Development and Validation of an In-Competition Emotion Measure: The Brief In-Competition Emotion (BICE) Scale

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Abstract

Objectives: We aimed to develop a concise psychometric scale to assess athletes' in-competition emotions, which would reduce the practical and conceptual limitations of previous measures. **Design:** Four studies were designed to develop and assess the validity of the new Brief In-Competition Emotion (BICE) scale. **Method:** In Study 1, the content validity of 39 emotion adjectives was investigated using expert analysis, 9 adjectives were subsequently removed. In Study 2, 402 university athletes used the remaining 30 adjectives to record their in-competition emotions and confirmatory factor analyses and a reliability removal method was used to create the 10-item BICE scale. Study 3 (N = 109) and Study 4 (N = 74) consisted of both concurrent and predictive validity assessments of the BICE scale. **Results:** Construct validity, reliability and confirmatory factor analyses completed during Study 1 and Study 2 resulted in the development of the 10-item BICE scale, consisting of five composite emotion factors: anger, anxiety, excitement, dejection and happiness. The findings from Study 3 and Study 4 showed that the BICE scale presented acceptable levels of concurrent and predictive validity. **Conclusions:** The BICE scale is a rigorously developed parsimonious scale which offers researchers new opportunities for investigation and provides applied practitioners with a new method of evaluating in-competition intervention efficacies.

Keywords: in-competition, measurement, emotion, affect, BICE, performance

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Research has shown that an athlete's emotions can have a major impact upon their success in sporting competitions (see Hanin & Ekkekakis, 2014 for a summary). This effect has been highlighted by researchers assessing athletes' pre-competition (Brandt et al., 2016; Samełko & Guszkowska, 2016), in-competition (Allen et al., 2013; Martinent & Ferrand, 2015; Totterdell, 2000; van Kleef et al., 2019) and post-competition (Kerr & Males, 2010) emotional states. A prominent methodology in these instances has been the use of self-report questionnaires. Nevertheless, a concise, practical questionnaire to effectively assess the in-competition emotions of athletes does not currently exist. In this article we present four studies which contributed to the development and initial validation of a scale to assess athletes' subjective in-competition emotions. Here athletes' emotions are defined as brief, discrete subjective experiences specifically caused in response to an event related to sport (Lazarus, 2000; Wagstaff & Tamminen, 2021). In this research we refer to "in-competition" as any time-point between the start of a competitive event and the end of that event. These instances could include cases such as during the 80 minutes of a rugby match, the twelve rounds of a boxing match or between the first and last attempt of a field athletic event. The aim of this scale is to assist in the collection of emotion data during time-sensitive situations and to offer a contribution to the literature by providing a more reliable assessment of athletes' in-competition emotional experiences.

Current Emotion Measures

Questionnaires offer a simple technique to ascertain the subjective emotional states of many athletes simultaneously. The ease of the self-report method has led to the development of numerous emotion-related questionnaires for use within sporting contexts (see for review, Lane et al., 2012). Although conceptually related, mood differs from emotion in that moods are typically longer lasting and created by lower intensity stimuli (Wagstaff & Tamminen,

2021). Affect is a summative term used to refer to both mood and emotion (Forgas, 1995). Many of the questionnaires frequently used in the literature to assess athletes' emotions, are in fact measures of mood, yet, in this research, we aim to develop a scale relevant to specifically emotional measurement. Typically, a small number of measures have been used to investigate the moods and emotions of athletes, such as: the Profile of Mood States (POMS; McNair et al., 1971), the Profile of Mood States-Adolescents, also called the Brunel Mood Scale (POMS-A/BRUMS; Terry et al., 1999), the Positive and Negative Affect Scale (PANAS; Watson et al., 1988) and the Sport Emotion Questionnaire (SEQ; Jones et al., 2005). These scales have afforded valuable opportunities to undertake affect measurements pre- and post- competition, however, limitations exist concerning their use in assessing athletes' emotional states in-competition (Ekkekakis & Petruzello 2000; Lane, 2007).

The Profile of Mood States (POMS) is a commonly used scale within the field of psychology and was developed to assess the moods of psychiatric patients. Owing to the comprehensive collection of affect adjectives utilised within the POMS, the scale has been used in multiple studies to measure mood (at times labelled as emotion) among athletes (e.g., Hoover et al., 2017; Samełko & Guszkowska, 2016; Szczepaniak & Guszkowska, 2016). Nevertheless, following concern over the POMS accuracy in assessing specifically athletes' moods (LeUnes & Burger, 2000; Prapavessis, 2000), Terry et al. (1999, 2003) developed the POMS-A, later named the Brunel Mood Scale (BRUMS), as a sport specific alternative which still used items solely from the original POMS longlist. Although validated in sporting populations, some researchers maintain that the BRUMS is limited for use within sport, owing to the clinical foundations of the original POMS (Jones et al., 2005). For instance, the BRUMS is heavily focused on negative moods, however, Grove and Prapavessis (1992) and LeUnes and Burger (2000) have criticised the utility of largely negatively oriented instrument designs for use within sport as athletes tend to experience both positive and negative affect to

similar extents (McCarthy, 2011). Moreover, Jones et al. (2005) argued that the face validity and efficacy of the BRUMS may suffer as a result of the inclusion of the items fatigue, confusion and depression which may not be seen as relevant to sport (see also Nicolas et al., 2019). In contrast to the POMS and its derivatives, the Positive and Negative Affect Scale (PANAS) utilises an emotional cross-valence approach with 10 positive items and 10 negative items. A short form version of the PANAS, the I-PANAS, which features 5 positive and 5 negative items has also been developed (Thompson, 2007). Despite considerable use within sport (e.g., Martinent & Nicolas, 2016; Samełko & Guszkowska, 2016), the PANAS, and therefore the I-PANAS, are perhaps of a similar limited utility as the POMS within sporting contexts, owing to the use of non-sporting samples in the development and validation process (Ekkekakis & Petruzzello, 2000) for these scales. Additionally, it could be argued that the PANAS items such as interested, attentive and distressed, may not be commonly experienced by athletes whilst they are competing. Some researchers within sport have used single item assessment methods to assess a global affective dimension (e.g., Stanger et al., 2013). Nonetheless, these types of measures have been shown to suffer from statistical limitations, can be less reliable and at times are not sufficiently validated before use in sport (Ekkekakis, 2012; McCarthy, 2011). The single item emotion assessment method used in Doron and Martinent (2016) adopted a definitional approach which specifically listed items from the PANAS. The use of this PANAS-based definition is likely to lead to the same validity issues as when using the full PANAS scale.

