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The Coach–Athlete Relationship Questionnaire (CART-Q): development and initial validation

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The purpose of the present study was to develop and validate a self-report instrument that measures the nature of the coach–athlete relationship. Jowett et al.'s (Jowett & Meek, 2000; Jowett, in press) qualitative case studies and relevant literature were used to generate items for an instrument that measures affective, cognitive, and behavioral aspects of the coach–athlete relationship. Two studies were carried out in an attempt to assess content, predictive, and construct validity, as well as internal consistency, of the Coach–Athlete Relationship Questionnaire (CART-Q), using two independent British samples. Principal component analysis and confirmatory factor analysis were used to reduce the number of items, identify principal components, and confirm the latent structure of the CART-Q. Results supported the multidimensional nature of the coach–athlete relationship. The latent structure of the CART-Q was underlined by the latent variables of coaches' and athletes' Closeness (emotions), Commitment (cognitions), and Complementarity (behaviors).

Sport and physical activity are carried out in the presence of others. Based on this premise, a conceptual framework was advanced by Iso-Ahola (1995) to show that athletic performance is a multiplicative function of intrapersonal (e.g., coping skills) and interpersonal (e.g., coach–athlete relationship) factors. Iso-Ahola's proposed framework emphasizes that for successful performance, an athlete's intrapersonal and interpersonal psychosocial factors are required to be developed. Despite the apparent significance of both intrapersonal and interpersonal factors in athletic performance, the interest of sport psychology researchers has been predominantly concentrated on the intrapersonal factors such as motivation and anxiety (Biddle, 1997). Guisinger & Blatt (1994) stated that ''western psychologies have traditionally given greater importance to self-development than to interpersonal relatedness, stressing the development of autonomy, independence, and identity as central factors in the mature personality'' (p. 104). Guisinger and Blatt challenged theories that emphasize either dimension at the expense of the other because they restrict people's understanding of psychological development.

It is necessary to consider the nature of the self as a social entity, especially because there is evidence to indicate that our relationships with others (more so those relationships that we perceive as close and significant) affect our views about ourselves (Hinde, 1997). In the sport context, and more specifically in the context of coaching, the relationship established between the coach and his/her athletes, plays a central role in athletes' physical and psychosocial development (Jowett & Cockerill, 2002). The dynamics between coaches and athletes have been largely examined from a leadership perspective (Chelladurai, 1990; Riemer & Chelladurai, 1998). However, Hinde (1997) states that studies of social behavior such as those observed in leadership research, should not be a substitute for studies of social relationships and in order to understand relationships fully, it is necessary to incorporate alongside the behavioral aspect of relationships their affective and cognitive aspects. Consequently, the need for more research in the area of coach–athlete relationships has recently been identified (Vanden Auweele & Rzewnicki, 2000).

A series of qualitative case studies were conducted in order to ascertain the nature of the coach–athlete relationship from a relationship perspective (Jowett & Meek, 2000, 2002; Jowett, in press; Jowett & Cockerill, in press). Jowett and colleagues started their investigations by defining this unique interpersonal relationship as the situation in which coaches' and athletes' emotions, thoughts, and

behaviors are mutually and causally interconnected (cf. Kelley et al., 1983). This definition of relationship is useful because it identifies the major constituents of coach–athlete relationships and their inter-relations. Subsequently, the interpersonal constructs of Closeness (Berscheid et al., 1989), Co-orientation (Newcomb, 1953), and Complementarity (Kiesler, 1997) were utilized to define broadly coaches' and athletes' emotions, thoughts, and behaviors, respectively. The following discussion aims to provide a summarized overview of the constructs and results generated from the qualitative case studies conducted by Jowett and colleagues.

Closeness refers to feeling emotionally close with one another in the coach–athlete relationship. The qualitative case studies indicated that feelings of being cared for, liked, and valued, as well as the ability to trust one another had an affirmative effect on coaches' and athletes' intrapersonal (e.g., creativity, determination) and interpersonal (e.g., compatibility, relationship maintenance) factors (Jowett & Meek, 2000; Jowett & Cockerill, in press). Co-orientation represents coaches' and athletes' shared perspectives (common goals, values, beliefs), which are developed as a result of open channels of communication. Jowett & Meek (2000) and Jowett & Cockerill (in press) found that shared knowledge that emerged from self-disclosure and information exchange, as well as shared understanding that emerged from common goals and social influence enabled coaches and athletes in reacting sensitively and appropriately to each other's needs, aspirations, and problems. The construct of Complementarity reflects coaches' and athletes' complementary or co-operative interactions, especially during training. Complementary roles, tasks, and support were found to play a significant role in the relationship because it enabled both coaches and athletes to channel all their efforts towards accomplishing the goals set (Jowett & Meek, 2000; Jowett & Cockerill, in press). Lack of Closeness, Co-orientation, and Complementarity in the coach–athlete relationship was linked with interpersonal conflict (Jowett & Meek, 2002; Jowett, in press). Overall, results from these studies reveal not only the existence and properties of the constructs, but also terms and issues that tap into processes specific to the coach–athlete relationships examined.

Relationship research has shown that the variable of interpersonal satisfaction, which is treated both as an outcome and as an antecedent, implies a standard or ideal of the relationship (Hinde, 1997). For example, an athlete would be more satisfied if the relationship with his/her coach approached the athlete's ideal, and less satisfied if large discrepancies from his/her ideal relationship existed. Indeed, sport psychology research reveals that satisfaction is associated with athletes' perceptions of coach behavior (see Chelladurai, 1993), coach–athlete compatibility (Horne & Carron, 1985), and communication (Berardinis, Barwind, Flaningam, & Jenkins, 1983). This evidence makes it possible that coaches' and athletes' emotions, thoughts, and behaviors through the constructs of Closeness, Co-orientation, and Complementarity may also be associated with the variable of satisfaction. In fact, there is some evidence to indicate that coaches' and athletes' emotions, thoughts, and behaviors are associated with the variable of interpersonal satisfaction in a Greek sample (Jowett & Ntoumanis, in press).

