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An Ecological Dynamics Perspective on Playing Styles of Football Teams: Analysis of Performance Determinants and Multilevel Modeling of Eco-Cultural Constraints

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SUMMARY

The overarching purpose of the doctoral thesis is to provide empirical evidence linking culture to sporting performance and to playing styles in football. The author pursues an exploration of questions pertaining to the historical and contemporary relationship between football, culture, and performance, embracing multidisciplinary lines of inquiry whilst maintaining a psychological focus on collective team behaviors – their patterns and sociocultural embeddedness, associated decision-making processes as well as their development, adaptation and evolution. Despite football's global outreach and its extraordinary popularity, there is a dearth of empirical investigations into the relationships between sociocultural macro- and micro-level determinants and sporting performance or game styles. The current thesis seeks to fill these gaps by eliciting empirical links.

The dissertation comprises three studies and is guided by a number of theoretical frameworks and lines of inquiry, including ecological, dynamical as well as sport psychological and cross-cultural perspectives on group/team behaviors. Chapter One provides an overview of literature concerned with the sociohistorical aspects of style development, the psychology of small groups and its relevance within the dissertation, the main paradigms for studying team behaviors in sport (social cognitive and ecological dynamics), and debates on embodied cognition within sport psychology, sociology and the discipline of performance analysis in sport. The subsequent three chapters are dedicated to Study 1, Study 2 and Study 3 accordingly. The final Chapter Five integrates findings across all three studies, identifies their utility in applied contexts, and highlights possibilities for future research.

Study 1: Styles of play. The study aimed to (1) identify and describe playing styles based on a larger sample than used in previous research, and to (2) provide inter-league comparisons. Data was collected from two samples, the first covering 21 professional football leagues consisting of 12 379 matches played by 375 teams in the 2018/2019 football season,

and the second covering 45 professional leagues consisting of 23 186 matches played by 728 teams. Principal component analysis (PCA) was run on 20 team-level performance indicators, producing three components that explained 66,96% and 55,79%, respectively, of the total variance. The components were attributed to three (larger sample) playing styles: possession-based, constructive attacking, and defensive. Cross-level measurement equivalence checks for three levels of isomorphism supported the three-component structure. K-means analysis, preceded by hierarchical cluster analysis using Ward's method, grouped teams into three distinct clusters characterized by the prevalence of each of the three playing styles. This parsimonious classification of styles can serve to profile teams for strategic purposes, such as developing player profiles for scouting, assessing team/club long-term goals for senior player development and junior level training / transitioning, as well as shorter-term tactical planning.

Study 2: Styles of play, cultural diversity and sporting success. The study aimed to (1) offer new empirical insights into the relationship between teams' sporting outcomes and their economic/market value, dominant playing style and cultural composition; and to (2) provide theoretical grounding that draws on ecological dynamics and social (cross-cultural) psychology. Based on the review of relevant literature and theory, nine hypotheses were formulated to test the effect of macro-level (i.e., country level income, national sport expenditure and league-level market value) and micro-level (i.e., team market value, possession-based style, constructive attacking style, and defensive style) determinants on teams' sporting performance. The dependent variable "goal difference" (GD expressing sporting performance or sporting success) was operationalized as the difference between goals scored and conceded by teams during the 2020/21 footballing season. The study's hypotheses guided by ecological dynamics were tested using moderated regression modeling (i.e., total of 23 models) based on the 45-league sample. Support was found for (1) the association of the constructive attacking style with a higher ratio of foreign offensive players, and for (2) the greater reliance of defensively oriented teams on cultural homogeneity in defense for improving performance. Based on the proposed Integrated Categorization-Intentionality Model (ICIM), the difference between defensively vs. offensively inclined teams was explained in terms of reliance on tactics that require greater coordination through in-action communication (i.e., in defense) contrasted with tactics that rely to a lesser degree on highly synchronized pitch maneuvers (i.e., in offense). Furthermore, the study found that cultural diversity was a better predictor of favorable sporting outcomes than teams' wealth, although only in defensively oriented teams. Nonetheless, wealthier teams were found to be more successful. Analogously, expectations were confirmed that in terms of sporting efficiency, poorer teams regardless of their tactical orientation, benefitted from cultural heterogeneity to a greater extent compared to wealthier teams. However, upon investigation of the wealth-performance relationship, it was discovered that other factors such as players' cultural background, their in-action communication efficiency, be it within the team as a whole or the defense formation in particular, can play an equally, if not more, important role in determining sporting success.

Study 3: Social and ecological determinants of playing styles. The study was designed as exploratory, seeking sociocultural and ecological explanations for the development and utilization of styles of play, based on a multilevel modeling design with team level (i.e., CDI, temperature and precipitation, number of yellow cards per team) and league (country) level (i.e., thermal heat, homicide rate index, ingroup collectivism, ingroup favoritism and self-expression / traditionalism values) variables/constraints. The study's research questions and hypotheses were formulated drawing on the results of a pilot study, which was run on the smaller 21-league sample and relevant literature from the disciplines of performance analysis, ecological, sport and cross-cultural psychology. Guided by the ecological premise that the footballing playing field/niche mirrors higher level (i.e., societal) social processes and dynamics, the author postulated that the environmental and sociocultural aspects of life are embodied in the way football is played, or in styles of play. The results of Study 3 empirically supported the idea that ecological (i.e., temperature, precipitation) and sociocultural (i.e., cultural orientations and values) constraints affect how players and teams utilize available opportunities for action or affordances. In addition to ecological factors contributing to reliance on specific playing styles, teams' offensive orientation was found to be associated with more individualized play (i.e., negative values for ingroup collectivism), whereas ingroup favoritism characterized by conformity was revealed as predicting greater reliance on defensive tactics.

To conclude, the most important empirical finding concerns the functioning of multicultural teams in football. Study 2 and Study 3 showed that teams' cultural composition affects their sporting success and the way they play in a statistically significant manner, even minimizing, in specific circumstances, the ubiquitous impact of wealth at a micro or macro scale. Moreover, multilevel modelling (Study 3) suggested that certain combinations of variables (constraints) predict the utilization of particular footballing styles, including ecological (i.e., climatic) and sociocultural (i.e., cultural dimensions and values), in addition to cultural diversity (i.e., operationalized as CDI). Finally, the dissertation makes a theoretical contribution by proposing an integrated embodied cognition approach, exemplified in ICIM, and demonstrates how cross-cultural psychology can complement ecological dynamics in gleaning new insights on collective behaviors in sport.

STRESZCZENIE

Głównym celem niniejszej rozprawy doktorskiej jest dostarczenie dowodów empirycznych potwierdzających zasadność związku między kulturą a sukcesem sportowym, oraz kulturą i stylami gry w piłce nożnej. Opierając się na podejściu interdyscyplinarnym, przy jednoczesnym utrzymaniu psychologicznego ukierunkowania na zachowania zespołowe, w szczególności na wzorce tych zachowań wraz z ich zakorzenieniem społeczno-kulturowym, rozwojem, adaptacją i ewolucją, oraz związanymi procesami decyzyjnymi przeprowadzona została analiza historycznych i współczesnych relacji między piłką nożną, kulturą i wynikami sportowymi. Pomimo globalnego zasięgu piłki nożnej i jej niezwykłej popularności, brakuje badań naukowych dotyczących wpływu czynników społeczno-kulturowych z poziomu makro i mikro na osiągnięcia sportowe drużyn i ich style gry. Obecna praca wypełnia istniejącą lukę badawczą poprzez poszukiwanie odpowiednich dowodów empirycznych.

Praca bazuje na trzech badaniach osadzonych w interdyscyplinarnym kontekście kilku dyscyplin i kierunków teoretyczno-badawczych. Zarysowane podejście autorskie w odniesieniu do problematyki zachowań grupowych/zespołowych można określić mianem ekologiczno-dynamicznego, sportowo-psychologicznego oraz międzykulturowego. Struktura dysertacji obejmuje pięć rozdziałów. Rozdział pierwszy, teoretyczny, zawiera przegląd literatury dotyczącej społeczno-historycznych aspektów rozwoju stylów gry w piłce nożnej, psychologii małych grup i jej znaczenia dla celów rozprawy. Omówione są główne paradygmaty w psychologii sportowych gier zespołowych: model poznania społecznego i ekologiczne podejście dynamiczne; włączając dyskusję na temat ucieleśnionego poznania w zakresie psychologii sportu. Wprowadzona również jest *performance analysis,* czyli *ilościowa analiza działania* będąca podstawą pomiaru indywidualnych i zespołowych zachowań w każdej dyscyplinie sportowej. Hipotezy badawcze sformułowane są w paradygmacie ekologiczno-dynamicznym. Kolejne rozdziały poświęcone są trzem badaniom. Ostatni,

rozdział piąty jest dyskusją; przedstawia on zintegrowane wnioski ze wszystkich trzech badań, naświetla możliwe kierunki badawcze oraz określa rekomendacje dla klubów sportowych co do praktycznego zastosowania wyników dla usprawnienia funkcjonowania wielokulturowych drużyn sportowych.

Badanie 1: Style gry. Celem Badania 1 było (1) zidentyfikowanie i opisanie stylów gry w piłce nożnej na podstawie dużych i zróżnicowanych baz danych, znacznie przekraczających próby znane z dotychczasowej literatury przedmiotu; oraz (2) dokonanie analizy porównawczej między ligami. Dane zebrano z dwóch próbek: pierwsza obejmująca 21 profesjonalnych lig piłkarskich i składająca się z 12 379 meczów rozegranych przez 375 drużyn w sezonie 2018/2019, oraz druga obejmująca 45 lig zawodowych składająca się z 23 186 meczów rozegranych przez 728 drużyn. W wyniku analizy czynnikowej (PCA) przeprowadzonej na 20 wskaźnikach meczowych (np. liczba i rodzaj podań, przejęć, ataków pozycyjnych, itd.) wyłonione zostały trzy komponenty wyjaśniające odpowiednio, w obu badaniach, 66,96% i 55,79% całkowitej wariancji. Komponenty przypisano trzem (próba większa) stylom gry opartym na: posiadaniu piłki (possession-based), konstruktywnym ataku (constructive attacking) i grze defensywnej (defensive). Potwierdzony został izomorfizm w pomiarze między dwoma poziomami (tzn. zespołów oraz lig), dodatkowo uzasadniając trzyczynnikową strukturę. Za pomocą analizy skupień metodą *K*-średnich poprzedzoną hierarchiczną analizą skupień metodą Warda ustalono trzy grupy zespołów w ramach odrębnych skupień charakteryzujących się przewagą każdego z trzech wymienionych stylów gry. Powstała klasyfikacja regulowana metodą parsymonii może służyć do profilowania drużyn w celach strategicznych, takich jak opracowywanie profili zawodników do skautingu, ocena długoterminowych celów drużyny/klubu w zakresie rozwoju zawodników na poziomie seniorskim jak również do szkolenia zawodników młodszych w ramach przygotowania do piłki seniorskiej, a także do krótkoterminowego planowania taktycznego.

Badania 2: Style gry i zróżnicowanie kulturowe drużyny a wyniki sportowe. Celem Badania 2 było (1) uzyskanie nowego empirycznego wglądu w związek między wynikami sportowymi drużyn a ich wartością ekonomiczną/rynkową, dominującym stylem gry i zróżnicowaniem kulturowym; oraz (2) zastosowanie podejścia ekologiczno-dynamicznego do wyjaśnienia osiągnięć sportowych, włącznie z zarysowaniem modelu teoretycznego sukcesu sportowego drużyny piłkarskiej, ICIM (Integrated Categorization-Intentionality Model), a następnie jego weryfikacja przy pomocy stylów gry z Badania 1. Sformułowano dziewięć hipotez testujących wpływ czynników z poziomu makro (tj. dochód na poziomie kraju, wydatki budżetowe na sport i wartość rynkowa na poziomie ligi) i mikro (tj. wartość rynkowa drużyny, trzy style gry) na sukces sportowy drużyn piłkarskich. Zmienna zależna została zoperacjonalizowana jako różnica między bramkami zdobytymi i straconymi przez drużyny w sezonie piłkarskim 2020/21. Hipotezy badawcze zostały przetestowane przy użyciu moderowanego modelowania regresji, łącznie 23 modele, w oparciu o próbę 45-ligową. Stwierdzone zostały następujące zależności wiążące sukces sportowy ze stylem gry i wskaźnikiem zróżnicowania kulturowo-etnicznego drużyny (CDI): (1) efektywność stylu konstruktywnego ataku wiąże się z wyższym odsetkiem zagranicznych graczy ofensywnych; zaś (2) w stylu defensywnym wyższe wyniki uzyskują drużyny z niższym CDI a zwłaszcza te z wyższym odsetkiem lokalnych obrońców. W oparciu o proponowany model zintegrowanej kategoryzacji i intencjonalności (ICIM), różnica między zespołami polegającymi na grze defensywnej a tymi o orientacji ofensywnej została wyjaśniona poprzez odwołanie się do rozwiązań taktycznych, które wymagają nasilonej koordynacji za pomocą komunikacji w działaniu (tj. w obronie) w przeciwieństwie do taktyk opierających się w mniejszym stopniu na wysoce zsynchronizowanych akcjach (tj. w ataku). Co więcej, badanie wykazało, że różnorodność kulturowa była lepszym predyktorem korzystnych wyników sportowych niż bogactwo zespołów, chociaż tylko w zespołach zorientowanych defensywnie. Ogólnie rzecz biorąc, zespoły bogatsze wykazały większą skuteczność. Analogicznie potwierdziły się oczekiwania, że pod względem efektywności sportowej drużyny biedniejsze, niezależnie od orientacji taktycznej, czerpią większe korzyści z heterogeniczności kulturowej w porównaniu z zespołami bogatszymi. Jednak po zbadaniu zależności między bogactwem a wynikami odkryto, że inne czynniki, takie jak pochodzenie kulturowe graczy, ich skuteczność komunikacji w działaniu/akcji, zarówno w ramach zespołu jaki i konkretnej formacji (defensywnej czy ofensywnej), odgrywają równie ważną rolę determinantów sukcesu sportowego.

Badanie 3: **Makro-społeczne i ekologiczne determinanty stylów gry.** Badanie zostało zaprojektowane jako eksploracyjne, mające na celu poszukiwanie społeczno-kulturowych i ekologicznych wyjaśnień dla rozwoju i stosowania przez zespoły określonych w Badaniu 1 stylów gry. Wykorzystano tu technikę wielopoziomowego modelowania (metodę modelów mieszanych), określając zmienne z poziomu drużyny: CDI, temperatura i opady, liczba żółtych kartek na zespół); oraz z poziomu ligi krajowej: wskaźnik ekologiczny *thermal heat*, międzynarodowy indeks przestępczości, orientacja kolektywistyczna, faworyzowanie grupy własnej, wartości kulturowe autoekspresji oraz tradycjonalizmu (WVS). Pytania i hipotezy badawcze sformułowano na podstawie wyników badania pilotażowego przeprowadzonego na mniejszej próbie z 21 lig i odpowiedniej literatury z dyscyplin ilościowej analizy działania, psychologii ekologicznej, sportowej i międzykulturowej. Kierując się ekologicznym założeniem, że boisko/nisza piłkarska odzwierciedla wyższe (tj. społeczne) procesy i dynamikę społeczną przewidywano, że środowiskowe i społeczno-kulturowe aspekty życia są ucieleśniane w sposobie gry w piłkę nożną reprezentując style gry. Wyniki Badania 3 potwierdziły empirycznie ideę, że *ograniczenia* (contraints) ekologiczne (tj. temperatura, opady) i społeczno-kulturowe (tj. orientacje kulturowe i wartości) wpływają na sposób w jaki gracze i zespoły wykorzystują dostępne możliwości działania, *afordancje* (affordances). Oprócz czynników ekologicznych przyczyniających się do polegania na określonych stylach gry, stwierdzono, że styl ofensywny zespołów wiąże się z bardziej zindywidualizowaną grą (tj. wartości ujemne kolektywizmu), podczas gdy preferowaniu taktyk defensywnych sprzyja konformistyczne faworyzowanie grupy własnej.

Podsumowując, główne konkluzje płynące z obecnych badań dotyczą przede wszystkim funkcjonowania wielokulturowych drużyn w piłce nożnej. Badanie 2 i Badanie 3 potwierdziły, że zróżnicowanie kulturowe składu drużyn wpływa na ich osiągnięcia sportowe i styl gry w sposób istotny statystycznie, przy czym osłabiając, w określonych okolicznościach, wszechobecne oddziaływanie bogactwa w skali mikro lub makro na sukces sportowy. Co więcej, wyniki modelowania wielopoziomowego (Badanie 3) wykazały, że niezależnie od różnorodności kulturowej drużyny ligowej (CDI), pewne kombinacje zmiennych przewidują wykorzystanie określonych stylów gry, w tym zmiennych ekologicznych (tj. klimatyczne) i społeczno-kulturowych (tj. wymiary i wartości kulturowe). Wreszcie, wkładem teoretycznym pracy jest zintegrowane podejście do ucieleśnionego poznania, którego przykładem jest zaproponowany model ICIM łączący psychologię międzykulturowa z podejściem ekologiczno-dynamicznym w celu uzyskania nowego wglądu do zachowań zbiorowych w sporcie.

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TABLE OF CONTENTS

CHAPTER ONE: Introduction and Literature Review

1.1 Introduction

Football is the world's most popular sport. Four out of ten people worldwide identify themselves as football fans[1]. It is also the most culturally diverse sport with the longest tradition of player migration on a global scale. Despite the significance of football as a global phenomenon, research linking football performance to culture is surprisingly scarce. One of the reasons for the dearth of relevant studies, is the reluctance of academia to cross disciplinary boundaries. This dissertation accomplishes precisely what many other scholars have resisted; it attempts to bridge several fields of sport science while maintaining a psychological focus. The doctoral project sprouted in the applied field of sport psychology and its roots, relentlessly watered by intellectual curiosity, grew into academically barren, cross-disciplinary terrain. The author's scholarly journey started with looking for answers to deceivingly simple questions. Does ecology impact how people play the game? How important is culture to the performance of multicultural teams? Are there distinct styles of play in football or have styles dissipated, coalesced into universality in today's globalized world? Is there an authentically and uniquely Brazilian, Argentinian or Germany way to play football? The initial investigation avalanched into new lines of inquiry, from player skill development/adaptation and decision making to their sociocultural embeddedness, subsequently extending into philosophical and psychological deliberations on embodied cognition.

[1] The data originates form Nielsen's World Football Report (2018) released in the dawn of the 2018 FIFA World Cup in Russia.

1.1.1 Relevance and Importance of the Dissertation

The dissertation addresses critical questions pertaining to the functioning of multicultural teams, their playing styles, sporting efficiency and the key contributors to performance enhancement. The intensification of global sport migration processes over the past three decades, and most notably the increase in the cross-border mobility of football players has brought about a number of challenges for sport practitioners and footballing stakeholders engaged in the day-to-day management of culturally diverse teams. The benefits and drawbacks of recruiting foreign sourced footballing talent have been investigated by scholars within various disciplines including psychology, sociology, economics, management and performance analysis. For instance, research in cultural sport psychology (CSP) has provided abundant and pervasive support for the salience of psychological processes in the adaptation of migrant athletes to new sporting contexts. CSP studies have emphasized the critical role of communication (primarily verbal) in player's acculturation, in addition to other key factors such receiving social support from friends and family, experiencing feelings of belonging to the team/club, as well as functioning within an integrated, cohesive environment (Darpatova-Hruzewicz & Book, 2021). However, less is known about the effect of cross-cultural transitions on unconscious, motor/movement-based behaviors engaged in coordinated collective action. In fact, the adjustment of players to new training sessions (i.e., content- and intensity-wise), playing positions or a style of play is usually considered by practitioners as equally, if not, more critical. Despite its perceived importance, the adaptation of individual embodied practices has not received the scholarly attention it deserves. This dissertation aims to fill these gaps.

1.1.2 Dissertation Objectives

The overarching aim of the dissertation is to elicit empirical links between culture on the one hand and sports performance and playing styles on the other. By applying a broad multidisciplinary lens, the parallel placement of insights from different disciplines is achieved, presenting their perspectives on a common topic (Jones, 2009).

Three studies were conducted to address a number of secondary objectives. The first objective is to gain a more nuanced understanding of the sociocultural rootedness of national playing styles by gleaning historical perspectives on their development and evolution, as covered in section 1.3. The second objective, specifically addressed in Study 1, is to (a) identify (i.e., describe and measure) dominant playing styles across a selection of leagues in men's professional football, using performance indicators pertaining to tactical behaviors on attacking, defense and transitional play, and (b) to compare teams across leagues depending on their degree of utilization of specific playing/game styles. The third objective, formulated in Study 2, is to investigate teams' *sporting success*, and more specifically the impact of teams' cultural composition, their market/economic value and dominant playing style on sporting results, as well as the potential interaction effects of macro (country) level variables on sporting outcomes. The fourth objective, elaborated through four research questions in Study 3, is to seek out sociocultural explanations or cross-national variation in footballing styles of play, using multilevel statistical modeling, where teams are nested within country-level leagues. The fifth and final objective of this dissertation is to show how ecological dynamics and cross-cultural psychology can be employed to generate new insights on collective behaviors in team sports manifested by playing styles.

1.1.3 Structure of the Dissertation

This section provides further justification for the structure of the dissertation, and briefly outlines the content of each chapter. The thesis is organized in five chapters, including a general literature review (sections 1.2 through to 1.6), followed by three chapters dedicated to three distinct research studies, and concluding with a general discussion integration the findings from all three studies.

In line with the multidisciplinary approach outlined in the preceding section, in addition to identifying the five main objectives of the dissertation, Chapter 1 encompasses a review of the literature concerned with playing styles in three disciplinary domains: sociohistorical, theoretically-focused psychological, and performance analytical. First, the historical perspective on the development of selected national playing styles is presented, followed by a critical exploration of paradigms applicable to the study of small groups, including the psychological theories and lines of inquiry applicable to the study of collective behaviors in team sports. Next, a summary of the history and debates concerning embodied cognition in sport is presented, along with justification for the use of ecological dynamics as the dissertation's leading theoretical framework, accompanied by a critical summary of its limitations in relation to each study. Lastly, playing styles are problematized in the context of performance analysis research and relevant gaps in the literature are identified.

Chapter 2 is solely dedicated to Study 1. In the introduction, the research aims and relevant theoretical considerations are presented along with a summary of the literature exploring research on cross-cultural differences between leagues. The methodology section includes a review of key performance indicators used in performance analysis and a description of the types of statistical tests employed in the measurement and comparison of styles of play. Following a traditional representation style, the chapter details information on the two samples, measures and procedure, as well as types of analyses conducted and results obtained. The chapter concludes with a discussion of findings.

The sole focus of Chapter 3 is on Study 2. The introduction details the study's overarching research aims and elaborates on its theoretical grounding, which includes one existing and one proposed theoretical model, both guiding the analysis of data and the interpretation of results. The literature review expands on sports scholarship applicable to team performance with emphasis on wealth, playing styles and cultural diversity. Next, justification is provided for the research hypotheses drawn based on presented empirical evidence and in connection with the described theoretical models. Traditionally, information on the sample, measures and procedure is included, followed by a presentation of results and their interpretation within the discussion section.

Study 3 is covered in Chapter 4. First, the study's overarching aim is introduced within the relevant theoretical context, and an elaborate summary is provided of the literature covering research and theory on environmental/ecological and sociocultural factors that could potentially affect team behaviors. Next, the results of a pilot study are presented, followed by justification for the study's design and the derivation of its hypotheses. The specific hypotheses and study measures are included in the methodology section, along with a description of relevant procedures used in data centering/standardization, approach to missing data and power analysis/simulations. The results comprise of two sections: (1) a step-by-step presentation of the analytical plan, and (2) multilevel modeling results in relation to each style of play, including cross-level interaction effects. Lastly, the discussion of findings centers around the effects of environmental and sociocultural factors on playing styles.

