

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

Edson Filho^{ab}, Gershon Tenenbaum^b & Yanyun Yang^b

^a Behavioral Imaging and Neural Dynamics Center, University of Chieti-Pescara, Chieti, Italy

^b Department of Educational Psychology and Learning Systems, Florida state University, Tallahassee, FL 32306, USA

Corresponding Author:

Edson Filho

Behavioral Imaging and Neural Dynamics Center

University of Chieti-Pescara

Via dei Vestini, 33 - 66013, Chieti, Italy

Email: soares_medeiros@yahoo.com.br

Phone: +39 333.304.5650 / +49 0176.3514.6564

Running title: Nomological network of team dynamics

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

Number of figures: 2

NOMOLOGICAL NETWORK OF TEAM DYNAMICS

Running head: NOMOLOGICAL NETWORK OF TEAM DYNAMICS

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

NOMOLOGICAL NETWORK OF TEAM DYNAMICS

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

24 shared performance related goals. The notions of task and social cohesion are at the core of the
25 *conceptual model of group cohesion* proposed by Carron et al. (1985), which is an important part
26 of research on group dynamics in sport psychology (Carron & Eys, 2012), and has been
27 incorporated in the nomological network of team dynamics proposed herein.

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

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

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

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

59 Defined as a "group's shared belief in its conjoint capabilities to organize and execute the
60 courses of action required to produce given levels of attainment" (Bandura 1997, p. 4), CE is
61 thought to be based on the same antecedents of self-efficacy, and is considered to mediate
62 between TMM and Perceived Performance Potential (PPP). To this extent, CE is theoretically
63 seen as a variable with predictive power over team performance (Bandura, 1997; Edmonds et al.,
64 2009; Feltz, Short, & Sullivan, 2008; Myers, Payment, & Feltz, 2004). The notion of PPP, which
65 is correlated with objective performance scores as a reliability check, reflects a probabilistic
66 rather than deterministic view of performance in working groups in general, and in sport in
67 particular (Kamata, Tenenbaum, & Hanin, 2002; Stumpf, Doh, & Tymon, 2010). Foremost, this
68 notion is congruent with the self-reported measures utilized in the current study.

69 The model proposed herein is based on Carron and Hausenblas (1998) organizational
70 framework of team dynamics in sports (see Figure 1). Nonetheless, certain aspects of the *group*
71 *structure* were not included in the model but indirectly measured through the consideration of
72 member attributes (i.e., demographic factors, such as mean age, gender, players' nationality)
73 pertaining to the participants and their teams. *Individual products* were not considered here
74 because the focus was at the team-level of analysis. Leadership and environmental factors, which
75 have been associated with group dynamics in sport (Carron & Eys, 2012), were also beyond the
76 scope of the present study, which was centered on integrating cohesion, TMM and CE using
77 structural equation modeling techniques. Accordingly, from a path-analytical perspective, this
78 model postulates that (a) cohesion is an antecedent variable of TMM, and (b) TMM mediates the
79 relationship between cohesion and CE, and (c) CE predicts PPP. In addition to being grounded in
80 the seminal conceptualization of team dynamics in sports proposed by Carron and Hausenblas
81 (1998), these directional paths are aligned with extant research suggesting that (a) team cohesion,
82 TMM, and CE are intrinsically related constructs (Feltz et al., 2008; Mohammed et al., 2010),
83 and (b) CE beliefs evolve once a sense of "team" has been established, and have a positive effect
84 on performance (Bandura, 1997; Myers et al., 2004; Zaccaro et al., 1995).

85 From a factor analysis standpoint, the proposed model considers leading instruments
86 designed to measure cohesion, TMM and CE. Also, we aimed for a parsimonious model with
87 non-overlapping factors. Accordingly, we focused on measuring only the *unique factorial*
88 *contributions* representing cohesion, TMM, and CE. In other words, potentially overlapping
89 factors among the instruments utilized in this study were not considered. In particular, two sub-
90 dimensions of TMM (i.e., General Task and Team Knowledge, Attitude Towards Teammate
91 Task) as measured by the Team Assessment Diagnostic Measure (see Johnson et al., 2007) and

92 one sub-dimension of CE (i.e., Team Unity) as measured by the Collective Efficacy
93 Questionnaire for Sports (see Short, Sullivan, & Feltz, 2005), were not included in the model. To
94 this extent, a pilot study indicated statistical overlapping among these factors and cohesion
95 scores as measured by the Group Environment Questionnaire (see Carron et al., 1985).
96 Furthermore, peer-debriefing meetings among the authors led to a unanimous agreement
97 regarding the “conceptual equivalence” of the aforementioned factors. Hence, in the proposed
98 model cohesion portrays the idea of “team bonding,” whereas TMM reflects the notion of
99 “coordination links” (i.e., synchronized action or effort among teammates during moments of
100 action) (see Eccles & Tenenbaum, 2007). In essence, cohesion was conceptualized as having
101 social and task dimensions at both individual and group levels of analysis. TMM was thought to
102 reflect teammates’ (a) coordination links, (b) communication dynamics, and (c) resource sharing.
103 Finally, congruent with its theoretical roots, CE was thought to represent teammates’ perceived
104 “capability” of (a) ability, (b) effort, (c) persistence, and (d) preparation.

105 Altogether, our aim was to explore how various team properties are interrelated in a
106 factorial and structural fashion. Specifically, our aim was to propose and empirically test,
107 through structural equation modeling analyses, a nomological network of team dynamics in
108 sports as related to cohesion, TMM and CE. We also examined the intra and inter team
109 variability in cohesion, TMM, and CE scores of college soccer teams. This is in line with the
110 importance of properly examining nested data in social sciences in general, and in sport and
111 exercise psychology in particular (Feltz et al., 2008; Hershberger, 2006). Informing from the
112 reviewed literature, we hypothesized that: (a) the proposed model would adequately fit the data,
113 thereby supporting a parsimonious integrated view of team dynamics in sports, as related to

114 cohesion, TMM and CE; and (b) path coefficients would vary by gender as men's and women's
115 group behaviors and beliefs tend to differ.

116 **Method**

117 **Participants**

118 An a priori power analysis was conceptualized to reflect the minimum number of cases
119 needed to propose and test a statistically valid model. Therefore, this analysis conducted for
120 testing model fit as a whole (i.e., $\Sigma=\Sigma(\theta)$; power = .80, $\alpha = .05$, RMSEA = .00 for null
121 hypothesis, and RMSEA = .05 for alternative hypothesis) defined the target sample size ($n \geq$
122 214). Three hundred and forty college soccer players (178 females and 162 males) representing
123 17 different teams affiliated with the National Association of Intercollegiate Athletics
124 participated in the study. The 17 teams were from 9 different states across the country and had a
125 mean of 20 athletes per team ($SD = 3.48$). Participants were 20.38 years old on average ($SD =$
126 2.12), and had 14.66 years ($SD = 3.92$) of experience in soccer. On average, the participants had
127 been playing for their respective teams for 2.40 years ($SD = 1.11$). They had played a median of
128 20 matches ($M = 19.70$, $SD = 1.39$) over the season before taking part in the study. The majority
129 of participants were Caucasians (70.62%), followed by "other races" (15.28%), Black/Afro-
130 Americans (6.67%), and Hispanic/Latinos (4.23%).

