Asian Journal of Sport and Exercise Psychology xxx (xxxx) xxx

Contents lists available at ScienceDirect

Asian Journal of Sport and Exercise Psychology

journal homepage: www.elsevier.com/locate/ajsep

# Imagery, competitive anxiety, and performance: An investigation with junior athletes

Stefan Koehn [a,*], Tony Morris [b]

[a] School of Health and Sport Sciences Liverpool Hope University Liverpool, United Kingdom
[b] College of Sport and Exercise Science Institute of Sport, Exercise and Active Living Victoria University, Melbourne, Australia

ARTICLE INFO

*Keywords:*
SIQ-C
CSAI-2C
Confirmatory factor analysis
Performance

ABSTRACT

Conducting research with youth athletes is an important and challenging area of study. The aims of the current study are twofold: (i) testing the psychometric properties of the Sport Imagery Questionnaire-Children Version (SIQ-C, Hall et al., 2009) and the Competitive State Anxiety Inventory-2 Children Version (CSAI-2C; Stadulis et al., 2002), as well as the examination of a new directional scale added to the CSAI-2C, and (ii) the relationship between key psychological variables, namely, imagery, anxiety, and confidence with performance. The sample consisted of 123 junior male soccer players aged 7 to 12 years. CFA showed some support for the SIQ-C (CFI = .890, TLI = .867, RMSEA = .085), stronger results for the CSAI-2C measure (CFI = .934, TLI = .918, RMSEA = .055), and particularly strong indices for the newly tested directional scale (CFI = .969, TLI = .963, RMSEA = .072). Motivational General-Mastery was a significant predictor of self-confidence (intensity, beta = .19, and direction, beta = .44) and of cognitive anxiety (direction only, beta = .45). Testing the effect of imagery, anxiety, and self-confidence on performance, only the cognitive specific dimension significantly predicted subjective performance (beta = .26). The results partly confirmed previous findings. The results are also encouraging as the new direction scale of the CSAI-2C revealed stable psychometric properties and was a more sensitive measure than the self-confidence and cognitive anxiety intensity scales.

## Introduction

Imagery, anxiety, and confidence are some of the key concepts in sport psychology. Numerous studies have emerged based on Paivio's (1985) analytic framework and Martin Moritz and Hall's (1999) applied model of imagery in conjunction with the Sport Imagery Questionnaire (Hall, Mack, Paivio, & Hausenblas, 1998) as operationalization of imagery in sport. Similarly, anxiety and self-confidence have been widely studied based on tenets of multidimensional anxiety theory (Martens Vealey & Burton, 1990) and Jones' (1995) control model of competitive anxiety, measured by the Competitive State Anxiety Inventory-2 (CSAI-2; Martens et al., 1990) and the amended version, the CSAI-2D, also testing directionality (Jones & Swain, 1992). The field of youth research has gained momentum with the development of the Sport Imagery Questionnaire Children Version (SIQ-C; Hall Munroe-Chandler Fishburne & Hall 2009) and the Competitive State Anxiety Inventory-2 Children Version (CSAI-2C; Stadulis MacCracken Eidson & Severance, 2002), allowing researchers to test imagery use, anxiety, and self-confidence in junior athletes. Besides some promising findings during the validation stages and following research studies, there have been issues in the use of these measures. This study has two aims. First, this study aims to assess the psychometric properties and reliability of the SIQ-C and CSAI-2C, as well as the directional scale of the CSAI-2C. The directional scale will serve as an alternative measure to help interpret anxiety and self-confidence in junior competition. Secondly, the relationship between imagery and competitive anxiety has been tested with junior athletes in the past; this study aims to re-examine the results.

Psychological skills and individual experiences in junior athletes have received more interest over the last decade. Researchers generally focused on imagery (e.g., Munroe-Chandler Hall Fishburne O, & Hall, 2007; O, Munroe-Chandler Hall & Hall, 2014; Simonsmeier & Buecker, 2016) and the relationship between imagery and anxiety and confidence (e.g., Hall et al., 2009; Munroe-Chandler Hall, & Fishburne, 2008; Strachan & Munroe-Chandler, 2006). To date, only a few validated children's versions are currently available for quantitative

Peer review under the responsibility of Tianjin University of Sport.
* Corresponding author at: Liverpool Hope University, United Kingdom.
*E-mail address:* koehns@hope.ac.uk (S. Koehn).

https://doi.org/10.1016/j.ajsep.2026.10.002
Received 2 July 2025; Received in revised form 25 August 2026; Accepted 18 October 2026
2667-2391/Copyright © 2026 The Authors. Publishing services by Elsevier B.V. on behalf of KeAi Communications Co. Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

research. These measures include the SIQ-C (Hall et al., 2009), CSAI-2C (Stadulis et al. 2002), and the Sport Anxiety Scale-2 (SAS-2; Smith, Smoll, Cumming, & Grossbard, 2006). Unlike the SIQ-C and CSAI-2C, the SAS-2 was developed for use with adult and child athletes.

Validation studies on imagery and competitive anxiety used a rigorous research design that incorporated several phases in developing and examining the respective measures. The SIQ-C (Hall et al., 2009) is a parallel version of the SIQ (Hall et al., 1998), which is firmly based on Paivio (1985) analytical framework of imagery. Despite the use of a large sample with 628 child athletes between seven and 14 years of age, confirmatory factor analysis (CFA) revealed rather low values for Goodness of Fit, CFI = .89, GFI = .91, and RMSEA = .06. The SIQ-C measures various aspects of imagery, namely cognitive specific (CS), cognitive general (CG), motivational specific (MS), motivational general-arousal (MS-A), and motivational general-mastery (MG-M). To validate the CSAI-2C, Stadulis et al. (2002) included 632 participants between the ages of eight and 13. CFA results showed fairly strong values, GFI = .959, AGFI = 943, RMSR = .042. The CSAI-2C measures cognitive anxiety, somatic anxiety, and self-confidence. Although the scale revealed good psychometric properties, Stadulis and colleagues (2002) did not incorporate a directional measure of competitive anxiety.