Chapter 5 concludes the thesis by highlighting and discussing the overall results across the three studies, limitations and suggestions for future research, as well as their practical utility in applied contexts.

applied implications of the research findings,

1.2 Literature Review: Sociohistorical, Theoretical and Performance Analytical

The current literature review follows a multidisciplinary organizational framework that draws on insights from psychology, sports history and sport sociology alongside performance analysis to provide an integrative view on playing styles in professional football. For the purposes of maintaining a clear focus while tackling the complexity of the adopted multidisciplinary research design underpinned by epistemological pluralism[2], this section is broken down into distinct subparts that problematize playing styles within three domains: sociohistorical, theoretically-driven psychological and performance analytical. First, the historical, economic, political and sociocultural context in which playing styles develop is highlighted, along with examples from selected cultures: Brazil, the Netherlands and Japan. Next, the psychological perspective is presented through key theoretical paradigms applicable to the study of sport teams. Finally, the relevance of performance analysis as a sport science discipline is explained in the context of identification and description of national playing styles. The aforementioned outline is preceded by an introduction of the concept of playing style.

1.2.1 Broad Conceptualization of Playing Style

Styles of play or game styles[3] are concepts widely used by coaches, commentators and other stakeholders in football, or any other team sport for that matter, with the presumption of a common understanding. Colloquial terms such as the Italian “catenaccio” (Wolstenholme, 1992), the Brazilian “joga bonito” (play beautifully) or the Spanish “tika-taka” (Hewitt et al., 2016; Lapresa et al. 2018; Sarmento et al., 2013) provide a visual depiction of game style and

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[2] *Epistemological pluralism* assumes that knowledge emerges from the cross-fertilization of different disciplinary perspectives. As such, it rejects the existence of absolute truth and embraces the ambiguity that arises upon application of diverse disciplinary approaches to knowledge production (Repko & Szostak, 2017).

[3] Styles of play (playing styles) and games styles are used interchangeably throughout the thesis.

its aesthetic dimension, but there is little agreement amongst scholars or practitioners on the meaning of playing style or its conceptualization. Historically, playing style has been associated with “playing formation” (Talaga, 1988), and mostly considered in the context of offense vs. defensive actions (Larson, 2010). Moreover, football theoreticians have traditionally equated playing styles with particular schools of thought in coaching and talent development such as the Dutch, skills-centered “total football” (Jensen, 2014), the “Swedish model” rooted in pragmatism, professionalism and moderation (Andersson & Radmann, 2001), the Austrian system characterized by elegant movement, accurate passing, and dribbling, the Czech approach marked by effectiveness, intense rivalry and “the Czech street”, or the Hungarian school, famous for its temperament, speed and long passing sequences (Talaga, 1988). Olsen et al. (1998) suggested a conceptualization of playing style as a three-tier operational model. The first tier concerns the strategy and philosophy of playing style and is influenced by various sociocultural factors (culture, history, tradition, identity, etc.) at the conscious (e.g., knowledge, experience) or unconscious (e.g., Bourdieu’s “habitus preferences”) level. The second tier encompasses the deliberate style or the preferred strategy of a team, including specific principles of play, playing formations and player functional roles (i.e., playing positions). The third tier is match-based and as such accounts for the impact of players, managers, coaches, match officials, the opposing team, game venue and other situational variables.

Prior to providing a working definition of styles of play, it is important to situate this concept within a framework of related terms and principles. The principles of field-based invasion sports can be viewed as a relationship between teams where each must coordinate its actions in order to recover, conserve, and effectively move the ball into a scoring zone (Grèhaigne & Godbout, 1995). Wade (1996) identified three broad phases of football: attack, defense and preparation or midfield play. Therefore, team sports can be conceptualized as a function of two networks, attempting to anticipate opponent movements in attack or defense. The outcome of a game and successful performance overall are influenced by two fundamental factors: effective team strategies and tactics (Carling et al., 2006). Although operationally little distinction is made between the terms *strategy* and *tactics*, these represent two differing constructs (Gréhaigne et al., 1999). Team *tactics* refers to specific attacking and defensive actions that address match-play situations that arise during a game as preplanned, contextual (e.g., changes in score, player dismissals, time remaining, etc.) or opponent-driven actions (Taylor et al., 2005). Thus, tactics are more likely to be adaptive and continually evolving in response to varying situations and game contexts. *Strategies* refer to plans, principles of play and action guidelines that are agreed upon before a game with the aim of organizing the activities of the whole team as well as individual player interactions (Gréhaigne & Gadbout, 1995; Yiannakos & Armatas, 2006). These are influenced by coaching philosophies such as possession-based play or counter-attacking football as explained below. Contrastingly, team strategies are typically enforced via the adoption of specific tactics.

The most straight-forward way of looking at the analysis of tactics and strategy in soccer is through the prism of ball possession (Wade, 1996). Defensively, when a team loses possession of the ball, players must switch to defensive thinking. The defending team's objective is then to regain possession of the ball, restrict the attacking team's time on the ball and prevent goal scoring opportunities (Wade, 1996). Analogously, when a team is in possession, each player transitions into an attacking mode, so as to maintain possession whilst advancing the ball to create a goal scoring opportunity (Wade, 1996). The attacking and offensive phases of play involve players moving across the field into positions that allow receipt of the ball or utilization of a scoring opportunity. Thus, successful penetration is achieved by progressing with the ball whilst causing imbalances in the opponent's defensive structures (Clemente et al., 2014). Despite varying definitions of playing styles, most researchers in sports sciences agree that playing styles reflect collective team tactical behaviors aimed at achieving the game's attacking and defense objectives. This definition, however, fails to capture football's dynamic nature and its rootedness in sociocultural and historical contexts that shape its aesthetic and technical manifestation. A more theoretically driven definition of playing styles framed within ecological dynamics in provided further on (see section 1.5.4).

1.3 Sociohistorical Perspective

In this section, playing styles are considered in a historical context with emphasis being placed on the sociocultural, political and economic factors that have shaped the game's technical and aesthetic dimensions. The analysis that follows builds on the idea that sport in general, and football in particular, can be viewed as microcosms of society, with playing styles reflecting idiosyncratic social values (Filho et al., 2013). In this sense, football draws a proverbial cultural map, a metaphorical representation, which facilitates navigation through the society, in which it is played (Bateson, 1972). Football's cultural centrality in many societies implies that it carries a heavy political and symbolic significance, to the extent that the game can contribute fundamentally to the social actions, practical philosophies and cultural identities of nations and their individual members (Giulianotti, 1999). Thus, it can be said that football is shaped by and within the broader society, and produces unique worlds of power relations, meanings, discourses and aesthetic styles (Wren-Lewis & Clarke, 1983).

The ensuing discussion of game styles draws on sociocultural perspectives structured around the historical trajectory of global football development, broken down into three distinct stages: traditional (i.e., "pre-modern" or pre-industrial and pre-capitalist), modern (i.e., associated with rapid urbanization and the demographic and political rise of the working class) and postmodern (i.e., "contemporary" rejection of modernity, globalization, technological progress, fluidity of social/cultural identities, etc.) (see Bauman, 2000, 2011; Giddens, 1990, 1991). This periodization, originally proposed by Guilianotti (1999) in the context of football, is conventionally sociological. The three historical categories are not hermetically sealed from each other, contrarily, their underlying dimensions overlap to elicit a heuristic and hermeneutic value in investigating the cultural embeddedness of game styles (Guilianotti, 1999). Following the aforementioned historical overview, a more detailed discussion is presented of the tactical and aesthetic origin of Brazilian, Dutch and Japanese styles of playing football.

1.3.1 Historical Overview: Traditional Phase

Historical scholars have established that some of the earliest civilizations such as indigenous Amazon tribes (c.a. 1500 BC; Galeano, 1997), or the indigenous peoples of Chile and Patagonia played folk variants of football (Oliver, 1992). Different forms of football became popular also in Antiquity, as in the Roman game of *harpastum* or the e*piscyros* of Ancient Greece (Sweet, 1987). In the Far East, other variants the game emerged such as the Chinese *cuju* (also known as *Tsu' Chu*), which became widespread during the Han Dynasty (206 BC – AD 220)4, or the Japanese *kemari*, which came about 500-600 later and is still played today (Walvin, 1994). Playing ball games can be traced as early as 1650 BC amongst the pre-Columbian people of Ancient Mesoamerica (e.g., the Mayans, Aztecs, Toltecs). The Mayans played *pok-tak-pok*, a cross between modern-age football and basketball. The game was not only played for leisure or athletic competition, but carried ceremonial significance as a religious ritual that at times involved the sacrifice of human life (Blomster et al., 2020). Folk football was also spread among Celtic peoples, French peasants, Englishmen and Scotts (Elias & Dunning, 1987). Florentine *calcio*, originating in the 13th century, is the predecessor of the

[4] During the Ming Dynasty, the game was banned twice, in 1389 and in 1625.

modern Italian game (De Biasi & Lanfranchi, 1997). Overall, the aforementioned form of folk football was characterized by violent behaviors on the part of players, who would commonly get into fights, as well as serious injuries, including deaths (Elias & Dunning, 1970).

The transition from folk football to modern association football was facilitated by codification of its rules[5], which first occurred in Britain, considered to be the cradle of the contemporary game. The rules lead to the establishment of sporting exchanges, initially between Britain's football playing schools (e.g., Oxford, Cambridge, etc.), but then across regions and nations. As football became more autonomous and expanded during the late 19th century, hegemonic battles took place along class and regional lines, or the so-called "gentlemen and players dispute" (Birley, 1995). Elite clubs comprised of players of aristocratic descent and predominantly located in south England defended the amateur ethos of the game, whilst clubs in northern England and the midlands, controlled by industrialists and petty bourgeoisie, argued for the professionalization of the game. The Football Association eventually reluctantly recognized professional players in July 1885[6]. The international diffusion of football was procured by British political, economic and cultural policy/interests. More imperial sports such as rugby and cricket prevailed in the dominions (e.g., India, Australia, colonial Africa), whereas the new industrial game of football was more easily introduced through trading and educational networks (Collins, 2019).

Football's earliest playing styles reflected the game's middle-class values of entrepreneurial risk-taking and individualistic action, which translated into an atavistic, "kick and rush" approach on the field (Giulianotti, 1999), characterized by athleticism, speed and vigor. The "kick and rush" attitude became a distinctive feature of English football and

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[5] These are referred to as the 13 "Cambridge rules" and their introduction ultimately distinguished football from rugby.
[6] The origins of modern association football in England is depicted in the popular historical sports drama television miniseries developed by Julian Fellowes for Netflix and released in 2020.

brought with it aggression, insults (against referees), the advent of fans and regional rivalry, thus making the game increasingly less aristocratic (Missiroli, 2002). Until the 1880s, English football focused on players' unique skills, of which flamboyant dribbling with emphasis on individualized action was most characteristic. As football became more of a working-class game, preferences shifted from pseudo-artistry to professionalization that prioritizes winning and collective play (Walvin, 1994). Consequently, a more successful, rationalized form of play – the "passing game" – gained ascendancy. It featured a more advanced division of labor, in which players were allocated spatial positions to perform their allotted tasks, and was characterized by greater skill such as ball control (Giulianotti, 1999). During the traditional period, the attacking manoeuvre remained the principal strategy, although after World War I, consequent to the introduction of the new offside rule, teams' tactical orientation shifted towards defensive pragmatism (Meisl, 1955). The offside rule enabled forward progressive passing, thus precipitating football's transition from an essentially individualistic to a collectivistic game (Teoldo et al., 2021).

1.3.2 Historical Overview: Modernity and Post-Modernism

Modernization manifested itself in football's spread around the world and the domestic institutionalization of the game. The first official football body was founded in England in 1863 as the Football Association (FA). Association football emerged in other parts of Europe and the Americas in the late 19th and early 20th century[7]. Early modernization is also reflected in how the game was organized. Following the first offside rule change, there was a decrease in the number of forwards and an increase of players with defensive and

[7] The Royal Dutch Football Association was founded in 1889, as was the Danish Football Association. The German Football Association was founded in the early 1900s, although the modern German league (i.e., the Bundesliga) was not set up until 1963. The Spanish La Liga had its first season in 1928, and the Italian Serie A was organized into a national league a year later, in 1929. The current national association of Portuguese football clubs was founded in 1926. The Argentine Primera División is the oldest league in South America, being first held in 1891. The Uruguayan Football Association was established in 1900, whilst the Brazilian Football Confederation was founded in 1914. Most North American football associations were set up in the 1890s.

organizational tasks. The second alteration of offside rules prompted center-backs, who had previously played in projection (i.e., one in front and the other behind), to play in line. Consequently, the players positioned up the field, by the side corridors (i.e., the wingers), progressed closer to the line of the center-backs, forming a letter “W” shape.

In the 1920s and 1930s, Arsenal’s manager Hubert Chapman introduced the “WM” formation, comprising three forwards and two attacking half-backs supported by two defensive half backs and a final line of three full-backs (including the “stopper”). Chapman’s Arsenal exhibited a unique style distinguished by composure in defense that was buttressed by reliance on devastating counter-attacks (Holt, 1989). The WM system was further developed by Italian coach Vittorio Pozzo, who centralized rigorous defensive organization aimed at regaining possession and counter-attacking through fast and in-depth play. In southern Europe, similar styles were introduced by the “Danubian school” of football represented by clubs and coaches from three Central European capitals: Vienna, Prague and Budapest. The Danubian school promoted football that was based on individual technical skills, narrow exchanges, and a solid technical organization. It first conquered most of the European continent, and then spread into Latin America. In Italy, during the 1930s this system became known as *il metodo* (“the method”), centered around the idea that footballers were the nation’s warriors without armour (De Biasi & Lanfranchi, 1997). In Europe, WM was “creolized” to fit local conditions/cultures. For instance, in the 1940s it was adapted to Russian contexts by Mikhail Yakushin, the legendary coach of Dinamo Moscow. He introduced greater flexibility to this “bourgeois” system of play by encouraging constant change of positions within the attacking formation, so as to unsettle opponents. Some authors suggest that Yakushin’s vision of player mobility is a precursor to the Dutch “total football” model of the 1970s (Giulianotti, 1999).

After World War II, the WM was reconceptualized by the Swiss, resulting in the "Swiss Bolt", a fluid defensive system, which followed the flow of the game and thus demanded high tactical intelligence. Its contribution to football was the invention of the "sweeper", a position further developed within the *catenaccio* playing system. The *catenaccio* was created by Helenio Herrera, and dominated Italian football for two decades (1960s through the 1980s; Grozio, 1990 as cited in Giulianotti, 1999). It was founded on the notion of ultra-professionalism characterized by discipline, regimental training, elaborate planning, and an intelligent use of ball possession, requiring wit and creativity on the part of defensive players. The libero ("free man") swept behind the defensive line, focused on reading the game, and neutralizing opponents' attacking attempts. Giulianotti (1999) suggested that the *catenaccio*, with its reliance on bluff-calling and deception, reflected the cultural politics of the Cold War as the war of attrition. Two other notable playing strategies were advanced during the 1950s and 1960s. One was the 4-2-4 formation, which signified the highly aesthetic Brazilian attacking style, and the other was the 4-3-3 "Wingless Wonders" system devised by the Englishman Alf Ramsey, who replaced individualistic players with versatile and hardworking midfielders. He also initiated the "scientific" turn in the philosophy of the game, resulting in the domination of scientific approaches in football throughout the phase of modernity. Consequently, the famous English "direct football" style was conceptualized by Charles Hughes, who leveraged scientific approaches and a highly Fordist[8] managerial style, including management by objectives (Drucker, 1954). Teams were instructed to play the "long ball" as data analysis "showed" that up to 90 per cent of goals came from less than five

[8] Fordist approaches, implemented by Henry Ford in his automobile assembly line, are based on using science-driven, high levels of managerial direction and control, standardizing and routinizing work tasks as well as creating whole departments designed to break labor down scientifically into its component parts.

passes (Wilkinson, 1996). Moreover, the physical dimension of the game became more prominent, with some scholars referring to a distinct "physical style" (Teoldo et al., 2021).

The need for greater dynamism as opposed to sheer physicality gave rise to a more fluid attacking style, known as *total football*. It was brought into life in the late 1960s and 1970s by the Dutch club Ajax, and specifically its legendary coach Rinus Michels. This style of constant movement and positional realignment demanded of players to be highly adaptable and capable of playing in most outfield positions. Unlike the scientific orientation and hierarchical management of English football (the British "Boss" and the "lads"), Dutch "total football" pioneered the endorsement of an increasingly egalitarian model, characterized by more mature relationships between coaches and players, who were expected to contribute to the training process (Jensen, 2014). Notwithstanding the appeal of the aforementioned Dutch style, by the mid-1980s the tactical focus of most clubs and international teams shifted towards the deployment of various defensive solutions, for instance involving the libero or a four-based defense formation. In the late 1980s, the Italian catenaccio was gradually abandoned and replaced by the *zona* style, which borrowed from the English flat back four and added a midfield "pressing" tactic. It was referred to by its critics as a "robotic" style grounded in a schematic geometric framework (Giulianotti, 1999).

In the early 1990s, a shift occurred between the modern tactical thinking based, for instance, on the fixed Fordist 4-4-2 model in favor of a post-modern approach that incorporated a more flexible and fluid system of play, suited to specific match circumstances. Once more, attention turned largely to the defensive formation, although some found their own post-modern solution in attack. For instance, Italians formulated the highly creative role of the *mezzopunta*, positioned between midfield and attack, thus giving rise to four- vs.

traditional three-digit formations[9] (e.g. 4-4-2 vs. 4-2-4-1). This "anomalous" player, neither forward, nor midfielder, served to disorient the defender's opposition. According to Giulianotti (1999), the rupture between modern and post-modern tactical thinking was instigated by post-modern scepticism of scientific predictability of coaching and management. Although nowadays, analytical, data driven approaches have become essential to club/team management, a large number of contemporary coaches focus on processes rather than results, acknowledging that predictions are worthless, given that there are no guarantees in football.

As evident in the historical summary above, playing styles as representations of transnational cultural practices overlap both geographically and in terms of timing. Guilianotti (1999) applied the model of scientific paradigms (Kuhn, 1962) to explain sudden changes in playing styles. This happens when footballing communities experience an epiphanic "gestalt shift" resulting in the replacement of dominant traditions, exemplified by a particular playing style, with newer models (e.g., Italy's switch from *catenaccio* to *zona* in the 1980s). In examining the evolution of playing styles, scholars have often reverted to dichotomous understandings, which despite claims of inherent reductionism can, nonetheless, serve useful in explaining football phenomena. Specifically, Guilherme (2004) as cited in Teoldo et al., 2021, referred to distinct forms of footballing expression simplified as "technical-tactical" and "tactical-physical", the former focused on the qualitative relation between offense and defense, underpinned by player technical skills, whereas the latter characterized by discipline, organizational capabilities and superior physical skills. Alternative conceptions centralize the defensive vs. offensive dichotomy of footballing tactical expression, as ultimately proposed

[9] Formations are typically denoted by three or four numbers specifying the number of players positioned in each segment of the pitch. For example, 4-2-2 comprises four defenders, four midfielders and two attackers. While formations may change during matches in response to player substitutions or game-related events, managers typically select one of a finite, and, in practice, relatively small set of starting formations. Formations are a key component of overall tactics. Most teams in the Polish Ekstraklasa use a 4-4-2 formation.

and corroborated by the three studies in this dissertation (see sections 5.1 to 5.3). Notwithstanding the direction and interpretation of evolutionary changes in playing styles and related influences, it can be argued that playing skills and technical organization, being constitutive of specific game styles, originate in particular cultures that generate their own understandings of football style, tactics and aesthetics. The following sections focus on demonstrating this point by using the examples of Brazil, the Netherlands and Japan.

1.3.3 Brazilian Style

Brazilian football is renowned for its technical perfection and aesthetics. The "Brazilian footballer" can be equated in terms of symbolic meaning to the "French chef" or the "Tibetian monk" (Bellos, 2014). Historically, football in Brazil was imported by the British who came to the country in the 19th century looking for work (e.g., in infrastructure, banking and trade), and in the meantime set up schools and sports clubs. The development of football in Brazil was marked by class and racial conflicts. Initially, football was introduced and played by members Brazil's elite as a way of confirming their distinctive position against other social groups (Leite Lopes, 1999). However, in the 1920s, following the game's extraordinary popularization, highly talented players emerged among the working classes and were increasingly employed by clubs[10], thus sketching the beginnings of the professional age. This shift towards professionalism was openly resisted by the Brazilian elites, who similar to British aristocracy, defended the amateur spirit and noble roots of the game. Ultimately, football's transformation to a mass activity and subsequently a national sport was associated with the acceptance into its ranks of Mulato and Black Brazilians, who were members of the lower classes.

[10] This process of employing lower class players by clubs has been referred to as the "proletarizaton" of football (Leite Lopes, 2000).

At first, Brazilian football was reminiscent of the English game in terms of organization and style of playing, with its focus on results and tactics that optimize performance rather than emphasis on game aesthetics. However, the influx of working-class players brought a footballing style, which was spontaneous and enjoyable to the eye, the kind played on improvised football fields (*peladas*) and by small-town suburban teams (Leite Lopes, 1999). The distinctive Brazilian way of playing the game was first described (in 1938) by Gilberto Freyre[11], a distinguished Brazilian social scientist:

> Our style of playing football seems to contrast to the European style because of a set of characteristics such as surprise, craftiness, shrewdness, readiness, and I shall even say individual brilliance and spontaneity, all of which express our "mulattoism"…Our passes…our tricks…that something which is related to dance, to capoeira, mark the Brazilian style of football, which rounds and sweetens the game the British invented, the game which they and other Europeans play in such an acute and angular way – all this seems to express…the flamboyant and at the same time shrewd mulattoism, which can today be detected in every true affirmation of Brazil (p. 282).

Brazil's triumphant, first-time win of FIFA's World Cup in 1958 is a brilliant example of such newfound tactical organization carried out by two supreme attacking talents: 17-year old Pelé and Garrincha.

In terms of cultural factors impacting on the development of a unique game style, various authors have referred to the concepts of Malandragem and Ginga (e.g., Follett, 2008; Melosik, 2016; Uehara et al., 2020). The Portuguese noun *Malandragem* is translated into English as "cunning" and the related adjectives *malandro*/*malandra* (both for male and female) denote a person, who is a trickster, who possesses "street smarts" and even malice.

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[11] This quote was taken from Goldblatt (2006) and is a translation from Portuguese.

The term can be traced back to the 1880s when slavery was abolished in Brazil and many ex-slaves were drawn into undervalued activities to survive, as regular work/employment was inaccessible due to their lack of qualifications. Thus, Malandro individuals adapted to their social circumstances by using manipulation, deceit (largely perceived as deceit of oppressive authority) and bypassing laws, so as to be able to survive and achieve some level of well-being (Uehara, 2020). Such individuals were viewed as resourceful in providing for themselves and their families rather than malicious. In a cultural context, the *malandro* has been equated with the “Japanese samurai” or the “American cowboy” (Gastaldo, 2007), although the analogy itself is a striking example of cultural insensitivity.

In the context of football, deception emerges in a plethora of behaviors, ranging from simulation and diving to gain a competitive advantage, to deceptive moves that seek an optimal way out of a difficult situation on the field and perceptual-motor skills that bring out efficient football action including dribbling or disguise in passing to trick defenders, elucidating a special type of Brazilian creativity. In Brazil, it is commonly accepted that dribbling skills mirror real-life survival skills (Kuper, 2006), and a typical *malandro* achieves skillful deceit using *Ginga* - a fluid swaying of the body, a coordinated movement pattern that introduces uncertainty about one’s behavior (i.e., as deceptive action). It can be found in Brazilian samba, capoeira[12] and the carnival tradition. In football, playing with *ginga* is defined by fluidity, improvisation, surprise (lack of predictability) and craftiness. Thus, the notion of *Malandragem* coupled with *Ginga* underpins the highly individualistic style, characterized by emancipative initiative, improvisation and a public display of skill mastery (e.g., individual dribbling action that does not necessarily fall into a rigid tactical plan or is

[12] Capoeira is a Brazilian martial art developed by enslaved Africans in Brazil at the beginning of the 16th century. It combines elements of dance, acrobatics and music, placing emphasis on flowing movements rather than fixed stances.

said to be “without purpose”), delivering aesthetic delight to audiences. One example of superior skill mastery, even artistry, is the “banana kick” first developed by Brazilian forward Didì and later showcased notably by Rivelino. In cultural terms, Freyre used terms from Greek mythology to compare the Brazilian style of play to a “Dionysian dance” that allows for improvisation, diversity and individual spontaneity, and contrasted it with European football as a signifier of Apollonian rationality, order, control and perfection. The likes of Pelé and Ronaldinho are best known for their unsurpassed ball handling skills, aesthetically reminiscent of “dancing with the ball” in fluid motion. Another dichotomy has also been popular, in representing Brazilian game style as poetry, and European – as prose (Melosik, 2016).

