., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterised model misspecification. *Psychological Methods, 3,* 424. Retrieved from http://dx.doi.org/10.1037/1082-989X.3.4.424

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. New York, NY: Guilford.

Lan, M. F., Lane, A. M., Roy, J., & Hanin, N. A. (2012). Validity of the Brunel Mood Scale for use with Malaysian athletes. *Journal of Sports Science and Medicine, 11,* 131–135. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3737843/

Lane, A. M., Crone-Grant, D., & Lane, H. (2002). Mood changes following exercise. *Perceptual and Motor Skills, 94,* 732–734. doi:10.2466/pms.2002.94.3.732

Lane, A. M., Soos, I., Leibinger, E., Karsai, I., & Hamar, P. (2007). Validity of the Brunel Mood Scale for use with UK, Italian and Hungarian athletes. In A. M. Lane (Ed.), *Mood and human performance: Conceptual, measurement, and applied issues* (pp. 119–130). Hauppauge, NY: Nova Science.

Lane, A. M., & Terry, P. C. (2000). The nature of mood: Development of a conceptual model with a focus on depression. *Journal of Applied Sport Psychology, 12,* 16–33. doi:10.1080/10413200008404211

Lee, S. T. H., Hartanto, A., Yong, J. C., Koh, B., & Leung, A. K. Y. (2020). Examining the cross-cultural validity of the Positive Affect and Negative Affect Schedule between an Asian (Singaporean) sample and a Western (American) sample. *Asian Journal of Social Psychology, 23,* 109–116. doi:10.1111/ajsp.12390

Leiner, D. J. (2019). Too fast, too straight, too weird: Non-reactive indicators for meaningless data in Internet surveys. *Survey Research Methods, 13,* e7403. doi:10.18148/srm/2018.v13i3.7403

Leong, C. W., Yang, W. H., & Ho, H. (2013). Singaporeans' attitudes to national service. *Lee Kuan Yew School of Public Policy, National University of Singapore*. Retrieved from https://lkyspp.nus.edu.sg/docs/default-source/ips/ns-study-8-oct-2013_web.pdf

LeUnes, A. (2000). Updated bibliography on the Profile of Mood States in sport and exercise psychology research. *Journal of Applied Sport Psychology, 12,* 110–113. doi:10.1080/10413200008404216

LeUnes, A., & Burger, J. (1998). Bibliography on the Profile of Mood States in sport and exercise, 1971–1995. *Journal of Sport Behaviour, 21,* 53–70.

Lee, T. (2017, Dec 4). Singapore women more likely to suffer from depression than men: IMH study. *Today Online.* Retrieved from https://www.todayonline.com/singapore/spore-women-more-likely-suffer-depression-men-imh-study

Lovell, G. (2004). Mood states and overtraining. In D. Lavalle, J. Thatcher, & M. V. Jones (Eds.), *Coping and emotion in sport* (pp. 55–73). Hauppauge, NY: Nova Science.

Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales (DASS)*. Sydney, NSW: Psychology Foundation Monograph.

McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *Manual for the Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Services.

Meisenberg, G., & Williams, A. (2008). Are acquiescent and extreme response styles related to low intelligence and education? *Personality and Individual Differences, 44,* 1539–1550. doi:10.1016/j.paid.2008.01.010

Morgan, W. P. (1980). Test of champions: The iceberg profile. *Psychology Today, 14*, 92–99.

Nolen-Hoeksema, S., & Jackson, B. (2001). Mediators of the gender difference in rumination. *Psychology of Women Quarterly, 25,* 37–47. https://doi.org/10.1111/1471-6402.00005

Nunnally, J. C. (1994*). Psychometric theory* (3rd ed.). New York, NY: McGraw-Hill.

Oei, T. P., Sawang, S., Goh, Y. W., & Mukhtar, F. (2013). Using the Depression Anxiety Stress Scale-21 (DASS-21) across cultures. *International Journal of Psychology, 48,* 1018–1029. doi:10.1080/00207594.2012.755535

Parsons-Smith, R. L., Terry, P. C., & Machin, M. A. (2017). Identification and description of novel mood profile clusters. *Frontiers in Psychology, 8,* e1958. doi:10.3389/fpsyg.2017.01958

Proper, K. I., Singh, A. S., van Mechelen, W., & Chinapaw, M. J. (2011). Sedentary behaviours and health outcomes among adults: A systematic review of prospective studies. *American Journal of Preventive Medicine, 40,* 174–182. https://doi.org/10.1016/j.amepre.2010.10.015

Quartiroli, A., Terry, P. C., & Fogarty, G. J. (2017). Development and initial validation of the Italian Mood Scale (ITAMS) for use in sport and exercise contexts. *Frontiers in Psychology, 8,* e1483. doi:10.3389/fpsyg.2017.01483

Quartiroli, A., Parsons-Smith, R. L., Fogarty, G. J., Kuan, G., & Terry, P. C. (2018). Cross-cultural validation of mood profile clusters in a sport and exercise context. *Frontiers in Psychology, 9,* 1949. https://doi.org/10.3389/fpsyg.2018.01949

Reed, J., & Ones, D. S. (2006). The effect of acute aerobic exercise on positive activated affect: A meta-analysis. *Psychology of Sport and Exercise, 7,* 477–514. doi:10.1016/j.psychsport.2005.11.003

Rohlfs, I. C. P. M., Rotta, T. M., Luft, C. B., Andrade, A., Krebs, R. J., & Carvalho, T. (2008). Brunel Mood Scale (BRUMS): An instrument for early detection of overtraining syndrome. *Brazilian Journal of Sports Medicine, 14,* 176–181. doi:10.1590/S1517-86922008000300003

Salleh, N. A. M. (2017, May 20). Singaporeans have evolved a distinctive identity: PM Lee Hsien Loong. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/singaporeans-have-evolved-a-distinctive-identity-pm

Saw, A. E., Main, L. C., & Gastin, P. B. (2016). Monitoring the athlete training response: Subjective self-reported measures trump commonly used objective measures: A systematic review. *British Journal of Sports Medicine, 50,* 281–291. doi:10.1136/bjsports-2015-094758

Singapore Department of Statistics (2018). *Population trends 2018* (ISSN 2591-8028). Department of Statistics: Ministry of Trade and Industry, Republic of Singapore.

Singapore Statutes Online (2020). *The enlistment act (Chapter 93).* Retrieved from https://sso.agc.gov.sg/Act/EA1970

Subramaniam, M., Vaingankar, J., Heng, D., Kwok, K. W., Lim, Y. W., Yap, M., & Chong, S. A. (2012). The Singapore Mental Health Study: An overview of the methodology. *International Journal of Methods in Psychiatric Research, 21,* 149–157. doi:10.1002/mpr.1351

Subramaniam, M., Abdin, E., Vaingankar, J. A., Shafie, S., Chua, B. Y., Sambasivam, R., ... & Verma, S. (2020). Tracking the mental health of a nation: Prevalence and correlates of mental disorders in the second Singapore Mental Health Study. *Epidemiology and Psychiatric Sciences, 29,* 1–10. doi:10.1017/ S2045796019000179

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioural Research, 25,* 173–180. https://doi.org/10.1207/s15327906mbr2502_4

Sties, S. W., Gonzáles, A. I., Netto, A. S., Wittkopf, P. G., Lima, D. P., & de Carvalho, T. (2014). Validation of the Brunel Mood Scale for cardiac rehabilitation program. *Brazilian Journal of Sports Medicine, 20,* 281–284. doi:10.1590/ 1517-86922014200401999

Tabachnick, B. L., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). Boston, MA: Pearson Education.

Terry, P. C. (1995). The efficacy of mood state profiling with elite performers: A review and synthesis. *The Sport Psychologist, 9,* 309–324. doi:10.1123/tsp.9.3.309

Terry, P. C., Karageorghis, C. I., Saha, A. M., & D'Auria, S. (2012). Effects of synchronous music on treadmill running among elite triathletes. *Journal of Science and Medicine in Sport, 15,* 52–57. doi:10.1016/j.jsams.2011.06.003

Terry, P. C., & Lane, A. M. (2000). Development of normative data for the Profile of Mood States for use with athletic samples. *Journal of Applied Sport Psychology, 12,* 69–85. doi:10.1080/10413200008404215

Terry, P. C., & Lane, A. M. (2010). *User guide for the Brunel Mood Scale*. Toowoomba, QLD: Peter Terry Consultants.

Terry, P. C., & Lane, A. M. (2011). Mood and emotions. In T. Morris & P. C. Terry (Eds.), *The new sport and exercise psychology companion* (pp. 63–87). Morgantown, WV: Fitness Information Technology.

Terry, P. C., Lane, A. M., & Fogarty, G. J. (2003). Construct validity of the Profile of Mood States–Adolescents for use with adults. *Psychology of Sport and Exercise, 4,* 125–139. doi:10.1016/S1469-0292(01)00035-8

Terry, P. C., Lane, A. M., Lane, H. J., & Keohane, L. (1999). Development and validation

of a mood measure for adolescents. *Journal of Sports Sciences, 17,* 861–872. doi:10.1080/026404199365425

Terry, P. C., Malekshahi, M., & Delva, H. A. (2012). Development and initial validation of the Farsi Mood Scale. *International Journal of Sport and Exercise Psychology, 10,* 112–122. doi:10.1080/1612197X.2012.645133

Terry, P. C., Potgieter, J. R., & Fogarty, G. J. (2003). The Stellenbosch Mood Scale: A dual-language measure of mood. *International Journal of Sport and Exercise Psychology, 1,* 231–245.doi:10.1080/1612197X.2003.9671716

Teychenne, M., Costigan, S.A. & Parker, K. (2015). The association between sedentary behaviour and risk of anxiety: A systematic review. *BMC Public Health, 15,* 513. https://doi.org/10.1186/s12889-015-1843-x

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38,* 1–10. doi:10.1007/BF02291170

van Wijk, C. H., Martin, J. H., & Hans-Arendse, C. (2013). Clinical utility of the Brunel Mood Scale in screening for post-traumatic stress risk in a military population. *Military Medicine, 178,* 372–376. doi:10.7205/MILMED-D-12-00422

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063–1070. doi:10.1037/0022-3514.54.6.1063

Zhang, C. Q., Si, G., Chung, P. K., Du, M., & Terry, P. C. (2014). Psychometric properties of the Brunel Mood Scale in Chinese adolescents and adults. *Journal of Sports Sciences, 32,* 1465–1476. doi:10.1080/02640414.2014.898184

Table 1

Demographic Distribution of the Sample (N = 1,444)

Source	Group	*n*	%
Gender	Male	991	68.6%
	Female	440	30.5%
	Unspecified	13	≤ 1%
Ethnicity	Chinese	1163	80.5%
	Malay	119	8.2%
	Indian	118	8.2%
	Other	31	2.1%
	Unspecified	13	≤ 1%
Age Group	≤ 25 years	763	52.8%
	26+ years	667	46.2%
	Unspecified	14	≤ 1%
Level of Education	Primary & Secondary	70	4.8%
	JC/IB/Poly/ITE*	873	60.5%
	University	370	25.6%
	Postgraduate	93	6.4%
	Other	18	1.2%
	Unspecified	20	1.4%
Sport Participation	Yes	954	66.1%
	No	476	33.0%
	Unspecified	14	≤ 1%
Level of Participation	Recreational	514	35.6%
	School & Club	339	23.5%
	Regional & International	92	6.4%
	Unspecified	9	≤ 1%
	Not Applicable	490	33.9%
Mode of Administration	Online	695	48.1%
	Paper-pencil	749	51.9%

Note. *JC = Junior College; IB = International Baccalaureate; Poly = Polytechnic Diploma; ITE = Institute of Technical Education Certification.

Table 2

Model Testing of the BRUMS (N = 1,444)

Group	χ^2	*df*	CFI	TLI	RMSEA	90% CI
Full sample one-factor	8478	252	.609	.572	.150	[.148, .153]
Full sample six-factor	1561	237	.937	.927	.062	[.059, .065]
Full sample six-factor modified	1157	235	.956	.949	.052	[.049, .055]
Subsamples (Gender)	1871	496	.933	.925	.044	[.042, .046]
Subsamples (Age Group)	1806	474	.937	.926	.044	[.042, .047]
Subsamples (Sport Participation)	1548	494	.950	.944	.038	[.036, .041]

Note. CFI = Comparative fit index, TLI = Tucker-Lewis index, RMSEA = Root mean square error of approximation, CI = Confidence interval. Full sample (*N* = 1,444), Subsamples: Male (*n* = 991) vs. Female (*n* = 440); Subsamples: Age < 26 yr. (*n* = 763) vs. Age 26+ yr. (*n* = 667); Subsamples: Sport (*n* = 954) vs. Non-sport (*n* = 476).

Table 3

Standardised Factor Loadings of the BRUMS (N = 1,444)

	Factors					
Items	Anger	Confusion	Depression	Fatigue	Tension	Vigour
Annoyed	0.77					
Bitter	0.73					
Angry	0.76					
Bad tempered	0.70					
Confused		0.69				
Mixed up		0.76				
Muddled		0.71				
Uncertain		0.74				
Depressed			0.78			
Downhearted			0.79			
Unhappy			0.88			
Miserable			0.76			
Worn out				0.86		
Exhausted				0.91		
Sleepy				0.62		
Tired				0.78		
Panicky					0.76	
Anxious					0.85	
Worried					0.82	
Nervous					0.79	
Lively						0.74
Energetic						0.89
Active						0.82
Alert						0.52

Table 4

Descriptive Statistics, Reliabilities, and Intercorrelations Among BRUMS Subscales (N = 1,444)

Subscale	*M*	*SD*	Range	T-score	*α*	2	3	4	5	6
Anger	1.69	2.63	0–16	44–97	0.82	0.63**	0.75**	0.46**	0.51**	-0.04
Confusion	2.75	3.00	0–16	42–94	0.81		0.68**	0.49**	0.68**	-0.02
Depression	2.10	3.07	0–16	43–98	0.89			0.52**	0.52**	-0.16**
Fatigue	6.47	4.21	0–16	38–74	0.89				0.37**	-0.26**
Tension	2.90	3.32	0–16	42–103	0.88					0.07*
Vigour	6.49	3.52	0–16	34–77	0.83					

Note. $^{*}p < .05$, $^{**}p < .01$.

Table 5

Standard Scores for the BRUMS (N = 1,444)

Raw Score	Anger	Confusion	Depression	Fatigue	Tension	Vigour
0	44	41	43	35	41	32
1	47	44	46	37	44	34
2	51	48	50	39	47	37
3	55	51	53	42	50	40
4	59	54	56	44	53	43
5	63	58	59	46	56	46
6	66	61	63	49	59	49
7	70	64	66	51	62	51
8	74	68	69	54	65	54
9	78	71	72	56	68	57
10	82	74	76	58	71	60
11	85	78	79	61	74	63
12	89	81	82	63	77	66
13	93	84	85	66	80	69
14	97	88	89	68	83	71
15	100	91	92	70	86	74
16	104	94	95	73	89	77

Table 6

Descriptive Statistics and Reliabilities for PANAS and DASS-21 Subscales, and Correlations with BRUMS Subscales (n = 243)

	PANAS-NA	PANAS-PA	DASS-Dep	DASS-Str	DASS-Anx
M	16.30	22.27	6.26	7.30	4.88
SD	7.12	8.22	5.10	4.61	3.89
Range	10–50	10–45	0–21	0–21	0–21
α	0.91	0.92	0.90	0.85	0.79
Anger	0.72**	-0.11	0.54**	0.49**	0.37**
Confusion	0.76**	-0.09	0.58**	0.61**	0.57**
Depression	0.75**	-0.22**	0.73**	0.62**	0.56**
Fatigue	0.45**	-0.17**	0.40**	0.46**	0.39**
Tension	0.79**	0.03	0.48**	0.60**	0.62**
Vigour	-0.11	0.80**	-0.26**	-0.17**	-0.12

Note. $^{*}p < .05$ (two-tailed), $^{**}p < .01$ (two-tailed).

Table 7

MANOVAs of BRUMS Subscale Scores by Gender, Age Group, and Sport Participation

Gender (N =1,431)						
	Male (n = 991)		Female (n = 440)			
Subscale	*M*	*SD*	*M*	*SD*	*F*	Partial η^2
Anger	1.39	2.30	2.39	3.16	45.16†	.03
Confusion	2.53	2.77	3.25	3.42	17.61†	.01
Depression	1.66	2.73	3.08	3.55	67.68†	.05
Fatigue	5.92	3.98	7.70	4.45	56.23†	.04
Tension	2.78	3.23	3.20	3.52	4.87*	.00
Vigour	6.83	3.52	5.77	3.40	28.37†	.02
Age Group (N = 1,430)						
	Age ≤ 25 yr. (n = 763)		Age 26+ yr. (n = 667)			
Subscale	*M*	*SD*	*M*	*SD*	*F*	Partial η^2
Anger	1.60	2.48	1.81	2.80	2.27	.00
Confusion	3.02	3.06	2.44	2.91	13.14†	.01
Depression	2.09	2.99	2.11	3.17	0.21	.00
Fatigue	6.73	4.18	6.17	4.22	6.44*	.00
Tension	3.35	3.59	2.41	2.92	29.24†	.02
Vigour	6.41	3.57	6.61	3.45	1.19	.00
Sport Participation (N = 1,430)						
	Participant (n = 954)		Non-participant (n = 476)			
Subscale	*M*	*SD*	*M*	*SD*	*F*	Partial η^2
Anger	1.50	2.45	2.08	2.94	15.31†	.01
Confusion	2.63	2.92	2.99	3.16	4.59*	.00
Depression	1.86	2.87	2.57	3.40	17.33†	.01
Fatigue	6.23	4.03	6.94	4.52	9.05**	.01
Tension	2.71	3.15	3.31	3.64	10.39†	.01
Vigour	6.86	3.54	5.78	3.35	30.89†	.02

Note. $^{*}p < .05$, $^{**}p < .01$, $^{\dagger}p < .001$.

Figure 1

Normative Data for Use with Singaporean Athletes and Non-athletes

T-Score	FACTOR						T-Score
	Tension	Depression	Anger	Vigour	Fatigue	Confusion	
90+							90+
89	16	14	12				89
88						14	88
87							87
86	15						86
85		13	11				85
84						13	84
83	14						83
82		12	10				82
81						12	81
80	13						80
79		11					79
78			9			11	78
77	12			16			77
76		10					76
75							75
74	11		8	15		10	74
73					16		73
72		9					72
71	10			14		9	71
70			7		15		70
69		8		13			69
68	9				14	8	68
67							67
66		7	6	12	13		66
65	8						65
64						7	64
63		6	5	11	12		63
62	7						62
61					11	6	61
60				10			60
59	6	5	4				59
58					10	5	58
57				9			57
56	5	4			9		56
55			3				55
54				8	8	4	54
53	4	3					53
52							52
51			2	7	7	3	51
50	3	2					50
49				6	6		49
48						2	48
47	2		1				47
46		1		5	5		46
45							45
44	1		0		4	1	44
43		0		4			43
42					3		42
41	0					0	41
40				3			40
39					2		39
38							38
37				2	1		37
36							36
35					0		35
34				1			34
33							33
32				0			32
31							31
30							30

Chapter 3: Study 2 – Mood Profiling in Singapore: Cross-Cultural Validation and Potential Applications of Mood Profile Clusters

frontiers in Psychology

ORIGINAL RESEARCH
published: 09 April 2020
doi: 10.3389/fpsyg.2020.00665

Mood Profiling in Singapore: Cross-Cultural Validation and Potential Applications of Mood Profile Clusters

Christie S. Y. Han[1], Renée L. Parsons-Smith[1,2] and Peter C. Terry[3]*

[1] School of Psychology and Counselling, University of Southern Queensland, Toowoomba, QLD, Australia, [2] School of Social Sciences, University of the Sunshine Coast, Sippy Downs, QLD, Australia, [3] Division of Research and Innovation, University of Southern Queensland, Toowoomba, QLD, Australia

Mood profiling is a popular method of quantifying and classifying feeling states. Previous research has identified several novel mood profiles in predominantly Western English-speaking populations (Parsons-Smith et al., 2017), and replicated the findings in the domain of sport and exercise (Quartiroli et al., 2018; Terry and Parsons-Smith, 2019). The aim of the current study was to investigate if six hypothesized clusters of mood responses were evident in a population of English-speaking sport and non-sport participants in Singapore. A seeded k-means cluster analysis was applied to the mood responses of 1,444 participants (991 male, 440 female, 13 unspecified; aged 18–65 years) who completed the Brunel Mood Scale (BRUMS; Terry et al., 1999, 2003a). The six hypothesized mood profiles (i.e., iceberg, inverse Everest, inverse iceberg, shark fin, submerged, and surface profiles) were identified clearly. Chi-squared analyses showed unequal distribution of the profiles by gender, age group, ethnicity, education level, and sport participation. Findings support the cross-cultural generalizability of the six mood profiles in English-speaking sport and non-sport samples in Singapore and contribute to investigation into the antecedents, correlates, and consequences of each mood profile.

Keywords: affect, emotion, cluster analysis, mood profiling, BRUMS

OPEN ACCESS

Edited by:
Ingo Wagner,
Karlsruhe Institute of Technology (KIT), Germany

Reviewed by:
Charles Van Wijk,
Stellenbosch University, South Africa
Ricardo Brandt,
Universidade Estadual do Oeste do Paraná, Brazil

****Correspondence:***
Christie S. Y. Han
hsychristie@gmail.com

Specialty section:
This article was submitted to Movement Science and Sport Psychology, a section of the journal Frontiers in Psychology

Received: *05 February 2020*
Accepted: *19 March 2020*
Published: *09 April 2020*

Citation:
Han CSY, Parsons-Smith RL and Terry PC (2020) Mood Profiling in Singapore: Cross-Cultural Validation and Potential Applications of Mood Profile Clusters. Front. Psychol. 11:665. doi: 10.3389/fpsyg.2020.00665

INTRODUCTION

Sport psychologists have long been interested in the study of mood and its relationship with performance. For the purpose of our investigation, mood is defined as "a set of feelings, ephemeral in nature, varying in intensity and duration, and usually involving more than one emotion" (Lane and Terry, 2000, p. 17). Morgan (1980) reported that mood responses were predictive of athletic performance and developed a mental health model proposing that positive mood is associated with psychological well-being and athletic success, whereas negative mood is associated with psychopathology and poor performance (Morgan, 1985). The notion that the *iceberg* profile, a pattern of mood responses characterized by above average vigor and below average tension, depression, anger, fatigue, and confusion, was the "test of champions" (Morgan, 1980) gained much traction and spawned a large body of research on the subject (see Rowley et al., 1995; Beedie et al., 2000). Research subsequently showed that the iceberg profile was the

typical mood profile reported by athletes, successful or otherwise, and hence its predictive effectiveness may be more limited than previously claimed (Renger, 1993; Terry and Lane, 2000).

Athletic performance for some individuals is closely related to mood but this is not the case for other individuals (Totterdell, 1999; Lane and Chappell, 2001) and therefore the utility of mood profiling for predicting performance may rely on the individualized assessment of idiosyncratic mood-performance relationships (Terry, 1995). Other applications of mood profiling in sport include assessing risk of burnout by overtraining (Morgan et al., 1987), screening for risk of eating disorders (Terry and Galambos, 2004), quantifying the beneficial effects of music (Terry et al., 2020), and as a catalyst for discussion between practitioner and athlete to gain insights into performance and well-being (Terry, 1995).

In addition to the iceberg profile, other distinct mood profiles have been identified. The *inverse iceberg* profile, characterized by below average scores for vigor and above average scores for tension, depression, anger, fatigue, and confusion, has been shown to be associated with reduced performance (Budgett, 1998), higher occurrence of athletic injury (Galambos et al., 2005), and risk of mental health disorders (van Wijk et al., 2013). The *Everest* profile, a more prominent iceberg profile characterized by higher vigor scores, and lower tension, depression, anger, fatigue, and confusion scores, is anecdotally associated with superior performance (Terry, 1995).

More recent studies (Parsons-Smith et al., 2017; Quartiroli et al., 2018) have identified new profiles, referred to as the *inverse Everest*, *surface*, *shark fin*, and *submerged* profiles. As described by Parsons-Smith et al. (2017, pp. 4–5), the inverse Everest profile is characterized by low vigor scores, high scores for tension and fatigue, and very high scores for depression, anger, and confusion. The surface profile is characterized by average scores for all six mood dimensions. The shark fin profile is characterized by below average scores for tension, depression, anger, vigor, and confusion, combined with a high score for fatigue. The submerged profile is characterized by below average scores for all six mood dimensions.

To date, research on mood profile clusters has been limited largely to Western populations. In order to demonstrate the cross-cultural stability and generalizability of clusters, it is necessary to identify them in different cultures. Singapore is a multicultural society whose citizens are mainly of Asian descent, with the main ethnic groups being Chinese, Malay, and Indian. Singapore's multiculturalism is reflected in its official documents and public signs, which are available in English, Mandarin, Malay, and Tamil. English is the official language of the country, largely due to acculturation from previous British colonial rule; hence English serves as the official medium of instruction in schools and businesses (Tanzer et al., 1996). As such, the large majority of Singaporeans, especially those educated in the public schools since the 1980s, are fluent in the English language.

Our study had two aims: (1) To examine if mood profile clusters previously reported are also evident in the general Singapore English-speaking population; and (2) to examine the distribution of distinct mood profiles across various demographic variables of interest. Retrieving the hypothesized mood profile clusters in a Singaporean sample will provide further support for the validity and generalizability of these mood profiles, demonstrating their cross-cultural replicability. Mood profiling as an applied technique has considerable potential for practitioners to examine relationships between mood and various outcomes of interest in clinical as well as non-clinical settings. Clarification of the distribution of mood profiles in relation to various demographic variables may provide insights into the design and implementation of potential interventions and programs to better serve various segments of the Singaporean population. Results from this study set the stage for further research in Singapore to explore the practical, clinical, and theoretical implications of mood profiling.

MATERIALS AND METHODS

Participants

A total of 1,444 Singapore residents participated in the study (991 male, 440 female, 13 unspecified; age range: 18–65 years). The ethnic distribution of participants was 80.5% Chinese, 8.2% Malay, 8.2% Indian, and 2.1% other, which approximates the ethnic distribution of Singapore as a whole (Department of Statistics Singapore, 2018). All participants could read and write in English, which is the first language of most Singaporeans. A total of 65.4% (n = 945) of respondents participated in sport either for leisure (n = 514) or competitively (n = 431). **Table 1** presents the sample demographics.

Measures

Participants reported relevant demographic information (gender, age band, ethnicity, education level, sport participation, participation level) and completed a mood scale. Mood was assessed using the Brunel Mood Scale (BRUMS; Terry et al., 1999, 2003a), a 24-item scale of basic mood descriptors, in its original format with the recommended response timeframe of "How do you feel right now?" (Terry et al., 2005). Participants rated their responses on a five-point Likert scale (0 = *not at all*, 1 = *a little*, 2 = *moderately*, 3 = *quite a bit*, and 4 = *extremely*). The measure has six subscales (i.e., anger, confusion, depression, fatigue, tension, and vigor) each with four items, with total subscale scores ranging from 0 to 16. No total mood disturbance scores were calculated, as the focus of the study was on the profiles generated from the six subscale scores. The BRUMS has been validated across diverse cultures (e.g., Terry et al., 2003b; Zhang et al., 2014) and contexts (e.g., van Wijk et al., 2013; Sties et al., 2014). Subscales show good internal consistency, with Cronbach alpha coefficients ranging from 0.74 to 0.90 (Terry et al., 1999). Cross-cultural assessment of the BRUMS has supported it as a valid measure of mood in the Singaporean context, and local norms are available (Han et al., 2019).

Procedure

Two methods of data collection were used to recruit English-speaking Singaporean participants. First, a link to an online version of the BRUMS, hosted on the university's eResearch

TABLE 1 | Sample demographics (N = 1,444).

Source	*n*	%
Gender		
Male	991	68.6
Female	440	30.5
Unspecified	13	<1
Age band		
18–21	507	35.1
22–25	256	17.7
26–30	336	23.3
31–35	140	9.7
36–40	75	5.2
41–45	34	2.4
46–50	22	1.5
51–55	24	1.7
>55	36	2.5
Unspecified	14	1.0
Age group		
≤25 years	763	52.8
26+ years	667	46.2
Unspecified	14	1.0
Ethnicity		
Chinese	1163	80.5
Malay	119	8.2
Indian	118	8.2
Other	31	2.1
Unspecified	13	<1
Education level		
Primary/Secondary	70	4.8
JC/IB/Poly/ITE[#]	873	60.5
University	370	25.6
Postgraduate	93	6.4
Other	18	1.2
Unspecified	20	1.4
Sport participation		
Sport	954	66.1
Non-sport	476	33.0
Unspecified	14	1.0
Participation level		
Recreational	514	35.6
School/Club	339	23.5
Regional/International	92	6.4
Unspecified	9	<1

[#]*JC, Junior College; IB, International Baccalaureate; Poly, Polytechnic Diploma; ITE, Institute of Technical Education Certification.*

Survey System was distributed to a sample of Singapore residents using snowball sampling and assistance from the Singapore Sport Institute, which produced a sample of 695 respondents (48.1% of the total sample). A second group of participants was recruited at random from a range of organizations (e.g., schools and workplaces) who completed a paper-and-pencil version of the BRUMS. Participants were informed they were part of a research study aimed at validating a mood scale for use in Singapore, and their informed consent was sought prior to participation in the study. This study was conducted in accordance with the Australian Code for the Responsible Conduct of Research. The protocol was approved by the Human Research Ethics Committee at the University of Southern Queensland (USQ; approval number: H17REA143).

Data Screening

A total of 13 cases with missing values for the BRUMS were excluded from the analysis. Data were screened for compliance with the assumptions of univariate and multivariate normality. Like previous samples (Parsons-Smith et al., 2017), significant univariate non-normality was found in some subscales (e.g., depression, anger, and tension), consistent with typical mood subscale distributions. Negative mood scores tended toward higher numbers at the lower end, and lower numbers at the upper end (Terry et al., 1999). The frequency distributions for skewness and kurtosis were examined and it was concluded that deviations from normal distribution were unlikely to make a substantive difference to the analyses, thus no data were removed. A total of 45 multivariate outliers were identified according to a Mahalanobis distance statistic at $p < 0.001$. A case-by-case visual inspection suggested that response patterns were plausible. Given this, all outliers were retained, leaving a final sample of 1,444 respondents.

RESULTS

The results of this study are presented in three parts–cluster analysis, discriminant function analysis, and distribution of mood profiles by demographic variables.

Cluster Analysis

The objective of cluster analysis was described by Anderberg (2014) as the separation of data units or variables into groups (i.e., clusters), such that the elements within a cluster have a high degree of natural association and the clusters are relatively distinct from one another. The Statistical Package for Social Sciences, version 25 was used to conduct the cluster analysis, specifically k-means clustering (MacQueen, 1967), a method used to automatically split a dataset into a specified number of clusters. Using raw score cluster centroids from Quartiroli et al. (2018) (see **Table 2**), a seeded k-means cluster analysis with a prescribed six-cluster solution was run on the whole sample, and then separated by sport and non-sport participants. The six clusters previously identified by Parsons-Smith et al. (2017) and Quartiroli et al. (2018), referred to as the iceberg profile (23.3% of the sample), inverse Everest profile (4.8%), inverse iceberg profile (12.2%), shark fin profile (16.6%), submerged profile (27.3%), and surface profile (15.9%), were clearly identified in the present sample. Descriptive statistics of the six-cluster solution are presented in **Table 3**, presented as T-scores derived from local norms provided by Han et al. (2019). The distribution of clusters is similar to that reported by Parsons-Smith et al. (2017). Visual representations of the six mood profiles are shown in **Figure 1**.

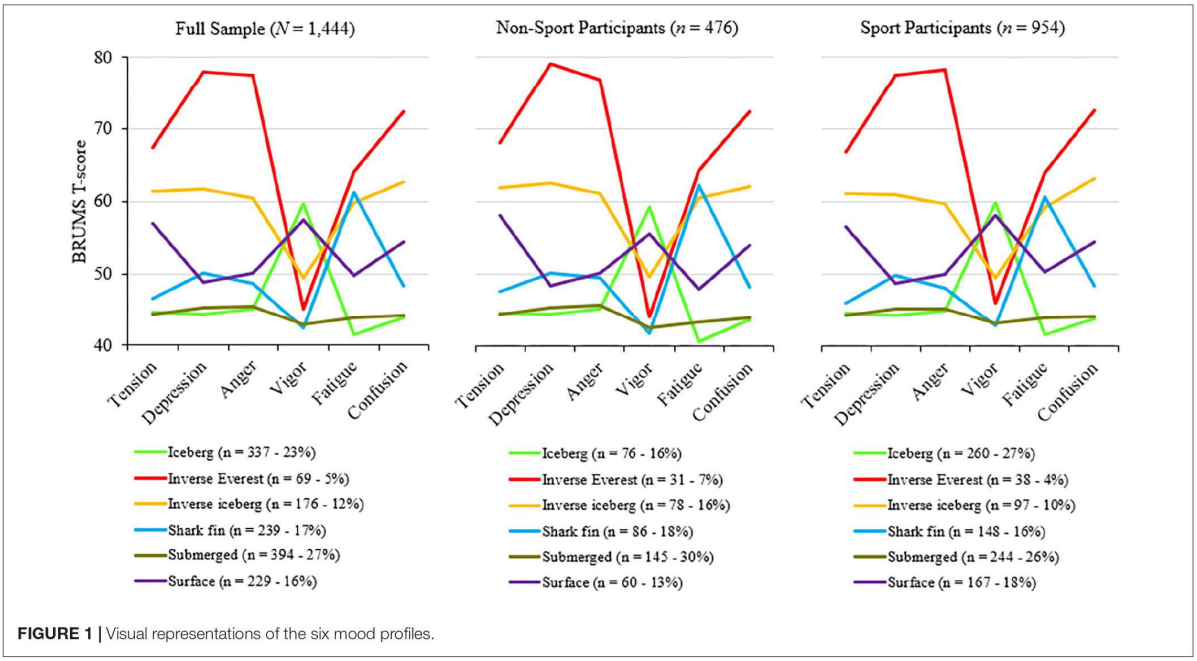


FIGURE 1 | Visual representations of the six mood profiles.