Following the validation of the SIQ-C (Hall et al., 2009) and CSAI-2C (Stadulis et al, 2002), research studies using both or just one of these scales have generally recruited smaller sample sizes for their examinations, for instance, Strachan et al. (2006) recruited 76 competitive baton twirlers, Munroe-Chandler and colleagues (2008) 122 soccer players, and Simonsmeier and Buecker (2016) 80 gymnasts. Correlation and regression results consistently found positive significant associations between confidence and motivational functions of imagery, such as MS (Munroe-Chandler et al., 2008; Strachan et al., 2006), MG-A (Hall et al., 2009; Strachan et al., 2006), and MG-M (Hall et al., 2009; Munroe-Chandler et al., 2008; Strachan et al., 2006) subscales. In addition, anxiety was negatively related to imagery (Strachan et al., 2006). These results were generally confirmed in a sample of junior athletes using the original SIQ and CSAI-2 (Vadocz et al., 1997).

Several methodological issues arise when conducting research with youth athletes. One key issue in research with youth samples is the relatively low reliability produced by scales in conjunction with child athletes. In the validation phase, the cognitive general dimension had an alpha score of .62 (Hall et al., 2009). Although the SIQ-C has been used in several studies, the scale's reliability was not always above the .70 threshold (Nunnally & Bernstein, 1994). For instance, Munroe-Chandler et al. (2008) reported alpha values of .68 (MS) and .69 (MG-A), and Simonsmeier and Buecker (2016) reported alpha values of .60 (for CS and CG) and .62 (MS) for the SIQ-C subscales. Furthermore, Strachan et al. (2006) found internal consistency below .70 for three of the five imagery dimensions in the 12- to 15-year-old cohort, and particularly low internal reliability for the CG ($\alpha = .31$) and MG-M ($\alpha = .47$) dimensions in the 7- to 11-year-old cohort. Therefore, we removed these subscales from further analysis. Based on suggestions by Biddle and Brooke (1992), Strachan and colleagues (2006) argued that Cronbach alphas as low as .60 would be acceptable for youth research, although this argument may be more appropriate for research testing youth athletes with scales validated for adults. For instance, using the original Sport Imagery Questionnaire (SIQ; Hale et al., 1998) with 12- to 18-year-old athletes ($M = 15.39$, $SD = 1.58$), Vadocz and colleagues (1997) also reported low alpha values for cognitive general ($\alpha = .61$) and motivational general-arousal ($\alpha = .67$) subscales. Given that Biddle and Brooke's (1992) comment was made before psychometrically tested and validated children's scales were available, research with youth athletes should not accept internal consistency below the generally accepted .70 threshold (Nunnally & Bernstein, 1994). Future studies need to closely monitor the reliability of youth scales and whether poor psychometric properties could affect measures.

Another measurement limitation is that the children's version of the CSAI-2C currently consists of one response scale measuring intensity perceptions of cognitive anxiety, somatic anxiety, and self-confidence. Theoretical arguments and empirical results indicated the relevance of examining anxiety on a directional scale. For instance, Mahoney and Avener (1977) reported that successful Olympic athletes perceived anxiety levels as more positive than their unsuccessful counterparts. To measure directionality, Jones and Swain (1992) modified the original CSAI-2 from Martens and colleagues (1990) by adding a direction scale to each original item to assess whether athletes experience the CSAI-2 subcomponents as facilitative or debilitative. The 7-point directional scale ranges from +3 (*very facilitative*) to -3 (*very debilitative*), with 0 as *unimportant*. On a theoretical level, Jones (1995) proposed a control model of competition anxiety, suggesting that anxiety symptoms can be interpreted as positive or negative. Based on a review of preliminary findings, Jones (1995) concluded that the directional scale appears valuable for better understanding the relationship between state self-confidence, state anxiety, and performance. Despite theoretical considerations and empirical evidence for the CSAI-2 directional scale (e.g., Jones & Swain, 1992), the CSAI-2 children version has not yet been used with a directional component.

In this study, the first aim was to test the psychometric properties and reliability of the SIQ-C and CSAI-2C. Both scales underwent rigorous validation (Hall et al., 2009; Stadulis et al., 2002) but later studies reported reliability issues (e.g., Munroe-Chandler et al., 2008; Simonsmeier & Buecker, 2016; Strachan & Munroe-Chandler, 2006). Similar to Jones and Swain's (1992) adjustment to the CSAI-2, a directional scale to the CSAI-2C will be tested. This new scale, referred to as CSAI-2Cd, will be examined on its psychometric properties, including CFA and reliability analyses. In addition, the relationships between the directional components of the CSAI-2Cd and imagery and performance will be tested. A meta-analysis by Craft Magyar Becker and Feltz (2003) between intensity measures of the CSAI-2 and performance revealed moderate links between confidence and performance and weaker connections between both anxiety components and performance. Using the directional scale with adult samples has helped to better understand the competitive anxiety – performance relationship (Jones, 1995). It is hypothesized that the directional measure will provide stronger correlations with performance than the intensity scale.

The second aim was to examine the relationships between imagery, competitive anxiety, and performance. Previous studies showed significant positive relationships between motivational functions of imagery and self-confidence (Munroe-Chandler et al., 2008; Strachan & Munroe-Chandler, 2006) and significant negative relationships with cognitive anxiety (Strachan & Munroe-Chandler, 2006). Re-testing these findings is expected to yield more evidence confirming these relationships.

Furthermore, the relationships between imagery, competitive anxiety, and performance will be assessed. In their review of imagery in sport, Martin et al. (1999) summarized previous findings indicating that CS and CG have helped athletes develop performance skills and strategies. In addition, MG-M has been strongly linked to confidence, which also strongly influences performance. In accordance with Martin et al.'s (1999) review, it was hypothesized that CS, CG, and MG-M are significant predictors of performance. Martens et al. (1990) hypothesized that self-confidence and cognitive anxiety have stronger relationships with performance than somatic anxiety, because both factors are connected to expectancies and social evaluation, whereas the influence of somatic anxiety on performance is rather weak, given the prediction that somatic anxiety will fall with the onset of physical activity. In accordance with Martens et al. (1990), it was hypothesized that self-confidence and performance are associated by a positive linear relationship, and cognitive anxiety and performance by a negative linear relationship.

## Method

### Participants

The sample consisted of 123 junior male soccer players between 7 and 12 years of age ($M$ = 9.25; $SD$ = 1.42). Participants had been involved in soccer practice for an average of 4.61 years ($SD$ = 2.26), in soccer competition for 3.12 years ($SD$ = 1.74), and trained for an average of 5.13 hours ($SD$ = 3.17) per week. All players were based in the UK and played at a club level.