1.3.4 Dutch “Total Football”

Dutch football has had a tremendous impact on global football and how the game is played internationally, primarily due to the development by the Dutch of “total football” in the late 1960s and early 1970s. This style of play is attributed to the legendary Ajax Amsterdam coach Rinus Michels, who adapted it from the flexible approach employed by the great Hungarian national team of the early 1950s. Total football as a system of play takes a geometric approach that dictates the angles of defense and attack taken by the 10 outfield players. Concurrently, it is characterized by flexibility and fluidity, requiring all players to think and act both as defenders and attackers, thus allowing defending players to move into attacking positions and attackers to fall back into their space as required to maintain balance (Parrish & Nauright, 2014). This reduces focus on specialization (by getting rid of a traditional and rigid division of labor between attackers and defenders) and opens up play to creativity and a more attacking style that became synonymous with the Netherlands in the era of Johan Cruyff during the 1970s (Merkel, 2006). Subsequently, Cruyff introduced this style in Barcelona, and it eventually evolved into the style currently known as *tiki-taka*, focused on ball control and passing but less concerned with player circulation.

Football's development in the Netherlands has been influenced by a myriad of processes within politics, culture and sport. Some authors suggest that the genealogy of "total football" is rooted in Dutch culture and history, specifically the regional rivalry with Belgium[13] and the German occupation of the Netherlands during World War II[14] (Missiroli, 2002). As a collective style of play, "total football" relies on each player's ability to take critical decisions quickly and within a limited physical space (i.e., the pitch). The latter is a reflection of the Dutch attitude towards the scarcity of land and the constant battle for reclaiming it from the sea[15]. In this regard, the philosophy of "total football" is based on optimal management of the limited space of the pitch, showcased by the ability of players to find new spaces though accurate positioning and passing. It has also been proposed that the origins of "total football" can be traced to Dutch architectural traditions that underscore the efficient use of space whilst accommodating the playful aesthetic of geometrical shapes and extravagant *art deco*, propagated by the expressionist Amsterdam School movement (Winner, 2008)[16]. Interestingly, the innovative and playful style of "total football" is said to epitomize

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[13] Belgium and the Netherlands share a history that dates back to 1815, when the Congress of Vienna (after the fall of Napoleon) established Dutch rule by Prince Willem I (known as William of Orange) of the former Austrian Netherlands (currently Belgium) located in the South. The people living in South Netherlands revolved against the prince in 1830, and declared Belgium's independence. In 1831, King Leopold took Belgium's throne, marking the ending of the revolution. William of Orange was forced to recognize Belgium's independence by the Treaty of London in 1839.

[14] After Nazi Germany invaded the Netherlands, and specifically following the bombing of Rotterdam, the Dutch forces surrendered in July 1940. The German occupation of the Netherlands continued throughout WWII, ending with Germany's surrender in 1945.

[15] Approximately one third of the Netherlands is located below average sea level, with over 6,500 square km of land reclaimed from the sea along the coastal line, as well as from lakes and rivers on the interior (Van Koningsveld et al., 2008).

[16]The term "art deco" was first used by Bevis Hillier (1968) to describe the interrelated art and design movement of the era. In Europe, three main movements developed. The first, known as *jogendstil*, appeared in Austria and Germany, and was characterized by its emphasis on functional design based on logic and geometry. The second, referred to as decorative *art nouveau*, captured the highly colorful and ornamental style, which ruled Paris in the

the traits of famous Dutch painters, explorers and creative thinkers (Jensen, 2014). “Total football” is thus associated with artful design, aesthetics, harmony and beauty combined with an intelligent use of space (Melosik, 2016). Unlike Brazilian approaches, which encourage aesthetic display of skill regardless of the purpose it serves on the field, creativity and football artistry in Dutch football are valued insofar as they serve the system of play. Thus, “total football” places emphasis on creative individualism as part of the collective system that acknowledges diversity. This approach aligns with the country’s liberal political orientation in the 1970s. The revolutionary approach of “total football” coincided with the cultural revolution that was taking place in the Netherlands at the time. In this regard, Ajax’s ultra-aggressive style symbolized the free mind, liberated from constraints.

1.3.5 Japanese Stylistic Rootlessness

Football in Japan is the product of a complex interplay between globalization and glocalization processes as well as unique cultural adaptation pathways. It represents a “cultural laboratory” of sorts wherein the “creolization “ of football’s basic properties occurs in adapting it to fit Japanese circumstances, much similar to how the game developed in other cultures (Armstrong & Giulianotti, 1999). Football was imported to Japan by British troops in the 1870s (10 years after codification of football rules in England), and eventually spread through the schooling/collegiate system, reaching notable levels of popularity by the end of the 20th century (Parrish & Nauright, 2014). Following the 1964 Tokyo Olympics, the Japan Soccer League (JSL) was inaugurated and featured teams supported by heavy industry corporate giants such as Mitsubishi, Furukawa, Hitachi, Toyo (now Mazda), Yanmer, Toyota, Yahata and Nagoya Sogo Bank (Nogawa & Maeda, 1999). Although JSL’s establishment

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post-WWI years. The third was associated with the Dutch modern decorative and decorative movement in architecture, represented by the Amsterdam School from 1910 to 1930, and typified by modern expressionism and rational, structure-based architecture.

marks the first attempt at a top-flight professional league in Japan, the underlying motivation at the time was less concerned with promoting the game and more so with creating a corporate publicity vehicle (Parrish & Nauright, 2014). Due to a steady decline in game attendance coupled with poor JSL team performances on the international stage, in 1993 the new and improved Japan Professional Soccer League (J-League) was launched, signifying a clear break from amateurism and a full commitment to professionalism (Horne, 1994).

Amongst the sports disciplines imported from the West (e.g., basketball, golf, volleyball, ice hockey, rugby, tennis, gymnastics, etc.), football appears to be one of the least compatible with traditional Japanese values. It is described in Japan as more "free" (*jiyū*) compared to "traditional" Japanese sports like baseball and sumo, which are considered "stiff" (*katai*) and "serious" (*majime*) (Edwards, 2014). Given these implicit incongruences, scholars have posed the question as to whether Japanese football can reconcile Japanese values with Western skills. Some experts claim that Japanese footballers lack the mental aptitude required to compete at the highest international level. It is argued that the group orientation that prevails in Japanese society impedes the development of individual player dispositions, which are essential in football notwithstanding the collective character of the game. Arguably, Japanese players find it difficult to take swift autonomous decisions in competitive contexts, to frame success and failure in terms of personal responsibility, to perceive risk-taking as an opportunity rather than a threat or to endorse goal-oriented behaviors (Melosik, 2016).

Some scholars highlight the inherent conflict between European individualism (*kosei*) and Japanese conformity, which hinders the players' flexibility and aggressiveness on the field (Edwards, 2014). As noted by Harald Dolles and Stan Söderman (2005), the very nature of football involving direct field contact, speedy decision making, individualized action and initiative is contrary to Japanese mentality acquired through traditional socialization. For instance, Japanese players are socialized into regarding the coach as the highest authority that is ultimately responsible for decision-making, even during matches (Kozuma, 2009). Therefore, foreign coaches, who have historically managed JSC or J-League teams, have attempted to "Westernize" players by urging them to think critically, express themselves, communicate their decisions on the pitch, and display leadership (Melosik, 2016). Analogously, foreign coaches are said to have exerted the greatest influence on the playing style of J-League clubs. Thus, game styles would change, even within a single season, into "Brazilian", "Argentinian" or "European" depending on the nationality of the coach, who would take over a particular team (Horne, 1999).

Other scholars argue that the Japanese style of play has been influenced to some extent by the physical attributes of a Japanese male's body. To this effect, Ogasawara Hiroki (2004) suggested that Japanese players are inferior to their White European counterparts in terms of sheer physical strength and similarly to Latin players in relation to technical capabilities. For this reason, Japanese game style has developed reliance on "game organization" rather than physicality or individuality. The concept of "organized football" was used to frame a scientific approach to training and developing players' cognitive competencies relating to evaluation and anticipation of on-field events. The main assumption was that timely and accurate assessments within limited spaces is contingent on collective effort. In other words, if each player is able to predict the movements of other players, the team as a whole would be in a position to self-organize (coordinate) in a harmonious manner in attack (Lee et al., 2010). In summary, the organized collective aspect of the game is the most characteristic feature of Japanese football. However, it is premature at this point to speak of an identifiable, highly recognizable playing style that can be attributed to teams in the J-League, contrasted with the distinct features of the Dutch total football for instance. The phenomena of style or lack thereof is in no way suggestive of the popularity or importance of football on the Japanese sports arena. On the contrary, football has become a significant driver of social change, especially amongst younger generations, a symbol of freedom and modernity that breaks away from traditional hierarchy and conformity pervasive in all domains of life, including amateur and professional sport (Edwards, 2013).

1.4 Theoretical Perspectives on Small Groups

This section elaborates on the literature, which provides theoretical grounding for the three studies. First, a summary is presented of the main theoretical perspectives applicable to small groups along with a brief overview of embodied approaches in sport, followed by a discussion of the relevant implications for this dissertation. Next, the two main theoretical approaches, namely social cognitive and ecological dynamics, guiding research on team behaviors in sport psychology are critically discussed. Additionally, the central tenets of ecological dynamics are outlined with reference to styles of play, and the limitations of ecological dynamics are highlighted in relation to each study. Lastly, performance analysis is introduced as a discipline, within which playing styles have been explored.

Much of life is shaped by the small groups to which we belong. These groups include families, work teams, and book clubs, to name a few examples. Given their importance, small groups are studied by scholars from different disciplines. Within psychology, most of the research on groups is conducted by social and organizational psychologists, although increasingly by scholars in sport, developmental, clinical and evolutionary psychology. Small groups are also examined by scientists from several other disciplines, including anthropology, sociology, political science, business and education.

Psychological research on group behaviors has been carried out from a variety of theoretical perspectives, which can be broadly typified as functional, psychodynamic, social identity, power-status-conflict, evolutionary, interpretative and temporal/dynamic (Poole & Hollingshead, 2005). For instance, the author’s prior ethnographic work (Darpatova-Hruzewicz & Book, 2021), grounded in cultural sports psychology (CSP), investigated interactions within multicultural teams in professional football using an interpretative, social constructionist lens. However, the majority of sport psychology research on sport teams is framed within positivist understandings of reality and knowledge production, and is guided by functional theories rooted in cognitive science. The prevalent theoretical orientation in group research within sport and social psychology is also founded on functional, social identity, or power-status-conflict theoretical paradigms. Lastly, in the past two decades, a burgeoning body of literature in psychology, including sport and social psychology, has embraced dynamics and complexity approaches in the investigation of team behaviors, specifically emergent, patterned and goal-directed behavior, translating into team performance. In the following subsections, the author first explains the guiding principles behind the dominant theoretical perspectives in the psychology of small groups, providing examples of pertinent theoretical frameworks. Next, within the context of sport psychology, the two competing theoretical paradigms, namely the social-cognitive and ecological dynamics, are compared and contrasted with the aim of justifying the overall theoretical framework as it applies to the structure of the dissertation, and the design of the underlying studies. The theoretical framing of research questions and hypotheses, as well the discussion of results within theoretically relevant context is provided separately for each study within relevant sections.

1.4.1 Structural-Functionalist Perspective

The structural-functionalist perspective of the late 20th century[17] has produced a greater number of studies than any other, and has guided much, if not most, of small group research in psychology and sociology. Theories and lines of research developed within this

[17] In early 20th century psychology, structuralists were distinct from functionalists, and different from scholars dealing with the philosophy of mind (i.e., philosophical functionalists). Psychological structuralism derived from Wilhelm Wundt's German psychology program, and ultimately from Kant and Descartes. It was underpinned by the belief that determining the structure of items in the mental lives of people is central to psychology, whereas understanding their function is secondary. Psychological functionalism, traceable to Darwin and the American psychology of William James, claimed that mental acts can only be understood in terms of their functions.

perspective include the functional theory of group decision-making[18] (Gouran & Hirokawa, 1996), social combination models of group decision making (Davis, 1973), groupthink[19] (Janis, 1982), social loafing[20] (Harkins et al., 1980; Ingham et al., 1974), shared information bias[21] (e.g., Faulmüller, et al., 2010), brainstorming[22] (e.g., Diehl & Stroebe, 1987) or team conflict management[23] (e.g., Guetzkow & Gyr, 1954; Jehn, 1995; Jehn & Mannix, 2001). Structuralist functional approaches have examined group interactions from the vantage point of group structure and member roles (Stogdill, 1974) in organizational as well as team sporting contexts (e.g., Cope et al., 2011; Mertens et al., 2021a, 2021b). In sport psychology, scholarship has focused on formal vs. informal roles (e.g., Kim et al., 2020), task vs. social roles, communication of role responsibilities (e.g., Eys et al., 2005), role performance (e.g., e.g., Beauchamp et al., 2003), role clarity/ambiguity (e.g., Beauchamp et al., 2003), role

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[18] The *functional theory of group decision-making* addresses questions that explore why some groups arrive at better decisions than others. Generally, it is assumed that groups can outperform individuals on decision-making tasks, and one of the factors responsible for that being “interdependence.” Positively interdependent (cooperative) groups have been found to make better decisions than both negatively interdependent (competitive) groups and individuals, particularly in complex tasks (Johnson & Johnson, 2012). These process gains come from a variety of other factors such interaction-based generation of ideas. When group members interact, they often generate new ideas and solutions that they would not have arrived at individually (Watson, 1931). Moreover, groups tend to have better collective memory, meaning that many minds hold more relevant information than one, and superior transactive memory, which occurs when interactions between group members facilitate the recall of important material (Forsyth, 2010). Also, when individual group members share information that is unique to them, they increase the total amount of data that the group can then draw on when making sound decisions (Johnson & Johnson, 2012).

[19] *Groupthink* is one example of a group process that can lead to very poor group decisions. It occurs when a group that is made up of members who may actually be very competent and thus quite capable of making excellent decisions nevertheless ends up making a poor one as a result of a flawed group process and strong conformity pressures (Baron, 2005; Janis, 2007).

[20] *Social loafing* is the tendency for individual effort to decline in a curvilinear fashion when people work in a group or only believe to be working in a group (Ingham et al., 1974).

[21] *Shared information bias* is the tendency of group members to discuss information that they all have access to while ignoring equally important information that is available to only a few of the members (Faulmüller et al., 2010; Reimer et al., 2010).

[22] *Brainstorming* was coined by Osborn (1953) as a technique used to produce creative decision-making in working groups. Despite profuse research efforts, there is limited empirical evidence supporting its effectiveness (Diehl & Stroebe, 1991; Stroebe & Diehl, 1994).

[23] In the psychological literature, research on *conflict in groups* is often based on social-psychological theory regarding group activity, member interaction, and social processes (e.g., communication, team building, leadership). It has been asserted that conflict is a common trait in every teamwork activity and inherent within daily interactions (Jia et al., 2011; Müller et al., 2016; Tjosvold, 2008). Three types of conflict have been recognized: task, relationship and process conflict (Jehn, 1995). Evidence suggests that the way a team deals with different types of conflict significantly impacts its performance, with effects being not only harmful but also remarkably beneficial (De Dreu & Gelfand, 2008; Liu & Cross, 2016; Prieto-Remón et al., 2015; Yosefi et al., 2010).

conflict (e.g., Volp & Keil, 1987), role efficacy (e.g., Bray et al., 2004), role acceptance (e.g., Eys et al., 2006), and role satisfaction (e.g., Beauchamp et al., 2005). The collective information-sharing area has focused on the influence of expert roles on the information sharing and decision making. Moreover, in sport psychology, the focus has been on team-level constructs such as team cohesion[24] (Carron et al., 1985), collective efficacy[25] (Short et al., 2005), or team resilience[26] (Morgan et al., 2013) and their effect on team performance.

Ultimately, what lies at the heart of functional approaches is the performance of ***tasks*** as well as the production of ***goal-oriented behavior*** and ***performance*** that can be evaluated. Importantly, the focus is on <u>cognitive tasks</u> such as problem solving, decision making, negotiation, verbal communication rather than *behavioral task*s in the physical realm, including physical performance, be it non-verbal communication and coordination in sports teams (e.g., tactical team coordination during matches) or performance in artistic contexts (e.g., ballet dancing). Related theories suggest that successful goal attainment by groups is predicated on certain actions / activities, which encompass information processing, conflict management, development of group culture (Hirokawa & Poole, 1996). When the goal is task-oriented (e.g., pressing on the opponent by executing a passing sequence that moves the ball forward and into high field) and involves making a “good decision” (i.e., whom to pass

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[24] The concept of *cohesion* was brought to the realm of social psychology by Kurt Lewin, who described it as a willingness to stick together, or incorporating forces of attraction that keep group members together (Dion, 2000). In sport psychology, the most prominent and still widely used theoretical model of cohesion in sport teams was developed by Carron et al. (1985) along with a theory-driven measure – the Group Environment Questionnaire (GEQ).

[25] *Collective efficacy* represents one of the most studied psychosocial constructs given its implications for performance (Myers et al., 2004), and was initially defined as “the shared perception of a group of its efficacy to perform a behavior and to organize and execute the actions required to reach certain levels of achievement” (Bandura, 1997, p. 447). From a sport psychology perspective, collective efficacy beliefs depict the teams’ shared confidence in the team’s ability to generate collective action and successfully complete a sport task relative to a specific goal or criteria (Short et al., 2005).

[26] As defined by West et al. (2009, p. 254), *team resilience* is a “team level capacity that aids in the repair and rebound of teams when facing potentially stressful situations. Teams which display the ability to either thrive under high liability situations, improvise and adapt to significant change or stress, or simply recover from a negative experience are less likely to experience the potentially damaging effects of threatening situations.”

to), the requisite actions or activities are largely based on a ***rational model*** that presumes there to be an optimal or “best” solution in given circumstances.

According to the functional perspective, factors emanating from within the group (e.g., homogeneity/heterogeneity of member cultural or talent/skill composition, group size), and external circumstances (e.g., outside threat, time pressure, match venue location, weather, etc.) affect how the group performs. Thus, group performance is a causal outcome of these internal and external outputs. However, the possibilities are numerous in that inputs can generate many potential outcomes, and vice versa, one outcome can be the product of multiple inputs. Moreover, inputs may interact with outputs and this interactive relationship / process (e.g., communication, coordination, conflict management) can influence group outcomes causally. Thus, the functional perspective assumes a sequential causal string: input factors influence interaction processes, which influence group performance outcomes (e.g., team sporting results).

In sum, the functional perspective explains many group decision-making and performance dynamics. Its strength lies in its ability to predict and explicate task-oriented group performance as influenced by static inputs and processes. However, performance is evaluated against normative criteria that identify how groups should perform, assuming the existence of a *rational* model. In other words, the assumption is that if members act logically, using reason and conscious deliberation, an optimal rational decision can be reached. Researchers in the functional tradition generally assume that they understand group processes and outcomes better than the group members (Hollingshead et al., 2005). Another characteristic of functional theories is that they consider group outcomes to be a linear function of inputs and processes, with group action viewed as the product of a chainlike series of events. However, linearity fails to explicate cyclical, nonlinear group dynamics or reverse causality. Therefore, the functional perspective cannot account for dynamic systems that are complex and adaptive.

1.4.2 Social Identity Perspective

The social identity perspective defines the group as a subjective entity, and explains groups in terms of members' sense of the social groups to which they belong, their identification with these groups, the social identity they construct based on this identification, and the dynamics between ingroups and outgroups driven by social identity (Poole et al., 2005). Key theories within this paradigm are social identity theory[27] (Tajfel, 1970, 1981; Tajfel & Turner, 1979), self-categorization theory[28] (Turner et al., 1987), as well as variants / developments of these such as optimal distinctiveness theory (Brewer, 1991), social self-regulation model (Abrams 1994), common in-group identity model (Gaertner & Dovidio, 2012), subjective group dynamics model (Abrams et al., 2003) and many other. The primary focus of theories within this perspective is on the relations between different social groups, but also on within-group dynamics, although to a lesser extent. Effects at different levels are considered in cross-cultural studies, with small groups analyzed in larger societal contexts (e.g., value orientations or preferences for conflict resolution approaches and how these impact leadership behaviors). In sport, social identity theories have been applied to examine various aspects of individuals' identification with sport entities or *fandom*, (e.g., Branscombe & Wann, 1992; Gantz, 1981; Wann & Branscombe, 1990, 1993). Scholars have investigated how and why fans develop psychological connections to sporting clubs/teams and how these connections influence behaviors and self-understandings (e.g., Fink et al., 2002; Heere et al.,

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[27] *Social identity theory* addresses the ways that social identities affect people's attitudes and behaviors regarding their ingroup and the outgroup. Key processes associated with social identities include *within-group assimilation* (pressures to conform to the ingroup's norms) and forms of *intergroup bias* (positively evaluating one's ingroup relative to outgroup (i.e., ingroup favoritism) and possibly negatively evaluating the outgroup.

[28] *Self-categorization theory* concentrates more directly on the mechanisms by which the self becomes transformed from an individual to a group member. People categorize the self and others in ways that are contextually fitting. Key consequences of social categorization is group polarization and depersonalization.

2011; Heere & James, 2007; James, 2001). The phenomenon of home field advantage has also been studied through the lens of social identification theories (Jamieson, 2010).

Important inputs in social identity approaches include the structure of the surrounding society, culture and cultural understandings of self (e.g. relational and collective self), member characteristics, and cues that make group vs. individual identity salient. Self-categorization, depersonalization, inclusion/exclusion, social influence, stereotyping, and intergroup conflict are some of the key processes. Relevant outputs for social identity theory include member self-concept, cohesiveness, loyalty, turnover, conformity, and social loafing. Similar to functional approaches, the self-categorization perspective draws on cognitive understandings and assumes linearity of relationships between inputs and outputs. Related research has primarily relied on experimental and quasi-experimental designs with emphasis of laboratory simulations involving conceptual rather than naturally occurring groups such as sports teams, although the phenomena of fan identification and home field advantage have been investigated using various other methods.

1.4.3 Conflict-Power-Status Perspective

This perspective explains groups in terms of the dynamics of power, status, resources, and social relationships, and the group structure associated with these processes. Related theories and lines of inquiry include the power-dependence theory (Emerson, 1962, 1964), the bargaining and coalition theories (Komorita & Chertkoff, 1973), game theory (e.g., Camerer, 2003; Colman, 1995; Schroeder, 1995), social exchange theory (e.g., Thibaut & Kelley, 1959), or social dilemma research (Komorita & Parks, 1995; Ostrom, 1990). Group composition (i.e., as a function of **diversity** in cultural/ethnic composition, skill/talent, value orientations) has been an important component (variable) of conflict-related research, which differentiates between personal, task (cognitive) and process conflict (Jehn & Mannix, 2001). A popular stance among scholars is that diversity enhances decision quality in groups through the presence of task-related cognitive conflict. Researchers seek to disentangle the different types of compositional diversity and their effects on process and performance, typically mediated by conflict. Conflict-oriented studies have largely assumed that minority groups (i.e., subgroups within sports teams) conform to majority norms/culture (Asch, 1951). An alternative view was postulated by Moscovici (1976, 1980), who argued that it is also possible for a minority to influence the majority via either *compliance* (i.e., individuals publicly conform to group norms but privately reject them) or conversion (i.e., convincing the majority to conform to the minority).