131 **Instruments**

132 A demographic form was utilized to collect normative data. Additionally, the primary
133 choices of sport psychologists for studying cohesion (i.e., The Group Environment
134 Questionnaire) and CE (i.e., Collective Efficacy Questionnaire for Sports) were utilized. TMM
135 scores were assessed through the Team Assessment Diagnostic Measure (TADM) and PPP was

136 measured through the Team Outcome Questionnaire (TOQ). Objective performance scores were
137 obtained from the National Association of Intercollegiate Athletics' official website.

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

154 **Team Assessment Diagnostic Measure** (TADM; Johnson et al., 2007). The Team
155 Assessment Diagnostic Measure was designed to measure sharedness of team-related
156 knowledge, thereby focusing on assessing similarity, rather than accuracy, of teammates
157 perceived TMM. This 15-item questionnaire, with anchors ranging from 1 (i.e., *strongly*
158 *disagree*) to 5 (i.e., *strongly agree*), was conceptualized to assess latent shared mental states

159 (through its perceived functional roles) according to the following five factors: (a) General Task
160 and Team Knowledge (GTTK, 3 items; e.g., “My team knows specific strategies for completing
161 various goals.”), (b) General Task and Communication Skills (GTC, 3 items; e.g., “My team
162 consistently demonstrates effective listening skills.”), (c) Attitudes Toward Teammates and Task
163 (GTT, 3 items; e.g., “My team takes pride in our work.”), (d) Team Dynamics and Interactions
164 (TDI, 3 items; e.g., “My team solves problems that occur while doing our tasks.”), and (e) Team
165 Resources and Working Environment (TRWE, 3 items; e.g., “My team knows the environmental
166 constraints when we perform our tasks.”). These factors were found to have satisfactory
167 reliability coefficients (i.e., $\alpha \geq .75$) and to account for 82% of the variance on sharedness of
168 team-related knowledge (Johnson et al., 2007). Only General Task and Communication Skills,
169 Team Dynamics and Interactions, and Team Resources and Working Environment were included
170 in the proposed model. In this study, Cronbach alpha coefficients ranged from .77 to .84, and the
171 entire scale’s alpha reliability was .91.

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

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

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

199 The notion of PPP was utilized in terms of coherence, given that all other constructs (i.e.,
200 cohesion, TMM and CE) were based on self-reported measures. In this regard, Chelladurai
201 (2007) posited that subjective reports may better represent athletes' performance experiences.
202 Purely objective scores do not account for an outstanding performance from the opposing team,
203 referee mistakes, among other situational and environmental factors (e.g., bad weather, home
204 advantage, injury).

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

210 **Procedures**

211 Institutional Review Board approval was obtained prior to the commencement of this
212 study. College soccer coaches, affiliated with the National Association of Intercollegiate
213 Athletics, received an email detailing the objectives of the project. Telephone calls and personal
214 contacts were posteriorly arranged aiming to build rapport with the coaches. A pool of 44
215 coaches (all representing teams in the regional and national finals), was initially contacted, with
216 17 agreeing to participate in the study. Upon permission from the coaches, a time was scheduled
217 to meet their respective players. The players were informed about the overarching theme of the
218 study and asked to sign the written informed consent. Following the completion of the consent
219 form, participants received a package containing a copy of the Group Environment
220 Questionnaire, Team Assessment Diagnostic Measure, Collective Efficacy Questionnaire for
221 Sports, Team Outcome Questionnaire, and the demographic information form. Questionnaires
222 were presented in a randomized order in an attempt to control for learning and motivational
223 effects. Participants were instructed to complete each questionnaire individually, and to be
224 honest and serious in their responses. They received an envelope to confidentially return their
225 responses upon completion. The questionnaires were administered in a quiet environment (i.e.,
226 meeting rooms) to secure the comfort and privacy of the participants. Coaches did not remain in
227 the room during data collection. Data were collected at the end of the season. Participants had

228 played a median of 20 matches ($M = 19.7$, $SD = 1.39$) over the season before taking part in the
229 study. Moreover, data was deliberately collected one day before a decisive playoff game at the
230 national tournament as teammates' beliefs assessed prior to competition have been found to
231 reliably predict team performance (Myers, et al., 2007).

232 **Results**

233 **Demographic Analyses**

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

239 **Psychometric Analyses**

240 **Reliability Analyses.** Descriptive statistics and estimates of internal consistency
241 reliability are presented in Table 1. Overall, means across items were above the 70th percentile
242 for each subscale. The reliability coefficient obtained for each scale was adequate (i.e., $\alpha \geq .85$).
243 The alphas for the subscales ranged between .56 - .75 for the Group Environment Questionnaire,
244 .77 - .84 for the Team Assessment Diagnostic Measure, and .83 - .89 for the Collective Efficacy
245 Questionnaire for Sports. Item 17 (i.e., "Overcome distractions") and 19 (i.e., "Devise a
246 successful strategy") were excluded from the Collective Efficacy Questionnaire for Sports
247 questionnaire due to a small correlation with the other items represented in the "Effort" and
248 "Preparation" subscales, respectively. Alpha coefficients for the Group Environment
249 Questionnaire subscales were not ideal, particularly for the Attraction to Group Task (.56) and
250 Attraction to Group Social (.63). These two subscales were excluded from the model proposed

251 herein (see Figure 2). This is congruent with different interpretations of the Group Environment
252 Questionnaire, in which the instrument was found to assess two, and not four, latent factors
253 (Carless & De Paola, 2000; Schutz et al., 1994). The maintenance of GI-T and GI-S in the model
254 proposed herein is (a) congruent with the overarching theoretical notion of *social* and *task*
255 cohesion, and (b) representative of participants' *group* views of cohesion.

