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Cohesion, team mental models, and collective efficacy: towards an integrated framework of team dynamics in sport

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Cohesion, Team Mental Models, and Collective Efficacy: Towards an Integrated Framework of Team Dynamics in Sport

Abstract

A nomological network on team dynamics in sports consisting of a multi-framework perspective is introduced and tested. The aim was to explore the interrelationship among cohesion, team mental models (TMM), collective-efficacy (CE), and perceived performance potential (PPP). Three hundred and forty college-aged soccer players representing 17 different teams (8 female and 9 male) participated in the study. They responded to surveys on team cohesion, TMM, CE and PPP. Results are congruent with the theoretical conceptualization of a parsimonious view of team dynamics in sports. Specifically, cohesion was found to be an exogenous variable predicting both TMM and CE beliefs. TMM and CE were correlated and predicted PPP, which in turn accounted for 59% of the variance of objective performance scores as measured by teams' season record. From a theoretical standpoint, findings resulted in a parsimonious view of team dynamics, which may represent an initial step towards clarifying the epistemological roots and nomological network of various team-level properties. From an applied standpoint, results suggest that team expertise starts with the establishment of team cohesion. Following the establishment of cohesiveness, teammates are able to advance team-related schemas and a collective sense of confidence. Limitations and key directions for future research are outlined.

Keywords: team dynamics, cohesion, team mental models, collective efficacy, nomological network.

Cohesion, Team Mental Models, and Collective Efficacy: Towards an Integrated Framework of Team Dynamics in Sport

Theoretical and empirical evidence supports the notion that cohesion, team mental models (TMM), and collective efficacy (CE) are positively associated with team performance (Fiore, Salas, Cuevas, & Bowers, 2003; Mohammed, Ferzandi, & Hamilton, 2010). However, scarce evidence exists on how these team level attributes are interrelated (Bandura, 1997; Ward & Eccles, 2006). Specifically, a parsimonious nomological network involving these variables has not been tested yet (see Bandura 1997; Carron & Hausenblas, 1998; Eccles & Tenenbaum, 2007; Klimoski & Mohammed, 1994; Mohammed et al., 2010; Salas, Sims, & Burke, 2005). The present study revolves around this long standing research question, and aims at testing the notion of integrating main concepts of team dynamics into a multimodal yet parsimonious model. The aim was to propose and test an integrated view of team dynamics in sports. The organization framework for examining sport teams first proposed by Carron and Hausenblas (1998) served as an initial base to integrate cohesion, TMM, and CE under the same "meta-conceptual umbrella" (see Figure 1). Leading frameworks on cohesion (Carron, Widmeyer, & Brawley, 1985), TMM (TMM; Eccles & Tenenbaum, 2007), and CE (CE; Bandura, 1997) were considered in light of current evidence on team dynamics in sport psychology (Myers, Paiement, & Feltz, 2007; Ward & Eccles, 2006).

Team cohesion is a multidimensional phenomenon that includes both social and task components at an individual and team level of analysis (Carron et al., 1985). Social cohesion pertains to the notion of teammates bonding for social reasons, thus reflecting the extent that members of a team like to interact and enjoy each other's company. Task cohesion refers to the degree that members of a team bond to work together on a task, thus remaining united to achieve shared performance related goals. The notions of task and social cohesion are at the core of the *conceptual model of group cohesion* proposed by Carron et al. (1985), which is an important part of research on group dynamics in sport psychology (Carron & Eys, 2012), and has been incorporated in the nomological network of team dynamics proposed herein.

Of particular importance to this study is the notion that team cohesion is related to other team-level constructs, such as TMM and CE (Eccles & Tenenbaum, 2007; Fiore et al., 2003). In particular, we conceptualized team cohesion as an antecedent variable of team processes (e.g., TMM). To this extent, there is a general agreement that shared goals and a sense of social support and accountability antecedes the development of team related knowledge (Arrow, Poole, Henry, Wheelan, & Moreland, 2004). This is also congruent with both theoretical reasoning and empirical findings suggesting that teammates' social and task beliefs are essential to the development of TMM (Carron & Hausenblas, 1998; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000).

TMM refer to the "collective task and team-relevant knowledge that team members bring to a situation" (Cooke et al., 2003, p. 153). TMM is thought to provide a heuristic route (i.e., rule of thumb) to members of a given team, thus accelerating teamwork coordination and optimizing team decision-making (Salas & Klein, 2001). Accordingly, TMM is a multi-factorial phenomenon composed by declarative (i.e., "what to do"), procedural (i.e., "how to do"), and strategic information (i.e., macro-level knowledge; general game plan). Furthermore, teammates must possess and share both individual task-specific knowledge (i.e., idiosyncratic knowledge held by individual team members) and team-related knowledge (i.e., collective understanding of team procedures, strategies and contingency plans) in order to facilitate team coordination and performance (Filho, Gershgoren, Basevitch, Schinke, & Tenenbaum, 2014; Klimoski &

Mohammed, 1994; Mohammed et al., 2010). Finally, TMM relies on coordinated division of labor, which is primarily developed via implicit and explicit communication channels (Eccles & Tenenbaum, 2007; Lausic, Tenenbaum, Eccles, Jeong, & Johnson, 2009).

TMM is at the core of the framework adapted from Carron and Hausenblas (1998), and proposed herein. More specifically, TMM is conceptualized as being endogenous to cohesion and exogenous to CE. To this extent, Bandura (1997) noted that CE is influenced by a myriad of team level attributes, such as cohesion and team-related knowledge. This is also consistent with the view that TMM is a process variable, which evolves over time and influences teammates' CE beliefs (Eccles & Tenenbaum, 2007; Eccles, 2010). Finally, this linkage is congruent with the notion that teammates possessing more refined implicit and explicit coordination mechanisms are more likely to evolve enduring efficacy beliefs (Mathieu et al., 2000; Peterson, Mitchell, Thompson, & Burr, 2000; Salas et al., 2005).

Defined as a "group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainment" (Bandura 1997, p. 4), CE is thought to be based on the same antecedents of self-efficacy, and is considered to mediate between TMM and Perceived Performance Potential (PPP). To this extent, CE is theoretically seen as a variable with predictive power over team performance (Bandura, 1997; Edmonds et al., 2009; Feltz, Short, & Sullivan, 2008; Myers, Payment, & Feltz, 2004). The notion of PPP, which is correlated with objective performance scores as a reliability check, reflects a probabilistic rather than deterministic view of performance in working groups in general, and in sport in particular (Kamata, Tenenbaum, & Hanin, 2002; Stumpf, Doh, & Tymon, 2010). Foremost, this notion is congruent with the self-reported measures utilized in the current study.