The Sport Emotion Questionnaire

In light of the above limitations, Jones et al. (2005) developed and initially validated the Sport Emotion Questionnaire (SEQ) using an athlete-grounded four-stage process. Five theoretically supported factors, excitement, happiness, anger, anxiety and dejection, were selected to form the SEQ latent factors. Each factor was included as it had been shown to be

present within the self-reported emotional experiences of athletes and to be predictive of performance or similar outcome measures. For instance, the experience of happiness and excitement, the two positive SEQ latent factors, have both been shown to be beneficial to performance (Rathschlag & Memmert, 2015; Vast et al., 2010). However, the relationships between negative emotions included in the SEQ and sporting performance are less clear. Traditionally, researchers have suggested that experiences of anger have a negative effect on sporting performance (Lane & Terry, 2000). However, Woodman et al. (2009) have presented evidence of the benefits of experiencing anger when competing. Researchers have shown that this may be because anger causes an increased generation of energy targeted at the attainment of a task (Robazza & Bortoli, 2007; Ruiz & Hanin, 2011). Anxiety has been found to have a negative effect on performance (Judge et al., 2016), although this impact can be improved through effective regulation (for a review see Wagstaff et al., 2012). Dejection will often cause a decrease in the capabilities of sport performers owing to the associated arousal depletion (Lane et al., 2001).

Researchers (e.g., Allen et al., 2013; Vast et al., 2010) have used the SEQ to assess athletes' subjective within-game emotions. Yet, Jones et al. (2005) cautioned that the use of the SEQ in these instances is inappropriate as the tool was validated for the assessment of pre-game emotions. In addition, due to the time constraints of completing the 22-item scale, Allen et al. (2013) and Vast et al. (2010) had to rely on the potentially inaccurate post-competition emotional recall method (Hetland et al., 2018). As a result of these limitations, it does not appear practical for athletes to complete the SEQ in-competition and, it is also probable that many of the 22 SEQ items will not be relevant for measuring specifically in-competition emotions.

Measuring athletes' emotional experiences during competition offers researchers a unique insight into these previously underexplored emotional states, an insight which pre-

and post-competition approaches cannot provide. As suggested by Campo et al. (2019), solely pre-competitive emotion measurement removes the opportunity to study athletes' transitory emotional states and the effect that competition features, such as half-time breaks, have upon this affect. There is a need to undertake more context specific, in-competition assessments of athlete emotion so as to examine the impact of athletes' ongoing and transient emotional states on continual athletic performance (Campo et al., 2018). Nevertheless, the environments within which researchers aim to collect in-competition sport emotion data present practical issues. Typically, athletes do not have the time, or in some cases the inclination, to complete arduous questionnaires during a game or at an official break in play (Horvath & Rothlin, 2018). Presently, only two studies have successfully measured athlete affect within competition. First, Totterdell (2000) used the PANAS to measure cricket players' in-competition mood states. Relevant here, is the fact that cricket allows for easier collection of in-competition affect data owing to long stoppages in play and players waiting, for extended periods of time, to bat. Similarly, van Kleef et al. (2019) advanced the literature by assessing the emotional experiences of soccer players during matches by asking participants to complete emotion measures at half-time. However, van Kleef et al. (2019) did not use a validated psychometric emotion measurement scale. The development and validation of a parsimonious emotion measure that can be completed more readily during short competition intervals, will help to increase the strength and depth of the literature examining athletes' emotions across a range of sports and competition time-points. Moreover, a brief scale will allow for multiple measurement instances throughout competition and therefore enable and encourage longitudinal investigations of athletes' in-competition emotions.

As well as the academic advantages, the applied sport psychology domain will also benefit from a valid in-competition emotion questionnaire. The proposed measure (the Brief

In-Competition Emotion, BICE, scale) can be used to assess the specific in-competition emotions that athletes experience, to allow sport psychology professionals to develop behavioural interventions and assess intervention effectiveness with an accuracy that is not currently possible. In addition, a shorter measure could alleviate athletes' negative responses to questionnaire completion and allow practitioners to better engage their athletes in emotion measurement and wider psychometric assessment (Horvath & Rothlin, 2018).

The objective of the subsequent four studies was to develop and consequently assess the validity of a new in-competition emotion questionnaire. Study 1 aimed to use expert analysis to ensure that the item list was relevant and valid, Study 2 utilised the experiences of athletes to develop the 10-item scale, and Study 3 and Study 4 aimed to assess the validity of the newly developed questionnaire.

Study 1: Expert Analysis and Initial Item Selection

In line with recommendations for scale development (Carpenter, 2018; Hardesty & Bearden, 2004), an expert panel was used in Study 1 to assess the content validity of the proposed emotion items so as to exclude any items that may not be pertinent to an in-competition context.

The development process of the aforementioned Sport Emotion Questionnaire (SEQ; Jones et al., 2005) began with the compilation of a comprehensive list of emotion adjectives curated using relevant literature and athletes' experiences. This compiled list was grounded in the context of sport and focused specifically on short-term emotions rather than the longer-term moods of athletes, with the aim of avoiding some of the conceptual problems associated with other affect measures (Jones et al., 2005). Following two stages of rigorous item deletion and face validity assessments, the SEQ item list was reduced to 39 sport specific emotions which were each found to load onto one of five theoretically and statistically supported latent factors: anger, anxiety, happiness, excitement and dejection. At this stage of

the SEQ development process, this initial 39 emotion adjective list represented a valid and reliable indication of the emotions that athletes experience at all stages of competition: pre-competition, in-competition and post-competition. It is worth noting that whereas the final (22 item) SEQ was developed for *pre*-competition emotional states, we were specifically aiming to develop a measure which could be used to assess emotion for an *in*-competition context. For this reason, it was not possible to undertake a simple scale reduction process of the SEQ to develop a brief in-competition emotion scale. On that basis, we therefore utilised the original SEQ broader (39 item) list, relevant to all sport competition timepoints, as the initial item list in our in-competition emotion measure creation process (see Table 1). In contrast to the intentions of the authors of the SEQ, we were aiming to develop a measure which could be used to assess emotion for a specifically in-competition context, as a result, the employed methodology differed from that of Jones et al. (2005) hereafter.

[Insert Table 1 here]

Method

Participants

Eleven sport psychology professionals with experience of both research and applied practice were recruited by email using opportunity sampling. The eleven recruited sport psychology professionals had an average of 12.4 years of experience (SD = 8.7) working across 19 different sports. Ethical approval was granted for this study, as well as the three succeeding studies (SFEC 2018-127).

Procedure

A survey assessed the extent to which the sport psychology professionals believed that the 39 presented emotion adjectives (procured from the SEQ longlist item pool – see Table 1) were relevant to specifically athletes' in-competition emotional experiences. For each of the 39 listed items, the experts on the panel were asked to rate their agreement with

the statement ‘the relevance of this emotion will be easily understood by an athlete attempting to identify and record their own emotions in a within-game sporting context’. Participants’ agreement with this statement was measured on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*).