256 **Correlational Analyses.** Correlation coefficients among the Team Outcome
257 Questionnaire and objective performance measures were positive and moderate- to-high, hence
258 supporting the predictive validity of this instrument. Specifically, Team Outcome Questionnaire
259 and team season record showed a $r = .77$ ($R^2 = .59$), whereas Team Outcome Questionnaire and
260 the National Association of Intercollegiate Athletics's final ranking correlated positively with a r
261 $= .55$ ($R^2 = .30$). Correlation coefficients among Group Environment Questionnaire, Collective
262 Efficacy Questionnaire for Sports, Team Assessment Diagnostic Measure, and Team Outcome
263 Questionnaire composite scores ranged from .51 to .71. Overall, correlation coefficients were
264 higher among the subscales of each instrument, but relatively lower between subscales
265 measuring different constructs. Specifically, the correlations ranged from .35 - .62 for the Group
266 Environment Questionnaire and Team Assessment Diagnostic Measure, .29 - .62 for the Group
267 Environment Questionnaire and Collective Efficacy Questionnaire for Sports, and .36 - .66 for
268 the Team Assessment Diagnostic Measure and Collective Efficacy Questionnaire for Sports.
269 Correlations for the Team Outcome Questionnaire ranged from .31 - .54 with the Group
270 Environment Questionnaire, .53 - .56 with the Team Assessment Diagnostic Measure, and .53 -
271 .61 with the Collective Efficacy Questionnaire for Sports (see Table 2). Altogether, these
272 findings support the notion that cohesion, TMM, CE and PPP are interrelated but not identical
273 constructs, thereby warranting the examination of the nomological network proposed herein.

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

295 **Structural Equation Modeling**

296 A two-step approach was utilized to test the fit of the hypothesized full structural model
297 (see Kline, 2011). The first step consisted of evaluating the measurement model. The second step
298 consisted of evaluating and revising the structural model. Although continuous data were utilized
299 in this study (i.e., the average of scores across the set of items composing the Group
300 Environment Questionnaire, Team Assessment Diagnostic Measure, Collective Efficacy
301 Questionnaire for Sports, and Team Outcome Questionnaire subscales), visual inspection of Q-Q
302 plots suggested the data were not normally distributed. Multivariate kurtosis was 17.84 with $p <$
303 $.01$. We thus applied robust maximum likelihood estimation method for SEM analysis using
304 Satorra-Bentler (S-B) correction for non-normality (Kline, 2011). In all tested models, the error
305 variance of PPP was fixed as zero because this construct has only one indicator. Chi-square with
306 S-B correction (χ^2_{S-B} with non-significance indicating good fit), comparative fit index ($CFI \geq .95$
307 indicating good fit), root mean square error approximation ($RMSEA \leq .08$ indicating good fit),
308 standardized root mean square residual ($SRMR \leq .06$ indicating good fit), and weighted root
309 mean square residual ($WRMR \leq 1$ indicating good fit) were used to evaluate model-fit (Kline,
310 2011).

311 **Measurement model.** The measurement model associated with the hypothesized full
312 structural model is presented in Figure 2. The tested model allowed for 30 degrees of freedom,
313 with $\chi^2(30) = 55.14$, $p < .01$, S-B correction factor of 1.21, $CFI = .986$, $RMSEA = .050$, $SRMR =$
314 $.026$, and $WRMR = .505$. Except χ^2 , which is influenced by sample size, these results suggested
315 reasonable model-data fit. Standardized factor loadings were significant and moderate-to-high
316 ranging from $.67$ to $.91$. Modification indices did not suggest any theoretical or statistically
317 meaningful adjustments. Hence, this model was considered the final measurement model.

318 **Hypothesized structural model.** The tested model (Structural Model 1) allowed for 33
319 degrees of freedom with $\chi^2(33) = 122.83$, $p < .01$, a S-B correction factor of 1.24, $CFI = .950$,
320 $RMSEA = .089$, $SRMR = .063$, and $WRMR = 1.292$ (see Table 3). This model did not fit
321 adequately to the data. Modification indices and theoretical meaning were considered in
322 proposing the revised structural model. In particular, two structural changes, one at a time, were
323 added to the revised structural models. First, a direct effect from cohesion to CE was added.
324 This is congruent with empirical and theoretical evidence suggesting that cohesion scores predict
325 CE beliefs in team sports (Bandura 1997; Heuzé, Sarrazin, Masiero, Raimbault, & Thomas,
326 2006). Second, a direct link between TMM and PPP was also added in an attempt to improve
327 overall model fit. This modification is congruent with empirical findings regarding the overall
328 positive impact of TMM on team outcomes (Mathieu et al., 2000; Mohammed et al., 2010).

329 **Revised structural models.** This revised structural model with a direct effect from
330 cohesion to CE (Structural Model 2) allowed for 32 degrees of freedom, with $\chi^2(32) = 71.75$, $p <$
331 $.01$, a S-B correction factor of 1.21, $CFI = .978$, $RMSEA = .060$, $SRMR = .033$, and $WRMR =$
332 $.611$. The revised structural model with both the direct effect from cohesion to CE and the direct
333 effect from TMM to PPP (Structural Model 3) had 31 degrees of freedom, with $\chi^2(31) = 55.79$, $p <$
334 $.01$, a S-B correction factor of 1.20, $CFI = .986$, $RMSEA = .048$, $SRMR = .026$, and $WRMR =$
335 $.502$. Both models demonstrated adequate fit. A χ^2 difference ($\Delta \chi^2$) test was conducted to
336 evaluate their relative fit. The $\Delta \chi^2(1) = 13.07$, $p < .01$, suggesting that Model 3 fit significantly
337 better than Model 2. Furthermore, a χ^2 difference test was performed between Structural Model 3
338 and the measurement model with $\Delta \chi^2(1) = 0.25$, $p > .05$. This result indicated that Structural
339 Model 3 did not demonstrate a significantly worse fit to the data when compared to the
340 measurement model, and that its structural component fit the data well. Standardized factor

341 loadings were moderate-to-high and ranged from .68 to .90. The standardized coefficients
342 connecting factors were also moderate-to-high and ranged from .27 to .76. Modification indices
343 did not suggest any statistically meaningful adjustments. Given that this model represented a
344 plausible nomological network of team sports, the next step consisted of testing for alternative
345 statistical models. This is congruent with the importance of considering alternative explanations
346 for the data set, particularly in cross-sectional study designs (Hershberger, 2006).