Theories within this paradigm generally assume there are inequalities among members in terms of resources, status, and power, and focus on how these inequalities are generated and reproduced as well as how they influence group processes and outcomes (Lovaglia et al., 2005). In sport psychology and sociology, diversity research has traditionally focused on ethnic/racial minorities (e.g., Butryn, 2002, 2009; Blodgett et al., 2017; Book et al., 2020). However, in recent years, cultural sport psychology (CSP) has extended its reach to other marginalized athletes and groups (Light et al., 2019; McGannon & Schinke, 2015;) functioning within larger society but also within smaller groups such as multinational teams (Darpatova-Hruzewicz & Book, 2021).

Inequalities within and between groups are also addressed by game theory, which seeks to provide mathematical solutions for an optimal course of action in a competitive or co-operative situation based on the *Nash equilibrium*[29] (Nash, 1950). Game theory is applicable to any social interaction involving decision-making at individual or group level,

[29] The *Nash equilibrium* (Nash, 1950, 1951) is central to classical game theory, and is concerned with optimum strategy for multiple players in games. The main idea is that in non-cooperative games there exists a set of optimal strategies, so that no player can benefit by unilaterally changing their strategy, if the strategies of the other players remain unchanged (Sindik & Vidak, 2008). In a two-person game, an equilibrium point is a pair of strategies that are best replies to each other, or in other words, a strategy that maximizes a player's payoff, given the strategy chosen by the other player. The existence of a *rational solution* implies the existence of *an equilibrium point*.

and as such has been instrumental in analyzing strategy in sport. Flanagan (1998) used a mixed strategy model to analyze the optimal proportion of left- and right-handed players in the lineup of baseball teams. Boronico and Newbert (1999) built a complex model combining game theory and stochastic dynamic programming to determine the optimal game plan for an American football team after the first down and goal. In soccer, McGarry and Franks (2000) used a probability model to simulate the outcome of a penalty shoot-out. Walker and Wooders (2001) tested mixed strategy for serving in tennis. Finally, Kai (Kyle) Lin (2014) applied game theory for volleyball strategy. The aforementioned research adopts a rational view of the strategy-outcome relationship, in that cooperation involves rational decision-making by players or teams. However, rationality does not explain complex team behaviors, where decisions are driven by the collective interest, even if it conflicts with individual rational choices/preferences. Moreover, equilibria come into being divorced from a dynamic process (Samuelson, 2016).

1.4.4 Evolutionary Perspective

Scholarship within this perspective is concerned with the influence of evolutionary forces on group structure and inter-/intragroup interactions. Evolutionary psychologists (e.g., Buss, 1999, 2005; Campbell, 1975, 1982; Campbell & Gatewood, 1994; Kameda & Tindale, 2006) argue that human preferences for certain types of groups and general norms that govern group behavior (e.g., cooperation) have evolved since the advent of humankind through a process of variation, selection, and retention (natural selection). Group-level adaptations come in many different forms, and behavioral elements. Evolutionary psychology represents an enormously diverse set of theories, which differ in how they conceptualize groups (Gangestad & Simpson, 2000). Some scholars treat groups as simply aggregates of rationally self-interested individuals (or dyads), with the assumption that group behavior is a product of individual behavior (dyadic interactions) that scales up to the group level (Palmer et al., 1997). For instance, this approach is typical of social psychological game theory[30] (Axelrod, 1997; Gintis, 2000; Van Vugt et al., 2007). Other researchers view groups as meaningful entities that have evolved along with cultures through group selection at the cultural level, and they focus on cultural variation in group behavior (Boehm, 1996; Boyd & Richerson, 1985). A few theorists posit that the small group is in fact a basic unit through which human society has evolved, and propose that groups are structured as a nested hierarchy of subgroups (Caporael, 1997; Dunbar, 1993). A number of cross-cultural psychologists who draw on evolutionary theory such as Van de Vliert (2009) or Inglehart (1990; 1997) also view small groups as nested within larger societal groups.

1.4.5 Dynamics (Temporal) Perspective

The temporal perspective is a process-focused view that treats groups as systems, and provides explanations on how groups change or develop over time. Some theories in this perspective focus on development, whereas others examine change *per se*, however, all emphasize process over inputs and outputs. Inputs function primarily as contingencies that influence how the process unfolds. Outputs are products of the process and, in some cases, also feedback to influence it. A broad array of theories and research is subsumed under the temporal perspective, which includes studies on group development (Hill & Gruner, 1973; Poole & Baldwin, 1996; Wheelan, 1994; Wheelan & Kaeser, 1997), the group socialization model (Moreland & Levine, 1982), collective action theory (Olson, 1965) or complexity models of groups (Arrow et al., 2000).

Pertinent to this dissertation is the conceptualization of **groups as complex systems**. This approach abandons the search for simple, straightforward patterns and theories to explain

[30] Psychological game theory is a burgeoning area in the behavioral sciences. Social psychologists employ experimental methods to study interactions between players in games such as the prisoner's dilemma game, the ultimatum game, the dictator game, and the public good game in which players allocate resources. Using an evolutionary lens, research has identified a number of social adaptations.

group behaviors, and instead embraces the notion that complexity and complex dynamic patterns are inherent properties of small groups. Related theories share a set of assumptions. First, groups are influenced by a variety of factors that interact in *nonlinear fashion*. Second, the behavior of the system is marked by *emergent* phenomena. Third, group systems are composed of *multiple levels*, both within the group and between the group and its environment, and cross-level influences are *complex* and nonlinear. Fourth, the behavior of group systems is unpredictable, characterized by novelty, discontinuities (thresholds), and multiple causal factors operating at different levels and times.

The framework of groups as complex systems (Arrow et al., 2000) adapts ideas from the interdisciplinary field of *complexity science* to conceptualize groups (e.g., sports teams) as open, adaptive systems that interact with component systems (i.e., team players), which are hierarchically embedded within them and within multiple larger systems (e.g., leagues, countries), thus displaying a multiplicity of embeddedness. The collective behavior of group-level activity emerges out of the interactions of group members, and the behavior of the collective evolves over time based in part on the *constraints* of the group’s embedding contexts (Arrow et al., 2005). Importantly, this evolving group behavior cannot be deduced from nor reduced to the characteristics or the agent’s (e.g., player’s) individual behavior; rather the dynamic within-system interaction gives rise to a unique Gestalt[31] that is not reducible to the system’s additive components (group members), and the same elements can be reorganized into different wholes (Read et al., 1997). In other words, group/system behavior depends not on the details of its components, but on the ensemble of nonlinear interactions among its components. Moreover, the hierarchical organization of complex systems (i.e., from local to global levels) implies that interactions among components occur

[31] Krech and Crutchiefled (1948) were among the first social psychologists to use Gestalt psychology to frame behavior and cognition in terms of constant (dynamical) reconfiguration in response to conflicting psychological forces.

both within and between levels, and this ordered behavior is not imposed from outside the system but emerges out of the system in a process of *self-organization*. In this regard, social psychology theory tends to assume that some higher level agent is necessary to impose order to lower level elements[32] (Nowak & Vallacher, 1998). Contrastingly, the principle of self-organization implies that the interaction among low level elements, which are involved in mutual adjustment, facilitates the emergence of coherent structures and behavior, thus framing the coordination of the lower level elements (Haken, 1978; Kelso, 1984, 1995). In other words, complex systems have the capacity to display hierarchically generated dynamics and to evolve even in the absence of external influences. In sum, the emergence of patterns, self-organization, irregularity and associated unpredictability are characteristic traits of nonlinear dynamical systems. Even if a system shows constant adaptation/evolution, it is considered stable as long as the changes in interaction conform to a reliable pattern.

The complex interactions within and between systems are explained by various theoretical models of action. Von Cranach's (1996) action theory is concerned with group systems and other social systems and environments. It is founded on three basic principles: (1) *multilevel organization* (i.e., individual, group and several societal levels); (2) *self-activity*, understood as individuals and systems acting on their own, directed by information and energy from within rather than from outside, and interacting with their environments; (3) *historicity*, meaning that human affairs are historically embedded and thus should be studied in the context of previous history. As groups act, they coevolve with other interlocking systems on multiple levels. Group action is organized around tasks in a structured way, for instance, by assigning tasks to members depending on their roles in the group. This

[32] For instance, in a group context, it is commonly assumed that leadership and social norms are necessary to impose order on the interactions among individuals comprising a given group (Nowak & Vallacher, 1998). Similarly, intergroup relations are commonly assumed to achieve coherence by way of endorsement of cultural values, customs, and adherence to formal laws/regulations. In the case of the human mind, such assumptions lead to the philosophically untenable notion of the homunculus – the mind-within-the-mind that itself cannot be explained without invoking an infinite regress (Ryle, 1949).

conceptualization of action reflects the task-oriented coordination of game play in football teams, with players fulfilling specific roles in relation to the realization of field/game-related tasks. Long and short-term activities during a match can evolve (e.g., phase transition from defense to attack), with the group (team) coevolving with other groups (i.e., the opponent team) in coordinating action. Group structure is linked to information processing and to task execution, and is the product of task interaction, system dynamics, member characteristics, history of the group as well as environmental influences. Thus, action theory is a theoretical frame on which situated theories of group processes can be built such as Tschan's (1995) model on the effects of communication on group task performance or Gibson's (1979) direct perception-action model (discussed in greater detail in the following subsections) and Wakefield and Dreyfus's action model (1991), which emphasizes the role of *intentions* in skilled actions, engendered by the coupling of perception and action.

1.4.6 Role of Cognition: History and Debates

In addition to the theoretical perspectives described above, the study of sporting behaviors has been shaped by philosophical (i.e., theories of mind) and scientific cognitive understandings of the mind-body relationship. The debate on the role of the body in cognition can be traced to Plato (428/427 to 348/347 B.C.) and a plethora of modern thinkers, most notably Descartes (1596-1650), but also Spinoza (1632-1677), La Mettrie (1709-1751), and Condillac (1715-1780). The current debate about embodied cognition was initiated by disagreements between behaviorists and cognitivists. Continued tensions within the cognitive sciences (i.e., between contrasting functionalist and neurobiological accounts) shifted the focus on internalist explanations of brain function, thus diminishing the role of body and environments. These tendencies facilitated the emergence of contemporary views on embodied cognition such as the *enactivist* perspective, which centralizes the dynamical coupling of brain-body-environment (e.g., Clark & Chalmers, 1998; Hutchins, 1995; Varela et al., 1991). Many of these scholars were inspired by Gibson's ecological psychology and his ideas that cognition is not limited to processes in the head, but is embodied, embedded, extended and enactive. Over the past two decades, the representational and computational model of cognition underpinning traditional cognitive science has attracted much criticism (Walter, 2014). According to the model, cognition is an information process, which is located in the brain, and consists of syntactically driven manipulations of representational mental structures (Newen et al., 2018). This conception of cognition draws on structural-functionalist claims (section 1.4.1) that cognitive phenomena are contingent on their functional role, and therefore form an autonomous level of analysis. Contrastingly, in embodied cognitive science, the pivotal role of an agent's body (i.e., its biological, morphological and physiological characteristics) is recognized, along with its active and embodied interaction with the natural, technological, or social environment (Newen et al., 2008). Importantly, the body-environment interaction is assumed to be dynamical, reciprocal and occurring in real time, or in line with the dynamics (temporal) perspective (section 1.4.5).

In sum, embodied cognitive science departs markedly from the traditional computational view that the brain is the sole basis of cognitive processes. However, embodied cognitive approaches differ on two key aspects: (1) constitution and (2) representation. Constitution refers to the degree of involvement, strong or weak, of various "extracranial processes"[33] (i.e., processes taking place outside of the brain) in cognition. *Strong* embodiment implies that cognitive processes are partially constituted by extracranial processes or essentially based on them, whereas *weak* embodiment infers a non-constitutional relatedness, meaning that cognitive processes are only causally dependent upon extracranial processes. Weak embodiment is equivalent to the property of *being embedded*, i.e., being

[33] Newen et al. (2018) refer to extracranial (extrabodily) processes in relation to where cognition is supposed to take place, drawing on the notion of "contingent intracranialism" defined by Adams and Aizawa (2008).

causally dependent on extrabodily processes in the environment. Note that cognition scholars differ in their commitments to the claims to embodiment and embeddedness. Another debatable issue in embodied cognition concerns what role, if any, *mental representations* play in cognitive processing. Related theories span from radical anti-representational and anti-computational approaches (e.g., Chemero, 2011; Thelen et al., 2001) to more moderate versions of embodied cognition such as “wide computationalism” (Wilson, 1994) or “extended functionalism” (Clark, 2008). An interesting comparative perspective is provided by Raab and Araújo (2019), who discuss the empirical findings of two studies involving decision-making in sports from the vantage point of two embodied cognition approaches, one that showcases moderate embodiment (i.e., assuming the mediation between athletes and their environments), and another exemplifying radical embodiment (i.e., assuming direct contact with no representation).

Pertinent to this dissertation is the debate on whether motor “representations” are in fact representations. Several authors (e.g., Butterfill & Sinigaglia, 2014; Jacob & Jennerod, 2003) have argued that sensorimotor representations are object-oriented actions (i.e., passing a ball to a specific teammate), which use a “pragmatic” mode for the selection of appropriate movements. They are in fact more primitive and informationally impoverished compared to representations used for other aspects of object-oriented behavior such as categorization or recognition. Their function is in part sensory and in part motor, and as such relational (Desmurget & Grafton, 2000). Some authors claim that motor “representations” meet less demanding criteria for representationality such as those set by Bermúdez (1998)[34], while others argue that motor intentionality is better characterized nonrepresentationally in terms of

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[34] Bermúdez (1998) proposed that for a state to qualify as representational, the following criteria should be met: (1) the state should have correctness conditions and allow for the possibility of misrepresentation; (2) it should be compositionally structured, (3) it should admit of cognitive integration; and (4) it should play a role in the explanation of behavior that cannot be accounted for in terms of invariant relations between sensory input and behavioral output.

dynamic systems of self-organizing continuous reciprocal causation between sensorimotor processes and the environment (e.g., Dreyfus, 2000; Gallagher, 2008). Another argument, used by represenationalists and mild embodiment scholars is that core "complex" representations required in ubiquitous perceptual classification such as recognizing categories of things (e.g., books, animals), or types of intentional movements of players on the field (e.g., moves intended to deceive the opponent, or moves suggestive of moving the ball to a particular section of the pitch) cannot be explained solely in Gibsonian terms without adding numerous complex and often unfounded assumptions (Glenberg et al., 2013). This so called "prototype abstraction"[35] is a purely cognitive human activity, rooted in the relationships among encoded memories (Goldinger et al., 2016). Counter-arguments have been offered by some radical embodiment scholars on a similar concept of *analogical reasoning*, deemed to be a uniquely human cognitive ability. Young and Wasserman (1997) suggested that the higher-order variable *entropy* carries sufficient information for animals to perceive sameness and difference, and to engage in analogical reasoning without relying on mental representations[36].

To conclude, cognition theories are situated at opposite ends of a continuum, with social cognitive (representation and computational) at one end, and radical embodiment (nonrepresentational and noncomputational) at the other.

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[35] Prototype abstraction refers to people's ability to fluently recognize objects that they have never previously encountered (Posner & Keele, 1968, 1970). This indicates that people have strong intuitive ideas about category prototypes, their central tendencies or best representations. Two major theories explain how people derive prototypes: based on porotype views (e.g., Reed, 1972), or based on exemplar views (e.g., Nosofsky, 1988). Both theories acknowledge that people are engaged daily in the recognition of new instances of already known categories, and use prior knowledge to mediate new perception.

[36] In a series of experiments involving a relational matching task, Ed Wasserman and his colleagues demonstrated that pigeons and baboons can perceive sameness and difference in arrays of icons. Interestingly, as the number of icons in the array to be matched decreased from 16 to 2, the ability of pigeons and baboons to correctly match arrays dropped significantly. The explanation provided was that larger arrays were easier to match on sameness and difference, because the animals responded to the *entropy* in the arrays. Smaller arrays were more difficult, because differences in entropy on which to make discriminations were smaller.

1.4.7 Theoretical Implications for the Dissertation

This dissertation aims to investigate research questions and hypotheses related to the sporting behaviors of football teams. This formulation raises two principal questions of a theoretical nature. First, are small groups, including sports teams, proper units of psychological analysis? Second, how is theorizing for this dissertation constructed to reconcile the seemingly different paradigmatic perspectives afforded by the social and sports sciences? The answer to the first question is relatively straight-forward and draws on the above review of small groups psychology. Addressing the second question requires more elaborate justification, which is provided partially below, and is also covered more specifically within each study.

With reference to the first question, the disagreement on what constitutes proper level of psychological analysis dates back to the beginning of the 20th century. Sociologically oriented social psychologists, who examine groups as determinants of social behavior, tend to view groups, small and large, as meaningful entities that exhibit unique behaviors. Contrastingly, psychologically oriented social psychologists, who focus on determinants within the individual, tend to treat groups as subjective entities that exist in the minds of individuals, and group behavior as the aggregate of individual behaviors. In this regard, cross-cultural psychologists have long warned about the dangers of scaling individual level data up to the group (societal) level and vice versa, *that is*, inferring individual-level relationships from group aggregated data. There are a number of so called multilevel fallacies[37], including construct-aggregation fallacy when constructs (or relations of constructs) of lower order units are incorrectly applied to higher order units, or **ecological fallacy** when characteristics of

[37] Multilevel fallacies can take different forms, and four types have been identified in multilevel research: type A, B, C & D errors (Van de Vijver & Poortinga, 2002). Type A involves construct-aggregation fallacies when constructs of lower units are incorrectly applied to higher order units. Type B is committed when a higher level construct or relationship is incorrectly applied to a lower level of aggregation. In Type C and type D fallacies, quantitative differences in score scales are incorrectly applied at a lower or a higher level.

counties are applied to individuals. For instance, Schwartz (1992, 1994) argued that values at the individual level and culture/societal level (the latter based on individual level scores aggregated per country) do not have the same structure; the country level structure is simpler than and overlaps only partially with the individual level structure. To this effect, Schwartz admitted to committing ecological fallacy in his earlier research and consequently resigned from the use of aggregated measures (Schwartz, 2014). Finally, although sport psychology has historically emphasized individual units of analysis, in the past two decades a sharp turn was made toward identifying and investigating team level phenomena such as team cohesion, collective efficacy, team cognition, etc. Given the impressive number of theories on the psychology of small groups, albeit within varying perspectives, the choice of sports teams as levels of analysis for collective behaviors seems well justified.

Addressing the second question, the theoretical framing of this dissertation was driven primarily by considerations pertaining to the sporting context, in which the research questions and hypotheses are formulated. Specifically, all three studies examine different aspects of *team behavior*, ranging from how the game of football is played in terms of style, to the factors that contribute to teams' sporting success. Moreover, styles of play and team performance are analyzed as group level phenomena, given that football is a team sport. Despite the contention that behavior is central to psychological theory and research, the first three theoretical perspectives (i.e., functional-structural, social identity, conflict-power-status; see sections 1.4.1, 1.4.2 and 1.4.3 respectively) focus on the more abstract notion of "action", which links overt behavior to the mental underpinnings that give rise to it (Wegner & Vallacher, 1987). Conventional social and sport psychology centralize the role of mental processes within the individual, thus effectively decoupling human action from issues of motor control, interlimb coordination, patterns of movement etc. (Nowak & Vallacher, 1998). This mentalizing perspective is innately subjective, and contrasts with the relative objectivity of performance measurement, which treats sporting results (i.e., win/loss, points earned) as derivatives of concrete actions rather than subjective assessments that occur in the minds of individuals. Furthermore, all perspectives (with the exception of the temporal/dynamic) are guided by social cognitive (i.e., representational) models of human behavior, and linearity assumptions. However, competitive sports performance is characterized by complexity and a high degree of uncertainty. The outcome of a match depends on a myriad of variables ranging from physical (weather and pitch conditions), contextual (home or away game), players' skill level/expertise, coaching instruction, tactical preparation, team coordination, the opponent team, etc. Unlike higher order cognitive function, movement-related behavior is better explained from an embodied perspective. In recent years, advances in theory and research on complex dynamical systems, especially in the sport sciences, have offered a platform for bridging discrepant views on small team dynamics. In this dissertation, the temporal/dynamic approach is viewed as embodied and embedded, and as such is employed to provide the scaffolding upon which ecological, sport and cross-cultural psychology stand to produce new knowledge and gain empirical insights on team behavior in sport. The remainder of this section elaborates on the justification for the use of ecological dynamics within an embodied cognition framework. *Ecological dynamic*s is contrasted with *social cognitive models* in the context of sport psychology, so as to demonstrate how the former provides a more opportune fit in meeting the aims of the doctoral project.

1.5 Sport Psychology Paradigms

In sport psychology, the research on team behaviors has traditionally adopted a social orientation (Eccles, 2010), being predominantly concerned with the investigation of social phenomena in team dynamics (e.g., group development, group norms, social roles, group conflicts, social climate, social loafing, etc.), less so with team processes (e.g., communication, coordination, leadership, decision making) or team constructs such as cohesion, efficacy, resilience. Although many insights have been gained within cognitive sports psychology about skill acquisition and competent sport performance (i.e., with regard to perception, attention, and memory processes), the focus has historically been placed on the individual as the unit of analysis as opposed to the team. In the last 10 years sports psychology scholarship has moved beyond notions that team-level phenomena (e.g., team cognition) are more than just the sum of its individual parts (Eccles & Tenenbaum, 2004), and towards greater convergence of cognitive and social conceptualizations of team functioning, specifically relating to coordination, decision-making and learning as key team processes. These processes underpin team behaviors, which in turn shape the production of game play or playing styles. To advance related understandings, scholars in sport psychology have relied on two main theoretical paradigms[38], namely the **social-cognitive** approach and **ecological dynamics.** These are largely situated within the *structuralist-functional* (section 1.4.1) and the *dynamics (temporal)* (section 1.4.5) perspectives respectively, although social-cognitive models used in sport psychology also draw on social identity, and to a more limited extent, on conflict-power status perspectives. The topology presented in section 1.4 groups underlying theories based the distinct but relatively broad resemblance of their assumptions about what is important for small group functioning. Within these broad theoretical contours, new paradigms have developed to account for the idiosyncrasies of particular groups such as sports teams, and to accommodate the specificity of research questions investigated within given disciplines, including sport psychology. The social-cognitive (representational/computational) and ecological dynamics (radically or moderately embodied) models commonly applied in sport psychology are compared and discussed below.

[38] In addition to the social cognitive and ecological dynamics approaches, collective behaviors in sport have been studied using the less popular *enactive* approach, also referred to in section 1.4.6. The enactive perspective embraces phenomenological understandings of lived experience (more in Araújo & Bourbousson, 2016).

1.5.1 Social-Cognitive Models

The social-cognitive approach centralizes the role of team cognition in the functioning of sports teams, specifically their ability to coordinate member actions and achieve mastery. Team cognition[39] has been used in cognitive and social psychology to explore how shared knowledge can be represented in groups of coordinating individuals (Cannon-Bowers et al., 1993). This paradigmatic stance is grounded on the premise, considered foundational to cognitive science, that performance (individual or collective) is buttressed by the existence of a representation or schema, responsible for the organization and regulation of behaviors (e.g., Rentch & Davenport, 2006; Araújo & Bourbousson, 2016). The assumption of shared knowledge results from the possession by team members of complementary goals, strategies and relevant tactics that provide a basic shared understanding of desired performance outcomes, thus directing how each team member individually, or the team globally, aims to achieve a set performance goals (Ward & Eccles, 2006). Team members' expectations about each other's actions allows them to coordinate quickly and efficiently, and to adapt to the dynamic changes and demands of competitive performance environments. Coordination is achieved by selecting appropriate goal-directed actions to execute at appropriate times (Eccles, 2010; Salas et al., 1997). In this context, the processing of information is considered to play a crucial role in understanding how shared cognitive entities provide the basis of players' decision making within teams (Reimer et al., 2006). This traditional view of cognition focuses on the "analogy between the mind and the digital computer" (Eysenck & Keane, 2001, p. 1) as an input-process-output framework, thus highlighting the mediating role of mental representations. Sports teams are portrayed as information processors that measure

[39] There are numerous concepts and constructs used in the literature with reference to team cognition, including schemas, mental models, knowledge structures and cognitive representations. In this dissertation paper, I use these terms interchangeably, also to include *shared* (or collective) mental models, structures and representations.

cognition at the individual (team member) level with results being aggregated at team level, or directly at the team level to reflect team processes and structure (e.g., Hinsz, 1999).