Clearly, more research is needed to investigate the dynamics involved between the coach and the athlete from a relationship perspective. In order to accelerate the knowledge gained in this area, the development of a measure that assesses coaches' and athletes' emotions, cognitions, and behaviors is required. A well-developed measure of the coach–athlete relationship would provide a vehicle for studying associations between the nature of the coach–athlete relationship and personal (e.g., satisfaction, motivation), situational (e.g., motivational climate), and other important variables (e.g., moral development). The study of such associations would promote knowledge and understanding relevant to the significance of the coach–athlete relationship in both athletes' and coaches' psychosocial development and athletic effectiveness.

Thus, utilizing the results generated from the qualitative case studies (Jowett & Meek, 2000; Jowett, in press; Jowett & Cockerill, in press), the goals of the present two studies were to: (a) develop a self-report instrument that assesses the nature (i.e., quality and quantity) of the coach–athlete relationship. Given the time constraints and the increasing competition for accessing sport populations, we aimed to create a brief and simple-to-use instrument; (b) provide evidence of the instrument's psychometric properties (i.e., validity and reliability); and (c) investigate the associations between the variable of interpersonal satisfaction and coaches' and athletes' emotions, thoughts, and behaviors.

Study 1

Study 1 aimed to fulfill two sequential objectives. The first objective involved three phases. Phase 1 concentrated on developing items that are relevant to both coaches and athletes in the context of the coach–athlete relationship, irrespective of its relational complexity (e.g., family vs. marital coach–athlete relationships), sport type (e.g., team vs. individual), and level of sport (e.g., club vs. international). This phase aimed at developing a question-

naire that is broad, comprehensive, and applicable to the majority of coaches and athletes. Moreover, it was decided that the questionnaire should largely reflect (a) the positive aspects of coaches' and athletes' emotions (Closeness), cognitions (Co-orientation), and behaviors (Complementarity); and (b) the practice environment in which the coach and the athlete operate, because in this environment they have more opportunities to develop and "use" their relationship compared to competitions. Items were generated based on the qualitative studies conducted by Jowett and colleagues. Subsequently, an initial pool of 39 items was developed where each construct was represented by 13 items.

In Phase 2, a panel consisting of a club coach, a former international athlete, and two research students in sport psychology, evaluated the content validity of the 39 items. The evaluation process involved classifying the 39 items into one of the constructs of Closeness, Co-orientation, and Complementarity, as well as rating the degree to which the content of each item reflected the chosen construct in a percentage scale (0–100%; a higher percentage indicated a closer association between the item's content and the construct). Finally, the members of the panel assessed the items for clarity in a dichotomous "Yes–No" scale. The members of the panel worked independently. Items were retained only when all members (a) categorized the items into the same constructs, (b) rated the items as being highly associated with their respective constructs, and (c) indicated that the items were comprehensible. Following this process, seven items each represented the constructs of Closeness and Co-orientation, whereas nine items represented the construct of Complementarity (see Table 1). Two equivalent versions were produced, one for the coach and another for the athlete. Both versions contained 23 items, which were similar in terms of content, numbering, format, and mode of response.

Phase 3 involved the generation of two further items in order to examine the criterion validity of the developed questionnaire. Criterion validity is used in two main contexts: concurrent and predictive validity, both of which are often used for the validation of new instruments. Predictive validity is used in this study and involves the use of a criterion to be predicted. Satisfaction was selected as the criterion variable over other possible criteria because there is evidence to suggest an association between interpersonal relationships and satisfaction (e.g., Hinde, 1997; Jowett & Ntoumanis, in press). Although this type of validity has been termed predictive validity, "the term has been used in general sense to refer to functional relations between an instrument and events occurring before, during and after the instrument is applied" (Nunnaly, 1967, p. 76). Thus, the intention was to "predict" who does and who does not experience interpersonal satisfaction at the time when the CART-Q was administered. Satisfac-

Table 1. The 23-item CART-Q (coach's version) as derived from the qualitative case studies

	Items
	Closeness
1.	Do you feel *close* to your athlete?
2.	Do you *like* your athlete?
3.	Do you *trust* your athlete?
4.	Do you *respect* your athlete's efforts?
5.	Do you feel *committed* to your athlete?
6.	Do you *appreciate* the 'sacrifices' your athlete has experienced in order to improve his/her performance?
7.	Do you feel that your *sport* (coaching) career with your athlete is *promising*?
	Co-orientation
8.	Do you *communicate enough* with your athlete about training?
9.	Do you *agree* with your athlete's views?
10.	Do you *know* your athlete's strong points?
11.	Do you *know* your athlete's weak points?
12.	Do you *communicate well* with your athlete?
13.	Do you strive to achieve *similar goals* with your athlete?
14.	Do you feel there is *understanding* between your athlete and yourself?
	Complementarity
15.	Do you think that both of you *work appropriately* in achieving the goals set?
16.	Do you think that both of you *work well* in achieving the goals set?
17.	When I coach my athlete, I feel *competent*.
18.	When I coach my athlete, I feel *interested*.
19.	When I coach my athlete, I am *understood*.
20.	When I coach my athlete, I am *ready* to do my best.
21.	When I coach my athlete, I feel at *ease*.
22.	When I coach my athlete, I feel *responsive*.
23.	When I coach my athlete, I adopt a *friendly* stance.

Note. The relational properties that constitute the key constructs are in italics; they are supported by the literature either at a theoretical or empirical level or both.

tion was measured in terms of a global judgment made by the coach and athlete about their athletic relationship. The two satisfaction items were, "Do you feel satisfied by your overall coach–athlete relationship?", and "Do you think your athlete/coach feels satisfied by your coach–athlete relationship as a whole?" The generation of two items, as opposed to one item was thought more appropriate because the estimation of the reliability of the measure is possible. The same two items were used in Jowett & Ntoumanis' (in press) study.