347 **Alternative Models.** Alternative models are models with different specifications but
348 yielding similar fit (Hershberger, 2006). Such models provide alternatively meaningful
349 explanations for the inter-correlation among the latent factors considered in this study. Numerous
350 exploratory analyses of other theoretically plausible models, such as testing a correlational link
351 between CE-PPP (i.e., *reciprocal determinism*; Bandura, 1997) or reversing the directional path
352 (e.g., CE-TMM-CO), were conducted. However, no statistically reliable results were obtained.
353 We thus tested an equivalent alternative model to the Structural Model 3 by replacing the direct
354 effect from TMM to CE with the correlation between their disturbances. Accordingly, TMM and
355 CE were hypothesized as sharing covariance rather than representing a sequential process. This
356 alternative Model (Structural Model 4) yielded the same fit and factor loadings as Structural
357 Model 3, with 31 degrees of freedom, $\chi^2(31) = 55.79, p < .01$, a S-B correction factor of 1.20,
358 $CFI = .986, RMSEA = .048, SRMR = .026$, and $WRMR = .502$. Noteworthy, we opted for
359 Structural Model 4 as the final solution. This model is in agreement with the overarching notion
360 that team-level properties tend to be functionally co-dependent, thus mutually influencing each
361 other (Bandura, 1997; Klimoski & Mohammed, 1994). In effect, there is theoretical and
362 empirical evidence suggesting that more confident group units are more likely to possess
363 elaborate information sharing systems and vice-versa (Bandura, 1997; Little & Madigan, 1997).

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

370 **Multiple-Sample Analyses**

371 **Measurement models by gender.** A multiple-sample SEM was employed to test for
372 gender invariance based on the Structural Model 4. Idiosyncratic models by gender yielded
373 different but reasonable fit indices (Table 3). In particular, the measurement model for both
374 females and males allowed for 30 degrees of freedom. For the female group, $\chi^2 (30) = 50.40$, $p =$
375 $.01$, a S-B correction factor of 1.17, $CFI = .980$, $RMSEA = .062$, $SRMR = .033$, and $WRMR =$
376 $.545$. For the male group, $\chi^2 (30) = 42.66$, $p = .06$, a S-B correction factor of 1.20, $CFI = .985$,
377 $RMSEA = .051$, $SRMR = .030$, and $WRMR = .375$. Given that both models demonstrated
378 reasonable fit, additional constrained models were considered to test for measurement and
379 structural invariance across genders.

380 **Unconstrained measurement model.** In the first step of the multiple-sample analysis an
381 unconstrained model was examined. This model allowed for 60 degrees of freedom, with $\chi^2 (60)$
382 $= 92.94$, $p < .01$, a S-B correction factor of 1.18, $CFI = .982$, $RMSEA = .057$, and $SRMR = .032$,
383 and $WRMR = .472$. Taken together, these fit indices indicated adequate fit. Thus, the constrained
384 measurement model was analyzed in the next step.

385 **Constrained measurement model.** The second step of the analysis involved a
386 constrained model in which the factor loadings were equalized across groups. This model

387 demonstrated reasonable fit, with $\chi^2 (66) = 95.01, p = .01$, a S-B correction factor of 1.20, $CFI =$
388 $.984, RMSEA = .051, SRMR = .036$, and $WRMR = .524$. A χ^2 difference test revealed a non-
389 significant increase in chi-square when compared to the unconstrained measurement model, $\Delta \chi^2$
390 $(6) = 3.10, p > .05$. Accordingly, there was evidence of metric invariance (i.e., factor loadings
391 invariance) across genders. Next, the tenability of equal structural coefficients (i.e., coefficients
392 among factors) across groups was tested.

393 **Unconstrained structural model.** The measurement component of the unconstrained
394 structural model was the same as that in the constrained measurement model. The path
395 coefficients connecting factors were freely estimated for both groups. This model demonstrated
396 adequate fit with $\chi^2 (68) = 95.91, p = .01$, a S-B correction factor of 1.19, $CFI = .985, RMSEA =$
397 $.049, SRMR = .036$, and $WRMR = .518$. This model did not fit significantly worse than the
398 constrained measurement model with $\Delta \chi^2 (2) = .14, p > .05$. Thus, a constrained structural model
399 to test for the equality of structural coefficients was analyzed in the next step.

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

409

Discussion

410
411 A nomological network of team dynamics considering cohesion, TMM and CE was
412 proposed and tested. Overall, findings support the factorial and conceptual validities of an
413 integrated framework of team dynamics in sport. Results also revealed expressive nationality
414 diversity among the soccer teams surveyed, thereby reinforcing the importance of studies
415 addressing multiculturalism in team sports. Demographic analyses also revealed that starters
416 reported a higher level of “attraction to group task” as measured by the Group Environment
417 Questionnaire. Starters are probably clearer of their roles than non-starters as playing time offer
418 opportunities to evolve task-related knowledge (Eccles & Tenenbaum, 2007). The lack of effect
419 of other demographic factors on cohesion, TMM, CE, and PPP scores may be linked to the
420 homogeneity of the sampled population. The majority of the teams ($n = 12$) were in the top-16 in
421 the country, and the remaining teams ($n = 5$) were region finalists.

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

430 The theoretical view of team dynamics in sports presented herein is consistent with an
431 extensive body of literature on the predictive power of task-shared knowledge and CE on
432 performance measures (Fiore et al., 2003; Salas & Klein, 2001; Bandura, 1997). Additionally,

433 this final model reflects the notion that cohesion antecedes team processes (e.g., TMM, CE),
434 thereby lending support for Carron and Hausenblas' (1998) conceptualization of team dynamics
435 in sports. Indeed, research has consistently shown that teammates' agreement on social and task-
436 related behaviors may antecede the development of team mental "schemas" and group-level
437 confidence (Mathieu et al., 2000). To this extent, Eccles and Tenenbaum (2007) posited that the
438 allocation of social and task responsibilities antecede the development of implicit and explicit
439 processes in sport teams. Empirical evidence is also in favor of the notion that cohesion scores
440 predict CE beliefs in team sports (Heuzé et al., 2006).

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

450 Theoretically, the parsimonious view of team dynamics proposed herein may represent an
451 initial step towards clarifying the epistemological and nomological network roots of various
452 team-level properties. Theoretical models in sport sciences should focus on clarifying
453 (conceptually and statistically) the unique factorial contributions of its underlying latent factors.
454 For instance, the model proposed herein is statistically valid and supports the tested notion that
455 TMM is represented by *coordination*, *communication*, and *team's resources* networking. This

456 may be seen as an initial step towards clarifying the unique antecedents of TMM - where the
457 epistemological traits and antecedent variables are not yet clear (Cooke et al., 2003; Johnson et
458 al., 2007). More specifically, different authors have proposed numerous conceptual frameworks
459 describing hypothetical variables underlying the notion of TMM. Although conceptually
460 appealing, these frameworks are primarily based on face-validity, thereby lacking statistical
461 corroboration (Klimoski & Mohammed, 1994; Mohamed et al., 2010; Salas et al., 2005). Future
462 studies should therefore expand the analysis of TMM in an attempt to establish the *unique*
463 variables antecedent to this group level phenomenon.