TABLE 2 | Raw score centroids used in the cluster analysis.

	Cluster					
Mood dimension	**1**	**2**	**3**	**4**	**5**	**6**
Tension	1.15	10.42	6.34	1.75	1.29	4.58
Depression	0.25	11.19	5.11	1.26	0.59	1.69
Anger	0.41	10.23	4.52	0.95	0.48	2.26
Vigor	10.62	4.69	5.98	4.14	4.72	9.10
Fatigue	2.39	11.83	8.59	9.97	2.91	4.76
Confusion	0.54	10.75	5.84	1.32	0.90	3.27

1 = iceberg, 2 = inverse Everest, 3 = inverse iceberg, 4 = shark fin, 5 = submerged, 6 = surface.

Discriminant Function Analysis

To explore the clusters further, a *post hoc* simultaneous multiple discriminant function analysis (DFA) was conducted to evaluate how well the clusters were classified. DFA predicts group membership in naturally occurring groups, based on predictor variables, and is not affected by unequal sample sizes (Tabachnick and Fidell, 2013). DFA is a two-step statistical procedure which involves significance testing of discriminant functions, followed by a computational process of classification. The ratio of cases to independent variables was 241 to 1, which far exceeds the recommended minimum ratio of 20 to 1. The DFA identified five functions accounting for 100% of the variance with the first three functions accounting for 98.2% of the variance (**Table 4**). A single-factor MANOVA was conducted to assess the between-cluster differences in subscale scores, which showed a significant omnibus effect, Wilks' $\lambda = 0.031$, $F(30,5734) = 266.04$ $p < 0.001$, partial $\eta^2 = 0.502$. Using a Bonferroni-adjusted alpha level of 0.008, significant univariate effects were confirmed for all mood dimensions: tension, $F(5,1438) = 352.14$, $p < 0.001$, partial $\eta^2 = 0.550$; depression, $F(5,1438) = 609.78$, $p < 0.001$, partial $\eta^2 = 0.680$; anger, $F(5,1438) = 444.98$, $p < 0.001$, partial $\eta^2 = 0.607$; vigor, $F(5,1438) = 347.85$, $p < 0.001$, partial $\eta^2 = 0.547$; fatigue, $F(5,1438) = 667.34$, $p < 0.001$, partial $\eta^2 = 0.699$; confusion, $F(5,1438) = 539.79$, $p < 0.001$, partial $\eta^2 = 0.652$.

Mood dimensions strongly associated with Function 1 were high depression, fatigue, confusion, anger, and tension. Function 2 identified high vigor and tension, and low fatigue. Function 3 identified low depression and anger, and high fatigue and vigor. **Table 5** lists all five discriminant functions. The findings suggest that the distribution overlap was small and the functions discriminated between clusters with a very high degree of accuracy, with correct classifications for the iceberg profile at 99.1%, inverse iceberg profile at 89.9%, inverse iceberg at 94.3%, shark fin profile at 95.4%, submerged profile at 99.5%, and surface profile at 91.7% (see **Table 6**). It was found that 96.4% of the cases were correctly reclassified back into the original clusters, which is markedly higher than the minimum classification accuracy rate of 44.9% (i.e., the proportional by chance accuracy +25%).

Demographic Influences on Mood Responses

Single-factor MANOVAs were used to provide an initial assessment of the influence of demographic variables on mood responses. Participants in the unspecified and "other" categories were excluded from these analyses. Significant multivariate variability was found for gender, age group,

TABLE 3 | Descriptive statistics of the 6-cluster solution (N = 1,444).

	Iceberg (n = 337, 23.3%)			Inverse Everest (n = 69, 4.8%)		
Mood dimension	***M***	***SD***	**95% CI**	***M***	***SD***	**95% CI**
Tension	44.65	4.37	[44.18, 45.12]	67.40	12.35	[64.44, 70.37]
Depression	44.30	2.87	[44.00, 44.61]	78.06	7.97	[76.15, 79.98]
Anger	45.08	3.42	[44.72, 45.45]	77.52	11.55	[74.75, 80.30]
Vigor	59.70	6.04	[59.05, 60.35]	45.20	9.49	[42.92, 47.48]
Fatigue	41.43	4.97	[40.89, 41.96]	64.10	6.97	[62.43, 65.78]
Confusion	43.83	4.13	[43.39, 44.27]	72.42	8.76	[70.31, 74.52]
	Inverse iceberg (n = 176, 12.2%)			**Shark fin (n = 239, 16.6%)**		
Mood dimension	***M***	***SD***	**95% CI**	***M***	***SD***	**95% CI**
Tension	61.40	9.20	[60.03, 62.77]	46.64	5.90	[45.89, 47.39]
Depression	61.69	8.17	[60.47, 62.90]	50.06	7.30	[49.13, 50.99]
Anger	60.38	9.58	[58.95, 61.80]	48.65	6.41	[47.84, 49.47]
Vigor	49.52	8.14	[48.31, 50.73]	42.48	6.94	[41.59, 43.36]
Fatigue	59.78	7.09	[58.72, 60.83]	61.27	5.28	[60.60, 61.94]
Confusion	62.68	8.22	[61.46, 63.90]	48.35	6.41	[47.53, 49.17]
	Submerged (n = 394, 27.3%)			**Surface (n = 229, 15.9%)**		
Mood dimension	***M***	***SD***	**95% CI**	***M***	***SD***	**95% CI**
Tension	44.43	4.65	[43.97, 44.89]	56.96	8.50	[55.85, 58.07]
Depression	45.38	4.16	[44.96, 45.79]	48.84	5.92	[48.07, 49.61]
Anger	45.54	4.08	[45.13, 45.94]	50.05	7.03	[49.14, 50.97]
Vigor	42.99	5.72	[42.42, 43.55]	57.46	6.94	[56.56, 58.36]
Fatigue	43.80	4.83	[43.32, 44.27]	49.77	5.63	[49.03, 50.50]
Confusion	44.17	4.54	[43.72, 44.62]	54.33	6.45	[53.49, 55.17]

Table presents T-scores converted from raw scores with reference to local norms reported by Han et al., 2019.

ethnicity, education level, and sport participation (see **Table 7**) but not for participation level, which was excluded from subsequent analyses. Univariate analyses identified many significant between-group differences. Females reported higher scores for anger, confusion, depression, and fatigue, and lower scores for vigor, compared to males. Younger participants reported higher scores for confusion and tension than older participants. Malay participants reported higher anger, confusion, depression, fatigue, and tension scores than Chinese participants. Participants with up to secondary education reported lower scores for fatigue and higher scores for vigor than those with a university education. Those involved in sport reported lower scores for anger, depression, fatigue, and tension, and higher scores for vigor, than those not involved in sport.

Distribution of Mood Profiles by Demographic Variable

Chi-squared tests were used to assess the distribution of mood profile clusters according to the demographic variables of interest. Significant variations in distribution were evident (see **Table 8**), for gender, age group, ethnicity, level of education, and sport participation. Adjusted residuals were used to investigate the source of these differences. The distribution of mood profiles by the various demographic variables are elaborated below.

Gender

The distribution of the six mood profiles varied significantly by gender for all profiles. Males were over-represented in the iceberg, submerged, and surface profiles, whereas females were over-represented in the inverse Everest, inverse iceberg, and shark fin profiles, consistent with the findings of Parsons-Smith et al. (2017) and Quartiroli et al. (2018).

Age Group

The distribution of inverse Everest, shark fin, and submerged profiles was independent of age group. Younger participants (≤25 years) were over-represented

TABLE 4 | Discriminant functions (N = 1,444).

Discriminant function	Eigenvalue	% of variance	Cumulative%	Canonical correlation
1	6.373	74.2	74.2	0.930
2	1.551	18.1	92.3	0.780
3	0.507	5.9	98.2	0.580
4	0.151	1.8	100.0	0.363
5	0.003	0.0	100.0	0.055

TABLE 5 | Structure matrix (N = 1,444).

	Discriminant function				
Mood dimension	**1**	**2**	**3**	**4**	**5**
Tension	0.388	0.349	−0.030	−0.701*	0.079
Depression	0.558*	0.091	−0.411	0.509	−0.445
Anger	0.469	0.165	−0.407	0.371	0.662*
Vigor	−0.104	0.808*	0.473	0.302	0.137
Fatigue	0.529	−0.417	0.720*	0.139	0.088
Confusion	0.520*	0.282	−0.117	−0.376	−0.311

**Largest absolute correlation between each variable and any discriminant function.*

TABLE 6 | Cluster classifications (N = 1,444).

	Cluster							
Cluster	**1**	**2**	**3**	**4**	**5**	**6**	***n***	**%**
Iceberg	334	0	0	0	3	0	337	99.1
Inverse Everest	0	62	7	0	0	0	69	89.9
Inverse iceberg	0	0	166	8	0	2	176	94.3
Shark fin	0	0	5	228	6	0	239	95.4
Submerged	1	0	0	0	392	1	394	99.5
Surface	11	0	2	0	6	210	229	91.7

1 = iceberg, 2 = inverse Everest, 3 = inverse iceberg, 4 = shark fin, 5 = submerged, 6 = surface.

TABLE 7 | MANOVA of BRUMS subscales by demographic variables.

	Tension		Depression		Anger		Vigor		Fatigue		Confusion	
Source	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
Gender $F(6, 1424) = 17.52^{\dagger}$												
Male ($n = 991$)	49.63	9.74	$48.57^{\dagger}$	8.89	$48.84^{\dagger}$	8.76	$50.99^{\dagger}$	10.00	$48.69^{\dagger}$	9.45	$49.27^{\dagger}$	9.25
Female ($n = 440$)	50.89	10.60	53.19	11.57	52.64	12.00	47.96	9.68	52.90	10.59	51.67	11.39
Age group $F(6, 1423) = 11.54^{\dagger}$												
≤25 years ($n = 763$)	$51.35^{\dagger}$	10.82	49.96	9.75	49.63	9.44	49.78	10.15	50.61	9.95	$50.91^{\dagger}$	10.21
26+ years ($n = 667$)	48.50	8.79	50.04	10.33	50.43	10.64	50.35	9.80	49.27	10.03	48.99	9.70
Ethnicity $F(12, 2784) = 6.43^{\dagger}$												
Chinese[a] ($n = 1,163$)	49.57	9.73	49.42	9.45	49.43	9.44	49.57^{*c}	9.82	49.88	9.75	49.68	9.72
Malay[b] ($n = 119$)	$53.89^{\dagger a}$	11.35	$54.81^{\dagger a}$	12.35	$55.00^{\dagger a}$	12.70	51.15	10.58	$53.95^{\dagger ac}$	11.19	$53.63^{\dagger a}$	11.82
Indian[c] ($n = 118$)	51.56	11.43	51.46	11.77	51.17^{*b}	11.36	53.03	10.58	47.94	10.34	50.34	10.74
Level of education $F(18, 3951) = 4.52^{\dagger}$												
Primary/Secondary[a] ($n = 70$)	50.29	9.88	50.04	9.92	50.03	9.17	54.75^{*b}	10.56	45.92^{*bc}	9.08	48.71	8.87
JC/IB/Poly/ITE[#b] ($n = 873$)	50.82	10.44	49.56	9.61	49.60	9.73	50.12	9.97	50.20	10.05	50.44	10.01
University[c] ($n = 370$)	48.86	9.35	51.12	10.81	50.76	10.76	$48.67^{\dagger a}$	9.63	50.71	10.23	49.61	10.39
Postgraduate[d] ($n = 93$)	48.09	8.49	49.35	10.11	50.35	10.31	50.88	10.12	48.72	9.13	49.09	9.47
Sport participation $F(6, 1423) = 8.86^{\dagger}$												
Sport ($n = 954$)	49.41^{*}	9.48	$49.20^{\dagger}$	9.33	$49.27^{\dagger}$	9.31	$51.07^{\dagger}$	10.07	49.43^{*}	9.58	49.61	9.73
Non-sport ($n = 476$)	51.22	10.96	51.52	11.08	51.46	11.20	47.99	9.52	51.11	10.74	50.81	10.54

*Table presents T-scores converted from raw scores with reference to local norms reported by Han et al., 2019. [#]JC = Junior College, IB = International Baccalaureate, Poly = Polytechnic Diploma, ITE = Institute of Technical Education Certification. *$p < 0.008$, $^{\dagger}p < 0.001$.*

TABLE 8 | Distribution of clusters by demographic variables.

	Cluster											
Source	**1**	**%**	**2**	**%**	**3**	**%**	**4**	**%**	**5**	**%**	**6**	**%**
Gender $\chi^2(5, 1431) = 80.81^{\dagger}$												
Male ($n = 991$)	$256^{\$+}$	25.8	$31^{\dagger-}$	3.1	$94^{\dagger-}$	9.5	$137^{\dagger-}$	13.8	285^{*+}	28.8	$188^{\dagger+}$	19.0
Female ($n = 440$)	$80^{\$-}$	18.2	$38^{\dagger+}$	8.6	$81^{\dagger+}$	18.4	$97^{\dagger+}$	22.0	104^{*-}	23.6	$40^{\dagger-}$	9.1
Age group $\chi^2(5, 1430) = 25.78^{\dagger}$												
≤25 years ($n = 763$)	$148^{\dagger-}$	19.4	32	4.2	$110^{\$+}$	14.4	127	16.6	205	26.9	$141^{\$+}$	18.5
26+ years ($n = 667$)	$187^{\dagger+}$	28.0	37	5.5	$65^{\$-}$	9.7	107	16.0	184	27.6	$87^{\$-}$	13.0
Ethnicity $\chi^2(10, 1400) = 38.49^{\dagger}$												
Chinese ($n = 1,163$)	266	22.9	$46^{\$-}$	4.0	$131^{\$-}$	11.3	200	17.2	$335^{\$+}$	28.8	185	15.9
Malay ($n = 119$)	24	20.2	$14^{\$+}$	11.8	$25^{\$+}$	21.0	18	15.1	$18^{\$-}$	15.1	20	16.8
Indian ($n = 118$)	36	30.5	7	5.9	18	15.3	12	10.2	26	22.0	19	16.1
Level of education $\chi^2(15, 1406) = 39.77^{\dagger}$												
Primary/Secondary ($n = 70$)	23^{*+}	32.9	3	4.3	4	5.7	5^{*-}	7.1	16	22.9	$19^{\$+}$	27.1
JC/IB/Poly/ITE[#] ($n = 873$)	189	21.6	37	4.2	112	12.8	139	15.9	237	27.1	$159^{\$+}$	18.2
University ($n = 370$)	87	23.5	24	6.5	46	12.4	76^{*+}	20.5	102	27.6	$35^{\dagger-}$	9.5
Postgraduate ($n = 93$)	28	30.1	5	5.4	9	9.7	11	11.8	28	30.1	12	12.9
Sport participation $\chi^2(5, 1430) = 40.32^{\dagger}$												
Sport ($n = 954$)	$260^{\dagger+}$	27.3	38^{*-}	4.0	$97^{\dagger-}$	10.2	148	15.5	244^{*-}	25.6	167^{*+}	17.5
Non-sport ($n = 476$)	$76^{\dagger-}$	16.0	31^{*+}	6.5	$78^{\dagger+}$	16.4	86	18.1	145^{*+}	30.5	60^{*-}	12.6

*1 = iceberg, 2 = inverse Everest, 3 = inverse iceberg, 4 = shark fin, 5 = submerged, 6 = surface. [#]JC = Junior College, IB = International Baccalaureate, Poly = Polytechnic Diploma, ITE = Institute of Technical Education Certification. *$p < 0.05$, $^{\$}p < 0.01$, $^{\dagger}p < 0.001$. $^{+}$over-represented, $^{-}$under-represented.*

in the inverse iceberg and surface profiles and under-represented for the iceberg profile. Older participants (26+ years) were over-represented in the iceberg profile and under-represented in the inverse iceberg and surface profiles.

Ethnicity

The distribution of iceberg, shark fin, and surface profiles was independent of ethnicity. Chinese Singaporeans were over-represented in the submerged profile and under-represented in the inverse Everest and inverse iceberg profiles. Malay

Singaporeans were over-represented in inverse Everest and inverse iceberg profiles and under-represented in the submerged profile.

Level of Education

The distribution of the inverse Everest, inverse iceberg, and submerged profiles was independent of level of education. Participants with secondary school or below level of education were over-represented in the iceberg and surface profiles and under-represented in the shark fin profile. Participants with pre-university education (JC/IB/Poly/ITE) were over-represented in the surface profile, whereas those with a university education were over-represented in the shark fin profile and under-represented in the surface profile.

Sport Participation

The distribution for the shark fin profile was independent of sport participation. Those who participated in sport were over-represented in the iceberg and surface profiles and under-represented in the inverse Everest, inverse iceberg, and submerged profiles. Those who did not participate in sport were over-represented in the inverse Everest, inverse iceberg, and submerged profiles and under-represented in the iceberg and surface profiles.

DISCUSSION

Six mood profile clusters previously identified by Parsons-Smith et al. (2017) and Quartiroli et al. (2018), referred to as the iceberg, inverse iceberg, inverse Everest, shark fin, submerged, and surface profiles, were clearly retrieved among our sample of Singaporean participants, showing a similar structure matrix.

Support for the cross-cultural generalizability of these mood profiles makes a significant contribution to the literature on mood profiling and, more specifically, to the validation of the BRUMS as a tool for mood profiling in Singapore. The identification of associations between demographic variables and the incidence of mood profiles across multiple studies provides support for the use of mood profiling for various purposes, ranging from screening or monitoring of mental health to providing a tool to predict performance or other outcome variables of interest. Our findings enhance understanding of the association between demographic variables and mood profiles and may serve as a guide for practitioners and policy makers in the design of potential interventions to promote well-being among general as well as clinical populations.

A noteworthy finding of our study was that men were over-represented in the more positive iceberg profile whereas females were over-represented in the more negative inverse Everest, inverse iceberg, and shark fin profiles. There are several possible explanations for this gender difference. First, it has been reported that men and women regulate mood differently. For example, women are more likely to ruminate that men, which may influence their reported mood (Nolen-Hoeksema and Jackson, 2001). Second, there is a gender difference in hormonal activity (e.g., premenstrual syndrome, postnatal depression, menopause; Halbreich and Kahn, 2001) which may make some women more prone to negative moods. Third, it has been reported that women are more likely than men to report feeling depressed, sad, anxious, or nervous (American Psychological Association, 2012b), potentially explaining why women were over-represented in the more negative mood profiles. Finally, males are often taught from a young age to inhibit expression of emotion to a greater extent than females (Underwood et al., 1992), which may explain why males were over-represented for the submerged profile which has low scores on all six dimensions of mood.

In relation to age group, younger participants were under-represented while older participants were over-represented for the iceberg profile, whereas the reverse was true for the inverse iceberg profile. This is similar to trends identified in previous investigations of the age-related incidence of mood profile clusters (Parsons-Smith et al., 2017; Quartiroli et al., 2018). Interestingly, the age of onset of mood disorders is typically around the mid-20s (Kessler et al., 2007) and data from the *Stress in America* survey showed younger people report higher stress levels than older generations and also report that they do not manage it well (American Psychological Association, 2012a). These age-related trends in mood responses are worthy of further investigation in a Singaporean context.

With regard to ethnicity, our findings showed a higher incidence of negative mood profiles (inverse Everest, inverse iceberg) among Malay Singaporeans and a lower incidence among Chinese Singaporeans. Previous studies have found differences in health status as well as variations in the occurrence of mood disorders according to ethnicity (Johnson-Lawrence et al., 2013). Further investigation of ethnic differences in mood is warranted among the Singaporean population, perhaps by mapping the incidence of negative mood profiles in our dataset to the incidence of mental health disorders at the national level. Such investigations would further inform policy makers and practitioners on potential preventive or protective measures as well as interventions for the vulnerable groups.

There were few significant variations in the distribution of mood profiles related to level of education, although the relatively small number of participants in the primary/secondary and postgraduate education groups should be noted. Previous literature suggests that level of education and socioeconomic status may have an influence on the mental health of individuals (Hudson, 2005; Eid et al., 2013) and therefore the relationship between education level and mood profiles might provide the focus for future investigations in a Singaporean context.

A significant finding from our study relates to the distribution of mood profile clusters in relation to participation in sport. Our findings showed a clear association between sport participation and mood responses. Those engaged in sport were over-represented in the positive iceberg mood profile and under-represented in the more negative inverse Everest, inverse iceberg, and submerged profiles. This association between sport participation and positive mood profiles might be related to the positive effects of sport on mood or the effects of mood on

physical functioning (Morgan, 1985; Beedie et al., 2000; Terry and Lane, 2000), although the direction of effects cannot be ascertained in our study due to its correlational design. The study also found that a lack of participation in sport was associated with experiencing negative moods, as evident in the over-representation of the inverse Everest (the most negative profile, characterized by high scores for tension and fatigue, combined with very high scores for depression, anger, and confusion, and perhaps indicative of psychopathology), inverse iceberg, and submerged profiles.

Research has increasingly shown physical activity to be an effective intervention to promote physical and psychological benefits for both healthy and clinical populations (Penedo and Dahn, 2005; Thøgersen-Ntoumani et al., 2005; Biddle and Asare, 2011) and our results are certainly consistent with that burgeoning evidence base. Practitioners can be confident in the potential for sport and other forms of physical activity to be effective interventions to enhance mood and health, and the findings from our study can be used to inform health programs targeted at the different demographic groups. Given the inherent benefits of physical activity on mood and well-being, future studies could adopt experimental designs to evaluate the effectiveness of specific interventions (e.g., music listening; Terry et al., 2020) used to encourage and maintain participation in physical activity, with mood profiling used to evaluate the efficacy of interventions for promoting positive moods.

Despite our sample size of 1,444 participants, when participants were distributed across the six mood profiles the number of participants in some cells was very small (see **Table 8**). We acknowledge this as a limitation of our study and hence some findings, particularly those related to ethnicity and education level, should be treated with caution. Some of the less frequently reported profiles, notably the inverse Everest profile which was reported by fewer than 5% of participants, would require a much larger overall sample for detailed exploration. Larger and/or more targeted samples would allow researchers to investigate if certain profile types, especially those with a negative orientation, could predict physical or mental health deficits that might signal the need for detailed follow-up or intervention. The lack of planned follow-up with respondents reporting extremely negative mood profiles was another limitation, given that only email addresses were recorded, which participants could decline to provide. Future studies should consider carefully the kind of contact information to be collected, inform participants of potential follow-ups, and provide them a brief mood report as well as avenues for assistance if required.

In summary, when the previous validation of the BRUMS for use in a Singaporean context (Han et al., 2019) is considered in tandem with the replication of mood profiles in the present study, many potential applications of mood profiling are feasible. The mood profile clusters identified provide local practitioners with a way to better interpret BRUMS test scores. The utility and meaningfulness of mood profiles will increase further once associations are established with objective measures of performance, behavioral outcomes or mental health indicators. Such knowledge would inform practitioners how to use mood profiling more effectively in clinical and non-clinical settings. For example, practitioners could use mood profiling as a method to help individuals and teams to build a stronger understanding of whether certain mood profile types facilitate or debilitate performance, especially in occupations and work conditions that are demanding or high-risk, such as military environments, law enforcement, elite sport, aviation, and so on. There is also the possibility of using the BRUMS as a screening or monitoring tool for mental health purposes, once the therapeutic meaningfulness of each of the six mood profiles is established.

CONCLUSION

The findings of the current study provide evidence that the mood profile clusters previously reported by Parsons-Smith et al. (2017) and Quartiroli et al. (2018) are also evident in the English-speaking Singaporean resident population, confirming the cross-cultural replicability of the clusters. The current study raises many research questions for future investigation that relate to the antecedents, correlates, and consequences of the six mood profile clusters, and how mood profiling can be used to, for example, predict performance outcomes or monitor mental health status. Results from this study set the stage for further research in Singapore to explore the practical, clinical, and theoretical implications of mood profiling.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request from the corresponding author.

ETHICS STATEMENT

This study involving human participants was reviewed and approved by the Human Research Ethics Committee at the University of Southern Queensland (approval number: H17REA143). The participants provided informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

ACKNOWLEDGMENTS

The authors thank the Singapore Sport Institute and Dr. Emily Ortega for assistance with data collection and acknowledge the contributions of Emeritus Professor Gerard Fogarty.

REFERENCES

American Psychological Association (2012a). *Stress by Generations*. Available online at: https://www.apa.org/news/press/releases/stress/2012/generations

American Psychological Association (2012b). *Stress by Gender*. Available online at: https://www.apa.org/news/press/releases/stress/2012/gender-report.pdf

Department of Statistics Singapore (2018). *Population Trends 2018 (ISSN 2591–8028)*. Singapore: Department of Statistics: Ministry of Trade and Industry.

Anderberg, M. R. (2014). *Cluster Analysis For Applications: Probability And Mathematical Statistics: A Series Of Monographs And Textbooks*. Cambridge, MA: Academic Press.

Beedie, C. J., Terry, P. C., and Lane, A. M. (2000). The Profile of Mood States and athletic performance: two meta-analyses. *J. Appl. Sport Psychol.* 12, 49–68. doi: 10.1080/10413200008404213

Biddle, S. J., and Asare, M. (2011). Physical activity and mental health in children and adolescents: a review of reviews. *Br. J. Sports Med.* 45, 886–895. doi: 10.1136/bjsports-2011-090185

Budgett, R. (1998). Fatigue and underperformance in athletes: the overtraining syndrome. *Br. J. Sports Med.* 32, 107–110. doi: 10.1136/bjsm.32.2.107

Eid, L., Heim, K., Doucette, S., McCloskey, S., Duffy, A., and Grof, P. (2013). Bipolar disorder and socioeconomic status: what is the nature of this relationship? *Int. J. Bipolar Disord.* 1:9. doi: 10.1186/2194-7511-1-94

Galambos, S. A., Terry, P. C., Moyle, G. M., and Locke, S. A. (2005). Psychological predictors of injury among elite athletes. *Br. J. Sports Med.* 39, 351–354. doi: 10.1136/bjsm.2005.01844

Halbreich, U., and Kahn, L. S. (2001). Role of estrogen in the aetiology and treatment of mood disorders. *CNS. Drugs* 15, 797–817. doi: 10.2165/00023210-200115100-00005

Han, C., Parsons-Smith, R., Fogarty, G., and Terry, P. (2019). "Psychometric characteristics of the Brunel Mood Scale in a Singaporean context," in *Poster Presented at the 15th European Congress of Sport and Exercise Psychology*, Munster.

Hudson, C. G. (2005). Socioeconomic status and mental illness: tests of the social causation and selection hypotheses. *Am. J. Orthopsychiat.* 75, 3–18. doi: 10.1037/0002-9432.75.1.3

Johnson-Lawrence, V., Griffith, D. M., and Watkins, D. C. (2013). The effects of race, ethnicity, and mood/anxiety disorders on the chronic physical health conditions of men from a national sample. *Am. J. Men Health* 7, 58S–67S. doi: 10.1177/1557988313484960

Kessler, R. C., Amminger, G. P., Aguilar-Gaxiola, S., Alonso, J., Lee, S., and Ustun, T. B. (2007). Age of onset of mental disorders: a review of recent literature. *Cur. Opin. Psychiatry* 20:359. doi: 10.1097/yco.0b013e32816ebc8c

Lane, A. M., and Chappell, R. C. (2001). Mood and performance relationships among players at the world student games basketball competition. *J. Sport Behav.* 24, 182–196.

Lane, A. M., and Terry, P. C. (2000). The nature of mood: development of a conceptual model with a focus on depression. *J. Appl. Sport Psychol.* 12, 16–33. doi: 10.1080/10413200008404211

MacQueen, J. B. (1967). "Some methods for classification and analysis of multivariate observations," in *Proceedings of the Fifth Symposium on Math, Statistics, and Probability* (Berkeley, CA: University of California Press), 281–297.

Morgan, W. P. (1980). Test of champions: the iceberg profile. *Psychol. Today* 14, 92–108.

Morgan, W. P. (1985). "Selected psychological factors limiting performance: a mental health model," in *Limits of Human Performance*, eds D. H. Clarke, and H. M. Eckert (Champaign, IL: Human Kinetics), 70–80.

Morgan, W. P., Brown, D. R., Raglin, J. S., O'Connor, P. J., and Ellickson, K. A. (1987). Psychological monitoring of overtraining and staleness. *Br. J. Sports Med.* 21, 107–114. doi: 10.1136/bjsm.21.3.107

Nolen-Hoeksema, S., and Jackson, B. (2001). Mediators of the gender difference in rumination. *Psychol. Women* 25, 37–47. doi: 10.1111/1471-6402.00005

Parsons-Smith, R. L., Terry, P. C., and Machin, M. A. (2017). Identification and description of novel mood profile clusters. *Front. Psychol.* 8:1958. doi: 10.3389/fpsyg.2017.01958

Penedo, F. J., and Dahn, J. R. (2005). Exercise and well being: a review of mental and physical health benefits associated with physical activity. *Curr. Opin. Psychiatry* 18, 189–193. doi: 10.1097/00001504-200503000-00013

Quartiroli, A., Parsons-Smith, R. L., Fogarty, G. J., Kuan, G., and Terry, P. C. (2018). Cross-cultural validation of mood profile clusters in a sport and exercise context. *Front. Psychol.* 9:1949. doi: 10.3389/fpsyg.2018.01949

Renger, R. (1993). A review of the Profile of Mood States (POMS) in the prediction of athletic success. *J. Appl. Sport Psychol.* 5, 78–84. doi: 10.1080/10413209308411306

Rowley, A. J., Landers, D. M., Kyllo, L. B., and Etnier, J. L. (1995). Does the iceberg profile discriminate between successful and less successful athletes? A meta-analysis. *J. Sport Exer. Psychol.* 17, 185–199. doi: 10.1123/jsep.17.2.185

Sties, S. W., Gonzales, A. I., Netto, A. S., Wittkopf, P. G., Lima, D. P., and de Carvalho, T. (2014). Validation of the Brunel Mood Scale for cardiac rehabilitation program. *Rev. Bras. Med. Esport.* 20, 281–284. doi: 10.1590/1517-86922014200401999

Tabachnick, B. L., and Fidell, L. S. (2013). *Using Multivariate Statistics*, 6th Edn, Boston, MA: Pearson Education.

Tanzer, N. K., Sim, C. Q., and Spielberger, C. D. (1996). "Experience, expression and control of anger in a Chinese society: the case of Singapore," in *Stress and Emotion: Anxiety, Anger, and Curiosity*, eds C. D. Spielberger and I. G. Sarason (Washington, DC: Taylor and Francis), 51–65.

Terry, P. C. (1995). The efficacy of mood state profiling among elite performers: a review and synthesis. *Sport Psychol.* 9, 309–324. doi: 10.1123/tsp.9.3.309

Terry, P. C., and Galambos, S. (2004). "Utility of mood profiles in identifying risk of eating disorders among adolescent rowers," in *Proceedings of the 39th Australian Psychological Society Annual Conference*, Sydney.