The model proposed herein is based on Carron and Hausenblas (1998) organizational framework of team dynamics in sports (see Figure 1). Nonetheless, certain aspects of the *group structure* were not included in the model but indirectly measured through the consideration of member attributes (i.e., demographic factors, such as mean age, gender, players' nationality) pertaining to the participants and their teams. *Individual products* were not considered here because the focus was at the team-level of analysis. Leadership and environmental factors, which have been associated with group dynamics in sport (Carron & Eys, 2012), were also beyond the scope of the present study, which was centered on integrating cohesion, TMM and CE using structural equation modeling techniques. Accordingly, from a path-analytical perspective, this model postulates that (a) cohesion is an antecedent variable of TMM, and (b) TMM mediates the relationship between cohesion and CE, and (c) CE predicts PPP. In addition to being grounded in the seminal conceptualization of team dynamics in sports proposed by Carron and Hausenblas (1998), these directional paths are aligned with extant research suggesting that (a) team cohesion, TMM, and CE are intrinsically related constructs (Feltz et al., 2008; Mohammed et al., 2010), and (b) CE beliefs evolve once a sense of "team" has been established, and have a positive effect on performance (Bandura, 1997; Myers et al., 2004; Zaccaro et al., 1995).

From a factor analysis standpoint, the proposed model considers leading instruments designed to measure cohesion, TMM and CE. Also, we aimed for a parsimonious model with non-overlapping factors. Accordingly, we focused on measuring only the *unique factorial contributions* representing cohesion, TMM, and CE. In other words, potentially overlapping factors among the instruments utilized in this study were not considered. In particular, two sub-dimensions of TMM (i.e., General Task and Team Knowledge, Attitude Towards Teammate Task) as measured by the Team Assessment Diagnostic Measure (see Johnson et al., 2007) and one sub-dimension of CE (i.e., Team Unity) as measured by the Collective Efficacy Questionnaire for Sports (see Short, Sullivan, & Feltz, 2005), were not included in the model. To this extent, a pilot study indicated statistical overlapping among these factors and cohesion scores as measured by the Group Environment Questionnaire (see Carron et al., 1985). Furthermore, peer-debriefing meetings among the authors led to a unanimous agreement regarding the “conceptual equivalence” of the aforementioned factors. Hence, in the proposed model cohesion portrays the idea of “team bonding,” whereas TMM reflects the notion of “coordination links” (i.e., synchronized action or effort among teammates during moments of action) (see Eccles & Tenenbaum, 2007). In essence, cohesion was conceptualized as having social and task dimensions at both individual and group levels of analysis. TMM was thought to reflect teammates’ (a) coordination links, (b) communication dynamics, and (c) resource sharing. Finally, congruent with its theoretical roots, CE was thought to represent teammates’ perceived “capability” of (a) ability, (b) effort, (c) persistence, and (d) preparation.

Altogether, our aim was to explore how various team properties are interrelated in a factorial and structural fashion. Specifically, our aim was to propose and empirically test, through structural equation modeling analyses, a nomological network of team dynamics in sports as related to cohesion, TMM and CE. We also examined the intra and inter team variability in cohesion, TMM, and CE scores of college soccer teams. This is in line with the importance of properly examining nested data in social sciences in general, and in sport and exercise psychology in particular (Feltz et al., 2008; Hershberger, 2006). Informing from the reviewed literature, we hypothesized that: (a) the proposed model would adequately fit the data, thereby supporting a parsimonious integrated view of team dynamics in sports, as related to cohesion, TMM and CE; and (b) path coefficients would vary by gender as men's and women's group behaviors and beliefs tend to differ.

Method

Participants

An a priori power analysis was conceptualized to reflect the minimum number of cases needed to propose and test a statistically valid model. Therefore, this analysis conducted for testing model fit as a whole (i.e., $\Sigma=\Sigma(\theta)$; power = .80, α = .05, RMSEA = .00 for null hypothesis, and RMSEA = .05 for alternative hypothesis) defined the target sample size ($n \geq 214$). Three hundred and forty college soccer players (178 females and 162 males) representing 17 different teams affiliated with the National Association of Intercollegiate Athletics participated in the study. The 17 teams were from 9 different states across the country and had a mean of 20 athletes per team (*SD* = 3.48). Participants were 20.38 years old on average (*SD* = 2.12), and had 14.66 years (*SD* = 3.92) of experience in soccer. On average, the participants had been playing for their respective teams for 2.40 years (*SD* = 1.11). They had played a median of 20 matches (*M* = 19.70, *SD* = 1.39) over the season before taking part in the study. The majority of participants were Caucasians (70.62%), followed by "other races" (15.28%), Black/Afro-Americans (6.67%), and Hispanic/Latinos (4.23%).

Instruments

A demographic form was utilized to collect normative data. Additionally, the primary choices of sport psychologists for studying cohesion (i.e., The Group Environment Questionnaire) and CE (i.e., Collective Efficacy Questionnaire for Sports) were utilized. TMM scores were assessed through the Team Assessment Diagnostic Measure (TADM) and PPP was measured through the Team Outcome Questionnaire (TOQ). Objective performance scores were obtained from the National Association of Intercollegiate Athletics' official website.

Group Environment Questionnaire (GEQ; Carron et al., 1985). The Group Environment Questionnaire is an 18-item measure, with anchors ranging from 1 (i.e., *strongly disagree*) to 9 (i.e., *strongly agree*) with higher scores reflecting greater perceptions of cohesion. Specifically, the Group Environment Questionnaire was designed to assess the degree of cohesion among team members in the following four dimensions: (a) Individual Attraction to the Group-Social (ATG-S, 5 items; e.g., "Some of my best friends are on this team."), (b) Individual Attraction to the Group-Task (ATG-T, 4 items; e.g., "I like the style of play on this team."), (c) Group Integration-Social (GI-S, 4 items; e.g., "Our team would like to spend time together in the off-season."), and (d) Group Integration-Task (GI-T, 5 items; e.g., "Our team is united in trying to reach its performance goals."). Carron, Brawley, and Widmeyer (1998) reported that Cronbach alphas for the four hypothetical dimensions of the Group Environment Questionnaire are for the most part satisfactory (i.e., $\alpha \geq .70$). They also reported extensive data suggesting the content, concurrent and predictive validities of the Group Environment Questionnaire. In this study, we used the original Group Environment Questionnaire by Carron et al. (1985), reversing the negatively worded items before computing the Cronbach alpha coefficient, which ranged from .56 to .75. The entire scale's alpha reliability was .85.