The examination of the psychometric properties of the initial Coach–Athlete Relationship Questionnaire (CART-Q) was the second objective set to achieve in Study 1.

Method

Participants

The sample comprised 120 British participants, of which 50% were athletes and 50% were coaches. The participants were selected based on the following criteria: (a) a chronological age of at least 16 years for both coach and athlete, and (b) a coach–athlete relationship of at least 6 months. The coaches and athletes selected to participate were from Southwest, Midlands, and Northwest regions of England. Sixty-five percent were males and 33% were females. The majority (80%) of the dyads performed in individual sports such as, athletics, swimming, badminton, squash, tennis, fencing, and golf. All levels of sport were represented. More specifically, 30% of the participants participated at a national level, 27% at a club level, 26% at an international level, and 17% at a collegiate level. Twenty percent (20%) of the participants identified to have an atypical coach–athlete relationship type (e.g., parental, marital, correspondence).

Instrumentation

Coach–Athlete Relationship Questionnaire. The initial 23-item CART-Q was employed in order to assess reliability and construct validity. Two further items were included in order to evaluate the criterion-related validity of the CART-Q. A 7-point response scale was adopted for all 25 items. The scale ranged from 1 (*Not-at-all*), to 7 (*Extremely*) with a mid-point 4 (*Half-way*).

Procedure

Senior coaches, three sports clubs, and a coaching education center were contacted in order to attract coaches' and athletes' interest. Prospective participants were handed over packets. Each packet contained (a) a letter describing the study and assuring confidentiality, (b) the questionnaire, and (c) a stamped addressed envelope for return mail. All participants were informed about the nature of the study and about the voluntary nature of their participation. Receipt of returned questionnaires was taken as informed consent. A total of approximately 200 questionnaires were sent out, of which 120 were returned completed. The overall return rate was 60%. Denscombe (1998) argued that the proportion of people who respond to postal questionnaires is as low as 20%; thus, it could be said that the return rate was satisfactory.

Data analysis

Item analysis was carried out in order to assess the reliability of the CART-Q subscales. The achievement of high reliabilities would indicate item homogeneity and, in turn, will reflect reliable subscales. Principal component analysis (PCA) of items was subsequently conducted in order to reduce the items and group them into meaningful components.

Results

Item analysis

Researchers (e.g., see Tabachnick & Fidell, 1996) have suggested certain criteria in refining scales with item analysis. In this study, three criteria were employed, (a) a range of inter-item correlations between 0.30 and 0.70, (b) a minimum corrected item-total correlation coefficient of 0.40, and (c) an increase in the α estimate if an item was deleted. For items to be retained, at least two were required to be adhered to. In view of the above, Co-orientation, and Complementarity subscales had two items each that did not meet any two criteria and, therefore, these items (10, 11, 17, 19) were excluded. Following these exclusions, Cronbach's α's were $\alpha = 0.80$ for Closeness, $\alpha = 0.78$ for Co-orientation, and $\alpha = 0.85$ for Complementarity, demonstrating sufficient internal consistency for all subscales (Nunnally & Bernstein, 1994).

Moreover, methodologists have recommended that at least three to five items should represent each component, factor, or dimension (Fabrigar et al., 1999). In this study, the number of items retained per component was above that recommended.

Principal components analysis

PCA with an oblique rotation, direct oblimin, that allows components to correlate (Tabachnick & Fidell, 1996) was performed because of the potential interdependent nature of coaches' and athletes' emotions (Closeness), cognitions (Co-orientation),

and behaviors (Complementarity). Criteria for extraction as proposed by Kline (1994) and others (Tabachnick & Fidell, 1996) included: (a) eigenvalues greater than 1.0, to indicate that a component explains more variance than any single item; (b) a minimum of around 5% explained variance per component; (c) unique loadings of 0.40 and above, and of at least 0.10 cross-loading differences; and (d) acceptable Kaiser–Meyer–Olkin measure of sampling (KMO) and Bartlett's tests for sampling adequacy and sphericity.

For the 19 items, a three-component structure was revealed that accounted for a total of 65.8% of the overall variance. The generated solution indicated that two items (12 and 14) had cross-loadings smaller than 0.10, and another two items (9 and 18) recorded component loadings smaller than 0.40. KMO and Bartlett's tests were significant. PCA with an oblique rotation was conducted once again on the remaining 15 items. A simple three-component solution emerged, accounting for 63.1% of the overall variance. Note that item 9 failed to record a loading of 0.40 or above. Table 2 displays the components on which the items loaded, the items' loadings, communalities (h^2), the percentage of variance explained by each component, the eigenvalues, and the α coefficients. The following discussion examines the composition and meaning of each component.

Component 1 (Closeness). Six items (i.e., 2, 3, 4, 6, 15, and 16) loaded on component 1. The majority of the items in this component were related to the construct of Closeness (i.e., 2, 3, 4, 6). However, component 1 attracted two further items "work appropriately" (15) and "work well" (16), which were originally hypothesized to belong to the construct of Complementarity (see Table 1). The two items of Complementarity, although interrelated with the items of Closeness, cannot define the construct of Closeness per se. Thus, items 15 and 16 were excluded from the ensuing analysis in order to retain a component that represents a singular aspect of the coach–athlete relationship, namely, the affective aspect.