Terry, P. C., Karageorghis, C. I., Curran, M. L., Martin, O., and Parsons-Smith, R. L. (2020). Effects of music in exercise and sport: a meta-analytic review. *Psychol. Bull.* 146, 91–117. doi: 10.1037/bul0000216

Terry, P. C., and Lane, A. M. (2000). Development of normative data for the Profile of Mood States for use with athletic samples. *J. Appl. Sport Psychol.* 12, 69–85. doi: 10.1080/10413200008404215

Terry, P. C., Lane, A. M., and Fogarty, G. J. (2003a). Construct validity of the profile of mood states – adolescents for use with adults. *Psychol. Sport Exerc.* 4, 125–139. doi: 10.1016/S1469-0292(01)00035-8

Terry, P. C., Potgieter, J. R., and Fogarty, G. J. (2003b). The Stellenbosch Mood Scale: a dual-language measure of mood. *Int. J. Sport Exerc. Psychol.* 1, 231–245. doi: 10.1080/1612197X.2003.9671716

Terry, P. C., Lane, A. M., Lane, H. J., and Keohane, L. (1999). Development and validation of a mood measure for adolescents. *J. Sports Sci.* 17, 861–872. doi: 10.1080/026404199365425

Terry, P. C., and Parsons-Smith, R. L. (2019). Identification and incidence of mood profile clusters among sport participants. *J. Sci. Med. Sport* 22:S100. doi: 10.1016/j.jsams.2019.08.129

Terry, P. C., Stevens, M. J., and Lane, A. M. (2005). Influence of response timeframe on mood assessment. *Anxiety Stress Coping* 18, 279–286. doi: 10.1080/10615800500134688

Thøgersen-Ntoumani, C., Fox, K. R., and Ntoumanis, N. (2005). Relationships between exercise and three components of mental well-being in corporate employees. *Psychol. Sport. Exer.* 6, 609–627. doi: 10.1016/j.psychsport.2004.12.004

Totterdell, P. (1999). Mood scores: mood and performance in professional cricketers. *Br. J. Psychol.* 90, 317–332. doi: 10.1348/000712699161422

Underwood, M. K., Coie, J. D., and Herbsman, C. R. (1992). Display rules for anger and aggression in school-age children. *Child Dev.* 63, 366–380.

van Wijk, C. H., Martin, J. H., and Hans-Arendse, C. (2013). Clinical utility of the Brunel Mood Scale in screening for post-traumatic stress risk in a military population. *Mil. Med.* 178, 372–376. doi: 10.7205/MILMED-D-12-00422

Zhang, C.-Q., Si, G., Chung, P.-K., Du, M., and Terry, P. C. (2014). Psychometric properties of the Brunel Mood Scale in Chinese adolescents and adults. *J. Sports Sci.* 32, 1465–1476. doi: 10.1080/02640414.2014.898184

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Chapter 4: Study 3 – Mood and Pistol Shooting Performance

Introduction

Pre-competition mood states have been a subject of keen interest amongst researchers and practitioners in sport psychology. It is recognised that an important part of getting mentally prepared for athletic competition is to get into the right mood for performance (Prapavessis & Grove, 1991; Terry, 1995). Anecdotal, scientific and empirical evidence has repeatedly shown that the emotions experienced by athletes prior to and during sport performance have a significant effect on the quality of their performances (see Hanin, 2000; Lane, 2007a). Multiple studies have been conducted to explore the relationship between mood states and performance (e.g., Campo et al., 2016; Craft, Magyar, Becker, & Feltz, 2003; Moen, Myhre, & Sandbakk, 2016), which have typically involved use of the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) or one of its derivatives. The POMS is a 65-item, self-report scale designed to assess the six mood dimensions of Anger, Confusion, Depression, Fatigue, Tension, and Vigour, which was originally developed for use with clinical populations before being applied to sport. Following Morgan's (1980) finding that successful performances were often characterised by above average Vigour, combined with below average Anger, Confusion, Depression, Fatigue, Tension, researchers started to study how mood relates to performance, with a strong focus on psychometric testing. This combination of mood scores came to be known as the "iceberg profile" which was proposed to be associated with athletic success, positive mental health and good performance (Raglin, 2001).

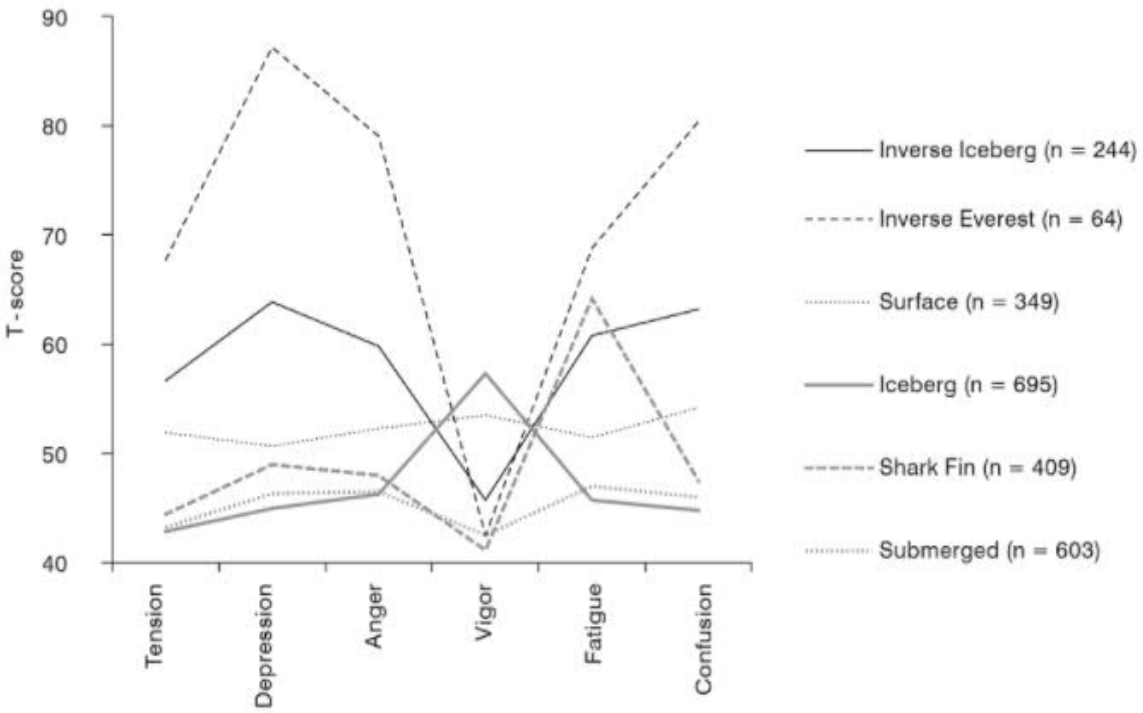
The 24-item Brunel Mood Scale (BRUMS; Terry, Lane, Lane, & Keohane, 1999; Terry, Lane, & Fogarty, 2003) is one of the few variations of the POMS that has been extensively validated via multi-sample confirmatory factor analysis (i.e., adults, adolescents, athletes, non-athletes), with normative values produced for athletes and non-athletes (Terry &

Lane, 2010). The BRUMS has also been translated and validated in several languages, demonstrating excellent factorial and concurrent validity, internal consistency, and test-retest reliability (Terry et al., 1999; 2003). Thus, the BRUMS has been shown to be a psychometrically robust inventory for assessing mood, and its brevity makes it appropriate for use in performance settings.

Besides using the BRUMS to assess discrete mood dimensions, the BRUMS has also been used as part of mood profiling that looks for patterns in how an athlete scores on the six dimensions of mood, giving rise to a particular mood profile. Since the identification of the iceberg profile (Morgan, 1980), six additional mood profiles have been identified in the literature, namely the *Everest profile* (Terry, 1995), *inverse iceberg profile* (Budgett, 1990) and more recently the *inverse Everest*, *surface*, *shark fin* and *submerged* profiles (Parsons-Smith, Terry, & Machin, 2017; see Figure 1).

Figure 1

Six Distinct Mood Profiles Identified via Cluster Analysis (N = 2,364; Parsons-Smith et al., 2017)



The *Everest* profile, which is not shown in Figure 1, is characterised by high scores on Vigour (*T* score ≥ 60) and low scores on the remaining factors (*T* score ≤ 40), and is associated with superior performance (Terry, 1995). The *inverse Everest* profile is characterised by a low score for Vigour, high scores for Tension and Fatigue, and very high scores for Depression, Anger, and Confusion, which may be indicative of clinical mood disorders (Lane & Terry, 2016). While van Wijk, Martin, and Hans-Arendse (2013) have demonstrated that the BRUMS has utility as a screening tool for clinical conditions, Lane and Terry (2016) cautioned that BRUMS should not be used as the sole basis for a clinical diagnosis. The *inverse iceberg* profile is characterised by a low Vigour score, and high scores for Tension, Depression, Anger, Fatigue, and Confusion. The *shark fin* profile is characterised by below average scores for Tension, Depression, Anger, Vigour, and Confusion, together with a high score for Fatigue. The *surface* profile is characterised by slightly above average scores for each mood dimension. Finally, the *submerged* profile is characterised by below average scores for all mood dimensions (Parsons-Smith et al., 2017).

Two recent studies provided evidence of the cross-cultural validity and replicability of these six mood profiles, which were also found in an Italian sample (Quartiroli, Parsons-Smith, Fogarty, Kuan, & Terry, 2017) and a Singaporean sample (Han, Parsons-Smith, & Terry, 2020). However, the relationship between these four novel mood profiles and performance has not yet been tested. Researchers have yet to investigate if and how the novel mood profiles are related to sporting performance, though it has been found that the inverse Everest and shark fin profiles are associated with debilitated performance. For example, in the study involving workers from the construction and mining industries, Parsons-Smith (2015) found that individuals experiencing the iceberg profile had higher endorsement of policies and procedures that promoted safety and were more likely to comply with core activities and practices that maintain workplace safety and facilitate a supportive safety environment compared with those experiencing the shark fin and inverse iceberg profiles. Individuals

reporting an iceberg profile also had a higher endorsement in terms of the perception of safety climate compared with those reporting the inverse Everest profile. On the contrary, individuals with the inverse iceberg profile were less likely to comply with core activities and practices that maintain workplace safety compared to those with the submerged and surface profiles. Individuals with the inverse iceberg profile were also less motivated to perform safety behaviours compared to those with the submerged, shark fin, surface, and iceberg profiles. Most importantly, Parsons-Smith (2015) reported that the effects sizes ranged from small to moderate (i.e., .21 to .40), suggesting that mood profile classifications can have practical implications in occupational settings. In this case it relates to potential applications to workplace safety behaviours. The findings from this study could spur more researchers to explore the potential applications of mood profiling in relation to how they value-add to good practices and performance in the workplace.

Nonetheless, previous studies have questioned the utility of mood profiling and the iceberg profile in predicting athletic achievement (Renger, 1993; Rowley, Landers, Kyllo, & Etnier, 1995). For example, the reviews by Renger (1993) and Rowley and colleagues (1995) casted doubt on the utility of POMS in predicting successful performance. Renger (1993) found that elite athletes did not always report an iceberg profile and some non-athletes showed an iceberg profile and therefore argued that the POMS was a poor tool to differentiate elite from non-elite athletes or to differentiate athletes from non-athletes. Next, a meta-analysis of pertinent studies of mood and performance by Rowley and colleagues (1995) concluded that the iceberg profile accounted for less than 1% of the variance in performance, suggesting that 99% of the variance was unexplained. Thus Rowley and colleagues (1995) arrived at a similar conclusion as Renger (1993), questioning “the utility of the POMS in predicting athletic success” (p. 185).

Prior to these two reviews, it was widely documented that the typical mood profiles reported by athletes across different sports and situations was an iceberg profile, thus these

two reviews with differing findings stood out (Lane, 2008), increasing the doubt on the utility of POMS and the iceberg profile. In reality, athletes can be expected to deviate from the iceberg profile. Following injury, loss, tough training or stressful events, athletes may undergo the typical stages of grief (e.g., denial, anger, depression, acceptance, and hope), and as a result may experience a certain degree of disturbed mood during such periods (Terry, 1995). It is also important to note that previous studies had plotted scores of athletes against that of student norms or psychiatric outpatients (see McNair et al., 1971), thus the finding that an iceberg profile was the norm for athletes should be more cautiously evaluated, since they had compared athletes against psychiatric or general populations. As such, the iceberg profile is unlikely as predictive as previously claimed. Recent studies have also provided greater clarity that the relationship between mood responses and performance is probably more subtle and complex than can be elucidated by the iceberg profile (Terry & Lane, 2011). Thus while an iceberg profile has been shown to be desirable, its significance may have been inflated given its widespread occurrence amongst athletes (Terry & Lane, 2011). It also raised a clear need for sport-specific tables of normative data to inform this line of research, which were first provided by Terry and Lane (2000).

Since then, several studies have demonstrated that the equivocal findings have been in part due to the various theoretical and methodological issues in the study of mood and performance, which limited researchers in examining the underlying mechanisms of mood in relation to performance (Terry, 1995; Beedie, Terry, & Lane, 2000; Lane & Terry, 2000; Prapavessis, 2000). Firstly, Terry (1995) pointed out that multiple studies conducted previously did not always report the response set that was being used, which can influence the mood-performance relationship as well as how the results were eventually interpreted. Terry (1995) argued that mood should be assessed by using the response set “How do you feel right now?” Lane, Beedie and Devonport (2011) agreed that a response timeframe of ‘how do you feel right now’ was most appropriate for assessing mood which was transient in nature. Since

mood states are transient, research that explores mood-performance relationships should ideally assess mood during competition but this is almost impossible or inappropriate as it may distract or interrupt the athlete in the midst of competition preparation (Lane, 2008). The standard approach in anxiety research has been to assess psychological states about an hour before competition (see Martens, Vealey, & Burton, 1990) and Lane (2008) recommended that mood research could apply this guideline too. In addition, when short response timeframe like "Have you felt angry today?" was used compared to a longer timeframe like "Have you felt angry this week?", respondents reported more intense experiences. This may be due to respondents inferring that researchers were looking for more intense feelings within the longer timeframe (Winkielman, Knauper, & Schwarz, 1998) and this perception seem to get stronger with longer response timeframe, demonstrating that mood assessments over a longer timeframes are more predisposed to being influenced by relatively short but intense feelings, potentially inflates mood scores. In summary, it appears the "right now" response timeframe is most appropriate for mood research to capture the mood states experienced before competition.

Secondly, relating to performance, Terry (1995) suggested that it should be assessed by using the quality of a single performance rather than several performances so as to most accurately capture the mood-performance relationships.

Subsequent studies also suggested that pre-competition mood profiling can be useful in predicting athletic performance under certain conditions (see Beedie et al., 2000). Predictive effectiveness is proposed to increase (i) when using an idiographic approach, given that performance is mood-dependent for some athletes but not for others (see Lane & Chappell, 2001; Diment & Terry, 2003); (ii) when using the response set of "How do you feel right now?"; and (iii) when mood assessment occurs close to competition, to genuinely reflect pre-competition mood (Terry, Stevens, & Lane, 2005). Besides these conditions, mood measures have been shown to have the most success in predicting performance in sports of short

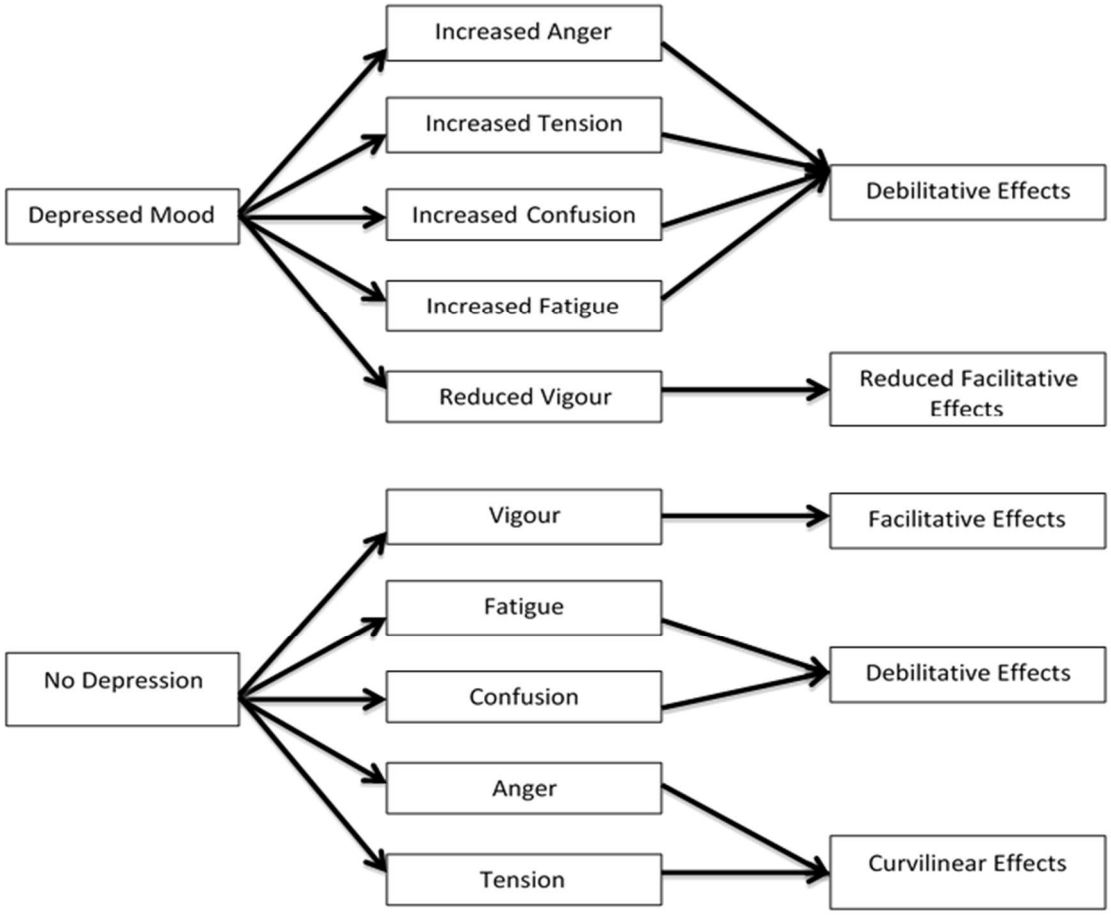
duration, sports of closed skills rather than open skills, individual rather than team-based sports, amongst groups with homogenous abilities, and finally where performance outcome is individualised and can be self-referenced (Terry, 1995; Terry & Slade, 1995; Terry & Youngs, 1996). Therefore existing evidence demonstrates that mood profiling may have utility for performance prediction or systematic evaluation of individual athletes if sport psychologists consider individualised and regular assessment of the idiosyncratic mood-performance relationships (Terry, 2005), with assessment administered close to the competition, using the appropriate response set. Individualised evidence-based interventions can then be implemented to assist athletes in the mood regulation process to reach their optimal state.

Finally, recognising that the lack of theory in the earlier days of mood and performance research hampered progress, Lane and Terry (2000) developed a conceptual model around the POMS mood states, to predict athletic performance from pre-competition mood. The model explored the nature of each mood state and provided a definition of each construct while identifying its antecedents, correlates, and proposed that performance is influenced by the interactive, rather than independent, effects of specific mood dimensions. Central to this conceptual model was the pivotal role of Depression, where depressed mood acts as a catalyst for reduced Vigour and increased Anger, Confusion, Fatigue and Tension which debilitates performance. The most significant aspect of this model is the effect of depressed mood upon Anger and Tension, which can be facilitative or debilitative to performance depending on how these two dimensions interact with depressed mood to influence performance. Lane and Terry (2000) proposed that individuals with depressed mood are more likely to supress their anger, blame themselves or direct the feelings internally (Spielberger, 1991), which inevitably leads to poorer performances. Individuals with depressed mood are also more likely to transfer tension into feelings of threat or worry, which also affects performance negatively. On the other hand, in the absence of depressed mood, Anger and Tension may instead act as a signal to the individual to take positive action (Bless, 2001; Schwarz, 2001). For example, Anger will

be expressed outwardly at the source of frustration (e.g., person or object) and the individual may channel that anger into determination to do well. Similarly, Tension experienced in the absence of depressed mood may more likely to be seen by an individual as readiness to perform. Thus in the absence of depressed mood, Anger and Tension may facilitate performance (Lane, 2007a).

Figure 2

Lane and Terry's (2000) Conceptual Model of Mood and Performance with a Focus on Depression



This conceptual model has been tested and most of its hypotheses have been supported in several studies (see Lane & Terry, 2000; Lane, 2007; Lane, Terry, Devonport, Friesen, & Totterdell, 2017), where the results provide clarity on how mood relates to performance in

various unique sporting contexts. After exploring the nature of each mood state in the POMS, Lane and Terry proposed that depressed mood should have the strongest influence on sport performance.

The present study sought to examine the relationship between mood and pistol shooting performance. Pistol shooting makes a good candidate for such a study as it meets the characteristics mentioned above (i.e., individual, closed skill). Previous studies of mood and performance have sometimes failed to be precise in operationalising performance, which has created problems of interpretation of the mood-performance relationship (Prapavessis & Grove, 1991). This is not an issue for shooting as performance is measured using precise scores attained by shooters at each match. Most importantly, the impetus for this study was to better understand the how mood influences performance in the sport of pistol shooting to allow the first author to provide better informed support to the team as their psychologist. It was observed that the participant shooters did not shoot as well during competitions compared to their usual standards at training. They shared that they were at times affected by the stress of competition and became “not themselves” or observed team mates to “lose themselves”, that is, to start doing things that were out of their regular repertoire or routines. They may then inadvertently try to self-remedy yet fail to repeat their usual performance but could not identify the cause of their poor performance.

Besides remaining unfazed in the face of competition, pistol shooting is a sport that requires firm control and precision. Shooters must stand firm and be in control of their body posture, maintaining tension in some muscle groups while being relaxed in others. Such precise, firm and fine control can only be accomplished with a clear mind with no distractions, which requires intense focus on self, the pistol and the target. As Indian former world champion Heena Sidhu explained, pistol shooting is a sport that requires precision, consistency and attention to detail, where even micro movements can cost a shot (Agotra, 2014).

Thus, the current study examined the relationship between mood and pistol shooting performance and assessed whether mood profiling has utility for performance enhancement in shooting. Four research questions were of interest: (1) How is pre-performance mood related to shooting performance? (2) What is the relationship between individual mood dimensions and shooting performance? (3) Does an idiographic approach to the study of mood-performance relationships yield any insights? and (4) Is there an ideal pre-performance mood profile for pistol shooters? Findings from this study would inform shooting athletes and sport psychology practitioners on how mood relates to performance, uncover the utility of mood profiles in competition preparation and prediction of performance, and act as a reference point for individual interventions that may be suitable for athletes based on their mood profiles.

Method

Participants

Participants were 10 elite pistol shooters from the Singapore Armed Forces (age range: 27 to 43 years; male = 5, female = 5). Years of experience in competitive shooting ranged from 2 to 16 years, with an average of 9.3 years. All participants could read and write fluently in English.

Measures

The BRUMS was chosen to assess pre-performance mood as it is short (24 basic mood descriptors) and easy to administer prior to performance, requiring less than two minutes to complete. It has six subscales namely Anger, Confusion, Depression, Fatigue, Tension, and Vigour, with each subscale having four mood descriptors. The standard response timeframe of "How do you feel right now?" was used, and participants rated their responses on a five-point Likert scale (0 = *not at all*, 1 = *a little*, 2 = *moderately*, 3 = *quite a bit*, and 4 = *extremely*; Terry & Lane, 2010), with each subscale score ranging from 0 to 16.

In a recently completed validation study of the BRUMS in Singapore (Han, Parsons-Smith, Fogarty, & Terry, 2019), results of a confirmatory factor analysis (CFA) indicated a

good fit of the measurement model to the data [CFI = .937, TLI = .927, RMSEA = .062], supporting the factorial validity of the BRUMS. In addition, multi-sample CFA further supported factorial validity across samples that varied by sport participation, age group, and gender. Concurrent validity was also supported by Han and colleagues (2019), using concurrent measures such as the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and the Depression Anxiety Stress Scales-21 (DASS-21; Henry & Crawford, 2005). Hypothesised relationships between the six subscales of the BRUMS, the two subscales of the PANAS (i.e., positive affect and negative affect), and the three subscales of the DASS-21 (i.e., depression, stress, and anxiety) were consistent with theoretical predictions. The BRUMS has also demonstrated high internal consistency previously, with Cronbach alpha coefficients ranging from .74 to .90 for each of the six subscales (Terry et al., 1999).

Performance scores of the shooters from their six matches were obtained from their coaches. Of the six matches, two were simulated matches as part of their competition preparation, while the other four matches were part of the Association of South East Asian Nations (ASEAN) Armies Rifle Meet (AARM). The AARM has been conducted annually since 1991 to promote solidarity amongst ASEAN armies through friendly competition, with disciplines covering carbine, machine gun, pistol ladies, pistol men and rifle. The teams of interest in this study were the pistol men's and women's teams, which competed in two types of matches, with elements to test the shooters' precision, agility and speed to varying degrees. Against a field of 90 other shooters from the nine other ASEAN countries (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam), they sought to achieve the highest score by aiming at the bull's eye for each shot, sometimes shooting single-handedly and sometimes with both hands, depending on the match rules. All shots were completed under the pressure of a time limit. For ease of comparison and standardisation of

performance measures, all match scores were converted to a percentage of the maximum available score, since different matches were scored differently.

Procedure

Prior to the conduct of this study, permission was granted by the management in the psychology department which the first author worked, after which permission was received from the Human Research Ethics Committee at the University of Southern Queensland (USQ; approval number: H17REA143). This study was conducted in accordance with the Australian Code for the Responsible Conduct of Research. Data were collected over the course of two months leading up to the AARM. The shooters and coaches were provided with an information sheet regarding the nature of the study and their written informed consent was provided before data collection began. On match days, shooters were reminded by their team captain to complete the mood assessment online, hosted on the USQ's eResearch Survey System, no earlier than two hours prior to their matches. All data were analysed using SPSS Software Version 25.0 (2017). Raw mood scores on the BRUMS were converted to T-scores with reference to the local norms attained from the validation study of the BRUMS using a Singaporean population (Han et al., 2019). A *k*-means cluster analysis was also conducted using the cluster centroids from Quartiroli and colleagues (2018) with the "classify" option so as to sort the mood profiles into one of the six potential clusters. In addition, the raw data for the six mood dimensions were inspected visually to check if they had been corrected classified. Several cases that were found to be incorrectly classified were re-examined and reclassified manually.

Data Analysis

Six matches were included as part of this study, which resulted in a total of 60 cases of mood and performance data, with six cases per shooter. A visual inspection of the dataset was undertaken, and no abnormalities or missing values were detected. When the data were tested for normality, significant univariate non-normality was found for all six mood dimensions but

not for performance scores. In this sample, most mood scores tended to fall below the mean and this is not unexpected since it is a small sample of elite shooters, thus all cases were taken as valid.

The first step in the analysis was to categorise each BRUMS profile into one of the six mood profile clusters (Parsons-Smith et al., 2017) to facilitate a meaningful analysis of the relationship between mood profiles and performance. As mentioned above, this was done using two steps, first using a *k*-means cluster analysis, followed by a visual inspection to check if the classification was done correctly. Cases that did not fit into the six identified mood profile clusters were labelled as "unclassified". Next, given the non-normal distribution of mood scores and the small sample size, a non-parametric test was judged to be appropriate. Hence, the Spearman's rank-order correlation test was used to quantify the degree of association between mood scores and performance scores. Before this non-parametric correlational analysis was performed, mean scores for the six mood dimensions and a mean performance score (as a percentage of the maximum possible score) were calculated for each shooter. A Fisher's exact test (FET) was then used to further understand how performance varies with mood scores. This test tends to be used when sample size is small and when we want to test if two categorical variables are associated with each other.

As the FET requires variables to be nominal, the mood and performance means were transformed to nominal variables using '1 = Below the mean' or '2 = Above the mean', producing a 2 x 2 contingency table of mood and performance scores. The objective was to establish if high/low mood scores were related to high/low performance scores. Finally, as it was of interest to investigate if pre-performance mood correlated with performance, a mean overall mood score for each shooter was calculated by summing their mood scores on the six dimensions and then averaging across the six matches. This method of summation is similar to previous studies of mood-performance relationships, which calculated a Total Mood Disturbance (TMD) score by summing scores for the negative mood dimensions of Tension,

Depression, Anger, Fatigue and Confusion, and subtracting the score for the positive mood dimension of Vigour (e.g., Berger et al., 1999; Raglin, 2001). The method of summing all mood scores was judged to be appropriate because most mood scores in the current study fell below the normative mean, and hence it was more useful to consider an overall mood score rather than pre-judging mood dimensions as positive or negative. This overall mean mood score was then was correlated with their *mean performance scores* attained by averaging performance scores across the six matches, using the non-parametric Spearman correlational analysis.

Results

Table 1 presents the descriptive statistics of mood and performance scores. Figure 3 provides a visual representation of the mean mood profile of elite shooters in this study. All six mood dimensions fell below the population mean, indicating that a *submerged profile* was the norm for the elite pistol shooters.

Table 1

Descriptive Statistics of Mood and Performance Scores across Six Matches (N = 10)

Measure	Mean	SD	Range
Tension	44.10	4.02	41.00–59.00
Depression	43.43	1.67	43.00–45.17
Anger	44.27	1.10	44.00–45.17
Vigour	41.35	8.63	34.67–47.17
Fatigue	38.30	4.70	35.33–41.83
Confusion	42.32	4.39	41.00–45.83
Scores (%)	92.69	2.74	86.34–99.52

Figure 3

Mean Mood Profile of Elite Pistol Shooters (*N = 10*)

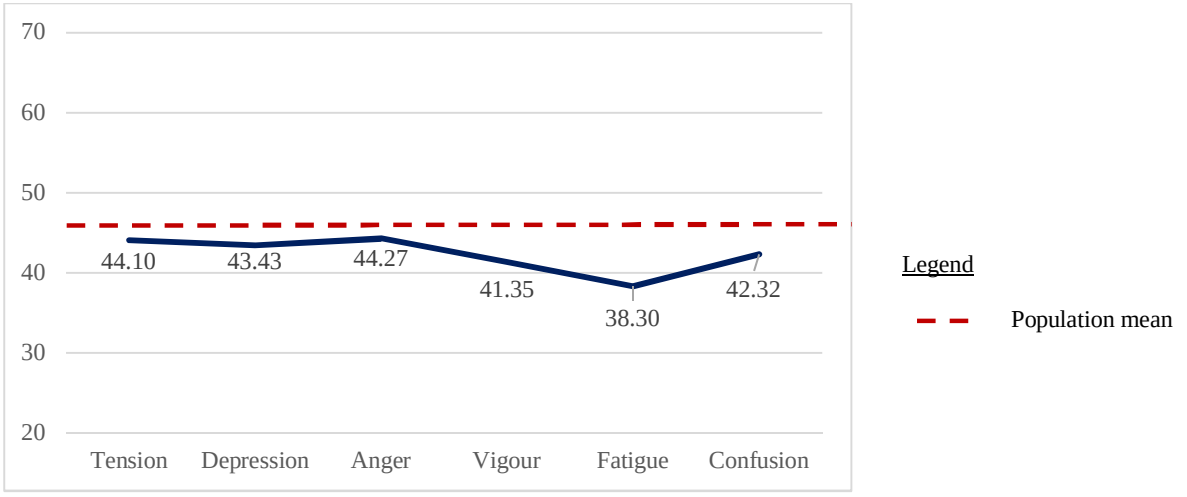


Table 2 presents the mean mood and performance scores of each shooter across the six matches. It is notable that all mood scores were below the normative mean values, and that performance scores were uniformly high which would be expected from elite shooters.

Table 2

Mean Mood and Performance Scores across Six Matches for each Shooter

ID	Tension	Depression	Anger	Vigour	Fatigue	Confusion	Performance (%)
F1	43.00	43.00	44.00	34.67	39.17	41.00	96.65
F2	46.00	43.00	44.00	39.33	36.00	41.00	93.35
F3	43.50	44.00	45.00	41.00	37.67	41.00	93.13
F4	42.00	43.00	44.00	47.17	38.17	42.67	92.59
F5	47.50	44.17	45.17	45.33	41.83	45.50	90.27
M1	44.00	43.00	44.00	41.50	39.00	41.00	94.06
M2	42.50	43.00	44.00	38.83	36.67	41.00	92.98
M3	43.00	45.17	44.50	39.83	40.50	45.83	90.06
M4	46.00	43.00	44.00	42.83	35.33	43.17	91.84
M5	43.50	43.00	44.00	43.00	38.67	41.00	91.95

Note. Shooter ID: F = female, M = male.

A 2 x 2 contingency table of mood and performance was prepared for the FET (see Table 3), sorting mood and performance scores into two categories of either “below mean” or

"above mean." Table 4 presents the results of the FET, which was significant (p = .024). In the below mean mood group, all six shooters except for one had above mean performance, while all four in the above mean mood group had below mean performance. Thus, only one person from below mean mood group was misclassified into above mean performance group. These results suggest that those with lower mood scores were more likely to have performance scores greater than the mean.

Table 3

A 2 x 2 Contingency Table of Mood and Performance

ID	Mood Category	Performance Category
F1	1	2
F2	1	2
F3	1	2
F4	2	1
F5	2	1
M1	1	2
M2	1	2
M3	2	1
M5	2	1
M8	1	1

Note. Shooter ID: F = female, M = male.
Mood/performance category: 1 = below mean; 2 = above mean.

Table 4

Cross-tabulations of Mood and Performance attained by Fisher's Exact Test

		Performance Category		
		Above Mean	Below Mean	Total Count
Mood Category	Above Mean	0	4	4
	Below Mean	5	1	6
Total Count		5	5	10

Note. FET was significant at p = .024, one-tailed. Only one person from the below mean mood group was misclassified into the below mean performance group.

Table 5 presents the mood profile distribution in the current study where 81.7% of the mood profiles were submerged, 11.7% iceberg, 1.7% surface, and 5% unclassified. These

results confirm that most of the elite shooters in this study had a submerged mood profile prior to their matches. No inverse Everest, inverse iceberg and shark fin profiles were reported.

Table 5

Distribution of Mood Profiles across Matches (N = 60)

Iceberg	Inverse Everest	Inverse Iceberg	Shark Fin	Submerged	Surface	Unclassified
7 (11.7%)	0 (0%)	0 (0%)	0 (0%)	49 (81.7%)	1 (1.7%)	3 (5%)

A Spearman rank-order correlation was conducted using the mean overall mood (where all six dimensions were summed for each match and averaged out) with mean performance scores across the six matches. The results indicated that mean overall mood was significantly negatively correlated with overall mean performance (r_s = -.842, p < .01; see Table 6).