Statistical Analysis

Decisions regarding the relevance or exclusion of items were based upon a combination of a sum score and a content validity ratio (CVR) method. The sum score method is a well-supported and well-used method (Hardesty & Bearden, 2004), which can assess the utility of individual questionnaire items when developing a measure. There is also support within the literature for employing a CVR technique (Wilson et al., 2012). The CVR score was calculated using Lawshe’s (1975) technique and any item which presented a CVR score of less than 0 was shortlisted for exclusion.

Results

The panel of sport psychology professionals gave a rating of perceived relevance for each of the 39 items. In this instance, the average sum score was calculated ($M = 42.15$) and any item which elicited a score of more than one standard deviation ($SD = 6.37$) below that average was shortlisted for exclusion. This method led to seven items, with a sum score of 35 or below, being considered for exclusion. There were 11 items with a CVR score of less than zero which were also shortlisted for exclusion. Each of the seven items that failed to meet the sum score threshold were also found to have CVR scores of less than zero and were excluded. Of the four remaining items with a CVR score below zero, two presented a sum score of only .22 above the threshold of 35.78 and were also excluded. The other two items presented scores that were further above the sum score threshold and were consequently included within the next phase of the scale development. Multiple expert analysis techniques can be used in tandem in order to maximise efficacy (Morgado et al., 2018), and in this

instance, uniformity between the two scoring techniques was paramount in the decision to exclude items. In addition, the sum score method has been shown to be most effective in contributing towards the development of questionnaire item lists (Hardesty & Bearden, 2004). Overall, 9 items were excluded, leaving 30 items to be employed in the subsequent studies investigating in-competition emotional states. All items shortlisted for exclusion can be found in Table 2.

[Insert Table 2 here]

Discussion

This study used the analysis of a panel of sport psychology professionals to develop a shortlist of 30 items which were considered relevant for athletes' in-competition emotional experiences. Although this constitutes evidence of an initial validity assessment, further research was required to develop the in-competition scale and assess its validity. The inclusion of athletes in each of the successive studies provided a foundation for creating an in-competition emotional scale that was valid within the contexts it was designed to assess.

Study 2: Confirmatory Factor Analysis and Item Reduction

The aim of this study was to develop a short-form questionnaire that was relevant for recording athletes' in-competition emotional experiences. To address this, data were collected from athletes regarding their common emotional experiences during sporting competition.

Method

Participants

Participants in this study were university athletes ($N = 402$) recruited from two UK universities. The data set included 270 males and 129 females, and the average age of the participants was 20.2 years ($SD = 2.2$). On average, the participants had 9.5 years' experience competing in their sport ($SD = 4.5$). The sampled sports included individual sports ($n = 80$),

such as swimming (n = 9) and tennis (n = 10), as well as team sports (n = 320) such as football (n = 163) and netball (n = 33). Two participants did not specify their sport.

Procedure

The participants volunteered to take part in this survey study following a university lecture. At the start of the survey, the participants were asked to state their 'chosen sport' and the number of years' experience that they had competing in that sport. The item list of thirty emotions developed in Study 1 was presented to the participants and they rated how frequently they experienced the given emotions during sporting competition. The participants rated the items on Likert scales ranging from 0 (*Not at all*) to 4 (*Extremely*). This represents the same anchoring system used in the development of the SEQ (Jones et al., 2005).

Statistical Analysis

Each of the 30 items that were presented to the athletes had been previously categorised into one of the five latent factors in the original SEQ development process (Jones et al., 2005). Of the 30 items, 7 items were categorised into an anger factor and 7 into an anxiety factor; both the excitement and the happiness factors contained 6 items, and 4 items were linked to the dejection factor. The SEQ five-factor structure was rigorously supported both theoretically and statistically and was consequently used as the scale structure in a Confirmatory Factor Analysis (CFA) to develop the new, brief in-competition questionnaire.

First, the data was screened for any missing data using SPSS (Version 25). Fourteen data points were found to be missing. These missing data presented a non-significant Little's MCAR test result (p = .06) indicating that the data points were missing at random. The missing data was replaced using the Expectation Maximisation (EM) method which allows the relationships between the data and variables to be preserved (Brown, 2006). Any impact of the EM method upon the standard error of individuals can be ignored as these standard errors are not vital in factor analysis (Brown, 2006).

Two measures of sampling adequacy were completed to assess the dataset. The Kaiser Meyer-Olkin value was .879 which is above the recommended value of .6, similarly, Bartlett's test of sphericity was significant, χ^2 (435) = 5278.39, $p < .001$ (Tabachnick & Fidell, 2007). Univariate normality was tested by calculating skewness and kurtosis scores for each item (Groenveveld & Meeden, 1984). Only the item 'sad' showed univariate kurtosis and no item showed univariate skewness. The multivariate normality was checked using Mardia's normalised coefficient of multivariate normality (Mardia, 1970) and it was found that the data did not show a multivariate normal distribution.

As a result of the normality tests, the utilised CFA estimation method needed to account for the non-normal multivariate distribution. The maximum likelihood method can often account for minor departures in normality (Chou & Bentler, 1995), yet the robust maximum likelihood method (Satorra & Bentler, 1994) is stronger in its estimation across differing levels of normality and sample size (Curran et al., 1996). Additionally, the robust maximum likelihood method is commonly used for similar data distribution constraints to those that this data presented (e.g., Lane et al., 1999), and was therefore utilised in this analysis. The Lavaan package (Rosseel, 2012) in R was used for all CFA procedures.

Two Items per Factor Management. The aim of this study was to produce the most parsimonious sporting emotion scale for use in an in-competition context. The error variance and participant comprehension issues associated with single item measures precluded a one item per factor questionnaire (Harmon-Jones et al., 2016). Similarly, when time constraints are of paramount concern, a large number of items per factor would be counterproductive practically and may cause issues with participant attitudes towards completion (Horvath & Rothlin, 2018). Therefore, a two item per factor design offered the most parsimonious and effective means to assess emotion here (Burisch, 1997). As a result of the criteria for over-identification, experts can discourage researchers from developing scales with two items per

factor unless previous evidence or theory provide a strong enough reason (Brown, 2006). In this instance, a short, statistically sound emotion scale would provide new avenues for research and more accurate emotion measurements and intervention assessments. This represented a comprehensive enough justification to proceed with a two item per factor scale, compared to a scale with a larger number of items per factor.

For a two item per factor model to be statistically sound, it must meet stringent criteria that allow for the model to be over-identified (Brown & Moore, 2012). The over-identification of a model is achieved when the number of known values exceeds the number of freely estimated model parameters, which allows the falsifiability of the model to be tested and fit statistics to be calculated (Kenny & Milan, 2011). Brown (2006) recommended a number of practices to implement for a two item per factor model to be found to be over-identified. The model must include more than two factors, both items loading onto each factor must be equally constrained, each latent variable must be correlated with at least one other latent variable, and the errors between indicators must be uncorrelated (Brown, 2006).

