Sport Connection Scale (ECE): Acquiescence Control and Invariance

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ABSTRACT – The Sports Connection Scale (ECE) is one instrument to assess the connection of the 5C's model of positive youth development. In a previous study, the scale presented a two-factor solution, despite the theory suggesting a unifactorial structure. This study aims to compare the ECE unifactorial model with and without acquiescence control to the two-factor model and to test the scale invariance between collective and individual modalities practitioners in a sample of young Brazilians. The results indicate the unifactorial solution is acceptable for the controlled model and that the instrument is not equivalent between the two groups. The adequacy of the instrument and the influence of response bias in the item's answers were verified.

KEYWORDS: sports psychology, psychometrics, test bias, psychological assessment

Escala de Conexão no Esporte (ECE): Controle de Aquiescência e Invariância

RESUMO – A Escala de Conexão no Esporte (ECE) é um dos instrumentos para avaliar a conexão no modelo dos 5C's do desenvolvimento positivo de jovens. Em estudo anterior, a escala apresentou uma solução de dois fatores, apesar da teoria sugerir uma estrutura unifatorial. Este estudo teve como objetivo comparar o modelo unifatorial da ECE, com e sem controle de aquiescência, ao modelo de dois fatores e testar a invariância da escala entre praticantes de modalidades coletivas e individuais, em uma amostra de jovens brasileiros. Os resultados indicaram a solução unifatorial como aceitável para o modelo controlado e que o instrumento não é equivalente entre os dois grupos. Constatou-se a adequação do instrumento e a influência de viés nas respostas aos itens.

PALAVRAS-CHAVE: psicologia do esporte, psicometria, viés do teste, avaliação psicológica

Sports practice is associated with several social benefits (e.g., interpersonal relationships), psychological benefits (self-confidence), and physical benefits (motor development; Galatti et al., 2017; Reverdito et al., 2017). Research focused on understanding the environment, relationships, and sports activities has advanced, especially among the young population (e.g., Côté et al., 2010; Fraser-Thomas et al., 2005; Kavussanu & Boardley, 2009; MacDonald et al., 2012; Panza et al., 2020; Turnnidge et al., 2012; Vierimaa et al., 2017). Among the perspectives for analyzing youth participation in sports and its benefits, Positive Youth Development (PYD; Holt, 2016; Holt et al., 2020) presents principles and assumptions from different measurement approaches of the construct. The 5C's theoretical model is one of the assumptions aimed at assessing PYD through five characteristics (competence, confidence, connection, caring, and character; Lerner et al., 2005). The C corresponding to connection is associated with fundamental skills for the maintenance of the other C's, such as social skills, based on the idea that athletes are constantly interacting with coaches or teammates (Goldenberg et al., 2016; Santos et al., 2016; Vierimaa et al., 2017). Understanding the various

measurement possibilities of this construct, this research proposes the investigation of the psychometric properties of the Sports Connection Scale (ECE).

Connection is an umbrella term that encompasses different constructs, such as social identity (Bruner et al., 2014), relationships with other athletes (Weiss & Smith, 2002), and cohesion (Eys et al., 2009). Furthermore, it refers to the quality of relationships built within a given environment. In the sports context, athletes can establish and develop bonds with coaches, fellow athletes, opponents, referees, or even with the institution itself (e.g., sports center). Meaningful and positive relationships within the sports environment can be an important component in promoting psychological well-being (Vierimaa et al., 2012), as most individuals need to belong and feel accepted within a group (Baumeister & Leary, 1995).

Among all these relationships, the relationship with the coach plays a fundamental role in the functioning of the relationship with other athletes (Compton, 2005; Tavares et al., 2021). The coach's role is associated with the responsibility of assisting in the development of a healthier, supportive, learning, and nurturing environment (Tavares et al., 2021). This enables a positive climate, encourages cooperation and contribution from the athletes, and promotes the development and strengthening of other relationships within the environment (Compton, 2005; MacDonald et al., 2010; Tavares et al., 2021; Weiss & Stuntz, 2004).

