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5C's of Positive Youth Development in Sports Battery: Short versions and acquiescence control

Batería de los 5Cs del Desarrollo Positivo de Jóvenes en el Deporte: Versiones breves y control de aquiescencia

Bateria dos 5Cs do Desenvolvimento Positivo de Jovens no Esporte: Versões curtas e controle de aquiescência

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Abstract: The 5C's of Positive Youth Development in Sports Battery is an instrument designed to access the 5C's Model in sport. The original version consists of 60 items organized into five subscales (competence, confidence, connection, care and character). The main objective of the present study was to assess the factorial structure and reliability of the 60 items and two brief versions with 30 and 15 items. Furthermore, the aim was also to compare the model with and without acquiescence control. Four hundred eleven athletes participated, aged between 12 and 24 years (M = 17.9 ± 2.84; 54 % male). Exploratory factor analysis and internal consistency indicators suggested the adequacy of the five-factor model for all versions. The results of the controlled model demonstrated better fit indices compared to the uncontrolled model. The adequacy of the new versions of the instrument and the potential of the battery for controlling response bias were verified.
Keywords: psychometric; sport psychology; test bias; psychological assessment; positive psychology

Resumen: La Batería de los 5Cs del Desarrollo Positivo de Jóvenes en el Deporte es un instrumento que evalúa el Modelo de las 5C en el deporte y que está compuesto por cinco subescalas: competencia, confianza, conexión, cuidado y carácter. Se realizaron estudios para verificar la estructura factorial y la confiabilidad de las versiones original (60 ítems), breve (30 ítems) y ultra breve (15 ítems), con la participación de 411 deportistas de 12 a 24 años (M = 17.9 ± 2.84; 54 % hombres). Los resultados del análisis factorial exploratorio y de consistencia interna respaldaron el modelo de cinco factores para todas las versiones. Además, se observó que el modelo con control de aquiescencia tuvo mejor ajuste que el modelo sin control. Esto sugiere que las nuevas versiones del instrumento son adecuadas y que la batería puede controlar el sesgo de respuesta.
Palabras clave: psicometría; psicología deportiva; sesgo de prueba; evaluación psicológica; psicología positiva

Resumo: A Bateria dos 5Cs do Desenvolvimento Positivo de Jovens no Esporte é um instrumento designado para acessar o Modelo dos 5C's no esporte. A versão original consiste em 60 itens organizados em cinco subescalas (competência, confiança, conexão, cuidado e caráter). O presente estudo teve como principal objetivo acessar a estrutura fatorial e confiabilidade dos 60 itens e de duas versões breves com 30 e 15 itens. Ainda, também objetivou-se comparar o modelo, com e sem controle de aquiescência. Participaram 411 atletas, com idade entre 12 e 24 anos (M = 17,9 ± 2,84; 54 % sexo masculino). A análise fatorial exploratória e os indicadores de consistência interna sugeriram a adequação do modelo de cinco fatores para todas as versões. Os resultados do modelo controlado demonstraram melhores índices de ajuste comparado ao modelo sem controle. Constatou- se a adequação das novas versões do instrumento e a potencialidade da bateria para o controle de vieses de resposta.
Palavras-chave: psicometria; psicologia do esporte; viés do teste; avaliação psicológica; psicologia positiva

The application of the 5C's Model in different areas to evaluate Positive Youth Development (PYD) has been discussed by different authors (e.g., Côté et al., 2010; Holt et al., 2020; Lerner et al., 2005; Silva, Romano et al., 2024; Vierimaa et al., 2012). The sporting context, in specific, has demonstrated to be effective in providing a learning and supportive environment, which facilitates the promotion of socio-emotional skills (Côté & Fraser-Thomas, 2016; Holt et al., 2016; Waid & Uhrich, 2019). The development of empirical studies, with the aim of operationalizing and improving tools to facilitate understanding of the 5C's in sports, provides scientific and practical advances (Campos et al., in press; Silva, Romano et al., 2024). Therefore, the present study aims to present the possibilities of improving a measure for measuring the model.

The PYD emerged in the mid-1990s, bringing reflections and discussions about the understanding of adolescence (Catalano et al., 2002; Lerner & Steinberg, 2004) by breaking the premise of problematic adolescence, with the tendency towards risky behavior, and adopting the perspective of the individual as someone with potential, capable of developing skills and competencies (teamwork, leadership, responsibility, trust, among others) (Catalano et al., 2002; Petitpas et al., 2008; Stephens et al., 2018).