Model Fit Statistics. Several model fit indices were used to assess the overall fit of the model. These indices included the Satorra-Bentler χ^2 statistic, Robust Comparative Fit Index (RCFI), Robust Tucker Lewis Index (RTLI), Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR) (Kline, 2005). In the present analysis, the non-centrality-based indices' thresholds used to indicate good fit were RCFI > .95 and RMSEA values close to or below .06 (Hu & Bentler, 1999), with RCFI > .90 and RMSEA values below .08 indicating acceptable fit (Bentler, 1990). The RTLI is a relative fit index and shares the same good and adequate fit thresholds as the RCFI (Hu & Bentler, 1999). The absolute fit indices include the χ^2 statistic and the SRMR value. SRMR values should fall close to or below .08 (Hu & Bentler, 1999), with values that fall below .05 indicating very good fit (Steiger, 1989). The χ^2/df statistic value indicates an

adequate fit if it is smaller than 5, and a good fit if the value is below 1 (Marsh & Hocevar, 1985). The χ^2 statistic should always be accompanied by a non-significant *p* value.

Results and Discussion

First, a CFA model which included all 30 items was assessed (RCFI = .85, RTLI = .83, RMSEA = .06, SRMR = .08). Several subsequent methods were then adopted to develop the most parsimonious and valid instrument, as the brevity and practicality of the scale would be improved through item reduction. The factor loadings presented in the full 30 item CFA were analysed (see Table 3). Any item which presented a loading of below .6, whilst retaining the theoretical coherence of the factor, was removed from the analysis (Matsunaga, 2010). This led to the removal of six items across four of the factors.

The remaining 24 items were then reduced using a reliability removal analysis method (Raubenheimer, 2004). This analysis used the command 'omega if item is removed' as the primary approach to item removal. The method was completed for each of the five factors in a step-by-step process with an item being removed after each level of analysis (see Table 4). Although omega was used as the reliability measure in this instance, using Cronbach's Alpha as an alternative reliability assessor in the same item removal process was found to yield the same factor pairings.

Disappointed and unhappy (dejection), enthusiastic and energetic (excited) and happy and cheerful (happiness), were all shown to be the most reliable pairings for their respective factor. These items also presented the two highest factor loadings for their factors following the full item list CFA model. As a result of this concordance, these three item pairs were chosen as the items to represent their respective factors, but the items for the remaining two factors, Anxiety and Anger, required further finalisation.

[Insert Table 4 here]

Factor Finalisation

The anger and anxiety factors required further investigation to ascertain the optimal items for each factor. The anxiety construct included ‘stressed’ and ‘nervous’ which both loaded onto the anxiety factor alongside ‘anxious’ at the same strength (.728) in the full item CFA analysis. Nevertheless, ‘stressed’ was excluded in favour of ‘nervous’, first, because ‘stressed’ presented a lower sum score in Study 1 and the results from Study 2 indicated that the athletes experienced ‘stressed’ less frequently. Second, there were poorer model fit statistics and factor loadings when ‘stressed’ was included in a two-item model with ‘anxious’ compared to when ‘nervous’ was included with ‘anxious’.

Within the full item CFA analysis, ‘angry’ had a primary factor loading of .758 which was a slightly higher loading onto the anger factor than ‘irritated’ (.753). Yet, the reliability analysis showed that ‘angry’ had a lower contribution to the anger factor reliability than ‘irritated’. Therefore, further comparisons were sought to ascertain which item should be excluded from the model. This investigation included running two CFA models, one with ‘angry’ and ‘frustrated’ inputted as the two anger items and one with ‘irritated’ and ‘frustrated’. The overall model fit statistics for both met all of the thresholds, however, the factor loadings were lower in the model with ‘angry’ (.705) and ‘frustrated’ (.764) than the model which included ‘irritated’ (.774) and ‘frustrated’ (.805).

Ten Item Model

After the final exclusions, the ten psychometrically strongest items included in the final model were: cheerful, happy, disappointed, unhappy, anxious, nervous, energetic, enthusiastic, irritated and frustrated (see Appendix). A CFA model, which met the two item per factor criteria (Brown, 2006), was then run with all ten items loaded onto their respective factors. The results showed a well-fitting model which surpassed each of the required model fit statistic thresholds, S-B $\chi^2(30) = 38.360$, $p = .141$, RCFI = .993, RTLI = .990, RMSEA = .028, SRMR = .031. Scale reliability was calculated using the Spearman-Brown split half

correlation which has been shown to be the most accurate reliability measure for a two-item factor (Eisinga et al., 2013). Each of the factors showed adequate reliability statistics above .7 (Parsons et al., 2019). The factor reliability values can be found in Table 5.

Study 3: Examining the Concurrent Validity

The aim of the third study was to examine the concurrent validity of the newly developed ten item BICE scale. Concurrent validity is assessed by correlating the scores of similar factors across multiple questionnaires (Kimberlin & Winterstein, 2008) and is an important procedure in scale development processes (e.g., Nassi et al., 2017). In this instance, the BRUMS was used, as the similarities between the BRUMS and the BICE scale latent factors were evident. Although the BRUMS was developed based upon the POMS scale, it has been assessed with adult athletes (Terry et al., 2003), and has been shown to be a valid measure of affect (see its inclusion in the concurrent validity assessment of the SEQ). In the context of our study, it was hypothesised that positive correlations would be found between the BRUMS factors of tension, depression, anger and vigour with the BICE factors of anxiety, dejection, anger and excitement factors respectively.

As previously described, a limitation of the BRUMS instrument is that vigour is the only positive factor. Consequently, the BICE scale was also compared with the PANAS. This comparison allowed the happiness BICE scale factor to be assessed for validity. It was hypothesised that the BICE scale factors of happiness and excitement would be positively correlated with the positive PANAS factor, and the factors of anger, anxiety and dejection would be positively correlated with the negative PANAS scores. Both the PANAS and the BRUMS were also included in the SEQ concurrent validity correlation assessment, as the scales consist of composite factors which can be easily compared to the five emotion factors that the SEQ and the BICE share.

Method

Participants

The participant cohort consisted of athletes from three different UK universities (N = 109). The 109 participants (n = 42 female) had a mean age of 19.74 years (SD = 1.59).

Procedure

A concurrent validity assessment involving three questionnaires was not possible to complete in an in-competition context owing to the time constraints that are placed on in-competition data collection. The impractical nature of in-competition data collection is an issue that it is hoped the BICE scale may aid in combatting. As a result of these time constraints, Study 3 comprised a survey in which the participants were asked to recall the most recent sporting competition in which they had participated and, with this competition in mind, complete the BICE, the PANAS and the BRUMS. The participants were asked to complete the scales whilst recalling the intensity of the emotions they had felt *in-competition*. The BICE scale and the BRUMS assessed affect on a scale of 0 (*Not at all*) to 4 (*Extremely*) and the PANAS used a scale of 1 (*Not at all*) to 5 (*Extremely*).