### Measures

**Sport Imagery Questionnaire – Children (SIQ-C**; Hall Munroe-Chandler Fishburne & Hall, 2009). The SIQ-C is a children's version of the commonly used Sport Imagery Questionnaire (Hall et al., 1998). Furthermore, the SIQ-C is a parallel version of the SIQ, consisting of the same subscale structure, namely cognitive specific (CS; item example: "before trying a skill, I see myself doing it perfectly"), cognitive general (CG; item example: "I see myself following the game plan or routine at competitions"), motivational specific (MS; item example: "I see myself doing my very best"), motivational general-arousal (MG-A; item example: "I imagine myself staying calm in competitions"), and motivational general-mastery (MG-M; item example: "I imagine myself being confident in competition") imagery. The SIQ-C validation study yielded a 21-item scale with a Likert response format anchored from 1 (*not at all*) to 5 (*very often*). The CFA results confirmed good fit of the five-factor model (CFI = .89; GFI = .91; RMSEA = .06), and Cronbach's alpha coefficients for the five SIQ-C subscales were generally acceptable, ranging between .69 and .82 (Hall et al., 2009). Following the SIQ-C validation stage (Hall et al., 2009), the measure has been used frequently in quantitative studies with junior athletes (Munroe-Chandler et al., 2008; Munroe-Chandler et al., 2012; Simonsmeier & Buecker, 2016; Strachan & Munroe-Chandler, 2006).

**Competitive State Anxiety Inventory–2 Children Version (CSAI-2C;** Stadulis, MacCracken Eidson & Severance, 2002). The CSAI-2C is a parallel version of the CSAI-2 (Martens et al., 1990) consisting of three subscales, namely cognitive anxiety, somatic anxiety, and self-confidence. The children's version of the CSAI-2 consists of 15 items and 5 items per subscale (Stadulis et al., 2002). The validation study by Stadulis and colleagues (2002) reported strong reliability for the overall scale (α = .96) and CFA results supporting the scale's three-factor structure (chi-square = 200.4, df = 87, $p$ < .001, GFI = .959, RMSR = .042). The CSAI-2C response format, identical to the original CSAI-2, is measured on a 4-point Likert scale asking participants to rate the intensity of their experience between 1 (*not at all*) and 4 (*very much so*). Item examples for the three subscales read "I'm concerned about not being able to concentrate today" (cognitive anxiety), "my body feels tense" (somatic anxiety), and "I feel self-confident" (self-confidence).

Jones and Swain (1992) modified the CSAI-2 by adding a directional perception scale to each original item, using a 7-point response format. In addition to the CSAI-2C intensity scale, this study also incorporated a directional scale. Similar to the directional scale used by Jones and Swain (1992) for the CSAI-2, items in this study were rated on an intensity scale and a directional scale, using a bipolar 7-point response format ranging from +3 (*very facilitative*) to -3 (*very debilitative*), with 0 as *neutral*. Previous studies with older athletes showed acceptable Cronbach alpha coefficients above .70 for the various subscales (e.g., Jones & Hanton, 2001; Koehn, 2013).

**Performance Measure**. Athletes' performance perceptions were examined through a single item asking participants, 'how did you perceive the performance of your last competition when compared to competitions of a similar level in general'. **Similar to the item-response format used by** Stavrou and Zervas (2004), **an 11-point Likert scale ranging from 0 (*very low performance*) to 10 (*very high performance*) was used. Subjective performance was preferred over an objective performance measure (e.g., win, lose, draw), as team performance in soccer may differ substantially from individual performance perceptions. The subjective performance question was also used in previous research with junior athletes aged 12 to 18 years** (Koehn & Morris, 2012). **None of these studies using a single-item performance measure reported issues regarding face validity or data collection.**

### Procedure

Following Ethics approval from the University ethics committee, access was requested to a range of junior soccer clubs that competed weekly throughout the season. The junior athletes competed frequently in rural and metropolitan Scotland. After establishing contact with various clubs and following standard consent procedures, parents of underage players who wanted to join the study as volunteers signed the consent form. Participants completed the questionnaires before (SIQ-C) and after (CSAI-2Cd and the subjective performance measure) the competition match. Participants spent approximately 10 to 15 minutes completing the entire set of questionnaires. We provided verbal and written explanations of the questionnaires, and athletes were encouraged to ask questions throughout data collection (for instance, if the meaning of item wording was unclear).

### Statistical analysis

Given the limited information on model testing, especially following the validation phase, it is relevant to assess the factor structure for the SIQ-C and CSAI-C, as well as the CSAI-2C directional scale. Confirmatory factor analysis (CFA) was undertaken using AMOS 22.0 software. Model estimations were based on maximum likelihood methods (Arbuckle, 2013). The measurement models were assessed through parsimonious fit, such as chi-square test ($\chi^2$), incremental fit, i.e., the comparative fit index (CFI; Bentler, 1990) and the Tucker-Lewis index (TLI; Bollen, 1989), and absolute fit, i.e. the standardized root-mean-square residual (SRMR; Hu & Bentler, 1998) and the root-mean-square error of approximation (RMSEA; Steiger, 1990). Hu and Bentler (1999) provided rather stringent cutoff values, indicating a very good fit of the data with CFI and TLI scores exceeding .95, SRMR below .08, and RMSEA below .06. Marsh Hau and Wen (2004) criticized the use of overly stringent criteria. Following testing, the authors concluded that "there is some evidence to suggest that even the old cutoff values (e.g., RNI and TLI > .90) are overly demanding in relation to a normative criterion of appropriateness based on the best existing psychological instruments" (p. 326). Given the rather low CFA scores for the SIQ-C and CSAI-2C during the validation stage, it seems appropriate to follow less stringent guidelines. For this study, we considered good model fit as CFI and TLI above .90 and RMSEA below .08 (MacCallum, Browne, & Sugawara, 1996; Marsh et al., 2004; Steiger, 2007).