Within this approach, sport has proven to be effective, as it has qualities that help development to happen in a facilitating manner (Jones et al., 2017). However, for PYD to be stimulated, it is necessary to consider some issues, for example, the competitive environment, social relationships and the sports practiced (Esperança et al., 2018; Holt et al., 2020). Furthermore, the role of the trainer also becomes necessary, as he is the figure who organizes and plans activities, providing support and learning skills (Bean et al., 2018; Holt et al., 2020).

In this scenario, programs that adopt the PYD premises can contribute in two ways, namely, preparing young athletes for society and promoting the learning of positive characteristics. That is, enhancing healthy habits (engagement in exercise and having a balanced diet), while risk behaviors are reduced (use of alcohol and drugs, violence and low self-esteem) (Esperança et al., 2018). Thus, the programs focus on investing in the development of socio-emotional skills, which can be transferred to other areas of life (family, school and community) (Peixoto et al., 2019).

One of the proposals for measuring PYD was developed by Lerner et al. (2005) and has been applied in research in different contexts (e.g., Chen et al., 2018; Dvorsky et al., 2019; Lerner et al., 2005; Phelps et al., 2009; Silva, Romano et al., 2024). Called the 5C's Model, it aims to assess five skills, considering relational, social, cognitive, contextual and emotional aspects. These include competence (skills and competencies in specific domains–strength, speed), confidence (belief and internal values–self-concept, self- esteem and self-efficacy), connection (quality relationships with coaches, teammates, opponents, among others), caring (feelings of compassion, kindness and empathy towards others and yourself) and character (respect for rules and moral values – violence and drug use) (Côté et al., 2010; Lerner et al., 2005).

In the sports context, the measurement of the 5C's model is still in its early stages of development. Vierimaa et al. (2012) provided a theoretical framework for the constructs and suggested measurement instruments based on Côté et al. (2010). However, no empirical studies have validated this proposal. Moreover, the decision to group care and character into a single 'C' has been debated, as research suggests that character is linked to prosocial behaviors, which, in turn, are associated with understanding and empathy. Based on these initial discussions, Vierimaa et al. (2012) suggested instruments to assess what they called the 4C's: competence (Sport Competence Inventory), confidence (Sport Confidence Inventory), connection (Coach-Athlete Relationship Questionnaire and Peer Connection), and character and care (Prosocial and Antisocial Behavior in Sport Scale). Despite its relevance in initiating the evaluation of emotional, social, contextual, and behavioral characteristics in sports, this proposal has limitations, such as the untested grouping of two C's and the inclusion of a sociometric measure (Peer Connection Inventory).

In Brazil, Silva, Romano et al. (2024) built upon the previously described proposal to advance the evaluation of the model in the sports context by using a grouping of instruments. Some instruments suggested by Vierimaa et al. (2012) were retained, while others were adapted to consider the original 5C's proposal. Thus, the grouping included the Sport Competence Inventory and Physical Self-Inventory (Competence), the Sport Confidence Inventory (Confidence), the Youth Teamwork Scale and Coach-Athlete Relationship Questionnaire (Connection), the Self-Compassion Scale (Caring), and the Youth Values in Sports Questionnaire (Character). The validity of the battery, defined as the set of instruments

used to measure PYD, was supported by results from Confirmatory Factor Analysis (CFA). However, some limitations were identified: a) the measures used were not designed to assess the C's specifically; b) the instruments present different response formats, which may hinder application and correction; c) instruments such as the Teamwork Scale and the Self-Compassion Scale were designed for a general context, not for sports. In summary, the assessment of the 5C's within PYD remains incomplete, with notable gaps in addressing sports-specific demands.

The 5C's: Positive Youth Development in Sports Battery (5C's Battery) was developed to advance the evaluation of the 5C's in sports and address the gaps previously observed. Developed by Campos et al. (in press), the battery was designed to create specific scales for each "C," allowing for the isolated evaluation of each characteristic while also offering an integrated measurement of positive development. This enables sports psychologists to assess athletes based on either the model as a whole or its individual characteristics. Therefore, it is important to test each scale's ability to evaluate its respective construct independently and the battery's ability to assess overall development, as described in the initial validity evidence based on internal structure and as will be applied in this study. The construction process occurs in three stages: scoping literature review, evidence of content validity, and application to the target population. Initially, 100 items were created, ranging from 20 to 25 items for each characteristic of the model. Content validity evidence was ensured by four expert judges in psychometrics and PYD, who analyzed aspects such as clarity of language, practical relevance, theoretical relevance, and adequacy to the proposed dimensions, as well as by a group of eight young athletes who identified possible difficulties in comprehension and semantic adequacy. As a result, seven items were removed due to unsatisfactory indices, resulting in the first version of the battery, composed of 93 items distributed across five subscales: competence, confidence, connection, caring, and character.