Research conducted within the social-cognitive paradigm has generated evidence of the association between shared knowledge and team effectiveness (Kozlowski & Ilgen, 2006; Mohammed & Dumville, 2001), and shared knowledge and collective efficacy (Shearer et al., 2009). It has been proposed that the degree of shared understanding of particular situations, actions and events impacts team cohesiveness, which in turn affects team coordination (Reimer et al., 2006), with higher cohesion signifying higher levels of coordination. Team efficacy thus increases "when a sophisticated, global and comprehensive representation of a collective action, linked to a mental representation of a performance context, is somehow shared by all players and put into practice" (Araújo & Bourbousson, 2016, p. 127). In other words, shared tacit understandings develop during simultaneous coordination of actions of team members that lead to an increase in the degree of similarity in individual representations. In this sense, potential discrepancies between the goals of individual performers and those of the team are indicative of insufficient "sharedness", with resulting difficulties in coordination between performers (Eccles, 2010).

At the individual level, the information-processing or computational approaches assume that "skilled action requires the deployment of effortful, top-down cognitive control processes whose function is to structure and coordinate multiple lower-level (perceptual, mnemonic, affective, motor) processes toward the attainment of the represented goal" (Bermúdez, 2017, p. 901)[40]. Memory plays a key role in the formation of mental

[40] Contemporary embodied approaches to cognition tend to embrace an intellectualist rather than a purely automatic account of skilled action. One influential assumption in the literature of skilled action is that expert motor behavior is automatic and reflex-like (Montero, 2016; Papineau 2013, 2015). Although intellectualist conceptions accept some degree of automation, they place emphasis on the intelligent rooting of skilled action characterized by "meaningful or semantic" interaction between the content of the motor and goal-representations through skill execution (Fridland, 2014, 2017). Thus, it can be said that skilled actions are neither *mindful* (based on conscious reflection), nor *mindless* (purely reactive and automatic), but *minded*, that is, involving some form of cognitive control (Segundo-Ortin & Heras-Escribano, 2020).

representations/schemas through the deployment of the mechanisms of encoding domain-specific information and its retrieval from long-term memory structures, whereas practice and experience are deemed to enhance these processes (Eccles, 2010; Eccles & Tenenbaum, 2004; Silva et al., 2013). Shared knowledge thus constitutes an emerging state that can be achieved by teams, and the amount of such shared knowledge (both explicit and implicit) is taken to discriminate between novice and expert teams. As shared knowledge is updated over time in dynamic sports environments, respective adjustments of individuals' representations are needed to maintain the validity of knowledge shared prior to the performance and hence ensure accurate anticipation across team members (Reimer et al., 2006). This updating can occur incidentally and/or by deliberate means (Eccles, 2010; Eccles & Tran-Turner, 2014).

Researchers have made attempts to understand how team members exchange and share knowledge during performance in the context of team coordination, in doubles in tennis (Blickensderfer et al., 2010; Lausic et al., 2009; Tenenbaum et al., 2005), table tennis (Poizat et al., 2009; Poizat et al., 2012), basketball (Bourbousson et al., 2010; Bourbousson et al., 2012;) and futsal (Travassos et al., 2012, 2013). For example, Bourbousson and colleagues (2010) found that basketball players coordinate their actions by making local adjustments and enhancing their interactions with a single teammate, and not by grasping the full game situation. Although shared cognition has tended to dominate research on coordination in groups, the mechanism underpinning the re-formulation of a team member's representation when changes occur in the content of another member's representation has been difficult to verify or explain (Mohammed et al., 2000). Moreover, it has proven problematic to justify the existence of a brain that stores each player's representations (Shearer et al., 2009) or that of shared mental representations beyond the boundaries of an individual organism (Riley et al., 2011; Silva et al., 2013).

1.5.2 Ecological Dynamics

Ecological dynamics combines concepts from dynamical systems theory to ecological psychology[41]. Ecological psychology is an embodied, situated/embedded, and non-representationalist approach to cognition pioneered by J. J. Gibson (1904-1979) in the field of perception, and by E. J. Gibson (1910-2002) in developmental psychology. Historically, ecological psychology sought to offer an innovative perspective on perception and perceptual learning, in contrast to the traditional psychological dichotomies of perception/action, organism/environment, subjective/objective, and mind/body (Lobo et al., 2018). By challenging these widely accepted dualisms in mainstream psychology, in the second half of the 20th century, the ecological approach became an alternative in the debate between cognitivism and behaviorism, by viewing these two competing approaches as complementary (Reed, 1991). Dynamical systems theory, which originated in thermodynamics (Kugler & Turvey, 1987) and synergetics (Nicolis & Prigogine, 1989; Haken, 1983), provides a conceptual framework for understanding neurobiological coordination at multiple levels (i.e., from behavior to brain; Lee, 1976; Kelso & Schöner, 1988; Kugler et al., 1980). Physical principles and concepts from nonlinear, dissipative, self-organizing systems explain coordination dynamics as a natural process of pattern formation in neurobiological systems (Kelso, 1995; Haken, 1996). Coordination dynamics explicates and predicts how patterns of coordination emerge, adapt, persist and change in integrated complex systems (Kelso, 1995; Haken, 1996). Thus, dynamical systems theory describes the dynamical patterns that continually form as the components of a *complex adaptive system*[42] interacting under

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[41] The leading schools of ecological psychology were influenced primarily by James Gibson (1904-1979), Roger Barker (1903-1991), Egon Brunswik (1903-1956) and Urie Bronfenbrenner (1917-1947), all of whom drew, to varying degrees, on the work of Kurt Lewin (1890-1947).

[42] *Complex adaptive systems* are defined as dynamical systems with many interacting components (e.g., players, ball, referees, pitch dimensions), whose interaction potential leads to the emergence of rich adaptive behaviors (Davids et al., 2013).

constraints (Kelso, 2012). Moreover, dynamical systems theory describes how complex adaptive systems reorganize system components over time by exploiting inherent *self-organization* tendencies. In sport, self-organization occurs during personal interactions between cooperating (within a single team) and competing (opponents) teams. Players' interpersonal coordination aims to achieve specific task goals predicated on the formation of synergies between players as elements of a complex adaptive system, that is, the team.

Given that dynamical systems theory is not a theory of behavior, it requires a complementary theory of behavior such as ecological psychology to form an integrated entity termed "ecological dynamics." The ecological scale of analysis emphasizes the role of environmental information guiding complex system behaviors (Turvey, 1992). In sport psychology, the ecological approach has adopted a predominantly Gibsonian perspective (see Davids et al., 1994; Araújo et al., 2006; Ibáñez-Gijón et al., 2017). Specifically, behavior is thought to emerge from the ongoing reciprocal relationship between (1) perception and information, which constrains movement, and (2) action, which creates information (Greenwood et al., 2016; Kelso, 1995; Warren, 2006). Reciprocity (Lombardo, 1987) and duality symmetry (Turvey & Shaw, 1995) of organisms and their environments are the cornerstones of ecological approaches.

Gibson (1979) proposed that humans can *directly perceive* the features of the environment (e.g., arrangement of surfaces, texture, object positioning), and this coupling of perception and action can be captured as opportunities for behavior/action (or options), known as *affordances*. In a sporting context, affordances are perceived possibilities for action that a player can undertake to achieve a specific goal within a dynamically changing environment.

To illustrate the concept of affordances, it may be useful to consider the sequence of tasks performed by a football player in the pursuit of scoring a goal: moving toward the ball, intercepting the ball by deceiving the opponent, navigating through the field, passing the ball to an unguarded teammate, using a gap between defenders to move the ball closer to the goal, running toward the side of the goal in anticipation of a pass, jumping up and heading the ball toward the adjacent upper corner of the goal. In selecting particular action solutions from the multitude of possibilities, players are guided by their intentions. However, the specific choices they make reflect the *affordances* that emerge and are discovered whilst engaging with the dynamic task environment. Examples of affordances include: bad passes by an opponent creating an opportunity for ball stealing; unmarked teammates, which afford passing the ball as they approach opponents; a gap between opponents affording movement up the field closer to the goal; or a soccer ball arching through the air, which affords heading to the goal only to players with the required jump height to reach the ball at a particular time (Silva et al., 2019). Thus, as posited by Fajen et al. (2009), the perception of affordances enables a continuous flow from intention formation to action execution, culminating in goal achievement.

Perception of affordances requires information about them (Silva et al., 2019). According to Gibson (1966; 1979), information refers to ambient energy fields (optical, mechanical, acoustic) that are structured by objects and surfaces in the environment and by perceivers' dynamical relations to them created during action. For instance, the patterning of optical energy available for a particular observation (i.e., the optic array) is specific to a particular relation of the observer to the environmental layout, and, therefore, presents reliable information about affordances. The implication is that perception of affordances is *direct* and unambiguous (Gibson, 1979); in other words, it does not need to be construed, inferred or computed as would be the case from a traditional information-processing perspective. The information is the optic flow pattern, and is not created in the organism's nervous system (Zhao & Warren, 2015) but gathered in active exploration of the environment. Thus, information about affordances can guide behavior directly, without mental gymnastics (Chemero, 2011).

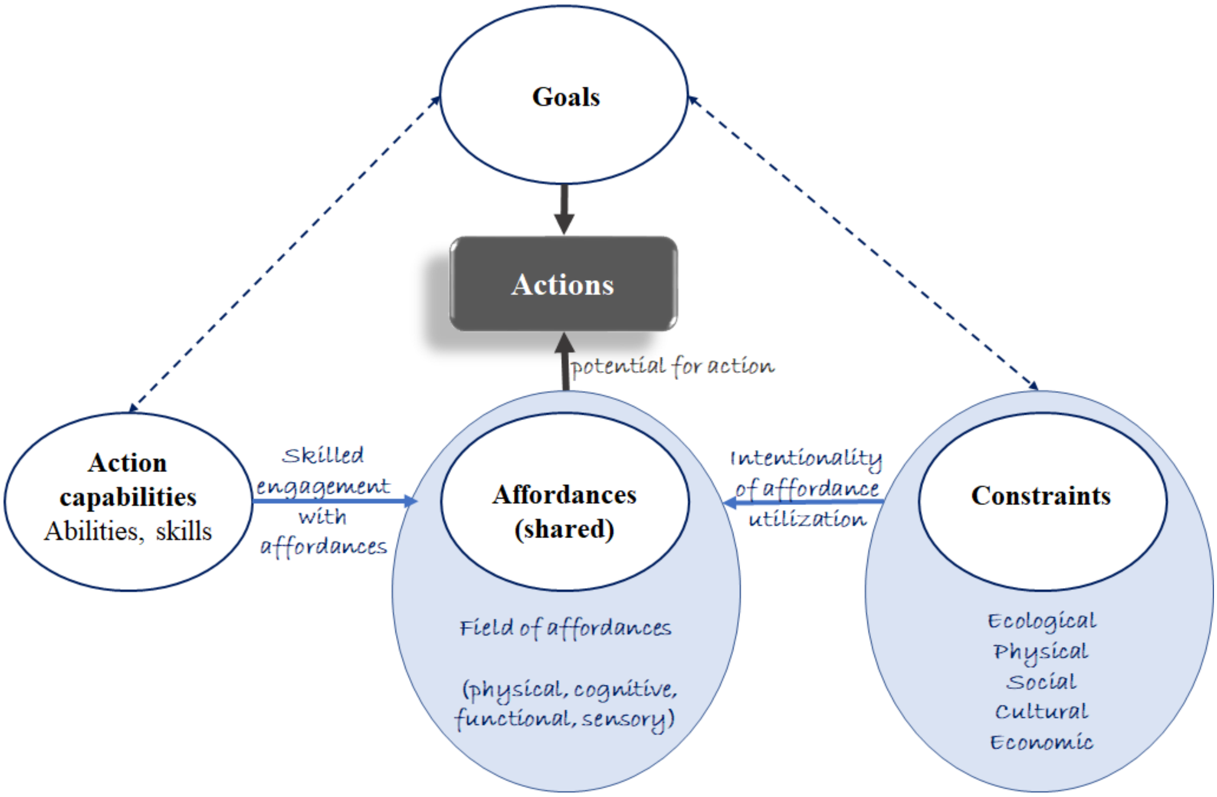
Within sport sciences, the ecological approach aims to determine the informational variables that regulate action behaviors such as passing, moving with the ball, intercepting the ball, hitting the ball, tackling an opponent, etc. Many studies provide empirical support to the idea that information regulates action directly (e.g., Fajen, 2005a; Fajen, 2005b; Michaels et al., 2006; Warren et al., 2001). Results have shown that movements can be mapped to optical patterns (informational variables) that emerge upon engagement with a particular task environments (Silva et al., 2019). Footballers can detect information from patterned energy arrays in the environment in relation to their characteristics (e.g., height) or action capabilities (e.g., attacking opportunity depending on field position; Esteves et al., 2011). Whether a gap between two defenders is passable, is not determined by its absolute size, but how it relates to the particularities (characteristics) of an individual player (e.g., their speed, size, agility). In other words, affordances are shaped both by the environment and the characteristics of players. However, affordances should not be viewed as unique causes of behavior, because a person may not act on a perceived accordance. To this effect, affordances favor certain behaviors and select against others (Withagen et al., 2012). Several authors have argued that affordances are not mere possibilities for action, but can also have the potential to attract or repel an agent, in other word, to *solicit* actions (Bruineberg & Rietveld, 2014; Käufer & Chemero, 2015; Withagen et al., 2012).

The intention to use an affordance, like other biological phenomena (Reed, 1993), emerges out of a process of variation and selection. In this way, people are “drawn into” interactions with affordances offered by a performance environment (Withagen et al., 2017). Relatedly, Kiversein and Rietvel (2015) defined *skilled intentionality* as “the individual’s selective openness and responsiveness to a rich landscape of affordances” (p. 701). This notion indicates that the everyday environment offers a range of more or less inviting affordances, however, these are relational. In other words, they are accessible to individuals with the necessary skills (e.g., developed through previous experience or practice, such as expert teams in sport) to act on them[43]. Thus, it can be said that sports athletes/teams interact with the surrounding environment through *skilled engagement* with the affordances that a specific environment offers to them, because of their unique skill set. From this viewpoint, *perceptual attunement* developed through experience brings an openness to affordances that, without skill, would not be accessible, since it is skill that opens up possibilities for action to an individual. Moreover, individuals act relative to multiple applicable affordances simultaneously, or to what Rietveld and colleagues (Kiverstein & Rietveld, 2015; van Dijk & Rietveld, 2017) termed as the *field of affordances.* For example, as the field of affordances for a goalkeeper in football only marginally overlaps with the field of affordances for an attacking player, the overlap is relatively bigger with the defensive formation players. Through experience, training and practice, individuals can display tendencies towards a specific link with the environment in a field of affordances as would be the case with decision making that illuminates styles of play. *Figure 1* provides a graphical illustration of these relationships.

Importantly, the ecological perspective assumes that affordances are realizable not only by individuals but also by groups such as sports teams, trained to become perceptually attuned to them (Silva et al., 2013). In collective sports like football, both teams have the same objective (i.e., to overcome the opposition and win). Team coordination aimed at the achievement of common goals is predicated on the team's collective attunement to *shared affordances* founded on a prior platform of (mainly non-verbal) communication or information exchange (Silva et al., 2013). Through practice players become perceptually attuned to affordances *of* others and affordances *for* others during competitive performance, and refine their actions (Fajen et al., 2009) by adjusting behaviors to functionally adapt to those of other teammates and opponents. This process allows them to act synergistically (i.e., form *synergies*) with respect to specific team goals (Araújo et al., 2015). The decisions and actions of players forming a synergy highlight the features of a situation that facilitates or perturbs interpersonal coordination within dynamic performance environments based on the perception of shared affordances (Silva et al., 2013). Related research investigating the emergence of interpersonal coordination and the dynamics of self-organization of coordinated action has demonstrated the close integration of all system interacting components (e.g., Araújo et al., 2020; Kelso, 1995; Silva et al., 2013), namely body (e.g., nervous, physiological, psychological, kinetic) and context (e.g., sociocultural, climatic, etc.). In other words, ecological dynamics highlights the *embodiment of cognition* and the *embeddedness* in the environments (Richardson et al., 2008).

Relevant to coordinated action that elicits behavioral patterns (i.e., decision making patters that materialize in styles of play), is the performers' prospective control of action, which produces movements guided by information about future states. To be successful on the pitch, players need to anticipate the actions of teammates as well opposition players in the dynamically changing environment of a match, and to adjust their actions appropriately while considering their own goals and the goals of others. The respective decision making process is not feasible by way of conscious deliberation, negotiation or verbal knowledge sharing but requires more rapid adjustments. The direct perception of information from the environment (i.e., display of actions that invite specific affordances) resulting in indirect knowledge acquisition provides players with the means of achieving effortless skillful coordination based in-action communication.

Figure 1. An ecological dynamics representation of skills, affordances and constraints.



1.5.3 Criticisms of Social-Cognitive Models

Social-cognitive models, as representational approaches to human performance, have been criticized for a number of shortcomings. As noted in section 1.4, the social cognitive perspective is based on an information processing assumption, which produces **linear** outcomes that are inherently **rational** (in terms of decision-making) and leave no room for response variability (Davids et al., 2007). In a sporting context, this assumption implies that athletes possess the necessary knowledge to conduct a cognitive evaluation of the costs and benefits of every specific performance solution. In effect, they are able to differentiate between correct and incorrect decisions, and deliberate on the "best" option that fits a particular task, however, ignoring the constraints continuously imposed on performers (Davids & Araújo, 2010; Araújo et al., 2005). Contrastingly, the ecological dynamics approach recognizes the focal role of *constrains* that give rise to variability of outcomes, and rejects the notion of "best" decision on grounds of incompatibility with open dynamic systems, where decisions are typified by temporal functionality that parlays into future decisions (Araújo et al., 2006). Some scholars have also argued that the cognitive load involved in information processing is significant, thus biologically inefficient in competitive contexts[44]. Moreover, the deliberate planning and decision making based on pre-existing knowledge, both associated with social-cognitive understandings, leave little room for emergent, unpredictable and novel situations during competitive performance. Particularly, the mechanism to explain re-formulations of team members' schema, when changes occur in the content of another member's schema, has proved difficult to verify (Silva et al., 2013). Generally, existing team cognition models fail to demonstrate how groups of expert players adapt to new changing conditions (Silva et al., 2013; Mohammed & Dumville, 2001). For instance, no plausible explanations have been offered by social cognitive science for the occurrence of sudden changes and disruptions in teams' coordination during matches, also known as "symmetry breaking." Such emergent processes can lead to changes in the structural organization of play by transforming the whole game context (Vilar et al., 2012). Thus, supporters of ecological dynamics in sport argue that behavior is not a consequence of a mental representation. They posit that internalized knowledge structures are not needed to explain behavior (Araújo et al., 2006, 2017), claiming instead that the brain and nervous system[45] represent the wrong level of analysis (Gobet, 2016). In social-cognitive models, the performer is typically regarded as the active agent, and the environment as the passive "back-drop" that merely supports an individual's selection of actions, thus leading to theorizing that awards significance to behavioral explanatory factors located within the organism (Araújo et

[44] Other scholars have shown that representational decision-making can also be efficient with fast and frugal heuristics, which are quick and accurate (Gigerenzer et al., 1999), allowing for greater flexibility of choice (Schultz, 2018).
[45] To exemplify, the mirror neuron hypothesis (Rizzolatti & Sinigaglia, 2016) is a theory, grounded on representations, located in the central nervous system, and considered to have the appropriate organizational capacity to produce behaviors (Churchland & Sejnowski, 1989).

al., 2017). This reductionist, organism-centered view of behavior that conceives of decision-making as an internalized neurophysiological process, essentially fails to recognize the reciprocity between an organism and its environment (Davids & Araújo, 2010). In this regard, proponents of ecological dynamics view the performer-environment system as the relevant unit of analysis, and therefore, understand behavior as self-organized under constraints, rather than organization being imposed from the inside (i.e., representations in the mind) or the outside (e.g., the instruction of a coach). In other words, behavior is best captured as an ongoing, dynamically varying relationship that emerges from the confluence of constraints imposed by the environment and the capabilities of a performer (Araújo & Davids, 2011).

1.5.4 Styles of Play: Ecological Dynamics Perspective

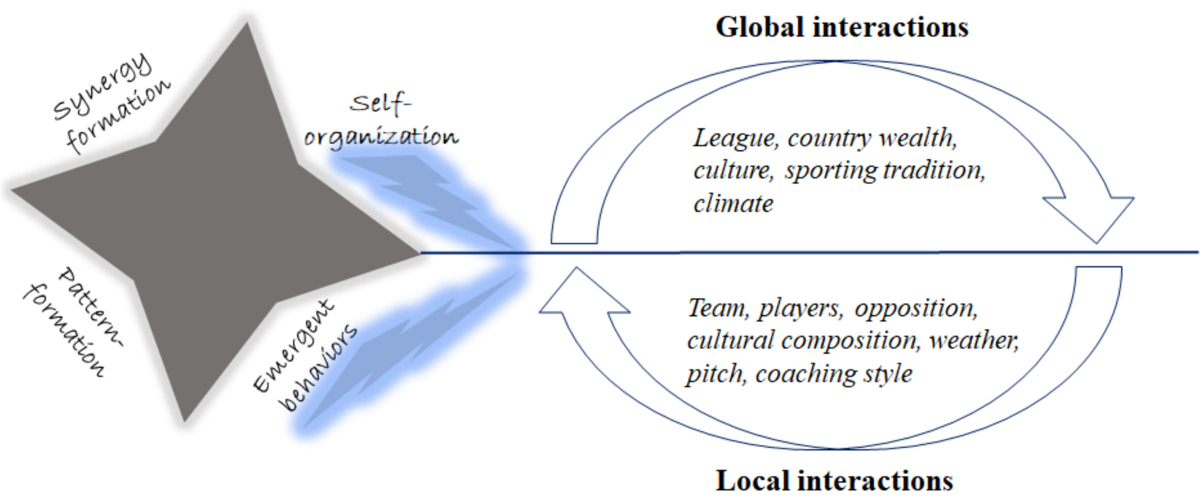
Ecological dynamics affords the paradigmatic and methodological means to accommodate for the delivery of a multidisciplinary perspective on playing styles in football. By focusing on the performer-environment relationship as a manifestation of the embeddedness and embodiment vs. representational nature of cognition, the research conducted herein seeks to advance knowledge on the social and historical “context” or the sociocultural constraints that influence the development and utilization of playing styles. From an ecological dynamics perspective, sports teams are conceptualized as complex adaptive systems (CAS) (Araújo & Davids, 2016; Davids et al., 2005) of interacting agents (e.g., players, coaches, game strategies and tactics; Hewitt et al., 2016), displaying certain tendencies such as self-organization under constraints, pattern forming dynamics, synergy formation, and emergent behaviors. Emergent behaviors and self-organization under constraints help explain the emergence of collective behaviors in such systems, with (1) *local-to-global* and (2) *global-to-loca*l self-organizing tendencies (Riley et al., 2012). The former implies that the rich patterns of behavior observed in a CAS are constrained by local interactions generated through cooperative or interactive behaviors among system components (i.e., members of a team). Conversely, the latter implies that global system behaviors govern or constrain local interactions of individual system components in a top-down fashion, exhibiting *circular causality* (Araújo & Davids, 2016; Kelso, 1995). As illustrated in *Figure 2,* such circular causality with reference to both types of self-organizing processes can signify, for instance, that players may interact locally with their nearest teammates (i.e., retrieving the ball from the pressure zone after recovering it) to produce a more complex set of behaviors in a non-linear fashion that elicits the causal relationships between the whole system (the sports team or the league) and its constituents (team members).