Team Assessment Diagnostic Measure (TADM; Johnson et al., 2007). The Team Assessment Diagnostic Measure was designed to measure sharedness of team-related knowledge, thereby focusing on assessing similarity, rather than accuracy, of teammates perceived TMM. This 15-item questionnaire, with anchors ranging from 1 (i.e., *strongly disagree*) to 5 (i.e., *strongly agree*), was conceptualized to assess latent shared mental states (through its perceived functional roles) according to the following five factors: (a) General Task and Team Knowledge (GTTK, 3 items; e.g., “My team knows specific strategies for completing various goals.”), (b) General Task and Communication Skills (GTC, 3 items; e.g., “My team consistently demonstrates effective listening skills.”), (c) Attitudes Toward Teammates and Task (GTT, 3 items; e.g., “My team takes pride in our work.”), (d) Team Dynamics and Interactions (TDI, 3 items; e.g., “My team solves problems that occur while doing our tasks.”), and (e) Team Resources and Working Environment (TRWE, 3 items; e.g., “My team knows the environmental constraints when we perform our tasks.”). These factors were found to have satisfactory reliability coefficients (i.e., $\alpha \geq .75$) and to account for 82% of the variance on sharedness of team-related knowledge (Johnson et al., 2007). Only General Task and Communication Skills, Team Dynamics and Interactions, and Team Resources and Working Environment were included in the proposed model. In this study, Cronbach alpha coefficients ranged from .77 to .84, and the entire scale’s alpha reliability was .91.

Collective Efficacy Questionnaire for Sports (Collective Efficacy Questionnaire for Sports; Short et al., 2005). This instrument was designed to capture team member’s beliefs regarding their team capabilities in sport relevant tasks. Specifically, the Collective Efficacy Questionnaire for Sports is a 5-factor instrument containing 20 items measuring athletes’ confidence levels in their team’s (a) ability (4 items; e.g., “ability to outplay their opponents”), (b) effort (4 items; e.g., “to show a strong work ethic”), (c) preparation (4 items; e.g., “to devise a successful strategy”), (d) persistence (4 items; e.g., “to be persistent when obstacles are present”), and (e) unity capabilities (4 items; e.g., “to resolve conflicts”), on a Likert-type scale ranging from 1 (i.e., not at all confident) to 10 (i.e., extremely confident). “Unity” was not considered in the proposed model given that its items are similar to the ones measured by the

Group Environment Questionnaire. Short et al. (2005) reported data demonstrating satisfactory reliability, discriminant, convergent and predictive validity scores for the Collective Efficacy Questionnaire for Sports. In the current study, Cronbach alpha coefficient ranged from .83 to .89, and the entire scale's alpha reliability was .95.

Team Outcome Questionnaire (TOQ; Coleman, 2011). The Team Outcome Questionnaire was utilized to assess perceived performance potential (PPP), which is a subjective account of a team's performance from the perspective of a team member. More specifically, PPP is a cross-domain topic pertaining to performance of working teams in business, sports, and the military (Stumpf et al., 2010). The Team Outcome Questionnaire consists of 9 items that describe goals related to team skills, strategy, effort, competitive outcomes, and fitness (e.g., "My team potential to accumulate its potential amount of victories."). The Team Outcome Questionnaire uses a Likert-type scale ranging from 0 (i.e., *low expectations*) to 4 (i.e., *high expectations*) to measure PPP in team sports. Initially based on a content analysis of team performance expectations (see Brawley, Carron, & Widmeyer 1992), the Team Outcome Questionnaire was found to be a unidimensional scale accounting for approximately 55% of the variability on team performance expectation. In this study, Cronbach alpha coefficient was .89.

The notion of PPP was utilized in terms of coherence, given that all other constructs (i.e., cohesion, TMM and CE) were based on self-reported measures. In this regard, Chelladurai (2007) posited that subjective reports may better represent athletes' performance experiences. Purely objective scores do not account for an outstanding performance from the opposing team, referee mistakes, among other situational and environmental factors (e.g., bad weather, home advantage, injury).

Objective performance. All teams' final year ranking and season record (i.e., average points per game as measured by the number of wins representing 3 points, ties representing 1 point, and losses representing 0 points) were obtained from the National Association of Intercollegiate Athletics official website and correlated with Team Outcome Questionnaire scores to assess the criterion-related validity of this instrument.

Procedures

Institutional Review Board approval was obtained prior to the commencement of this study. College soccer coaches, affiliated with the National Association of Intercollegiate Athletics, received an email detailing the objectives of the project. Telephone calls and personal contacts were posteriorly arranged aiming to build rapport with the coaches. A pool of 44 coaches (all representing teams in the regional and national finals), was initially contacted, with 17 agreeing to participate in the study. Upon permission from the coaches, a time was scheduled to meet their respective players. The players were informed about the overarching theme of the study and asked to sign the written informed consent. Following the completion of the consent form, participants received a package containing a copy of the Group Environment Questionnaire, Team Assessment Diagnostic Measure, Collective Efficacy Questionnaire for Sports, Team Outcome Questionnaire, and the demographic information form. Questionnaires were presented in a randomized order in an attempt to control for learning and motivational effects. Participants were instructed to complete each questionnaire individually, and to be honest and serious in their responses. They received an envelope to confidentially return their responses upon completion. The questionnaires were administered in a quiet environment (i.e., meeting rooms) to secure the comfort and privacy of the participants. Coaches did not remain in the room during data collection. Data were collected at the end of the season. Participants had played a median of 20 matches (M = 19.7, SD = 1.39) over the season before taking part in the study. Moreover, data was deliberately collected one day before a decisive playoff game at the national tournament as teammates' beliefs assessed prior to competition have been found to reliably predict team performance (Myers, et al., 2007).

Results

Demographic Analyses

Demographic analyses indicated expressive nationality and ethnic diversity among the teams surveyed (i.e., 33.2% international student-athletes). Starters were more likely to report higher levels of "attraction to group task" as measured by the Group Environment Questionnaire, and women's soccer teams showed a higher proportion of offensive players than male soccer teams (♀28.2% vs. ♂16.8%; $\chi 2 = 25.41$ $df = 3$, $p < .01$).

Psychometric Analyses

Reliability Analyses. Descriptive statistics and estimates of internal consistency reliability are presented in Table 1. Overall, means across items were above the 70th percentile for each subscale. The reliability coefficient obtained for each scale was adequate (i.e., $\alpha \geq .85$). The alphas for the subscales ranged between .56 - .75 for the Group Environment Questionnaire, .77 - .84 for the Team Assessment Diagnostic Measure, and .83 - .89 for the Collective Efficacy Questionnaire for Sports. Item 17 (i.e., "Overcome distractions") and 19 (i.e., "Devise a successful strategy") were excluded from the Collective Efficacy Questionnaire for Sports questionnaire due to a small correlation with the other items represented in the "Effort" and "Preparation" subscales, respectively. Alpha coefficients for the Group Environment Questionnaire subscales were not ideal, particularly for the Attraction to Group Task (.56) and Attraction to Group Social (.63). These two subscales were excluded from the model proposed herein (see Figure 2). This is congruent with different interpretations of the Group Environment Questionnaire, in which the instrument was found to assess two, and not four, latent factors (Carless & De Paola, 2000; Schutz et al., 1994). The maintenance of GI-T and GI-S in the model proposed herein is (a) congruent with the overarching theoretical notion of *social* and *task* cohesion, and (b) representative of participants' *group* views of cohesion.