Initial analyses of the internal structure, conducted through Parallel Analysis and Exploratory Factor Analysis (EFA), indicated that each subscale independently measures each "C" of the model, allowing for the isolated evaluation of each characteristic. However, some items were excluded due to lack of significant contribution, resulting in a second version comprising 67 items. Additionally, studies evaluating the overall 5C's model demonstrated that the set of subscales adequately represents the theoretical proposal. The results supported a structure with five interrelated factors (χ^2/df = 1.30; CFI = .973; TLI = .972; RMSEA = .040, 90 % CI: .035–.044). Additionally, a bifactor model was tested, consisting of five specific factors (competence, confidence, connection, care, and character) and one general factor representing PYD, which demonstrated excellent fit (χ^2/df = 1.02; CFI = .998; TLI = .998; RMSEA = .011, 90 % CI: .00–.020). The set of results regarding the internal structure analysis of the battery suggests that the subscales can be applied independently while also supporting the inference of the model when used collectively, allowing for a general PYD estimate for youth in sports (Campos, 2022).

Despite the satisfactory results of the initial validity studies for the 5C's Battery, improvements are necessary, including seeking new validity evidence and reducing the number of items in the battery. These initiatives can increase empirical support for the battery, following the guidelines of American Educational Research Association et al. (2014), which highlight the importance of multiple forms of evidence to ensure the adequacy of a measure. Regarding item reduction, shorter psychometric measures can facilitate large-scale research, reduce the average response time, support longitudinal evaluations, extend the scope of application, and eliminate redundancy among items. Thus, the use of brief measures has shown benefits in different areas (e.g., Cassepp-Borges & Pasquali, 2014; Costa Mastrascusa et al., 2023; Nunes et al., 2010), including Sport and Exercise Psychology (Marsh et al., 2006; Razon & Tenenbaum, 2014).

Another pertinent aspect for improving the measure is the control of response biases. These concern the way the individual responds to items, regardless of the content of the items (Valentini, 2017). Among several response biases, acquiescence stands out in this research. Because the 5C's – PYDSS presents items with positive and negative semantics, patterns of acquiescent responses can be observed through the endorsement of items regardless of content (Valentini, 2017). To this end, acquiescence control can be carried out using a random intercept model, in which an additional factor "acquiescence" is established, orthogonal to the five factors (competence, confidence, connection, caring and character) and its factor loadings are set to 1 (Maydeu-Olivares & Coffman, 2006). Finally, the scores for the acquiescence factor must correspond to the score for this response bias (Maydeu-Olivares & Steenkamp, 2018).

The present research aimed to estimate new validity evidence based on the internal structure for the full version of the 5C's Battery, controlling the acquiescence effect through the random intercept model, and to propose a short and super short version of the battery. Based on the theoretical foundation, the hypotheses are: (a) the brief versions will recover the factor structure composed of five factors correlated with each other, according to the findings of Campos (2022) and Geldhof et al. (2014), and (b) acquiescence control is expected to improve fit indices (Maydeu-Olivares & Coffman, 2006).

Method

Participants

The convenience sample consisted of 411 Brazilian participants, of both sexes (54 % male), aged between 12 and 24 years old (M = 17.9, SD = 2.84), predominantly from the southeast region (70 %), followed by the south (14 %), northeast (12 %), north (2.7 %) and central-west (0.5 %) regions. In general, they practice team sports (71 %), such as football, volleyball, basketball, among others. Others practice individually, for example, judo, athletics, swimming, among others. The majority have been practicing for more than five years (50 %), in addition to having already trained with other technicians (77 %).

Instruments

Sociodemographic questionnaire: Prepared for this research, with the objective of characterizing the sample, collecting information about the participants, such as gender, age, region in which they live, team or individual sport, competitive level, practice time and whether they have already practiced the sport with other technicians.