Statistical Analysis

The data was examined for normality using the Kolmogorov-Smirnov normality test (Ghasemi & Zahedrasl, 2012) and was found to be largely non-normally distributed and therefore required non-parametric testing. Skewness and Kurtosis were also assessed, with only the BRUMS depression factor showing a result indicating kurtosis (2.47). Owing to these results, a non-parametric Spearman correlation was completed rather than a Pearson's. Any Spearman correlation above .8 should be considered a high correlation and a correlation between .4 and .8 should be considered moderate to moderately high (Zhu, 2012).

Results

To optimise the accuracy of the participants' recall, any participant who had competed in their chosen sporting competition more than four weeks before the completion

of the survey was excluded from the participant group. This exclusion criteria removed 55 participants from an initial cohort of 164. The remaining participants had experience of competing in sports including football (n = 32), badminton (n = 15) and hockey (n = 13). The mean years' experience competing was 8.0 years (SD = 4.8), and on average the recalled contest took place 1.75 weeks prior to completion of the survey (SD = 1.06).

Of the 109 participants, three participants only completed the BICE scale and were therefore included in the reliability analysis but excluded from the concurrent validity tests.

Reliability Analysis

First, the BICE scale factors were each assessed for reliability using a Spearman Brown split-half correlation (Eisinga et al., 2013). Each of the factors presented a reliability of above .7 (see Table 5).

Validity Assessment

The correlation coefficients for the concurrent validity assessments can be found in Table 6. As hypothesised, the results showed moderate to high correlations between the comparable factors from the BRUMS and the BICE scales (see Zhu, 2012). The two anger factors were moderately highly correlated (r_s = .664), as well as the depression and dejection factors (r_s = .675) and the excitement and vigour factors (r_s = .661). The tension and anxiety factors were highly correlated (r_s = .820). Collectively, these correlation analysis results support Hypothesis one. The positive PANAS subscale was found to be moderately highly correlated with both the excitement BICE factor (r_s = .739) and the happiness BICE factor (r_s = .655). Similarly, the negative PANAS scores were moderately and moderately highly correlated to the BICE factors of anxiety (r_s = .645), anger (r_s = .446) and dejection (r_s = .478), thus supporting Hypothesis two.

[Insert Table 6 here]

Discussion

The BICE scale was shown to indicate a unique addition to the literature as the measure possesses practical benefits, such as a concise structure, whilst still assessing emotions in a similar capacity to the PANAS and the BRUMS, both of which are well-established measures of affect (Jones et al., 2005).

Although instructed to recall the emotions they had experienced whilst competing, since the participants did not actually complete the questionnaire in-competition, it could be argued that the emotions reported may not provide a complete reflection. Nevertheless, the exclusion of four items from the SEQ 22 item list during Study 1, indicated that the experts were able to differentiate the emotions that athletes experience before competition from those that they experience during competition. In addition, the data from Study 2 showed that the athletes tended to experience the BICE scale emotions more frequently during competition than other items included in the pre-competition specific SEQ. This evidence supports the notion that the athletes sampled during Study 3 were likely to have accurately differentiated the emotions that they had experienced during the competition from those that they had experienced before and after. Nonetheless, a further validation assessment which involved the measurement of athletes' emotions, taken at an in-competition time-point, was conducted.

Study 4: Predictive Validity

The aim of this study was to assess the predictive validity of the Brief In-Competition Emotion (BICE) scale when administered during sporting competition. Predictive validity measures the extent to which a scale can predict scores on a criterion measure. In this instance, the criterion measures were the emotional control subscale from the Test of Performance Strategies (TOPS; Thomas et al., 1999) and a subjective and objective performance assessment. In assessing the predictive validity of the SEQ using correlation analysis, Jones et al. (2005) included the TOPS emotional control subscale. Jones et al. (2005) found that pre-competitive feelings of dejection and anger were negatively correlated

with the TOPS emotional control subscale and excitement and happiness were positively correlated with the TOPS scale. It was thus decided that the TOPS emotional control scale should be included in the predictive validity assessment of the BICE, so as to examine the effect of an individual's tendency to control their emotions on the emotions that they experience in-competition. Nonetheless, despite sharing the same five composite emotion factors, the BICE scale assesses specifically in-competition emotion rather than pre-competitive emotion, therefore the analysis in this study was exploratory in nature.

Method

Participants

The participants were recruited at competitive amateur table tennis tournaments in the United Kingdom. There were 74 participants recruited with a mean age of 31.6 years (SD = 13.3). Each of the participants completed the BICE scale during a doubles table tennis match.

Measures

Emotion. The athletes' emotional states were measured using the Brief In-Competition Emotion Scale. This questionnaire assessed emotion across the five principal factors of anxiety, happiness, dejection, excitement and anger, each measured by two items. The questionnaire used a 5-point Likert scale ranging from 0 (*Not at All*) to 4 (*Extremely*) for each item (see Appendix for the full BICE scale).

Subjective Performance. The participants were asked to rate how well they believed they were playing using a 70mm visual analogue scale ranging from *Poor* to *Excellent*.

Objective Performance. The athletes' objective performance was recorded as the points' difference at the time of the emotion measurement. This was the number of points the participant pair had scored subtracted by the number of points their opponents had scored.

Emotional Control. Emotional control was measured using the emotional control subscale from the TOPS (Thomas et al., 1999). This self-report subscale featured four items

which assessed the athletes' ability to control their emotions during matches (for example, "My emotions keep me from performing at my best"). The emotional control subscale was measured on a 5-point Likert scale ranging from 0 (*Never*) to 4 (*Always*). A higher score represented a lower perception of personal emotional control.

Procedure

The participants completed the BICE scale during the official one-minute break in play allocated between the second and third game of their doubles match. At this time, the participants also recorded a visual analogue scale assessment of their own performance during the match. The match score line following the second game was also noted. Following the match, the participants completed the emotional control subscale from the TOPS questionnaire (Thomas et al., 1999).

Statistical Analysis

Scale reliability was assessed using Spearman-Brown split half scores. The correlations involving the personal subjective performance measure were completed using a Pearson's correlation, whilst each of the other correlation analyses were completed using a Spearman's Rho test as the variables were non-normally distributed. Only correlations involving two variables which are both non-normally distributed require the use of non-parametric correlation analysis (Armstrong, 2018). A mixed factorial ANOVA involving Emotion Factor and Competition Situation was completed to ascertain the participants' emotional experiences dependent upon how successful they were in the match. Emotion Factor was a repeated measures variable in that all participants recorded a score for each of the five BICE scale factors. Competition Situation was an independent groups variable as all participants were either winning, drawing or losing when the measurements were taken.