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

475 Team cohesion representing the initial stage of the proposed conceptual framework
476 reinforces the importance of preventing social isolation and attachment problems in team sports
477 (Carron et al., 1985; Carron & Eys, 2012). Low social cohesion may create negative affect and
478 aggravate communication problems, thereby hindering the development of TMM. Similarly, low

479 task cohesion may decrease members' contribution and perceived responsibility, thus resulting in
480 lack of effort and inefficient coordination mechanisms (Eccles, 2010). Organizational and
481 individual orientations aimed at preventing the development of "social cliques", along with the
482 establishment of challenge goals and group-level productive norms, are important in building
483 team cohesion (Carron & Eys, 2012).

484 The notion that TMM and CE are positively related is consistent with research findings
485 on working groups' coordination links and efficacy beliefs (Mathieu et al., 2000; Peterson et al.,
486 2000). For instance, Mathieu et al. (2000) found that communication breakdowns are less likely
487 to happen in highly confident military units. Within the sport context, Lausic et al. (2009)
488 observed that more successful teams possess more homogenous models of communicating
489 emotional and action verbal and non-verbal messages. Hence, performance enhancement
490 consultants should target vicarious and verbal persuasion techniques (e.g., video-analysis,
491 motivational lectures) aiming at concomitantly addressing teammates' confidence beliefs and
492 verbal and non-verbal communication skills.

493 Men's and women's soccer teams differed in their distribution of players by position. In
494 particular, women's teams showed a higher proportion of offensive players than male teams.
495 These differences warranted adoption of multiple-sample SEM procedures aimed at testing for
496 gender invariance given that in team sports each position has different objectives and demands
497 (Filho et al., 2014). Although presents results revealed measurement and structural invariance
498 across genders, a further study addressing a more heterogeneous sample may reveal gender
499 effects on team-level properties. Indeed, the analysis performed herein targeted the covariance
500 structure only (i.e., loadings, path coefficients). Accordingly, it is plausible that males and
501 females have a different means on the latent variables. Again, the athletes' surveyed represented

502 the top performers in their conference, thereby a ceiling-effect on athletes' mental skills may
503 have "masked" a gender effect on the nomological network proposed herein. Accordingly, it is
504 likely that a future study may reveal a different interrelationship among cohesion-TMM-CE-PPP.
505 For instance, CE may have a larger impact on PPP for women's soccer teams, whereas TMM
506 may be better predictor of performance for men's soccer teams. In this regard, research has
507 shown that males and females differ in their emphasis on task oriented behavior, as well as on
508 their cohesiveness and collective efficacy dynamics (Chelladurai, 2007; Feltz et al., 2008; Schutz
509 et al., 1994).

510 Caution is warranted in generalizing these findings to other interactive sports,
511 competition levels, and different periods within a competitive season. Another limitation pertains
512 to the non-inclusion of the interrelationship between coaches' leadership behaviors and team
513 cohesion in sports. Coaching leadership is a vast topic and has been extensively studied
514 elsewhere (see Martens, 2004). Furthermore, the proposed model should be considered in terms
515 of its theoretical roots (i.e., socio-cognition). For instance, models grounded in dynamic systems
516 perspectives (e.g., eco-dynamical, course of action frameworks) may also represent valid
517 interpretations of team dynamics. The adoption of the expert-novice paradigm may expose
518 differences among "top" and "bottom" teams while also allowing the implementation of
519 multilevel models. Again, our dataset was homogeneous in nature and ultimately reflected our
520 target sample (i.e., top ranked teams). The reliance on modification indices moved the analysis
521 from a confirmatory to (at least) partially exploratory standpoint. Therefore, other models may
522 be plausible and longitudinal studies in particular, rather than cross-sectional, may offer
523 alternative views on how cohesion, TMM and CE are inter-related and exogenous or endogenous
524 to each other. Specifically, in the present cross-sectional study, all variables were measured (at

525 the same time) at the end of the season, thus preventing the assessment of cyclical relationships
526 (involving cohesion, TMM, CE, and PPP) likely to change over time. Despite these limitations,
527 this study addressed a historically and scientifically pondered question of many leading scholars
528 in the field of group dynamics. In fact, this study is aligned with the need for theory integration
529 within the psychological domain (Gigerenzer, 2010). On this note, Waltkins (1984, p. 86)
530 observed that “psychologists treat other people’s theories like toothbrushes – no self-respecting
531 person wants to use anyone else’s”. Accordingly, the nomological network of team sports
532 proposed herein may represent an *initial step* towards clarifying the epistemological and
533 nomological network roots of various team-level properties. Finally, findings from this study
534 also provide applied guidelines to evaluate and improve performance of highly interactive and
535 complex team units.

536 Perhaps more importantly, this study leads to further questions on “how multiple minds
537 work in synchrony” towards excellence and conflict resolution. Targeting different sub-
538 population groups (e.g., competition levels, cross/multi-cultural studies) and conceptual roots
539 (e.g., dynamic systems) may allow further revisions of parsimonious integrated models of team
540 dynamics in sport psychology. Addressing different working groups (e.g., military units, medical
541 teams) and considering models proposed in the I/O psychology may evolve a nomothetic, cross-
542 domain view of team dynamics. Implementation of longitudinal quantitative approaches (e.g.,
543 longitudinal growth models) may reveal how team dynamics change over time, particularly in
544 regards to the nomological network pertaining to cohesion, TMM and CE. For instance,
545 addressing how performance (i.e., output) re-inform teammates’ appraisals (i.e., new inputs) on
546 their cohesiveness, TMM, and CE beliefs may reveal how circular loops of influence
547 continuously reshape team dynamics. Consideration of newly developed instruments for

548 cohesion (Eys, Carron, Bray, & Brawley, 2007) and TMM (see Gershgoren, 2012) may
549 strengthen the validity of a statistically parsimonious view of team dynamics in sports. Testing
550 for the specific effects pertaining to the sub-factors of cohesion (i.e., task and social), TMM and
551 CE are also important steps for future research.