Correlational Analyses. Correlation coefficients among the Team Outcome Questionnaire and objective performance measures were positive and moderate- to-high, hence supporting the predictive validity of this instrument. Specifically, Team Outcome Questionnaire and team season record showed a $r = .77$ ($R^2 = .59$), whereas Team Outcome Questionnaire and the National Association of Intercollegiate Athletics's final ranking correlated positively with a $r = .55$ ($R^2 = .30$). Correlation coefficients among Group Environment Questionnaire, Collective Efficacy Questionnaire for Sports, Team Assessment Diagnostic Measure, and Team Outcome Questionnaire composite scores ranged from .51 to .71. Overall, correlation coefficients were higher among the subscales of each instrument, but relatively lower between subscales measuring different constructs. Specifically, the correlations ranged from .35 - .62 for the Group Environment Questionnaire and Team Assessment Diagnostic Measure, .29 - .62 for the Group Environment Questionnaire and Collective Efficacy Questionnaire for Sports, and .36 - .66 for the Team Assessment Diagnostic Measure and Collective Efficacy Questionnaire for Sports. Correlations for the Team Outcome Questionnaire ranged from .31 - .54 with the Group Environment Questionnaire, .53 - .56 with the Team Assessment Diagnostic Measure, and .53 - .61 with the Collective Efficacy Questionnaire for Sports (see Table 2). Altogether, these findings support the notion that cohesion, TMM, CE and PPP are interrelated but not identical constructs, thereby warranting the examination of the nomological network proposed herein.

Multi-Level Assessment. Intraclass correlation coefficients were computed for each subscale included in further analyses. Table 1 shows intraclass correlation coefficients for each variable, ranging from .10 (for Persistence) to .32 (for GI-S) with the majority of the values lower than .20. Collectively, these results warranted the adoption of multi-level analysis (see Hershberger, 2006). We thus applied multi-level structural equation modeling techniques to the sample data following the stepwise procedure recommended by Stapleton (2006). The analyses were conducted using M*plus* 7. Stapleton (2006) suggested that the multi-level structural equation modeling should start with the model labeled as *maximal model,* which consists of two levels (i.e., between and within levels). At both levels, all pairs of variables are correlated with each other, as the purpose of this model is to decompose the observed covariance matrix into two components: (a) the covariance matrix for the between level, and (b) the covariance matrix for the within level. The maximal model did not converge to solutions, as the between level covariance matrix was not found to be positively definite. In addition, most of the estimated covariances among the variables at the between level were not statistically significant at alpha level of .05. This is likely due to the small sample size for the between level (i.e., 17 teams) and due to the homogeneity of the sampled teams (i.e., all teams participated in the national playoff finals). Specifically, when the sample size for the between level is small (< 100) and homogenous, the model tends to encounter convergence problems and the standard errors of the between level parameters tend to be equally small (Maas & Hox, 2005). Given that the *maximal model* did not converge to proper solutions, we were unable to continue with the multi-level SEM analysis. Instead, further data modelling were conducted based on single-level analysis.

Structural Equation Modeling

A two-step approach was utilized to test the fit of the hypothesized full structural model (see Kline, 2011). The first step consisted of evaluating the measurement model. The second step consisted of evaluating and revising the structural model. Although continuous data were utilized in this study (i.e., the average of scores across the set of items composing the Group Environment Questionnaire, Team Assessment Diagnostic Measure, Collective Efficacy Questionnaire for Sports, and Team Outcome Questionnaire subscales), visual inspection of Q-Q plots suggested the data were not normally distributed. Multivariate kurtosis was 17.84 with $p <$ .01. We thus applied robust maximum likelihood estimation method for SEM analysis using Satorra-Bentler (S-B) correction for non-normality (Kline, 2011). In all tested models, the error variance of PPP was fixed as zero because this construct has only one indicator. Chi-square with S-B correction (χ^2_{S-B} with non-significance indicating good fit), comparative fit index (CFI $\geq$ .95 indicating good fit), root mean square error approximation (RMSEA $\leq$ .08 indicating good fit), standardized root mean square residual (SRMR $\leq$ .06 indicating good fit), and weighted root mean square residual (*WRMR* $\leq$ 1 indicating good fit) were used to evaluate model-fit (Kline, 2011).

Measurement model. The measurement model associated with the hypothesized full structural model is presented in Figure 2. The tested model allowed for 30 degrees of freedom, with $\chi 2$ (30) = 55.14, $p < .01$, S-B correction factor of 1.21, *CFI* = .986, *RMSEA* = .050, *SRMR* = .026, and *WRMR* = .505. Except $\chi 2$, which is influenced by sample size, these results suggested reasonable model-data fit. Standardized factor loadings were significant and moderate-to-high ranging from .67 to .91. Modification indices did not suggest any theoretical or statistically meaningful adjustments. Hence, this model was considered the final measurement model.

Hypothesized structural model. The tested model (Structural Model 1) allowed for 33 degrees of freedom with χ^2 (33) = 122.83, p < .01, a S-B correction factor of 1.24, *CFI* = .950, *RMSEA* = .089, *SRMR* = .063, and *WRMR* = 1.292 (see Table 3). This model did not fit adequately to the data. Modification indices and theoretical meaning were considered in proposing the revised structural model. In particular, two structural changes, one at a time, were added to the revised structural models. First, a direct effect from cohesion to CE was added. This is congruent with empirical and theoretical evidence suggesting that cohesion scores predict CE beliefs in team sports (Bandura 1997; Heuzé, Sarrazin, Masiero, Raimbault, & Thomas, 2006). Second, a direct link between TMM and PPP was also added in an attempt to improve overall model fit. This modification is congruent with empirical findings regarding the overall positive impact of TMM on team outcomes (Mathieu et al., 2000; Mohammed et al., 2010).

Revised structural models. This revised structural model with a direct effect from cohesion to CE (Structural Model 2) allowed for 32 degrees of freedom, with χ^2 (32) = 71.75, p < .01, a S-B correction factor of 1.21, *CFI* = .978, *RMSEA* = .060, *SRMR* = .033, and *WRMR* = .611. The revised structural model with both the direct effect from cohesion to CE and the direct effect from TMM to PPP (Structural Model 3) had 31 degrees of freedom, with χ^2 (31) = 55.79, p < .01, a S-B correction factor of 1.20, *CFI* = .986, *RMSEA* = .048, *SRMR* = .026, and *WRMR* = .502. Both models demonstrated adequate fit. A χ^2 difference ($\Delta\chi^2$) test was conducted to evaluate their relative fit. The $\Delta\chi^2(1) = 13.07$, p < .01, suggesting that Model 3 fit significantly better than Model 2. Furthermore, a χ^2 difference test was performed between Structural Model 3 and the measurement model with $\Delta\chi^2(1) = 0.25$, p >.05. This result indicated that Structural Model 3 did not demonstrate a significantly worse fit to the data when compared to the measurement model, and that its structural component fit the data well. Standardized factor loadings were moderate-to-high and ranged from .68 to .90. The standardized coefficients connecting factors were also moderate-to-high and ranged from .27 to .76. Modification indices did not suggest any statistically meaningful adjustments. Given that this model represented a plausible nomological network of team sports, the next step consisted of testing for alternative statistical models. This is congruent with the importance of considering alternative explanations for the data set, particularly in cross-sectional study designs (Hershberger, 2006).