5C's: Positive Youth Development in Sports Battery (5C's Battery) developed by Campos et al. (in press). The instrument aims to evaluate the PYD's 5C's Model in sports. It consists of 60 items divided into five dimensions: competence (12 items: "I am capable of surpassing my abilities"), confidence (12 items: "I believe that I will be recognized as a good athlete"), connection (12 items: "I believe that other teammates like me"), caring (12 items: "I am attentive to injured teammates") and character (12 items: "I am responsible for my attitudes") that are answered using a five-point Likert scale: 1 *I strongly disagree* to 5 *I strongly agree*. Studies of psychometric properties demonstrated that the fit indices of the correlated model obtained adequate values for Comparative Fit Index (CFI) = .973 and Tucker-Lewis Index (TLI) = .972 and Root-Mean-Square Error of Approximation (RMSEA) = .040, suggesting a one-dimensional factorial solution for each C, with factor loadings that varied between -82 and .45 for competence, -.87 and .55 for confidence, -.75 and .66 for connection, .40 and .82 for caring, and .31 and .84 for character (Campos, 2022). Accuracy levels were satisfactory for all C's (Competence Ω = .86, Confidence Ω = .85, Connection Ω = .90, Caring Ω = .88 and Character Ω = .87).

Procedure and ethical aspects

Participants were recruited in two ways: (1) through the researchers' social networks, by sharing the form created by Google Forms, which was a completely online collection process, and (2) in educational environments, where students responded to the instruments using the form created by Google Forms, that is, partially in person and online. The research was approved by the Human Research Ethics Committee of Universidade São Francisco (CAAE: 50705221.3.0000.5514). Participants were guaranteed confidentiality of the data collected, informed about voluntary participation, and assured of the possibility of withdrawing at any time in accordance with Resolution No. 466/2012 of the National Health Council. Participation in the research was conditional on acceptance of the Free and Informed Consent Form for parents/guardians over 18 years of age and Free and Informed Assent Form for children under 18 years of age. The instruments were presented in the following order: sociodemographic questionnaire and 5C's – PYDS. The average time to complete was approximately 15 minutes.

Data analysis

The reduction of 5C's Battery was carried out in two stages, namely: a) estimation of the factor loadings of the version with 60 items through EFA, and b) selection of items from each subscale of the 5C's for versions with 30 (short) and 15 (super short) items. To select the items, the following criteria were adopted: any item kept in the battery should have a factorial load above .40; items in the

questionnaire that exhibited strong conceptual overlaps; and three items from each subscale of each C were maintained to ensure the heterogeneity of the construct.

To analyze whether the data set was suitable for carrying out EFA, the Kaiser- Meyer-Olkin (KMO) index was calculated, the value can vary from 0 to 1. Thus, values lower than .50 were disregarded, between .50 and .70 considered mediocre, .70 and .80 good and greater than .80 and .90 excellent (Hutcheson & Sofroniou, 1999). Bartlett's test of sphericity was also used to evaluate the extent to which the covariance matrix is like an identity matrix, and the general significance of all correlations in a data matrix, in which the level of significance of the results should obtain $p < .05$, suggesting that the matrix is adequate (Damásio, 2012). Analysis was performed using Factor v.12.03.02 software.

CFA was used with the Weighted Least Square (WLSMV) estimation method, through polychoric correlation matrices, using as parameters the fit indices $\chi 2$ (chi- square), *df* (degrees of freedom) $\chi 2/df \leq 5$, RMSEA ≤ .08, CFI ≥ .90 and TLI ≥ .90 (Muthén & Muthén, 2017; Tabachnick & Fidell, 2019). Furthermore, the Random Intercept (RI) model was used to estimate acquiescence control, using the Diagonal Weighted Least Square (DWLS) estimation method, considering the fit indices. To evaluate the internal consistency indicators, the McDonald's omega coefficient was estimated. Values ≥ .70 were considered good indicators of precision (Tabachnick & Fidell, 2019). The CFA analyzes and the RI model were performed in the RStudio software in the R language, using the Lavaan package (Rosseel, 2012).

It is worth noting that, in the EFA version with 60 items, the subscales were evaluated independently to assess their functioning separately, that is, each factor was interpreted as a subscale. The AFC considered the evaluation of the complete battery, aiming to evaluate whether all subscales work together, reflecting the 5C's Model.