Component 2 (Commitment). Four items (1, 5, 7, and 13) loaded on component 2. Items 1, 5, and 7 were representative of Closeness and item 13 was representative of Co-orientation (see Table 1). This cluster of items shows that although Co-orientation forms a small part of this component – as did the two Complementarity items in component 1, it does not fully explain it. Interestingly, items (8, 9, 10, 11, 12, 14) hypothesized to represent the construct of Co-orientation were eliminated (see Table 1), suggesting that Co-orientation is not a tenable component. Thus, given that the construct of Co-orientation is no longer representative of component 2, or any other component, it is important to address the identity of this emerged component. The literature on interpersonal relations and group processes has identified that a long-term orientation such as "commitment" and "future expectation" (see item 5 and item 7) in "close" relationships (see item 1) reflects the construct of Commitment (Wieselquist et al., 1999). [Item-13 was excluded due to the low communality produced, indicating that it is unrelated to the domain of interest (see Fabrigar et al., 1999).] Consequently, component 2 is likely to reflect the construct of Commitment. Rosenblatt (1977) defined interpersonal commitment as the intention of a person to maintain an interpersonal relationship. Here, Commitment is defined as coaches' and athletes' intention to maintain their athletic relation-

Table 2. PCA of the CART-Q (Structure Matrix)

Item no.	Items	Component 1	Component 2	Component 3	h^2
2	Do you like your athlete/coach?	0.72			0.65
3	Do you trust your athlete/coach?	0.79			0.67
4	Do you respect your athlete/coach's efforts?	0.84			0.76
6	Do you appreciate the sacrifices your athlete/coach has experienced . . . ?	0.67			0.59
15	Do you think that both of you work appropriately in achieving the goals set?	0.73			0.71
16	Do you think that both of you work well in achieving the goals set?	0.71			0.68
1	Do you feel close to your athlete/coach?		0.72		0.56
5	Do you feel committed to your athlete/coach?		0.72		0.63
7	Do you feel that your sport career with your athlete/coach is promising?		0.77		0.66
13	Do you strive to achieve similar goals with your athlete/coach?		0.44		0.43
20	When I coach my athlete/When I am coached by my coach, I am ready to do my best			0.54	0.56
21	When I coach my athlete/When I am coached by my coach, I feel at ease			0.56	0.61
22	When I coach my athlete/When I am coached by my coach, I feel responsive			0.68	0.51
23	When I coach my athlete/When I am coached by my coach, I adopt a friendly stance			0.77	0.69
	Percentage of Variance	42.2	11.2	9.7	
	Eigenvalues	5.5	1.5	1.3	
	Alpha coefficients	0.86	0.83	0.78	

ship, and implies the athletic dyad's cognitive orientations for the future.

Component 3 (Complementarity). Four items (20, 21, 22, and 23) loaded on component 3, accounting for 9.7% of the total variance. All four items were hypothesized to represent the Complementarity construct (i.e., co-operative acts of interaction in the coach–athlete relationship) (see Table 1). Component 3 was comprised of items such as being "ready" (20), "at ease" (21), "responsive" (22), and "friendly" (23). This component illustrates elements that are associated with co-operative acts of interaction during training. Thus, this component represents the construct of Complementarity as has been initially hypothesized.

Predictive validity of the CART-Q

The predictive validity of the CART-Q was tested by correlating the variable of satisfaction with the three derived constructs of Closeness (emotions), Commitment (cognitions), and Complementarity (behaviors). It was hypothesized that associations will emerge among the interpersonal constructs and the variable of satisfaction. The two items that were developed to measure the variable of interpersonal satisfaction were found to have satisfactory internal consistency ($\alpha = 0.83$). Pearson's correlation coefficients indicated positive and moderately high relationships between the variable of interpersonal satisfaction and Closeness ($r = 0.75$; $P < 0.01$), Commitment ($r = 0.62$; $P < 0.01$), and Complementarity ($r = 0.59$; $P < 0.01$). These results lend support to the predictive validity of the CART-Q.

Study 2

In Study 2, Confirmatory Factory Analysis (CFA) was applied in order to confirm the component structure obtained in Study 1 with data collected from an independent British sample. The examination of the predictive validity and internal reliability of the CART-Q were also objectives of this study. In light of the findings from Study 1, the intention was to demonstrate validity and reliability for a final version of the CART-Q.

Method

Participants

Participants in this study were selected based on the same criteria introduced in Study 1. The new sample consisted of a total of 214 British participants, of which 35% were coaches and 65% were athletes. A fairly equal split was observed between those involved in team (44%) and individual (56%) sports. Team sports included basketball, football, hockey, and volleyball. Individual sports included athletics, gymnastics, and swimming. All levels of sport were represented: recreational (8%), club (47%), collegiate (20%), national (16%), and international (9%). Eighty-nine percent of the participants had a typical relationship, whereas 6% had an atypical coach–athlete relationship; approximately 5% of the participants did not report the type of their relationship.

Instrumentation

The CART-Q. The refined 11-item CART-Q was employed. (The CART-Q is available from the first author.) Of the 11 items, three items measured the construct of Commitment, four items measured the construct of Closeness, and four items measured the construct of Complementarity. The 11 items were all formulated as statements (e.g., "I trust my coach"; "When I am coached by my coach, I am ready to do my best"). Two further items were added on the CART-Q in order to measure interpersonal satisfaction. Interpersonal satisfaction was incorporated in the investigation in order to provide additional evidence of the predictive validity of the CART-Q. The two items of interpersonal satisfaction were the same as those used in Study 1. All items were measured on a 7-point scale ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*).

Procedure

A British Coach Directory was used to contact coaches in the area of West Midlands, from which approximately 30 coaches were contacted initially by phone. Another 60 coaches who operated in Southwest regions of England were contacted directly by mail. In addition, sport coaches of three British Universities (Brunel, Loughborough, and Staffordshire) were also approached to participate in the study. The majority of athletes were contacted through their coaches or directly by phone. Prospective participants were sent packets similar to those used in Study 1. Coaches and athletes had approximately 4 weeks to complete the questionnaires. A reminder letter was sent 2 weeks following the initial contact. It is estimated that 500 questionnaires were administered to coaches and athletes. A satisfactory return rate of 43% was recorded (cf. Denscombe, 1998).