Table 6

Mean Overall Mood and Mean Performance Scores of each Shooter across Six Matches

	Mean Overall	
ID	Mood Scores	Performance
F1	244.83	96.65
F2	249.33	93.35
F3	252.17	93.13
F4	254.33	91.84
F5	258.83	90.06
M1	246.00	92.98
M2	252.50	94.06
M3	269.50	90.27
M4	253.17	91.95
M5	257.00	92.59

Note. Non-parametric correlation showed that overall mean mood was significantly negatively correlated with overall mean performance (r_s = -.842, p < .01).

Table 7 presents the results of Spearman's correlation tests, where negative correlations were found between each mood dimension and performance (range = -.12 to -.84). Specifically, Depression (r_s = -.57, p < .01) and Confusion (r_s = -.84, p < .01) had a significant negative correlation with performance, indicating that high performance scores were associated with low Depression and Confusion scores.

Table 7

Non-parametric Correlations between Mean Mood Scores and Mean Performance Scores

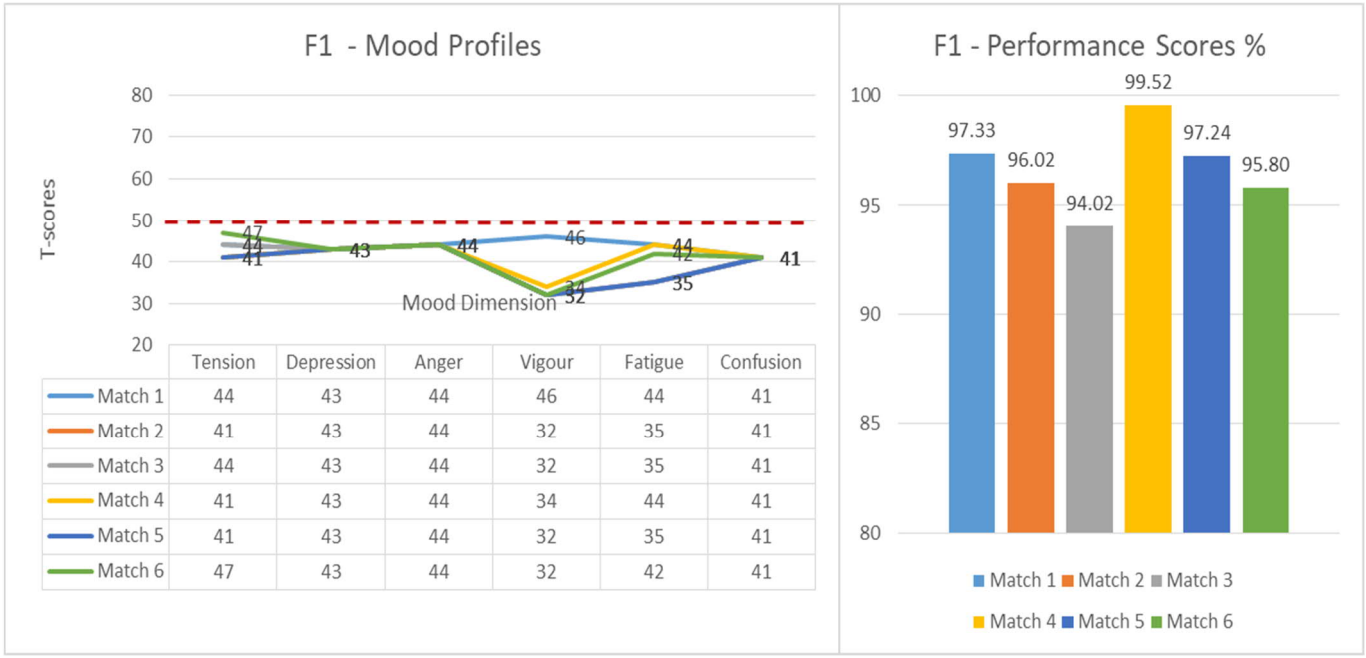
Scale	2	3	4	5	6	7
1 Tension	.16	.29	.21	-.03	.13	-.12
2 Depression		.95**	.10	.56*	.61*	-.57*
3 Anger			.19	.50	.49	-.47
4 Vigour				.13	.44	-.52
5 Fatigue					.35	-.20
6 Confusion						-.84**
7 Scores						

Note. *p < .05, ** p < .01.

Figures 4 to 13 show the mood profiles and performance scores for the 10 pistol shooters across six matches. It is apparent that the top two performing female shooters F1 and F2 (see Figure 4 and 5) and male shooters M1 and M2 (see Figure 9 and 10) had pre-performance mood profiles that were very similar and consistent across the six matches. With the exception of M1 (see Figure 9) who had one pre-performance mood profile classified as an iceberg profile, the best performing shooters mostly reported a submerged mood profile prior to performance. This was less evident for the six other shooters whose pre-performance mood profiles varied more across the six matches (see Figure 6 to 8 and 11 to 13). Hence, the findings are consistent with the notion that having a submerged profile (i.e., experiencing low levels of each mood dimension measured) is beneficial for performance in competitive pistol shooting, and supports the utility of mood profiling in facilitating competition preparation and performance.

Figure 4

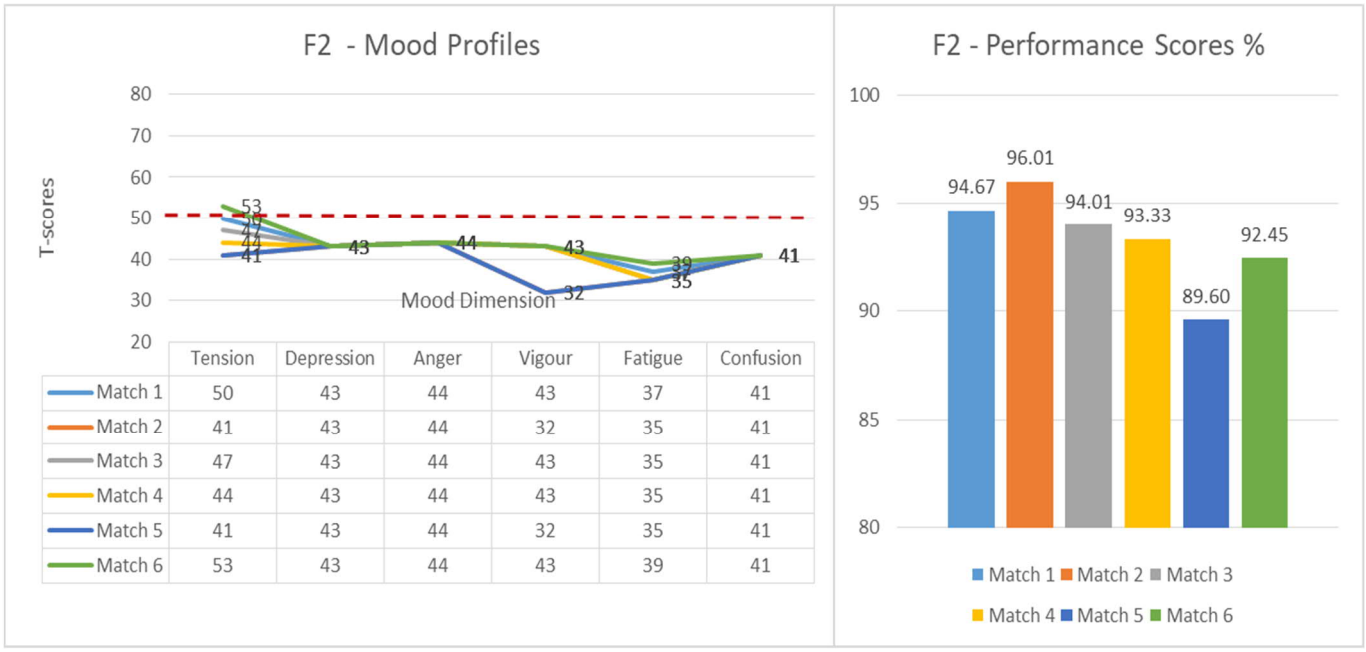
Mood Profiles and Performance Scores of Shooter F1



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	44	43	44	46	44	41
Match 2	41	43	44	32	35	41
Match 3	44	43	44	32	35	41
Match 4	41	43	44	34	44	41
Match 5	41	43	44	32	35	41
Match 6	47	43	44	32	42	41

Figure 5

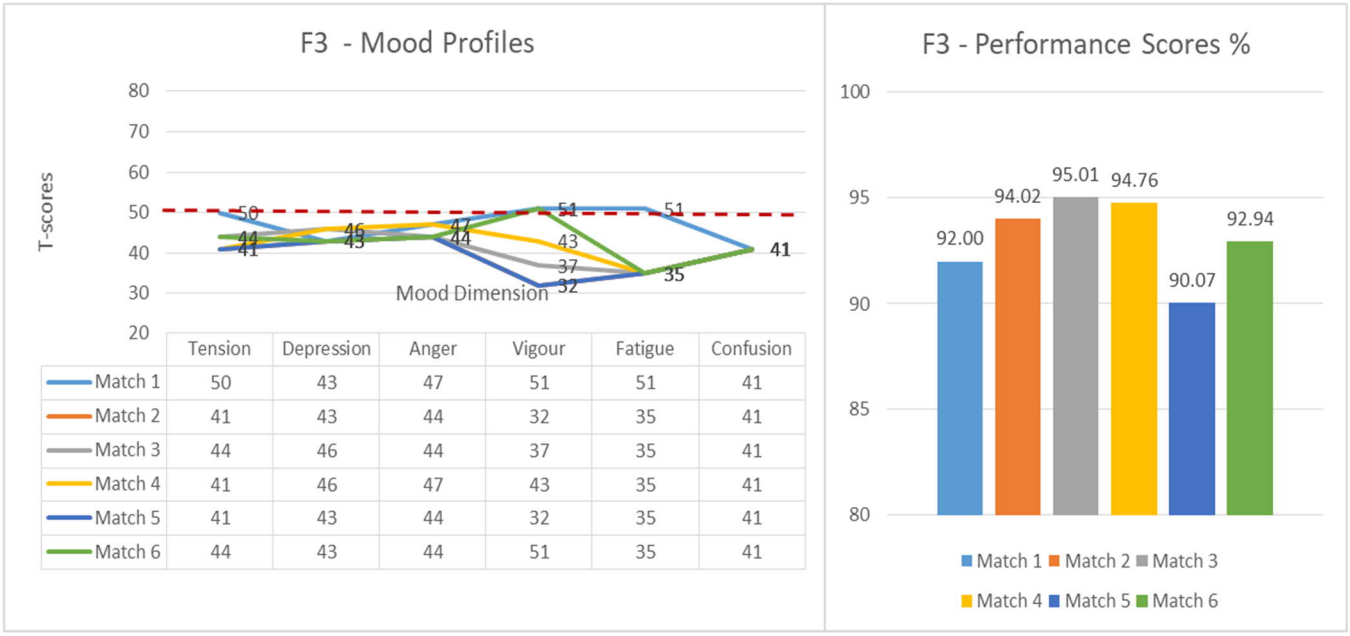
Mood Profiles and Performance Scores of Shooter F2



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	50	43	44	43	37	41
Match 2	41	43	44	32	35	41
Match 3	47	43	44	43	35	41
Match 4	44	43	44	43	35	41
Match 5	41	43	44	32	35	41
Match 6	53	43	44	43	39	41

Figure 6

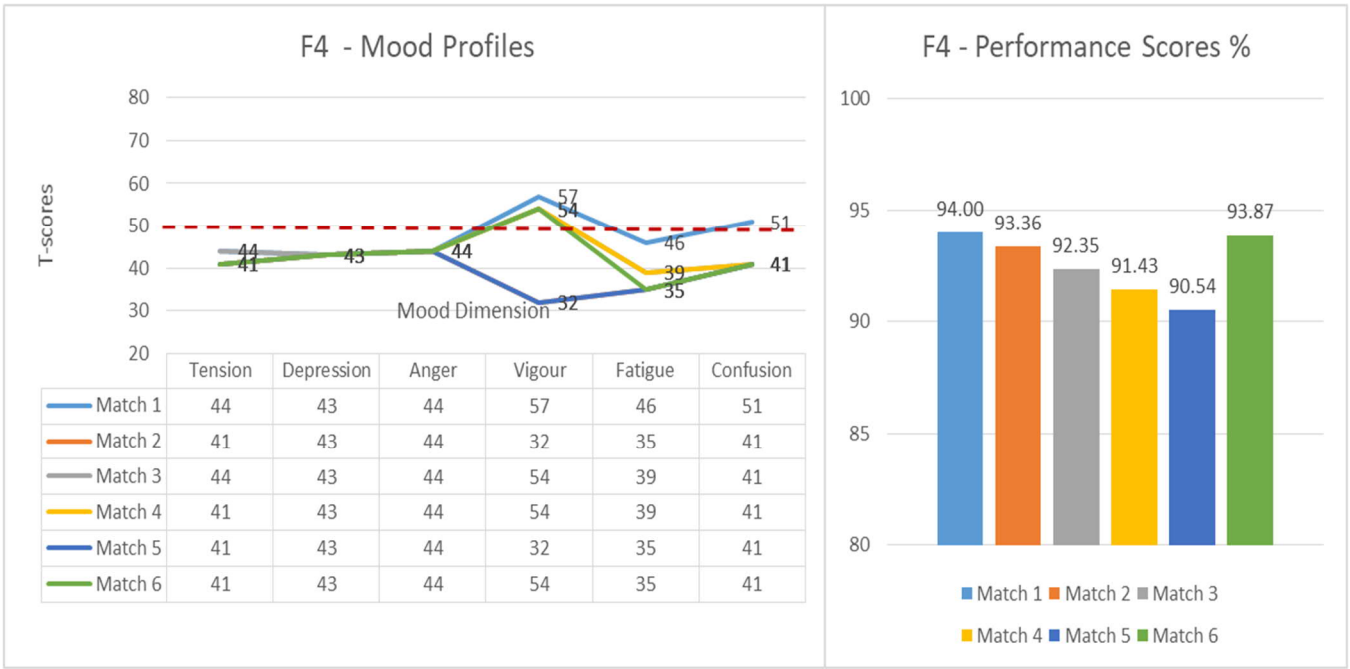
Mood Profiles and Performance Scores of Shooter F3



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	50	43	47	51	51	41
Match 2	41	43	44	32	35	41
Match 3	44	46	44	37	35	41
Match 4	41	46	47	43	35	41
Match 5	41	43	44	32	35	41
Match 6	44	43	44	51	35	41

Figure 7

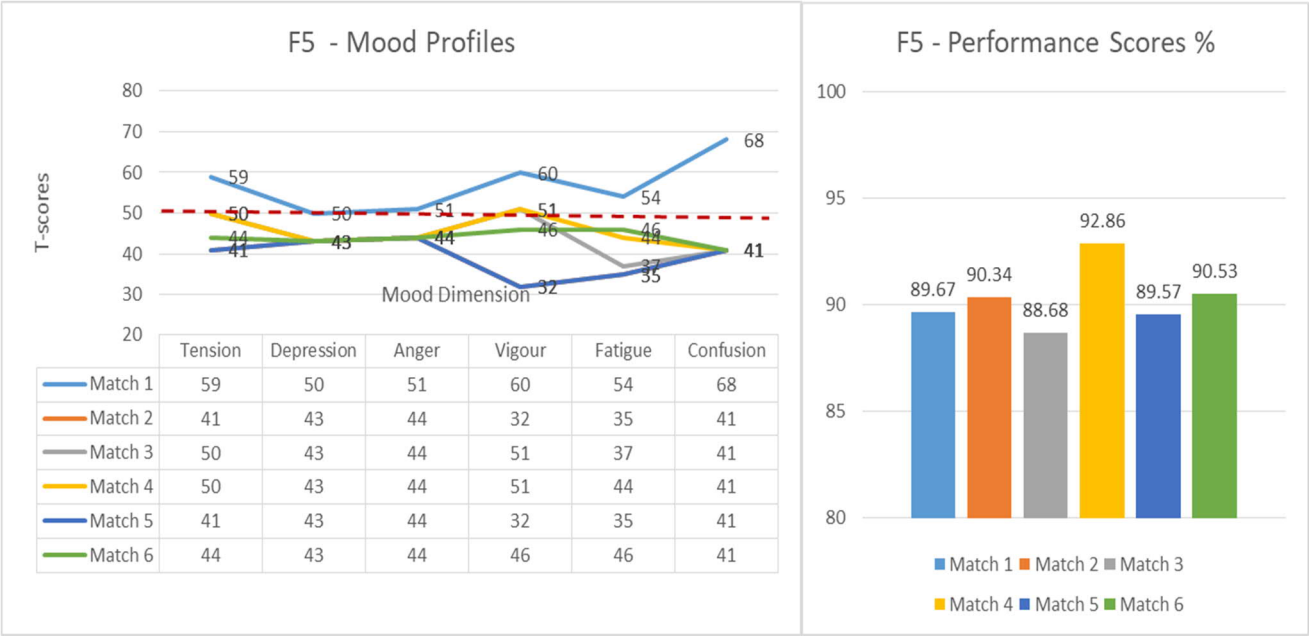
Mood Profiles and Performance Scores of Shooter F4



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	44	43	44	57	46	51
Match 2	41	43	44	32	35	41
Match 3	44	43	44	54	39	41
Match 4	41	43	44	54	39	41
Match 5	41	43	44	32	35	41
Match 6	41	43	44	54	35	41

Figure 8

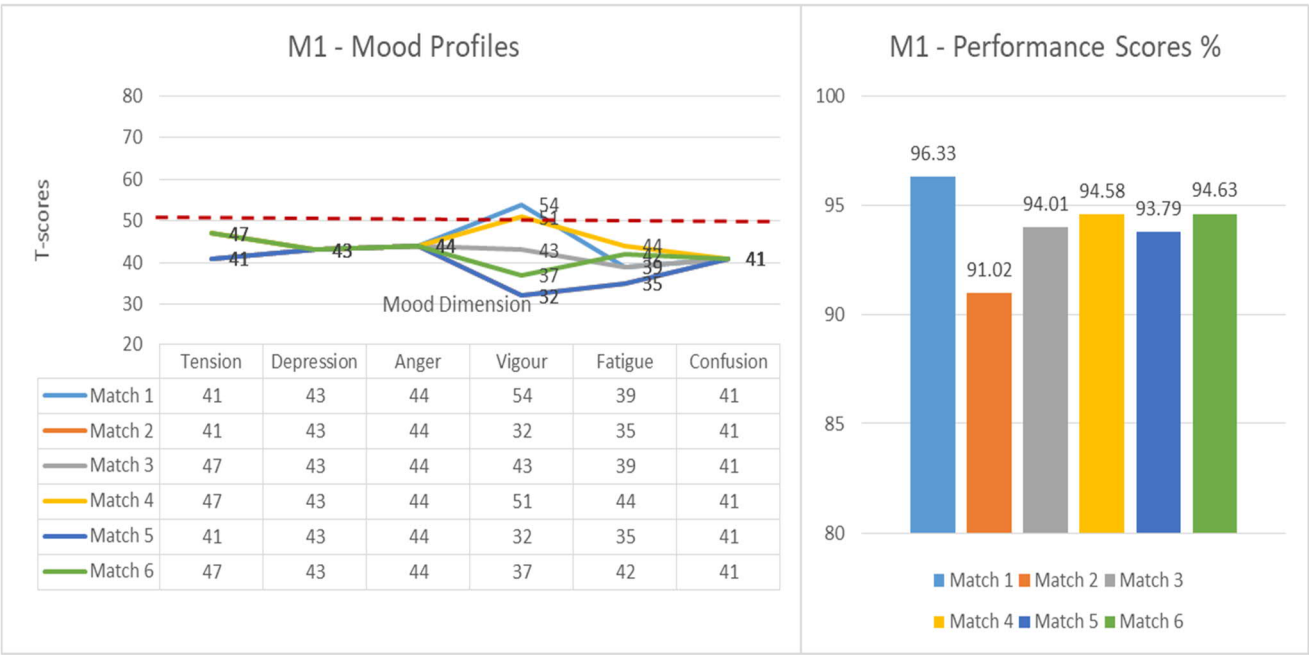
Mood Profiles and Performance Scores of Shooter F5



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	59	50	51	60	54	68
Match 2	41	43	44	32	35	41
Match 3	50	43	44	51	37	41
Match 4	50	43	44	51	44	41
Match 5	41	43	44	32	35	41
Match 6	44	43	44	46	46	41

Figure 9

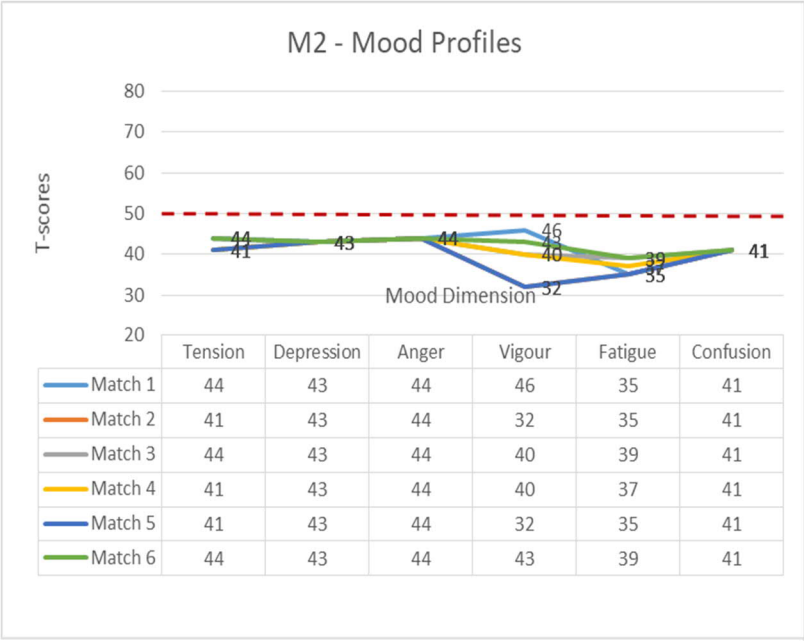
Mood Profiles and Performance Scores of Shooter M1



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	41	43	44	54	39	41
Match 2	41	43	44	32	35	41
Match 3	47	43	44	43	39	41
Match 4	47	43	44	51	44	41
Match 5	41	43	44	32	35	41
Match 6	47	43	44	37	42	41

Figure 10

Mood Profiles and Performance Scores of Shooter M2



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	44	43	44	46	35	41
Match 2	41	43	44	32	35	41
Match 3	44	43	44	40	39	41
Match 4	41	43	44	40	37	41
Match 5	41	43	44	32	35	41
Match 6	44	43	44	43	39	41

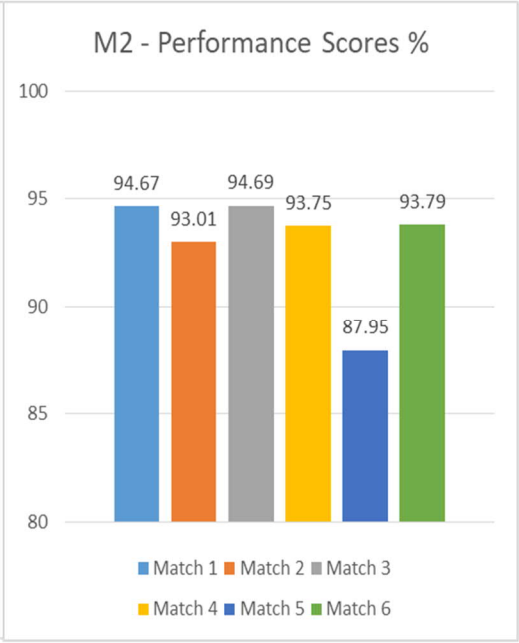
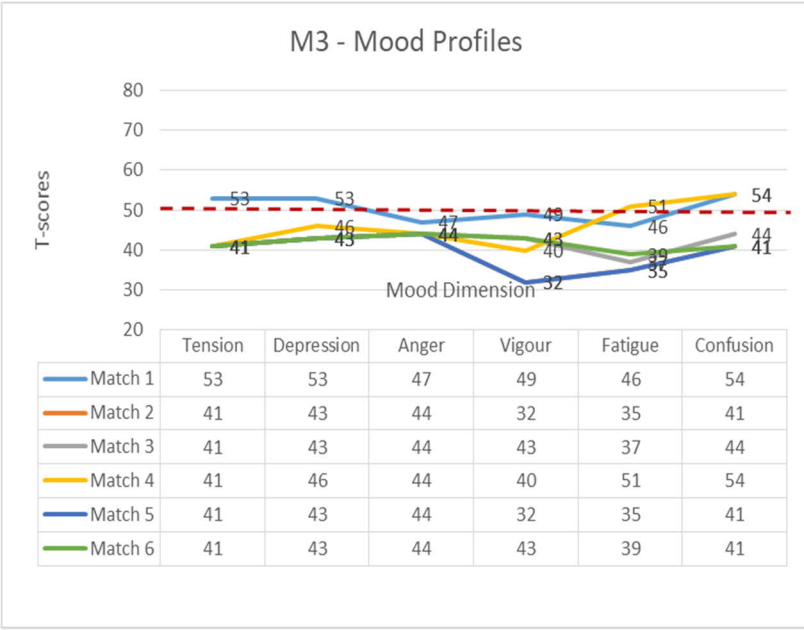


Figure 11

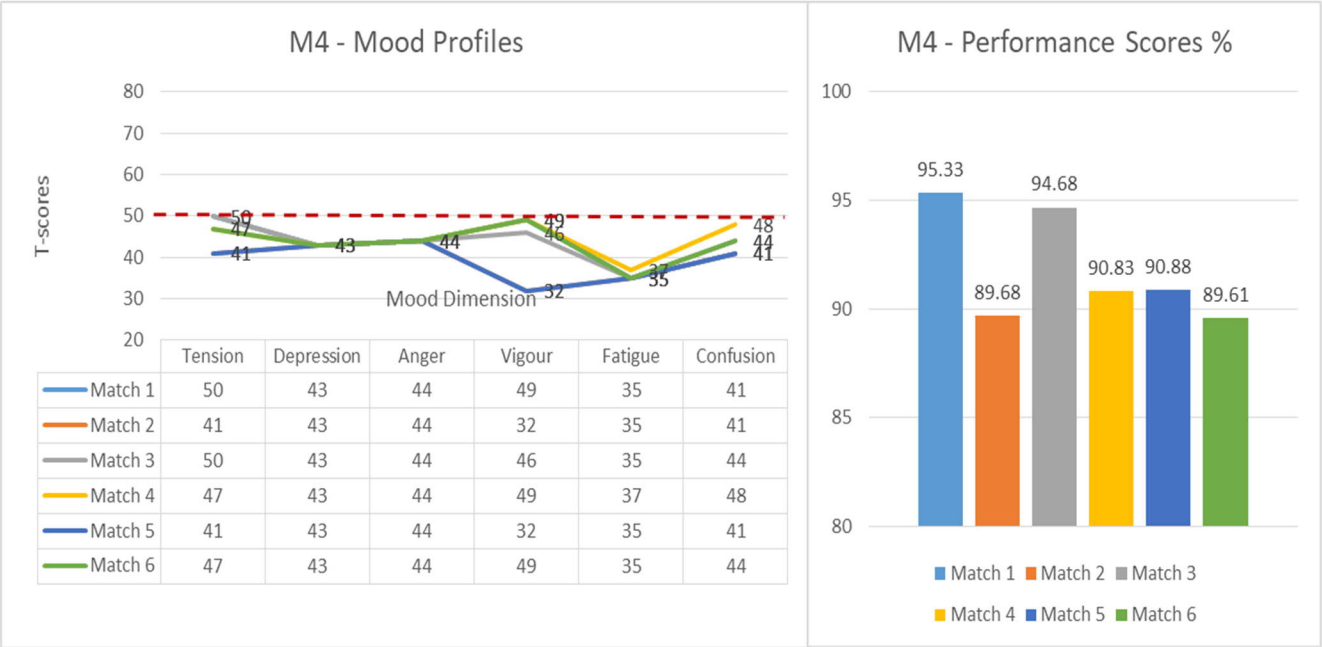
Mood Profiles and Performance Scores of Shooter M3



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	53	53	47	49	46	54
Match 2	41	43	44	32	35	41
Match 3	41	43	44	43	37	44
Match 4	41	46	44	40	51	54
Match 5	41	43	44	32	35	41
Match 6	41	43	44	43	39	41

Figure 12

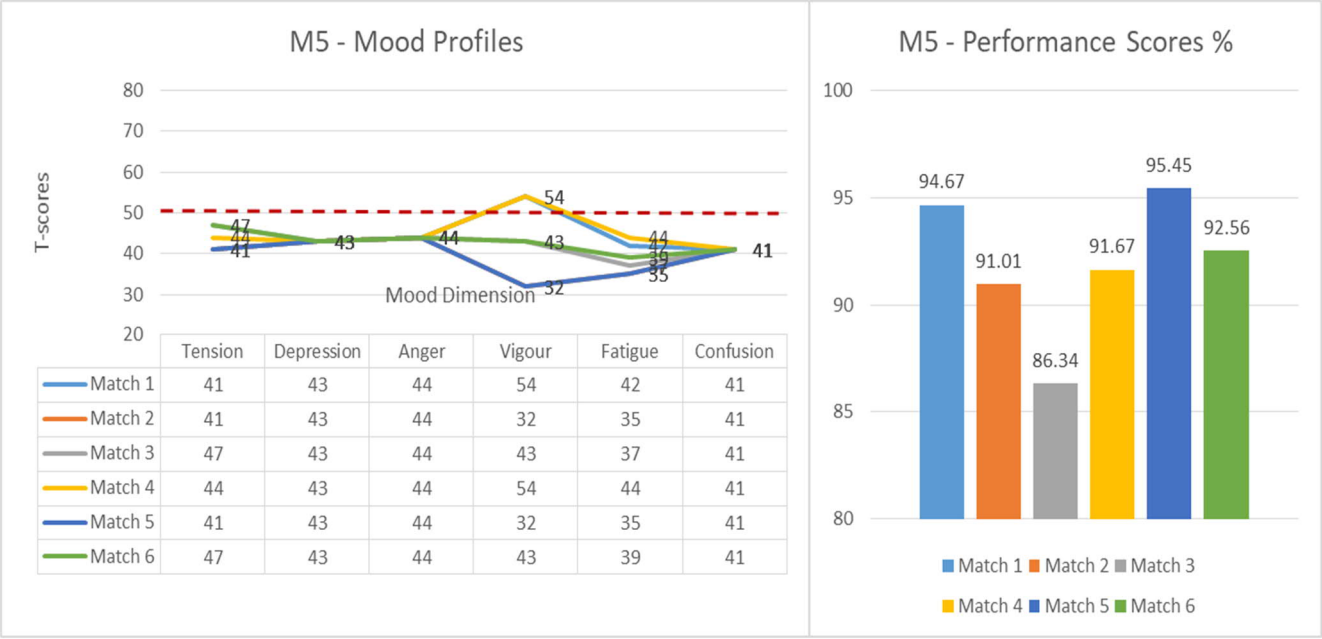
Mood Profiles and Performance Scores of Shooter M4



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	50	43	44	49	35	41
Match 2	41	43	44	32	35	41
Match 3	50	43	44	46	35	44
Match 4	47	43	44	49	37	48
Match 5	41	43	44	32	35	41
Match 6	47	43	44	49	35	44

Figure 13

Mood Profiles and Performance Scores of Shooter M5



	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Match 1	41	43	44	54	42	41
Match 2	41	43	44	32	35	41
Match 3	47	43	44	43	37	41
Match 4	44	43	44	54	44	41
Match 5	41	43	44	32	35	41
Match 6	47	43	44	43	39	41

Discussion

The study examined the relationship between mood and pistol shooting performance by exploring four research questions. The first finding was that overall mean mood was

significantly negatively correlated with overall mean performance, where shooters with lower overall mood scores had higher mean performance scores.

The second finding was that of the six mood dimensions, Confusion and Depression showed significant negative correlations with shooting performance. The scale of the correlation suggests that Confusion may be the worst aspect of mood to experience while engaging in pistol shooting, presumably because the sport requires very precise control of fine motor skills and a clear, focused mind. In a confused state of mind, an athlete's performance may be debilitated due to inefficient attentional and information processing. Depressed mood was also associated with poor pistol shooting performance. This has previously been shown to be the case in others sports (e.g., Hassmen & Blomstrand, 1995; Terry & Hall, 1996).

Depression influences the intensity, interaction, and performance effects of other mood dimensions, and the negative cognitive generalisations typical of depressed mood may have an omnipresent effect that acts as a catalyst for other unpleasant mood dimensions (see Lane & Terry, 2000). Depressed mood has also been associated with a focus on previous negative experiences, which may reduce perceptions of coping and ability (Rokke, 1993). Studies looking at emotional regulation has shown that depressive symptoms were associated with the frequent use of dysfunctional regulation strategies such as suppression and rumination (Campbell-Sills, Barlow, Brown, & Hofmann, 2006; Garnefski & Kraaij, 2006).

