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Evaluating Measures of Optimism and Sport Confidence

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Abstract

The psychometric properties of the LOT-R, the Sport Confidence Inventory (SCI), and the Carolina Sport Confidence Inventory (CSCI) were examined in a study involving 260 athletes. The study aimed to test the dimensional structure, convergent and divergent validity, and invariance over competition level of scores generated by these instruments. Exploratory structural equation modeling (ESEM) supported the measurement models for the SCI and CSCI but favoured a two-dimensional model for the LOT-R. ESEM analyses of the total pool of 33 items indicated satisfactory divergent validity among these optimism and sport confidence measures with the only overlap occurring between the LOT-R and CSCI measures of optimism. The SCI discriminated among athletes participating at different competitive levels and emerged as the most suitable instrument for measuring individual differences in sport confidence. The CSCI emerged as a better measure of optimism in a sporting context than the more general LOT-R.

Keywords: Optimism, sport confidence, instrument validity and reliability

Evaluating Measures of Optimism and Sport Confidence

Sport confidence was originally conceptualized as a unidimensional construct with state and trait characteristics. Vealey's (1986) Trait Sport-Confidence Inventory (TSCI) and State Sport-Confidence Inventory (SSCI) reflected this unidimensional view. That conceptualization changed with the publication of the Carolina Sport Confidence Inventory (CSCI: Manzo, Silva, & Mink, 2001), which had subscales measuring dispositional optimism and sport competence, and the Sport Confidence Inventory (SCI: Vealey & Knight, 2002), an instrument with subscales measuring cognitive efficiency, resilience, and confidence in physical skills and training. Both instruments measure sport confidence, but with different subscale structures. Two decades ago Marsh (1994) argued that, given the proliferation of apparently similar measures in sport and exercise psychology, it is important to evaluate the jingle fallacy (assuming that scales with the same label measure the same construct) and the jangle fallacy (assuming that scales with different labels measure different constructs). This paper takes up that challenge in relation to the constructs of sport confidence and optimism. We begin by tracing the origins of the *optimism* construct and its associations with sport confidence.

Dispositional Optimism and Sport Confidence

There are two popular ways of conceptualizing optimism. The first has its roots in attribution theory (Weiner et al., 1971) and the notion of explanatory style introduced by Abramson, Seligman, and Teasdale (1978). Within this tradition, Peterson et al. (1982) developed the Attributional Style Questionnaire (ASQ) to measure optimistic explanatory style. A sports-specific version of this scale, the Sport Attributional Style Scale (SASS), was developed by Hanrahan, Grove, and Hattie (1989). The second view of optimism, and the one that forms the basis of the current study, comes from the work of Scheier and Carver (Carver & Scheier, 2014; Scheier & Carver, 1985, 1992) who defined optimism as a personality disposition characterized by an enduring belief that good things will happen and that obstacles can be overcome. Persons with high levels of dispositional optimism see desired outcomes as attainable and continue to strive toward those outcomes, even when progress is difficult or slow (Scheier & Carver, 1992). Defined in this fashion, optimism is a disposition that can be measured by self-report items that tap the respondent's expectations regarding the likelihood of positive and negative outcomes. The Life Orientation Test (LOT) developed by Scheier and Carver (1985) and its successor, the LOT-R (Scheier, Carver, & Bridges, 1994), are among the most common measures of dispositional optimism in the general psychology literature (Nes & Segerstrom, 2006).

Researchers in the field of sport and exercise psychology with an interest in optimism have either adopted the attributional approach and used the SASS (e.g., Parkes & Mallett, 2011) or followed the dispositional approach and used the LOT-R (e.g., Albinson & Petrie, 2003; Brewer et al., 2007; Chen, Kee, & Tsai, 2008; De la Vega, Ruiz, Batista, Ortin, & Giesnow, 2012; Gaudreau & Blondin, 2004; Gordon, 2008; Gould, Dieffenbach, & Moffett, 2002; Nicholls, Polman, Levy, & Backouse, 2007; Venne, Laguna, Walk, & Ravizza, 2006). One of the distinguishing features of the two approaches is apparent in the studies just cited. Measuring causal attributions is a way of measuring optimism but, within this tradition, interventions designed to improve optimism tend to focus on ways of changing the attributions themselves. This is a cyclical process wherein attributions are measured, then challenged, then re-assessed (Rees, Ingledew, & Hardy, 2005). In the dispositional optimism tradition, on the other hand, the measure of optimism is typically used to assess the effect of an independent intervention, as illustrated by the De la Vega et al. (2012) study.

The dispositional optimism approach was considered more suitable for the current project which was motivated by a need to identify measures suitable for tracking change in positive thinking over the course of a psychological skills program (Furst, Thomas, & Fogarty, in preparation). The LOT-R was an instrument that could be used for this purpose. However, a disadvantage of the LOT-R in a sporting context is that it is very general in nature and an item such as “Overall, I expect more good things to happen to me than bad” may not give a true indication of an athlete’s expectation of success in a sporting context. There is also a question mark concerning the structure of the scale. A body of evidence has accumulated suggesting that it is not unidimensional but bidimensional with one factor representing optimism, the other pessimism (e.g., Appaneal, 2012; Herzberg, Glaesmer, & Hoyer, 2006). This uncertainty about the structure of the LOT-R is reflected in the sport-related publications cited above where four studies extracted a single measure from the LOT-R and five studies extracted measures of optimism and pessimism. The present study will explore the structure of the LOT-R.