Results

Scale Reliability

All of the five BICE scale factors were shown to have a reliability score of above .7, which is the required threshold for a reliable scale (Parsons et al., 2019) (see Table 5).

[Insert Table 5 here]

Correlations

Table 7 shows the correlations between the five BICE factors, the subjective and objective performance measures and the TOPS emotional control subscale. The subjective and objective performance measures were moderately correlated (r = .548). Only Excitement presented no correlation with the personal subjective performance measure. Happiness was positively correlated with subjective performance (r = .379), such that participants who believed they had performed better in the match so far were happier. Conversely, Anxiety, Dejection and Anger were all negatively correlated with subjective performance (r = -.301, r = -.526 and r = -.519 respectively). Happiness presented a low positive correlation, and Dejection and Anger a low and moderate negative correlation, with the objective performance measure. The Anxiety and Excitement factors both presented no correlation with objective performance.

The BICE Anxiety factor showed a low correlation with the TOPS emotional control subscale scores (r_s = .256). Whereas Excitement, Happiness, Dejection and Anger were not correlated with the TOPS emotional control subscale.

[Insert Table 7 here]

ANOVA

A mixed factorial ANOVA was employed to determine the effect of competition situation on the athletes' emotional states. There was a significant main effect of Emotion Factor, $F(2.24, 810.26) = 54.26$, $p < .001$, $\eta_p^2 = .43$, such that the five emotions measured by the BICE scale were experienced at different intensities from one another (see Table 5). The main effect of Competition Situation was also significant, $F(2, 52.74) = 5.79$, $p = .005$, $\eta_p^2 =$

.14. There was a significant interaction effect involving Competition Situation and Emotion Factor, $F(4.47, 140.58) = 4.71$, $p = .001$, $\eta_p^2 = .12$. Bonferroni pairwise comparisons showed that there was a significant difference between the Happiness scores for those participants winning ($M = 5.57$, 95% CI [4.67, 6.46]) and losing ($M = 3.61$, 95% CI [2.72, 4.50]). Additionally, participants felt less dejected when winning ($M = 0.91$, 95% CI [.12, 1.71]) compared to when losing ($M = 3.30$, 95% CI [2.51, 4.10]) and less dejected when drawing ($M = 1.89$, 95% CI [1.17, 2.62]) compared to when losing. Furthermore, the participants were significantly less angry when winning ($M = 1.17$, 95% CI [.26, 2.09]) compared to when losing ($M = 3.13$, 95% CI [2.22, 4.04]). There were no significant differences in Excitement or Anxiety scores across Competition Situation. The comparison of the intensity of emotions experienced across Competition Situation can be seen in Figure 1.

[Insert Figure 1 here]

Discussion

These results lend support to the predictive validity of the BICE scale. The significant correlations between the performance measures (both subjective and objective) and the BICE factors, indicate that, in general, individuals who are performing better and who rate themselves as performing better, feel happier. Similarly, those who are performing worse and rate themselves as performing worse, experience more negative emotions (dejection, anger and anxiety). The results presented within this study offer support to previous post-match emotional recall research which has provided evidence for a relationship in basketball matches between in-competition happiness and anger with successful and unsuccessful objective performance respectively (Uphil et al., 2013). In addition, the BICE Anxiety factor was found not to be related to the objective performance measure, as was also shown in the Uphill et al. (2013) study. This finding indicates that the anxiety that athletes experience when competing may be more closely related to subjective perceptions of their own

performance rather than objective score lines. The lack of correlation between the Excitement factor with subjective and objective performance suggests that the athletes' enthusiasm and energetic nature was unchanged whether subjectively or objectively performing well.

The results of the correlations between the BICE scale factors and the TOPS emotional control scale directly contrast with those of the pre-competitive SEQ with the TOPS. We suggest that this may be as a result of the BICE scale and the TOPS scale differing in their assessment technique. The TOPS emotional control subscale assesses how much control athletes generally perceive themselves to have over their emotions, yet the BICE scale measures athletes' subjective emotions at a specific time point in a competition. For instance, when completing the emotional control subscale, participants are asked, as an example, 'How often does your performance suffer when something upsets you during competition?'. However, it is possible that, for at least those participants who were winning when they completed the BICE scale, few events had so far occurred within the match to upset the athletes. As a result, the TOPS emotional control subscale may not offer the most valid assessment of the BICE scale's predictive validity. Both the subjective and objective performance measures seem to represent better investigations of the BICE scale predictive validity as they measure concepts that are specific to the same context in which the athletes' emotional states are assessed.

Nevertheless, the Anxiety BICE scale factor was found to be correlated with the TOPS emotional control subscale. These data can be interpreted to indicate that athletes who rated themselves as subjectively more anxious whilst they were competing also recognised that they generally struggle to control their emotions during competition.

General Discussion

In this series of studies, we aimed to develop and assess the validity of a short, self-report in-competition emotion measure that could be used in both research and applied

settings. This aim was achieved following four studies which focused upon, first, the development of the BICE scale using the expertise of sport psychology professionals and 402 athletes, and second, the validation assessment of the new scale with two further athlete cohorts. The ten items included in the BICE scale were found to load onto one of five theoretically supported latent factors: anger, anxiety, dejection, happiness and excitement (two items per factor). Following the scale development studies, a concurrent validity investigation was carried out which showed that the five BICE scale factors measured emotion in a similar manner to the analogous factors within both the PANAS and the BRUMS. The validation assessment of the BICE scale was then further supported through the inclusion of a fourth study which presented evidence to support the feasibility for the use of the BICE scale in an in-competition context (doubles table tennis matches) and additionally showed that the scale presented suitable reliability. The predictive validity was also assessed in this study, and BICE factors were found to be moderately to highly correlated with both subjective and objective performance measures.

The BICE scale is unique when compared to the pre-competition specific SEQ (Jones et al., 2005), as the BICE scale development process sought to produce a psychometrically strong scale which was relevant to an exclusively in-competition context. In doing this, 13 out of the final 22 SEQ items which were not pertinent to athletes' in-competition emotional states were excluded from the BICE scale, and an item (frustrated) not found in the final SEQ was included. The BICE scale development process has explicitly shown that the 10 BICE items are each relevant in measuring an athlete's in-competition emotional state, regardless of whether they are also relevant in measuring an athlete's pre-competitive emotional state. The BICE scale development methodology differed from the SEQ development process in chronological specificity as participants were instructed to only consider in-competition emotions. This in-competition specificity allows researchers using the BICE scale to

confidently undertake an assessment of exclusively in-competition emotion without any peripheral interference from extraneous items. The BICE scale is also distinct from other existing measures (i.e., BRUMS, POMS and PANAS), as demonstrated by the lack of similarity between the BICE scale item list and the item lists included in these measures.