552

553 References

- 554 Arrow, H., Poole, M. S., Henry, K. B., Wheelan, S., & Moreland, R. (2004). Time, change, and
555 development: The temporal perspective on groups. *Small Group Research, 35*, 73-105.
556 doi:10.1177/1046496403259757
- 557 Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: W.H. Freeman.
- 558 Brawley, L. R., Carron, A. V., & Widmeyer, W. N. (1992). The nature of group goals in sport
559 teams: A phenomenological analysis. *The Sport Psychologist, 6*, 323-333.
- 560 Carless, S. A., & De Paola, C. (2000). The measurement of cohesion in work teams. *Small*
561 *Group Research, 31*, 71-88. doi:10.1177/104649640003100104
- 562 Cannon-Bowers, J., & Bowers, C. (2006). Applying work team results to sports teams:
563 Opportunities and cautions. *International Journal of Sport and Exercise Psychology, 4*,
564 363-369.
- 565 Carron, A. V., Brawley, L. R., & Widmeyer, W. N. (1998). Measurement of cohesion in sport
566 and exercise. In J. L. Duda (Ed.). *Advances in sport and exercise psychology*
567 *measurement* (pp. 213-226). Morgantown, WV: Fitness Information Technology.
- 568 Carron, A. V., & Eys, M. A. (2012). *Group dynamics in sport*. (4th ed.), Morgantown, WV:
569 Fitness Information Technology.
- 570 Carron, A. V., & Hausenblas, H. A. (1998) *Group dynamics in sport* (2nd ed.). Morgantown,
571 WV: Fitness Information Technology.
- 572 Carron, A. V., Widmeyer, W. N., & Brawley, L. R. (1985). The development of an instrument to
573 assess cohesion in sport teams: The group environment questionnaire. *Journal of Sport*
574 *Psychology, 7*, 244-266.
- 575

- 576 Chelladurai, P. (2007). Leadership in Sports. In G. Tenenbaum & R. C. Eklund (Eds.),
577 *Handbook of sport psychology* (3rd ed., pp. 113-135). New Jersey: John Wiley & Sons.
- 578 Coleman, J. (2011). A functional model of team leadership for sport. The Florida State
579 University). ProQuest Dissertations and Theses, 136.
- 580 Cooke, N. J., Kiekel, P. A., Salas, E., Stout, R., Bowers, C., & Cannon-Bowers, J. (2003).
581 Measuring team knowledge: A window to the cognitive underpinnings of team
582 performance. *Group Dynamics: Theory, Research, and Practice*, 7, 179-199. doi:
583 10.1037/1089-2699.7.3.179
- 584 Eccles, D. (2010). The coordination of labour in sports teams. *International Review of Sport and*
585 *Exercise Psychology*, 3, 154-170. doi:10.1080/1750984X.2010.519400
- 586 Eccles, D. W., & Tenenbaum, G. (2007). A social-cognitive perspective on team functioning in
587 sport. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of sport psychology* (3rd ed.,
588 pp. 264-283). Hoboken, NJ: John Wiley & Sons, Inc.
- 589 Edmonds, W. A., Tenenbaum, G., Kamata, A., & Johnson, M. B. (2009). The role of collective
590 efficacy in adventure racing teams. *Small Group Research*, 40, 163-180.
591 doi:10.1177/1046496408328489
- 592 Eys, M. A., Carron, A. V., Bray, S. R., & Brawley, L. R. (2007). Item wording and internal
593 consistency of a measure of cohesion: The group environment questionnaire. *Journal of*
594 *Sport & Exercise Psychology*, 29, 395-402.
- 595 Feltz, D. L., Short, S. E., & Sullivan, P. J. (2008). *Self-efficacy in sport*. Champaign, IL, US:
596 Human Kinetics.

- 597 Fiore, S. M., Salas, E., Cuevas, H. M., & Bowers, C. A. (2003). Distributed coordination space:
598 Toward a theory of distributed team process and performance. *Theoretical Issues in*
599 *Ergonomics Science*, 4, 340-364. doi:10.1080/1463922021000049971
- 600 Filho, E., Gershgoren, L., Basevitch, I., Schinke, R., & Tenenbaum, G. (2014). Peer Leadership
601 and Shared Mental Models in a College Volleyball Team: A Season Long Case Study.
602 *Journal of Clinical Sport Psychology*, 8, 184-203.
- 603 Gershgoren, L. (2012). The development and validation of the Shared Mental Models in Team
604 Sports Questionnaire. (The Florida State University). ProQuest Dissertations and Theses,
605 320.
- 606 Gigerenzer, G. (2010). Personal reflections on theory and psychology. *Theory & Psychology*, 20,
607 733-743. doi :<http://dx.doi.org/10.1177/0959354310378184>
- 608 Hershberger, S. L. (2006). The problem of equivalent structural models. In G. R. Hancock, & R.
609 O. Mueller (Eds.). *Structural equation modeling: A second course* (pp.13-41).
610 Connecticut: Information Age Publishing.
- 611 Heuzé, J., Sarrazin, P., Masiero, M., Raimbault, N., & Thomas, J. (2006). The relationships of
612 perceived motivational climate to cohesion and collective efficacy in elite female teams.
613 *Journal of Applied Sport Psychology*, 18, 201-218. doi:10.1080/10413200600830273
- 614 Johnson, T. E., Lee, Y., Lee, M., OConnor, D. L., Khalil, M. K., & Huang, X. (2007). Measuring
615 sharedness of team-related knowledge: Design and validation of a shared mental model
616 instrument. *Human Resource Development International*, 10, 437-454.
617 doi:10.1080/13678860701723802
- 618 Kamata, A., Tenenbaum, G., & Hanin, Y. L. (2002). Individual zone of optimal functioning
619 (IZOF): A probabilistic estimation. *Journal of Sport & Exercise Psychology*, 24, 189-208.

- 620 Klimoski, R., & Mohammed, S. (1994). Team mental model: Construct or metaphor? *Journal of*
621 *Management, 20*, 403-437. doi:10.1016/0149-2063(94)90021-3
- 622 Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New
623 York, NY: The Guilford Press.
- 624 Lausic, D., Tennebaum, G., Eccles, D., Jeong, A., & Johnson, T. (2009). Intrateam
625 Communication and Performance in Doubles Tennis. *Research Quarterly for Exercise*
626 *and Sport, 80*, 281-290.
- 627 Lirgg, C. D. (1991). Gender differences in self-confidence in physical activity: A meta-analysis
628 of recent studies. *Journal of Sport & Exercise Psychology, 13*, 294-310. Retrieved from
629 <http://search.proquest.com/docview/618084666?accountid=4840>
- 630 Little, B. L., & Madigan, R. M. (1997). The relationship between collective efficacy and
631 performance in manufacturing work teams. *Small Group Research, 28*, 517-534.
632 doi:10.1177/1046496497284003
- 633 Martens, R. (2004). *Successful coaching*. (3rd ed.). Champaign, IL: Human Kinetics.
- 634 Maas, C. J. M., & Hox, J. J. (2005). Sufficient sample sizes for multilevel modeling.
635 *Methodology, 1*, 86-92.
- 636 Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. (2000). The
637 influence of shared mental models on team process and performance. *Journal of Applied*
638 *Psychology, 85*, 273-283. doi:10.1037/0021-9010.85.2.273
- 639 Mohammed, S., Ferzandi, L., & Hamilton, K. (2010). Metaphor no more: A 15-year review of
640 the team mental model construct. *Journal of Management, 36*, 876-910.
641 doi:10.1177/0149206309356804