When relationships occur healthily, whether with the coach or with other athletes, young individuals tend to engage more and become satisfied with their practice (Tavares et al., 2021; Weiss & Stuntz, 2004). This enables athletes to develop self-awareness, responsibility, and self-control, facilitating the enhancement and maintenance of social skills (e.g., leadership, and communication; Goldenberg et al., 2016; Sanches & Rubio, 2011), as well as promoting morality and integrity (Kavussanu & Stanger, 2017; Shields & Bredmeier, 2007).

It is important to highlight that when young individuals are committed to others, establishing emotional and trusting bonds, social and personal skills can also be developed (Bruner et al., 2014). However, the athlete-to-athlete connection will depend on the coach's role within the environment (Lorimer, 2009). In summary, the outcomes of healthy relationships in the sports environment promote feelings and thoughts directed toward the group, such as clarity of roles, empathy, and social acceptance (Jowett & Poczwardowski, 2007).

In this way, there are different instruments recommended to understand the connection in sports. When proposing a test battery to assess the 5C's model of Positive Youth Development (PYD) according to the theoretical framework developed by Côté et al. (2010), Vierimaa et al. (2012) suggested the *Coach-Athlete Relationship Questionnaire* (coach-athlete connection) and the *Peer Connection Inventory*

(athlete-athlete connection) as scales to evaluate connection in sports.

The *Coach-Athlete Relationship Questionnaire*, which measures the relationship between coach and athlete, consists of three dimensions: closeness (emotions), commitment (cognitions), and complementarity (behaviors). It is composed of two versions, one for the coach and one for the athletes (Jowett & Ntoumanis, 2004). The *Peer Connection Inventory* instrument aims to assess the relationship between athletes based on the athlete's selection of three teammates they enjoy working with. This type of assessment involves two oscillometric classifications: social impact and social preference (Coie & Dodge, 1983).

Despite the advancements in providing a measure to assess the 5C's, the Peer Connection Inventory has an intragroup evaluation approach, which hinders the understanding of connection in research with large samples (Vierimaa et al., 2012). Due to this limitation, a study conducted by Silva & Peixoto (in press) proposed a new scale to evaluate connection among athletes, called the Teamwork Scale for Youth (TSY; Anderson-Butcher et al., 2014). The TSY aims to measure adolescents' perceived ability to work and contribute with other team members towards a common goal. However, the instrument is focused only on the relationship among athletes within the same team, disregarding other relationships present in sports.

However, none of these instruments proposed to measure more than one perspective of connection. This can make it difficult for researchers in the field to assess athletes' relationships with coaches and other athletes since it would require applying multiple measures with divergent objectives and structures. In this regard, Campos et al. (2022) proposed a scale to measure both types of relationships (coach-athlete/athlete-athlete), called the Sports Connection Scale (ECE), as part of a battery to measure the 5C's of Positive Youth Development. The battery aims to evaluate the presence of positive skills fostered in the sports environment among young individuals aged 12 to 24 years. The results from exploratory factor analysis suggested a unifactorial structure for each subscale, except for the ECE, which exhibited a structure composed of two factors. However, it was interpreted that this configuration may have resulted from the organization of items based on positive and negative content.

Considering the importance of having appropriate instruments to assess the coach-athlete and athlete-athlete relationships in the sports context, the present study will utilize the ECE. The ECE is a brief two-factor instrument in which participants are asked to respond about the quality of relationships established in sports. The instrument addresses openness to new ideas and group goals, the relationship with the coach and team, and feelings of group belongingness. The scale has demonstrated adequate psychometric properties (Campos et al., 2022).

The fact that the ECE was the only subscale in the battery that did not exhibit a unifactorial internal structure may be attributed to measurement error due to response biases, as the results indicated two factors, with the first containing items of positive content and the second consisting of items of negative content (Campos et al., 2022). Response biases refer to the tendency of individuals to respond to a group of items based on factors other than the construct itself, such as a preference for extreme categories (extreme response style; Baumgartner & Steenkamp, 2001), a tendency to respond in a socially desirable manner according to social norms (social desirability; Uziel, 2010), and a tendency to agree with an item regardless of its content (acquiescence; Valentini, 2017; Ziegler, 2015).