Alternative Models. Alternative models are models with different specifications but yielding similar fit (Hershberger, 2006). Such models provide alternatively meaningful explanations for the inter-correlation among the latent factors considered in this study. Numerous exploratory analyses of other theoretically plausible models, such as testing a correlational link between CE-PPP (i.e., *reciprocal determinism;* Bandura, 1997) or reversing the directional path (e.g., CE-TMM-CO), were conducted. However, no statistically reliable results were obtained. We thus tested an equivalent alternative model to the Structural Model 3 by replacing the direct effect from TMM to CE with the correlation between their disturbances. Accordingly, TMM and CE were hypothesized as sharing covariance rather than representing a sequential process. This alternative Model (Structural Model 4) yielded the same fit and factor loadings as Structural Model 3, with 31 degrees of freedom, χ^2 (31) = 55.79, $p < .01$, a S-B correction factor of 1.20, *CFI* = .986, *RMSEA* = .048, *SRMR* = .026, and *WRMR* = .502. Noteworthy, we opted for Structural Model 4 as the final solution. This model is in agreement with the overarching notion that team-level properties tend to be functionally co-dependent, thus mutually influencing each other (Bandura, 1997; Klimoski & Mohammed, 1994). In effect, there is theoretical and empirical evidence suggesting that more confident group units are more likely to possess elaborate information sharing systems and vice-versa (Bandura, 1997; Little & Madigan, 1997).

Accordingly, Structural Model 4 was considered final (see Figure 2), hence supporting the concept of a parsimonious nomological network of team dynamics in sports. In particular, this model is grounded in the notion that (a) cohesion predicts TMM coordination links and CE efficacy beliefs, and (b) TMM and CE are correlated, mediate the CO-PPP relationship, and have a direct impact of moderate magnitude on PPP. Total variance accounted for TMM, CE and PPP was 58%, 78%, and 47%, respectively.

Multiple-Sample Analyses

Measurement models by gender. A multiple-sample SEM was employed to test for gender invariance based on the Structural Model 4. Idiosyncratic models by gender yielded different but reasonable fit indices (Table 3). In particular, the measurement model for both females and males allowed for 30 degrees of freedom. For the female group, χ^2 (30) = 50.40, p = .01, a S-B correction factor of 1.17, *CFI* = .980, *RMSEA* = .062, *SRMR* = .033, and *WRMR* = .545. For the male group, χ^2 (30) = 42.66, p = .06, a S-B correction factor of 1.20, *CFI* = .985, *RMSEA* = .051, *SRMR* = .030, and *WRMR* = .375. Given that both models demonstrated reasonable fit, additional constrained models were considered to test for measurement and structural invariance across genders.

Unconstrained measurement model. In the first step of the multiple-sample analysis an unconstrained model was examined. This model allowed for 60 degrees of freedom, with χ^2 (60) = 92.94, $p < .01$, a S-B correction factor of 1.18, *CFI* = .982, *RMSEA* = .057, and *SRMR* = .032, and *WRMR* = .472. Taken together, these fit indices indicated adequate fit. Thus, the constrained measurement model was analyzed in the next step.

Constrained measurement model. The second step of the analysis involved a constrained model in which the factor loadings were equalized across groups. This model demonstrated reasonable fit, with χ^2 (66) = 95.01, p = .01, a S-B correction factor of 1.20, *CFI* = .984, *RMSEA* = .051, *SRMR* = .036, and *WRMR* = .524. A χ^2 difference test revealed a non-significant increase in chi-square when compared to the unconstrained measurement model, $\Delta\chi^2$ (6) = 3.10, p > .05. Accordingly, there was evidence of metric invariance (i.e., factor loadings invariance) across genders. Next, the tenability of equal structural coefficients (i.e., coefficients among factors) across groups was tested.

Unconstrained structural model. The measurement component of the unconstrained structural model was the same as that in the constrained measurement model. The path coefficients connecting factors were freely estimated for both groups. This model demonstrated adequate fit with χ^2 (68) = 95.91, p = .01, a S-B correction factor of 1.19, *CFI* = .985, *RMSEA* = .049, *SRMR* = .036, and *WRMR* = .518. This model did not fit significantly worse than the constrained measurement model with $\Delta\chi^2$ (2) = .14, p > .05. Thus, a constrained structural model to test for the equality of structural coefficients was analyzed in the next step.

Constrained structural model. This model was the same as the unconstrained structural model except that the five path coefficients connecting factors were constrained to be equal across groups. This model also fit the data reasonably with χ^2 (73) = 105.26, p < .01, a S-B correction factor of 1.20, *CFI* = .982, *RMSEA* = .051, *SRMR* = .056, and *WRMR* =.753. A χ^2 difference test revealed a non-significant change in chi-square when compared to the constrained measurement model, $\Delta\chi^2$ (7) = 10.25, p >.05. Likewise, this model did not fit significantly worse than the unconstrained structural model, χ^2 (5) = 9.11, p > .05. Altogether therefore, there was evidence of measurement and structural invariance across genders. The parameter estimates for the constrained structural model are given in Figure 2.

Discussion

A nomological network of team dynamics considering cohesion, TMM and CE was proposed and tested. Overall, findings support the factorial and conceptual validities of an integrated framework of team dynamics in sport. Results also revealed expressive nationality diversity among the soccer teams surveyed, thereby reinforcing the importance of studies addressing multiculturalism in team sports. Demographic analyses also revealed that starters reported a higher level of “attraction to group task” as measured by the Group Environment Questionnaire. Starters are probably clearer of their roles than non-starters as playing time offer opportunities to evolve task-related knowledge (Eccles & Tenenbaum, 2007). The lack of effect of other demographic factors on cohesion, TMM, CE, and PPP scores may be linked to the homogeneity of the sampled population. The majority of the teams (n = 12) were in the top-16 in the country, and the remaining teams (n = 5) were region finalists.

The observation of moderate to high correlation coefficients among sub-factors of cohesion, TMM, and CE offered initial validation to the nomological network of team dynamics in sports proposed herein. The measurement model obtained is congruent with the organizational framework for examining sport teams offered by Carron and Hausenblas (1998). The final modified Structural Model 4 allowed adequate model fit by incorporating the notion that both TMM and CE have a direct impact on PPP. This final model (i.e., Structural Model 4) supports the notion of a parsimonious nomological network of team dynamics in sports, as related to cohesion, TMM and CE.