Results

The EFA was preceded by the assessment of the adequacy indicators of the correlation matrix. Thus, KMO (.86 to .98) and Bartlett's test of sphericity (2444.2 to 3318.6, $df = 66$, $p < .001$) suggested interpretability of the correlation matrices of the items representing each C (Tabachnick & Fidell, 2019).

In this direction, when considering obtaining adequate correlation matrix factors, the factor retention method was used. Therefore, the parallel analysis indicated the relevance of a unidimensional structure for each factor as more representative of the data, such as those presented in Table 1.

Table 1

Factor retention

Dimensions	% variance explained real data	% variance explained random data	
		Mean	95th percentile
Competence	54.64	17.95	21.24
Confidence	54.60	17.94	21.02
Connection	53.48	17.99	21.30
Caring	53.85	17.96	21.19
Character	56.66	18.06	21.34

It is noted that all factors indicated explained variance greater than the average of the variances obtained through the randomly estimated matrices, that is, 500 matrices estimated by the permutation method (Buja & Eyuboglu, 1992). Additionally, they were also higher than the value of variance explained in the 95th percentile among the random data.

Based on the solution indicated by the parallel analysis, the EFA itself was carried out, using the one-dimensional solution for each of the subscales representing each C of positive youth development in sports. Table 2 presents the factor loadings, commonality and precision using McDonald's omega coefficient.

Table 2

Factor loadings for 5C's Battery (60 items)

Items	Competence	h^2	Confidence	h^2	Connection	h^2	Caring	h^2	Character	h^2
1	.781	.610	.831	.690	.846	.716	.692	.479	.698	.487
2	.778	.606	.782	.612	.698	.487	.771	.595	.811	.658
3	.710	.505	.797	.635	.803	.645	.620	.385	.804	.646
4	.754	.568	.730	.534	.832	.692	.750	.563	.858	.736
5	.786	.618	.583	.340	.799	.638	.702	.492	.636	.405
6	.801	.642	.777	.603	-.621	.385	.758	.574	.647	.418
7	.593	.352	-.487	.237	.740	.548	.585	.342	.759	.576
8	-.402	.162	-.517	.267	-.440	.193	.529	.280	.727	.528
9	.608	.370	.826	.683	-.514	.264	.592	.350	.501	.251
10	.684	.467	.785	.617	-.565	.319	.498	.248	.710	.505
11	.466	.217	-.429	.184	.534	.285	.861	.742	.367	.135
12	.677	.459	.756	.571	-.489	.239	.609	.371	.361	.131
Ω	.90		.91		.90		.90		.90	

By observing the factor loadings obtained in the EFA of the 60-item version and the content of the items, the choice of items for the brief versions began. For example, it was possible to observe that item 8 (competence) "When I realize, I have already lost focus on the competition" with a factorial load of -0.402, presented a load below expectations and content that was already included in other items, such as item 11 "Few things can improve my attention", in this case the lack of attention is presented in the format of a positive item. Therefore, the battery in its short version was composed of 30 items organized into five dimensions with six items each (competence: 1, 2, 4, 5, 8 and 9; confidence: 1, 2, 4, 6, 8 and 9; connection: 1, 2, 3, 4, 6 and 7; caring: 2, 3, 6, 8, 9 and 12; and character: 1, 2, 4, 7, 8 and 10), while the super short version resulted in 15 items organized into five dimensions with three items each (competence: 5, 8 and 9; confidence: 1, 8 and 9; connection: 1, 4 and 6; caring: 2, 8 and12; and character: 1, 4, 7).

Additionally, a CFA with random intercept was used to control acquiescence for all versions of the instrument when evaluating the general model of the 5C's of PYD in sports. The results presented in Table 3 suggest that the fit indices in the random intercept model were higher in relation to previous models, indicating the presence of response biases, such as the individual's tendency to opt for extreme responses.

Table 3

Fit indices for the reduced versions of 5C's Battery without and with random intercept model

Version	**RI Model**	χ^2	**Df**	***P***	χ^2**/df**	**CFI**	**TLI**	**RMSEA (CI 90 %)**
60 items	With control	1700	4003.424	< .05	0.424	.946	.944	.058 (.055 - .060)
	Without control	1696	7415.963	< .05	0.228	.963	.962	.091 (.089 - .093)
30 items	With control	395	704.001	< .05	0.561	.975	.973	.044 (.038 – .049)
	Without control	392	1691.811	< .05	0.231	.975	.972	.090 (.085 - .094)
15 items	With control	80	174.422	< .05	0.458	.966	.956	.054 (.043 - .064)
	Without control		181.484	< .05	0.430	.990	.987	.057 (.046 – .068)

Regarding the factor loadings for the model without control and with acquiescence control, the values are shown in Table 4. According to the results, the items demonstrated a significant contribution to their respective value in both models (without control and with control) and for all versions (60, 30 and 15 items). However, it is worth noting that most items showed improvement when controlled, especially items with negative content.