In the same timeframe that measures of optimism began to appear, researchers in sport psychology were showing interest in the construct of sport confidence. Like optimism, sport confidence has its theoretical underpinnings in expectancy frameworks (Bandura, 1977; Vealey, 1986) and is associated with peak performance. Although sport confidence is now recognized as a multidimensional construct (Thomas, Lane, & Kingston, 2011; Vealey & Chase, 2008), early conceptualizations saw it as a unidimensional construct capturing the degree of certainty individuals possess about their ability to be successful in sport (Vealey, 1986). That conceptualization was quickly broadened to promote the notion that sport confidence, like Bandura’s self-efficacy construct, is multidimensional with optimism and resilience among its dimensions.

In keeping with this expanded view, Manzo et al. (2001) presented a dispositional model of sport confidence. Within this model, athletes form a relatively enduring belief system that is the result of the interaction between sport competence and dispositional optimism. To operationalize this construct, they developed the 13-item CSCI. The CSCI is of interest here because it contains two subscales, one of which is designed to measure dispositional optimism. The description of the dispositional optimism subscale suggests that it should correlate highly with the LOT-R. This is an instance of the “jingle” in Marsh’s (1994) metaphor: two measures with the same label, purportedly measuring the same construct.

Another inventory from the sport confidence field that highlights the close connection between optimism and sport confidence is Vealey and Knight’s (2002) SCI. The SCI, along with the CSCI, was one of the first instruments to attempt to capture the complex nature of sport confidence, a complexity that is now much more widely recognized (e.g., Thomas et al., 2011; Vealey & Chase, 2008). This instrument was developed to capture three important ways in which confidence is manifested in sport settings. The three dimensions are: (a) Sport Confidence-Physical Skills and Training (hereafter shortened to Physical Skills), which assesses confidence in the ability to execute physical skills and the level of physical training needed to succeed; (b) Sport Confidence-Cognitive Efficiency, which assesses confidence in the ability to make decisions, maintain focus, and effectively use strategies to succeed; and (c) Sport Confidence-Resilience, which assesses confidence in the ability to overcome problems, setbacks, and doubts, allowing the individual to bounce back and perform successfully.

The similarities between optimism, resilience, and sport confidence have long been acknowledged (e.g., Grove & Heard, 1997) but the nature of their relationship, how they interact with each other, and what differentiates them, is not clear. There are no studies that have examined all three constructs simultaneously. The LOT-R, the CSCI, and the SCI offer that opportunity. Of particular interest to the current study was the relationship between dispositional optimism, as measured by a general inventory, and the same construct measured by a sport-specific instrument.

Aims of Study

Given the paucity of validation information on the SCI and the CSCI and the questions raised about the dimensionality of the LOT-R, the first aim of this study was to test the structure of all three instruments. For the LOT-R, unidimensional and bidimensional models were tested. For the SCI and the CSCI, both of which are measures of sport confidence, unidimensional models were tested as well as the hypothesized three- and two-factor models. This study therefore provides information regarding the factorial validity of all three instruments as well as descriptive data for the SCI and the CSCI. The second aim of the study was to explore the evidence for convergent and discriminant validity among the measures; that is, to sort the “jingle” from the “jangle” among these similar-sounding constructs (Marsh, 1994). A third aim was to determine the relationship between scores obtained from these three instruments and measures of sporting achievement which would guide the intervention study that is to follow (Furst et al., in preparation). Assuming favourable psychometric outcomes for all the scales and subscales examined in the current study, the choice of instrument for the intervention study would be influenced by the extent to which scores discriminate among athletes representing different levels of sporting achievement.

Method

Participants

A total of 260 athletes (174 males) representing a variety of sports, ages, and ability levels were recruited for the study from the professional networks of the third author. The sample contained 93 international athletes, 155 domestic athletes, and 12 people who did not indicate their level of competition. The ages of the participants ranged from 16 to 63 years (*M* = 28.16, *SD* = 9.86).

Measures

Life Orientation Test-Revised (LOT-R; Scheier et al., 1994). The LOT-R is a 10-item test employing a five-point Likert response scale ranging from (0) S*trongly disagree* to (4)

Strongly agree. An example item is: “I am always optimistic about my future”. Four of the ten items are filler items and therefore ignored when scoring. Three (items 3, 7, and 9) of the remaining six items are reverse-scored. Responses to the six core items were summed to yield an overall dispositional optimism score ranging from 0-24 with higher scores indicating greater expectancy for positive outcomes. Scheier et al. (1994) reported a Cronbach alpha coefficient of .78 and test-retest correlations of .68, .60, .56 and .79 over four time intervals.

Sport Confidence Inventory (SCI; Vealey & Knight, 2002). The SCI is a 14-item inventory that requires respondents to indicate how certain they are that they can execute nominated physical, cognitive, or mental skills over a specified time period (e.g., how you feel right now, how you felt last week, how you feel about the upcoming season). The 14 items employ a seven-point Likert-type scale with anchors of (1) *Can’t do it at all* and (7) *Totally certain I can do it.* As a frame of reference, participants in this study were asked to indicate how confident they typically felt about executing these skills in a competitive sporting context. The SCI contains the three subscales described earlier: Cognitive Efficiency (SCI-CEF); Resilience (SCI-RES); and Physical Skills (SCI-PST). Internal consistency reliability estimates for the three subscales ranged from .78 to. 87 and test-retest reliability coefficients from .73 to .78 (Vealey & Knight, 2002). There were five marker items for each of the first two subscales and four items for the third. To accommodate the fact that subscales contained different numbers of items, responses to individual items were averaged to yield three subscale scores with higher scores indicating higher levels of each construct.