Dynamically speaking, football can be described as a competition between rival teams engaged in momentary states of disorder and order, the former characterized by frenzied attacking movement to destabilize player positions and numbers, and the latter - by rapid reorganization towards regaining control, possession and stability (Delgado-Bordonau & Mendez-Villanueva, 2012). Collective behaviors in football, such as cooperation and coordination among players, facilitate the creation of order and stability in an environment prone to disorder. These patterns of behaviors accompanied by player and ball movements, frequency and duration of attacking, defensive and transitional asymmetries, the speed of counter-attacks, the manner in which teams maintain possession while advancing strategically to goal-scoring areas and many other factors, characterize collectively game or playing style (Hewitt et al., 2016).

The concepts of self-organization and constraints help explain stability, variability and transitions between coordinate states in football (Glazier, 2010). Constraints are exploited by players/teams to achieve stability in terms of performance behaviors (Araújo & Davids, 2016). They also have the effect of reducing the number of configurations available to a player at any given instance, and thus facilitate adaptability and performance stability under perturbations from the environment. The dynamic instabilities in the athlete(team)-environment system trigger transitions between different behavioral states (i.e., changes from defensive to attacking action), and consequently switches between distinct behavioral patterns as a reflection of underlying decision making processes (Kelso, 1995).

Thus, styles of play can be conceptualized as *collective behavioral patterns* emerging under **constraints**, pertaining to the immediate performance context (e.g., quality of opposition, weather, pitch size, cultural composition) or macro-scale constraints (e.g., sociocultural factors, climate, coaching philosophy, national traditions in sport, etc.), predicated on collective **capabilities** and shaped by **shared affordances**. Analogously, it can be posited that the variability of playing styles and the stability in performance is conditional/constrained by team processes (e.g., synergetic behaviors), related to emerging states and team susceptibility to environmental perturbations.

Figure 2. A constraints-driven approach to conceptualizing playing styles at global (macro) and local (micro) levels.



1.5.5 Research within Ecological Dynamics

This section provides examples of studies grounded in ecological dynamics and concerned with collective behaviors in team sports. It is not meant to cover related research in a comprehensive or exhaustive manner.

Dynamical approaches to exploring cognitive phenomena often employ modeling techniques that capture specific aspects of cognitive performance. The modeling process involves analysis of time-series data, which is tested and interpreted with the aim of determining how well the cognitive phenomena in question are represented. Related research in team sports has focused on emergent behaviors and patterns thereof with the aim of identifying collective variables that express system organization and its changes over time. For instance, Bourbousson et al. (2010) measured the spatial trajectories of players as nonlinear coupled oscillators, leading to the emergence of “relative phase” as a collective variable candidate. The authors proposed that the dynamics of relative phase enhance the quantitative expression of coordination behaviors within performance dyads in team games. For instance, when both performers in a dyad move forwards and backwards (or from side to side) simultaneously, an “in-phase” (0 degrees) coupling between them can be measured. Conversely, an “anti-phase” (180 degrees) coordination emerges when two players concurrently move in opposite directions.

Another key line of inquiry within ecological dynamics focuses on how coordination in dyadic and complex dynamic systems is constrained by location of key objects in the field of play, such as the goal area and the ball, and how these constraints might shape the actions of players and teams. In research on 1v1 sub-phases in basketball (Davids et al., 2006), the authors described the organization of an attacker-defender system using the distance between the basket and the dyad as an order parameter (i.e., a collective variable that synthesizes the relevant coordinated parts of the system as a whole). The interpersonal distance between the attacker and the defender was set as a specific control parameter. The investigation considered whether changes in interpersonal distance were associated with dribbling success by attackers, and if the attacker–defender dyad became more frequently destabilized at critical values of interpersonal distance. Results showed that the attacker–defender system exhibited initial symmetry, which was subsequently broken during transition to a new state at a certain value of the control parameter (Davids et al., 2006). Research from futsal, using sequences of play, has shown that attackers often create shooting opportunities without transitioning beyond the defender but by merely facilitating misalignment of the defender in terms of their position between the attacker and the goal (Vilar et al., 2012). Results revealed how interpersonal coordination processes in each attacker-defender dyad emerged and were constrained by distances and angles of the players to the goal. To conclude, research from basketball, futsal and rugby suggests that the coordination processes within sport systems emerge from the task constraints present in specific performance environments (Araújo et al., 2004; Davids et al., 2006; Passos et al., 2008). Therefore, it is possible to interpret the dynamics of player interactions in terms of performance actions (e.g., dribbling) as emergent properties under **constraints**.

To advance understandings of cognitive function, sport scholars have also investigated **affordances**, especially their effect on different tasks such as reaching (Warren & Whang, 1987). In a study of dyadic interactions, Esteves et al. (2011) assigned the roles of attacker in a 1v1 subphase to 32 novice and intermediate basketball players. The researchers manipulated the defender's posture and measured both the postures of the defenders and attackers and the ensuing decision on drive direction, and found that the posture of defenders guided the decision behavior of the attacker. Both novice and intermediate attackers made the same affordance-based decision by driving to the side of the defender's most advanced foot (Esteves et al., 2011). Moreover, results showed that novice attackers conveyed postural information, but intermediate attackers were better at concealing it. Scholars have also investigated how action capabilities of performers influence the exploration of affordances. In an experimental study by Dicks et al. (2010), football goalkeepers attempted to intercept a penalty kick with deceptive and nondeceptive movements of the penalty taker. Results provided evidence that the behaviors of goalkeepers (i.e., related to timing and accuracy) were influenced by their individual action capabilities. Slower goalkeepers initiated their ball interception movements earlier, faster goalkeepers did so closer to the moment when the penalty kicker touched the ball. The authors concluded that the affordance exploration to intercept the penalty kick was largely dependent on the use of information on the perceiver's capabilities in relation to a specific set of environmental conditions (Dicks et al., 2010).

1.5.6 Theory Application for this Dissertation

Embodied approaches to cognition vary in terms of how strongly they embrace the Gibsonian view of direct affordance perception in juxtaposition to representationalist understandings of cognition (see section 1.4.6). Whilst some remain close the Gibsonian approach, including many scholars within sport psychology and sport pedagogy, others have departed from this framework. For instance, Julia Lupton (2014) argued that "Gibson's commitment to a model of immediate perception can seem at odds with the humanities' commitment to culture, language and history" (p. 617), especially when concerned with symbolic and creative considerations, which are difficult to fit within a Gibsonian model. This argumentation bears some relevance for fields of social science, which centralize the study of cultural, linguistic and sociohistorical phenomena. Within embodied approaches, so called *reflective* understandings of affordance perception with a focus on *affordance awareness* have recently gained popularity (Christensen & Bicknell, 2019). The notions of reflectivity and awareness are linked to the representational conception of cognition. Scholars advocating reflective approaches to affordance perception posit that dynamical processes such as self-organization cannot operate without a cognitive influence. In fact, representations can help resolve the perceptual ambiguities that arise in complex tasks and situations. It is likely that athletes draw on declarative memory to represent the structure of a particular performance situation or a learned training / competitive routine to form anticipation (i.e., through sporting enculturation). In a match context, footballers are engaged in a continuous process of anticipation and prediction of movements of the ball, teammates and opponents. This allows players to adjust their actions in relation to changing goals and circumstances.

As discussed in section 1.4.6, there are numerous points of contention within cognitive science and the embodied versions thereof. It is not the author's intention to pursue audacious goals of resolving long-ranging debates, empirically or otherwise using Hegelian logic[46]. However, the theoretical framing of this dissertation and its studies warrants taking a position on the matter of cognitive embodiment. The author concurs with scholarly claims that an embodied outlook is required to understand the dynamic interplay between individuals/ agents and their environments, and that the effects of sensorimotor processes on cognition should be accounted for. On the premises that players' behavior can be explained by both representational and non-representational decision-making, also referred to as *offline* and *online* effects in embodied cognition (Schütz-Bosbach & Prinz, 2007), the author acknowledges the role of cognition in collective match behaviors. *Online* effects refer to the influence of current information from a player's moving body on their judgement (e.g., when a players moves with the ball on the pitch). *Offline* effects relate to the self-stored experiences of movements influencing task decision-making, even in the absence of movement (e.g., football coach observing players). Online cognition is primary, and in that sense offline cognition builds upon existing cognitive circuitry for online cognition (Menary, 2018). In

[46] Hegelian logic/argumentation refers to the antiempirical methods of transcendental and continental philosophers.

proposing the Integrative Categorization-Intentionality Model (ICIM; see Study 2), the author makes the case for *cognitive integration* of sensorimotor capacities (online effects) with enculturated capacities (offline effects) for creating, maintaining, and manipulating complex systems of representation and communication in competitive environments. This model endorses the idea of theoretical complementarity of representational and antirepresentational approaches by combining the social categorization perspective with ecological dynamics. The social cognitive leg in ICIM facilitates theorizing about the footballing socialization of players or their footballing history, which affects how they detect and select affordances. The habitual utilization of affordances in turn translates into patterns of collective behaviors or styles of play.

In this dissertation styles of play and their efficiency is examined using a *constraints-led approach*, based on Newel's model (Newell, 1986), which has been applied to numerous movement science and sporting fields such as skill acquisition, motor performance, physical therapy and rehabilitation, physical conditioning, sports biomechanics and sport injuries, to name a few (Balaguè et al., 2019). In Study 2 and Study 3, constraints were hypothesized at the *macro* (e.g., country income and annual budgetary spending on sport in Study2; cultural dimensions and population level indicators in Study 3), and at the *micro* level (e.g. teams' market value, teams' cultural diversity in Study 2; cultural diversity, temperature and precipitation in Study 3). The author assumed that the constraints identifiable in the environment, in which teams operate, create alternative opportunities for action or affordances. For instance, cultural diversity operationalized as CDI (Cultural Diversity Index), was treated as a constraint for the purposes of hypothesis formulation and analysis in Study 2 and Study 3. On the premises that teams' cultural composition constrains their repertoire of collective action behaviors, the emergence of new opportunities for action was predicted, manifesting itself through varying reliance on styles of play. Similarly, the sociocultural and historical context (e.g., societal value orientations, country aggression levels) in which teams function was operationalized as a constraint, that is, defining the field of available affordances. Although the entanglement of affordances within sociocultural and historical context has been well theorized (van Dijk & Rietveld, 2017; Vaughan, 2021), the quantitative investigation of these ideas is novel and thus poses a number of challenges. For instance, constraints (and relevant affordances for that matter) gain an additional layer of complexity and abstraction when examined at the societal level, making team-level interpretation of empirical findings ever so taxing. Nevertheless, the author believes that the findings of these two studies, inspired and guided by ecological dynamics combined with social understandings of cognition, and its key role in team performance, are empirically compelling and merit appropriate scholarly consideration. The conceptualization of constraints and affordances is relatively straightforward when applied to motor behavior at the individual level in controlled lab experiments, which have dominated the ecological dynamical scene in the sports sciences. However, multilevel environments, which prevail in real life, are considerably more difficult to model and predict. Moreover, the results of such studies are less convincing, typically explaining relatively low proportions of modelled outcomes.

The application of psychological theory to Study 1 is more problematic, as it is concerned with identifying and measuring styles of play on the basis of select performance indicators and ratios gathered by way of computerized notational analysis. Such research conducted within a performance analysis framework is based on event data, which captures discrete categories of behaviors (McGarry, 2009) and lacks information pertaining to the context or the ongoing field interactions that precipitate the emergence of collective behaviors (Vilar et al., 2012). In other words, performance analysis adopts a quantitative operational approach focused on recording the frequency of discrete player/team actions, which are considered in isolation from specific performance contexts (Travassos et al., 2013). More advanced data collection methods enable the analysis of the spatial-temporal relations that characterize the emergence of match events measured by performance indicators. Spatial-temporal data allows researchers to combine the description of players' relations over space and time, and thus to investigate *how* and *why* field interactions occur in line with the tenets of ecological dynamics, specifically those involving the characterization of patterns of collective team behaviors. Many studies within ecological dynamics use spatial or sequential performance data so as to capture the associated spatiotemporal performance dynamics. Unfortunately, the data used for Study 1 provides some but limited spatial information relating to the area of the pitch, where a specific action event occurred, and does not account for temporality. For this reason, Study 1 is framed solely within performance analysis, although some of the analysis has been guided by dynamical systems theory as explained in Chapter 2.

1.6 Performance analysis

Whereas ecological dynamics affords explanations for team behavior, the discipline of performance analysis offers the tools to describe patterned behavior in qualitative terms using quantitative match data. Most performance analysis research fails to provide theoretical rationale of performance behavior. However, framing performance analysis research within ecological dynamics is associated with challenges that pertain to the type of data available as noted in section 1.5.6 above. The following paragraphs focus on the performance analysis literature concerned with playing styles in football.

Performance analysis of sport is a relatively new field of sports science and its history is rooted in biomechanics and notational analysis (Hughes & Bartlett, 2008). The scientific analysis of performance in team sports seeks to advance understanding of game behavior (McLean et al., 2019) that can inform decision making by those seeking to enhance sport performance (e.g., coaches; Maslovat & Franks, 2008). The complexities and dynamic nature of many team sports, including football warrants observation and measurement of behaviors during competitive performance as well as training. The purposes of performance analysis are varied, including assessment of technical, tactical aspects and behavioral aspects, evaluation of physical movement, video or statistical databasing, modelling, data presentation (Carling et al., 2006; Hughes, 1998), to name a few. The scientific discipline of performance analysis can be viewed both from an applied and theoretical perspective. Applied research is typically undertaken in real-world rather than laboratory settings. The focus on competitive behavior affords greater ecological validity compared to experimentally derived data. (O'Donoghue, 2014). Much of the research conducted in the discipline of performance analysis is of an applied nature, as it involves observational analysis of real-world sports performance (Fraser-Thomas et al., 2005). Theoretical studies typically use supporting evidence from real-world, objective performance data, as is the case with the data used for Study 1.

Nowadays, the role of performance analysis has evolved to meet the growing needs of analysts and researchers, who require greater technical, tactical and strategic expertise. Advances in technology have brought to the sports industry new tracking hardware and software that allow for more sophisticated data collection, storage and increased demands for data presentation (e.g., by coaches). With the growing phenomenon of "big data", the large amounts of data collected in the world of sport requires analytical resources to handle, disseminate and generate related insights. The application of performance analysis, including match analysis, in elite football has contributed not only to individual player development (Hughes & Franks, 2015) and successful player assessment, scouting and requisition (Pastor-Vicedo et al., 2017) but also to the enhancement of teams' competitive performance by enabling the creation of strategies that counter opponent teams' strengths and exploit their weaknesses (Carling et al., 2006) as well as predicting match outcomes (Miller, 2015).

Most performance analysis research in sport, including football, has focused on measuring the *effectiveness* of sporting behaviors of teams and individual players with the objective of achieving desirable outcomes. For instance, researchers have analyzed the effectiveness of passing (Cakmak et al., 2018; Goes et al., 2018; Power et al., 2017; Rein et al., 2017); counterattacks (Gonzalez-Rodenas et al., 2016); free kicks (Casal et al., 2015), attacking actions (Kempe et al., 2014; Link et al., 2016; Tenga et al., 2010b); defending situations (Le et al., 2017); possessions (Pollard & Reep, 1997; Szczepanski, 2008). Effectiveness of tactical behaviors in soccer has also been explored by identifying key variables associated with successful and unsuccessful teams (Castellano et al., 2012). Unlike *effectiveness* and *efficiency* of sporting behaviors, the actual *patterns* of behaviors, indicative of playing styles, have received considerably less attention.

Each team tends to utilize specific styles of play (Pollard et al., 1988). A team's characteristic playing pattern or a team's playing style is affected by specific strategies and tactics adopted during match-play. "Direct" and "possession" styles of play are the most commonly described attacking styles (Bate, 1988; Garganta et al., 1997; Hughes & Franks, 2005; Kempe et al., 2014; Olsen & Larsen, 1997; Redwood-Brown, 2008; Ruiz-Ruiz et al., 2013; Tenga et al., 2010a; Travassos, et al., 2013). Additionally, attacking styles such as "counter-attacks", "total soccer" (Bangsbo & Peitersen, 2000), and "crossing" (Pollard et al., 1988) have been examined with scarce information provided by scholars on the underlying metrics. The following sections highlight common playing styles depicted in prior research within the discipline of performance analysis.

1.6.1 Direct Style of Play

The **direct style** is the most frequently referred to style in the performance analysis literature. Bate (1988) analyzed matches of the English national teams (senior and youth) and data from 3rd division professional soccer in the English Football League. He suggested that the direct style of play is characterized by forward passes, forward runs and a low number of consecutive passes. Hughes and Franks (2005) looked at the 1990 and 1994 World Cup finals and found that the direct style of play is based on short passing sequences of four passes or less. An analysis of the Norwegian national team games played between 1989 and 1997 revealed that direct play was associated with direct passes over midfield as well as long passes (Olsen & Larsen, 1997). Tenga and Larsen (2003) expanded the definition of direct style by including attacks involving direct set plays, counter-attacks, attacks with at least one long pass, attacks with a maximum of two passes, and attacks moving fast over and through midfield. Also, Redwood-Brown (2008) investigated 120 matches from the 2004-2005 season of the English Premier League and defined direct play as possessions with few passes. Lastly, Tenga and colleagues (Tenga, Holme et al., 2010a; Tenga, Ronglan, et al., 2010) suggested that the direct style is part of a binary variable and is characterized by team position most reminiscent of counter-attacks. In their analysis of the Norwegian men's professional league in season 2004, the authors described the direct style as starting with a win of the ball in open play that progresses through to the end by taking advantage of imbalances, or by creating imbalances via the utilization of early penetrative passes or dribbles. Pollard et al. (1998) identified a combination of four variables (i.e., long forward passes, long goal clearances, negative possession in defense and multi-pass movements) that defined the direct style of play. Research on the effectiveness of this playing style has produced mixed results (Redwood-Brown, 2008; Tenga, Holme et al., 2010b). To conclude, direct forward passes along with a low number of passes in the attacking sequence have been most frequently attributed to the direct style of play.

1.6.2 Possession Style of Play

Possession style of play is another widely referenced game style that has been defined as involving a high number of consecutive passes (Bate, 1998) or long passing sequences of five or more passes (Hughes & Franks, 2005). Alternatively, Tenga and Larsen (2003) suggested that the possession style is characterized by long or elaborate play, attacks based solely on short passes, attacks with five or more passes, and attacks that move slowly or elaborately through midfield. Typical for this possession-based or *elaborate* style is retaining the ball and using the width of the pitch to penetrate the opponent's defenses (Lapresa et al., 2018). Moreover, short periods of possession have been attributed to direct approaches, whereas longer periods have been presented as elaborate attacks (Claudio et al., 2019; Jones et al., 2004). Pollard et al. (1988) identified four variables contributing to the possession playing style, namely positive possession in defense and multi-pass movements along with a negative score on long forward passes and long goal clearances. Analogously to the direct style of play, there is no consensus amongst scholars or practitioners on a common definition for the possession-based style of play or its association with specific variables (performance indicators). Research has produced mixed results on the effectiveness of this approach, especially when compared to the direct playing style (Bate, 1988; Hughes & Franks, 2005). To conclude, the use of short passes as well as a high number of passes in an attacking sequence can be said to be most characteristic of the possession style of play.

1.6.3 Other Styles

Counter-attacking, **total football** and **crossing** are other attacking styles of play commonly described in the performance analysis literature (Bangsbo & Peitersen, 2000). Counter-attacking involves ball recovery by defending players close to their goal, followed immediately by a rapid attacking transition towards the opposition's goal. Total football is an attacking style of play characterized by the attacking and midfield players changing their positions on the pitch in order to break down the opposing team's organized defense. The crossing style utilizes long passes and crosses (Konstadinidou & Tsigilis, 2005). Alternatively, the crossing style has been defined in terms of center measures (i.e., the number of centers expressed as a percentage of the number of attacks reaching the opponent's half of the field; Pollard et al., 1988).

In addition to attacking styles, a number of defensive styles of play have been identified, with **high pressure** and **low pressure** styles being the most prominent amongst them (Bangsbo & Peitersen, 2000; Pollard et al., 1988; Wright et al., 2011). These two defending styles of play are distinguished by the specific location on the pitch where teams apply defensive pressure on the opponent in possession of the ball. For instance, if defending players apply pressure in areas closer to the opponent's goal, they are said to be utilizing "high pressure" tactics, whereas "low pressure" involves the defending players applying pressure in the defending half of the pitch (Bangsbo & Peitersen, 2000; Pollard et al., 1988). Similarly, Tenga and Larsen (2003) described high pressure tactics as putting pressure on the ball once the opponent's defensive players regain it, and low pressure tactics as applying pressure on the ball once it reaches the half-way line.

Researchers have also tried to describe national styles of play in a small number of qualitative studies. For instance, Foot (2007) defined the Italian *Catenaccio* style as reliant on defensive tactics. Crolley, Hand and Jeutter (2000) described the English *Kick-and-Rush* (Crolley et al., 2000) as direct offensive play. Other researches have classified styles using aesthetic criteria such as the Brazilian *Joga Bonito* (i.e., literally translated as "playing beautifully"; Rossing & Skrubbeltrang, 2016) or the *Fúria Española* (Goig, 2007) with reference to the dynamic and technically skilled passing game played by the Spanish national football team.

CHAPTER TWO: Identification and Measurement of Playing Styles (Study 1)

2.1 Playing Styles

With the rise in the popularity of football, its impactful commercial outreach and intense competitive nature, the importance of building an edge over opponents to maximize sporting success has become ever so crucial. Performance analysis offers a way for clubs to gain a competitive advantage by providing stakeholders (e.g., coaches, managers, scouts, etc.) with analytical tools to use in the process of tactical and strategic decision making. The determinants of success in football have been long studied by scholars and in-house analysts and practitioners alike, ranging from sports-related (e.g., tactical and technical) to psychological and environmental (e.g., social, cultural, etc.) factors. This study utilizes the performance analysis framework in the investigation of *playing styles* as patterns of higher order tactical behaviors. Although academic research in the area has gained greater prominence over the past decade, related findings are inconclusive, and offer little consensus on the concept of playing style or associated performance indicators (Fernández-Navarro et al., 2016). As a result, the domain of playing styles within the disciplines of performance analysis and sport psychology has been prone to subjective assessments. Most studies have measured and consequently labeled styles of play in terms of isolated behaviors represented by single tactical variables, typically offensive, such as the number of passes (Hewitt et al., 2016). For instance, Tenga and Larsen (2003) defined the “direct style of play” as attacks involving set pieces, counterattacks, attacks with at least one long pass, attacks with a maximum of two passes, and fast attacks into midfield. Contrastingly, Hughes and Franks (2005) characterized the direct style of play in terms of low passing sequences. Moreover, the extant performance literature has focused on team level analysis within single national football leagues rather than on inter-league comparisons of playing styles.

Match analysis of teams from different leagues and/or competitions (e.g., World Cup, UEFA Cup) has been undertaken in the past (e.g., Fernández-Navarro et al., 2016; Gyarmati et al., 2014; Wallace & Norton, 2014), however, the corresponding studies have placed emphasis on team and player level game styles rather than league level patterns. In other words, there is a paucity of research to date investigating differences between national leagues. Some scholars have made attempts to describe the styles of play of national teams (Rossing & Skrubbeltrang, 2016) or country-level playing styles (Sarmento et al., 2013, 2014) using qualitative methods. Similarly, the number of comparative inter-league quantitative studies has been limited primarily to the analysis of performance indicators (e.g., Alberti et al., 2013; Oberstone, 2011), although more recently the focus has shifted to investigating differences in tactical behaviors between the biggest European leagues (e.g., Mitrotasios et al., 2019; Sarmento et al., 2017). To conclude, the scarcity of literature on league level patterns calls for a more comprehensive analysis of dominant trends worldwide. In view of the above, **the first aim of this study** is to identify and describe playing styles adopted by teams within leagues.