A bias of particular relevance in the case of the ECE is acquiescence. Due to the scale containing items with both positive and negative semantics, the endorsement of items regardless of their content will impair model fit and the factor loadings of negative items (Danner et al., 2015; Maydeu-Olivares & Coffman, 2006; Valentini, 2017). To control for this response bias, a random intercept model can be employed, in which an additional factor called "acquiescence" is established. This factor is orthogonal to the "connection" factor, and its factor loadings are fixed at 1 (Maydeu-Olivares & Coffman, 2006). The scores of the acquiescence factor will correspond to the scores resulting from this response bias (Maydeu-Olivares & Steenkamp, 2018).

By advancing measurement proposals with control for acquiescence using the random intercept model, professionals in the sports field can have more appropriate tools. The model has proven to be useful in estimating more accurate factorial structures (Maydeu-Olivares & Coffman, 2006; Maydeu-Olivares & Steenkamp, 2018). In other words, the intercept model has a positive impact on psychological assessment processes by offering a measure with a greater ability to capture the target construct while minimizing the effects of response biases generated by the sample (Primi et al., 2019; Valentini et al., 2020).

Additionally, it is important to consider the athlete-to-athlete relationship across different sports modalities. For instance, athletes involved in table tennis (Fuchs et al., 2019) and taekwondo (Kim & Nam, 2021; Wazir et al., 2019) have relationships with other athletes outside their team due to the individual nature of these sports. In contrast, team sports such as volleyball (Lidor & Ziv, 2010), basketball (Bazanov et al., 2006), and football (Jong et al., 2022) involve athletes playing as part of a team. Previous studies have observed that athletes in individual sports tend to have higher scores on the friendship component, while athletes in team sports tend to endorse more teamwork (Benar & Loghmani, 2014; Howard et al., 2018; Moradi et al., 2020).

The present study aims to estimate new evidence of validity based on the internal structure of the Scale of Connection in Sports using the random intercept model to control for acquiescence. It also seeks to investigate the equivalence of the instrument between team and individual sports modalities. Based on the theoretical foundation, the hypotheses are as follows: (a) the two-factor structure will fit the data from the sample, as found by Campos et al. (2022), considering the content of the items (positive and negative) for the model without controlling for acquiescence; (b) it is expected that in the model with control for the bias, the unidimensional structure will demonstrate the most appropriate fit; (c) controlling for acquiescence will improve the fit indices, indicating the influence of response biases (Maydeu-Olivares & Coffman, 2006); (d) the instrument will not be equivalent between the two groups (team vs. individual) since the items do not consider relationships with other athletes, but rather focus on team relationships.

METHOD

Data is available upon request to the authors.

Participants

We used a convenience sample of 377 young athletes, aged between 12 and 24 years ($M = 17.9 \pm 2.84$), of both genders (54.6% male). The majority of athletes described practicing team sports (52.5%), such as soccer, basketball, volleyball, and handball, among others. The remaining athletes described practicing individual sports, such as tennis, athletics, taekwondo, and judo, among others. Regarding the competitive level, 30% stated that they do not compete in their sport, 24.9% described themselves as competing at a national level, 18% at a state and regional level, with the remaining 9% at an international level. In general, the participants reported having at least three years of experience in their sport (65.8%), and it was not their first sport practiced (65.5%). Additionally, they mentioned having trained previously with other coaches (76.7%).

Instruments

Sociodemographic Questionnaire

Specifically designed for this research, the questionnaire aimed to obtain relevant information about the participants. For this purpose, questions were formulated regarding age, gender, type of sport practiced (team or individual), competitive level, years of experience, and whether they have practiced the sport with different coaches than the current ones.