Table 4

Factor loadings of correlated models without and with random intercept model

60 items				30 items				15 items			
	Without control	**With control**	**RI**		**Without control**	**With control**	**RI**		**Without control**	**With control**	**RI**
C1	.546	.676	.289	C1	.620	.693	.274	C1	.539	.453	.326
C1	.547	.576	.289	C1	.579	.627	.274	C1	-.439	-.639	.326
C1	.544	.588	.289	C1	.660	.686	.274	C1	.619	.555	.326
C1	.584	.716	.289	C1	.634	.690	.274	C2	.658	.585	.326
C1	.611	.640	.289	C1	-.430	-.640	.274	C2	-.456	-.630	.326
C1	.639	.703	.289	C1	.663	.654	.274	C2	.754	.664	.326
C1	.753	.630	.289	C2	.703	.758	.274	C3	.825	.795	.326
C1	-.519	-.658	.289	C2	.803	.806	.274	C3	.522	.408	.326
C1	.773	.615	.289	C2	.730	.693	.274	C3	-.517	-.744	.326
C1	.734	.696	.289	C2	.622	.682	.274	C4	.631	.546	.326
C1	.438	.338	.289	C2	-.385	-.572	.274	C4	.706	.658	.326
C1	.632	.591	.289	C2	.759	.773	.274	C4	.793	.734	.326
C2	.846	.728	.289	C3	.780	.801	.274	C5	.646	.524	.326
C2	.876	.788	.289	C3	.655	.694	.274	C5	.825	.702	.326
C2	.769	.767	.289	C3	.718	.755	.274	C5	.700	.569	.326
C2	.930	.689	.289	C3	.607	.745	.274				
C2	.632	.503	.289	C3	-.457	-.734	.274				
C2	.728	.648	.289	C3	.589	.690	.274				
C2	-.454	-.566	.289	C4	.652	.647	.274				
C2	-.548	-.623	.289	C4	.656	.683	.274				
C2	.757	.772	.289	C4	.794	.779	.274				
C2	.718	.753	.289	C4	.686	.653	.274				
C2	-.477	-.536	.289	C4	.606	.580	.274				
C2	.823	.749	.289	C4	.792	.800	.274				
C3	.924	.783	.289	C5	.531	.600	.274				
C3	.752	.784	.289	C5	.714	.889	.274				
C3	.722	.771	.289	C5	.711	.721	.274				
C3	.449	.732	.289	C5	.604	.660	.274				
C3	.519	.683	.289	C5	.747	.790	.274				
C3	-.615	-.735	.289	C5	.437	.421	.274				
C3	.492	.696	.289								
C3	-.455	-.644	.289								
C3	-.479	-.587	.289								
C3	-.598	-.713	.289								
C3	.518	.466	.289								
C3	-.406	-.648	.289								
C4	.581	.598	.289								
C4	.591	.625	.289								
C4	.420	.384	.289								
C4	.808	.743	.289								
C4	.812	.620	.289								
C4	.785	.667	.289								
C4	.632	.571	.289								
C4	.878	.571	.289								
C4	.619	.440	.289								
C4	.623	.598	.289								
C4	.813	.756	.289								
C4	.639	.584	.289								
C5	.459	.558	.289								
C5	.673	.768	.289								
C5	.660	.743	.289								
C5	.510	.756	.289								
C5	.491	.563	.289								
C5	.505	.541	.289								
C5	.450	.629	.289								

C5	.597	.860	.289
C5	.508	.410	.289
C5	.669	.744	.289
C5	.405	.263	.289
C5	.383	.240	.289

Note. C1: competence; C2: confidence; C3: connection; C4: caring; C5: character.

In Table 4, it is still possible to verify a factorial load for the random intercept factor, equal to .289 for the 60-item version, equal to .274 for the 30-item version and equal to .326 for the 15-item version. The result suggests that approximately 8.3 % of the variance of the 60-item version, 7.5 % of the variance of the 30-item version, and 10.6 % of the variance of the 15-item version can be attributed to response bias. The correlations between the factors of each version are presented in Table 5. The results indicated a strong relationship between the characteristics, which varied between .703 and .933 for the 60-item version, between .594 and .926 for the 30-item version and .483 and .929 for the 15-item version.