Carolina Sport Confidence Inventory (CSCI; Manzo et al., 2001). The CSCI is a 13-item inventory where each item requires participants to choose between two contrasting statements (e.g., *I feel I am not very good when it comes to playing sports OR I feel I am really good at many sports*). Having selected the statement that is most applicable, respondents then rate whether the statement is (1) *Very true for me* or (2) *Somewhat true for* *me*. Several items are reverse-scored. With two contrasting statements per item and two rating options associated with each statement, individual item scores range from 1 to 4. The CSCI contains two subscales. Seven items contribute to the Dispositional Optimism (CSCI-OPT) subscale, which yields scores ranging from 7 to 28 with high scores indicating a high degree of dispositional optimism. The other six items contribute to the Sport Competence (CSCI-COMP) subscale, which yields scores ranging from 6 to 24 and measures the belief in one's ability to successfully fulfil the demands of a sport task. Manzo et al. reported Cronbach alpha coefficients of .86 for the Dispositional Optimism subscale (CSCI-OPT), and .92 for the Sport Competence subscale (CSCI-COMP). Convergent validity of the CSCI-TOT is indicated by its strong correlation ($r > .50$) with other measures of sport confidence (Manzo et al., 2001).

Procedure

Ethics approval for the study was granted by the Griffith University Human Research Ethics Committee. The first group of participants completed a package consisting of three questionnaires including the LOT-R, SCI, and CSCI. An information sheet informed the respondents that the purpose of the study was to look at the relationship between sporting performance and both confidence and optimism. The questionnaires were distributed in person to the participants and they either completed them at the time of presentation or returned them to the researcher in person or via mail. The response rate was 49%.

Statistical Analysis

Following preliminary data screening, analyses were conducted in three phases in accordance with the study aims. In the first phase, confirmatory factor analysis (CFA) was used to test expected and alternative measurement models for each of the instruments. Where fit could not be established using CFA, exploratory structural equation modeling (ESEM) procedures were used. These procedures have been advocated in cases where construct-relevant multidimensionality due to item fallibility makes it difficult to satisfy the independent cluster models (ICM) restriction that underpins CFA (Asparouhov & Muthén, 2009; Morin & Maïano, 2011; Myers, 2013). For the congeneric CFA models, estimates from the final measurement solutions were used to compute factor reliability coefficients in line with McDonald's (1970) omega formula as shown in Equation 1 where λ_i is the standardized item loading and δ_{ii} is the item residual variance:

$$\omega = \frac{(\sum|\lambda_i|)^2}{([\sum|\lambda_i|]^2 + \sum\delta_{ii})} \qquad (1)$$

The second phase of analysis was associated with the second aim of the study and involved the examination of the convergent validity of LOT-R, SCI, and CSCI responses. A general measurement model was specified with links between the SCI and CSCI factors and from these factors to optimism (and pessimism) as measured by the LOT-R. Finally, to satisfy the third aim of the study, the retained LOT-R, SCI, and CSCI solutions were subjected to tests of full measurement and structural invariance over competition level (international athletes vs. domestic athletes). The multigroup tests were performed as per Millsap and Yun-Tein's (2004) taxonomy of invariance tests for models based on polytomous data.

All analyses in the present investigation were conducted using Mplus 7.3 (Muthén & Muthén, 1998-2014). Model solutions were estimated using diagonal weighted least squares with a mean-and-variance adjusted test statistic, operationalized as the WLSMV estimator in Mplus. The ESEM analyses were conducted using target rotation, which is appropriate when there is at least some knowledge of the factor structure, as in the present study (Browne, 2001; Myers, Jin, Ahn, Celimli, & Zopluoglu, 2015). For the assessment of model fit, we did not rely on the χ^2 test given its sample size dependency and restrictive hypothesis test (i.e., exact fit). Instead, three approximate fit indices were used to assess model fit as follows: comparative fit index (CFI) and Tucker-Lewis Index (TLI), > .90 and .95 for acceptable and excellent fit, respectively; and RMSEA, < .05, .08 and < .10 for close, reasonable fit and poor fit, respectively (Marsh, Hau, & Wen, 2004). For nested model comparisons, although we report the corrected χ^2 difference test (MD χ^2) appropriate for the WLSMV estimator, implemented via the DIFFTEST option in Mplus, because the MD χ^2 tends to be sensitive to even trivial differences in large samples, we relied on changes in the CFI (ΔCFI) and RMSEA (ΔRMSEA). A decrease in the CFI and increase in RMSEA of less than .010 and .015, respectively, are indicative of support for a more parsimonious model (Chen, 2007; Cheung & Rensvold, 2002).

Results

Data Screening

Inspection of observed bivariate contingency tables revealed a large number of cells with zero frequencies concerning the lowest three categories of the SCI and lowest category of the CSCI. As zero-frequency cells can result in model convergence problems under WLSMV estimation due to difficulties computing polychoric correlations, the lowest four categories of the SCI items and the lowest two categories of the CSCI items were collapsed, yielding four-point and three-point response scales, respectively. Across the SCI, CSCI and LOT-R, only four observed variables contained missing data (range = 0-1.5%), which were found to be non-systematically missing, χ^2 (128) = 111.44, p = .85 (Little, 1988). Pairwise present methods were used to account for this missingness. Sample estimates of the thresholds and polychoric correlations for the 33 observed indicators can be obtained by request from the first author.

Latent Structure

Results of the fit of the LOT-R, SCI and CSCI measurement structures are shown in Table 1. For the LOT-R, fit statistics for the unidimensional model were mixed. Whereas the CFI and TLI were suggestive of excellent and acceptable fit, respectively, the RMSEA indicated poor model fit. The test of the correlated trait (CT) bidimensional LOT-R model resulted in an excellent fit to the data in terms of the CFA and TLI and marginally acceptable fit in terms of the RMSEA. Notably, the bidimensional model provided an appreciably better fit to the data than the unidimensional solution and was thus retained as the preferred solution for the convergent validity tests.