The worst pre-competition mood for a pistol shooter would be to experience both confused and depressed mood simultaneously. This is because Confusion may be heightened in the presence of depressed mood, hence debilitating performance to a greater extent by introducing attributional process associated with Depression (see Beck & Clark, 1988; Lane & Terry, 2000). For example, a shooter with a confused and depressed mood may not be as confident or focused in the present moment, may worry about their performance, and may subconsciously adjust or evaluate themselves such that they lose focus on poise and their pre-shot routine execution, eventually leading to poor performance.

The third finding was that the idiographic approach, by which mood and performance relationships were assessed for each individual shooter, did not provide the anticipated insights. This initial plan did not yield fruitful findings, which may be due to the small sample size and the low variance in mean mood scores across shooters. Only two shooters showed significant Vigour-performance relationships and the other shooters showed non-significant findings that were not very meaningful. Hence, a different method was used to analyse the dataset wherein mood and performance scores were averaged to measure the degree of association between individual shooter's mean mood scores and their mean performance scores. These scores were then categorised into above or below the mean for mood and performance, with a Fisher's exact test performed.

The findings showed that those with below mean mood scores were more likely to produce above mean performance scores, suggesting that those who reported low scores across all mood dimensions (i.e., those who reported a submerged mood profile) were more likely to perform well. Future studies should continue to explore the idiographic approach when exploring mood and performance in shooting, perhaps using a larger sample with more data points, which would provide greater statistical power for a study of this nature. An idiographic approach may be worthwhile in helping shooters to identify their ideal pre-competition mood profile and in the design of interventions to enhance their performance.

The three main findings above provided strong support for the final and most important finding that is a submerged mood profile may be the optimum pre-performance mood profile for a pistol shooter. In this study, a majority of the elite shooters reported a submerged mood profile prior to their matches (see Figure 2 for average mood profile). The results also suggest that those with below mean mood scores were more likely to score above mean performance scores. Thus, experiencing low levels of the mood dimensions measured may be the most facilitative pre-competition mood state for pistol shooting.

These findings are consistent with anecdotes from world-class shooters, and shooters and coaches with whom the first author has worked with, in which a good shooter is said to have physical control over their bodies and weapon, and learn not to let competition stir up negative emotions, tension or distracting thoughts. They also need to know how to "empty their minds", focus on their well-established routines and execute them well one shot at a time, which is the focus that many psychologists teach their athletes in sports like shooting, bowling and archery where holding attention to the present shot was key to performing (Hinitz, 2016). Elite archers also shared that the key to success was to have task-focused attention and to "focus on correct execution" and "disregard mistakes" (Robazza & Bortoli, 1998), taking it one shot at a time. Shooters should avoid thinking about achieving a high score, but instead focus on processes and routines, maintain a quiet mind free from the clutter of unproductive thoughts, excess analysis, and self-recrimination (Terry & Cei, 2014).

However when placed under pressure, some shooters commit the common mistake of evaluating their performance or analysing their shots in the hope of shooting better, giving rise to self-doubt and confusion which leads them to make adjustments to their technique rather than relying on what is well-established and within their control, i.e.., their pre-shot routines, which are most likely to lead them to successful executions of shots. Psychologists have termed this pattern of behaviours during pressure situations in sport as "choking", which involves the sudden deterioration of normally expert skills under pressure, usually relating to athletes trying too hard when they are extremely anxious, which eventually leads to poor performance as athletes struggle to complete their well-practised movements (Kremer, Moran, & Kearney, 2019). Choking stems from being anxious, with symptoms closely similar to those when one is physiologically aroused like tense muscles, shaky limbs, high heart rates and racing thoughts (Kremer et al., 2019). This unpleasant feeling is often called "paralysis by analysis", where athletes underperform by thinking too much (Jackson & Beilock, 2007). With this in mind, it is now understandable why Confusion can be so debilitative in a sport that is

all about precision and fine motor control, where shooters perform largely by relying on their muscle memory. Thus confusion in any form (be it self-doubt or uncertainty) will almost certainly debilitate performance, as it may lead athletes to “paralysis by analysis” if they attempt to recover or help themselves by overanalysing during the competition, resulting in a loss of their usual control of bodily movements.

In summary, it appears that the key success factor to shoot well is to be as cool and calm as possible and not be affected by any emotions or situations. This is best encapsulated by the approach of Richard Faulds, the Olympic champion in double trap shooting at the Sydney 2000 Olympics, whose sport psychologist introduced the image of an “ice man” to help the shooter remain emotionless during competition, encouraging him to “walk like an ice-man and think like an ice-man” (Campbell, 2001).

Conclusions and Future Research

The current study examined the relationship between mood and pistol shooting performance. The findings indicated that experiencing low levels of the mood dimensions measured and hence reporting a submerged mood profile, may be the most facilitative pre-competition mood profile for high performance in pistol shooting. Given the association between submerged mood profile and above average performance, it suggests that mood profiling may have utility in pistol shooting, especially since the environmental and contextual factors are more controlled than in many other sports. Shooting is a closed skill sport and performance outcomes are individualised (Terry, 1995). The finding that Confusion is most debilitative mood dimension for shooting is noteworthy. With this knowledge, sport psychology practitioners could discuss with shooters and coaches how to put in place routines and practices to reduce confused mood and to develop a mindset to cope with the uncertainties that are inherent in elite sport to prevent them from causing poor performance.

Mood profiling perhaps also has the potential to provide an edge to athletes in other sports that share similar characteristics (e.g., archery, bowling) by helping them develop

greater awareness and sensitivity to their moods, and how they relate to their performance. Most importantly, mood profiling and the follow-up conversations with their sport psychologist or coach that follow can accelerate awareness of their optimal mood states to facilitate mental and physical rehearsal in preparation for competition.

The strengths of the current study include having a homogenous sample, where all shooters were of a high standard. This provides confidence that the differences in shooting performance can be associated with individual variations rather than differing abilities. Furthermore, given that the shooters were already selected into the team, it is unlikely that they would not report their moods truthfully, reducing the possibility that athletes may "fake good" to gain selection, thereby limiting the effects of potential confounds, allowing for an ecologically-valid evaluation of how mood scores are correlated to performance. However, the caveat is that there is still a possibility that some may not be entirely truthful (e.g., to save face, to protect their pride) when doing the self-report. A limitation of this study includes having a small sample size, which may lead to a Type II error in the conclusions drawn. In addition, alternative methods such as hierarchical linear modelling might have been used to assess the relationship between mood and performance, rather than combining scores on all mood dimensions into a single metric of overall mood. The method used makes sense given that the study found that being as unemotional as possible, as reflected in low scores on all mood dimensions, was beneficial for pistol shooting performance, and hence having a single mood index (overall mean mood score) may have utility in identifying an optimal mood for pistol shooting.

Future research should continue to explore how mood profiling relates to performance in other sports that shares similar characteristics to pistol shooting (e.g., archery, bowling), and if an ideal mood profile exists for performance in these different sports. Future studies could also replicate our study with a larger sample of pistol shooters, particularly by collecting data from Singaporean shooters who are performing well on the world stage. Mood profiling can

serve as a valuable tool to Singaporean shooters in their competition preparation and as a general indicator of mental health. Researchers and practitioners could also identify strategies and interventions to assist individual shooters to regulate their mood following mood profiling, and to evaluate the efficacy of mood regulation strategies.

Finally, given the potential utility of mood profiling, future studies could investigate links with broader psychological concepts such as emotional intelligence and psychological well-being. Mood profiling may prove effective as a brief screening tool among larger sections of the Singaporean population to identify areas where individuals may benefit from intervention, to track their mental health status, or simply to generate self-awareness of mood variations linked to health status among specific populations (e.g., children, athletes, students, and the elderly). Overall, it appears that it is worth further investigating whether the mood profile clusters and mood profiling can be applied to a range of sport, occupational and health contexts.

References

Agotra, M. (2014, Apr). *In five months, Heena Sidhu went from hopeful to world no.1*. Firstpost. http://www.firstpost.com/sports/in-five-months-heena-sidhu-went-from-hopeful- to-world-no-1-1476067.html

Beck, A. T., & Clark, D. A. (1988). Anxiety and depression: An information processing perspective. *Anxiety Research, 1,* 23–36. https://doi.org/10.1080/10615808808248218

Beedie, C. J., Terry, P. C., & Lane, A. M. (2000). The profile of mood states and athletic performance: Two meta-analyses. *Journal of Applied Sport Psychology, 12,* 49–68. doi:10.1080/10413200008404213

Berger, B. G., Motl, R. W., Butki, B. D., Martin, D. T., Wilkinson, J. G., & Owen, D. R. (1999). Mood and cycling performance in response to three weeks of high-intensity, short-duration overtraining, and a two-week taper. *The Sport Psychologist, 13*, 444–457. DOI: https://doi.org/10.1123/tsp.13.4.444

Bless, H. (2001). Mood and the use of general knowledge structures. In L. L. Martin, and G. L. Clore. (Eds.), *Theories of mood and cognition* (pp. 9–26). Mahwah, NJ: Lawrence Elbaum.

Budgett, R. (1990). Overtraining syndrome. *British Journal of Sports Medicine, 24*, 231–236. http://dx.doi.org/10.1136/bjsm.24.4.231

Campbell-Sills, L., Barlow, D. H., Brown, T. A., & Hofmann, S. G. (2006). Acceptability and suppression of negative emotion in anxiety and mood disorders. *Emotion, 6*, 587–595. doi:10.1037/1528-3542.6.4.587

Campo, M., Champely, S., Lane, A. M., Rosnet, E., Ferrand, C., & Louvet, B. (2016). Emotions and performance in rugby. *Journal of Sport and Health Science, 8*, 595–600. https://doi.org/10.1016/j.jshs.2016.05.007

Campbell, D. (2001, Feb). Life support. *The Guardian.* Retrieved from https://www.theguardian.com/theobserver/2001/feb/18/features.magazine47

Craft, L. L., Magyar, T. M., Becker, B. J., & Feltz, D. L. (2003). The relationship between the Competitive State Anxiety Inventory-2 and sport performance: A meta-analysis. *Journal of Sport and Exercise Psychology, 25,* 44–65. doi:10.1123/jsep.25.1.44

Diment, G. M., & Terry, P. C. (2003). Mood variability, personality and swimming performance. *Australian Journal of Psychology, 55,* 176. Retrieved from http://web.a.ebscohost.com.ezproxy.usq.edu.au/ehost/pdfviewer/pdfviewer?vid=1&sid=562cd14a-0f80-4246-bcfc-9f79fe50f594%40sdc-v-sessmgr02

Garnefski, N., & Kraaij, V. (2006). Relationships between cognitive emotion regulation strategies and depressive symptoms: A comparative study of five specific samples. *Personality and Individual Differences, 40,* 1659–1669. doi:10.1016/j.paid.2005.12.009

Han, C., Parsons-Smith, R., Fogarty, G., & Terry, P. C. (2019, July). *Psychometric characteristics of the Brunel Mood Scale in a Singaporean context*. Poster presented at the 15th European Congress of Sport and Exercise Psychology, Munster, Germany.

Han, C. S. Y., Parsons-Smith, R. L., & Terry, P. C. (2020). Mood profiling in Singapore: Cross-cultural validation and potential applications of mood profile clusters. *Frontiers in Psychology, 11,* 1–9. https://doi.org/10.3389/fpsyg.2020.00665

Hanin, Y. L. (2000). *Emotions in sport*. Champaign, IL: Human Kinetics.

Hassmen, P. & Blomstrand, E. (1995). Mood state relationships and soccer team performance. *The Sport Psychologist, 9,* 297–308. https://doi.org/10.1123/tsp.9.3.297

Hinitz, D. (2016). *Bowling Psychology*. Human Kinetics.

Jackson, R. C., & Beilock, S. L. (2007). Performance pressure and paralysis by analysis: Research and implications. In D. Farrow, J. Baker, C. MacMahon (Eds.), *Developing sport expertise*: *Researchers and coaches put theory into practice* (pp. 126-140). London, UK: Routledge. https://doi.org/10.4324/9780203934937

Kremer, J., Moran, A. P., & Kearney, C. J. (2019). *Pure Sport: Sport Psychology in Action*. New York: Routledge.

Lane, A. M. (2007). The rise and fall of the iceberg: Development of a conceptual model of mood-performance relationships. In A. M. Lane (Ed.), *Mood and human performance: Conceptual, measurement, and applied issues* (pp. 1–33). New York: Nova

Lane, A. M. (2008). Mood and sport performance. In A. M. Lane (Eds.), *Sport and Exercise Psychology* (pp. 1–24). London, UK: Routledge.

Lane, A. M., Beedie, C. J., & Devonport, T. J. (2011). Measurement issues in emotion and emotion regulation. In D. Lavallee, J. Thatcher, & M. Jones (Eds.), *Coping and Emotion in Sport* (pp. 255–271). London, UK: Routledge.

Lane, A. M., & Chappell, R. C. (2001). Mood and performance relationships among players at the World Student Games basketball competition. *Journal of Sport Behavior,* 182–196.

Lane, A. M., & Terry, P. C. (2000). The nature of mood: Development of a conceptual model with a focus on depression. *Journal of Applied Sport Psychology, 12,* 16–33. doi:10.1080/10413200008404211

Lane, A. M., & Terry, P. C. (2016). Online mood profiling and self-regulation of affective responses. In R. J. Schinke, K. R. McGannon, & B. Smith (Eds.), *Routledge International Handbook of Sport Psychology* (pp. 323–333). London, UK: Routledge.

Lane, A. M., Terry, P. C., Devonport, T. J., Friesen, A. P., & Totterdell, P. A. (2017). A test and extension of Lane and Terry's (2000) conceptual model of mood-performance relationships using a large internet sample. *Frontiers in Psychology, 8,* 470. https://doi.org/10.3389/fpsyg.2017.00470

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

McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *Manual for the Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Services.

Moen, F., Myhre, K., & Sandbakk, Ø. (2016). Associations between emotions and performance in cross-country skiing competitions. *The Sport Journal, 19.* Retrieved from http://thesportjournal.org/article/associations-between-emotions-and-performance-in-cross-country-skiing-competitions/

Morgan, W. P. (1980). Test of champions: The iceberg profile. *Psychology Today, 14*, 92–99.

Parsons-Smith, R. L. (2015). *In the mood: Online mood profiling, mood response clusters, and mood-performance relationships in high-risk vocations*. Unpublished doctoral thesis, University of Southern Queensland, Toowoomba, QLD.

Parsons-Smith, R. L., Terry, P. C., & Machin, M. A. (2017). Identification and description of novel mood profile clusters. *Frontiers in Psychology, 8,* e1958. doi:10.3389/fpsyg.2017.01958

Prapavessis, H. & Grove, J. R. (1991). Pre-competitive emotions and shooting performance: The mental health and zone of optimal function models. *The Sport Psychologist, 5*, 223–234. Retrieved from http://journals.humankinetics.com/tsp-back-issues/tspvolume5issue3september/precompetitiveemotionsandshootingperformancethementalhealthandzoneofoptimalfunctionmodels

Prapavessis, H. (2000). The POMS and sports performance: A review. *Journal of Applied Sport Psychology, 12,* 34–48. https://doi.org/10.1080/10413200008404212

Quartiroli, A., Parsons-Smith, R. L., Fogarty, G. J., Kuan, G., & Terry, P. C. (2018). Cross-cultural validation of mood profile clusters in a sport and exercise context. *Frontiers in Psychology, 9,* 1949. doi:10.3389/fpsyg.2018.01949

Raglin, J. S. (2001). Psychological factors in sport performance: The mental health model revisited. *Sports Medicine, 31,* 875–890. https://doi.org/10.2165/00007256-200131120-00004

Renger, R. (1993). A review of the Profile of Mood States (POMS) in the prediction of athletic success. *Journal of Applied Sport Psychology, 5,* 78–84. doi:10.1080/10413209308411306

Robazza, C., & Bortoli, L. (1998). Mental preparation strategies of Olympic archers during competition: An exploratory investigation. *High Ability Studies, 9,* 219–235. https://doi.org/10.1080/1359813980090207

Rokke, P. D. (1993). Social context and perceived task difficulty as mediators of depressive self-evaluation. *Emotion and Motivation, 17,* 23–40. doi:10.1007/BF00995205

Rowley, A., Landers, D., Kyllo, L., & Etnier, J. (1995). Does the iceberg profile discriminate between successful and less successful athletes? A meta-analysis. *Journal of Sport and Exercise Psychology, 17,* 185–199. https://doi.org/10.1123/jsep.17.2.185

Schwarz, N. (2001), Feelings as information: Implication for affective influences on information processing. In L. L. Martin, and G. L. Clore. (Eds.), *Theories of mood and cognition* (pp. 9–26). Mahwah, NJ: Lawrence Elbaum.

Spielberger, C. D. (1991). *Manual for the State-Trait Anger Expression Inventory*. Odessa, FL: Psychological Assessment Resources.

Statistical Package for Social Sciences (Version 25.0) [Computer software]. Chicago, IL: SPSS.

Terry, P. C. (1995). The efficacy of mood state profiling with elite performers: A review and synthesis. *The Sport Psychologist, 9,* 309–324. https://doi.org/10.1123/tsp.9.3.309

Terry, P. C. (2005). In the mood: Mood profiling applications and mood regulation strategies. Retrieved from https://eprints.usq.edu.au/657/1/Terry1.pdf

Terry, P. C., & Cei, A. (2014). Shooting in India. In P. C. Terry, L. Zhang, Y. Kim, T. Morris & S. Hanrahan (Eds.), *Secrets of Asian sport psychology.* Retrieved from http: //peterterry.wix.com/books

Terry, P. C., & Hall, A. (1996). Development of normative data for the Profile of Mood States for use with athletic samples. *Journal of Sports Sciences, 14*, 47–48. https://doi.org/10.1080/10413200008404215

Terry, P. C., Lane, A. M., & Fogarty, G. J. (2003). Construct validity of the Profile of Mood States-Adolescents for use with adults. *Psychology of Sport and Exercise, 4*, 125–139. (pp. 119–130). Hauppauge, NY: Nova Science.

Terry, P. C., Lane, A. M., Lane, H. J., & Keohane, L. (1999). Development and validation of a mood measure for adolescents. *Journal of Sports Sciences, 17,* 861–872. doi:10.1080/026404199365425

Terry, P. C., & Lane, A. M. (2010). *User guide for the Brunel Mood Scale*. Toowoomba, QLD: Peter Terry Consultants.

Terry, P. C., & Lane, A. M. (2011). Moods and emotions. In T. Morris & P. C. Terry (Eds.), *The new sport and exercise psychology companion* (pp. 63–87). Morgantown, WV: Fitness Information Technology.

Terry, P. C., & Slade, A. (1995). Discriminant effectiveness of psychological state measures in predicting performance outcome in karate competition. *Perceptual and Motor Skills, 81*, 275–286. doi:10.2466/pms.1995.81.1.275

Terry, P. C., Stevens, M. J., & Lane, A. M. (2005). Influence of response timeframe on mood assessment. *Anxiety, Stress, and Coping, 18,* 279–285. doi:10.1080/ 10615800500134688

Terry, P. C., & Youngs, E. (1996). Discriminant effectiveness of psychological state measures in predicting selection during field hockey trials. *Perceptual and Motor Skills, 82,* 371–377. https://doi.org/10.2466/pms.1996.82.2.371

van Wijk, C. H., Martin, J. H., & Hans-Arendse, C. (2013). Clinical utility of the Brunel Mood Scale in screening for post-traumatic stress risk in a military population. *Military Medicine, 178,* 372–376. doi:10.7205/MILMED-D-12-00422

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063–1070. doi:10.1037/0022-3514.54.6.1063

Winkielman, P., Knauper, B., & Schwarz, N. (1998). Looking back at anger: Reference periods change the interpretation of emotion frequency questions. *Journal of Personality and Social Psychology, 75*, 719–728. https://doi.org/10.1037/0022-3514.75.3.719

Chapter 5: General Discussion and Conclusion

In this chapter, the main findings from this PhD research are presented in section 5.1 and their implications are discussed in an integrated manner in section 5.2. The strengths and limitations of this project are discussed in section 5.3. Potential future research directions based on the findings from this thesis are in section 5.4 and general conclusions are in section 5.5.

5.1 Main Findings

5.1.1 Factorial Validity of the BRUMS and Generalisability of Mood Profiles in Singapore

Study 1 represents a first attempt to investigate mood responses in an English-speaking, Asian and multi-ethnic Singaporean sample using the BRUMS, a validated measure of mood. The study contributes to the literature by providing evidence of the factorial validity of the BRUMS for use in Singapore. Multisample analyses also supported the invariance of the measurement model in different subsamples, where it was demonstrated that the BRUMS was consistent across gender, age group, and sport participation. A set of local norms has also been generated, which will be meaningful for local practitioners and researchers when using the BRUMS. Study 1 also adds on the growing list of published studies that shows evidence of the psychometric robustness of the BRUMS for mood assessment across different cultures (e.g., Rajkovic, 2014; Terry et al., 2012; Zhang et al., 2014).

Next, the six mood profiles that were previously identified in the literature (see Parsons-Smith et al, 2017; Quartiroli et al., 2018), namely the iceberg, inverse iceberg, inverse Everest, shark fin, submerged, and surface profiles, were also clearly retrieved among our sample of Singaporean respondents. Thus, Study 2 provides support for the cross-cultural generalisability of these mood profile clusters, making a significant contribution to the literature on mood profiling and more specifically, to the validation of the BRUMS as a tool

for mood profiling in Singapore. When considered together with the validation of the BRUMS in Study 1, many potential applications of mood profiling are feasible. These two sets of findings pave the way for further investigations of the antecedents, correlates, and behavioural consequences of mood responses among sport and non-sport participants in Singapore. The mood profile clusters identified also provide local practitioners with a way to better interpret BRUMS test scores.

5.1.2 Associations between Demographic Variables and Mood Profile Distribution

In Study 2, the identification of associations between demographic variables and the incidence of mood profiles provides support that mood profiling can be used for various purposes, depending on the target group of interest. This information could serve to help policymakers with healthcare policies and resource planning that more aptly meet the needs of the local population. For example, Study 2 found that certain groups (e.g., women, younger ages of 25 or below, Malay respondents) were over-represented in negative mood profiles (e.g., inverse iceberg, inverse Everest or shark fin), which coincides largely with what was previously found in a local study on the prevalence of major depressive disorders (MDD), where MDD was found to be significantly higher among females, younger age group of 18 to 34 years old, Indians, and those whom are divorced or separated (Chong, Vainganker, Abdin, & Subramaniam, 2011). In addition, Study 2 also found that the incidence rate of the most negative mood profile, the inverse Everest profile was 5%, which is close to the reported lifetime prevalence rates of 6.3% for major depressive disorders as found in the 2016 Singapore Mental Health Study (Singapore Institute of Mental Health, 2018). Taken together, the findings from Study 2 and Chong et al. (2011) suggest that the BRUMS could potentially serve as an early detection tool for mental health disorders in Singapore, although further studies are required to confirm this. Practitioners and policy makers could also make use of the findings of various demographic groups to strategise a more rational allocation of

resources to these vulnerable groups, focusing on increasing the awareness and facilitating care towards these populations. Such a targeted approach may be more effective in the longer run in encouraging help-seeking and timely diagnosis and treatment for more vulnerable groups, which potentially reduces the burden on the public health system. A potential feasible application is to establish early detection or screening system in secondary schools or tertiary institutions to reach out to the vulnerable younger age group, with the BRUMS playing a part.

Another noteworthy finding is that respondents who engaged in sport and physical activity were over-represented in the positive iceberg mood profile and under-represented in the more negative inverse Everest, inverse iceberg, and submerged profiles. Conversely, the lack of participation in sport was associated with experiencing negative moods, as evident in the over-representation in the inverse Everest, inverse iceberg, and submerged profiles. This is not surprising as multiple studies have previously found that physical activity was the most effective of 10 general behavioural techniques for self-regulation of moods in normal populations (Thayer et al., 1994), and that exercise "was self-rated as the most successful at changing a bad mood, fourth most successful at raising energy, and third or fourth most successful at tension reduction" (p. 921). Although this research study is correlational in nature and therefore the direction of effects of sport participation and mood cannot be ascertained, many previous studies have found support for the positive effects of sport on mood or the effects of mood on physical functioning (Beedie et al., 2000; Morgan, 1985; Terry and Lane, 2000). In addition, research has increasingly shown that physical activity is an effective intervention to promote physical and psychological benefits for both healthy and clinical populations (Penedo & Dahn, 2005; Thøgersen-Ntoumani et al., 2005; Biddle & Asare, 2011). Thus the present results are certainly consistent with this growing evidence base. On the other hand, negative effects of physical inactivity or sedentary behaviour on various mental health outcomes have also been found. Sedentary behaviour was found to be

associated with depression, anxiety and lower self-esteem (e.g., Edwards & Loprinzi, 2016; Proper et al., 2011; Teychenne et al., 2015; Thyfault et al., 2015). Practitioners and clinicians can have greater confidence on the efficacy of physical activity as a form of intervention to improve their clients' physical and mental wellbeing.

5.1.3 The Utility of Mood Profiling in the Sport of Pistol Shooting

The final study in this PhD research was an applied study that investigated the relationship between mood and pistol shooting performance by looking at pre-performance mood states and subsequent shooting performance during a competition. Study 3 represents one of the first few studies that investigated the relationship between mood profiling and shooting performance. The study found that pistol shooters with lower mood scores had higher performance scores. Typically, the shooters reported a *submerged mood profile* prior to competition. These findings suggest that a key success factor to perform well as a pistol shooter is to be as cool and calm as possible, to stay in the present moment, focused on the execution of task-focused processes and not be affected by any emotions or situations. An anecdote that aptly represents this finding involves a strategy used by Richard Faulds, the British Olympic champion in double trap shooting at the Sydney 2000 Olympics. Faulds worked with his psychologist to come up with the self-image of the "ice man", to encapsulate it into his mental rehearsals which would prime him to be emotionless during competition, and to "walk like an ice-man and think like an ice-man" (Campbell, 2001).

Therefore Study 3 had demonstrated the utility of mood profiling for pistol shooting performance by establishing the link between having a submerged mood profile pre-competition and subsequent above average performance. This provides strong impetus for future research to continue exploring the potential applications of mood profiling in different sports, for the purpose of understanding the optimal pre-competition mood states that are associated with peak performance.

5.2 Implications

Based on the findings above, there are several practical, clinical, and theoretical implications. Firstly, establishing the factorial validity of the BRUMS in Singapore suggests the potential for it to be a universal measure of mood, though more cross-cultural validation studies will have to be conducted. Secondly, the BRUMS and its related negative mood profiles may potentially serve as an early detection tool for mental health issues if strong associations between the BRUMS and other measures of mental health can be established. Thirdly, mood profiling may play a part for the larger healthy populations by augmenting efforts to enhance mental health literacy and health promotion efforts nation-wide, by encouraging people to recognise the importance to taking ownership of their own mental and physical health. Finally, with the evidence collected about the utility of mood profiling in predicting shooting performance, practitioners can now more confidently use it as a tool to help their shooting athletes train and prepare for their competitions and continue to evaluate and strengthen the applied value of mood profiling in shooting. These implications are discussed in greater depth below.

5.2.1 The BRUMS as a potential universal measure of mood

The findings from Study 1 and 2 provides further impetus to explore the generalisability of mood profiling across other diverse populations. Most importantly, our study is the first in an Asian multicultural society to confirm the factorial validity of the BRUMS and its measurement invariance across different demographic groups (e.g., age, gender), in its original form and language as first devised in the West (i.e., United Kingdom). These findings suggest that the BRUMS may also potentially serve as a valid mood assessment in other Asian societies with a similar ethnic make-up or cultural groups, which further suggests a larger potential of the BRUMS becoming a universal measure of mood.

However, more validation studies across diverse cultures will have to be conducted to collect more evidence for this prospect.

5.2.2 BRUMS as a potential early detection tool for mental health issues

Interestingly, Study 2's findings on the associations between demographic variables of gender and age groups and the distribution of mood profiles are in line with the national statistics (e.g., prevalence rates, gender, age) on Major Depressive Disorders (MDD). For example, 5% of the sample of 1,444 surveyed reported an inverse Everest mood profile, which is the most negative mood profile. This is close to the reported lifetime prevalence rates (6.3%) of Major Depressive Disorders in the 2016 Singapore Mental Health Study (Singapore Institute of Mental Health, 2018). However, it remains to be seen if the inverse Everest profile, or other negative mood profiles, may serve the function of early detection or provide tell-tale signs of mental health concerns. Previous studies had used the BRUMS as a screening tool for potential risk of post-traumatic stress disorder (PTSD) in the military (see van Wijk et al., 2013). A moderate correlation was also previously found between the BRUMS Depression subscale and the depression scale of the Hospital Anxiety and Depression Scale (HADS; Terry, Lane et al., 2003; Zigmond & Snaith, 1983). Thus, more research has to be conducted in a general health setting, by correlating the BRUMS with other validated measures of mental health, in order to find further evidence of the efficacy of the BRUMS as an early identification tool of mental health issues in the general population.

5.2.3 Mood profiling as a tool to augment mental health literacy and health promotion efforts

It is proposed that mood profiling has positive prospects in augmenting mental health literacy and promotion if incorporated into mental health education and literacy programmes and initiatives in local schools, workplaces, and community. As Thayer (1997) described,

moods are a barometer of our bodily states that involve arousal, fear, and other psychological reactions. The introduction of mood profiles to the general public can capture interest and generate awareness by providing people with a common language, visual representation and a "window" into their mood and their mental health.

Based on the findings of the 2016 Singapore Mental Health Study, it was revealed that 1 in 7 people in Singapore has experienced a mental disorder in their lifetime (Subramaniam et al., 2020). Major Depressive Disorders (MDD) have been found to be the most common mental illness in Singapore, with nearly 1 in 20 having experienced it at some point in their life, affecting more women than men (National Council of Social Services, 2017). The 2016 Singapore Mental Health Study concluded that there is a need to increase the awareness and literacy of mental health among Singaporeans to raise the awareness and understanding on mental health issues and its costs to individuals and the society, and the importance of seeking treatment early (Singapore Institute of Mental Health, 2018). Local mental health professionals have also advocated for more preventative work (Lim, 2019). This includes having a more structured mental health literacy education in schools, where young students learn emotional resilience by learning to deal with failures and mistakes in a nurturing environment for them to bounce back which helps them develop a sense of responsibility, mastery, and confidence.

Studies of mental health literacy suggest that poor recognition of symptoms, the lack of knowledge and understanding about treatment options, and stigma related to mental disorders create barriers to help-seeking, all of which adversely affect treatment outcomes (e.g., Burns & Rapee, 2006; Thompson, Hunt, & Issakidis, 2004). It is proposed that mood profiling has the potential to fill this identified gap in mental health literacy by providing people with a common language and visual representation of their mental health. At the present moment, the poor mental health awareness and literacy society-wide may be attributed

to a lack of accessible indicators of mental health for self-assessment, and the general failure to recognise that a healthy individual is in the best position to protect or enhance his or her mental well-being. Thus, the first step to enhance mental wellness of individuals could be to provide them with personalised information that can be attained quickly and understood easily. The BRUMS, being short and easy to complete, could be placed online or on a mobile application to be made available to the masses, which can serve as a potential self-help tool as part of any mental health education and outreach campaigns in schools, workplaces, or the community. One successful example is that of Lim and Terry (2011), who started the *In the Mood* webpage, which consists of an online version of the BRUMS with an immediate generation of a mood profile, giving confidence that the proposed idea can be successfully implemented. After submitting their responses on the *In the Mood* website, respondents get a summary of their profile that is easy to understand, with possible mood regulation actions to consider taking. If the strengths and implications of various mood profiles are provided, along with strategies to enhance mood and well-being, the availability of such personalised self-help knowledge could encourage individuals to take a more active approach to manage their own mood and mental well-being.

A foreseeable way in which mood profiling could reach the masses in Singapore may be to capitalise on the current successful efforts of the Singapore Health Promotion Board (HPB), through their *Healthy 365* mobile application. Since 2015, the HPB has had huge success in nudging local residents to adopt a healthier lifestyle by partaking in physical activities through a series of community initiatives on a national scale such as the “National Steps Challenge”, the “Lose to Win Challenge” and “Sundays at the Park” (see Singapore Health Promotion Board, n.d.). Activity trackers or pedometers have been given free-of-charge to residents to track their physical activity, and those who consistently meet daily recommended physical activity levels are rewarded with various incentives. These initiatives

have had great success and brought about greater awareness on the importance of physical activity, which has improved participation rates (see Rohaidi, n.d.; “National Steps Challenge”, 2017). Given the success of the HPB in promoting better physical health, there is no better time than right now for health authorities and policy makers to explore accessible and affordable means to enhance the nation’s mental health promotion. Mood profiling certainly has good prospects to fill the role, to generate interest and awareness amongst citizens by providing a common language and a visual representation of their mental health, in the same vein as to how activity trackers had huge success in nudging positive behavioural change.