- 642 Myers, N. D., Payment, C. A., & Feltz, D. L. (2004). Reciprocal relationships between collective
643 efficacy and team performance in womens ice hockey. *Group Dynamics: Theory,*
644 *Research, and Practice, 8*, 182-195. doi:10.1037/1089-2699.8.3.182
- 645 Myers, N.D., Paiement, C.A., & Feltz, D.L. (2007). Regressing team performance on
646 collective efficacy: Considerations of temporal proximity and concordance.
647 *Measurement in Physical Education and Exercise Science, 11*, 1-24.
- 648 Peterson, E., Mitchell, T. R., Thompson, L., & Burr, R. (2000). Collective efficacy and aspects
649 of shared mental models as predictors of performance over time in work groups. *Group*
650 *Processes & Intergroup Relations, 3*, 296-316. doi:10.1177/1368430200033005
- 651 Salas, E., & Klein, G. (2001) Expertise and naturalistic decision making: An overview. In E.
652 Salas & G. Klein, (Eds.), *Linking expertise and naturalistic decision making* (pp. 3-8).
653 Hillsdale, NJ: Lawrence Erlbaum.
- 654 Salas, E., Sims, D. E., & Burke, C. S. (2005). Is there a "big five" in teamwork? *Small Group*
655 *Research, 36*, 555-599. doi:10.1177/1046496405277134
- 656 Short, S. E., Sullivan, P., & Feltz, D. L. (2005). Development and preliminary validation of the
657 collective efficacy questionnaire for sports. *Measurement in Physical Education and*
658 *Exercise Science, 9*, 181-202. doi:10.1207/s15327841mpee0903_3
- 659 Schutz, R. W., Eom, H. J., Smoll, F. L., & Smith, R. E. (1994). Examination of the factorial
660 validity of the group environment questionnaire. *Research Quarterly For Exercise &*
661 *Sport, 65*, 226-236.
- 662 Stapleton, L. M. (2006). Using multilevel structural equation modeling techniques with complex
663 sample data. In G. R. Hancock, & R. O. Mueller (Eds.). *Structural equation modeling: A*
664 *second course* (pp.345-383). Connecticut: Information Age Publishing.

- 665 Stumpf, S. A., Doh, J. P., & Tymon, W. (2010). The Strength of HR Practices in India and Their
666 Effects on Employee Career Success, Performance, and Potential. *Human Resource*
667 *Management, 49*, 353-375.
- 668 Tenenbaum, G., Eklund, R., & Kamata, A. (2012). *Measurement in sport and exercise*
669 *psychology*. Human Kinetics, Champaign, IL.
- 670 Ward, P., & Eccles, D. W. (2006). A commentary on "team cognition and expert teams:
671 Emerging insights into performance for exceptional teams." *International Journal of*
672 *Sport and Exercise Psychology, 4*, 463-483. doi:10.1080/1612197X.2006.9671808
- 673 Watkins, M. J. (1984). Models as toothbrushes. *Behavioral & Brain Sciences, 7*, 86.
674 doi:10.1017/S0140525X00026303
- 675 Zaccaro, S. J., Blair, V., Peterson, C., & Zazanis, M. (1995). Collective efficacy. In J. E.
676 Maddux (Ed.), *Self-efficacy, adaptation, and adjustment: Theory, research, and*
677 *application* (pp. 305-328). New York: Plenum.