Table 5

Intra-factor correlation

60 items	Competence	Confidence	Connection	Caring	Character
Competence	-				
Confidence	.933	-			
Connection	.703	.817	-		
Caring	.719	.768	.854	-	
Character	.819	.808	.763	.809	-
30 items	Competence	Confidence	Connection	Caring	Character
Competence	-				
Confidence	.926	-			
Connection	.730	.832	-		
Caring	.594	.636	.870	-	
Character	.725	.720	.827	.788	-
15 items	Competence	Confidence	Connection	Caring	Character
Competence	-				
Confidence	.929	-			
Connection	.818	.846	-		
Caring	.754	.618	.863	-	
Character	.570	.483	.616	.723	-

Note. All correlations are significant.

Finally, based on the values observed in the McDonald's omega coefficient, the brief versions of the 5Cs Battery indicated good levels of accuracy. The short version obtained Ω = .95 for the general factor, Ω = .82 for the competence, Ω = .87 confidence, Ω = .86 connection, Ω = .87 caring and Ω = .86 character. The super short version presented Ω = .90 for the general factor, Ω = .76 connection, Ω = .79 caring and Ω = .84 character. However, the coefficients of the competence and confidence scales in the super short version were mediocre, with values of Ω = .60 and Ω = .55, respectively.

Discussion

The objective of the present study was to seek the first evidence of validity for the brief versions of the 5C's Battery and to control acquiescence. The results indicated suitability for the structure of five correlated factors, corroborating the original proposal of the scale (Campos, 2022), with adequate fit indices, demonstrating applicability to all brief versions. The model controlled through the random intercept demonstrated better fit indices, suggesting the potential of the scale to control response biases that can influence the estimate of the target latent variable and, therefore, the interpretability of the factorial structure of the scales (Maydeu-Olivares & Coffman, 2006).

The EFA results showed adequacy to the unidimensional model for each subscale in the 60-item version. These findings were like previous studies (Campos, 2022; Geldhof et al., 2014; Silva, Romano et al., 2024), when verifying that C's can be measured independently, enabling application in test batteries or separately. Furthermore, they corroborated the theoretical structure proposed by Lerner et al. (2005), in which the PYD is evaluated by five facets. Finally, it indicated good levels of internal consistency through McDonald's omega coefficient, demonstrating a low level of error with the proposed measurement model based on the 5C's Battery (McDonald, 1999). As a result, it was possible to advance to the stage of reducing instrument items. Overall, the reduced versions of the 5C's Battery showed satisfactory results, especially for the 60 and 30 item version. In this sense, the new versions demonstrated a factorial structure like those that were based on the same theoretical understanding (Lerner et al., 2005), for sports (Campos, 2022; Silva, Romano et al., 2024) and school contexts (Dvorsky et al., 2019; Esperança et al., 2018). Regarding precision indicators, there were also good adjustments, given that the coefficient used, McDonald's omega, obtained values above .70, which can then be considered as adequate (Tabachnick & Fidell, 2019). Thus, hypothesis (a) of the present study, in which the brief versions should recover the factorial structure composed of five factors correlated with each other, was achieved. Also, the appropriate estimation of accuracy evidence for the new versions can be inferred.

However, it is important to highlight the low reliability of competence and confidence in the ultra-short version. Some possible explanations for this issue include the low number of items, which inherently reduces the internal consistency of the measure. In psychometric terms, a small number of items limits the extent to which different aspects of the construct can be represented, thereby increasing measurement error and reducing overall reliability. Additionally, the content of the selected items may capture diverse expressions of the construct, which is crucial for a broader understanding of the phenomenon. While this comprehensive approach enhances the ecological validity of the measure, it may also decrease item intercorrelations, ultimately weakening the internal consistency of the factor, highlighting the need for a careful balance between breadth of construct representation and psychometric robustness in future studies.