Data analysis

The model specification is based on the model comparison strategy (MacCallum, 1995). In this

approach, an investigator specifies a number of alternative a priori models and fits each model to the same data set. The comparison of alternative models is a common practice in the questionnaire validation process (see Jackson & Marsh, 1996; Li & Harmer, 1996), and aims to test the structural validity of a measure (Hoyle & Smith, 1994). Thus, four competing models were tested using EQS 5.7 (Bentler, 1995) in order to identify the model structure that best captures the dimensions of the coach–athlete relationship. The first three models specified and compared were first-order factor models. Model 1 (M1) hypothesized a single-factor structure representing a general coach–athlete relationship construct. This model is tested in order to examine whether the constructs of Closeness, Commitment, and Complementarity that the CART-Q attempts to measure, can be represented by a unidimensional construct. Model 2 (M2) hypothesized a two-factor structure. The first factor incorporated the Complementarity items and was hypothesized to reflect behaviors. The second factor comprised the Commitment and Closeness items and was hypothesized to represent feelings. Previous work (e.g., see Jowett & Meek, 2000) classified Commitment as a property of emotional Closeness. Therefore, the model's fit will provide an indication of a two-dimensional model, where Closeness and Commitment is represented as one single dimension and Complementarity as another. Model 3 (M3) included three first-order factors representing the Closeness, Commitment, and Complementarity dimensions identified in the PCA. This model has conceptual interest and significance. It is tested in order to examine whether the 11-item CART-Q measures the three interdependent constructs and thus reflects the emotional, cognitive, and behavioral aspects of the coach–athlete relationship. In view of the definition of the coach–athlete relationship, the first-order factors in M2 and M3 were allowed to covary. Finally, Model 4 (M4) was a higher-order factor model that examined whether a general factor, that of the coach–athlete relationship, can account for the correlations among the three first-order factors.

The ratio of sample size to free parameters in the four models was about 9:1, which was very close to the recommended 10:1 ratio (Bentler, 1995). The normalized estimate of Mardia's coefficient was high (35.40), indicating multivariate non-normality, and, therefore, the robust Maximum Likelihood estimation procedure was utilized. According to Byrne (1994), this procedure offers more accurate standard errors when the data are not normally distributed.

Fit indexes. Various goodness-of-fit indexes were utilized to evaluate the adequacy of the factorial structure of the four competing models (for a review, see Hair et al., 1998). The χ^2 statistic (in this case, the Satorra–Bentler scaled χ^2 as robust maximum likelihood was used) evaluates the absolute fit of the hypothesized model to the data. However, this statistic is very sensitive to sample size. Therefore, additional fit indexes were employed to evaluate model fit. The Robust Comparative Fit Index (CFI) and the Non-Normed Fit Index (NNFI) were utilized to compare the hypothesized model with the independence model. The Standardized Root Mean Square Residual (SRMR) was also employed, because it represents the average of the standardized residuals between the specified and obtained variance–covariance matrixes. The Root Mean Square Error of Approximation (RMSEA) was also utilized to assess the Closeness of fit of the hypothesized model to the population covariance matrix. When the 90% confidence interval of the RMSEA contains 0.05, it indicates the possibilities of close fit (Browne & Cudeck, 1993). A simulation study by Hu & Bentler (1999) suggested new cut-off criteria for the various fit indexes. According to these new criteria, a good model fit is indicated when the CFI and the NNFI are close to 0.95, the SRMR is close to 0.08, and the RMSEA is close to 0.06.

To compare the four models, χ^2 difference tests were carried out. However, due to the sensitivity of the χ^2 statistic, two more fit indexes were employed (see Hair et al., 1998). The first one was the Akaike Information Criterion (AIC), which assesses whether a good model fit can be achieved with fewer estimated parameters. The second fit index was the Expected Cross-Validation Index (ECVI), which represents an approximation of the fit that the hypothesized model would achieve in another sample of the same size. The AIC and ECVI do not have a specified range of acceptable values, but amongst the competing models, the one with the lowest AIC and ECVI values would be the most parsimonious and most likely to replicate to other samples.

Results

Descriptive statistics

Table 3 contains the means, standard deviations, skewness, and kurtosis scores of the 11 items. All mean scores were relatively high (i.e., above 5 on a 7-point scale). The skewness scores ranged from -0.67 to -1.77, and kurtosis scores ranged from 0.096 to 3.89, indicating some non-normality in the data distribution.

Model evaluation

Following the procedures used by Li & Harmer (1996), model evaluation and comparison were

Table 3. Descriptive statistics for the 11-item CART-Q

Items	*M*	SD	Skewness	Kurtosis
Commitment				
1. I feel close to my athlete/coach	5.26	1.31	−0.67	0.10
2. I feel committed to my athlete/coach	5.80	1.14	−0.82	0.18
3. I feel that my sport career is promising with my athlete/coach	5.25	1.36	−0.74	0.40
Closeness				
4. I like my athlete/coach	6.16	1.02	−1.52	
5. I trust my athlete/coach	6.02	1.13	−1.22	
6. I respect my athlete/coach	6.25	1.01	−1.77	
7. I feel appreciation for the sacrifices my athlete/coach has experienced in order to improve his/her performance	5.64	1.33	−0.89	
Complementarity				
8. When I coach my athlete/When I am coached by my coach, I feel at ease	5.97	1.23	−1.40	
9. When I coach my athlete/When I am coached by my coach, I feel responsive to his/her efforts	5.95	1.00	−1.15	
10. When I coach my athlete/When I am coached by my coach, I am ready to do my best	6.08	1.14	−1.64	
11. When I coach my athlete/When I am coached by my coach, I adopt a friendly stance	6.08	1.08	−1.31	

Table 4. Fit statistics for the four competing models

Models	*df*	Scaled x^2/df	Robust CFI	NNFI	SRMR	RMSEA (90% CI)	AIC	ECVI
M1	44	3.27	0.85	0.83	0.06	0.15 (0.13–0.17)	99.85	0.88
M2	43	2.29	0.92	0.90	0.05	0.12 (0.10–0.14)	52.48	0.68
M3	41	1.61	0.96	0.94	0.05	0.09 (0.07–0.11)	15.86	0.54
M4	41	1.61	0.96	0.94	0.05	0.09 (0.07–0.11)	15.86	0.54

Note. CFI = Comparative Fit Index, NNFI = Non-Normed Fit Index, SRMR = Standardized Root Mean Square Residual, RMSEA = Root Mean Square Error of Approximation, 90% CI = 90% confidence interval of RMSEA, AIC = Akaike Information Criterion, ECVI = Expected Cross-Validation Index, M1 = One-factor model, M2 = Two-factor model, M3 = Three-factor model, M4 = One-factor second-order model.

carried out in a two-step approach. In the first step, the three first-order models were compared and the best-fitting model was ascertained. Subsequently, the convergent and discriminant validities of this model were determined. In the second step, the best-fitting first-order model was compared to the high-order model to examine whether the higher-order factor can adequately represent the covariations among the first-order factors.