For the SCI, the unidimensional model provided a poor fit to the data and was rejected. The test of the CT three-factor model resulted in an acceptable fit to the data according to the CFI and TLI; however, the RMSEA exceeded the common cut-off criteria used for acceptable (.08) and poor fit (.10). A further problem with the three-factor SCI solution was the high correlation between the Cognitive Efficiency and Resilience factors (r = .88), suggesting a lack of discriminant validity. However, large factor correlations can arise because of the ICM-CFA restriction that ensures that all items load on one, and only one, factor. The ICM restriction means that any commonality, substantive or artifactual, between items and non-target factors must be expressed through over-estimated factor correlations. Misspecifications of this kind can also result in distorted structural relations (Asparouhov & Muthen, 2009). ESEM was developed to address this problem. As can be seen from Table 1, the CT ESEM solution fit the data appreciably better than the CT ICM-CFA and was retained for further scrutiny.

For the CSCI, the unidimensional solution provided an acceptable fit to the data in line with the CFI and TLI, but the RMSEA was suggestive of poor fit. On the contrary, the CT ICM-CFA (two factors) provided an acceptable-to-good fit to the data in terms of all three fit indices. Moreover, in relative terms, the CT ICM-CFA provided an appreciably better fit to the data than the unidimensional solution and was retained.

INSERT TABLE 1 ABOUT HERE

In summary, these CFA and ESEM findings supported a two-dimensional solution for the LOT-R, the a priori three-factor solution for the SCI but with factorial complexity permitted at the item level, and the a priori two-factor solution for the CSCI. The next three tables present the parameter estimates for each of the three instruments.

As shown in Table 2, the six LOT-R items loaded moderately-to-substantially onto their respective factors, and these loadings were uniformly statistically significant at $p < .001$. The factor correlation between Optimism and Pessimism was substantial ($r = –.74$). Factor reliability, computed according to McDonald's (1970) omega, was low for Optimism ($\omega = .67$) but acceptable for Pessimism ($\omega = .86$).

INSERT TABLE 2 ABOUT HERE

Parameter estimates from the retained CT ESEM solution for the SCI are shown in Table 3. Target factor loadings (range = .18 to.91, $M = .62$) were generally weaker than ICM-CFA analogues (range = .73 to .897, $M = .81$) but substantially stronger than non-target loadings (range = –.37 to .547, $|M| = .25$). There were, however, six cases where secondary loadings were sizeable (e.g., λ_{61}, λ_{141}, λ_{101}, λ_{52}, λ_{82}, λ_{12}). All three freely-estimated factor correlations in the ESEM solution were positive and statistically significant. Importantly, as shown in Table 3, the sizes of these correlations, especially between SCI-EFF and SCI-RES, were appreciably below estimates obtained from the ICM-CFA, supporting the discriminant validity of the SCI factors and, by implication, the multidimensionality of the SCI.

INSERT TABLE 3 ABOUT HERE

Parameter estimates from the retained CT ICM-CFA solution for the CSCI are shown in Table 4. All thirteen CSCI items loaded substantially onto their respective factors, and these loadings were uniformly statistically significant at $p < .001$. The factor correlation between CSCI-OPT and CSCI-COMP was likewise substantial ($r = .74$). Finally, factor reliability was acceptable for both CSCI-OPT ($\omega = .90$) and CSCI-COMP ($\omega = .85$).

INSERT TABLE 4 ABOUT HERE

Convergent Validity

A general seven-factor measurement model involving all 33 items was specified to test the convergent validity of the SCI, CSCI, and LOT-R scales. The model included the three factors retained in the CT ESEM solution for the SCI, the two factors retained in the CT ICM-CFA solution for the CSCI, and the optimism and pessimism factors from the best-fitting CFA solution for the LOT-R. The test of this measurement structure resulted in an acceptable-to-excellent fit to the data, χ^2 (452) = 772.31, *p* = < .001, RMSEA = .05 [.05, .06], CFI = .96, TLI = .96. As shown in Table 5, all 21 factor correlations were in the expected directions and statistically significant. The three SCI factors were moderately-to-strongly and positively associated with CSCI optimism, CSCI competence and optimism as measured by the LOT-R, and negatively associated with LOT-R pessimism. Similarly, CSCI optimism and competence were moderately-to-strongly and positively associated with LOT-R optimism, and negatively associated with LOT-R pessimism.

Consistent with our intention to explore the "jingle" and "jangle" among these measures, we also fitted a six-factor model that specified a Dispositional Optimism factor defined by items from both the optimism subscale of the LOT-R and the dispositional optimism scale of the CSCI. The fit statistics for the 6-factor model were acceptable: χ^2 (458) = 838.41, *p* = < .001, RMSEA = .06 [.05, .06], CFI = .96, TLI = .95. When compared to the 7-factor model, the Chi-Square difference test was significant, χ^2 (6) = 49.810, *p* = < .001; however the changes in the CFI and RMSEA did not reach the cut-offs of .01 and .015 indicative of an appreciable degradation in fit (Chen, 2007). Both models are tenable but we have retained the seven-factor model for the remaining analyses.