Scale of Connection in Sports (ECE)

The ECE is part of a battery to assess the theoretical model of the 5C's (competence, confidence, connection, caring, and character) of Positive Youth Development in Sport, initially developed by Campos et al. (2022). Its objective is to measure the C connection, which investigates the quality of relationships within the sports environment. The instrument consists of 15 items, in which participants are required to respond about the quality of relationships established in sport using a five-point Likert scale (1, *strongly disagree*, to 5, *strongly agree*). The content of the items generally addresses openness to new ideas, group goals, good relationships with the coach and team, and feelings of group belonging. Parallel analysis demonstrated the retention of two factors (Factor 1 = 44%; Factor 2 = 17%) given the item variances, compared to respective random data of 15% and 13%. Additionally, the fit indices of the one-factor structure obtained values below the expected for the Comparative Fit Index (CFI = .894) and Tucker-Lewis Index (TLI = .879), and presented values higher than expected for Root-Mean-Square Error of Approximation (RMSEA = .140; Campos et al., 2022).

Procedures

Ethical Aspects

The research was submitted to and approved by the Ethics Committee of the University of São Francisco (CAAE: 50705221.3.0000.5514). Participants were assured the right to confidentiality of the collected data and the possibility to withdraw from participation at any time, by Resolution No. 466/2012 of the Brazilian National Health Council.

Data collection was conducted in sports institutions and through the researchers' social media channels, with a link shared via Google Forms. Only athletes who agreed to the informed consent form and the assent form were eligible to participate in the research.

Data Analysis

To estimate the factorial structure of the scale, a Confirmatory Factor Analysis (CFA) was conducted using the Diagonal Weighted Least Square (DWLS) estimation method. For the interpretation of fit indices, the following cutoff parameter was used: $\chi^2/df \leq 3$, RMSEA $\leq .08$, CFI $\geq .90$, and TLI $\geq .90$ (Brown, 2015).

Next, to identify the influence of response bias, the Random Intercept (RI) model was employed to control for acquiescence, allowing for the estimation of improved parameters for the factorial structure of the instrument (Zanon et al., 2018). The analysis used the Diagonal Weighted Least Square (DWLS) estimation method, considering the parameters described in the previous paragraph. It aimed to account for individual differences not accounted for in common factor models, thus extending the standard confirmatory factor model (Maydeu-Olivares & Coffman, 2006).

To verify the invariance of item parameters, the Multigroup Confirmatory Factor Analysis (MG-CFA) method was employed, using the Diagonal Weighted Least Square (DWLS) estimator. Three models were compared to assess the equivalence of the measurement instrument among team and individual sport athletes: the configural model (internal structure), metric model (factor loadings), and scalar model (intercepts). The interpretation of the results considered the variability of the indices RMSEA (ΔRSMEA < .01), CFI (ΔCFI < .01), McDonald's (ΔMcDonald < .02) e Gamma-hat (ΔGamma-hat < .001; Cheung & Rensvold, 2002). All analyses were conducted using the RStudio software in the R language, through the *lavaan* package (Rosseel, 2012).

RESULTS

The CFA estimated two factorial structures, namely, a one-factor model and a correlated two-factor model. Among these structures, the two-factor model better fit the data, as it exhibited indices of good fit (χ^2 = 145.00, *df* = 89, CFI = .972, TLI = .967, and RMSEA = .041, CI 90% [.028, .053]). Although the items were designed to assess a single construct, the one-factor structure proved inadequate as it showed indices below the literature's expected values for CFI and TLI, along with a substantially higher value for RMSEA (χ^2 = 352.72, *df* = 90, CFI = .871, TLI = .849 and RMSEA = .088, CI 90% (.079, .098). The factor loadings for both structures were significant, for one-factor (λ < .38) and for the two-factor structure (first factor: positive λ < .59;

second factor: negative λ < .44). Item 11, however, did not load significantly in both cases.

Understanding that the purpose of the instrument is to assess a single construct, the CFA with random intercept was employed aiming to improve the parameters of the one-factor structure by controlling for acquiescence. The fit indices improved, providing support for the theoretical foundation by corroborating a one-factor structure: χ^2 = 176.26, *df* = 88, CFI = .957, TLI = .948, RMSEA = .052, 90% CI (.040, .063). The factor loadings of the model without and with acquiescence control for the ECE are presented in Table 1.

The factor loadings of the items with negative content increased substantially, and there was also an improvement

in the factor loadings of the positive items, except for items 1 and 14. Although the results were more appropriate with acquiescence control, item 11 did not show significant loading on the factor (Table 1). Additionally, an MG-CFA was employed to test the equivalence of the ECE between athletes who engage in team sports and athletes who engage in individual sports (Table 2).