For the reasons stated above and considering the potential role that mood profiling can play in augmenting current health promotion initiatives, it is recommended that local health authorities kick start campaigns to shift the mindset of the general public that each individual can take active control of not just their physical health, but also their mental health, so as to take the nation’s health promotion effort to the next level. Mood profiling could be introduced as part of these efforts to help people understand where they stand in terms of mental health, and how adopting healthy behaviours like physical activity can help to enhance positive energy (i.e., vigour) and reduce negative effects (e.g., anger, tension, depression, etc.), which eventually contributes to overall health. This is consistent with Study 2, which found that respondents who participated in sport and physical activity more often reported a positive mood profile, compared to non-participants. Two positive outcomes are likely to be attained if this recommendation is implemented. The first outcome is that when individuals receive personalised mental health information in the form of a mood profile and associated strategies to maintain wellbeing or to seek help, they more rapidly internalise that good health requires the active management of both their physical and mental health (Seifert, Chapman, Hart, & Perez, 2012). This is desirable for health promotion as internalisation of motives has been

shown to sustain positive behaviours over time (Deci & Ryan, 2012). The second positive outcome is that local health authorities will be heeding the call by mental health professionals to enhance mental health literacy by simply leveraging on a successful health promotion campaign that already has a wide outreach with the general populace. This is likely to be much more effective in capturing the target audience and delivering the necessary lessons, rather than pursuing multiple different campaigns to improve mental health awareness.

In summary, mood profiling has the potential to augment current mental health literacy efforts and health promotion campaigns. Local mental health experts have repeatedly called for the need to strengthen mental health literacy amongst the general populace, and mood profiling is proposed to be able fill this gap. However, more data will need to be collected, and more studies will need to be conducted to establish the meaning and implications of each mood profile in the local population, and how it correlates with other validated measures of mental health, especially since the present research only looked at a small section of the entire Singapore population. More substantially, the findings on how various groups are more susceptible to negative mood profiles will also help health authorities, clinicians and practitioners design more effective policies and interventions.

5.2.4 Expanding the Utility of Mood Profiling in Pistol Shooting

In Study 3, mood profiling was shown to have utility to predict pistol shooting performance. Specifically, the shooters who reported a submerged mood profile prior to performance were found to shoot better. With this relationship established, sport psychologists, coaches, and practitioners can have greater confidence when using mood profiling as a tool or technique to prepare their shooting athletes for training and competition. Mood profiling could first be introduced to all shooting athletes, allowing them to gain awareness of their own mood states, and to help them realise what their ideal pre-performance mood states feel like. With the knowledge that a submerged mood profile is facilitative of

shooting performance, it is possible to have a more structured training intervention that centres on mood profiling as a tool for baseline measurement and ongoing evaluation to help shooters learn the strategies and techniques that are effective in helping them arrive at their ideal pre-performance mood state. A systematic approach and the regular assessment and evaluation of progress will likely bring about clear returns in a closed-skill sport like pistol shooting, where the result depends on precision and the ability to remain cool and calm in intense competition environments. Sport psychologists must also continue strengthening the applied value of mood profiling for shooting by documenting the various unique ways athletes use to reach their ideal pre-performance mood states.

5.3 Strengths and Limitations

For Study 1 and 2, the strengths include having a sample that is proportionate to the ethnic distribution of the Singaporean population. This was deliberately planned according to the principles of stratified sampling, which is used to help researchers to improve precision and reduce error relative to simple random sampling and ensures that observations from all relevant strata are included in the sample (Salkind, 2010). Prior to the start of this research, statistics on the ethnic distribution of the Singapore population were attained from the Singapore Department of Statistics. Then a random sample of population members from within each stratum (i.e., Chinese, Malay, Indian, and Others) were recruited. This led to a final sample that was close to the distribution of the multiethnic population, which allows for the generalisation of the findings from this study to the general population in society. The second strength relates to the study's same size of 1,444, which was more than adequate for a Confirmatory Factor Analysis (CFA) of the BRUMS with 24 items, as Bentler (1995) had recommended a minimum ratio of 10 participants to 1 parameter for a CFA. Nonetheless, when participants were distributed across the six identified mood profiles, the number of participants in some cells became very small (see Chapter 4), which represents a limitation as

some findings (e.g., relating to ethnicity and education level) must be treated with caution. In addition, the least reported mood profiles, one of which is the inverse Everest profile (reported by about 5% of the sample) would require a much larger overall sample in order to conduct a detailed demographic analysis. A more deliberate method of population sampling according to the variable of interest (e.g., ethnicity or age) would be required to take into account the margin of error for the overall prevalence estimate of mental health conditions and associations with the incidence of the different mood profiles across various demographic groups (see Subramaniam, Abdin, Picco, Vaingankar, & Chong, 2014).

Another strength of Study 1 is that it is the first study that examined mood assessment and mood profiling in a multi-ethnic Asian population, in the English language, which allowed for cross-cultural comparisons with other similar studies published in English, furthering understanding of the subject area and its potential applications. On the other hand, a limitation is that only English-speaking Singaporean citizens were recruited to participate in this study, which means the ability to generalise findings from this study to local residents only proficient in languages other than English is limited. These are typically older generation individuals born prior to Singapore's independence in 1965, whom did not receive an English-medium education.

Moving on to Study 3, its strengths include having a homogenous sample, elite shooters of a high standard, which provides confidence that the differences in shooting performance can be associated with individual variations rather than differing abilities. There were two limitations for Study 3. Firstly, only a self-report measure, the BRUMS, was used to assess the athlete's pre-competition state. Future studies could consider having a more holistic assessment of the athlete which could involve physiological or neurophysiological measures (e.g., heart rate variability) which have been associated with shooting performance (Ortega & Wang, 2018). Secondly, the small sample size in Study 3 makes it prone to a Type II error in

the conclusions drawn. A larger sample of elite pistol shooters could be recruited in order to collect further evidence to reinforce the conclusions in Study 3.

Aside from the methodological limitations stated above, one theoretical limitation in this research project could be the choice of mood measure, the BRUMS. The BRUMS is based on the POMS, which has been criticised by some researchers (e.g., Ekkekakis, 2013; LeUnes & Burger, 2000) as being too limiting a measure on mood as it focuses primarily on negative mood states, with only one positive mood state of Vigour. However, several studies have shown the negative mood dimensions assessed by the BRUMS are significant predictors of athletic performance (see Beedie et al., 2000) and athletic injury (Galambos, Terry, Moyle, & Locke, 2005). Despite its limitations as a global measure of mood, the BRUMS is still a useful measure of a specific set of mood dimensions, in the context of our study, as a brief tool that has shown its utility in performance prediction in pistol shooting.

Finally, the use of PANAS when establishing the concurrent validity of the BRUMS may also be a potential limitation. There were previous conceptual and methodological concerns about the PANAS (see Ekkekakis, 2013) and a recent study by Lee, Hartono, Yong, Koh, and Leung (2020), published after the research project was completed, had also identified measurement noninvariance associated with the PANAS in a Singaporean context, implying that the two-factor measurement model (PA and NA) was unstable. Hence, future studies should consider using an alternative to PANAS to establish concurrent validity of the BRUMS.

5.4 Future Directions

This programme of research has generated several findings that contribute to the literature. However, there were some limitations as well as areas that extend beyond the scope of the current research project that would be worth exploring in the future. The general future directions are described below.

Firstly, there is a need for more validation studies of a similar nature across diverse cultures to continue investigating if the BRUMS and its mood profiles can be generalised across different cultures. Such studies serve to test the hypothesis that BRUMS and its mood profiles could potentially become a universal measure of mood that is indicative of psychological health.

Secondly, the next study in the Singapore context could examine the use of other validated versions of BRUMS in other languages for example, in Chinese (Zhang et al., 2014) and Malay (Hashim et al., 2010) so as to make mood assessment more widely available to other local residents who may not speak English. This could help researchers examine if differences in mood responses exist between Singapore citizens who spoke a different language. Doing so will also set the stage for the bigger plan of using mood profiling as a method to promote mental health awareness and literacy nationally, and it will be worth also exploring if the introduction of mood profiling improves mental health and literacy, and if it has any positive effect on the general population's ability to cope with daily stresses and take charge of their own mental health. A pilot study could first be done on a small scale, by riding on the successful community physical health promotion campaigns. A positive effect achieved in the pilot study would provide a bigger impetus to the health authorities to roll it out on a larger scale to mental health literacy programmes in schools and workplaces. The ultimate aim of introducing a tool like mood profiling would be to give people a common language to understand their own mental health and that of others, which hopefully leads to long-term improvement in the overall health (physical and psychological) of the entire population.

Future research could also investigate if the BRUMS is indicative of emerging mental health issues, by correlating the scores on BRUMS with other validated measures of mental health or wellbeing [e.g., Subjective Vitality Scale, Ryan & Frederick, 1997; Warwick-Edinburgh Mental Well-being Scale, Tennant et al., 2007]. While the use of BRUMS as an indicator may be argued by some as a less stringent criterion for diagnosis when compared to

those adopted in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria of mental health disorders (American Psychiatric Society, 2013), the benefit of doing so is that the BRUMS could then play a crucial role in early identification, active management and prevention of mental health issues in the community, since it is easier to administer a short measure to large groups by any trained healthcare professional before it is flagged up for further diagnosis by a trained mental health professional. This can only occur if future research finds evidence of the utility of the BRUMS as a screening tool for psychopathology.

In terms of applications, the lessons of Olympic champion Richard Faulds and the use of imagery to prime the ideal pre-performance mood state of being an "iceman" could also spur future studies to investigate what other psychological elements (e.g., mental imagery, self-talk, cue words) are most effective in priming the mood states to help athletes get into their desired mood profile, previously established as optimal in the various performance contexts. This would certainly enhance the meaning, value and efficacy of mood profiling as a technique in performance enhancement in the long run. It may also unveil new and undiscovered mood profiles. Beyond mood profiling in the sport of pistol shooting, future research could also examine if mood profiling can be extended beyond shooting performance to a range of sport, high performance, occupational or health contexts. These studies will serve to add further knowledge to the antecedents, correlates and consequences of the six identified mood profiles, in order to improve our collective understanding of mood profiling and the breadth of its potential applications.

Finally, to further the utility of the BRUMS as a measure of mood in Singapore, a much larger overall sample will be needed in order to do a detailed analysis**.** This is important in the longer run to further strengthen the validity and generalisability of the BRUMS and mood profiles to the local population. More data will lead to a set of norms that are more representative, which may eventually be large enough to generate local norms for various demographic groups (e.g., students, adolescents, athletes, working adults, elderly, etc.).

5.5 Conclusions

The key objectives that were established were achieved in this research project. The BRUMS was validated for use in a Singaporean context and evidence of the cross-cultural replicability of the previously identified mood profiles was also found. Mood profiles were also shown to have utility in predicting pistol shooting performance. These three outcomes set the stage for further exploration of mood assessment using the BRUMS and the multiple potential applications of mood profiling for performance enhancement or other new and untapped domains. The mood profile clusters identified provide local practitioners with a way to better interpret BRUMS test scores. The utility and meaningfulness of mood profiles will increase further once associations are established with objective measures of performance, behavioural outcomes or mental health indicators. There is also greater impetus to examine the antecedents, correlates and behavioural consequences of mood responses among Singaporean samples, and the meaning and implications of the identified mood profiles in the local context. This new knowledge improves our collective understanding of mood profiles and its potential applications in clinical and non-clinical settings, informing practitioners how to use mood profiling more effectively.

References

Adan, A., Archer, S. N., Hidalgo, M. P., Di Milia, L., Natale, V., & Randler, C. (2012). Circadian typology: A comprehensive review. *Chronobiology International, 29,* 1153–1175. https://doi.org/10.3109/07420528.2012.719971

Agotra, M. (2014, Apr). *In five months, Heena Sidhu went from hopeful to world no.1*. Firstpost. http://www.firstpost.com/sports/in-five-months-heena-sidhu-went-from-hopeful- to-world-no-1-1476067.html

Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control, 19,* 716–723. doi:10.1109/TAC.1974.1100705

Anastasi, A. and Urbina, S. (1997). *Psychological testing*. Upper Saddle River, NJ: Prentice Hall.

Anderberg, M. R. (2014). *Cluster analysis for applications: Probability and mathematical statistics: A series of monographs and textbooks*. Cambridge, MA: Academic Press.

American Psychological Association Dictionary of Psychology. (n.d.). *Affect*. Washington, DC: American Psychological Association. https://dictionary.apa.org/affect

American Psychological Association Dictionary of Psychology. (n.d.). *Construct validity*. Washington, DC: American Psychological Association. https://dictionary.apa.org/construct-validity

American Psychological Association Dictionary of Psychology. (n.d.). *Personality*. Washington, DC: American Psychological Association. https://dictionary.apa.org/personality

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5)*. Washington, DC: American Psychiatric Publishing.

American Psychological Association (2012). *Stress by gender. Retrieved from* https://www.apa.org/news/press/releases/stress/2012/gender-report.pdf

Arbuckle, J. L. (2017). Amos (Version 25.0) [Computer Program]. Chicago, IL: IBM SPSS.

Argus, G. R., Terry, P. C., Bramston, P., & Dinsdale, S. L. (2004). Measurement of mood in adolescents with intellectual disability. *Research in Developmental Disabilities, 25,* 493–507. https://doi.org/10.1016/j.ridd.2004.05.001

Ashkanasy, N. M., & Humphrey, R. H. (2011). Current emotion research in organizational behavior. *Emotion Review, 3,* 214–224. https://doi.org/10.1177/1754073910391684

Asmundson, G. J., Fetzner, M. G., DeBoer, L. B., Powers, M. B., Otto, M. W., & Smits, J. A. (2013). Let's get physical: A contemporary review of the anxiolytic effects of exercise for anxiety and its disorders. *Depression and Anxiety, 30,* 362–373. https://doi.org/10.1002/da.22043

Atkinson, G., & Reilly, T. (1996). Circadian variations in sport performance. *Sports Medicine, 21,* 292–312. https://doi.org/10.2165/00007256-199621040-00005

Augustine, A. A., & Hemenover, S. H. (2009). On the relative effectiveness of affect regulation strategies: A meta-analysis. *Cognition and Emotion, 23,* 1181–1220. doi:10.1080/02699930802396556

Ballard, R. (2002). Race, ethnicity and culture. In M. Holborn (Ed.), *New Directions in Sociology* (pp. 93–124) Ormskirk, UK: Causeway. https://doi.org/10.11588/xarep.00000283

Batson, C. D., Shaw, L. L., & Oleson, K. C. (1992). Differentiating affect, mood, and emotion: Toward functionally based conceptual distinctions. In M. S. Clark (Ed.), *Emotion* (pp. 294–236). Newbury Park, CA: Sage.

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology, 5*, 323–370. https://doi.org/10.1037/1089-2680.5.4.323

Babyak, M., Blumenthal, J. A., Herman, S., Khatri, P., Doraiswamy, M., Moore, K., ... & Krishnan, K. R. (2000). Exercise treatment for major depression: maintenance of therapeutic benefit at 10 months. *Psychosomatic Medicine, 62,* 633–638.

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine, 25,* 3186–3191.

Beck, A. T., & Clark, D. A. (1988). Anxiety and depression: An information processing perspective. *Anxiety Research, 1,* 23–36. https://doi.org/10.1080/10615808808248218

Beck, A. X., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4,* 561–571. doi:10.1001/archpsyc.1961.01710120031004

Beedie, C. J. (2007). Towards empirical distinctions between emotion and mood: a subjective contextual model. In A. M. Lane (Ed.), *Mood and human performance: Conceptual, measurement, and applied issues* (pp. 63–88). Hauppauge, NY: Nova Science.

Beedie, C. J., Terry, P. C., & Lane, A. M. (2000). The Profile of Mood States and athletic performance: Two meta-analyses. *Journal of Applied Sport Psychology, 12,* 49–68. https://doi.org/10.1080/10413200008404213

Beedie, C., Terry, P., & Lane, A. (2005). Distinctions between emotion and mood. *Cognition and Emotion, 19,* 847–848. doi:10.1080/02699930541000057

Beedie, C., Terry, P. C., Lane, A. M., & Devonport, T. (2011). Differential assessment of emotions and moods: Development and validation of the Emotion and Mood Components of Anxiety Questionnaire. *Personality and Individual Differences, 50,* 228–233. doi:10.1016/j.paid.2010.09.034

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107,* 238–246. doi:10.1037/0033-2909.107.2.238

Bentler, P. M. (1995). *EQS structural equation program manual*. Los Angeles, CA: BMDP Statistical Software.

Berger, B. G. (1994). Coping with stress: The effectiveness of exercise and other techniques. *Quest, 46,* 100–119. doi:10.1080/00336297.1994.10484112

Berger, B. G. (1996). Psychological benefits of an active lifestyle: What we know and what we need to know. *Quest, 48,* 330–353. doi:10.1080/00336297.1994.10484112

Berger, B. G., & McInman, A. (1993). Exercise and the quality of life. In R. N. Singer, M. Murphey, & L. K. Tennant (Eds.), *Handbook of research on sport psychology* (pp. 729–760). New York, NY: Macmillan Publishing.

Berger, B. G. & Motl, R. W. (2000). Exercise and mood: A selective review and synthesis of research employing the profile of mood states. *Journal of Applied Sport Psychology, 12,* 69–92. https://doi.org/10.1080/10413200008404214

Berger, B. G., Motl, R. W., Butki, B. D., Martin, D. T., Wilkinson, J. G., & Owen, D. R. (1999). Mood and cycling performance in response to three weeks of high-intensity, short-duration overtraining, and a two-week taper. *The Sport Psychologist, 13,* 444–457. DOI: https://doi.org/10.1123/tsp.13.4.444

Biddle, S. J. H. (2000). Emotion, mood and physical activity. In S. J. H. Biddle, K. R. Fox, & S. H. Boutcher (Eds.), *Physical activity and psychological well-being* (pp. 63–87). London, UK: Routledge.

Biddle, S. J., & Asare, M. (2011). Physical activity and mental health in children and adolescents: A review of reviews. *British Journal of Sports Medicine, 45,* 886–895. http://dx.doi.org/10.1136/bjsports-2011-090185

Blanchard-Fields, F. (2007). Everyday problem solving and emotion: An adult developmental perspective. *Current Directions in Psychological Science, 16,* 26–31. https://doi.org/10.1111/j.1467-8721.2007.00469.x

Blaney, P. H. (1986). Affect and memory: A review. *Psychological Bulletin, 99,* 229–246. doi:10.1037/0033-2909.99.2.229

Bless, H. (2001). Mood and the use of general knowledge structures. In L. L. Martin & G. L. Clore (Eds.), *Theories of mood and cognition: A user's handbook* (pp. 9–26). Mahwah, NJ: Lawrence Elbaum.

Bourgeois, A., LeUnes, A., & Meyers, M. (2010). Full-scale and short-form of the Profile of Mood States: A factor analytic comparison. *Journal of Sport Behavior, 33,* 355–376.

Bowles, L., Curtis, J., Davies, C., Lengerich, A., & Bugajski, A. (2019). The effect of music on mood, motivation, and exercise among patients in a cardiac rehabilitation program: A pilot study. *Nursing Forum, 54,* 340–344. https://doi.org/10.1111/nuf.12334

Boyle, G. J. (1987). Quantitative and qualitative intersections between the Eight State Questionnaire and the Profile of Mood States. *Educational and Psychological Measurement, 47,* 437–443. https://doi.org/10.1177/0013164487472015

Boyle, G. J. (1988). Central clinical states: An examination of the Profile of Mood States and the Eight State Questionnaire. *Journal of Psychopathology and Behavioral Assessment, 10,* 205–215. https://doi.org/10.1007/BF00962545

Brehm, J .W. (1999). The intensity of emotion. *Personality and Social Psychology Review, 3,* 2–22. doi:10.1207/s15327957pspr0301_1

Braekman, E., Berete, F., Charafeddine, R., Demarest, S., Drieskens, S., Gisle, L., … & Van Hal, G. (2018). Measurement agreement of the self-administered questionnaire of the Belgian Health Interview Survey: Paper-and-pencil versus web-based mode. *PLoS ONE, 13,* e0197434. doi:10.1371/journal.pone.0197434

Brandt, R., Herrero, D., Massetti, T., Crocetta, T. B., Guarnieri, R., de Mello Monteiro, C. B., ... & Andrade, A. (2016). The Brunel Mood Scale rating in mental health for physically active and apparently healthy populations. *Health, 8,* 125–132. doi:10.4236/health.2016.82015

Brown, D. R., Wang, Y., Ward, A., Ebbeling, C. B., Fortlage, L., Puleo, E., Benson, H., & Rippe, J. M. (1995). Chronic psychological effects of exercise and exercise plus cognitive strategies. *Medicine & Science in Sports & Exercise, 27,* 765–775. https://doi.org/10.1249/00005768-199505000-00021

Burns, J. R., & Rapee, R. M. (2006). Adolescent mental health literacy: young people's knowledge of depression and help seeking. *Journal of Adolescence, 29,* 225–239. https://doi.org/10.1016/j.adolescence.2005.05.004

Budgett, R. (1990). Overtraining syndrome. *British Journal of Sports Medicine, 24,* 231–236. http://dx.doi.org/10.1136/bjsm.24.4.231

Budgett, R. (1998). Fatigue and underperformance in athletes: the overtraining syndrome. *British Journal of Sports Medicine, 32,* 107–110. http://dx.doi.org/10.1136/bjsm.32.2.107

Byrne, A., & Byrne, D. G. (1993). The effect of exercise on depression, anxiety and other mood states. *Journal of Psychosomatic Research, 37,* 565–565.

Cañadas, E., García, C. M., Sanchis, C., Fargueta, M., & Herráiz, E. B. (2017). Spanish validation of BRUMS in sporting and non-sporting populations. *European Journal of Human Movement, 38,* 105–117. Retrieved from http://www.eurjhm.com/index.php/eurjhm/article/view/413/608

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155–159. doi:10.1037/0033-2909.112.1.155

Campbell, D. (2001, Feb 18). Life support. *The Guardian.* Retrieved from https://www.theguardian.com/theobserver/2001/feb/18/features.magazine47

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist, 54,* 165–181. doi:10.1037/0003-066X.54.3.165

Carstensen, L. L., & Mikels, J. A. (2005). At the intersection of emotion and cognition: Aging and the positivity effect. *Current Directions in Psychological Science, 14,* 117–121. https://doi.org/10.1111/j.0963-7214.2005.00348.x

Carstensen, L. L., Pasupathi, M., Mayr, U., & Nesselroade, J. R. (2000). Emotional experience in everyday life across the adult life span. *Journal of Personality and Social Psychology, 79,* 644–655. doi:10.1037/0022- 3514.79.4.644

Carstensen, L. L., Turan, B., Scheibe, S., Ram, N., Ersner-Hershfield, H., Samanez-Larkin, G. R., … & Nesselroade, J. R. (2011). Emotional experience improves with age: Evidence based on over 10 years of experience sampling. *Psychology and Aging, 26,* 21–33. https://doi.org/10.1037/a0021285

Catanzaro, S. J. (1996). Negative mood regulation expectancies, emotional distress, and examination performance. *Personality and Social Psychology Bulletin, 22,* 1023–1029. https://doi.org/10.1177/01461672962210005

Chan, J. S. Y., Liu, G., Liang, D., Deng, K., Wu, J., & Yan, J. H. (2019). Special issue–therapeutic benefits of physical activity for mood: A systematic review on the effects of exercise intensity, duration, and modality. *Journal of Psychology: Interdisciplinary and Applied, 153,* 102–125. https://doi.org/10.1080/00223980.2018.1470487

Channel News Asia (2017, Aug 25). National Steps Challenge has helped participants become more active: HPB study. *Channel News Asia*. Retrieved from: https://www.channelnewsasia.com/news/singapore/national-steps-challenge-has-helped-participants-become-more-9157956

Charles, S.T., Mather, M., & Carstensen, L.L. (2003). Focusing on the positive: Age differences in memory for positive, negative, and neutral stimuli. *Journal of Experimental Psychology, 85,* 163–178.

Clarey, C. (2009, Aug 19). Gender test after gold-medal finish. *The New York Times.* Retrieved from: https://www.nytimes.com/2009/08/20/sports/20runner.html

Collins, K. M. T., & Onwuegbuzie, A. J. (2003). Study coping and examination- taking coping strategies: The role of learning modalities among female graduate students. *Personality and Individual Differences, 35,* 1021–1032. doi:10.1016/S0191-8869(02)00315-X

Conroy, R. T. W. L., & Mills, J. N. (1970). *Human circadian rhythms*. London, UK: Churchill.

Clark, L. A., Watson, D., & Leeka, J. (1989). Diurnal variation in the positive affects. *Motivation and Emotion, 13,* 205–234.

Clore, G. L., Wyer R. S., Dienes, B., Gasper, K., Gohm, C. L., & Isbell, L. (2001). Affective feelings as feedback: Some cognitive consequences. In L. L. Martin & G. L. Clore (Eds.). *Theories of mood and cognition: A user's guidebook (*pp. 27–62). Mahwah, NJ: Erlbaum.

Craft, L. L., Magyar, T. M., Becker, B. J., & Feltz, D. L. (2003). The relationship between the Competitive State Anxiety Inventory-2 and sport performance: A meta-analysis. *Journal of Sport and Exercise Psychology, 25,* 44–65. doi:10.1123/jsep.25.1.44

Crawford, J. R., & Henry, J. D. (2004). The Positive and Negative Affect Schedule (PANAS): Construct validity, measurement properties and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 43,* 245–265. doi:10.1348/0144665031752934

Curran, S. L., Andrykowski, M. A., & Studts, J. L. (1995). Short form of the Profile of Mood States (POMS-SF): Psychometric information. *Psychological Assessment, 7,* 80–83. Retrieved from https://psycnet.apa.org/buy/1995-27722-001

Daley, A. J., & Maynard, I. W. (2003). Preferred exercise mode and affective responses in physically active adults. *Psychology of Sport and Exercise, 4,* 347–356. doi:10.1016/S1469-0292(02)00018-3

Dalgleish, T. (2004). The emotional brain. *Nature Reviews Neuroscience, 5,* 583–589. doi:10.1038/nrn1432

Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (pp. 416–436). London: Sage Publications Ltd. https://doi.org/10.4135/9781446249215.n21

Derogatis, L. R., Lipman, R. S., Rickels, K., Uhlenhuth, E. H., & Covi, L. (1974). The Hopkins Symptom Checklist (HSCL): A self-report symptom inventory. *Behavioral Science, 19,* 1–15. doi:10.1002/bs.3830190102

Diment, G. M., & Terry, P. C. (2003). Mood variability, personality and swimming performance. *Australian Journal of Psychology, 55,* 176. Retrieved from http://web.a.ebscohost.com.ezproxy.usq.edu.au/ehost/pdfviewer/pdfviewer?vid=1&sid=562cd14a-0f80-4246-bcfc-9f79fe50f594%40sdc-v-sessmgr02

Dishman, R. K., Nakamura, Y., Garcia, M. E., Thompson, R. W., Dunn, A. L., & Blair, S. N. (2000). Heart rate variability, trait anxiety, and perceived stress among physically fit men and women. *International Journal of Psychophysiology, 37,* 121–133. https://doi.org/10.1016/S0167-8760(00)00085-4

Duda, J. L., & Allison, M. T. (1990). Cross-cultural analysis in exercise and sport psychology: A void in the field. *Journal of Sport and Exercise Psychology, 12,* 114–131. https://doi.org/10.1123/jsep.12.2.114

Dunn, A. L., & Dishman, R. K. (1991). Exercise and the neurobiology of depression. *Exercise and Sport Sciences Reviews, 19,* 41–98.

Dunn, A. L., Trivedi, M. H., Kampert, J. B., Clark, C. G., & Chambliss, H. O. (2005). Exercise treatment for depression: efficacy and dose response. *American Journal of Preventive Medicine, 28,* 1–8. https://doi.org/10.1016/j.amepre.2004.09.003

Edwards, M. K., & Loprinzi, P. D. (2016). Effects of a sedentary behaviour–inducing randomised controlled intervention on depression and mood profile in active young adults. *Mayo Clinic Proceedings, 91,* 984–998. https://doi.org/10.1016/j.mayocp.2016.03.021

Eid, L., Heim, K., Doucette, S., McCloskey, S., Duffy, A., & Grof, P. (2013). Bipolar disorder and socioeconomic status: What is the nature of this relationship? *International Journal of Bipolar Disorders, 1*, 9. https://doi.org/10.1186/2194-7511-1-9

Ekkekakis, P. (2008). Affect circumplex redux: the discussion on its utility as a measurement framework in exercise psychology continues. *International Review of Sport and Exercise Psychology, 1*, 139–159. https://doi.org/10.1080/17509840802287200

Ekkekakis, P. (2012). The measurement of affect, mood, and emotion in exercise psychology. In G. Tenenbaum, R. C. Eklund, & A. Kamata (Eds.), *Measurement in sport and exercise psychology* (pp. 321–332). Champaign, IL: Human Kinetics.

Ekkekakis, P. (2013). *The measurement of affect, mood, and emotion: A guide for health-behavioural research*. New York, US: Cambridge University Press.

Ekkekakis, P., Hall, E. E., VanLanduyt, L. M., & Petruzzello, S. J. (2000). Walking in (affective) circles: Can short walks enhance affect? *Journal of Behavioral Medicine, 2,* 245–275. doi:10.1023/A:1005558025163

Ekkekakis, P., & Petruzzello, S. J. (2002). Biofeedback in exercise psychology. In B. Blumenstein, M. Bar-Eli, & G. Tenenbaum (Eds.), *Brain and body in sport and exercise: Biofeedback application in performance enhancement* (pp. 77–100). Chichester, UK: John Wiley.

Ekman, P. (1994). All emotions are basic. In P. Ekman & R. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 15–19). New York, NY: Oxford University Press.

Ekman, P. (1999). Basic emotions. In T. Dalgleish & M. J. Power (Eds.), *Handbook of cognition and emotion* (pp. 45-60). Chichester, UK: John Wiley.

Ekman, P., & Davidson, R. J. (Eds.). (1994). The *nature of emotion: Fundamental questions*. New York, NY: Oxford University Press.

Ethnicity. (n.d.). In *Oxford Learner's Dictionary*. Retrieved from shttps://www.oxfordlearnersdictionaries.com/definition/american_english/ethnicity

Fazackerley, R., Lane, A. M., & Mahoney, C. (2003). Confirmatory factor analysis of the Brunel Mood Scale for use with water-skiing competition. *Perceptual and Motor Skills, 97,* 657–661. https://doi.org/10.2466/pms.2003.97.2.657

Fazackerley, R., Lane, A. M., & Mahoney, C. A. (2007). Mood-performance relationships in wakeboarding: Measurement, performance, and intervention. In A. M. Lane (Ed.), *Mood and human performance: Conceptual, measurement, and applied issues* (pp. 301–312). Hauppauge, NY: Nova Science.

Fernandez, C. A., E. M. A. Fernandez, and G. S. Pesqueira. (2000). Spanish adaptation of the Profile of Mood States (POMS). *Psicothema, 12,* 47–51.

Fernandes, M., Ross, M., Wiegand, M., & Schryer, E. (2008). Are the memories of older adults positively biased? *Psychology and Aging, 23,* 297–306. https://doi.org/10.1037/0882-7974.23.2.297

Fried, E. I., & Flake, J. K. (2018, Feb 28). *Measurement matters.* Association for Psychological Science. https://www.psychologicalscience.org/observer/measurement-matters

Frijda, N.H., (1993). Moods, emotion episodes, and emotions. In M. Lewis, and J. M. Haviland (Eds.), *Handbook of emotions* (pp. 381–404). New York, NY: Guilford.

Fuchs, C., & Zaichkowsky, L. (1983). Psychological characteristics of male and female bodybuilders: The iceberg profile. *Journal of Sport Behavior, 6,* 136–145.

Fulmer, S. M., & Frijters, J. C. (2009). A review of self-report and alternative approaches in the measurement of student motivation. *Educational Psychology Review, 21,* 219–246. doi:10.1007/s10648-009-9107-x

Galambos, S. A., Terry, P. C., Moyle, G. M., & Locke, S. A. (2005). Psychological predictors of injury among elite athletes. *British Journal of Sports Medicine, 39,* 351–354. http://dx.doi.org/10.1136/bjsm.2005.018440

Garnefski, N., & Kraaij, V. (2006). Relationships between cognitive emotion regulation strategies and depressive symptoms: A comparative study of five specific samples. *Personality and Individual Differences, 40,* 1659–1669. doi:10.1016/j.paid.2005.12.009

Gaspar-Barba, E., Calati, R., Cruz-Fuentes, C. S., Ontiveros-Uribe, M. P., Natale, V., De Ronchi, D., & Serretti, A. (2009). Depressive symptomatology is influenced by chronotypes. *Journal of Affective Disorders, 119,* 100–106. https://doi.org/10.1016/j.jad.2009.02.021

Gauvin, L., & Spence, J. C. (1996). Physical activity and psychological well-being: knowledge base, current issues, and caveats. *Nutrition Reviews, 54,* S53.

Gendolla, G. H. E., Brinkmann, K., & Richter, M. (2007). Mood, motivation, and performance: An integrative theory, research, and applications. In A. M. Lane (Ed.), *Mood and human performance: Conceptual, measurement, and applied issues* (pp. 35–61). Hauppauge, NY: Nova Science.