Another important result is the high correlation between the competence and confidence components of the 5Cs. While this strong association aligns with theoretical expectations, since athletes who perceive themselves as more competent to handle the challenges of the sports context also tend to feel more confident in facing these situations, it raises questions about the distinctiveness of these constructs. Some studies, such as those conducted by Silva, Peixoto et al. (2024) and Silva (2024), have challenged the idea of overlapping between these constructs. The first argument is based on a network analysis that identified distinct groupings for each of the Cs, suggesting that competence and confidence, despite their close relationship, emerge as separate constructs. Another argument is that each of these components behaves differently when associated with other variables, reinforcing their uniqueness in measuring their intended constructs (Silva, 2024). High correlations between factors can indicate conceptual overlap, but they can also be a reflection of their theoretical interdependence rather than redundancy. Therefore, it is suggested that all five components be maintained for measuring the 5Cs of PYD, ensuring a more comprehensive assessment of youth development in sports.

This research contributes to the practice of sports psychologists by providing evidence of validity and accuracy of the brief versions of the 5C's Battery, results that suggest the potential of versions of the instrument in contexts where faster applications are necessary. In the sporting context, athletes are subjected to training routines, competitions, physiotherapy activities and physical recovery. Additionally, psychologists involved in this context are often involved in other activities, such as participating in meetings with the technical team, working with more than one category or sport modality within the sports organization and, consequently, they have little time available with athletes to apply long tools, which makes the use of brief measures to assess constructs of interest beneficial (Geldhof et al., 2014). Another relevant issue concerns the conditions in which monitoring of athletes is necessary over time. In these situations, relying on brief measurements can become more attractive to athletes who will respond to the instruments at different times (Marsh et al., 2006).

Relying on brief and super-brief measures from the 5C's Battery can bring contributions to the development of research that associates other psychological phenomena with the 5C's of the PYD in sports, given the difficulty for researchers to have a long period of access to athletes for applications on multiple scales. Therefore, the efforts made in this research can enhance research carried out on a large

scale, shorter average response time to items, longitudinal assessments, extension of the scope of application of instruments and elimination of item redundancy (Costa Mastrascusa et al., 2023).

From the CFA with bias control, through the random intercept, an improvement in the model's fit indices can be observed in the three versions evaluated. This potential of the 5C's Battery in controlling acquiescence bias can also be considered an important contribution to Brazilian sports psychology, as there are still few applications of this nature in research carried out in the area at the national level (Campos, 2022; Campos et al., in press; Silva, Romano et al., 2024). Furthermore, sports psychology is present in various application contexts, such as: participation sports, school and high-performance. Consequently, having measures capable of controlling response biases, such as acquiescence, can contribute to a better estimate of the constructs evaluated (Valentini, 2017).

Given the competitive nature of sports activities and the emphasis on athletes' skills at various competitive levels, athletes may tend to seek higher scores and performances. As a result, acquiescent responses may occur, as athletes may avoid demonstrating their weaknesses, fear making mistakes and losing, or feel that their place on the team is threatened (Elendu & Dennis, 2017). Additionally, the athlete may consider that indicating positive aspects in their answers is something socially expected, impacting the understanding of the data and, in the case of research, the internal structure of the instrument (Maydeu-Olivares & Steenkamp, 2018). Therefore, the importance of understanding the function of measurement instruments in sports psychology assessment processes is highlighted. Thus, before applying psychological instruments, it is necessary for the psychologist to seek to establish a bond with the athletes. For this, it is possible to choose to carry out interviews, which will enable the development of trust between the athlete and psychologist, consequently, enabling better conduct of the application (Garcia & Borsa, 2016). Furthermore, dialogue with the technical committee must also exist. Additionally, observations, both in training and in games, are essential for identifying demands and interactions in the sporting environment (Garcia & Borsa, 2016). Therefore, it is recommended that assessment in sports psychology is multi-method, that is, it relies on different tools, procedures and techniques (Pesca et al., 2019). Thus, it is also necessary for the sports psychologist to present skills to integrate the results from these different sources of information (Campos et al., in press; Vieira et al., 2010).

Still in relation to the development of brief versions, the present study was based on maintaining the content assessed by the set of items. In other words, we sought to ensure that the brief versions of the battery, as well as the original version, could continue to evaluate the different expressions of the construct. However, some limitations of the research deserve to be highlighted, such as the lack of estimated scores from different versions with external variables. It is therefore suggested that future studies consider estimating validity evidence based on the relationship with other variables, comparing the results of the different versions. In addition, only one technique was applied to control response bias, and then it is recommended that other methods be adopted in new studies. Finally, it is expected that more representative samples from other regions of Brazil will be accessed.

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