The variability of the indices was higher than expected, except for the RMSEA from the metric model to the scalar model (Table 2). Thus, the results suggest that the ECE is not equivalent between the two groups of athletes (team sports practitioners vs. individual sports practitioners), indicating that the scores are variant and the item parameters are biased.

Table 1
Factor loadings of the unifactorial structure

Items	Without control	With control	RI
1	.727	.722	.283
2	.463	.464	.283
3	.649	.652	.283
4	.547	.602	.283
5	.568	.603	.283
6	-.606	-.622	.283
7	.536	.570	.283
8	-.493	-.527	.283
9	-.332	-.386	.283
10	-.384	-.413	.283
11	-.002	-.014	.283
12	-.479	-.494	.283
13	-.541	-.581	.283
14	.543	.518	.283
15	-.386	-.461	.283
Variance			.08

Table 2
Factorial invariance between team sports (n = 198) and individual sports (n = 179)

Model	χ^2/df	p	CFI	TLI	RMSEA	MD	GH	ΔCFI	ΔRMSEA	ΔMD	ΔGH
1	247.98 (176)	.000	.969	.963	.047	.908	.994	-	-	-	-
2	397.50 (190)	.000	.911	.902	.076	.758	.984	.058	.029	.150	.010
3	448.76(203)	.000	.895	.891	.080	.720	.981	.016	.004	.038	.003

Note. 1 = Configural; 2 = Metric; 3 = Scalar. χ^2 = chi-square; *df* = degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error Approximation; MD = McDonald's Omega; GH = Gamma Hat.

DISCUSSION

The objective of the present study was to seek new evidence of validity regarding the internal structure of the ECE. The results demonstrated that the model controlling acquiescence by random intercepts yielded more appropriate fit indices for the one-factor structure, supporting hypothesis "b" of the present study by indicating the presence of response biases that influenced the interpretability of the data (Maydeu-Olivares & Coffman, 2006). As expected,

the MG-CFA indicated that the instrument does not work equivalently among athletes in team and individual sports (Cheung & Rensvold, 2002).

According to the results observed in the study by Campos et al. (2022), the two-factor structure was found to be more appropriate for the sample data, as it exhibited adequate fit indices. In this regard, the random intercept model was applied to control for acquiescence since the items in the

scale assess connection, representing a single construct. The comparison between the one-factor models with and without acquiescence control highlights the impact of response bias on the internal structure of the instrument.

In the model without the use of random intercepts, the factor loadings of the negative items were underestimated. Additionally, the model fit was biased, resulting in non-acceptable fit indices. In contrast, the model with the use of random intercepts showed an improvement in the factor loadings of the negative items, and the model obtained acceptable fit indices (Ziegler, 2015). Thus, the results indicate that biases should not be ignored in the estimation of factor scores (Valentini et al., 2020).

Regarding the factor loadings, item 11 showed a lower value compared to the other items, and it did not demonstrate a more appropriate value even in the controlled model. The low factor loading of item 11 may be attributed to its content, which differs from the other items that specifically refer to the team or coach, as it uses the term "participants." As a result, respondents may interpret "participants" as any individual involved in their sports practice context (e.g., coach, team athletes, opponents, referees, spectators, etc.). Due to this ambiguity, the factor loading of the item may have been heavily penalized.

By controlling for acquiescence, the data exhibited more reliable scores with more appropriate parameters (Zanon et al., 2018). These findings are aligned with the perspective that controlling for acquiescence is a significant procedure as it reproduces a more suitable internal structure that does not influence the data and does not compromise the validity evidence of the instrument and the reliability of the scores (Valentini, 2017; Zanon et al., 2018).

The results of the AFCMG indicated that the scale does not work equivalently across groups. This suggests that the instrument is not able to capture real differences between practitioners of team and individual sports regarding connection within the sports environment. Since invariance was only supported in the restricted model (configural), differences between groups may reflect measurement error rather than real differences (Fischer & Karl, 2019; Milfont & Fischer, 2010).