## Results

The data were analyzed using SPSS Version 22. We first examined the scales' psychometric properties and reliability, then examined the relationship between imagery, competitive anxiety, and performance. All measures were completed by the entire sample, $N$ = 123, except for the CSAI-2C directional scale, which were completed by 92 participants. **Due to attrition, non-response, and data cleaning, a smaller subsample returned complete data sets on the CSAI-2C directional scale.**

### Aim 1: CFA and reliability of the SIQ-C and CSAI-2C

The five-factor structure of the SIQ-C revealed lower-than-desirable cut-off values for CFI, TLI, and RMSEA (M1: SIQ-C). The CFA model modifications were made in accordance with suggestions by Xiong Xia

Ni & Hu (2025) and were data-driven, rather than amending underlying theoretical associations between key variables. Because factor loadings and reliability scores were acceptable, we based model modifications on modification indices. We constrained parameters with heightened error term covariances and modification indices, making sequential adjustments by starting with the highest values (Xiong et al., 2025). This approach was implemented for both the SIQ-C and CSAI-2C measurement models.

Modification indices for the SIQ-C indicated that several error terms were particularly high. Model modification included associations between error-term covariances for items within and between factors. Particularly high error terms were found between items 6 (CG "I see what I would do if my game plans or routines do not work out") and 7 (CG "I imagine continuing with my game plan or routine even if it is not going well.") and between error terms of items 20 (MG-M "I see myself being in control in tricky situations") and 21 (MG-M "I see myself getting through tough situations with good results"). In addition, error terms of items between factors emerged for item 6 (CG) and item 18 (MG-M "I see myself being mentally strong"), between items 6 (CG) and 20 (MG-M), and between item 18 (MG-M) and item 9 (MS "I see myself doing my very best") and 12 (MS "I see myself as a champion"). The modified SIQ-C model (M2) revealed the following indices, CFI = .890, TLI .867, SRMR = .061, and RMSEA = .085. To assess potential issues with individual factors of the SIQ-C scale, CS, CG, MS, MG-A, and MG-M factors were tested separately as one-factor congeneric models. One of the advantages of testing a unidimensional model is the confirmation of the construct's content validity by its fit indices. In addition, RMSEA confidence intervals help determine whether the model fits well. In Table 1, the results (M3 to M5) showed strong values for all indices for CS, CG, and MS, indicating that these models were not significantly different from optimally specified models. In contrast, the remaining congeneric models testing MG-A (M6) and MG-M (M7) showed low TLI and elevated RMSEA values (MG-A: TLI = .838, RMSEA = .206; MG-M: TLI = .835, RMSEA = .183).

The three-factor structure of the CSAI-2C (M8; Table 1) revealed lower-than-desirable cutoff values for CFI and TLI indices. Problematic error terms for items between factors emerged for items 10 (cognitive anxiety "I was worried about goals in competition") and 11 (somatic anxiety "I felt my stomach sinking"), between items 12 (cognitive anxiety "I was concerned that others were disappointed with my performance") and 5 (self-confidence "I felt secure"), and between items 14 (cognitive anxiety "I was concerned about not being able to concentrate") and 15 (somatic anxiety "My body felt tight"). Following model re-specifications, the retested model (M9) showed stronger indices: CFI = .934, TLI = .918, SRMR = .072, and RMSEA = .055.

Interestingly, the newly tested directional scale of the CSAI-2C showed particularly strong values across the model indices (M10), CFI = .969, TLI .963, SRMR = .037, and RMSEA = .072. The CFA results for all models are presented in Table 1. Cronbach's alpha displayed acceptable values for the SIQ-C (.93), for CSAI-2C intensity (.91) and direction (.97) scales. As shown in Table 2, the internal consistency on a subscale level was satisfactory for imagery subscales ranging between .70 and .85, and for CSAI-2C intensity (.76 to .78) and direction (.91 to .93) subscales. The somatic anxiety intensity measure showed an internal consistency of .68, which was the only subscale slightly below the desirable .70 threshold.

In addition to Cronbach's alpha, construct reliability was examined. Construct reliability is a model-based consistency of a set of measures (Bollen, 1989). To calculate construct reliability, $\rho_\eta$, the formula by Fornell and Larcker (1981) was used. The lower acceptable value for composite reliability is .70 (Yi & Davis, 2003). Although $\rho_\eta$ is based on calculations of the overall measurement model, the results are shown in Table 2. Model-based reliability estimates were above .70, although CG and somatic anxiety revealed values marginally below the threshold. Overall, the construct reliability was tenable. Although some issues occurred with MG-A and MG-M at the model specification level, the reliability assessments (alpha values and construct reliability) supported both constructs (Table 2). It was decided to retain both measures for the correlation analyses.

### *Aim 2: correlation and regression results*

The SIQ-C was not significantly related to the CSAI-2C but showed a significant association with the CSAI-2C directional scale, $r = .36$, $p < .01$. On a global level, significant results were found between performance and SIQ-C, $r = .29$; $p < .01$. All results on a subscale level are shown in Table 2.

### *Imagery predicting confidence*

The correlation findings indicated that all SIQ-C subscales are significantly associated with self-confidence. Significant results were found for the CSAI-2C confidence intensity and directional scales (except for the CS subscale, which was excluded from subsequent analysis). In the following regression analysis, one model included confidence intensity as the criterion variable, and a separate model tested confidence direction as the criterion variable. To test the hypothesis that MG-M is a significant predictor of confidence, we used the same approach as Munroe-Chandler and colleagues (2008). The overall regression result for self-confidence intensity was significant, $F(5, 117) = 2.60$, $p < .05$. MG-M explained 3.5 percent of the variance, and the four remaining imagery dimensions explained another 10 percent of the variance, although CS, CG, MS, and MG-A did not significantly predict self-confidence intensity. With regard to self-confidence

**Table 1**
Examination of fit indices for the CSAI-2C, CSAI-2C direction, and SIQ-C scales.

| Model | $\chi^2$ | *df* | CFI | TLI | SRMR | RMSEA | RMSEA 90% CI | Factor Loadings |
|---|---|---|---|---|---|---|---|---|
| SIQ-C Models | | | | | | | | |
| M1: SIQ-C | 401.985* | 179 | .838 | .810 | .068 | .101 | .088-.114 | .41-.79 |
| M2: SIQ-C modified | 323.964* | 173 | .890 | .867 | .061 | .085 | .070-.099 | .36-.80 |
| Congeneric SIQ-C Models | | | | | | | | |
| M3: CS | 5.866 | 2 | .972 | .917 | .037 | .126 | .000-.250 | .59-.83 |
| M4: CG | 2.070 | 2 | .999 | .997 | .027 | .017 | .000-.181 | .55-.73 |
| M5: MS | 3.635 | 2 | .987 | .962 | .030 | .082 | .000-.214 | .63-.75 |
| M6: MGA | 12.361* | 2 | .946 | .838 | .045 | .206 | .106-.323 | .74-.78 |
| M7: MGM | 25.518* | 5 | .917 | .835 | .055 | .183 | .117-.257 | .67-.76 |
| CSAI-2C Models | | | | | | | | |
| M8: CSAI2C | 146.976* | 87 | .870 | .843 | .078 | .075 | .054-.096 | .45-.73 |
| M9: CSAI-2C modified | 114.507* | 84 | .934 | .918 | .072 | .055 | .025-.078 | .40-.74 |
| M10: CSAI-2C Directional Scale | 128.142* | 87 | .969 | .963 | .037 | .072 | .043-.098 | .73-.91 |

*Note.*
* $p < .05$.