Gendolla, G. H. E., & Krüsken, J. (2002). The joint effect of informational mood impact and performance-contingent consequences on effort-related cardiovascular response. *Journal of Personality and Social Psychology, 83,* 271–283. http://dx.doi.org/10.1037/0022-3514.83.2.271

Goodwin, R. D. (2003). Association between physical activity and mental disorders among adults in the United States. *Preventive Medicine, 36,* 698–703. https://doi.org/10.1016/S0091-7435(03)00042-2

Gould, M. S., Marrocco, F. A., Kleinman, M., Thomas, J. G., Mostkoff, K., Cote, J., & Davies, M. (2005). Evaluating iatrogenic risk of youth suicide screening programs: A randomized controlled trial. *Journal of the American Medical Association, 293*, 1635–1643. doi:10.1001/jama.293.13.1635

Graham, B. M., Denson, T. F., Barnett, J., Calderwood, C., & Grisham, J. R. (2018). Sex hormones are associated with rumination and interact with emotion regulation strategy choice to predict negative affect in women following a sad mood induction. *Frontiers in Psychology, 9,* 1–11. https://doi.org/10.3389/fpsyg.2018.00937

Grawitch, M. J., Munz, D. C., & Kramer, T. J. (2003). Effects of member mood states on creative performance in temporary workgroups. *Group Dynamics: Theory, Research, and Practice, 7,* 41–54. https://doi.org/10.1037/1089-2699.7.1.41

Greist, J. H., Klein, M. H., Eischens, R. R., Faris, J., Gurman, A. S., & Morgan, W. P. (1979). Running as treatment for depression. *Comprehensive Psychiatry, 20,* 41–54.

Hall, A., & Terry, P. C. (1995). Trends in mood profiles in the preparation phase and racing phase of the 1993 World Rowing Championships, Roundnice, Czech Republic. *Journal of Sports Sciences, 13,* 56–57.

Halbreich, U., & Kahn, L. S. (2001). Role of estrogen in the aetiology and treatment of mood disorders. *CNS Drugs, 15,* 797–817. https://doi.org/10.2165/00023210-200115100-00005

Halloran, M. (2007). Culture. In R. F. Baumeister & K. D. Vohs (Eds.) *Encyclopedia of Social Psychology* (pp 210-212). London, UK: Sage Press.

Han, C., Parsons-Smith, R., Fogarty, G., & Terry, P. C. (2019, July). *Psychometric characteristics of the Brunel Mood Scale in a Singaporean context*. Poster presented at the 15th European Congress of Sport and Exercise Psychology, Munster, Germany.

Han, C. S. Y., Parsons-Smith, R. L., & Terry, P. C. (2020). Mood profiling in Singapore: Cross-cultural validation and potential applications of mood profile clusters. *Frontiers in Psychology, 11,* 1–9. https://doi.org/10.3389/fpsyg.2020.00665

Hanin, Y. L. (1993). The IZOF model. *Computerized adapted assessment programme (CAAP). A manual*. Jyväskylä, Finland: Practical Psychology.

Hanin, Y. L. (1997). Emotions and athletic performance: Individual zones of optimal functioning model. *European Yearbook of Sport Psychology, 1,* 29–72.

Hanin, Y. L. (2000). Individual zones of optimal functioning (IZOF) model: Emotion-performance relationships in sport. In Y. L. Hanin (Ed.), *Emotions in sport* (pp. 65–89). Champaign, IL: Human Kinetics.

Hanin, Y. L. (2000b). *Emotions in sport*. Champaign, IL: Human Kinetics.

Hansen, C. J., Stevens, L. C., & Coast, J. R. (2001). Exercise duration and mood state: How much is enough to feel better? *Health Psychology, 20,* 267–275. https://doi.org/10.1037/0278-6133.20.4.267

Hashim, H. A., Zulkifli, E. Z., & Yusof, H. A. (2010). Factorial validation of Malaysian adapted Brunel Mood Scale in an adolescent sample. *Asian Journal of Sports Medicine, 1,* 185–194. http://journals.tums.ac.ir/abs/17098

Hassmén, P. & Blomstrand, E. (1995). Mood state relationships and soccer team performance. *The Sport Psychologist, 9,* 297–308. https://doi.org/10.1123/tsp.9.3.297

Hassmén, P. Koivula, N., & Uutela, A. (2000). Physical exercise and psychological well-being: A population study in Finland. *Preventative Medicine, 30,* 17–25. doi:10.1006/pmed.1999.0597

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 44,* 227–239. doi:10.1348/014466505X29657

Heuchert, J. P., & McNair, D. M. (2012). *Profile of Mood States, POMS-2.* North Tonawanda, NY: Multi-Health Systems Inc.

Hinitz, D. (2016). *Bowling Psychology*. Human Kinetics.

Horne, J. A., & Östberg, O. (1976). A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *International Journal of Chronobiology, 4*, 97–110.

Horne, J. A., & Staff, L. H. E. (1983). Exercise and sleep: Body-heating effects. *Sleep, 6*, 36–46.

Houser, B. B. (2004). An investigation of the correlation between hormonal levels in males and mood, behaviour and physical discomfort. *Hormones and Behavior, 12*, 185–197. doi:10.1016/0018-506X(79)90020-5

Hu, L. T., & Bentler, P. M. (1998). Fit indices in covariance structure modelling: Sensitivity to underparameterised model misspecification. *Psychological Methods, 3*, 424. Retrieved from http://dx.doi.org/10.1037/1082-989X.3.4.424

Hudson, C. G. (2005). Socioeconomic status and mental illness: Tests of the social causation and selection hypotheses. *American Journal of Orthopsychiatry, 75*, 3–18. https://doi.org/10.1037/0002-9432.75.1.3

Iidan, T., Kunishige, M., Ito, Y., Tatsumi, A., Nagaoka, K., Ezoe, S., & Harada, T. (2018). Association between the Profile of Mood States and autonomic nervous system Activity during sleep in female students. *International Medical Journal, 25*, 66.

International Society of Sport Psychology (1991, Fall). Physical activity and psychological benefits: An ISSP position statement. *News Letter, 2*, 1–3.

Isaacowitz, D. M., & Blanchard-Fields, F. (2012). Linking process and outcome in the study of emotion and aging. *Perspectives on Psychological Science, 7*, 3–16. https://doi.org/10.1177/1745691611424750

Jacobs, M. H., Fehres, P., & Campbell, M. (2012). Measuring emotions toward wildlife: A review of generic methods and instruments. *Human Dimensions of Wildlife, 17,* 233–247. https://doi.org/10.1080/10871209.2012.680175

Jackson, R. C., & Beilock, S. L. (2007). Performance pressure and paralysis by analysis: Research and implications. In D. Farrow, J. Baker, C. MacMahon (Eds.), *Developing sport expertise*: *Researchers and coaches put theory into practice* (pp. 126-140). London, UK: Routledge. https://doi.org/10.4324/9780203934937

Jankowski, K. S., & Ciarkowska, W. (2008). Diurnal variation in energetic arousal, tense arousal, and hedonic tone in extreme morning and evening types. *Chronobiology International, 25,* 577–595. https://doi.org/10.1080/07420520802261770

Jaffery, A., Edwards, M. K., & Loprinzi, P. D. (2017). Randomised control intervention evaluating the effects of acute exercise on depression and mood profile: Solomon experimental design. *Mayo Clinic Proceedings, 92,* 480–481. https://doi.org/10.1016/j.mayocp.2016.12.017

Jayakody, K., Gunadasa, S., & Hosker, C. (2014). Exercise for anxiety disorders: Systematic review. *British Journal of Sports Medicine, 48,* 187–196. http://dx.doi.org/10.1136/bjsports-2012-091287

Johnson-Lawrence, V., Griffith, D. M., & Watkins, D. C. (2013). The effects of race, ethnicity, and mood/anxiety disorders on the chronic physical health conditions of men from a national sample. *American Journal of Men's Health, 7,* 58S-67S. doi:10.1177/1557988313484960

Jokela, M., & Hanin, Y. L. (1999). Does individual zones of optimal functioning model discriminate between successful and less successful athletes? A meta-analysis. *Journal of Sports Sciences, 17,* 873–887. https://doi.org/10.1080/026404199365434

Karageorghis, C. I., Dimitriou, L. A., & Terry, P. C. (1999). Effects of circadian rhythms on mood among athletes. *Journal of Sports Sciences, 17,* 56–57.

Karageorghis, C. I., & Terry, P. (2010). *Inside sport psychology*. Champaign, IL: Human Kinetics. Retrieved from https://ebookcentral-proquest-com.ezproxy.usq.edu.au

Kessler, R. C., Amminger, G. P., Aguilar-Gaxiola, S., Alonso, J., Lee, S., & Ustun, T. B. (2007). Age of onset of mental disorders: a review of recent literature. *Current Opinion in Psychiatry, 20,* 359–364. doi:10.1097/YCO.0b013e32816ebc8c

Krane, V. (1992). Conceptual and methodological considerations in sport anxiety research: From the inverted-U hypothesis to catastrophe theory. *Quest, 44,* 72–81. https://doi.org/10.1080/00336297.1992.10484042

Kremer, J., Moran, A. P., & Kearney, C. J. (2019). *Pure sport: Sport psychology in action*. New York: Routledge.

Kline, P. (1994). *The handbook of psychological testing*. London: Routledge.

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. New York: Guilford.

Lan, M. F., Lane, A. M., Roy, J., & Hanin, N. A. (2012). Validity of the Brunel Mood Scale for use with Malaysian athletes. *Journal of Sports Science and Medicine, 11,* 131–135. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3737843/

Lane, A. M. (2007a). The rise and fall of the iceberg: Development of a conceptual model of mood–performance relationships. In A. M. Lane (Ed.), *Mood and human performance: Conceptual, measurement, and applied issues* (pp. 1–34.). Hauppauge, NY: Nova Science.

Lane, A. M. (2007b). Developing and validating psychometric tests for use in high performance settings. In L. Boyar (Ed.), *Psychological tests and testing research* (pp. 203–213). Hauppauge, NY: Nova Publishers.

Lane, A. M. (2008). Mood and sport performance. In A. M. Lane (Eds.), *Sport and Exercise Psychology* (pp. 1–24). London, UK: Routledge.

Lane, A. M. (2012). How can we measure what we cannot see? Measurement issues in sport psychology. *Measurement and Control, 45,* 187–190. https://doi.org/10.1177/002029401204500605

Lane, A. M. (2015). Mood and sport performance. In *Sport and exercise psychology* (pp. 16–34). London, UK: Hodder Education.

Lane, A., Beedie, C., & Devonport, T. (2011). Measurement issues in emotion and emotion regulation. In J. Thatcher, M. Jones, D. Lavallee (Eds.). *Coping and emotion in sport* (pp. 93–115). London, UK: Taylor & Francis.

Lane, A. M., Beedie, C. J., and Stevens, M. J. (2005). Mood matters: A response to Mellalieu. *Journal of Applied Sport Psychology, 17,* 319–325. https://doi.org/10.1080/10413200500313610

Lane, A. M., & Chappell, R. C. (2001). Mood and performance relationships among players at the World Student Games basketball competition. *Journal of Sport Behavior, 24,* 182–196.

Lane, A. M., Crone-Grant, D., & Lane, H. (2002). Mood changes following exercise. *Perceptual and Motor Skills, 94,* 732–734. doi:10.2466/pms.2002.94.3.732

Lane, A., Hewston, R., Redding, E., & Whyte, G. P. (2003). Mood changes following modern-dance classes. *Social Behaviour and Personality: An International Journal, 31,* 453–460. https://doi.org/10.2224/sbp.2003.31.5.453

Lane, A. M., Soos, I., Leibinger, E., Karsai, I., & Hamar, P. (2007). Validity of the Brunel Mood Scale for use with UK, Italian and Hungarian athletes. In A. M. Lane (Ed.), *Mood and human performance: Conceptual, measurement, and applied issues* (pp. 119–130). Hauppauge, NY: Nova Science.

Lane, A. M., & Terry, P. C. (1999). The conceptual independence of tension and depression. *Journal of Sports Sciences, 17,* 605–606.

Lane, A. M., & Terry, P. C. (2000). The nature of mood: Development of a conceptual model with a focus on depression. *Journal of Applied Sport Psychology, 12,* 16–33. doi:10.1080/10413200008404211

Lane, A. M., & Terry, P. C. (2016). Online mood profiling and self-regulation of affective responses. In R. J., Schinke, K. R., McGannon, & B. Smith (Eds.), *Routledge International Handbook of Sport Psychology* (pp. 323–333). London, UK: Routledge.

Lane, A. M., Terry, P. C., Beedie, C. J., and Stevens, M. (2004). Mood and concentration grid performance: The moderating effect of depressed mood. *International Journal of Sport and Exercise Psychology, 2,* 133–145. https://doi.org/10.1080/1612197X.2004.9671737

Lane, A. M., Terry, P. C., Devonport, T. J., Friesen, A. P., & Totterdell, P. A. (2017). A test and extension of Lane and Terry's (2000) conceptual model of mood-performance relationships using a large internet sample. *Frontiers in Psychology, 8*, 470. https://doi.org/10.3389/fpsyg.2017.00470

Lane, A. M., Thelwell, R., & Devonport, T, (2009). Emotional intelligence, mood states and performance. *E-journal of Applied Psychology, 5,* 67–73.

Lane, A. M., Whyte, G. P., Godfrey, R., & Pedlar, C. (2003). Adaptations of psychological state variables to altitude among the Great Britain biathlon team preparing for the 2002 Olympic Games. *Journal of Sports Sciences, 21,* 281–282.

Lane, A. M., & Wilson, M. (2007). "Wandering through Britain like a horse with no name": Mood state changes and emotional intelligence among Marathon of Britain runners [Abstract]. *Journal of Sports Sciences, 25*, 313–314.

Larcom, M. J., & Isaacowitz, D. M. (2009). Rapid emotion regulation after mood induction: Age and individual differences. *Journal of Gerontology: Psychological Sciences, 64B,* 733–741. https://doi.org/10.1093/geronb/gbp077

Larsen, R. J., & Diener, E. (1987). Affect intensity as an individual difference characteristic: A review. *Journal of Research in Personality, 21,* 1–39. https://doi.org/10.1016/0092-6566(87)90023-7

Larsen, R. J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. In M. S. Clark, (Ed.), *Review of personality and social psychology: Vol. 13. Emotion* (pp. 25–29). Newbury Park, CA: Sage.

Lazarus, R. S. (1984). On the primacy of cognition. *American Psychologist, 39,* 124–129. doi:10.1037/0003-066X.39.2.124

Lee, S. T. H., Hartanto, A., Yong, J. C., Koh, B., & Leung, A. K. Y. (2020). Examining the cross-cultural validity of the Positive Affect and Negative Affect Schedule between an Asian (Singaporean) sample and a Western (American) sample. *Asian Journal of Social Psychology, 23,* 109–116. doi:10.1111/ajsp.12390

Lee, T. (2017, Dec 4). Singapore women more likely to suffer from depression than men: IMH study. *Today Online.* Retrieved from https://www.todayonline.com/singapore/spore-women-more-likely-suffer-depression-men-imh-study

Leith, L. M. (1994). *Foundations of exercise and mental health* (pp. 79–106). Morgantown, WV: Fitness Information Technology.

Leiner, D. J. (2019). Too fast, too straight, too weird: Non-reactive indicators for meaningless data in Internet surveys. *Survey Research Methods, 13,* e7403. doi: 10.18148/srm/2018.v13i3.7403

LeDoux, J. E. (1992). Emotion and the amygdala. In J. P. Aggleton (Ed.), *The amygdala: Neurobiological aspects of emotion, memory, and mental dysfunction* (pp. 339–355). New York: Wiley-Liss.

Leong, C. W., Yang, W. H., & Ho, H. (2013). Singaporeans' attitudes to national service. *Lee Kuan Yew School of Public Policy, National University of Singapore*. Retrieved from https://lkyspp.nus.edu.sg/docs/default-source/ips/ns-study-8-oct-2013_web.pdf

LeUnes, A. (2000). Updated bibliography on the Profile of Mood States in sport and exercise psychology research. *Journal of Applied Sport Psychology, 12*, 110–113. doi:10.1080/10413200008404216

LeUnes, A., & Burger, J. (1998). Bibliography on the Profile of Mood States in sport and exercise psychology research. 1971-1998. *Journal of Sport Behavior, 2*, 53–69.

LeUnes, A., & Burger, J. (2000). Profile of mood states research in sport and exercise psychology: Past, present, and future. *Journal of Applied Sport Psychology, 12*, 5–15. doi:10.1080/10413200008404210

LeUnes, A., Haywood, S.A., & Daiss, S. (1988). Annotated bibliography of the Profile of Mood States in Sport, 1975-1988. *Journal of Sport Behavior, 21*, 53–70.

Lee, K., & Allen, N. J. (2002). Organizational citizenship behavior and workplace deviance: The role of affect and cognitions. *Journal of Applied Psychology, 87,* 131–142. https://doi.org/10.1037/0021-9010.87.1.131

Lim, J., (2019, Oct 14). The big read: With youths more open about mental health, it's time others learn to listen. *Channel News Asia,* Retrieved from https://www.channelnewsasia.com/news/singapore/mental-health-youths-suicide-depression-listen-11994612

Lim, J., & Terry, P. C. (2011, March 15). *In The Mood.* Retrieved from http://www.moodprofiling.com

Lindgren, K. N., Masten, V. L., Tiburzi, M. J., Ford, D. P., & Bleecker, M. L. (1999). The factor structure of the Profile of Mood States (POMS) and its relationship to occupational lead exposure. *Journal of Occupational and Environmental Medicine, 41*, 3–10.

Little, W. (2016). Gender, sex and sexuality. In W. Little, R. McGivern, & N. Kerins (Eds.), *Introduction to sociology (2nd Ed)* (pp. 367–396). Vancouver, Canada: Rice University. Retrieved from: https://pressbooks.bccampus.ca/debraflew/chapter/chapter-12-gender-sex-and-sexuality/

Lorr, M., & McNair, D. M. (1988). *Profile of mood states-bipolar form.* San Diego, CA: Educational and Industrial Testing Service.

Lovell, G. (2004). Mood states and overtraining. In D. Lavalle, J. Thatcher, & M. V. Jones (Eds.), *Coping and emotion in sport* (pp. 55–73). Hauppauge, NY: Nova Science.

Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales (DASS)*. Sydney, NSW: Psychology Foundation Monograph.

MacQueen, J. (1967). Some methods for classification and analysis of multivariate observations. In L. Lecam, & J. Neyman (Eds.), *Proceedings of the fifth Berkeley symposium on mathematical statistics and probability* (pp. 281–297). California, US: University of California Press.

Maroulakis, E., & Zervas, Y. (1993). Effects of aerobic exercise on mood of adult women. *Perceptual and Motor Skills, 76,* 795–801. doi:10.2466/pms.1993.76.3.795

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

Masri, S., & Sassone-Corsi, P. (2018). The emerging link between cancer, metabolism, and circadian rhythms. *Nature Medicine, 24,* 1795–1803. https://doi.org/10.1038/s41591-018-0271-8

Mather, M., Canli, T., English, T., Whitfield, S., Wais, P., Ochsner, K., … & Carstensen, L.L. (2004). Amygdala responses to emotionally valenced stimuli in older and younger adults. *Psychological Science, 15,* 259–263. https://doi.org/10.1111/j.0956-7976.2004.00662.x

Matsumoto, D. (2003). Cross-cultural research. In S. F. Davis (Ed.), *Blackwell handbooks of research methods in psychology. Handbook of research methods in experimental psychology* (pp. 189–208). London, UK: Blackwell. https://doi.org/10.1002/9780470756973.ch9

Matthews, G., Jones, D. M., & Chamberlain, A. G. (1990). Refining the measurement of mood: The UWIST mood adjective checklist. *British Journal of Psychology, 81,* 17–42. https://doi.org/10.1111/j.2044-8295.1990.tb02343.x

McDonald, J. D. (2008). Measuring personality constructs: The advantages and disadvantages of self-reports, informant reports and behavioural assessments. *Enquire, 1,* 1–19.

McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology, 52,* 81–90. https://doi.org/10.1037/0022-3514.52.1.81

McFatter, R. M. (1994). Interactions in predicting mood from extroversion and neuroticism. *Journal of Personality and Social Psychology, 66,* 570–578. https://doi.org/10.1037/0022-3514.66.3.570

McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *Manual for the Profile of Mood States.* San Diego, CA: Educational and Industrial Testing Services.

McNair, D. M., Lorr, M., & Droppleman, L. F. (1992). *Revised Manual for the Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Services.

McNeil, J. K., Stone, M. J., Kozma, A., & Andres, D. (1994). Age differences in mood: Structure, mean level, and diurnal variation. *Canadian Journal on Aging, 13,* 201–220. DOI: https://doi.org/10.1017/S0714980800006024

Meisenberg, G., & Williams, A. (2008). Are acquiescent and extreme response styles related to low intelligence and education? *Personality and Individual Differences, 44,* 1539–1550. doi:10.1016/j.paid.2008.01.010

Mellalieu, S. (2003) Mood matters: But how much? A comment on Lane and Terry (2000). *Journal of Applied Sport Psychology, 15,* 99–114, doi:10.1080/10413200305395

Mischel. W. (1990). Personal dispositions revisited and revised: A view after three decades. In L. A. Pervin (Eds.), *Handbook of Personality* (pp. 111–134). New York, NY: Guildford Press.

Moen, F., Myhre, K., & Sandbakk, Ø. (2016). Associations between emotions and performance in cross-country skiing competitions. *The Sport Journal, 19.* Retrieved from http://thesportjournal.org/article/associations-between-emotions-and-performance-in-cross-country-skiing-competitions/

Mohammadi-Nezhad, M. (2011). An overview of hypotheses of antidepressant effects of exercise, part 1: Biological mechanisms. *Iranian Journal of Health and Physical Activity, 2,* 61–70. doi:10.22067/ijhpa.v2i2.9821

Morgan, W. P. (1974). Selected psychological considerations in sport. *Research Quarterly for Exercise and Sport, 45,* 374–390. https://doi.org/10.1080/10671315.1974.10615285

Morgan, W. P. (1980). Test of champions: The iceberg profile. *Psychology Today, 14,* 92–108.

Morgan. W. P. (1985a). Selected psychological factors limiting performance: A mental health model. In D. H. Clarke, & H. M. Eckeri (Eds.), *Limits of human performance* (pp. 70–80). Champaign. IL: Human Kinetics.

Morgan, W. P. (1985b). Affective beneficence of vigorous physical activity. *Medicine & Science in Sports & Exercise, 17,* 94–100. https://doi.org/10.1249/00005768-198502000-00015

Morgan, W. P., Brown, D. R., Raglin, J. S., O'Connor, P. J., & Ellickson, K. A. (1987). Psychological monitoring of overtraining and staleness. *British Journal of Sports Medicine, 21,* 107–114. http://dx.doi.org/10.1136/bjsm.21.3.107

Morgan, W. P., & Johnson, R. W. (1978). Personality characteristics of successful and unsuccessful oarsmen. *International Journal of Sport Psychology, 9,* 119–133.

Morgan, W. P., & Pollock, M. L. (1977). Psychologic characterization of the elite distance runner. *Annals of the New York Academy of Sciences, 301,* 383–403.

Morris, W.N. (1989). *Mood. The frame of mind.* New York: Springer.

Morris, W. N. (1992). A functional analysis of the role of mood in affective systems. In M. S. Clarke (Ed.), *Emotion: Review of personality and social psychology* (pp. 257–293). Newbury Park, CA: Sage.

Morris, M., & Salmon, P. (1994). Qualitative and quantitative effects of running on mood. *The Journal of Sports Medicine and Physical Fitness, 34,* 284–291.

Motl, R. W., Berger, B. G., & Leuschen, P. S. (2000). The role of enjoyment in the exercise-mood relationship. *International Journal of Sport Psychology, 31,* 347–363.

Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin, 126,* 247–259.

Muraven, M., Tice, D. M., & Baumeister, R. F. (1998). Self-control as a limited resource: Regulatory depletion patterns. *Journal of Personality & Social Psychology, 74,* 774–789.

Murray, G. (2007). Diurnal mood variation in depression: A signal of disturbed circadian function? *Journal of Affective Disorders, 102,* 47–53. https://doi.org/10.1016/j.jad.2006.12.001

Murray, G., Allen, N. B., & Trinder, J. (2002). Mood and the circadian system: Investigation of a circadian component in positive affect. *Chronobiology International, 19,* 1151–1169. https://doi.org/10.1081/CBI-120015956

National Council of Social Services (2017). *Understanding the quality of life of adults with mental health issues* (ISBN 978-981-11-4229-1). Singapore National Council of Social Services: Advocacy and Research Team. Retrieved from: https://www.ncss.gov.sg/Press-Room/Publications/Detail-Page?id=Understanding-the-Quality-of-Life-of-Adults-with-M

Nolen-Hoeksema, S., & Jackson, B. (2001). Mediators of the gender difference in rumination. *Psychology of Women Quarterly, 25*, 37–47. https://doi.org/10.1111/1471-6402.00005

North, T. C., McCullagh, P., & Tran, Z. V. (1990). Effect of exercise on depression. *Exercise and Sport Sciences Reviews, 18,* 379–416.

Nagle, F. J., Morgan, W. P., Hellickson, R. O., Serfass, R. C., & Alexander, J. F. (1975). Spotting success traits in Olympic contenders. *Physician and Sports Medicine, 3,* 31–34. https://doi.org/10.1080/00913847.1975.11948293

Narasimhan, L., Nagarathna, R., & Nagendra, H. R. (2011). Effect of integrated yogic practices on positive and negative emotions in healthy adults. *International Journal of Yoga, 4,* 13–19. doi:10.4103/0973-6131.78174

Nelson, R. J. (2005). *An introduction to behavioural endocrinology* (3rd ed.). Sunderland, MA: Sinauer Associates.

Nisbett, R. E., & Wilson, T. D. (1977). The halo effect: Evidence for unconscious alteration of judgments. *Journal of Personality and Social Psychology, 35,* 250–256. https://doi.org/10.1037/0022-3514.35.4.250

Nunnally, J. C. (1994*). Psychometric theory* (3rd ed.). New York: McGraw-Hill.

Oatley, K., & Jenkins, J. M. (1996). *Understanding emotions*. Cambridge, MA: Blackwell Scientific.

Oei, T. P., Sawang, S., Goh, Y. W., & Mukhtar, F. (2013). Using the Depression Anxiety Stress Scale-21 (DASS-21) across cultures. *International Journal of Psychology, 48,* 1018–1029. doi:10.1080/00207594.2012.755535

Ortega, E., & Wang, C. J. K. (2018). Pre-performance physiological state: Heart rate variability as a predictor of shooting performance. *Applied Psychophysiology and Biofeedback, 43,* 75–85. https://doi.org/10.1007/s10484-017-9386-9

Otto, M. W., Church, T. S., Craft, L. L., Greer, T. L., Smits, J. A., & Trivedi, M. H. (2007). Exercise for mood and anxiety disorders. *Primary care companion to the Journal of Clinical Psychiatry, 9,* 287. doi:10.4088/pcc.v09n0406

Owens, A. J. N., Lane, A. M., & Terry, P. C. (2000). Mood states as predictors of tennis performance: A test of a conceptual model. *Journal of Sports Sciences, 18,* 559–560.

Ozer, D. J., & Reise, S. P. (1994). Personality assessment. *Annual Review of Psychology, 45,* 357–393.

Paluska, S. A., & Schwenk, T. L. (2000). Physical activity and mental health. *Sports Medicine, 29,* 167–180. https://doi.org/10.2165/00007256-200029030-00003

Parkinson, B., Totterdell, P., Briner, R. B., & Reynolds, S. (1996). *Changing moods: The psychology of mood and mood regulation*. London, UK: Longman.

Parsons-Smith, R. (2015). *In the mood: online mood profiling, mood response clusters, and mood-performance relationships in high-risk vocations.* Unpublished PhD thesis, University of Southern Queensland, Toowoomba, QLD.

Parsons-Smith, R. L., Terry, P. C., & Machin, T. (2014). Profile clusters of mood responses. *Proceedings of the 28th International Congress of Applied Psychology*, Paris, France, 8–13 July. Retrieved from https://b-com.mci-group.com/Abstract/Statistics/AbstractStatisticsViewPage.aspx?AbstractID=183467

Parsons-Smith, R. L., Terry, P. C., & Machin, M. A. (2017). Identification and description of novel mood profile clusters. *Frontiers in Psychology, 8,* e1958. doi:10.3389/fpsyg.2017.01958

Paulhus, D. L., & Vazire, S. (2007). The self-report method. In R. W. Robins, R. C. Fraley, and R. Krueger (Eds.), *Handbook of research methods in personality psychology* (pp. 224–239). New York, NY: Guilford Press.

Paluska, S. A., & Schwenk, T. L. (2000). Physical activity and mental health. *Sports Medicine, 29,* 167–180. https://doi.org/10.2165/00007256-200029030-00003

Pedlar, C. R., Lloyd, J. C., Lane, A. M., Dawson, J., Emegbo, S., Stanley, N., & Whyte, G. P. (2007). Sleep profiles and mood state changes during an expedition to the South Pole: A case study of a female explorer. *Wilderness and Environmental Medicine, 18,* 127–132. https://doi.org/10.1580/06-WEME-BR-039R1.1

Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18,* 189–193.

Penner, L. A., Shiffman, S., Paty, J. A., & Fritzsche, B. A. (1994). Individual differences in intraperson variability in mood. *Journal of Personality & Social Psychology, 66,* 712–721. https://doi.org/10.1037/0022-3514.66.4.712

Pekrun, R. (2017). Achievement emotions. In E. J. Andrew, C. S., Dweck, & D. S., Yeager (Eds.), *Handbook of competence and motivation: Theory and application* (pp. 251–271). New York, NY: The Guilford Press

Pekrun, R., & Linnenbrink-Garcia, L. (2014). *International handbook of emotions in education.* Routledge.

Power, M. J. (2006). The structure of emotion: An empirical comparison of six models. *Cognition and Emotion, 20,* 694–713. https://doi.org/10.1080/02699930500367925

Prapavessis, H. (2000). The POMS and sports performance: A review. *Journal of Applied Sport Psychology, 12,* 34–48. https://doi.org/10.1080/10413200008404212

Prapavessis, H. & Grove, J. R. (1991). Pre-competitive emotions and shooting performance: The mental health and zone of optimal function models. *The Sport Psychologist, 5,* 223–234. Retrieved from http://journals.humankinetics.com/tsp-back-issues/tspvolume5issue3september/precompetitiveemotionsandshootingperformancethementalhealthandzoneofoptimalfunctionmodels

Prapavessis, H., & Grove, J. R. (1994). Personality variables as antecedents of precompetitive mood states. *International Journal of Sport Psychology, 25,* 81–99.

Proper, K. I., Singh, A. S., van Mechelen, W., & Chinapaw, M. J. (2011). Sedentary behaviours and health outcomes among adults: A systematic review of prospective studies. *American Journal of Preventive Medicine, 40,* 174–182. https://doi.org/10.1016/j.amepre.2010.10.015

Quartiroli, A., Terry, P. C., & Fogarty, G. J. (2017). Development and initial validation of the Italian Mood Scale (ITAMS) for use in sport and exercise contexts. *Frontiers in Psychology, 8,* e1483. doi:10.3389/fpsyg.2017.01483

Quartiroli, A., Parsons-Smith, R. L., Fogarty, G. J., Kuan, G., & Terry, P. C. (2018). Cross-cultural validation of mood profile clusters in a sport and exercise context. *Frontiers in Psychology, 9,* 1949. doi:10.3389/fpsyg.2018.01949

Quinn, R. W. (2007). Energizing others in work connections. In J. E. Dutton & B. R. Ragins (Eds.), *LEA's organization and management series. Exploring positive relationships at work: Building a theoretical and research foundation* (pp. 73–90). Mahwah, NJ: Lawrence Erlbaum.

Raglin, J. S. (1992). Anxiety and sport performance. In J. O. Holloszy (Ed.), *Exercise and sports sciences reviews* (Vol. 20, pp. 243–273). Baltimore, MD: Williams & Wilkins.

Raglin, J. S. (2001). Psychological factors in sport performance: The mental health model revisited. *Sports Medicine, 31,* 875–890. https://doi.org/10.2165/00007256-200131120-00004

Raglin, J. S., Eksten, E., & Garl, T. (1995). Mood state responses to a pre-season conditioning program in male collegiate basketball players. *International Journal of Sport Psychology, 26,* 214–224.

Rajkovic, I. (2014). *Translation and validation of Brunel Mood Scale for Serbian athlete population*. Unpublished master's thesis, University of Jyväskylä, Finland.

Ransford, C. P. (1982). A role for amines in the antidepressant effect of exercise: A review. *Medicine and Science in Sports and Exercise, 14,* 1–10. doi:10.1249/00005768-198201000-00001

Rasmussen, P. R., Jeffrey, A. C., Willingham, J. K., & Glover, T. L. (1994). Implications of the true score model in assessment of mood state. *Journal of Social Behaviour and Personality, 9,* 107–118. Retrieved from http://psycnet.apa.org/psycinfo/1994-31942-001

Reddon, J. R., Marceau, R., & Holden, R. R. (1985). A confirmatory evaluation of the Profile of Mood States: Convergent and discriminant item validity. *Journal of Psychopathology and Behavioural Assessment, 7,* 243–259. https://doi.org/10.1007/BF00960756

Reed, J. (2005). Acute physical activity and self-reported affect: A review. In A. V. Clark (Ed.), *Causes, role, and influence of mood states* (pp. 91–113). New York: Nova.