INSERT TABLE 5 ABOUT HERE

Competition Level Invariance

To test the association between level of sporting achievement and the seven factors, the retained models (see Tables 2-4) were subjected to tests of measurement and structural invariance across competition level. These tests were conducted separately for each of the instruments. The LOT-R invariance tests failed to yield admissible solutions, so those associations will be tested in other ways in the next section of the analyses. As shown in Table 6, the CT ESEM for the SCI provided support for configural invariance, equality of item loadings, thresholds, uniquenesses, and the factor variance-covariance matrices. However, the invariance of factor means was not supported. Inspection of a model in which the latent means were free to vary in the domestic athletes group, revealed small to moderate and statistically significant mean differences between international and domestic athletes on all three SCI factors. International athletes were found to be higher than domestic athletes on SCI-EFF (*d* = .42), SCI-RES (*d* = .26) and SCI-PST (*d* = .51).

INSERT TABLE 6 ABOUT HERE

Table 7 reports the results of tests of invariance for the CSCI. It can be seen from this table that configural invariance was found. There was also support for the invariance of item factor loadings, thresholds, uniquenesses, and variance-covariance matrices. A final model in which the two factor means were constrained to equality was supported, indicating the invariance of latent means. International athletes were trivially and non-significantly higher than domestic athletes on CSCI-OPT (*d* = .17), and no substantive differences were found on CSCI-COMP (*d* = .03).

INSERT TABLE 7 ABOUT HERE

Descriptive statistics for scales

Up until this point, the analyses have employed CFA and ESEM techniques because the focus has been on the constructs and the relations among those constructs. In practice, however, psychologists will construct scale scores from these instruments. They will do this by following instructions in which each of the items is assigned to a particular scale, as they were in the CFA (but not the ESEM) modeling described above. To complete the psychometric analysis of these three instruments, we present the familiar summary descriptive statistics, Cronbach alpha reliability estimates, and correlations for each of the measures. To facilitate comparisons with data already reported in the literature and to enable comparisons among subscales with different numbers of items, total scores are reported for LOT-R whereas item-level statistics are reported for the SCI and the CSCI subscales. Note that the full range of scores was used for these analyses. That is, the lowest scoring categories were not collapsed. Note also that to calculate Pessimism subscale scores for the LOT-R, the three negatively-worded items (3, 7, 9) were not treated as reverse-scored. Descriptive statistics, scale reliabilities, and correlations among all measures for the full sample are shown in Table 8.

The first question to ask regarding these descriptive data is whether they are similar to data reported on the same scales by other researchers. Gould et al. (2002) reported a LOT-R mean score of 18.70 and a standard deviation of 2.54 for their sample of Olympic medal winners. Scheier et al. (1994) reported a mean of 14.33 and a standard deviation of 4.28 for college students. The mean for this sample of athletes (16.72) fell between these two benchmarks which is where one might expect this mixed sample of athletes to score. The larger standard deviation in the current study (3.73) reflects the diversity of this sample in comparison with the Olympic champions sampled by Gould et al.

In relation to the SCI, the means for the three subscales were slightly lower than those reported by Vealey and Knight (2002) for their sample of 211 varsity athletes. However, the ranking of the subscale means was the same with Physical Skills receiving the highest mean score followed by Cognitive Efficiency and then Resilience. Regarding relations among the subscales, Vealey and Knight reported that the subscale correlations ranged from .35 to .57. The subscale correlations in the current study ranged from .45 to .79. As shown in Table 5, however, when cross-loadings were allowed, the correlations among the constructs ranged from .30 to .44. Internal consistency reliability coefficients were similar for the two studies.

Manzo et al. (2001) did not report any means, standard deviations, or correlations for the CSCI, so it is not possible to make comparisons between our descriptive data and theirs.

INSERT TABLE 8 ABOUT HERE

In the test for the invariance of latent mean structures reported in Tables 6 and 7, the three factors of the SCI were the only ones that discriminated between athletes performing at different levels of competition (international versus domestic levels). The LOT-R was not included in those analyses because of convergence problems but it was included in the analysis of group differences on scale scores. A multivariate analysis of variance of these scores (Wilks' Lambda) indicated that there was a significant main effect for competition level in favour of international athletes, F (6, 241) = 3.76, $p < .001$, $\eta^2 = .09$. Univariate F-tests revealed that the difference between competition levels occurred on all three SCI subscales.

Discussion

Findings relating to the LOT-R, the SCI, and the CSCI will be discussed separately before reviewing the aims of the study and reaching some conclusions about the suitability of these measures of sport confidence and dispositional optimism.

LOT-R

The LOT-R is a measure of dispositional optimism that can be used in a wide range of settings. As noted in the introduction to the paper, questions have been raised about its dimensionality, whether used in sporting contexts (Appaneal, 2012) or in more general settings (Herzberg et al., 2006). Carver and Scheier (2014) acknowledged this ambiguity, which applies to other instruments with a similar mix of positive and negative items, and encouraged researchers to examine the item subsets as well as the overall score. The CFA results in the current study showed that, compared with a unidimensional solution, the two-factor model provided a better fit to the data. The three positively-worded items defined an optimism factor and the three negatively-worded items defined a pessimism factor. This is the same result obtained by both Appaneal and Herzberg et al. and may be an artefact of measurement method rather than a reflection of substantive underlying individual differences (Marsh, 1996; Segerstrom, Evans, & Eisenlohr-Moul, 2011; Spector, 1997).

One solution to this problem involves continuing to use a unidimensional solution but weighting one set of items more than the other on the basis of factor coefficients (Marsh, 1996). In the present study, this approach would involve giving more weight to the negatively-worded items because the loadings for those items were considerably higher. However, an argument against this approach is that the weightings and factor inter-correlations could vary from sample to sample. More validation research on samples of athletes is required before adopting this approach. A further option is to use two subscales instead of a single scale. However, that option is not available if the reliability of one of the subscales drops to unacceptable levels, as was the case in the present study and also in Appaneal's (2012) study. In the longer term, we support the suggestion that the LOT-R requires further revisions (Appaneal). In particular, the reliance on three negatively-valenced and three positively-valenced items is likely to continue to create confusion about the dimensionality of the scale.