**Table 2**
Correlation coefficients, cronbach alpha scores, means, and standard deviations.

| | Perf | CS | CG | MS | MGA | MGM | cog | Som | s-c | $cog_{dir}$ | $som_{dir}$ | $s\text{-}c_{dir}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CS | .34 | | | | | | | | | | | |
| CG | .26 | .51 | | | | | | | | | | |
| MS | .24 | .55 | .49 | | | | | | | | | |
| MGA | .16 | .53 | .49 | .81 | | | | | | | | |
| MGM | .24 | .59 | .59 | .80 | .82 | | | | | | | |
| COG | -.14 | -.09 | .02 | .01 | .04 | .08 | | | | | | |
| SOM | -.07 | -.17 | -.06 | -.07 | -.07 | -.12 | .57 | | | | | |
| CONF | .05 | .25 | .25 | .23 | .23 | .19 | -.07 | .22 | | | | |
| COGdir | .11 | .13 | .27 | .25 | .21 | .36 | -.08 | -.26 | .15 | | | |
| SOMdir | .13 | .18 | .35 | .29 | .22 | .38 | -.08 | -.29 | .16 | .93 | | |
| CONFdir | .16 | .15 | .42 | .32 | .27 | .44 | -.07 | -.27 | .23 | .85 | .89 | |
| $\alpha$ | | .79 | .70 | .78 | .84 | .85 | .76 | .68 | .78 | .93 | .91 | .92 |
| $\rho_\eta$ | | .80 | .65 | .79 | .84 | .84 | .75 | .68 | .78 | .93 | .91 | .92 |
| Range | 0 - 10 | 1 - 5 | 1 - 5 | 1 - 5 | 1 - 5 | 1 - 5 | 1 - 4 | 1 – 4 | 1 - 4 | -3 - +3 | -3 - +3 | -3 - +3 |
| *M* | 6.97 | 3.40 | 3.22 | 3.81 | 3.69 | 3.62 | 2.20 | 2.58 | 2.96 | -0.37 | -0.19 | 0.28 |
| *SD* | 1.87 | 0.74 | 0.79 | 0.81 | 0.86 | 0.81 | 0.75 | 0.73 | 0.76 | 1.86 | 1.70 | 1.60 |

*Note*. Correlation coefficients ≥ .19 are significant at .05 level, coefficients ≥ .27 are significant at .01 level, and coefficients ≥ .35 are significant at .001 level. Perf = performance. $\alpha$ = internal consistency. $\rho_\eta$ = construct reliability.
cog = cognitive anxiety, som = somatic anxiety, s-c = self-confidence, $cog_{dir}$ = cognitive anxiety direction, $som_{dir}$ = somatic anxiety direction, $s\text{-}c_{dir}$ = self-confidence direction.

direction, only four imagery dimensions, namely CG, MS, MG-A, and MG-M, were significantly correlated with self-confidence (Table 2). Therefore, these four predictor variables were included in the regression equation. The results were significant, $F(4, 87) = 6.68$, $p < .001$. MG-M explained 18.9 percent of the variance. The second model accounted for another 6.4 percent of the variance. MG-M was also a significant predictor of self-confidence direction (Table 3).

*Imagery predicting competitive anxiety*

The correlation results in Table 2 indicated that no significant links emerged between SIQ-C dimensions and cognitive and somatic anxiety intensity measures. Therefore, no regression analyses were conducted in conjunction with anxiety intensity as a criterion variable. With regard to directional measures of the CSAI-2C, cognitive anxiety and somatic anxiety subscales showed significant correlations with imagery dimensions of CG, MS, MG-A, and MG-M. Therefore, two multiple regressions were conducted with these dimensions as predictor variables and cognitive anxiety, somatic anxiety, and self-confidence as criterion variables. Both regression equations were significant with 14.7 per cent of variance explained in cognitive anxiety direction, $F(4, 87) = 3.75$, $p < .01$, and 18.4 per cent in somatic anxiety direction, $F(4, 87) = 4.89$, $p < .01$. As shown in Table 4 only MG-M was the only significant predictor for cognitive anxiety, beta = .45, although MG-M was just outside the significance cut-off value, $p = .058$, for somatic anxiety.

**Table 3**
Regression analysis between imagery variables and self-confidence.

| Model | Variable | B | SE *B* | *β* | *t* |
|---|---|---|---|---|---|
| Self-confidence intensity | | | | | |
| Model 1 | MG-M | .18 | .08 | .19 | 2.10* |
| Model 2 | MG-M | .20 | .17 | .21 | 1.19 |
| | CS | .14 | .12 | .14 | 1.23 |
| | CG | .17 | .11 | .18 | 1.59 |
| | MS | .10 | .15 | ,10 | 0.63 |
| | MG-A | .14 | .15 | .16 | 0.95 |
| Self-confidence direction | | | | | |
| Model 1 | MG-M | .88 | .19 | .44 | 4.59* |
| Model 2 | MG-M | .82 | .38 | .41 | 2.18* |
| | CG | .53 | .27 | .24 | 1.95 |
| | MS | .09 | .35 | .05 | 0.26 |
| | MG-A | -.39 | .33 | -.20 | -1.17 |

*Note*.
* $p < .05$.