2.2 Differences Between Leagues

The way football is played and practiced around the world is influenced by an array of historical, social and cultural factors (Melosik, 2015, 2016; Parrish & Nauright, 2014; Sarmento et al., 2013; Tamir, B.-O., 2014; Wharton, 2007). As noted in the Introduction, a small number of qualitative researchers, primarily within sport sociology, have attempted to describe national styles of play. Similarly, there has been a dearth of quantitative studies investigating inter-country or inter-league differences (Mackenzie & Cushion, 2013). A short summary of quantitative research on inter-league/country differences is provided below.

Anthropometric measurements and players’ physical performance have been the subject of two comparative studies. Specifically, Bloomfield and colleagues (2005a) investigated whether differences in age, stature, body mass (BMI) existed between different positions in the four biggest European leagues (English Premier League, Spanish La Liga, Italian Serie A and the Bundesliga). The researchers identified variability across leagues depending on player positions, and attributed the differences to variability in playing styles, leagues' physical demands, physical conditioning methods, and/or to the recruitment of players with desirable characteristics for a particular playing position. When comparing the physical performance of players from the English Premier League (EPL) and La Liga, Dellal et al., (2011) found no differences in distances covered by individual playing positions. However, EPL players generally covered greater distances in sprinting, although La Liga players sprinted over longer distances when in possession of the ball. Moreover, central attacking midfielders in the La Liga spent the greatest total time in possession, whereas wide midfielders did so in the EPL. The results suggested that the technical demands in ball possession differ significantly across certain playing positions in these two leagues. Another comparative study was developed by Vales-Vázquez and colleagues (2017) with the aim of analyzing the competitive profiles of the main championships that make up the current European football scene, namely: the Spanish La Liga, the English Premier League, the German Bundesliga, the Portuguese Primeira Liga, the French Ligue 1 and the Italian Serie A. The findings revealed significant differences between the championships on three dimensions: excellence of the championship, team equality and type of match[47].

[47] For the purposes of the analysis, an ad-hoc instrument (i.e. Battery of Indicators for the Assessment of Competitive Profile of a Championship - BIACPC), was designed to assess the championships' competitive profile, by measuring the (1) degree of *excellence* using the International Achievement Index (IAI) and the Classification Dominance Index (CDI-75); (2) *team equality* using the Classification Compactness Index (CCI), Performance Sustainability Index (PSI) and the Home Advantage Index (HAI); and (3) *type of matches* by using the Match Openness Index (MOI), Match Equality Index (MEI) and the Result Uncertainty Index (RUI) (see Vales-Vázquez et al., 2017).

Another interesting study was conducted by Prüßner and Siegle (2015), who examined the influence of the playing country and referee on additional time awarded to teams at the end of soccer matches. They discovered significant differences between leagues (i.e., the greatest difference in the duration of matches in relation to additional time was observed in the German Bundesliga) but not for referees. Finally, Pollard and Gómez (2014) analyzed home advantage in 157 national domestic soccer leagues worldwide for six seasons between 2006 and 2012, and found it to be present in all continents with considerable variation between countries. It was the highest in Nigeria (86.82%), followed by Bosnia-Herzegovina, Guatemala, Indonesia, Algeria, Bolivia and Ghana (all between 70% and 80%) and lowest in the Arabian Peninsula and the Baltic counties. The authors suggested that the high variability was due to two main factors, which were not accounted for in the explanatory model: (1) the effect of team supporters identifying with smaller, regional ethnic groups (i.e., accompanied by intragroup distrust and conflict) and (2) corruption. Other factors, which were not captured in the model, but possibly enhanced the high home advantage effect were travel distance (Indonesia, where teams also come from five different islands), altitude (Guatemala and Bolivia) and civil wars (Indonesia, Guatemala and Bosnia-Herzegovina). An earlier conclusion that territoriality was the main explanation for the high home advantage in the Balkans and Andes might also apply to Indonesia and Guatemala, as well as Nigeria and Ghana as well as other countries in Western Africa.

A limited number of studies have conducted comparative, inter-league, match analysis. One example is the research conducted by Alberti et al. (2013) on temporal goal distribution. The authors observed that the number of goals scored is greater in the second half, with the scoring rate being highest in the last 15 minutes of a match, across all major European leagues (i.e., the English Premier League, the French Ligue 1, the Italian Seria A and the Spanish La Liga) during three consecutive seasons (2008/9, 2009/10; 2010/11). Additionally, Oberstone

(2011) compared match performance indicators across the top three European leagues and discovered that the Italian Serie A was the best passing league, the English Premier League had the highest number of tackles and the least number of fouls, yellow and red cards. The Spanish La Liga reported the highest percentage of shots on target and the highest conversion of shots into goals. More recently, Sarmento et al. (2017) analyzed 68 matches from the Spanish La Liga, the Italian Serie A, the German Bundesliga, the English Premier League and the European Champions League. Results showed that counter-attacks and fast attacks increased the success rate of an offensive sequence by 40% compared to positional attacks. The chances of an offensive sequence finishing successfully in the Spanish, Italian and the English leagues were higher than in the Champions League. Finally, Mitrotasios et al. (2019) compared how goal scoring opportunities emerge in the top four European soccer leagues (i.e., Spanish, German, English and Italian) and found significant tactical differences. For instance, the Spanish La Liga obtained the highest values for passing and offensive elaboration as well as the largest number of assists by means of passing. The English Premier League demonstrated a significant tendency for offensive verticality (i.e., fast and direct attacks), as well as a high number of crosses and aerials when finishing actions. The Bundesliga showed the greatest number of counter-attacks, whilst crossing highly contributed to the creation of scoring opportunities. The Italian La Liga was characterized by the shortest offensive sequences, whilst counter-attacks and direct attacks prevailed over combinative and fast attacks. Most studies, including those cited above, tend to focus on the big five European leagues. There is practically no information available regarding second-tier leagues in these countries or comparable leagues worldwide. Therefore**, the second aim** of this study is to provide more comprehensive inter-league comparisons across a more elaborate sample of leagues in terms of reliance on specific playing styles.

2.3 Research Aims

The majority of published research within the discipline of performance analysis, specifically in relation to team behaviors and patterns thereof, has come short of theorizing research findings, much less providing theoretical grounding for the design, methodology or analyses undertaken. Although this *exploratory* study is not specifically grounded within a theoretical framework, it is nevertheless informed by dynamical approaches, so as to achieve two basic aims formulated on the basis of the foregoing review of the extant literature, namely:

(1) To identify and describe stable patterns of collective team behaviors manifested in distinct playing styles across two samples (21 and 45 leagues);

(2) To compare leagues in terms of reliance on particular playing styles.

2.4 Theoretical Considerations

The study is conducted within the framework of performance analysis. It is also informed by two complementary theoretical perspectives, namely action theory of group behavior (Von Cranach, 1996) and dynamical theory. Both share a number of commonalities, including the notion of *hierarchical organization* of performance with teams as primary units of analysis, the conceptualization of teams as complex adaptive systems endowed with *self-organization* characteristics, and the focus on team *actions* rather than cognition. Patterns in teams' behavior with the aim of identifying playing styles are sought by examining individual player actions that aggregate to team level (e.g., passes, crosses and shots made by individual players during a match) as well as team level performance indicators such as match tempo. Specific player actions and match events, cumulatively referred to as team performance indicators, are taken as input process variables for the purpose of identifying patterns in the data. Given that the data does not provide spatiotemporal information on performance indicators, ecological dynamics is not directly applicable to the formulation of research aims or the interpretation of ensuing findings.

As described below, one of the most useful approaches for detecting patters in the relationships among action variables is principal component analysis, which was employed in Study 1. Further, as dynamical systems can be described in terms of relative stability between levels of analysis, cross-level equivalence (i.e., isomorphism) was measured to identify latent relationships that may cause destabilization. Justification for the choice of performance indicators and substantiation of the statistical analyses used to identify and test patterns of team behaviors are outlined in section 2.5 below.

2.5 Methodology

The methodology section is structured in the following manner. First, considerations for choosing specific performance indicators for the identification and description of playing styles are highlighted as well as common statistical methods for their measurement. Next, information is provided on the samples used in the analyses, followed by a description of the measures chosen and the study procedure adopted, concluding with a discussion of the statistical analyses conducted and the study's findings.

2.5.1 Key Performance Indicators

In an attempt to advance knowledge on how various factors impact competitive performance in football, scholarship has focused on defining key performance indicators (KPIs) that drive sporting outcomes (Araripe Medeiros et al., 2014). Performance indicators are "a selection, or combination, of action variables that aims to define some or all aspects of a performance" (Hughes & Bartlett, 2008, p. 739) and are used to assess the performance of individual players or teams. The usefulness of performance indicators as analytical tools for coaches, analysts and researchers is predicated on the strength of their association with successful sporting outcomes. Performance indicators in invasion sports such as football are typically classified into four categories: match-related (e.g., scores, shots on and off target, corners, crosses; Hughes, 1993), technical (e.g., passing accuracy, tackles won/lost, dribbles; Pettit & Hughes, 2001), tactical (passes/possession, pace of attack, shots, length of passes; Hughes, 1993), and biomechanical (e.g., kicking, ball projection velocity and spin, kinematics and kinetics of kicking leg, including energy transfers; Lees & Nolan, 1998).

Different performance indicators, mostly match-related and tactical, have been examined in the literature in relation to game style. Technical and biomechanical parameters have predominantly been used to measure the effectiveness, efficiency and key determinants of sporting success or to predict team/player performance in competitions such as the World Cup (Castellano et al., 2012; Hughes & Franks, 2004, 2005; Lago & Martín, 2007; Liu, Gomez et al., 2015; Ridgewell, 2011; Ruiz-Ruiz et al., 2013; Scoulding et al., 2004), the Euro Cup (Yiannakos & Armatas, 2006), the Champions League (Almeida et al., 2014; Di Salvo et al., 2007; Lago-Peñas, Lago-Ballestoros & Rey, 2011), the English Premier League (Adams et al., 2013; Bradley et al., 2014; Bush et al., 2015; Oberstone, 2009; Redwood-Brown, 2008), the Spanish League (Castellano et al., 2013; Lago-Peñas & Dellal, 2010; Lago-Peñas & Lago-Ballesteros, 2011; Sala-Garrido et al., 2009), and the Bundesliga (Hiller, 2015; Vogelbein et al., 2014; Yue et al., 2014). Currently, there are variations in the number and type of performance indicators that reliably predict a team's chance of winning a match. Also, certain indicators have been shown to be associated with successful and unsuccessful teams. The most common performance indicators and variables employed to analyze the tactical performance patterns displayed by teams are detailed next.

2.5.1.1 Shots

Shots are measured to assess a team's attacking performance. The related performance indicators include the pitch location from which the shot is made (Ensum et al., 2000, 2005), the distance of the shot from the goal (Ensum et al., 2005), the outcome of the shot (i.e., shot on goal, shot on post, shot out from goal, goalkeeper’s save; Chervenjakov, 1988; Collet, 2013; Corbellini et al., 2013; Garganta et al., 1997), the surface utilized to make ball contact (Corbellini et al., 2013), and shot frequency (Bate, 1988; Hughes & Franks, 2005). In a recent study, Bostanci et al. (2018) observed that teams which reached the knockout phase of the 2016 European Championships had a greater number of total shots and shots on-target compared to teams who dropped out in the group round. This finding reinforced earlier research results indicating that the number of scoring opportunities were strong indicators of a match’s outcome in the 2012 European Championship (Sgrò et al., 2015). Moreover, research has revealed that shots taken from pitch areas located closer to the goal and from central positions are generally more effective. Lastly, it has been found that the direct style of play generates greater shot frequency.

2.5.2.2 Ball Possession

Possession is considered to be a particularly important performance indicator and a key determinant of success in invasion sports such as football (Claudio et al., 2019; Jones et al., 2004). Moreover, depending on its duration, possession has been categorized as reflecting a direct (i.e., involving short periods of possession) or an elaborate (i.e., involving longer periods of possession) style of play. The association of possession with sporting success has been long debated. Some researchers have argued that possession is not a significant contributor to the success of a team (e.g., Stanhope, 2001), while others have posited that scoring opportunities increase with the lengthening of ball control time (Hughes & Franks, 2005). Bate (1988) reviewed possession related literature and pointed to evidence suggesting that possession-based patterns of play are less effective compared to direct tactical approaches. He postulated that the greater number of possessions that a team is able to achieve, the higher their chances of entering “the critical scoring area” of the pitch (i.e., the final third), thus increasing the probability of creating goal scoring opportunities. More recent studies have examined the superiority of teams in the biggest European leagues and have found that the top teams are able to maintain greater possession compared to other teams and thus tend to be more successful (Bloomfield et al., 2005b). Possession was recognized as a key determinant of success in the Spanish league during the 2008/2009 season, especially in the case of top tier teams (Lago-Ballesteros & Lago-Peñas, 2010). This finding was reinforced by Collet (2013), who examined matches from various top European national leagues and international competitions such as the Champions League and the Europa League. However, other studies have failed to confirm this distinction between more and less successful teams (Castellano et al., 2012). In conclusion, although possession appears to be a key performance indicator, it does not comprehensively measure the intricate interactions between players on the pitch. Due to its limited insight into a team’s playing style, possession has been regarded as providing general information on performance (Mahoney et al., 2012). When using possession-based indices in performance analyses, it is important to remember that possession can be influenced by contextual variables such as the quality of players (i.e., superior tactical and technical skill increases capacity to maintain possession for longer), match location and match status (Lago-Peñas & Dellal, 2011; Lago, 2009; Lago & Martín, 2007; Taylor et al., 2008). For instance, Collet (2013) reported that possession was a poor predictor of performance once team quality and home advantage were accounted for.

2.5.2.3 Passing

Passing is commonly understood as the action of transferring possession of the ball between team mates with the objective of creating and exploiting space. It constitutes an important tactical element of play and is central to the debate on possession-based vs. direct football. One of the first notational analysis studies conducted by Reep and Benjamin (1968) spanning 15 years and covering over 3,000 matches, found that 80% of goals were scored as a result of passing sequences of 3 or less and that a goal was scored from an average of about

10 attempts. This study, therefore, advocated for a direct approach in terms of footballing philosophy and playing style, implicating that fewer numbers of direct passes are the most effective method for exploiting the opposition's defense. This study was later replicated by Hughes and Franks (2005), who demonstrated that successful teams had longer possessions with a greater number of touches of the ball.

Earlier studies found that approximately 48% of goals were scored using 0-1 passes and 84% of goals were scored with fewer than 4 passes (in 1982 World Cup; Bate, 1988) or 94% of goals scored with 4 or less passes (Hughes, 1987). Later studies produced similar results. For example, Acar et al. (2009) analyzed matches from the 2006 World Cup and observed that 54% of goals resulted from 0-4 possession passes, 29% - from over 5 passes and the remainder were accounted for by set pieces or other events. A more recent analysis by Tenga and Sigmundstad (2017) of the Norwegian top division spanning three seasons showed that successful teams scored a significantly greater number of goals using passing sequences between 0-4 actions compared to less successful teams. This has been associated with counter-attacking strategies employed by successful teams utilizing a direct playing style of forward passes and dribbling. Thus, the number of passes that a team makes during attacking actions can explain its playing style. In addition to the number of passes, researchers have looked into other qualitative aspects of passes, including their length (e.g., Bostanci et al., 2018; Hughes & Churchill, 2005; Michalidis et al., 2018; Mitshke & Milani, 2014; Tenga & Larsen, 2003), direction (Bostanci et al., 2018; Carling et al., 2016), execution (i.e., part of the foot used to perform the pass; Acar et al., 2009; Mitschke & Milani, 2014), the area of the pitch where passes are received/made (e.g., James et al., 2002; Pollard, et al., 1988; Szczepański, 2008) and the type of player (defender, striker, midfielder, goalkeeper) making the pass (e.g., Dunn et al., 2003). Another type of passes often measured in research are crosses (e.g., Breen et al., 2006). Crosses are passes directed towards the opposition's penalty box from a wide area (Ensum et al., 2005).

In terms of direction, the use of forward passes is indicative of a more direct and potentially penetrative approach. Studies suggest that significantly more goals are scored using a higher percentage of forward passes in the build-up to scoring a goal (Bostanci et al., 2018). To this effect, Carling et al., (2006) showed that superior teams made on average 25 passes in central areas, 70% of these being forward passes, whereas weaker teams made 15 passes on average, with 63% of these being forward passes. Therefore, higher quality teams tend to have greater passing accuracy when penetrating the opposition's defensive block and a higher percentage of forward passes could be indicative of a direct playing style (Fernandez-Navarro et al., 2016). Regarding other directional passes (i.e., backward, lateral), there is a paucity of research exploring their contribution to success or game styles. One targeted study (Folgado et al., 2018) looked at a wider scope of directional passes in the context of small-sided games (i.e., training tasks) rather than competitive events.

In terms of passing length, short and long passes have also been associated with specific playing styles. For instance, Barcelona's famous "tiki-taka" football characterized by a high frequency of short passes played to penetrate the opposition's defense has been contrasted with the early English playing style of long-ball passes directed towards getting the ball to the optimal scoring zone in a most efficient manner. After analyzing over 28,000 passes from the 2012 European Championship, Mitschke and Milani (2014) found that most passes made were low and short. A study by Michailidis et al. (2018) revealed that most goals resulted from passes with a length of 10 or more meters, closely followed by passes of 10 meters or less. Contrastingly, Bostanci et al. (2018) found that long balls (over 35 meters in length) were counter-indicative of goal scoring, possibly due to increased chances of interception or misplacement. The aforementioned findings provide insight into how the length of passes can mark the playing style of a team.

2.5.2.4 Ball Recovery

Ball recovery (regain) is a key attribute of defensive play and as such constitutes a crucial element of a team's playing style. Ball recovery patterns have been examined by Barreira and colleagues (2013), who found that direct ball recoveries were more frequent than indirect recoveries. In other words, regaining ball possession during open play via tackles or interceptions was more common than regaining possession following set plays. These results are consistent with findings from Almeida et al. (2014), who found that the majority of ball recoveries occurred from a tackle or an interception as opposed to set plays.

Two dominant styles of defensive play have been most often mentioned in the literature: "high" and "low" pressure (Fernandez-Navarro et al., 2016). High-pressure defensive approaches have been increasing in popularity, with the likes of Liverpool's "Gegen-press" and some other elite teams employing high pressing tactics to push into the opponents' half (Bell-Walker et al., 2006). Low-pressing tactics are typically associated with weaker teams, who are more likely to set up an organized defense block in front of their penalty area with the aim of impeding penetrability (Barreira et al., 2013). Researchers often refer to these two concepts in relation to the location of ball recoveries as indicative of the defensive tactics utilized by a team (Fernandez-Navarro et al., 2016).

Investigations into the areas of the pitch where ball recoveries take place have revealed that regains of ball possession typically occur in the "middle third" (comprising attacking and defensive midfield zones) (Barreira et al., 2013; Claudio Alberto et al., 2016). One possible explanation is defensive density or the greater concentration of defensive players in these areas. These finding have been replicated in World Cup competitions (Smith & Lyons, 2017) as well as domestic leagues (Tenga et al., 2010a). It has also been found that ball recoveries made in the final third of the pitch had a considerably higher goal scoring rate compared to the defensive and middle thirds (Tenga et al., 2010a). In conclusion, the majority of research findings confirm that goals are more likely to result from high-pressing vs. low-pressing tactics.

2.5.2.5 Set Plays

A substantial body of research has also investigated the influence of **set plays** or dead ball routines on the outcome of matches at various levels of play (Bangsbo & Peitersen, 2000). Irrespective of the tournament of level of play, many of these studies have provided evidence for the high proportion of goals being scored following set plays; with 5% to 35,6% of goals scored from such situations (Yiannakos & Armatas, 2006). Successful football teams are generally more efficient than their opponents at scoring from set-plays. For example, successful teams in the 2006 Soccer World cup had a set-play to goal ratio of 1:7.5 (semi-finalists) whereas unsuccessful teams had a ratio of 1:14 (Bell-Walker et al., 2006).

To sum up, there are a large number of performance indicators used by researchers to provide insight into team tactical behaviors represented by playing styles. With advancements in data analysis technology, new variables (e.g., based on positional data), techniques (e.g., machine learning analysis) and coverage (i.e., greater geographical areas and numbers of leagues across the world) have become available to deepen the analytical lens. Accordingly, playing style research can be expanded to include more high quality data, including more refined performance indicators.

2.5.2 Measuring Styles of Play

There are two main approaches for measuring styles of play that have been used in sports performance analysis research: (1) factor / principal component analysis (PCA) and (2) advanced statistical methods such as machine learning and algorithm-based network analysis. The extant literature has provided inconclusive results as to which methods are optimal and how researchers can make informed choices (Hewitt et al., 2016). To date, a relatively small number of studies have attempted to describe and measure playing styles, as summarized below.

2.5.2.1 Factor and Principal Component Analyses

Both, factor analysis and principal component analysis are techniques for identifying clusters of variables and are used to reduce a set of variables into a smaller set of dimensions (called "factors" in factor analysis and "components" in PCA). In factor analysis, these dimensions, or factors, are estimated from the data and are believed to reflect constructs that can't be measured directly. Contrastingly, PCA transforms the data into a set of linear components; it does not estimate unmeasured variables. Despite differences, both techniques look for variables that correlate highly with a group of other variables, but do not correlate with variables outside of that group (Field, 2017). Styles of play represent patterns of offensive and defensive sporting behaviors that can be measured using performance parameters/indicators. Therefore, factor analysis or PCA is suitable for grouping variables so as to identify specific playing styles. If each factor/component is viewed as being placed on a continuum, its negative and positive values/scores would represent opposing ends of one style of play, whereas the magnitude of the value/score would determine a team's reliance on that specific style of play. Both, factor analysis and PCA, have been instrumental in the investigation of footballing styles of play.

The first targeted measurement of playing styles was conducted by Pollard et al. (1988), who employed PCA to determine the styles of play in the English league teams during the 1984/5 season as well as the national teams that played in the 1982 World Cup. Three components were extracted from the analysis of six variables (i.e., long forward passes, long goal clearances by the goalkeeper, crosses, regain of ball possession in attack, possession in defense and multi-pass movements) to identify distinct styles of play, namely: (1) passing and possession; (2) centers actions, and (3) regaining possession in attack. These components accounted for 92.5% of the variance. Thus, teams' playing styles were mainly found to be dependent on the length and the number of passes made.

Approximately three decades later Fernandez-Navarro et al. (2016) conducted PCA to identify the playing styles of teams in the English Premier League and the Spanish La Liga. They described and measured 12 different playing styles, split into eight attacking.(i.e., direct, possession, crossing, no crossing, wide possession, narrow possession, fast progression, slow progression) and four defending (i.e., pressure on wide areas, pressure on central areas, low pressure, high pressure) styles of play that in combination explained 87,5% of the total variance. Most recently, Gómez et al. (2018) analyzed matches from the 2013-2014 season of the Greek Superleague top football division and extracted eight principal components (i.e., ball possession, ending actions, individual challenges, counter-attack, set piece, transitional play, fouling actions, free-kick) that accounted for different styles of play and explained 64,3% of the total variance. Finally, Lago-Peñas et al. (2018) found five styles of play (i.e., possession, set piece, counter-attack and two types of transitional play) employed by teams during the 2016 season of the Chinese Soccer Super League. The principal components extracted explained 79,6% of the total variance.

In sum, research to date has relied on different methodological approaches to collecting, measuring and analyzing data with the aim of identifying higher order patterns of play. The results overlap to a certain extent (i.e., the direct and possession attacking styles identified by most researchers), with some scholars opting for a greater level of detail. However, findings are not essentially comparable due to methodological incongruencies as well as lack of validation of results (e.g., by way of subsequent confirmatory factor analysis). In this regard, advanced statistical approaches provide a promising pathway.