The fit indexes in Table 4 show that M1 and M2 did not fit the data very well, as they had high corrected x^2/df ratios, low CFI and NNFI, and high RMSEA values. M3 had a superior fit compared to the first two models. Specifically, the x^2/df ratio was below 2, and the CFI, NNFI, and SRMR values verged on the cut-off criteria proposed by Hu & Bentler (1999). Nevertheless, the RMSEA was relatively high (0.09) and its confidence interval did not include the 0.05 value. However, it is worth mentioning that when the sample size is small ($N<250$), as in the present study, the RMSEA is problematic, because it tends to over-reject true population models (Hu & Bentler, 1999).

A comparison of the three models clearly shows the superiority of M3. Specifically, χ^2 difference tests between M1 and M3 ($x^2_{\text{diff}}(3) = 77.99$; $P<0.001$) and between M2 and M3 ($x^2_{\text{diff}}(2) = 32.62$; $P<0.001$) were significant. These tests demonstrate a significant loss of fit moving from the three-factor model to the two- and one-factor models. Furthermore, M3 had lower AIC and ECVI values, indicating that it is more parsimonious and more likely to be replicated in an independent sample compared to M1 and M2.

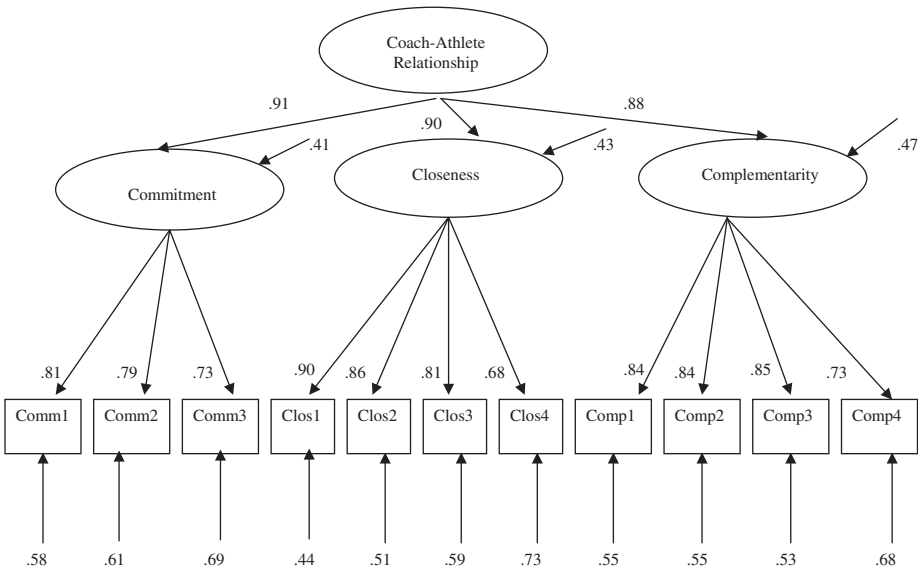
Convergent and discriminant validity. According to Li & Harmer (1996), convergent validity is reflected by the degree to which certain items "converge" as indicators of a hypothesized construct. This was evaluated by examining whether each of the items in the best-fitting model M3 had substantial loadings to their hypothesized factors. All factor loadings were high, ranging from 0.68 to 0.90 (M factor loading = 0.80) and statistically significant ($P<0.001$). Additional evidence for the convergent validity of the refined CART-Q was obtained in the variance extracted estimate (Fornell & Larcker, 1981). This estimate represents the average proportion of variance in the items accounted for by their underlying factors in relation to the amount of variance due to measurement error. According to Fornell & Larcker (1981), values above 0.50 are satisfactory. In this study, the values were 0.61 for the Commitment factor, 0.66 for the Closeness factor, and 0.67 for the Complementarity factor. Taken together, the results supported the convergent validity of the refined CART-Q subscales.

Discriminant validity refers to the extent to which the three factors exhibit uniqueness (Li & Harmer, 1996). The factor correlations, which were corrected for attenuation due to measurement error, were high ($M = 0.81$) casting doubt on the discriminant validity of the refined CART-Q. Anderson & Gerbing (1988) suggested that discriminant validity could be tested by establishing whether the upper limit of the 95% confidence intervals of the factor correlations approach unity. In all three possible combinations between factors, the upper limit of the 95% confidence intervals approached or exceeded unity. This suggested that the three refined CART-Q factors can sometimes be perfectly correlated and that their items may be tapping a single underlying construct.

To examine this possibility, and following the suggestion by Markland et al. (1997), M3 was compared against three two-factor models in which two of the CART-Q factors were combined in turn. As shown above, when the Commitment and Closeness items were hypothesized to load on the same factor (i.e., M2), the model fit was poorer than that of M3. Furthermore, fit indexes not reported here, showed that M3 was far superior to a model in which Closeness and Complementarity loaded on the same factor (e.g., $x^2_{\text{diff}}(3) = 58.53$; $P < 0.001$), and to a model in which Commitment and Complementarity loaded on the same factor (e.g., $x^2_{\text{diff}}(3) = 35.84$; $P < 0.001$). These findings indicate that despite the high factor correlations, the three refined CART-Q factors should be conceptualized as separate dimensions.