As other emotion measurement authors often caution, questionnaires do not always represent best practice for measuring individuals' emotional experiences (Lane et al., 2012). Typically, a questionnaire cannot record a wide range of subjective emotions to the same extent as a qualitative exploration (e.g., Martinent & Ferrand, 2015). Nevertheless, questionnaires offer researchers and practitioners a normative measure that can be used to easily compare assessments. In addition, despite its comparable parsimony, in Study 3 the BICE scale recorded similar latent factor scores as the PANAS and the BRUMS, both of which are composed of many more items.

The concise nature of the BICE scale offers a potential solution to the time-constrained methodological issues experienced by researchers and practitioners. Within a sporting context, the BICE scale affords researchers and practitioners more opportunities for self-report emotion measurements to take place, as the measure is short enough to be completed during almost any break in play (see Burke, 2007 for a summary of interval characteristics across various sports). This utility was evidenced during Study 4, in which the athletes completed the questionnaire during the allotted one-minute break in play between game two and three of their table tennis matches. By using the BICE scale for this kind of data collection, researchers will be able to investigate research questions that have been otherwise impractical in the past, and practitioners will be able to accurately understand the effectiveness of a range of emotional regulation techniques and interventions. An additional advantage of the BICE scale is the ease with which longitudinal emotional assessments can be conducted by both researchers and practitioners. As well as the practical benefits of

completing the short BICE scale at multiple time points during competition, athletes may also be more inclined to complete a specifically short questionnaire on multiple occasions compared to a longer measure (Horvath & Rothlin, 2018). Emotions have been shown to fluctuate during sport (e.g., Hetland et al., 2018), and without having a tool capable of measuring these emotions, the effect of these transitory states upon the athlete would stay hidden. The development of the BICE scale addresses this often-cited issue within the sport emotion literature (see Campo et al., 2018; Campo et al., 2019; Hetland et al., 2018; Uphill et al., 2012), and offers an alternative method for researchers. Finally, although the BICE scale represents a potentially useful tool in the measurement of emotions during a range of sporting competitions, a limitation of the scale is that it is less suitable for use in sports without a recognised break in competition (for example, marathon or cycling races). In these contexts, an in-competition emotion questionnaire may not be the most efficacious methodology and instead, it is recommended that innovative, non-intrusive, real-time emotion measurement techniques should be developed and utilised (see Hetland et al., 2019).

In conclusion, a parsimonious but robust and psychometrically strong emotion scale has been developed which is able to assess athletic emotional experience across the five principal factors of anger, anxiety, happiness, excitement and dejection. This is the first questionnaire to be developed specifically to assess in-competition sporting emotions and the BICE scale has been shown to offer a valid and reliable, brief assessment of emotion in the contexts assessed. This newly developed technique can assist in furthering academic research opportunities and improving the applied assessment of emotion. Scale validation is a continual process and, in order to examine new environments within which the BICE scale may present benefits, further validation and feasibility tests are encouraged.

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Appendix

The Brief In-Competition Emotion Scale

Below you will find a list of words that describe a range of feelings that sport performers may experience *during competition*. Please read each one carefully and indicate on the scale next to each item how you feel *right now, at this moment, in relation to your current competition.*

There are no right or wrong answers. Do not spend too much time on any one item but choose the answer which best describes your feelings right now in relation to your current competition.

	Not at all	A little	Moderately	Quite a bit	Extremely
Frustrated	0	1	2	3	4
Anxious	0	1	2	3	4
Energetic	0	1	2	3	4
Unhappy	0	1	2	3	4
Cheerful	0	1	2	3	4
Enthusiastic	0	1	2	3	4
Disappointed	0	1	2	3	4
Nervous	0	1	2	3	4
Irritated	0	1	2	3	4
Happy	0	1	2	3	4

Scoring Instructions:
Anxiety = anxious + nervous
Anger = frustrated + irritated
Dejection = unhappy + disappointed
Excitement = enthusiastic + energetic
Happiness = happy + cheerful

Tables

Table 1

The Initial Item List of 39 Items Procured from the Sport Emotion Questionnaire Development Procedure

Item	Item
Excited	Cheerful
Anxious	Upset
Fulfilled	Furious
Unhappy	Content
Charged	Exhilarated
Dejected	Frustrated
Nervous	Pleased
Daring	Joyful
Enthusiastic	Irritated
Energetic	Stressed
Happy	Annoyed
Hatred	Alert
Angry	Pleasure
Tense	Provoked
Satisfied	Sad
Uneasy	Depressed
Attacking	Apprehensive
Motivated	Disappointed
Concerned	Comfortable
Pressured	

Table 2

Items Shortlisted for Exclusion Following the Expert Phase of Research

Item	Sum Score	Content Validity Ratio
Fulfilled	31	-0.455
Dejected	31	-0.455
Daring	31	-0.455
Hatred	34	-0.273
Uneasy	35	-0.273
Depressed	35	-0.273
Joyful	35	-0.091
Exhilarated	36	-0.273
Content	36	-0.273
Cheerful	38	-0.091
Pleasure	40	-0.091

Note. Excluded items in italics.

Table 3

The Factor Loading Scores for all 30 items included in the initial 30 item Confirmatory Factor Analysis

Factor	Item	Factor Loading
Anger	Frustrated	.784
	Irritated	.753
	Angry	.758
	Annoyed	.750
	Furious	.678
	Provoked	.628
	Attacking	.336
Happiness	Happy	.774
	Cheerful	.694
	Pleased	.661
	Satisfied	.646
	Pleasure	.618
	Comfortable	.590
Anxiety	Anxious	.745
	Nervous	.728
	Stressed	.728
	Pressured	.686
	Tense	.671
	Concerned	.501
	Apprehensive	.499
Excitement	Enthusiastic	.752
	Energetic	.747
	Excited	.611
	Motivated	.610
	Alert	.434
	Charged	.371
Dejection	Unhappy	.796
	Disappointed	.715
	Upset	.693
	Sad	.649

Note. Excluded items in italics.