(A) Founding Conceptualization of Team Dynamics in Sports

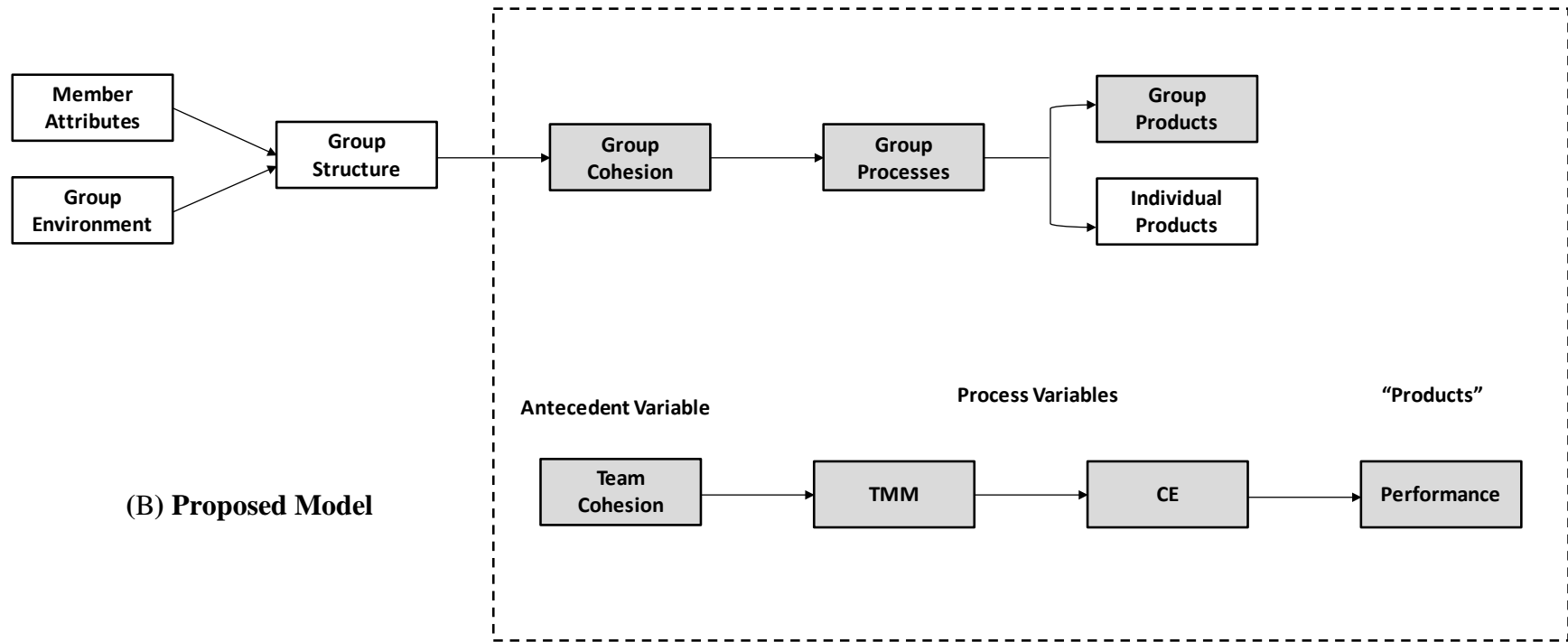
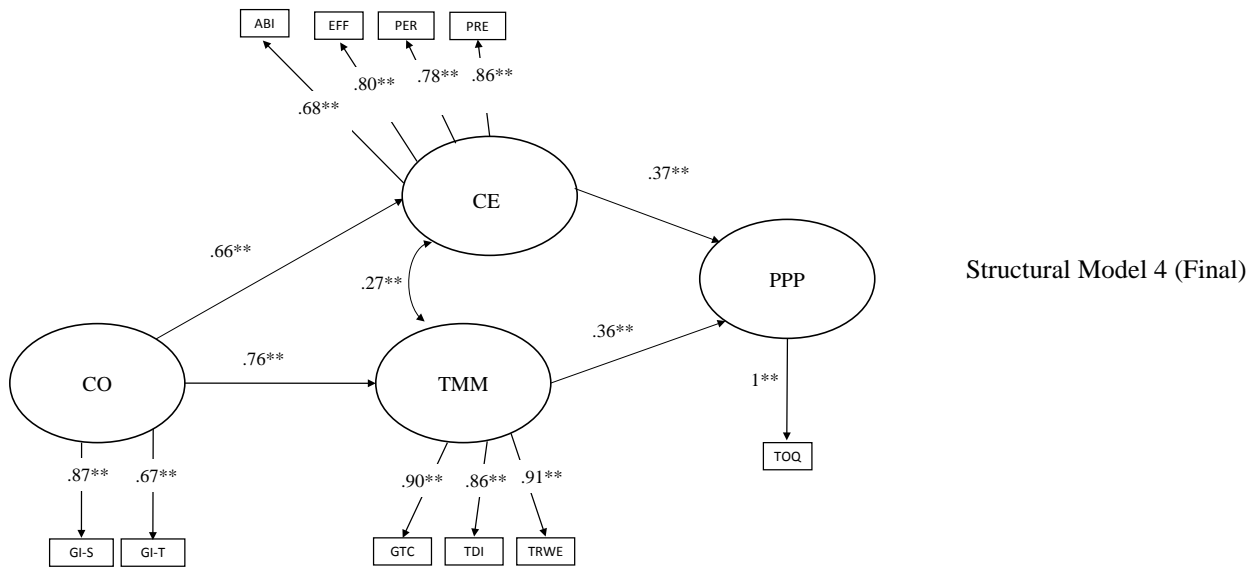
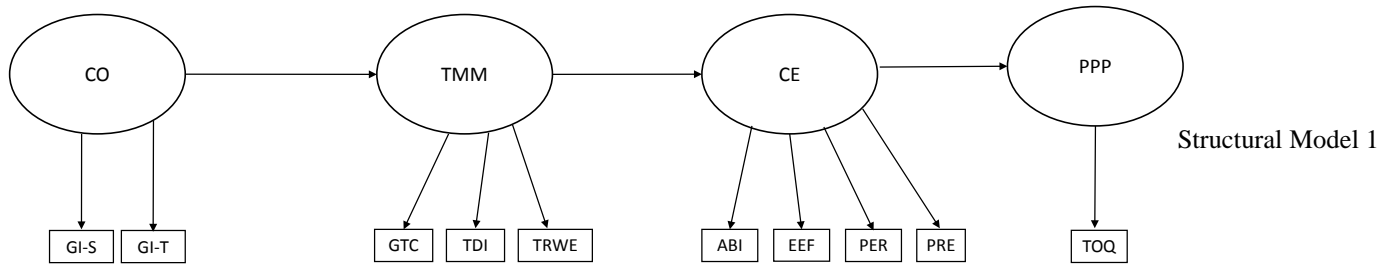
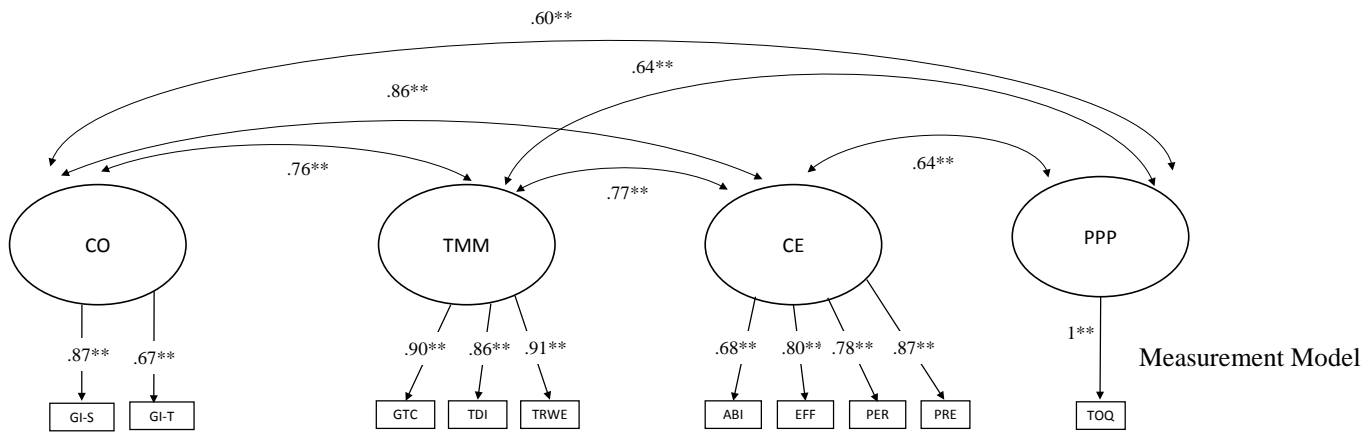


Figure 1. (A) “Conceptual Framework for Examining Sport Teams” by A. V. Carron and H. Hausenblas, 1998, Group dynamics in sport, p. 166. Copyright 1998 by Fitness Information Technology. Adapted with permission. (B) Proposed Nomological Network of Team Dynamics in Sports.

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

<i>Scale</i>	<i>Descriptive Statistics</i>				
	<i>M</i>	<i>SD</i>	<i>Range</i>	<i>Alpha</i>	<i>ICC</i>
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
<i>Measurement Model</i>	55.14**	30	1.21	.986	.050	.026	.505
<i>Structural Model</i>							
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
<i>Measurement Model by Gender</i>							
Female Group	50.40**	30	1.17	.980	.062	.033	.545
Model Group	42.66	30	1.20	.985	.051	.030	.375
<i>Two-Sample Measurement Model</i>							
Unconstrained Model	92.94**	60	1.18	.982	.057	.032	.472
Constrained Model	95.01**	66	1.20	.984	.051	.036	.524
<i>Two-Sample Structural Model</i>							
Unconstrained Model	95.91**	68	1.19	.985	.049	.036	.518
Constrained Model	105.26**	73	1.20	.982	.051	.056	.753

** $p < .01$.