The theoretical view of team dynamics in sports presented herein is consistent with an extensive body of literature on the predictive power of task-shared knowledge and CE on performance measures (Fiore et al., 2003; Salas & Klein, 2001; Bandura, 1997). Additionally, this final model reflects the notion that cohesion antecedes team processes (e.g., TMM, CE), thereby lending support for Carron and Hausenblas' (1998) conceptualization of team dynamics in sports. Indeed, research has consistently shown that teammates' agreement on social and task-related behaviors may antecede the development of team mental "schemas" and group-level confidence (Mathieu et al., 2000). To this extent, Eccles and Tenenbaum (2007) posited that the allocation of social and task responsibilities antecede the development of implicit and explicit processes in sport teams. Empirical evidence is also in favor of the notion that cohesion scores predict CE beliefs in team sports (Heuzé et al., 2006).

The final model illustrated in Figure 2 is also congruent with the notion that CE is influenced by a myriad of other team-level attributes (Bandura 1997; Zacarro et al., 1995). In particular, CE beliefs were found to be anteceded by cohesion scores and correlated with TMM scores. In this regard, Bandura (1997) posited that cohesion is a major source of CE, which is also associated with socio-cognitive variables, such as TMM. In this regard, Bandura (1997) posited that cohesion is a major source of CE, which is also associated with socio-cognitive variables, such as TMM. Hence, training sessions tailored to evolve team coordination and communications links are likely to enhance a team's efficacy beliefs while also impacting team performance.

Theoretically, the parsimonious view of team dynamics proposed herein may represent an initial step towards clarifying the epistemological and nomological network roots of various team-level properties. Theoretical models in sport sciences should focus on clarifying (conceptually and statistically) the unique factorial contributions of its underlying latent factors. For instance, the model proposed herein is statistically valid and supports the tested notion that TMM is represented by *coordination*, *communication*, and *team's resources* networking. This may be seen as an initial step towards clarifying the unique antecedents of TMM - where the epistemological traits and anteceding variables are not yet clear (Cooke et al., 2003; Johnson et al., 2007). More specifically, different authors have proposed numerous conceptual frameworks describing hypothetical variables underlying the notion of TMM. Although conceptually appealing, these frameworks are primarily based on face-validity, thereby lacking statistical corroboration (Klimoski & Mohammed, 1994; Mohamed et al., 2010; Salas et al., 2005). Future studies should therefore expand the analysis of TMM in an attempt to establish the *unique* variables anteceding this group level phenomenon.

From an applied standpoint, findings from this study illustrate the importance of (a) investing in the development of team cohesion in sports as this team attribute antecedes TMM and CE, and (b) TMM to team performance and confidence. Accordingly, results suggest that team expertise starts with the establishment of positive social relations (social cohesion), and task cohesion (i.e., teammates sharing the same task goals). Specifically, the large effect size found for the cohesion-TMM and cohesion-CE relationships illustrates the importance of performance enhancement activities aimed at improving team cohesiveness. Following the establishment of cohesiveness levels, teammates are able to advance team-related schemas and a collective sense of confidence. Hence, activities promoting heuristic (e.g., implicit and explicit) communication links, and a “team belief” on its capability to accomplish outcomes are subsequent steps in evolving team expertise.

Team cohesion representing the initial stage of the proposed conceptual framework reinforces the importance of preventing social isolation and attachment problems in team sports (Carron et al., 1985; Carron & Eys, 2012). Low social cohesion may create negative affect and aggravate communication problems, thereby hindering the development of TMM. Similarly, low task cohesion may decrease members' contribution and perceived responsibility, thus resulting in lack of effort and inefficient coordination mechanisms (Eccles, 2010). Organizational and individual orientations aimed at preventing the development of "social cliques", along with the establishment of challenge goals and group-level productive norms, are important in building team cohesion (Carron & Eys, 2012).

The notion that TMM and CE are positively related is consistent with research findings on working groups' coordination links and efficacy beliefs (Mathieu et al., 2000; Peterson et al., 2000). For instance, Mathieu et al. (2000) found that communication breakdowns are less likely to happen in highly confident military units. Within the sport context, Lausic et al. (2009) observed that more successful teams possess more homogenous models of communicating emotional and action verbal and non-verbal messages. Hence, performance enhancement consultants should target vicarious and verbal persuasion techniques (e.g., video-analysis, motivational lectures) aiming at concomitantly addressing teammates' confidence beliefs and verbal and non-verbal communication skills.

Men's and women's soccer teams differed in their distribution of players by position. In particular, women's teams showed a higher proportion of offensive players than male teams. These differences warranted adoption of multiple-sample SEM procedures aimed at testing for gender invariance given that in team sports each position has different objectives and demands (Filho et al., 2014). Although presents results revealed measurement and structural invariance across genders, a further study addressing a more heterogeneous sample may reveal gender effects on team-level properties. Indeed, the analysis performed herein targeted the covariance structure only (i.e., loadings, path coefficients). Accordingly, it is plausible that males and females have a different means on the latent variables. Again, the athletes' surveyed represented the top performers in their conference, thereby a ceiling-effect on athletes' mental skills may have "masked" a gender effect on the nomological network proposed herein. Accordingly, it is likely that a future study may reveal a different interrelationship among cohesion-TMM-CE-PPP. For instance, CE may have a larger impact on PPP for women's soccer teams, whereas TMM may be better predictor of performance for men's soccer teams. In this regard, research has shown that males and females differ in their emphasis on task oriented behavior, as well as on their cohesiveness and collective efficacy dynamics (Chelladurai, 2007; Feltz et al., 2008; Schutz et al., 1994).

Caution is warranted in generalizing these findings to other interactive sports, competition levels, and different periods within a competitive season. Another limitation pertains to the non-inclusion of the interrelationship between coaches' leadership behaviors and team cohesion in sports. Coaching leadership is a vast topic and has been extensively studied elsewhere (see Martens, 2004). Furthermore, the proposed model should be considered in terms of its theoretical roots (i.e., socio-cognition). For instance, models grounded in dynamic systems perspectives (e.g., eco-dynamical, course of action frameworks) may also represent valid interpretations of team dynamics. The adoption of the expert-novice paradigm may expose differences among "top" and "bottom" teams while also allowing the implementation of multilevel models. Again, our dataset was homogeneous in nature and ultimately reflected our target sample (i.e., top ranked teams). The reliance on modification indices moved the analysis from a confirmatory to (at least) partially exploratory standpoint. Therefore, other models may be plausible and longitudinal studies in particular, rather than cross-sectional, may offer alternative views on how cohesion, TMM and CE are inter-related and exogenous or endogenous to each other. Specifically, in the present cross-sectional study, all variables were measured (at the same time) at the end of the season, thus preventing the assessment of cyclical relationships (involving cohesion, TMM, CE, and PPP) likely to change over time. Despite these limitations, this study addressed a historically and scientifically pondered question of many leading scholars in the field of group dynamics. In fact, this study is aligned with the need for theory integration within the psychological domain (Gigerenzer, 2010). On this note, Waltkins (1984, p. 86) observed that “psychologists treat other people’s theories like toothbrushes – no self-respecting person wants to use anyone else’s”. Accordingly, the nomological network of team sports proposed herein may represent an *initial step* towards clarifying the epistemological and nomological network roots of various team-level properties. Finally, findings from this study also provide applied guidelines to evaluate and improve performance of highly interactive and complex team units.