Sport Confidence Inventory

The SCI was developed to measure sport confidence in three areas: physical skills and training, cognitive efficiency, and resilience. Convergent validity indicators for the three factors were sound and reliability estimates for all subscales were very good but factor and scale inter-correlations showed that there was a lot of overlap between Resilience and Cognitive Efficiency, indicating problems with discriminant validity. We explored the possibility that the high degree of overlap was due to the ICM requirement for items to have zero loadings on non-target factors. Relaxing the ICM requirement through the use of ESEM

(Asparouhov & Muthén, 2009) resulted in factor correlations that were more in line with expectations (see Table 5) and removed concerns about discriminant validity at the construct level. As Table 8 shows, however, the correlation between Cognitive Efficiency and Resilience was still high at the scale level because in the process of scale formation even factorially complex items were assigned to a single scale. It would be impractical to suggest scoring methods that weighted the contribution of complex items to multiple scales. A better option is to refine those items that demonstrated factorial complexity.

Carolina Sport Confidence Inventory

The CSCI was developed to measure individuals' sport confidence levels with subscales of dispositional optimism and sport competence. The CFA supported the proposed two-factor structure. Scales formed from these two factors were moderately correlated and demonstrated satisfactory internal consistency reliability. An interesting outcome of the analysis of all 33 items from the three instruments was the support found for a six-factor model in which the LOT-R-OPT and CSCI-OPT items defined a single factor. On these grounds, the CSCI is a viable alternative measure of dispositional optimism when working with athletes.

Overall evaluation of measures

Tests of configural invariance showed that the factor structure of all three instruments remains robust across different levels of athletic achievement. However, there are other aspects of these instruments to be considered when evaluating their suitability for use in sport and exercise settings. The mean scores for each instrument are reported in Table 8 alongside the possible range for each score. It is a simple matter to convert these means to percentages. When that is done, the mean scores were 55.74% for LOT-R, 75.79% for the SCI, and 82.35% for the CSCI. The high mean score for the CSCI suggests that the instrument may be subject to ceiling effects. Neither the LOT-R nor the CSCI discriminated between international level and domestic level athletes. The mean for the SCI was also somewhat high at nearly 76% but the mean did vary according to level of sporting achievement.

The face validity of the three instruments should also be taken into consideration. The LOT-R uses a familiar item format and assesses the athlete's overall outlook on life. Using the LOT-R in a sporting context therefore requires the athlete to make the transition from the general to the specific. For example, a question such as "I'm always optimistic about my future" (LOT-R) can be applied to sport and even to a situation in a contest but the application is easier for a question such as "How certain are you that you can regain your mental focus after an error?" (SCI). In the same vein, although the word "sport" is included in item stems, the CSCI is also general in nature. That is, some transition to particular game contexts is still required. For example, the item "I believe that I have a bright future in sporting events" (CSCI) is designed to tap dispositional optimism but it may not be useful for tracking confidence levels from game to game. We can summarise these observations by noting that in terms of their general orientation, LOT-R applies to life in general, the CSCI to sport in general, and the SCI to actual game scenarios.

An important point that follows from this summary is that an instrument may be better suited to some situations than to others, even when sport is the focus of attention. For example, if the aim is to assess an athlete's general sense of optimism, the LOT-R may be a good choice. If the aim is to assess, say, attitudes within a student population towards sport as well as confidence in actual sporting activities, the CSCI comes into consideration. If the focus is much narrower and confidence during specific sports competitions is the centre of attention, of the three instruments we have evaluated, the SCI is the best choice.

Limitations and Further Research

The absence of actual performance measures was a limitation in this study, as was the adoption of a data collection technique that did not control for variance in competitive pressure. The best way to test the sensitivity of psychological measures is to collect both psychological and performance data over time, as Vealey and Knight (2002) did in Phase 4 of their SCI validation study. It is also what we did in the final stage of this research program. All three measures were administered repeatedly over the course of an individually-administered psychological skills program. The contents of that intervention and the changes in optimism and confidence as measured by the three instruments validated in this paper are described elsewhere (Furst, Thomas, & Fogarty, in preparation).

In terms of further research, we have already indicated that despite the generally sound psychometric properties exhibited by the LOT-R, the SCI, and the CSCI, more research is needed at the item level to determine whether greater discrimination can be achieved among the subscales of these instruments. However, we also emphasise that such research efforts should not focus on item content alone. The validation samples themselves may prove to be of interest. Inspection of SCI item content, for example, suggests that it should be possible to distinguish among the three constructs it purportedly measures. A possible explanation is that it may take a lot of practice in psychological skills before athletes distinguish readily between these different types of sport confidence. Until they reach that level of knowledge, confidence, broadly defined, is just one of the many psychological skills they are trying to acquire. This phenomenon is well-known in the differential and developmental psychology fields where, during the course of mental development, global, undifferentiated constructs become increasingly differentiated, articulated, and hierarchically integrated (e.g., Burt, 1954). Such a developmental sequence in the athlete would mirror the conceptual developments in the discipline itself, where sport confidence was once seen as a unidimensional construct (Vealey, 1986).

An additional line of research involves extending the methodology we used to embrace other psychological tests. We examined just three instruments and their associated constructs from what is now a large pool of instruments designed to measure aspects of sport confidence, optimism, resilience, tough-mindedness, and the like. The study therefore samples from that pool and makes no judgements about instruments we did not examine. Such a line of research would provide valuable psychometric data on established tests as well as continuing to address the jingle-jangle fallacy posed by Marsh (1994). Ultimately, more evaluative research of this kind would help psychologists to select suitable measures from a confusing array of assessment tools in a popular domain of sport and exercise psychology.