Therefore, the results support hypothesis "d" of the present study by suggesting that although the ECE demonstrates configural invariance across groups in terms of factorial structure, it does not exhibit stability in terms of the weight of items on the latent factor (factor loadings) and item intercepts (endorsement difficulty). One possibility for the lack of invariance may stem from the content of the items, which, when referring to athletes' relationships with other athletes, are focused on the team. Athletes who participate in individual sports may train with other athletes, develop a bond, and establish trust, i.e., a connection with another athlete. However, their focus is not on facing competitive

challenges through the team's potential, as they tend to compete alone.

The content of the item influences the factor loadings and intercept, impairing the equivalence of the instrument for athletes in both types of sports. In individual sports, the items may not be assessing what they intend to measure, namely the connection between athletes. The factor loadings, therefore, tend to be lower for the individual sport group compared to the team sport group, making it impossible to compare the relationships between constructs (Brown, 2015), and indicating that the items do not have the same relevance for the construct (Byrne, 2010). Regarding the intercepts, the results suggest that there is no equality among the items, as the latent means are different between the two groups (Steenkamp & Baumgartner, 1998).

In the sports environment, relationships are essential components for the development and enhancement of skills (Santos et al., 2016; Vierimaa et al., 2017). The role of the coach influences the athlete's relationship with other athletes and is also associated with learning and support. In this scenario, the athlete tends to develop aspects both within and outside of sports, such as leadership, academic performance, and family relationships (Bean et al., 2018). In turn, the relationship with other athletes is associated with motivation and engagement. When athletes feel part of a group, they build a connection with others and experience a supportive environment, which stimulates their social and personal skills (Bruner et al., 2014).

Based on the above considerations, the importance of proposing and refining measures that assess the quality of relationships in the sports context becomes evident. Such measures can identify the quality of connections and pinpoint areas that require interventions for improvement, leading to the development of beneficial relationships and an environment that fosters positive athlete development (Scott et al., 2021; Silva & Peixoto, in press; Van Yperen et al., 2021; Yukhymenko-Lescroar, 2021).

In sum, advancing with instruments that aim to assess relationships in the sports environment provides professionals (e.g., coaches, physical educators, and sports psychologists) a better understanding of the athlete's feelings, emotions, and behaviors towards others. It also helps in planning strategies to facilitate connection and, consequently, stimulates the enhancement of skills such as empathy, leadership, and decision-making (Holt et al., 2017; Santos et al., 2016; Vierimaa et al., 2017).

Thus, these professionals can use the instrument to provide a more appropriate assessment of the construct in different circumstances, depending on the team's demands, individual athletes, or sport-specific characteristics. An example of application would be during competitive moments when athletes are more prone to response biases due to environmental stressors and internal pressure for performance

(Coakley & Pike, 2009; Elendu & Dennis, 2017). In this case, applying the ECE controlled by the RI model allows evaluators to interpret the quality of relationships more suitably with low indications of response biases (Maydeu-Olivares & Coffman, 2006; Primi et al., 2019).

The results of the present study indicate the adequacy of the instrument in measuring overall connection. Results also suggest the influence of response bias in answering the items. Thus, providing support for a tool that assists professionals in psychology and sports sciences. Additionally, the results contribute to the advancement of assessment in the sports context by considering adaptive aspects and athletes' potential beyond competitive gains and high performance. By operationalizing a tool capable of identifying relationships and social skills, the assessment can encompass a broader understanding. However, despite the relevance of the findings and the progress made in measuring relationships in the sports environment, the present study has some limitations.

It was not possible to estimate mean differences between groups since the instrument demonstrated a lack of equivalence among the groups. Therefore, the comparisons could be associated with measurement error rather than the latent trait. In this regard, investments should be made to separately develop standardization proposals for athletes in team sports and individual sports. It is recommended that future studies adapt the ECE or include new items, considering the control of response biases through other techniques, such as social desirability. Suggestions include adapting or constructing new items using quadruplets, item neutralization (Costa & Hauck-Filho, 2017; Ziegler, 2015), and excluding item 11 as it did not show values considered adequate in factor loading in both models (with and without control of acquiescence).

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