Second-order factor analysis. The second step, following Li & Harmer's (1996) model validation procedure, was to compare the best-fitting first-order model (M3) with a single-factor higher-order model (M4). The hierarchical model is nested under the first-order model because it attempts to explain the correlations among the three first-order factors in terms of a single higher-order factor (Jackson & Marsh, 1996). The fit indexes of the higher-order factor are worse or, in the best case, identical to the fit indexes of the corresponding correlated first-order model (Table 4). According to Marsh (1987), when the fit of a higher-order model is identical or very similar to the fit of the corresponding first-order model, support for the hierarchical model has been demonstrated. M3 and M4 had identical fit.

The second-order factor loadings were substantially high (0.91, 0.90, 0.88) and significantly different from zero ($P < 0.001$) (Fig. 1). Jackson & Marsh (1996) suggested that in evaluating a higher-order model, it is informative to examine the proportion of variance of each first-order factor that can by accounted by the higher-order factor. The results in this study indicated that the higher-order factor accounted for a large percentage of the variance of the first-order factors (83%, 82%, and 78% of Commitment, Closeness, and Complementarity variance, respectively). Furthermore, Marsh's (1987) Target Coefficient was used to indicate the extent to which the covariations among the first-order factors can be accounted for by the higher-order factor. This coefficient varies between 0 and 1 and in this study had a value of 1, indicating that the higher-order



Note. Comm= Commitment, Clos= Closeness, Comp= Complementarity. Models 3 and 4 had identical factor loadings.

Fig. 1. Model 4 represents the higher-order factor Coach–Athlete Relationship and the three first-order factors Commitment, Closeness, and Complementarity. All parameters are standardized and significant ($P < 0.001$).

factor was able to explain all the first-order factor covariations. In conclusion, the results showed that the coach–athlete relationship could be conceptualized along three dimensions, which could be subsumed within a higher-order generic dimension.

Predictive validity of the CART-Q. An attempt was made to distinguish the two equivalent models by including interpersonal satisfaction as an outcome variable in the analysis (H. Marsh; personal communication, February 11, 2001). A model (M5) in which the correlated three first-factors predicted interpersonal satisfaction was compared against a model (M6) in which the hierarchical factor predicted the same outcome variable. Since M6 used 1 *df* to explain the predicted path, it was nested under M5, which required 3 *df* to explain the three paths. Therefore, it was possible to compare the fit of the two new models statistically using χ^2 difference testing, the CAIC and the ECVI.

The two models were not significantly different ($x^2_{\text{diff}}(2) = 1.28$, $P > 0.05$). Furthermore, the CAIC and ECVI values were very similar. Although both models had good predicted validity, M6 was more parsimonious than M5 because it achieved the same fit with fewer degrees of freedom. Since in social science research we aim for parsimony, M6 should be preferred over M5. However, further research is needed with additional outcome variables before any conclusions are made regarding the utility of the hierarchical vs. the first-order model. In M6, the path coefficient between the higher-order factor and interpersonal satisfaction was very high ($\beta = 0.89$; $P < 0.01$). In M5, the path coefficients between interpersonal satisfaction and the three factors of Commitment, Closeness, and Complementarity were $\beta = 0.20$ ($P > 0.05$), $\beta = 0.37$ ($P < 0.01$), and $\beta = 0.36$ ($P < 0.01$), respectively. Thus, the results indicated that interpersonal satisfaction was predicted by Closeness and Complementarity, but not by Commitment.

Reliability. In addition to examining the factorial validity of the questionnaire, the internal consistency of each of the CART-Q subscales was assessed. Cronbach's α coefficients were $\alpha = 0.82$ for Commitment, $\alpha = 0.87$ for Closeness, and $\alpha = 0.88$ for Complementarity. The α for the higher-order Coach–Athlete Relationship scale was 0.93. All coefficients exceeded the minimum level of $\alpha = 0.70$ recommended by Nunnally & Bernstein (1994). In addition, the composite reliability estimates (Fornell & Larcker, 1981; Li & Harmer, 1996), which represent the ratio of squared loadings to error variance, were calculated. The estimates of each subscale were high providing further evidence for the internal consistency of the refined CART-Q: 0.82 for Commitment, 0.89 for Closeness, and 0.89 for Complementarity.

Summary and discussion

This paper presented results related to the development and validation of the CART-Q, which was grounded in previous qualitative work, as well as in interpersonal relationship and behavior literatures. Two studies were conducted. Study 1 focused on developing and refining a self-report instrument that measures affective, cognitive, and behavioral aspects of the coach–athlete relationship. The development and refinement of the CART-Q was based on a systematic series of procedures involving item generation, expert panel agreement, item analysis, and PCA. PCA revealed that Closeness and Complementarity were clearly identified components in the solution representing the affective, and behavioral aspects of the coach–athlete relationship. Both Closeness and Complementarity were operationally defined by their corresponding component loadings in a manner that was in line with the initial definitions. However, this was not the case for the construct of Co-orientation.

Jowett et al. (Jowett & Meek, 2000; Jowett, in press; Jowett & Cockerill, in press) qualitative case studies supported the existence of Closeness, Co-orientation, and Complementarity in the coach–athlete relationship. However, the present results indicate that the construct of Co-orientation cannot be supported. This finding may be due to the initial operational definition of Co-orientation. More specifically, Jowett and colleagues defined Co-orientation in terms of coaches' and athletes' verbal communication based on Duck's (1994) proposition that communication provides a platform from which Co-orientation develops. However, Newcomb's (1953) original definition of Co-orientation referred to relationship members' perceptual consensus. Taken together, communication is more likely to be a determinant of Co-orientation than a definition. In an attempt to revive and revise the construct of Co-orientation, an approach has been recently presented in order to measure coaches' and athletes' perceptual consensus in relation to Closeness, Commitment, and Complementarity (see Jowett & Cockerill, 2002). Although this approach is not yet empirically tested, it provides a means by which the construct of Co-orientation is continued to be included in investigations of the coach–athlete relationship.