Conclusion

Our first aim in this study was to test the factor structure of the LOT-R, the SCI, and the CSCI. Regarding the LOT-R, our conclusion is that it can be treated as a unidimensional instrument but a more accurate description is that it contains two correlated dimensions, one reflecting dispositional optimism, the other dispositional pessimism. Regarding the SCI, we found evidence to support its hypothesized three-dimensional structure. We also found that some of the SCI items have loadings on two or more factors, a problem that needs to be addressed, especially in relation to the SCI-Efficiency and SCI-Resilience subscales. Regarding the CSCI, the hypothesized two-factor structure was supported in this study.

The second aim of this study was to explore relations among the constructs of dispositional optimism and sport confidence. This aim was prompted by Marsh's (1994) caution that in an era of rapid test development, the same construct can appear under different labels and different constructs can appear under the same label. Our CFA of all 33 items indicated that this type of confusion is not happening across these three instruments. Dispositional optimism and sport confidence emerged as distinct but related constructs. The seven-factor solution provided a good fit to the data, suggesting that although they are highly correlated there is sufficient discriminant validity among the seven constructs measured by the LOT-R, the SCI, and the CSCI. A six-factor solution also fitted the data but the two constructs that merged were both labelled dispositional optimism, so there was no confusion.

The third aim of the study was to explore relations between scores on the three instruments and a measure of sporting achievement. Interpreted differently, the aim was to develop an understanding of which of the three instruments might be most useful in sport psychology research and practice. Vealey and Chase (2008) commented that the different approaches to the measurement of sport confidence now offer plenty of choice and they advised researchers to select the instrument that suits their research purposes. On the basis of the data collected in this study, of the three instruments we evaluated, the SCI is likely to be the most useful for sport and exercise psychologists interested in the effects of interventions on confidence. Most importantly, item content is based on actual competition situations.

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Table 1.

Fit Statistics for the LOT-R, Sport Confidence Inventory, and Carolina Sport Confidence Inventory Measurement Models

Model	χ^2	*df*	CFI	TLI	RMSEA	90% CI	ΔCFI	ΔRMSEA
				LOT-R				
Independence Model	1498.25***	15						
Unidimensional	65.24***	9	.96	.94	.16	[.12, .19]		
CT ICM-CFA	22.26**	8	.99	.98	.08	[.04, .13]	+.03	–.07
				Sport Confidence Inventory				
Independence Model	5659.54***	91						
Unidimensional	910.41***	77	.85	.82	.20	[.19, .22]		
CT ICM-CFA	362.92***	74	.95	.94	.12	[.11, .14]	+.10	–.08
CT ESEM	178.96***	52	.98	.96	.10	[.08, .11]	+.03	+.03
				Carolina Sport Confidence Inventory				
Independence Model	2725.64***	78						
Unidimensional	250.79***	65	.93	.92	.11	[.09, .12]		
CT ICM-CFA	143.47***	64	.97	.96	.07	[..05, .08]	+.04	–.04

Note. ** $p < .01$, *** $p < .001$ *df* = degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = Root Mean Square Error of Approximation; CI = Confidence interval; CT = correlated traits

Table 2

Factor Loadings for the LOT-R Indicators with Bidimensional and Unidimensional Solutions

	Bidimensional Solution			Unidimensional Solution		
Latent variable and indicators	λ	λ_{cs}	SE^a	λ	λ_{cs}	SE^a
Optimism						
LOT-R 1	1.00 [b]	.49	.04	1.00	.42	.05
LOT-R 4	1.26	.57	.04	1.26	.50	.05
LOT-R 10	2.57	.82	.03	1.89	.65	.03
Pessimism						
LOT-R 3	1.00 [b]	.69	.05	1.99	-.67	.04
LOT-R 7	1.93	.88	.05	3.75	-.86	.02
LOT-R 9	2.15	.90	.05	4.17	-.89	.02

Note. λ = unstandardized factor loading; λ_{cs} = completely standardized factor loading. [a] These values are based on standardized estimates. [b] These loadings were fixed to 1.00 to establish the metric of the latent variable. All factor loadings are significant at $p < .001$.

Table 3

Factor Loadings from the retained ESEM Correlated Factors Model for the SCI

Item	SCI-EFF	SCI-RES	SCI-PST
SCI-2	**.68**	.34	.08
SCI-5	**.20**	.55	.18
SCI-8	**.18**	.52	.27
SCI-11	**.60**	.35	.20
SCI-3	.11	**.73**	.10
SCI-6	.37	**.59**	.09
SCI-9	.24	**.69**	.02
SCI-12	.25	**.60**	.13
SCI-14	.45	**.46**	.03
SCI-1	–.31	.49	**.60**
SCI-4	.20	–.24	**.85**
SCI-7	.14	–.35	**.89**
SCI-10	–.37	.28	**.79**
SCI-13	.18	–.27	**.91**
SCI-EFF	–	.88	.62
SCI-RES	.31	–	.53
SCI-PST	.44	.42	–

Note. All factor loading estimates are standardized, and target loadings are shown in bold. Correlations above the diagonal are from the ICM-CFA solution whereas those below the diagonal are ESEM estimates. All factor correlations are significant at $p < .001$.