Table 4

The Reliability Removal Process for each of the Five Composite Factors of the Brief In-Competition Emotion Scale

Factor	Item	ώ if item deleted	ώ if item deleted	ώ if item deleted	ώ if item deleted	Spearman-Brown if item deleted
Anger	Frustrated	.843	.820	.798	.730	.730
	Irritated	.849	.829	.814	.761	.762
	Annoyed	.852	.830	.804	.766	.767
	Angry	.842	.823	.821		
	Furious	.853	.850			
	Provoked	.859				
Happiness	Happy	.770	.714	.590		.590
	Cheerful	.781	.723	.630		.630
	Pleased	.787	.751	.749		.749
	Satisfied	.777	.752			
	Pleasure	.784				
Anxiety	Anxious	.789	.747	.677		.677
	Nervous	.794	.751	.688		.688
	Stressed	.810	.797	.833		.833
	Pressured	.822	.816			
	Tense	.822				
Excitement	Enthusiastic	.672	.578			.578
	Energetic	.679	.631			.631
	Excited	.749	.749			.749
	Motivated	.751				
Dejection	Unhappy	.722	.650			.652
	Disappointed	.758	.694			.696
	Upset	.766	.760			.760
	Sad	.784				

Table 5

Spearman-Brown Split Half Correlation, Mean and Standard Deviation for each of the Five Factors of the Brief In-Competition Emotion Scale in Study 2, Study 3 and Study 4

	Study 2			Study 3			Study 4		
Factor	Spearman-Brown Split Half Correlation	Mean	Standard Deviation	Spearman-Brown Split Half Correlation	Mean	Standard Deviation	Spearman-Brown Split Half Correlation	Mean	Standard Deviation
Anger	.770	2.75	1.94	.754	2.96	2.05	.870	2.24	2.30
Excitement	.749	6.17	1.45	.708	6.06	1.39	.747	5.46	1.84
Anxiety	.833	3.96	2.08	.873	3.30	2.21	.742	1.90	1.83
Happiness	.749	5.46	1.68	.756	5.55	1.57	.814	4.57	2.26
Dejected	.760	2.17	1.82	.740	1.86	1.93	.716	2.03	2.12

Note. Study 2 $N = 402$, Study 3 $N = 109$, Study 4 $N = 74$

Table 6

Bivariate Spearman's Rho Correlations between BICE scale Factors, BRUMS Factors and PANAS Scores (Study 3)

	2	3	4	5	PANAS Positive	PANAS Negative	BRUMS Anger	BRUMS Confusion	BRUMS Depression	BRUMS Fatigue	BRUMS Tension	BRUMS Vigour
1. Anxiety	.114	.078	.072	.114	.132	.645**	.136	.328**	.209*	.274**	.820**	-.028
2. Anger		-.160	-.28**	.727**	-.223*	.446**	.664**	.412**	.615**	.305**	.239*	-.187
3. Excitement			.702**	-.339**	.739**	-.044	-.228*	-.061	-.194*	.036	.039	.661**
4. Happiness				-.450**	.655**	-.177	-.336**	-.089	-.318**	.081	-.033	.489**
5. Dejected					-.388**	.478**	.615**	.458**	.675**	.321**	.321**	-.268**

Note. $N = 106$
*p<.05, **p<.01

Table 7

Bivariate Correlations between BICE Scale Factors, Subjective and Objective Performance Measures, and the TOPS Emotional Control Subscale

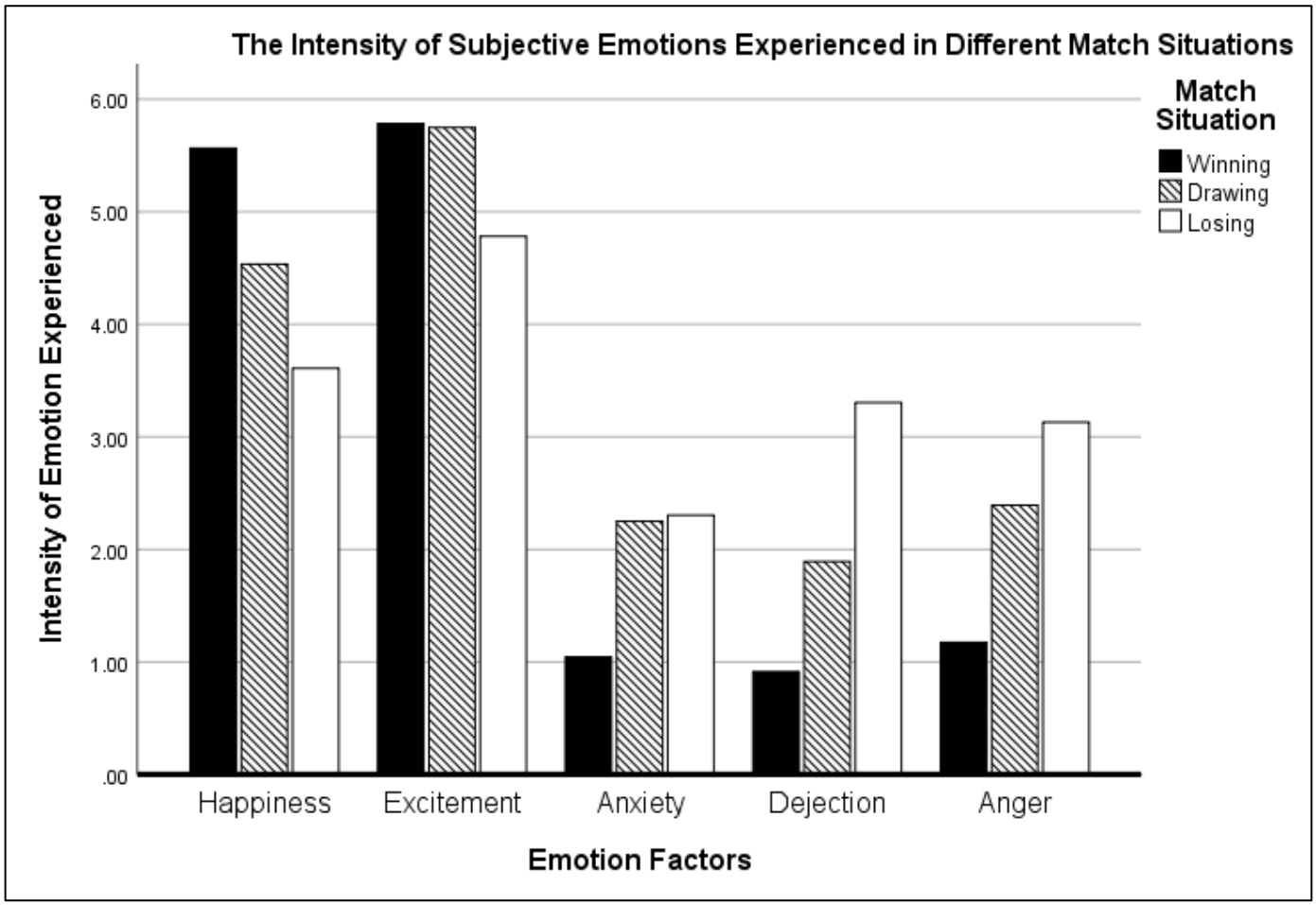
	Pearson's Correlation	Spearman's Rho Correlation	
BICE scale Factor	Subjective Performance	Objective Performance	TOPS Emotional Control Subscale
Happiness	.379**	.316**	-.030
Excitement	-.142	-.107	.196
Anxiety	-.301*	-.181	.266*
Dejection	-.526**	-.511**	.197
Anger	-.519**	-.366**	.195

Note. $N = 74$
*p<.05, **p<.01

Figures

Figure 1

The Intensity of BICE Scale Factor Emotions Experienced Whether Winning, Drawing or Losing



Note. $N = 74$