PCA revealed a previously "unknown" component. A careful inspection of the items' substance and their relations with the literature revealed that the constellation of items under this component may

be representative of the interpersonal construct of Commitment. Commitment was evidenced in the qualitative case studies (e.g., Jowett & Meek, 2000; Jowett & Cockerill, in press), however, it was viewed as a property of the construct of Closeness. Both Studies 1 and 2 indicate that Commitment is an independent relational aspect that broadly refers to coaches' and athletes' intention to maintain their athletic relationship over time.

Study 2 assessed the construct validity of the refined CART-Q through CFA. This technique was applied to confirm the refined multidimensional structure of the CART-Q by comparing this structure with other conceptually competing structures. The measurement model suggested that distinct, yet related aspects of the coach–athlete relationship existed. The poor fit of the first-order one-factor model demonstrated that the nature of the coach–athlete relationship is not unidimensional. Equally, the poor fit of the first-order two-factor indicated that Closeness and Commitment should be better viewed as independent factors. Indeed, the coach–athlete relationship is best represented in either a first-order three-factor model or in a higher-order model in which the three factors are subsumed.

Both Studies 1 and 2 showed that the constructs of Closeness, Commitment, and Complementarity are associated with the variable of interpersonal satisfaction in a theoretically meaningful way, lending support to the predictive validity of the CART-Q. The findings on the reliability and validity of the CART-Q indicate that the measure can be used in research related to the coach–athlete relationship. In effect, the CART-Q is a brief, simple-to-use 11-item measure that reflects the affective (i.e., Closeness), cognitive (i.e., Commitment), and behavioral (i.e., Complementarity) aspects of the coach–athlete relationship. However, because the instrument is newly developed, it is crucial that researchers continue to test the psychometric properties when using the CART-Q. Specifically, tests of predictive validity are required to be carried out with a wide variety of outcome variables in order to provide further evidence of the predictive validity of the CART-Q. Predictive validity tests would offer a clearer delineation of an uncompromising model structure, as the present findings cannot clearly distinguish between the hierarchical model or the three first-order factor model. Although the hierarchical model is preferred on parsimony grounds, further research with additional outcome variables would provide evidence regarding which model structure is more appropriate. Test–retest reliability was not examined in the studies presented. Consequently, test–retest reliability is an important psychometric property that needs to be investigated in future research.

A plethora of research topics await investigation at methodological, conceptual, and practical levels. Methodologically, researchers have often used a person as the unit of analysis in studying socially skilled vs. unskilled persons and in studying how fathers and mothers soothed their infant children (see Kenny, 1988). Similarly, in the present studies coaches and athletes were used as the unit of analysis because separate analyses for coaches and athletes were not justifiable. Separate analyses would have been possible if the two samples were drawn independent of each other. Nevertheless, it is recommended that studies that aim to investigate dyads such as pairs of children, parent–child or coach–athlete should consider the dyad as the unit of analysis because it is likely that their scores are correlated and not independent. Kenny (1988, 1996) and colleagues (Kenny & Acitelli, 2001) have presented new approaches to the analysis of dyadic data that could be used to match the complexity that underline two-person relationships.

Moreover, an investigation into the structure of the CART-Q across potentially different types of samples is useful in empirically testing the assumption of invariance. A comparison between individual vs. team sports, combat vs. non-combat sports, male vs. female, typical vs. atypical relationships, and coaches vs. athletes, will provide evidence of the invariance of the CART-Q, or the need for modifying the instrument to meet the needs of the specific samples. In a similar vein, the method of invariance can also be used to determine equivalence of factor structure across time by employing longitudinal research designs. An examination of the factor structure of the CART-Q in the early and later developmental stages of the athletic relationship may uncover equivalence and/or interesting patterns. Duda & Hayashi (1998) cautioned that instruments developed in a specific cultural context should not be uncritically employed in different cultures. Thus, researchers are advised to investigate the factor structure, and hence applicability of the CART-Q in other cultural groups (see Jowett & Ntoumanis, in press). Such comparative studies are important in developing a theoretical framework of the coach–athlete relationship that is comprehensive and applicable to different cultural contexts.

The definition of the coach–athlete relationship states that a coach's and an athlete's emotions, thoughts, and behaviors are causally interconnected. Thus, it will be of conceptual interest to examine the manner and degree to which coaches' and athletes' Closeness, Commitment, and Complementarity are causally related with one another. It is also important to examine antecedents (e.g., communication) and outcomes (e.g., performance), as well as moderating and mediating variables of the

coach–athlete relationship. A sample of research questions that await exploration include, does the nature of coach–athlete relationship affect the manner in which the motivational climate is perceived or vice versa? Does the coach–athlete relationship affect, or is it affected by coaches' and athletes' motivational and confidence levels? What are the predictors of effective coach–athlete relationships? Under what conditions can the coach–athlete relationships influence performance, dropout, attrition, and burnout? The CART-Q comes at a time where the coach–athlete relationship has been identified as an important future research area for sport psychology (Vanden Auweele & Rzewnicki, 2000). The CART-Q provides an opportunity to pursue research questions that would promote knowledge and understanding of the complex dynamics involved between athletes and coaches from a relationship perspective. It could also contribute to the development of interventions for enhancing the quality of this athletic relationship and its associated outcomes (e.g., motivation, performance, well-being).

Perspectives

The study presented provides a scientific delineation of the coach–athlete relationship and an instrumentation to measure its nature. Future research in this area would permit the development of a credible information depository about coach–athlete relationships and relationship issues that impact on performance accomplishments, success, and satisfaction. Practically, by identifying what makes an effective coach–athlete relationship, coach education programmes can be developed and codes of conduct devised that can be implemented by National Governing Sport Bodies.

Key words: coach–athlete relationship, scale development, validation

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