**Table 4**
Regression analysis between imagery variables and anxiety.

| Variable | *B* | SE *B* | *β* | *t* | *B* | SE *B* | *β* | *T* |
|---|---|---|---|---|---|---|---|---|
| | Cognitive Anxiety Direction | | | | Somatic Anxiety Direction | | | |
| CG | .19 | .33 | .07 | 0.57 | .43 | .30 | .18 | 1.45 |
| MS | .03 | .43 | .01 | 0.07 | .30 | .39 | .14 | 0.77 |
| MG-A | -.42 | .41 | -.19 | -1.03 | -.56 | .37 | -.27 | -1.54 |
| MG-M | 1.06 | .46 | .45 | 2.31* | .79 | .41 | .37 | 1.92 |

*Note*.
* $p < .05$.

*Imagery and competitive anxiety as predictors of performance*

Although strong theoretical and empirical evidence suggests that anxiety and confidence predict performance, the intensity and directional scales did not show significant correlations with the subjective performance measure (Table 2). Therefore, no additional regression analyses were conducted. Imagery use showed several significant associations with performance. CS, CG, MG-A, and MG-M were entered as predictor variables, and subjective performance as the criterion variable, in a regression equation. The regression was significant, with 12.5 percent of the variance in subjective performance explained, $F(4, 118) = 4.20$, $p < .01$. The only significant predictor of performance was CS, *beta* = .26, $p < .05$.

## Discussion

The purpose of the study was to investigate the relationship between imagery, anxiety, self-confidence, and performance in youth soccer players. Furthermore, the applied questionnaires, SIQ-C and CSAI-2C, as well as the newly added directional scale of the CSAI-2C, were tested for psychometric properties and reliability. **The measurement models provided some evidence for the usefulness of the three scales with child athletes. Results of the current study partly support previous youth studies.**

*Psychometric properties of the SIQ-C, CSAI-2C, and CSAI-2CD*

The CFA corroborated the five-factor structure of the SIQ-C, although CFI and TLI remained under the .90 cutoff. Therefore, the results should be interpreted with caution, and conclusions are tentative. The three-factor structure of the CSAI-2C intensity and directional scales performed better than the SIQ-C, although key CFA indices indicated

acceptable fit. Similar to CFAs conducted by Hall et al. (2009) and Stadulis et al. (2002), the psychometric properties of the CSAI-2C showed acceptable scores for CFI, TLI, SRMR and RMSEA, but the results did not provide excellent fit under the more stringent cut-off values suggested by Hu and Bentler (1999). In particular, the SIQ-C fit indices showed lower-than-desirable TLI and RMSEA values. Follow-up tests with a one-factor congeneric model provided only partial support and also highlighted issues with the MG-A and MG-M subscales.

In this context, the RMSEA results appear particularly important. RMSEA is less sensitive to sample size but more sensitive to simple model misspecifications and very sensitive to complex model specifications (Hu & Bentler, 1998). Given that the one-factor congeneric model, based on Hu and Bentler's (1998) suggestions, is rather simple, the results of these models, therefore, indicate potentially serious misspecifications. Morton-Williams and Sykes (1984) have considered that issues might be due to a lack of young participants' understanding of particular concepts rather than a lack of vocabulary understanding. This suggests that changes in item wording may not automatically improve model specifications.

Regarding the overall models, another important aspect of the RMSEA is the option to use a confidence interval as part of a hypothesis-testing framework (Browne & Cudeck, 1993). Absolute fit indices, such as the RMSEA, do not rely on comparisons with a baseline model, but assess how well the sample data fits an a priori model (McDonald & Ho, 2002). The RMSEA null hypothesis test, therefore, is a test of close fit, in which the null hypothesis is accepted when RMSEA is smaller than .05, whereas the null hypothesis needs to be rejected when RMSEA is larger than .05 (Browne & Cudeck, 1993). More specifically, if the RMSEA confidence interval is entirely above the .05 threshold, the close-fit hypothesis must be rejected; if the lower bound is below .05, a close fit is tenable (Browne & Cudeck, 1993). Based on this argument, the five-factor SIQ-C models (M1 and M2) do not show a close fit; the three-factor CSAI-2C model, M8, also does not show a good fit of the data, whereas closer model fit is tenable for the amended CSAI-2C (M9) and the CSAI-2CD (M10). Unfortunately, comparisons to other studies are limited as neither Hall et al. (2009) for the SIQ-C (only the RMSEA = .06 has been mentioned without reporting confidence intervals) nor Stadulis et al. (2002) for the CSAI-C (RMSEA and confidence intervals have not been reported) included such information. **Furthermore, no such information, i.e., CFA results, was available from any study following the validation research. Future studies would be more helpful if they reported CFA results more routinely, particularly RMSEA indices and confidence intervals.**

*Relationships between imagery, competitive anxiety, and performance*

The relationships between imagery types and confidence were positive and small to moderate. Interestingly, confidence intensity was the only measure significantly associated with imagery functions. Except for CS, the remaining imagery functions showed significant links with CSAI-2Cd scales (Table 2). The regression results showed that MG-M was a significant predictor of cognitive anxiety direction, and a significant trend between MG-M and somatic anxiety direction. In addition, only MG-M emerged as a significant predictor of confidence intensity and confidence direction. Therefore, imagery mastery appears important for youth athletes' perceptions of confidence and their interpretation of anxiety. The relationship between MG-M and confidence is particularly relevant as it supports previous research by Munroe-Chandler et al. (2008) with youth soccer players of a similar age. Hence, the association between MG-M and confidence is valuable for practitioners and sport psychologists who aim to improve confidence and anxiety interpretation through imagery. For instance, a recent intervention aimed at enhancing self-efficacy through mastery imagery showed improvements in youth squash players (O et al., 2014). **From a theoretical perspective, psychometrically sound measures are required to strengthen the external validity when testing key variables, such as imagery, anxiety, and confidence.**

The relationship between performance and imagery showed several significant relations (Table 2). In the regression results, only cognitive specific imagery, that is, the use of images related to technical skills, was a significant predictor of performance. None of the competitive anxiety measures showed significant correlations with performance and were therefore excluded from further analysis. **The subjective performance measure may have been too generic, and participants may have understood the question differently. The soccer competition, as a team sport event, may have affected the results; for instance, players may not have differentiated between team and individual performance. That is, players who frequently use imagery linked to mastery, goal setting, or arousal may have performed well individually but been let down by team performance (e.g., a draw or loss), which may have resulted in lower performance scores. To avoid bias on performance questions, future research could incorporate the coach in the study, who provides feedback on athletes' performances.**