Table 4

Factor Loadings for the CSCI Indicators

Latent variable and indicators	λ	λ_{cs}	SE[a]
CSCI-OPT			
item 2	1.00 [b]	.68	.04
item 5	1.27	.77	.04
item 6	1.93	.88	.03
item 8	0.92	.65	.05
item 10	1.85	.87	.02
item 11	1.19	.75	.04
item 13	0.93	.66	.06
CSCI-COMP			
item 1	1.00[b]	.67	.05
item 3	1.20	.74	.05
item 4	0.98	.66	.05
item 7	2.05	.88	.03
item 9	0.83	.60	.05
item 12	0.87	.62	.05

Note. λ = unstandardized factor loading; λ_{cs} = completely standardized factor loading. [a] These values are based on standardized estimates. [b] These loadings were fixed to 1.00 to establish the metric of the latent variable. All factor loadings are significant at $p < .001$.

Table 5.

Correlations among the SCI, CSCI and LOT-R Factors in a General Measurement Model

	SCI-EFF	SCI-RES	SCI-PST	CSCI-OPT	CSCI-COMP	LOT-R-OPT	LOT-R-PES
SCI-EFF	–						
SCI-RES	.30	–					
SCI-PST	.44	.42	–				
CSCI-OPT	.44	.53	.57	–			
CSCI-COMP	.27	.39	.54	.74	–		
LOT-R-OPT	.49	.50	.56	.79	.50	–	
LOT-R-PES	–.28	–.34	–.26	–.60	–.34	–.77	–

Note. All correlations are significant at $p < .001$.

Table 6

Fit Statistics for Competition Level Invariance (IN) SCI Models

Model	χ^2	*df*	CFI	TLI	RMSEA	90% CI	MD χ^2	Δ*df*	ΔCFI	ΔRMSEA
MGM1 (Configural IN)	223.482***	104	.977	.960	.096	[.079, .114]				
MGM2 (IN FL)	242.564***	137	.980	.973	.079	[.062, .095]	51.967*	33	+.003	–.017
MGM3 (IN FL + Th)	277.783***	162	.978	.975	.076	[.061, .091]	43.194*	25	–.002	–.003
MGM4 (IN FL + Th + Uniq)	305.862***	176	.975	.974	.077	[.062, .043]	37.870**	14	–.003	+.001
MGM5 (IN FL + Th + Uniq + FVCV)	268.144***	182	.984	.984	.062	[.045, .077]	12.536	6	+.009	–.015
MGM6 (IN FL + Th + Uniq + FVCV + FM)	329.087***	185	.973	.973	.079	[.065, .093]	24.760***	3	–.011	+.017

Note. * $p < .05$, ** $p < .01$, *** $p < .001$ *df* = degrees of freedom; Δ*df* = change in *df*; MD χ^2 = change in χ^2 relative to the preceding model computed using the Mplus DIFFTEST function; ΔCFI = change in comparative fit index; ΔRMSEA = change in root mean square of approximation; MGM = multiple-group model; IN = invariance; FL = factor loadings; Th = Thresholds; Uniq = uniquenesses; FVCV = factor variance-covariance matrix; FM = factor means.

Table 7

Fit Statistics for Competition Level Invariance (IN) CSCI Models

Model	χ^2	*df*	CFI	TLI	RMSEA	90% CI	MD χ^2	Δdf	ΔCFI	ΔRMSEA
MGM1 (Configural IN)	200.763***	128	.973	.967	.068	[.049, .085]				
MGM2 (IN FL)	210.129***	139	.973	.970	.064	[.046, .081]	14.064	11	.000	–.004
MGM3 (IN FL + Th)	226.721***	150	.971	.970	.064	[.046, .081]	19.143	11	–.002	–.003
MGM4 (IN FL + Th + Uniq)	255.832***	163	.965	.967	.068	[.051, .083]	31.782**	13	–.006	+.004
MGM5 (IN FL + Th + Uniq + FVCV)	284.600***	166	.956	.958	.076	[.061, .091]	14.500**	3	–.009	+.008
MGM6 (IN FL + Th + Uniq + FVCV + FM)	279.681***	168	.958	.961	.073	[.058, .088]	1.593	2	+.002	–.003

Note. * $p < .05$, ** $p < .01$, *** $p < .001$ *df* = degrees of freedom; Δdf = change in *df*; MD χ^2 = change in χ^2 relative to the preceding model computed using the Mplus DIFFTEST function; ΔCFI = change in comparative fit index; ΔRMSEA = change in root mean square of approximation; MGM = multiple-group model; IN = invariance; FL = factor loadings; Th = Thresholds; Uniq = uniquenesses; FVCV = factor variance-covariance matrix; FM = factor means.

Table 8

Descriptive Statistics and Correlations for LOT-R, SCI, and CSCI Scales (N = 260)

Measure	Range	M	SD	1	2	3	4	5	6	7	8	9	10
1. LOT-R	0-24	16.72	3.73	.77									
2. LOT-R Optimism	0-12	8.21	2.01	.84	.58								
3. LOT-R Pessimism	0-12	4.13	2.94	-.86	-.47	.79							
4. SCI	1-7	5.31	.72	.47	.51	-.31	.91						
5. SCI Cognitive Efficiency	1-7	5.31	.83	.40	.42	-.27	.89	.86					
6. SCI Resilience	1-7	5.21	.85	.48	.49	-.35	.87	.79	.86				
7. SCI Physical Skills	1-7	5.40	.86	.32	.39	-.18	.79	.53	.45	.85			
8. CSCI	1-4	3.29	.43	.52	.50	-.39	.59	.50	.52	.48	.85		
9. CSCI Optimism	1-4	3.31	.42	.59	.58	-.43	.62	.54	.58	.46	.88	.82	
10. CSCI Competence	1-4	3.28	.50	.33	.31	-.26	.42	.34	.34	.39	.89	.57	.76

Note. All correlations are significant at $p < .01$.

Scale reliabilities (α) are underlined in the main diagonal