Perhaps more importantly, this study leads to further questions on “how multiple minds work in synchrony” towards excellence and conflict resolution. Targeting different sub-population groups (e.g., competition levels, cross/multi-cultural studies) and conceptual roots (e.g., dynamic systems) may allow further revisions of parsimonious integrated models of team dynamics in sport psychology. Addressing different working groups (e.g., military units, medical teams) and considering models proposed in the I/O psychology may evolve a nomothetic, cross-domain view of team dynamics. Implementation of longitudinal quantitative approaches (e.g., longitudinal growth models) may reveal how team dynamics change over time, particularly in regards to the nomological network pertaining to cohesion, TMM and CE. For instance, addressing how performance (i.e., output) re-inform teammates’ appraisals (i.e., new inputs) on their cohesiveness, TMM, and CE beliefs may reveal how circular loops of influence continuously reshape team dynamics. Consideration of newly developed instruments for cohesion (Eys, Carron, Bray, & Brawley, 2007) and TMM (see Gershgoren, 2012) may strengthen the validity of a statistically parsimonious view of team dynamics in sports. Testing for the specific effects pertaining to the sub-factors of cohesion (i.e., task and social), TMM and CE are also important steps for future research.

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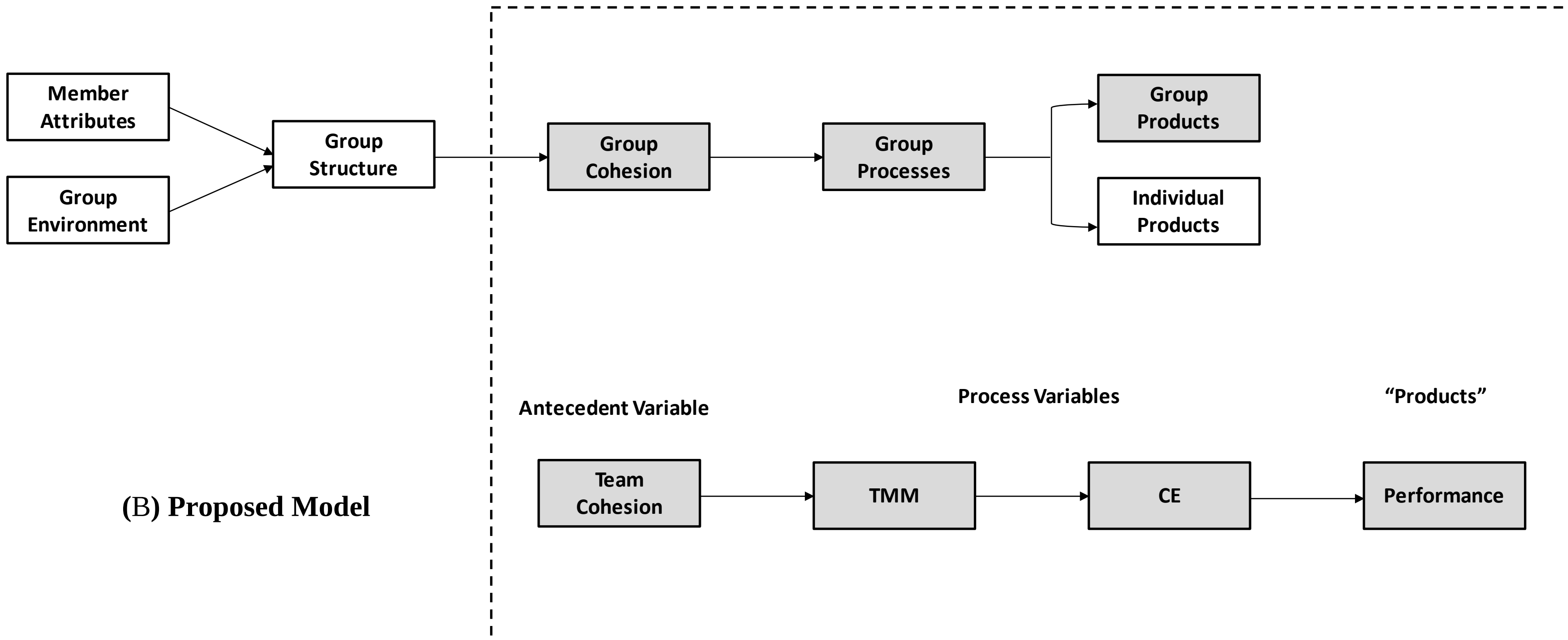
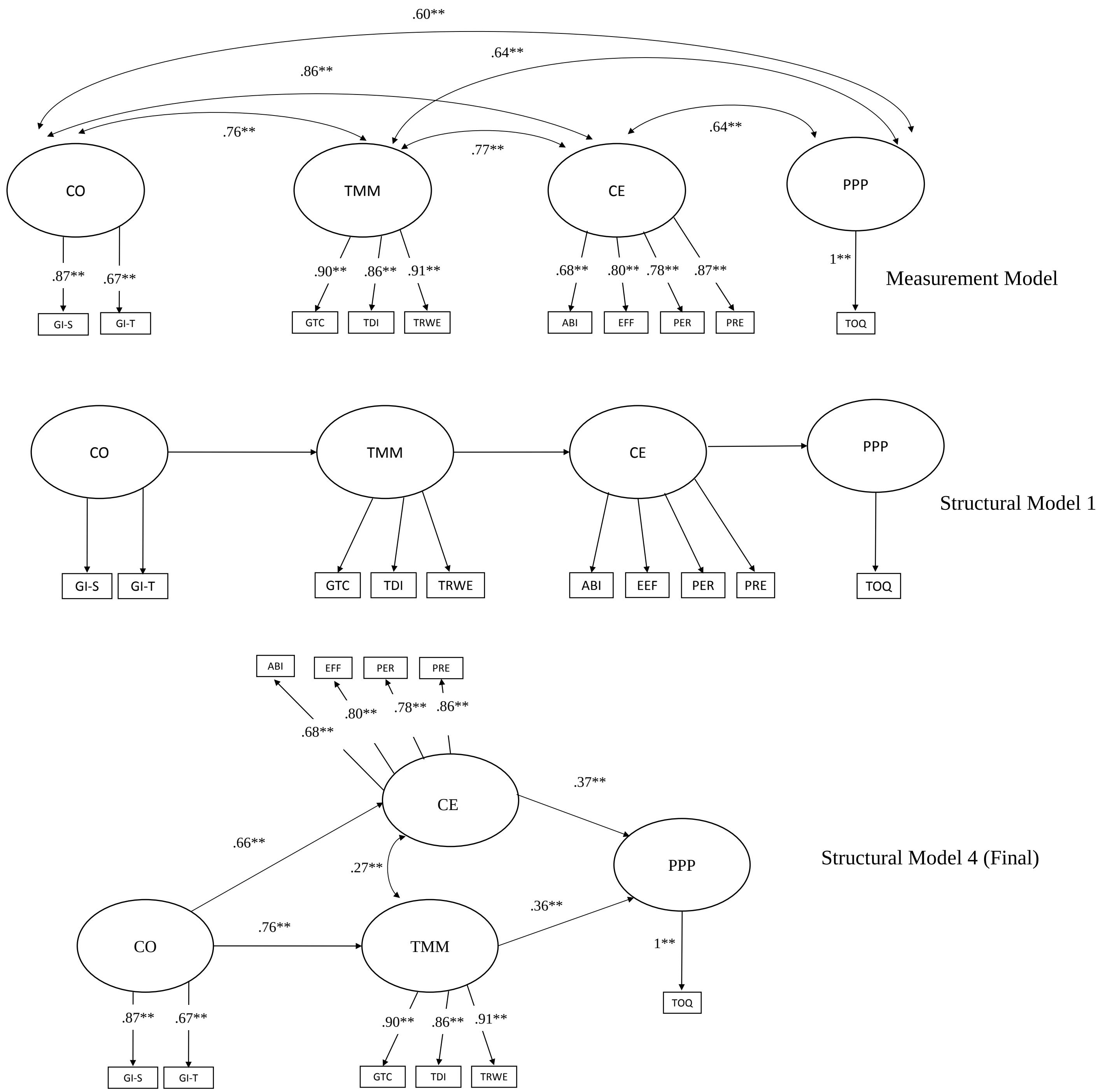
(A) Founding Conceptualization of Team Dynamics in Sports