*Limitations and future research*

Previous research found issues with the reliability of measures designed for use with child athletes (e.g., Strachan & Munroe-Chandler, 2006). This issue was partly confirmed within the current sample. Interestingly, the direction scales of the CSAI-2C showed the strongest Cronbach's alpha values and construct reliability of all applied subscales. Although previous studies did not explicitly mention reliability issues, most studies at the developmental or user stage reported lower-than-desirable values, particularly for the SIQ-C. **Future research should address whether children find it more challenging to answer questions due, in part, to limited vocabulary or misunderstandings of item phrases or constructs related to the research. If a low reliability score has been detected, it would be helpful to investigate whether participants may have had difficulty understanding item wording, as suggested by** Morton-Williams and Sykes (1984), **or difficulty understanding the measured concepts.** A problem associated with low reliability is small sample size. Several studies used relatively small samples (e.g., Strachan & Munroe-Chandler, 2006, $N = 76$; Simonsmeier & Buecker, 2016, $N = 80$). Collecting data from larger groups of youth athletes may be more challenging than from adult samples. One of the issues could be related to obtaining ethics approval, as some University Ethics Committees may categorize underage participants as vulnerable. Another issue is obtaining consent, which may require the signature from athletes as well as parents or guardians. Both obstacles can be time-consuming, and researchers may refrain from collecting data from larger samples. Given the relevance of this research area for athlete development, psychometrically sound measures based on sufficient sample sizes are needed to provide robust findings.

To date, sample sizes involving child athletes have been relatively small (see Simonsmeier & Buecker, 2016; Strachan & Munroe-Chandler, 2006). Although none of these studies reported sample size limitations affecting the results, previous research beyond the validation stage did not examine the psychometric properties of the SIQ-C or CSAI-2C. In a simulation study, Hoyle and Kenny (1999) found improper solutions of about 14 percent for small samples of 50 participants, whereas problematic solutions were minimal with samples of at least 100 participants and moderate Cronbach's alpha reliability of .75. Both of these preconditions were met in this study. Furthermore, testing the effects of indicators per factor, Marsh Hau Balla and Grayson (1998) found that the percentage of proper solutions increased with the number of indicators per factor. Four to six indicators lowered the percentage of improper solutions for samples of $N = 50$, whereas improper solutions were rare at $N = 100$ (Marsh et al., 1998). Bentler (1990), testing fit indices in small samples, also found a trivial number of improper solutions at $N = 100$ but highlighted that the CFI was more stable in smaller

samples, whereas the TLI showed more variability. Taking these findings into account, the CFA results (Table 1) provided some support for the psychometric properties of the CSAI-2C (i.e., M9) and tentative evidence for the SIQ-C (i.e., M2). The directional scale of the CSAI-2C showed the strongest fit indices (CFI, TLI, and SRMR) among all models without any model modifications. The findings indicate that the directional scale could be a helpful addition for interpreting results on cognitive and somatic anxiety, as well as confidence in youth competition.

Performance outcomes could have affected participants' perceptions of post-match assessments, such as their own performance, anxiety, or confidence levels. Participant bias due to the retrospective nature of part of the data collection may have affected subjective assessments. For instance, post-match assessments among winning teams may have led to reports of lower anxiety, higher confidence, and better performance ratings than they experienced during the competition. The opposite pattern may have occurred for participants who lost. To mitigate this bias in measuring subjective performance, coaches' assessments could provide more objective ratings. A multimodal approach, using psychological measures before and after the competition outcome is known to the participant, could provide more detailed information about participant bias. This approach would be difficult to implement in soccer, where participants are aware of the score at all times. Alternatively, sports that involve judges, such as gymnastics, figure skating, or surfing, could provide an opportunity to measure athletes' performance perceptions independently of the actual performance outcome. For instance, subjective performance could be measured *before* the results are known.

Future research should focus more on youth athletes. Advancing quantitative research and theoretical models would require developing and validating new children's versions in addition to those already available. Substantial research on motivation has been conducted with adolescent and adult athletes. Testing types of motivation in youth athletes would help develop tailored programs that facilitate intrinsic motivation and longer-lasting involvement in sport. A children's version measuring flow state, a special case of intrinsic motivation, would be particularly helpful in this context. Jackson (2004) emphasized that youth athletes are susceptible to flow experiences, and Koehn (2013) provided some evidence with junior tennis players supporting this notion.

Researchers interested in competitive anxiety should consider using the CSAI-2C intensity scale alongside the directional scale. The initial assessment of the CSAI-2CD was promising regarding CFA results, internal consistency, and construct reliability. In addition, the directional scale was more sensitive than the intensity scale when correlated with the SIQ-C. In future research using children's versions, it would be helpful to report CFA results more frequently. So far, the results of the SIQ-C and CSAI-2C validation studies are encouraging, but more evidence is needed to support their validity and to use these scales with greater confidence.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

The main author is neither an editorial board member or involved in the editorial review or decision making to publish this article. The authors declare no financial interest or personal relationships that may be considered as potential competing interest.

## References

Arbuckle, J. L. (2013). *IBM SPSS AMOS 22.0 User's Guide*. Chicago, IL: IBM Software Group.

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

Biddle, S., & Brooke, R. (1992). Intrinsic versus extrinsic motivational orientation in physical education and sport. *British Journal of Educational Psychology, 62*, 247–256. https://doi.org/10.1111/j.2044-8279.1992.tb01018.x

Bollen, K. A. (1989). *Structural equations with latent variables*. NY: John Wiley & Sons.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.), *Testing Structural Equation Models*. Newbury Park, CA: Sage.

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 & Exercise Psychology, 25*, 44–65. https://doi.org/10.1123/jsep.25.1.44

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*, 39–50.

Hall, C. R., Mack, D. E., Paivio, A., & Hausenblas, H. A. (1998). Imagery use by athletes: Development of the sport imagery questionnaire. *International Journal of Sport Psychology, 29*, 73–89.

Hall, C. R., Munroe-Chandler, K. J., Fishburne, G., J., & Hall, N. D (2009). The sport imagery questionnaire for children (SIQ-C). *Measurement in Physical Education and Exercise Science, 13*, 93–107. https://doi.org/10.1080/10913670902812713

Hoyle, R. H., & Kenny, D. A. (1999). Sample size, reliability, and tests of statistical mediation. In H. Hoyle (Ed.), *Statistical strategies for small sample research* (pp. 195–222). Thousand Oaks, CA: Sage Publications.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods, 3*, 424–453. https://doi.org/10.1037/1082-989X.3.4.424

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55. https://doi.org/10.1080/10705519909540118

Jackson, S. A. (2004). Flow. In T. Morris, & P. Terry (Eds.), *The New Sport and Exercise Psychology Companion*. Morgantown, WV: Fit Information Technology.