Reed, J., & Ones, D. S. (2006). The effect of acute aerobic exercise on positive activated affect: A meta-analysis. *Psychology of Sport and Exercise, 7,* 477–514. doi:10.1016/j.psychsport.2005.11.003

Remington, N. A., Fabrigar, L. R., & Visser, P. S. (2000). Reexamining the circumplex model of affect. *Journal of Personality and Social Psychology, 79,* 286–300. doi:10.1037//0022-3514.79.2.286

Renger, R. (1993). Predicting athletic success: Issues related to analysis and interpretation of study findings. *The Sport Psychologist, 7,* 262–274. https://doi.org/10.1123/tsp.7.3.262

Riddick, C. (1984). Comparative psychological profiles of three groups of collegians: Competitive swimmers, recreational swimmers, and inactive swimmers. *Journal of Sport Behavior, 7,* 160–174.

Robinson, M. D., & Clore, G. L. (2002). Episodic and semantic knowledge in emotional self-report: Evidence for two judgment processes. *Journal of Personality and Social Psychology, 83,* 198–295. https://doi.org/10.1037/0022-3514.83.1.198

Roecke, C., Li, S.-C., & Smith, J. (2009). Intraindividual variability in positive and negative affect over 45 days: Do older adults fluctuate less than younger adults? *Psychology and Aging, 24,* 863–878. doi:10.1037/ a0016276

Rohaidi, N. (n.d.). How Singapore 'nudges' citizens to better health. *Hospital Insider by Gov Insider*. Retrieved from https://govinsider.asia/health/zee-yoong-kang-ceo-health-promotion-board-singapore/

Rohlfs, I. C. P. de M., Terry, P. C., de Carvalho, T., Krebs, R. J., Andrade, A., Rotta, T. M., & Iizuka, C. A. (2008). Development and initial validation of the Brazil Mood Scale. In N. Voudouris & V. Mrowinski (Eds.), *Psychology leading change: Proceedings of the 42nd Annual Conference of the Australian Psychological Society* (pp. 269–273). Melbourne, VIC: Australian Psychological Society.

Rokka, S., Mavridis, G., & Kouli, O. (2010). The impact of exercise intensity on mood state of participants in dance aerobic programs. *Studies in Physical Culture and Tourism, 17,* 241–245. http://www.wbc.poznan.pl/Content/147546/05_Rokka_%20REV.pdf

Rokke, P. D. (1993). Social context and perceived task difficulty as mediators of depressive self-evaluation. *Emotion and Motivation, 17,* 23–40.

Rouveix, M., Duclos, M., Gouarne, C., Beauvieux, M. C., & Filaire, E. (2006). The 24h urinary cortisol/cortisone ratio and epinephrine/norepinephrine ratio for monitoring training in young female tennis players. *International Journal of Sports Medicine, 27,* 856–863. doi:10.1055/s-2006-923778

Rowley, A. J., Landers, D. M., Kyllo, L. B., & Etnier, J. L. (1995). Does the iceberg profile discriminate between successful and less successful athletes? A meta-analysis. *Journal of Sport & Exercise Psychology, 17,* 185–199. https://doi.org/10.1123/jsep.17.2.185

Ruiz, M. C., Raglin, J. S., & Hanin, Y. L. (2017). The individual zones of optimal functioning (IZOF) model (1978–2014): Historical overview of its development and use. *International Journal of Sport and Exercise Psychology, 15,* 41–63. https://doi.org/10.1080/1612197X.2015.1041545

Russell, J. A. (1980). A circumplex model of affect. Journal *of Personality and Social Psychology, 39,* 1161–1178. https://doi.org/10.1037/h0077714

Russell, J. A., & Feldman Barrett, L. (1999). Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality and Social Psychology, 76,* 805–819. https://doi.org/10.1037/0022-3514.76.5.805

Rust, J. & Golombok, S. (1999). *Modern psychometrics: The science of psychological assessment*. London, UK: Routledge.

Rusting, C. L., & Larsen, R. J. (1997). Extraversion, neuroticism, and susceptibility to positive and negative affect: A test of two theoretical models. *Personality and Individual Differences, 22,* 607–612. https://doi.org/10.1016/S0191-8869(96)00246-2

Ryan, R. M., & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality, 65,* 529–565. https://doi.org/10.1111/j.1467-6494.1997.tb00326.x

Ryan, R., & Thayer, R. (2012). Moods of energy and tension that motivate. In R. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 408–419). New York, US: Oxford University Press. doi:10.1093/oxfordhb/9780195399820.013.0023

Salleh, N. A. M. (2017, May 20). Singaporeans have evolved a distinctive identity: PM Lee Hsien Loong. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/singaporeans-have-evolved-a-distinctive-identity-pm

Salkind, N. J. (2010). *Encyclopedia of research design*. Thousand Oaks, CA: Sage Publications. doi: 10.4135/9781412961288

Saw, A. E., Kellmann, M., Main, L. C., & Gastin, P. B. (2017). Athlete self-report measures in research and practice: Considerations for the discerning reader and fastidious practitioner. *International Journal of Sports Physiology and Performance, 12,* 127–135. http://dx.doi.org/10.1123/ijspp.2016-0395

Saw, A. E., Main, L. C., & Gastin, P. B. (2016). Monitoring the athlete training response: Subjective self-reported measures trump commonly used objective measures: A systematic review. *British Journal of Sports Medicine, 50,* 281–291. doi:10.1136/bjsports-2015-094758

Seifert, C. M., Chapman, L. S., Hart, J. K., & Perez, P. (2012). Enhancing intrinsic motivation in health promotion and wellness. *American Journal of Health Promotion, 26,* 1–12. https://doi.org/10.4278/ajhp.26.3.tahp

Schimmack, U., & Siemer, M. (1998). *Moods and emotions: Folk psychology's contribution to scientific taxonomies of affective experiences.* Unpublished manuscript, Free University Berlin, Germany.

Schwarz, N. (1990). Feelings as information: Informational and motivational functions of affective states. In E. T. Higgins & R. M. Sorrentino (Eds.), *Handbook of motivation and cognition: Foundations of social behaviour* (Vol. 2, pp. 527–561). New York, NY: The Guilford Press.

Schwarz, N. (1999). Self-reports: How the questions shape the answers. *American Psychologist, 54*, 93–105. https://doi.org/10.1037/0003-066X.54.2.93

Schwarz, N. (2001), Feelings as information: Implication for affective influences on information processing. In L. L. Martin, and G. L. Clore. (Eds.), *Theories of mood and cognition* (pp. 9–26). Mahwah, NJ: Lawrence Elbaum.

Schwarz, N., & Bless, H. (1991). Happy and mindless, but sad and smart? The impact of affective states on analytic reasoning. In J. P. Forgas (Ed.), *Emotion and social judgements* (pp. 55–71). London, UK: Pergamon Press.

Shacham, S. (1983). A shortened version of the Profile of Mood States. *Journal of Personality Assessment, 47,* 305–306.

Schuch, F. B., Vancampfort, D., Richards, J., Rosenbaum, S., Ward, P. B., & Stubbs, B. (2016). Exercise as a treatment for depression: a meta-analysis adjusting for publication bias. *Journal of Psychiatric Research, 77,* 42–51. doi: 10.1016/j.jpsychires.2016.02.023

Siemer, M. (2009). Mood experience: Implications of a dispositional theory of moods. *Emotion Review, 1,* 256–263. https://doi.org/10.1177/1754073909103594

Simon, A., McGowan, C. R., Epstein, L. H., Kupfer, D. J., & Robertson, R. J. (1985). Exercise as a treatment for depression: An update. *Clinical Psychology Review, 5*, 553–568. doi:10.1016/0272-7358(85)90034-0

Singapore Department of Statistics (2018). *Population trends 2018* (ISSN 2591-8028). Department of Statistics: Ministry of Trade and Industry, Republic of Singapore.

Singapore Statutes Online (2020). *The enlistment act (Chapter 93).* Retrieved from https://sso.agc.gov.sg/Act/EA1970

Singapore Health Promotion Board (n.d.). *Healthy 365 app*. Health Hub. Retrieved from https://www.healthhub.sg/apps/25/healthy365

Singapore Health Promotion Board (n.d.). *Lose to Win*. Health Hub. Retrieved from https://www.healthhub.sg/programmes/29/lose_to_win

Singapore Health Promotion Board (n.d.). *National Steps Challenge*. Health Hub. Retrieved from https://www.healthhub.sg/programmes/37/nsc

Singapore Health Promotion Board (n.d.). *Sundays at the Park*. Health Hub. Retrieved from https://www.healthhub.sg/programmes/142/moveit#sundays-at-the-park

Singapore Institute of Mental Health (2018, Dec). Latest nationwide study shows 1 in 7 people in Singapore has experienced a mental disorder in their lifetime. Singapore: National Healthcare Group. Retrieved from https://www.imh.com.sg/uploadedFiles/Newsroom/News_Releases/SMHS%202016_Media%20Release_FINAL_web%20upload.pdf

Smith, R. E., Leffingwell, T. R., & Ptacek, J. T. (1999). Can people remember how they coped? Factors associated with discordance between same-day and retrospective reports. *Journal of Personality and Social Psychology, 76,* 1050–1061. doi:10.1037/0022-3514.76.6.1050

Solanki, D., & Lane, A. M. (2010). Relationships between exercise as a mood regulation strategy and trait emotional intelligence. *Asian Journal of Sports Medicine, 1,* 195–200. doi: 10.5812/asjsm.34831

Spielberger, C., Gorsush, R., & Lushene, R. (1970). *State-trait anxiety inventory manual*. Palo Alto, CA: Consulting Psychologists Press.

Spielberger, C. D. (1991). *Manual of the State-Trait Anger Expression Inventory*. Odessa, FL: Psychological Assessment Resources.

Stafford, L. D., Ng, W., Moore, R. A., & Bard, K. A. (2010). Bolder, happier, smarter: The role of extraversion in positive mood and cognition. *Personality and Individual Differences, 48,* 827–832. https://doi.org/10.1016/j.paid.2010.02.005

Statistical Package for Social Sciences (Version 25.0) [Computer software]. Chicago, IL: SPSS.

Stevens, M., & Lane, A. M. (2000). Mood-regulating strategies used by athletes [Abstract]. *Journal of Sports Sciences, 18,* 58–59. doi:10.1080/026404100365289

Stevens, M. J. (2007). A transactional model of mood. In M. L. Andrew (Ed.), *Mood and human performance: Conceptual, measurement and applied issues* (p. 89–118). Nova Science Publishers.

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioural Research, 25,* 173–180. https://doi.org/10.1207/s15327906mbr2502_4

Sties, S. W., Gonzales, A. I., Netto, A. S., Wittkopf, P. G., Lima, D. P. & de Carvalho, T. (2014). Validation of the Brunel Mood Scale for cardiac rehabilitation program. *Revista Brasileira De Medicina Do Esporte, 20,* 281–284. http://dx.doi.org/10.1590/1517-86922014200401999

Strauss, M. E., & Smith, G. T. (2009). Construct validity: Advances in theory and methodology. *Annual Review of Clinical Psychology, 27,* 1–25. doi:10.1146/annurev.clinpsy.032408.153639

Subramaniam, M., Vaingankar, J., Heng, D., Kwok, K. W., Lim, Y. W., Yap, M., & Chong, S. A. (2012). The Singapore Mental Health Study: An overview of the methodology. *International Journal of Methods in Psychiatric Research, 21,* 149–157. doi:10.1002/mpr.1351

Subramaniam, M., Abdin, E., Picco, L., Vaingankar, J. A., & Chong, S. A. (2014). Multiple chronic medical conditions: Prevalence and risk factors - results from the Singapore Mental Health Study. *General Hospital Psychiatry, 36,* 375–381. https://doi.org/10.1016/j.genhosppsych.2014.03.002

Subramaniam, M., Abdin, E., Vaingankar, J. A., Shafie, S., Chua, B. Y., Sambasivam, R., ... & Verma, S. (2020). Tracking the mental health of a nation: Prevalence and correlates of mental disorders in the second Singapore Mental Health Study. *Epidemiology and Psychiatric Sciences, 29,* 1–10. doi:10.1017/ S2045796019000179

Suchy, Y. (2011). *Clinical neuropsychology of emotion.* New York, NY: Guildford Press.

Sue, S. (1999). Science, ethnicity, and bias: Where have we gone wrong? *American Psychologist, 54,* 1070–1077. https://doi.org/10.1037/0003-066X.54.12.1070

Tabachnick, B. L., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). Boston, MA: Pearson Education

Tamir, M., John, O. P., Srivastava, S., & Gross, J. J. (2007). Implicit theories of emotion: Affective and social outcomes across a major life transition. *Journal of Personality and Social Psychology, 92,* 731–744. https://doi.org/10.1037/0022-3514.92.4.731

Tanzer, N. K., Sim, C. Q., & Spielberger, C. D. (1996). Experience, expression, and control of anger in a Chinese society: The case of Singapore. In C. D. Spielberger, & I. G. Sarason (Ed.), *Stress and emotion: Anxiety, anger, and curiosity* (Vol 16, pp. 51–65). Washington, US: Taylor & Francis.

Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph,. S., Weich, S., … & Steward-Brown, S. (2007). The Warwick-Edinburgh Mental Well-being Scale (WEMWBS): Development and UK validation. *Health and Quality of Life Outcomes, 5,* 1–13. https://doi.org/10.1186/1477-7525-5-63

Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In A. H. Tuma & J. D. Maser (Eds.), *Anxiety and the anxiety disorders* (pp. 681–706). Hillsdale, NJ: Erlbaum.

Tellegen, A. (1991). Personality traits: Issues of definition, evidence, and assessment. In W.M. Grove & D. Cicchetti (Eds.). *Thinking clearly about psychology: Vol. 2. Personality and psychopathology* (pp. 10–35). Minneapolis, MN: University of Minnesota.

Terry, P. C. (1995). The efficacy of mood state profiling with elite performers: A review and synthesis. *The Sport Psychologist, 9*, 309–324. https://doi.org/10.1123/tsp.9.3.309

Terry, P. C. (2000). Introduction to the special issue: Perspectives on mood in sport and exercise. *Journal of Applied Sport Psychology, 12*, 1–4.

Terry, P. C. (2003). An overview of mood and emotion in sport. In *4th Asia-South Pacific Association of Sport Psychology (ASPASP) International Congress* (pp. 1–11). Seoul, South Korea: ASPASP

Terry, P. C. (2005). In the mood: Mood profiling applications and mood regulation strategies. Retrieved from https://eprints.usq.edu.au/657/1/Terry1.pdf

Terry, P. C. (2010). It's nice to go travelling, BUT … In S. Hanrahan, & M. Andersen (Eds.), *The Routledge handbook of applied sport psychology: A comprehensive guide for students and practitioners.* Milton Park, UK: Routledge.

Terry, P. C., & Cei, A. (2014). Shooting in India. In P. C. Terry, L. Zhang, Y. Kim, T. Morris & S. Hanrahan (Eds.), *Secrets of Asian sport psychology.* Retrieved from http: //peterterry.wix.com/books

Terry, P. C., Dinsdale, S. L., Karageorghis, C. I., & Lane, A. M. (2006). Use and perceived effectiveness of pre-competition mood regulation strategies among athletes. In M. Katsikitis (Ed.), *Psychology bridging the Tasman: Science, culture and practice: Proceedings of the 2006 Joint Conference of the Australian Psychological Society and the New Zealand Psychological Society* (pp. 420–424). Melbourne, VIC: Australian Psychological Society.

Terry, P. C., & Galambos, S. A. (2004). Utility of mood profiles in identifying risk of eating disorders among adolescent rowers. *Proceedings of the 39th Australian Psychological Society Annual Conference: Psychological Science in Action* (pp. 269-273). Sydney, NSW: Australian Psychological Society.

Terry, P. C., & Hall, A. (1996). Development of normative data for the Profile of Mood States for use with athletic samples. *Journal of Sports Sciences, 14*, 47–48. https://doi.org/10.1080/10413200008404215

Terry, P. C., Janover, M. A., & Diment, G. M. (2004). Making a splash: Mood responses and swimming performance. *Australian Journal of Psychology, 56,* S227–228. Retrieved from http://eprints.usq.edu.au/id/eprint/4421

Terry, P. C., Karageorghis, C. I., Curran, M. L., Martin, O. V., & Parsons-Smith, R. L. (2020). Effects of music in exercise and sport: A meta-analytic review. *Psychological Bulletin*, *146,* 91–117. http://dx.doi.org/10.1037/bul0000216

Terry, P. C., Karageorghis, C. I., Saha, A. M., & D'Auria, S. (2012). Effects of synchronous music on treadmill running among elite triathletes. *Journal of Science and Medicine in Sport, 15,* 52–57. doi:10.1016/j.jsams.2011.06.003

Terry, P. C., Keohane, L., & Lane, H. (1996). Development and validation of a shortened version of the Profile of Mood States suitable for use with young athletes. *Journal of Sports Sciences, 14,* 49.

Terry, P. C., & Lane, A. M. (2000). Development of normative data for the Profile of Mood States for use with athletic samples. *Journal of Applied Sport Psychology, 12,* 69–85.

Terry, P. C., & Lane, A. M. (2010). *User guide for the Brunel Mood Scale*. Toowoomba, QLD: Peter Terry Consultants.

Terry, P. C., & Lane, A. M. (2011). Moods and emotions. In T. Morris & P. C. Terry (Eds.), *The new sport and exercise psychology companion* (pp. 63–87). Morgantown, WV: Fitness Information Technology.

Terry, P. C., Lane, A. M., & Fogarty, G. J. (2003). Construct validity of the Profile of Mood States-Adolescents for use with adults. *Psychology of Sport and Exercise, 4,* 125–139. https://doi.org/10.1016/S1469-0292(01)00035-8

Terry, P. C., Lane, A. M., Lane, H. J., & Keohane, L. (1999). Development and validation of a mood measure for adolescents. *Journal of Sports Sciences, 17,* 861–872. doi:10.1080/026404199365425

Terry, P. C., Malekshahi, M., & Delva, H. A. (2012). Development and initial validation of the Farsi Mood Scale. *International Journal of Sport and Exercise Psychology, 10,* 112–122. https://doi.org/10.1080/1612197X.2012.645133

Terry, P. C., & Parsons-Smith, R. (2019). Identification and incidence of mood profile clusters among sport participants. *Journal of Science and Medicine in Sport 22,* S100. https://doi.org/10.1016/j.jsams.2019.08.129

Terry, P. C., Potgieter, J. R., & Fogarty, G, J. (2003). The Stellenbosch Mood Scale: A dual-language measure of mood. *International Journal of Sport and Exercise Psychology, 1,* 231–245. doi:10.1080/1612197X.2003.9671716

Terry, P. C., & Slade, A. (1995). Discriminant effectiveness of psychological state measures in predicting performance outcome in karate competition. *Perceptual and Motor Skills, 81,* 275–286. doi:10.2466/pms.1995.81.1.275

Terry, P. C., Stevens, M. J., & Lane, A. M. (2005). Influence of response timeframe on mood assessment. *Anxiety, Stress, and Coping, 18,* 279–285. doi:10.1080/10615800500134688

Terry, P. C., & Youngs, E. (1996). Discriminant effectiveness of psychological state measures in predicting selection during field hockey trials. *Perceptual and Motor Skills, 82,* 371–377. https://doi.org/10.2466/pms.1996.82.2.371

Teychenne, M., Costigan, S.A. & Parker, K. (2015). The association between sedentary behaviour and risk of anxiety: A systematic review. *BMC Public Health, 15,* 513. https://doi.org/10.1186/s12889-015-1843-x

Thayer, R. E. (1978). Toward a psychological theory of multidimensional activation (arousal). *Motivation and Emotion, 2,* 1–34.

Thayer, R. E. (1987). Problem perception, optimism, and related states as a function of time of day (diurnal rhythm) and moderate exercise: Two arousal systems in interaction. *Motivation and Emotion, 11,* 19–36. doi:10.1007/BF00992211

Thayer, R. E. (1989). *The biopsychology of mood and arousal*. New York, NY: Oxford University Press.

Thayer. R. E. (1997). *The origin of everyday moods: Managing energy, tension, and stress.* New York, NY: Oxford University Press

Thayer, R. E. (2001). *Calm energy: How people regulate mood with food and exercise.* New York, NY: Oxford University Press.

Thayer, R. E., Newman, J. R., & McClain, T. M. (1994). Self-regulation of mood: Strategies for changing a bad mood, raising energy, and reducing tension. *Journal of Personality and Social Psychology, 67,* 910–925. doi:10.1037/0022-3514.67.5.910

Thomas, J. C., & Christiansen, L. R., (2011). Measurement theory in research. In J. C. Thomas & M. Hershen (Eds.). *Understanding research in clinical and counseling psychology* (pp. 29–56). New York, NY: Routledge.

Thompson, A., Hunt, C., & Issakidis, C. (2004). Why wait? Reasons for delay and prompts to seek help for mental health problems in an Australian clinical sample. *Social Psychiatry and Psychiatric Epidemiology, 39,* 810–817.

Thøgersen-Ntoumani, C., Fox, K. R., & Ntoumanis, N. (2005). Relationships between exercise and three components of mental well-being in corporate employees. *Psychology of Sport and Exercise, 6,* 609–627. https://doi.org/10.1016/j.psychsport.2004.12.004

Thyfault, J. P., Du, M., Kraus, W. E., Levine, J. A., & Booth, F. W. (2015). Physiology of sedentary behaviour and its relationship to health outcomes. *Medicine & Science in Sports & Exercise, 47,* 1301. doi:10.1249/MSS.0000000000000518

Totterdell, P. (1999). Mood scores: Mood and performance in professional cricketers. *British Journal of Psychology, 90,* 317–332. doi:10.1348/000712699161422

Totterdell, P., & Leach, D. (2001). Negative mood regulation expectancies and sports performance: An investigation involving professional cricketers. *Psychology of Sport and Exercise, 2,* 249–265. doi:10.1016/S1469-0292(01)00016-4

Totterdell, P., & Parkinson, B. (1999). Use and effectiveness of self-regulation strategies for improving mood in a group of trainee teachers. *Journal of Occupational Health Psychotherapy, 4,* 219–232. doi:10.1037/1076-8998.4.3.219

Treiber, F. A., Baranowski, T., Braden, D. S., Strong, W. B., Levy, M., & Knox, W. (1991). Social support for exercise: relationship to physical activity in young adults. *Preventive Medicine, 20,* 737–750.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38,* 1–10. doi:10.1007/BF02291170

Underwood, M.K., Coie, J.D., and Herbsman, C.R. (1992). Display rules for anger and aggression in school-age children. *Child Development, 63,* 366–380. https://doi.org/10.1111/j.1467-8624.1992.tb01633.x

Ungerleider, S., Golding, J. M., & Porter, K. (1989). Mood profiles of masters track and field athletes. *Perceptual and Motor Skills, 68,* 607–617. https://doi.org/10.2466/pms.1989.68.2.607

Vallerand, R. J., & Blanchard, C. M. (2000). The study of emotion in sport and exercise: Historical, definitional, and conceptual perspectives. In Y. L. Hanin (Ed.), *Emotions in sport* (pp. 3–38). Champaign, IL: Human Kinetics.

Vanden Auweele, Y., De Cuyper, D., Van Mele, V., & Rzewnicki, R. (1993). Elite performance and personality: From description and prediction to diagnosis and intervention. In R. Singer, M. Murphy, & L. Tennant (Eds.), *Handbook of Research on Sport Psychology* (pp. 257–289). New York: Macmillan.

van Wijk, C. H., Martin, J. H., & Hans-Arendse, C. (2013). Clinical utility of the Brunel Mood Scale in screening for post-traumatic stress risk in a military population. *Military Medicine, 178,* 372–376. https://doi.org/10.7205/MILMED-D-12-00422

Wagner, H. E., & Manstead, A. E. (1989). *Handbook of social psychophysiology*. John Wiley & Sons.

Wang, C., Bannuru, R., Ramel, J., Kupelnick, B., Scott, T., & Schmid, C. H. (2010). Tai Chi on psychological well-being: Systematic review and meta-analysis. *BMC Complementary and Alternative Medicine, 10,* 23. http://www.biomedcentral.com/1472-6882/10/23

Watson, D. (1988). The vicissitudes of mood measurements: The varying descriptors, time frames, and response formats on the study of positive and negative affect. *Journal of Personality and Social Psychology, 55,* 128–141.

Watson, D. (2000). *Mood and temperament*. New York: Guilford.

Watson, D., & Clark, L. A. (1994). Emotions, moods, traits, and temperaments: Conceptual distinctions and empirical findings. In P. Ekman and R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 89–93). New York: Oxford University Press.

Watson, D., & Clark, L.A. (1997). Measurement and mis-measurement of mood: Recurrent and emergent issues. *Journal of Personality Assessment, 68,* 267–296. doi:10.1207/s15327752jpa6802_4

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063–1070. doi:10.1037/ 0022-3514.54.6.1063

Watson, D., & Tellegen, A. (1985). Toward a conceptual structure of mood. *Psychological Bulletin, 98,* 219–235. https://doi.org/10.1037/0033-2909.98.2.219

Watson, D., Wiese, D., Vaidya, D., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology, 76,* 820–838.

Westen, D., & Rosenthal, R. (2003). Quantifying construct validity: Two simple measures. *Journal of Personality and Social Psychology, 84,* 608–618. https://doi.org/10.1037/0022-3514.84.3.608

White, R. L., Babic, M. J., Parker, P. D., Lubans, D. R., Astell-Burt, T., & Lonsdale, C. (2017). Domain-specific physical activity and mental health: A meta-analysis. *American Journal of Preventive Medicine, 52,* 653–666. https://doi.org/10.1016/j.amepre.2016.12.008

Winkielman, P., Knäuper, B., & Schwarz, N. (1998). Looking back at anger: Reference periods change the interpretation of emotion frequency questions. *Journal of Personality and Social Psychology, 75,* 719–728. doi:10.1037/ 0022-3514.75.3.719

Wieck, A. (1996). Ovarian hormones, mood and neurotransmitters. *International Review of Psychiatry, 8,* 17–25. doi:10.3109/09540269609037814

Wirz-Justice, A. (2008). Diurnal variation of depressive symptoms. *Dialogues in Clinical Neuroscience, 10,* 337.

Yeung, R. R. (1996). The acute effects of exercise on mood state. *Journal of Psychosomatic Research, 40,* 123–141. https://doi.org/10.1016/0022-3999(95)00554-4

Yik, M. S. M, Russell, J. A., & Feldman Barrett, L. (1999). Structure of self-reported current affect: Integration and beyond. *Journal of Personality and Social Psychology, 77,* 600–619. https://doi.org/10.1037/0022-3514.77.3.600

Yokoyama, K., Araki, S., Kawakami, N., & Tkakeshita, T. (1990). Production of the Japanese edition of profile of mood states (POMS): Assessment of reliability and validity. *Japanese Journal of Public Health, 37,* 913–918.

Zhang, C. Si, G., Chung, P., Du, M. & Terry, P. (2014): Psychometric properties of the Brunel Mood Scale in Chinese adolescents and adults, *Journal of Sports Sciences, 32,* 1465–1476. https://doi.org/10.1080/02640414.2014.898184

Zigmond, A. S., & Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica, 67,* 361–370. doi:10.1111/j.1600-0447.1983.tb09716.x

List of Appendices

Appendix A: Human Ethics Approval 206

Appendix B: The Brunel Mood Scale (BRUMS) & Biodata Questionnaire 207

Appendix C: Positive and Negative Affect Schedule (PANAS) 208

Appendix D: Depression, Anxiety, and Stress Scales (DASS-21)..... 209

Appendix A – Human Ethics Approval

OFFICE OF RESEARCH
Human Research Ethics Committee
PHONE +61 7 4687 5703| FAX +61 7 4631 5555
EMAIL human.ethics@usq.edu.au

UNIVERSITY OF SOUTHERN QUEENSLAND

3 July 2017

Ms Christie Han

Dear Christie

The USQ Human Research Ethics Committee has recently reviewed your responses to the conditions placed upon the ethical approval for the project outlined below. Your proposal is now deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research (2007)* and full ethical approval has been granted.

Approval No.	**H17REA143**
Project Title	Psychometric characteristics, mood profile clusters, and predictive effectiveness of the Brunel Mood Scale in a Singaporean context
Approval date	3 July 2017
Expiry date	3 July 2020
HREC Decision	**Approved**

The standard conditions of this approval are:

(a) Conduct the project strictly in accordance with the proposal submitted and granted ethics approval, including any amendments made to the proposal required by the HREC
(b) Advise (email: human.ethics@usq.edu.au) immediately of any complaints or other issues in relation to the project which may warrant review of the ethical approval of the project
(c) Make submission for approval of amendments to the approved project before implementing such changes
(d) Provide a 'progress report' for every year of approval
(e) Provide a 'final report' when the project is complete
(f) Advise in writing if the project has been discontinued, using a 'final report'

For (c) to (f) forms are available on the USQ ethics website:
http://www.usq.edu.au/research/support-development/research-services/research-integrity-ethics/human/forms

Samantha Davis
Ethics Officer

Appendix B – Brunel Mood Scale (BRUMS) & Biodata Questionnaire

Below is a list of words that describe feelings. Please read each one carefully. Then cross the box which best describes **HOW YOU FEEL RIGHT NOW**. Make sure you answer every question and provide your biodata below.

Please check <u>one</u> box for each word.

		Not at all	A little	Moderately	Quite a bit	Extremely
1.	Panicky	❑	❑	❑	❑	❑
2.	Lively	❑	❑	❑	❑	❑
3.	Confused	❑	❑	❑	❑	❑
4.	Worn out	❑	❑	❑	❑	❑
5.	Depressed	❑	❑	❑	❑	❑
6.	Downhearted	❑	❑	❑	❑	❑
7.	Annoyed	❑	❑	❑	❑	❑
8.	Exhausted	❑	❑	❑	❑	❑
9.	Mixed-up	❑	❑	❑	❑	❑
10.	Sleepy	❑	❑	❑	❑	❑
11.	Bitter	❑	❑	❑	❑	❑
12.	Unhappy	❑	❑	❑	❑	❑
13.	Anxious	❑	❑	❑	❑	❑
14.	Worried	❑	❑	❑	❑	❑
15.	Energetic	❑	❑	❑	❑	❑
16.	Miserable	❑	❑	❑	❑	❑
17.	Muddled	❑	❑	❑	❑	❑
18.	Nervous	❑	❑	❑	❑	❑
19	Angry	❑	❑	❑	❑	❑
20.	Active	❑	❑	❑	❑	❑
21.	Tired	❑	❑	❑	❑	❑
22.	Bad tempered	❑	❑	❑	❑	❑
23.	Alert	❑	❑	❑	❑	❑
24.	Uncertain	❑	❑	❑	❑	❑

Age	**Gender**	**Race**	**Highest Education**	**Occupation**	**Participation in Sport? (select Yes or No)**
	□Male □Female	□Chinese □Malay □Indian □ Eurasian □Others (pls state): _____	□ Primary □ Secondary □ ITE □ JC/IB/Poly □ University □ Postgraduate		❑ Yes ❑ No If yes, state sport(s) & level of participation: ❑ International ❑ Inter-school ❑ Inter-club ❑ Leisure/Recreation

Appendix C – Positive and Negative Affect Schedule (PANAS)

Instructions:

1. This scale consists of a number of words that describe different feelings and emotions.
2. Read each item and then list the number from the scale below next to each word.
3. Indicate to **what extent you feel this way right now**, that is, at the **present moment**.

1	2	3	4	5
Very Slightly or Not at All	A Little	Moderately	Quite a Bit	Extremely

	Interested
	Distressed
	Excited
	Upset
	Strong
	Guilty
	Scared
	Hostile
	Enthusiastic
	Proud
	Irritable
	Alert
	Ashamed
	Inspired
	Nervous
	Determined
	Attentive
	Jittery
	Active
	Afraid

Appendix D – Depression, Anxiety, and Stress Scale (DASS-21)

DASS 21 NAME _____ DATE _____

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all - NEVER

1 Applied to me to some degree, or some of the time - SOMETIMES

2 Applied to me to a considerable degree, or a good part of time - OFTEN

3 Applied to me very much, or most of the time - ALMOST ALWAYS

		N	S	O	AA	FOR OFFICE USE D	A	S
1	I found it hard to wind down	0	1	2	3			
2	I was aware of dryness of my mouth	0	1	2	3			
3	I couldn't seem to experience any positive feeling at all	0	1	2	3			
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3			
5	I found it difficult to work up the initiative to do things	0	1	2	3			
6	I tended to over-react to situations	0	1	2	3			
7	I experienced trembling (eg, in the hands)	0	1	2	3			
8	I felt that I was using a lot of nervous energy	0	1	2	3			
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3			
10	I felt that I had nothing to look forward to	0	1	2	3			
11	I found myself getting agitated	0	1	2	3			
12	I found it difficult to relax	0	1	2	3			
13	I felt down-hearted and blue	0	1	2	3			
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3			
15	I felt I was close to panic	0	1	2	3			
16	I was unable to become enthusiastic about anything	0	1	2	3			
17	I felt I wasn't worth much as a person	0	1	2	3			
18	I felt that I was rather touchy	0	1	2	3			
19	I was aware of the action of my heart in the absence of physicalexertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3			
20	I felt scared without any good reason	0	1	2	3			
21	I felt that life was meaningless	0	1	2	3			
					TOTALS			

Credits: Black Dog Institute