(B) Proposed Model

Figure 1. (A) "Conceptual Framework for Examining Sport Teams" by A. V. Carron and H. Hausenblas, 1998, Group dynamics in sport, p. 166. Copyright 1998 by Fitness Information Technology. Adapted with permission. (B) Proposed Nomological Network of Team Dynamics in Sports.

Note. *Group structure* was indirectly measured through the consideration of demographic information pertaining to the participants and their teams. *Individual products* were not considered here because the focus was at the team-level of analysis.



**$p < .01$

Figure 2. Integrated Nomological Network of Team Dynamics in Sport

Note.: Cohesion: Group Integration-Social (GI-S). Group Integration Task (GI-T). TMM: General Task and Communication (GTC). Team Dynamics Interactions (TDI). Team Resources and Working Environment (TRWE). CE: Ability (ABI). Effort (EFF). Persistence (PER). Preparation (PRE). Performance Expectation (PPP).

Table 1

Descriptive Statistics and Reliability Estimates and Intra-Class Correlation Coefficients (ICC) for the GEQ, TADM, CEQS and TOQ

	Descriptive Statistics				
Scale	*M*	*SD*	*Range*	*Alpha*	*ICC*
GEQ					
ATG-T[a]	6.96	1.59	2-9	.56	.14
ATG-S[b]	7.29	1.45	1-9	.63	.12
GI-T[c]	6.79	1.44	2-9	.75	.15
GI-S[d]	6.70	1.65	1-9	.72	.32
Total GEQ	6.94	1.19	3-9	.85	.22
TADM					
GTC[e]	3.84	.68	2-5	.84	.13
TDI[f]	3.89	.65	2-5	.81	.13
TRWE[g]	3.99	.64	1-5	.77	.10
Total TADM	3.91	.59	2-5	.88	.16
CEQS					
Ability	8.30	1.36	3-10	.89	.10
Effort	8.44	1.35	3-10	.83	.12
Persistence	8.27	1.41	2-10	.87	.19
Preparation	8.53	1.32	2-10	.83	.13
Total CEQS	8.33	1.20	3-10	.95	.10
TOQ	3.29	.54	1-4	.89	.24

Note.: [a] Individual Attraction to the Group-Task. [b] Individual Attraction to the Group-Social. [c] Group Integration Task. [d] Group Integration-Social. [e] General Task and Communication. [f] Team Dynamics Interactions. [g] Team Resources and Working Environment.

Table 2

Correlation Matrix among GEQ, CQES, TADM Subscale, and TOQ

	ATG_T	ATG_S	GI_T	GI_S	GTC	TDI	TRWE	Ability	Effort	Persistence	Preparation	TOQ
ATG-T[a]		.47	.44	.24	.35	.38	.41	.35	.44	.40	.43	.35
ATG-S[b]			.52	.49	.39	.46	.44	.29	.42	.36	.38	.31
GI-T[c]				.58	.59	.62	.62	.44	.62	.55	.56	.54
GI-S[d]					.47	.54	.51	.29	.42	.32	.40	.37
GTC[e]						.70	.66	.36	.60	.52	.53	.53
TDI[f]							.76	.42	.60	.55	.55	.53
TRWE[g]								.45	.57	.54	.55	.56
Ability									.61	.66	.62	.51
Effort										.82	.80	.61
Persistence											.79	.53
Preparation												.54

Note.: All Correlations are significant at $p < .01$. [a] Individual Attraction to the Group-Task. [b] Individual Attraction to the Group-Social. [c] Group Integration Task. [d] Group Integration-Social. [e] General Task and Communication. [f] Team Dynamics Interactions. [g] Team Resources and Working Environment.

Table 3

Model-Data Fit for the Proposed Nomological Network of Team Dynamics in Sport

Model	χ^2_{S-B}	*Df*	Correction factor	CFI	RMSEA	SRMR	WRMR
Measurement Model	55.14**	30	1.21	.986	.050	.026	.505
Structural Model							
Model 1	122.83**	33	1.24	.950	.089	.063	1.292
Model 2	71.75**	32	1.21	.978	.060	.033	.611
Model 4 (Final)	55.79**	31	1.20	.986	.048	.026	.502
Measurement Model by Gender							
Female Group	50.40**	30	1.17	.980	.062	.033	.545
Model Group	42.66	30	1.20	.985	.051	.030	.375
Two-Sample Measurement Model							
Unconstrained Model	92.94**	60	1.18	.982	.057	.032	.472
Constrained Model	95.01**	66	1.20	.984	.051	.036	.524
Two-Sample Structural Model							
Unconstrained Model	95.91**	68	1.19	.985	.049	.036	.518
Constrained Model	105.26**	73	1.20	.982	.051	.056	.753

** $p < .01$.