Jones, J. G. (1995). More than just a game: Research developments and issues in competitive anxiety in sport. *British Journal of Psychology, 86*, 449–478. https://doi.org/10.1111/j.2044-8295.1995.tb02565.x

Jones, J. G., & Hanton, S. (2001). Pre-competitive feeling states and directional anxiety interpretations. *Journal of Sport Sciences, 19*, 385–395. https://doi.org/10.1080/026404101300149348

Jones, J. G., & Swain, A. B. J. (1992). Intensity and direction dimensions of competitive anxiety and relationships of competitiveness. *Perceptual and Motor Skills, 74*, 467–472.

Koehn, S. (2013). Effects of confidence and anxiety on flow state in competition. *European Journal of Sport Science, 13*, 543–550. https://doi.org/10.1080/17461391.2012.746731

Koehn, S., & Morris, T. (2012). The relationship between performance and flow state in tennis competition. *Journal of Sports Medicine and Physical Fitness, 52*(4), 437–447.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130–149.

Mahoney, M. J., & Avener, M. (1977). Psychology of the elite athlete: An exploratory study. *Cognitive Therapy and Research, 1*, 135–141. https://doi.org/10.1007/BF01173634

Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing. *Structural Equation Modeling, 11*, 320–341. https://doi.org/10.1207/s15328007sem1103_2

Marsh, H. W., Hau, K. T., Balla, J. R., & Grayson, D. (1998). Is more ever too much? The number of indicators per factor in confirmatory factor analysis. *Multivariate Behavioral Research, 33*(2), 181–220. https://doi.org/10.1207/s15327906mbr3302_1

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

Martin, K. A., Moritz, S. E., & Hall, C. (1999). Imagery use in sport: a literature review and applied model. *The Sport Psychologist, 13*, 245–268. https://doi.org/10.1123/tsp.13.3.245

McDonald, R. P., & Ho, M.-H. R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods, 7*, 64–82. https://doi.org/10.1037//1082-989X.7.1.64

Morton-Williams, J., & Sykes, W. (1984). The use of interaction coding and follow-up interviews to investigate comprehension of survey questions. *The Journal of Market Research Society, 26*, 109–127.

Munroe-Chandler, K., Hall, C., & Fishburne, G. (2008). Playing with confidence: The relationship between imagery use and self-confidence in youth soccer players. *Journal of Sport Sciences, 26*, 1539–1546. https://doi.org/10.1080/02640410802315419

Munroe-Chandler, K., Hall, C., Fishburne, G. J.,O. J., & Hall, N. (2007). The content of imagery use in youth sport. *International Journal of Sport and Exercise Psychology, 5*, 158–174. https://doi.org/10.1080/1612197X.2007.9671817

Munroe-Chandler, K. J., Hall, C. R., Fishburne, G. J., Murphy, L., & Hall, N. D. (2012). Effects of a cognitive specific imagery intervention on the soccer skill performance of young athletes: Age group comparisons. *Psychology of Sport and Exercise, 13*, 324–331. https://doi.org/10.1016/j.psychsport.2011.12.006

Nunnally, J. C., & Bernstein, I. (1994). *Psychometric theory* (3rd ed.). New York: McGraw Hill.

O, J., Munroe-Chandler, K. J., Hall, C. R., & Hall, N. D (2014). Using motivational general-mastery imagery to improve the self-efficacy of youth squash players. *Journal of Applied Sport Psychology, 26*, 66–81. https://doi.org/10.1080/10413200.2013.778914

Paivio, A. (1985). Cognitive and motivational functions of imagery in human performance. *Canadian Journal of Applied Sport Science, 10*(4), 22S–28S.

Simonsmeier, B. A., & Buecker, S. (2016). Interrelations of imagery use, imagery ability, and performance in young athletes. *Journal of Applied Sport Psychology, 00*, 1–12. https://doi.org/10.1080/10413200.2016.1187686

Smith, R. E., Smoll, F. L., Cumming, S. P., & Grossbard, J. R. (2006). Measurement of multidimensional sport performance anxiety in children and adults: The sport anxiety scale-2. *Journal of Sport & Exercise Psychology, 28*, 479–501. https://doi.org/10.1123/jsep.28.4.479

Stadulis, R. E., MacCracken, M. J., Eidson, T. A., & Severance, C. (2002). A children's form of the Competitive State Anxiety Inventory: The CSAI-2C. *Measurement in Physical Education and Exercise Science, 6*, 147–165. https://doi.org/10.1207/S15327841MPEE0603_1

Stavrou, N. A., & Zervas, Y. (2004). Confirmatory factor analysis of the flow state scale in sports. *International Journal of Sport and Exercise Psychology, 2*, 161–181. https://doi.org/10.1080/1612197X.2004.9671739

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

Steiger, J. H. (2007). Understanding the limitations of global fit assessment in structural equation modelling. *Personality and Individual Differences, 42*, 893–898. https://doi.org/10.1016/j.paid.2006.09.017

Strachan, L., & Munroe-Chandler, K. (2006). Using imagery to predict self-confidence and anxiety in young elite athletes. *Journal of Imagery Research in Sport and Physical Activity, 1*, 1–19. https://doi.org/10.2202/1932-0191.1004

Vadocz, E. A., Hall, C. R., & Moritz, S. E. (1997). The relationship between competitive anxiety and imagery use. *Journal of Applied Sport Psychology, 9*, 241–253. https://doi.org/10.1080/10413209708406485

Xiong, Z., Xia, H., Ni, J., & Hu, H. (2025). Basic assumptions, core connotations, and path methods of model modification—using confirmatory factor analysis as an example. In *Frontiers in Education, 10*. Frontiers Media SA, Article 1506415. https://doi.org/10.3389/feduc.2025.1506415

Yi, M. U., & Davis, F. D. (2003). Developing and validating an observational learning model of computer software training and skill acquisition. *Information Systems Research, 14*, 146–169. https://doi.org/10.1287/isre.14.2.146.16016