2.5.2.2 Advanced statistical Analyses

Technological progress has facilitated the proliferation of advanced statistical approaches in sports analytics such as machine learning and various type of network analysis. *Machine learning* is an artificial intelligence technology that allows classification and prediction from data (Bunker & Thabtah, 2017). It has been applied in a variety of research and applied fields and is becoming increasingly popular in sport science. For instance, STATS LLC, a data provider company, has developed a proprietary algorithm to measure styles of play in soccer using a machine learning approach (Ruiz, 2016). Ruiz (2016) identified eight playing styles (i.e., direct, maintenance, build-up, sustained threat, fast tempo, counter-attack, crossing and high pressure), however, no detailed information is available on the procedure used to quantify styles. Interestingly, they overlap with styles identified in prior research, although due to the lack of data on the methodological approach employed, it is difficult to judge the validity of results.

In recent years, the exponential growth of available data and the progressive opening up to "statistical culture" by football operators have given rise to the development of advanced performance analysis techniques using weighted *networks* (i.e., directed or undirected; Newman, 2010) of data represented by spatial coordinates (x, y). These techniques extract information on tactics and playing styles respectively by designating players as nodes and the passes between them as edges (Clemente et al., 2015; López-Peña & Tochette, 2012; Pina et al., 2017). Alternatively, playing styles have been represented by a network whose nodes identify different areas into which the pitch is divided and whose edges describe the movements of the ball between these areas (Diquigiovanni & Scarpa, 2018). Essentially, performance data of teams portrayed as networks are clustered to identify styles of play. The aim is to divide the number of directed or undirected weighted networks into groups according to a specific criterion. Most certainly, the research on styles of play can benefit from greater engagement of advanced statistical analysis methods.

2.5.3 Match Samples

Two match samples were used, the first consisting of 12 379 matches played by 375 teams in 21 leagues across the world during the 2018-2019 football season, and the second comprising 23 186 matches played by 728 teams in 45 leagues during the 2020-2021 football season (Table 1). The initial statistical analysis was run on the first (smaller) sample, and the results were subsequently retested on the second (larger) sample. The choice of leagues was dictated by the aim of achieving large geographical coverage to capture maximum cultural diversity as well as relative comparability in terms of team and player quality (Table 2). Due to the said quality considerations, four out of the big five European leagues were selected for the sample. Namely, the second division English Championship league was included in the analysis as opposed to the top division English Premier League[48]. Analogously, teams from the second division in Spain (i.e., the Spanish Segunda Division), Germany (i.e., German Bundesliga 2) and Italy (i.e., the Italian Serie B) were chosen rather than their top tier equivalents. The choice of leagues was also substantiated with practical considerations in mind related to the utility of the current study for football analysts, coaches, scouts, agents and other stakeholders. Specifically, the interest in playing styles arises in connection with the practicalities of predicting the success of international transfers and associated suitability of international players to particular national leagues. Given that the greatest turnover of players

[48] Most team sports are organized in a hierarchy of leagues. The top of the hierarchy contains the major league, premier league, or first division, followed by minor leagues or lower divisions. In English football, the hierarchy is extremely deep, with ten levels of the Football Association (Noll, 2003).

in terms of volume (not market value) occurs outside of the big five European leagues, the latter were excluded from the study[49].

Table 1. Summary of match data per league.

LEAGUE	Season 2018/19		Season 2020/21	
	Nr of teams (N)	*Nr of matches (N)*	*Nr of teams (N)*	*Nr of matches (N)*
Argentinian Superliga	28	816	24	552
Australian A-League	10	280	12	322
Belgian Pro League (Jupiler Pro League)			18	660
Belorussian Premier League			16	478
Brazilian Serie A	20	734	20	760
Bulgarian A League (Efbet Liga)			14	442
Chilean Primera Division			18	612
Chinese Super League	16	280	16	320
Colombian Primera A			20	462
Croatian 1.HNL	10	360	10	358
Czech Fortuna Liga	17	696	18	612
Danish Super Liga	16	502	12	386
English Championship	24	1112	25	1124
French Ligue 1			20	760
Georgian Erovnuli Liga			10	180
German Bundesliga 2	18	612	18	612
Greek Super League 1			14	480
Hungarian NB1			12	394
Israeli Premier League			14	480
Italian Serie B	19	702	20	772
Japanese J1 League	18	612	18	612
Kazach Premier League			11	220
Korean K League 1			12	322
Lithuanian A Lyga			6	118
Mexican Liga MX			18	646
Netherlands Eredivisie			18	618
Norwegian Elitserien	16	483	16	480
Paraguayan Primera Division			12	410
Peruvian Primera Division Peruana			20	542
Polish Ekstraklasa	16	592	16	480
Portuguese Primeira Liga	18	612	18	604
Qatar Stars League (Q-League)			12	264
Romanian Liga I			17	646
Russian Premier League	16	480	16	476
Serbian Super Liga	16	590	20	744

[49]An exception was made for France for reasons of data availability. Thus, the first division French Ligue 1 was included rather than the second division Ligue 2.

Slovak Super Liga			12	386
South African Premier Division	17	254	16	382
Spanish Segunda Division	22	890	22	936
Swedish Allsvenskan	16	480	16	480
Swiss Super League			10	360
Turkish Super Lig	18	612	21	840
Ukrainian Premier Liha			14	362
United Arab Emirates (UAE) Pro League			14	362
Uruguayan Primera Division			16	584
US Major League Soccer MLS	24	840	26	546
TOTAL:	*375*	*12 539*	*728*	*23 186*

Table 2. Geographical distribution of leagues across the two data samples.

Geography	**Season 2018/19**				**Season 2020/21**			
	Nr of leagues (N)	*%*	*Nr of teams (N)*	*%*	*Nr of leagues (N)*	*%*	*Nr of teams (N)*	*%*
Europe	14	*67*	242	*65*	28	*62*	449	*62*
South America	2	*10*	48	*13*	7	*16*	128	*18*
North America	1	*5*	24	*6*	1	*2*	26	*8*
Asia	2	*10*	34	*9*	4	*9*	57	*8*
Middle East	0	*0*	0	*0*	3	*7*	40	*5*
Africa	1	*5*	17	*5*	1	*2*	16	*2*
Australia	1	*5*	10	*3*	1	*2*	12	*2*
TOTAL:	21		375		45		728	

2.5.4 Measures

A total of 20 performance indicators were included in the study (Table 3). These were chosen in the following manner. First, a comprehensive list of technical and tactical performance indicators was prepared based on a thorough review of soccer-related notational analysis literature spanning the last 35 years. Second, the indicators thus identified were collated and grouped into relevant themes fitting within three categories that measure tactical aspects of the game: attacking, defending and transitional play. Third, the grouped variables were compared against the team level technical and tactical parameters (i.e., over 100 in total) available in the Wyscout data base, and a final selection was made that discriminated between indicators depending on their suitability for capturing playing styles rather than teams' tactical effectiveness. In other words, game *effectiveness and efficiency* variables (e.g., accurate passes, shots on target, duels won, etc.) were intentionally excluded from the analysis, given that this study is concerned with variables indicative of *patterns* of behaviors relevant to game style, not their effectiveness. In addition to the research highlighted in section 2.5.1, the following performance analysis scholarship was considered for the selection of the designated 20 variables: possession per minute indicators (Jones et al., 2004; Lago & Martin, 2007), crosses (Lago-Peñas et al., 2010), shots (Hughes & Franks, 2005; Lago-Ballesteros & Lago-Peñas, 2010; Pollard & Reep, 1998), counter-attacks (Tenga, Ronglan et al., 2010), transitions (Turner & Sayers, 2010), and ball recoveries in different areas of the field (Garganta et al., 1997; Vogelbein et al., 2014). The remaining performance indicators were considered to be relevant for determining playing styles due to the importance of events-based parameters for measuring the tactical aspects of the game (Castellano et al., 2013).

2.5.5 Procedure

Match statistics were obtained from Wyscout (Wyscout, Chiavari, Italy), a technical platform for scouting, match and performance analysis in professional football. Wyscout data has been increasingly used by sport scientists (e.g. Gonzales-Rodenas et al., 2020; Pappalardo et al., 2019a; Mitrotasios et al., 2019) and practitioners (e.g., scouts and football analysts) alike. Wyscout is a commercial enterprise that sells data, primarily to sports organizations such as football clubs. Data collection is performed by Wyscout expert video analysts (operators) using proprietary software, which tracks and tags match events based on match video material, and the tagging of events is conducted by three or four operators (Pappalardo, et al., 2019b).

Given the lack of published studies on the reliability of Wyscout's observational system, it was necessary to verify its accuracy and the consistency of data entry through inter-operator reliability testing procedures. For this purpose, a sample of 4 matches from the 2020/21 season (i.e. one from each of the Polish Ekstraklasa, the Chinese Super League, the

German Bundesliga and the US Major League Soccer) were randomly selected and coded by two experienced soccer professionals, an international licensed scout and a soccer coach-analyst with 15 and 20 years of experience, respectively, in performance analysis in football. The data sets (i.e., from Wyscout and from the two coders) were then compared through calculation of percentage errors at the level of analysis (Hughes et al., 2002; Severini, 2020). In line with previous behavioral assessment research, a 5% error level was deemed acceptable for each variable except for pitch areas where the level can be extended to 10% due to the difficulties associated with accurate spatial identification (Wilson & Barnes, 1998). Inter-rater reliability showed good kappa values for the weighted Kappa correlation coefficients for all three types of performance indicators (attacking, defensive and transitional play ($k = 0.72$, $k = 0.85$, and $k = 0.89$ respectively). The results suggested that the Wyscout system can be used validly and reliably to gather match statistics, although the small number of matches (4 matches) and coders (only two analysts) warrants a more elaborate investigation.

2.5.6 Statistical Analysis

Statistical analyses were conducted to address the aims of this dissertation, as follows:

(1) Principal component analysis was performed to identify and describe playing styles (section 2.6.2).

(2) Inter-league comparisons of differences in the utilization of playing styles were conducted using cluster analysis (section 2.6.3).

All statistical analyses, data checks and data transformations were conducted in R (R Core Team, 2020) and R Studio (RStudio Team, 2019).

2.5.6.1 Standardization of data

Prior to running team level PCA and cluster analyses, match data were standardized. This step was necessary, given teams can play more or less games over a particular season, depending on the total number of teams in each league. First, the averages of KPI indicators weighted by the number of games played per team in relation to total league games were normalized according to the following formula:

$$\frac{\mathrm{KPI}_{ni} \times \mathrm{Games}_{j}}{\mathrm{KPI}_{ni} \times \mathrm{Games}_{i}}$$

KPI_{ni}: one of 20 KPIs in league *i*

Games_{i}: the total games played in league *i*

Games_{j}: the total games played in the sample of all leagues

Second, for each of the components extracted (i.e., representing different styles of play) league averages were computed based on normalized KPI values. The normalized KPIs were assigned to components consistent with the outcomes of PCA (i.e., grouped per component). Given that the number of teams in each league varies, an additional transformation using *Z*-score measurement of KPIs was conducted as per the following formula:

$$\frac{\mathrm{KPI}_{ni} - \mu}{\sigma}$$

KPI_{ni}: any of 20 KPIs in league *i*

μ: mean of KPI_{ni}

σ: the standard deviation of μ

Z-scores take into account both the average value of the measurement and its variability, as measured by its standard deviation. *Z*-scores give a simple way to compare a statistic for a particular team to the values obtained for other teams across leagues.

2.5.6.2 Principal Component Analysis

As a first step, the mean values of the 20 KPIs were calculated for each team (*N*=375; *N*=728) for both match data samples. All team level statistical analyses were applied to standardized data. Statistical component analysis (PCA) and exploratory factor analysis

(EFA) were both considered for extracting factors that could be equated to styles of play across the two samples (21 and 45 leagues). PCA is a statistical data reduction method that involves taking scores on a large set of measured variables and reducing them to scores on a smaller set of composite components that capture/retain as much information from the original variables as possible (Bentler & Kano, 1990; Fabrigar et al., 1999). The goal of EFA is to arrive at a more parsimonious representation of the associations among measured variables when researchers try to identify a set of latent constructs underlying a battery of measured variables (Fabrigar et al., 1999). EFA is based on the common factor model (Thurstone, 1947) that aims to understand the structure of correlations among measured variables. This model postulates that each measured variable in a battery of measured variables is a linear function of one or more common factors (i.e., unobservable latent variables that influence more than one measured variable) and one unique factor (i.e., latent variables that influence only one measured variable). Unique factors are assumed to have two components: a specific factor component (i.e., systematic latent factors that influence only one measured variable) and an error of measurement component (i.e., unreliability in a measured variable).

Contrastingly, PCA does not differentiate between common and unique variance (i.e., assumes no error in measurement). Rather, this approach defines each measured variable as a linear function of principal components, with no separate representation of unique variance. Mathematically, these principal components can be defined as linear composites of the original measured variables and thus contain both common and unique variance. Each original variable contributes with a different weight to the principal component formation. In other words, PCA projects the original data onto a smaller dimension where the components retain the maximal possible variance. The algebraic representation of PCA for m ($\leq p$) principal components is as follows:

$PC_{(1)} = w_{(1)1}X_1 + w_{(1)2}X_2 + \ldots\ldots + w_{(1)p}X_p$

$PC_{(2)} = w_{(2)1}X_1 + w_{(2)2}X_2 + \ldots\ldots + w_{(2)p}X_p$

$PC_{(m)} = w_{(m)1}X_1 + w_{(m)2}X_2 + \ldots\ldots + w_{(m)p}X_p$

m: the number of principal components

p: the number of measured variables

X: performance indicator (measured original variables)

PC: principal component $w_{(i)j}$: the weight chosen (loadings) for the *j*th measured variable(KPI) to maximize the ratio of variance of $PC_{(j)}$ to the total variation, $i = 1, 2, m, j = 1, 2, \ldots, p$

Methodologists have argued that PCA is a reasonable substitute for analyses of common factors and might even be superior (e.g., Velicer & Jackson, 1990a). Also, the two approaches generally produce very similar results (e.g., Velicer & Jackson, 1990b). The greatest differences in results are most likely when communalities are low (e.g., below 0.40) and there are a modest number of measured variables (e.g., below 3) per factor (Widaman, 1993). The total number of measured variables included should be at least 3 to 5 times the number of expected principal components / common factors. Also, when data are relatively consistent with the assumptions of PCA (e.g., little unique variance present in the measured variables), extraction of common factors does as well as extraction of principal components (Gorsuch, 1990).

Given that (1) the data presented little unique variance, (2) communalities for the most part exceeded 0.6 (i.e., for 19 out of 20 measured variables in PCA in 2018/19 and 18 out of 20 variables in 2020/21), and (3) the variables per factor ratio exceed 3 (i.e., measured variables per factor averaged 3.8), both, PCA and EFA were conducted by the researcher on the data set, and produced very similar results in line with previous findings. PCA has been the preferred statistical tool used by researchers to describe and measure styles of play in professional football (e.g., Gómez, 2018; Fernandez-Navarro et al., 2016; Lago-Peñas, 2018; Pollard et al., 1988) for a number of reasons, including the fact that PCA aims to retain as much information as possible from the original variables. The latter supports representation of results as composite components corresponding to specific styles of play. In view of the above, PCA was designated as the statistical analysis of choice, deemed most appropriate for this study.

As a second step, the PCA analysis on the 20 team-level KPIs was conducted using both an orthogonal (varimax) and an oblique (oblimin) rotation. Rotation of the factor axis (dimensions) identified in the initial extraction of factors is recommended when seeking to obtain simple and interpretable factors/components (Yaremko et al., 1986). Generally, orthogonal rotations constrain factors to be independent of each other, whereas oblique rotations allow correlations between factors. The component transformation matrix of the oblique (oblimin) rotation showed a negligible correlation between factors and, therefore, orthogonal rotation was used (Fabrigar et al., 1999; Field, 2017). The Kaiser-Meyer-Olkin measure (Kaiser, 1974) and communalities values after extraction (MacCallum et al., 1999) were employed to verify the sampling adequacy for the analysis. Bartlett's test of sphericity was carried out to test whether the correlation matrix was significantly different from the identity matrix. Kaiser's criterion of 1 (Kaiser, 1960) and interpretation of the scree plot were considered for factor retention. Performance indicators with factor loadings greater than **0.6** showed a strong positive or negative correlation and indicated a substantial value for factor interpretation (Comrey & Lee, 2013).

2.5.6.3 Cross-level measurement equivalence

Given the hierarchical nature of the data (i.e., teams nested within leagues), the results of PCA analyses were tested for measurement equivalence across levels. For this purpose, raw team level data was aggregated at the league level and a separate PCA analysis was run on this data set to examine the comparability of the factor(component) structure between the team and league levels.

In cross-cultural research, measurement equivalence is typically investigated in relation to construct equivalence, or ensuring that an instrument measures the same construct across contexts (countries). Although the importance of assessing measurement equivalence *across groups* (countries) has been well acknowledged, the assessment of measurement equivalence *across levels* has attracted surprisingly scarce attention as “probably the most underrated topic in cross-cultural research” (Byrne & van de Vijver, 2015, p. 170). Cross-level measurement equivalence has also been referred to as *isomorphism*. Erroneous assumptions of factor solutions being isomorphic (i.e., equivalent across levels) can lead to overestimation of inter-item correlation or covariances, and, as a consequence, to misleading standard errors for parameter estimates and model fit statistics (e.g., Julian, 2001; Muthén & Satorra, 1995). There are several levels of isomorphism that can be measured, including *configural* (i.e., implies that the component structure of the lower and higher level constructs is similar) and *metric* (i.e., implies that components are measured on an identical scale, requiring that factor loadings be equal across levels) (Dyer et al., 2005). Moreover, it can be estimated *separately* for each level or *simultaneously* in a multilevel model (Chen et al., 2004). The latter is more complex, requires theory testing, and typically involves multilevel confirmatory factor analysis within a SEM framework. The former does not fully disentangle within- and between-group variability (Muthén, 1994), but is deemed appropriate when lower level scores measure higher unit properties (Tay et al., 2014). Importantly, these lower level units represent objective match data, which is not burdened by reporting biases inherent to psychometric measurement of survey-type data. For these reasons, the separate measurement approach for estimating configural and metric isomorphism was used in the study. The objectivity of data measurement across contexts (i.e., leagues) was tested using inter-rater reliability (see section 2.5.5).

2.5.6.4 Cluster analysis

Cluster analysis was employed to explore differences in the utilization of playing styles across 45 leagues. As recommended by Gordon (1999), a two-step procedure was followed to identify cluster groups. First, a *hierarchical cluster analysis* was performed using as input standardized team level data on the utilization of playing styles. The distance metric used was squared Euclidean distance along with Ward's (Ward, 1963) method of linkage. Whereas distance refers to the unit of measurement for expressing the distances between the cases in multivariate space, linkage signifies the point in a cluster from which distance measures are calculated. Ward's method links clusters together on the basis of the degree of similarity between observations in the same cluster. It minimizes the within-cluster sum of squares of each cluster when clusters are joined together, thus showing a bias towards even within-cluster distributions (Wishart, 1969).

Second, the nested structure of clusters generated by the hierarchical analysis in step one was used to determine the discrete number of clusters to be employed in step two of *nonhierarchical clustering* with the K-means algorithm (MacQueen, 1967). With this method, the initial cluster centers are assigned to the cluster with the nearest center resulting in subsequent changes of centers, which are continuously updated as objects get re-assigned. The stability of the cluster structure was examined by determining the agreement between the two methods (hierarchical and nonhierarchical) using Cramer's V test. This test allows determination of whether similar clusters are present regardless of the algorithm used to derive them.

Next, clusters were compared relative to the sporting success achieved by teams within these clusters, by running a one-way ANOVA. The dependent variable of sporting success was operationalized as goal difference, namely the difference between goals scored and goals conceded by teams in league games (see section 3.5.2 in Study 2 for further details). Finally, K-means clustering analysis was run on raw (i.e., unscaled) team-level data, which was aggregated at the group/league level. The resulting cluster structure and group/cluster mean values were compared to team-level clustering results, so as to test for structural invariance, analogously to investigating comparability in the component(factor) structure derived from PCA. Gap analysis using the “Cluster” package in R (Maehler et al., 2021) was run at both levels (i.e., team and league) to identify the optimal cluster structure. More specifically, the “gap” statistic was calculated as a goodness of clustering measure, using k-means on centered and rotated (PCA varimax) variables after bootstrapping (500).

2.6 Results

The results of statistical analyses are presented separately as (1) descriptive statistics, (2) PCA and related tests, and (3) cluster analyses.

2.6.1 Descriptive Statistics

The mean values for all KPIs were derived by calculating the game averages of team KPIs (within a particular league) weighted by the number of games played (see Table 4 for season 2018/2019). In other words, the match data (i.e., from all games played by particular teams in a given season) were aggregated at the team level, which is also the level at which subsequent PCA and cluster analyses were conducted. Additionally, PCA and cluster analyses were run on league-level aggregated data, so as to test whether the component or cluster structure derived from team level data would differ at league level. The differences in KPIs across leagues are reflective of particular patterns of game behaviors expressed as a preference for reliance on specific tactical and technical solutions/events. The said patters are explicated through interpretation of the PCA analysis results.

2.6.2 Principal Component Analysis

The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.864 (2018/19) and KMO = 0.860 (2020/21). Bartlett's test of sphericity (χ^2 = 180883.512, df = 190, $p < 0.001$ for 2018/19; χ^2 = 306393.068, df = 190, $p < 0.001$ for 2020/21) indicated that correlations between items were sufficiently large for PCA. In 2018/19, five components had eigenvalues over Kaiser's criterion of 1 and in combination explained 72,9% of the total variance. The percentage of variance explained by each component decreased from component 1 to component 5. However, the scree plot (*Figure 3*, *Figure 4*) showed inflexion points that would justify retaining four components explaining 66,96% of the variance. Therefore, four factors were extracted in line with Kaiser's criterion given that the number of performance indicators was less than 30 and communalities after extraction were greater than 0.6 (Stevens, 2009). In 2020/21, the four-component structure explaining 63,7% of the variance was tested, but finally rejected in favor of three components that explained 55,79% of the variance (Table 5, Table 6). The decision against retaining the fourth factor was dictated by the fact that only one item with a loading exceeding 0.6 (i.e., counterattacks = 0.664) was identified. Table 7 shows the rotated component matrix on both data sets (2018/19 and 2020/21) for the factor loadings identified based on the performance indicators (KPIs) associated with each component.

The description of playing styles draws on the interpretation of performance indicators associated with each component in terms of highest factor loadings. *Component 1* is characterized by emphasis on passing, including forward, lateral and back passes, as well as reliance on possession exemplified by a relative high proportion of passes per possession and passes per minute. This style can be broadly defined as **"possession-based"**, with players making use of wide areas of the pitch, progressing slowly toward the opponent's goal while seeking to utilize imbalances in the opposition's defense to score. The same items, with the exception of forward passes, loaded onto the first component in 2018/2019 as in 2020/21, and the loading values were very similar. *Component 2* is characterized by ball and player movements in the opponent's half, specifically the final third of the pitch (i.e., high field), using positional attacks and by applying high pressure. Unlike the "possession-based" approach associated with Component 1, this style can be defined as **"constructive attacking"** in that the opponent is actively forced to move thus creating space for attack. Shots and crosses loaded onto *Component 2* only in 2018/2019, and recoveries in mid-field only in 2020/21. These differences, however, were not taken to alter the core style characteristics or its definition. *Component 3* is characterized by the prevalence of defensive actions (recoveries/losses) occurring in the middle and the lower sections of the field (i.e., a team's defensive third of the pitch) as well as clearances and interceptions. Respectively, the underlying style can be defined as **“defense-oriented.”** In season 2020/21, losses in low field and clearances were replaced by losses in mid-field and long passes. Whereas the change in losses from low to mid-field does not affect the style’s defensive characteristics, increased reliance on long-passes rather than clearances points to greater directness in transitions from defensive to offensive actions. Action events concentrated in low and mid-field imply a low-risk approach based on protecting space and retaining compactness in deeper areas whilst inviting more pressure from the opposition team, thus allowing space to open up behind opposition players, enabling subsequent penetration. The directness of build-up of play develops with defensive players making longer passes toward offensive players. *Component 4* is characterized by action events (losses and recoveries) that take place in midfield and by emphasis on long passes. This style can be defined as “long-ball” and would often involve high passes toward a tall or a very fast forward rather than making a series of short passes along the ground to another player. Essentially, it represents a more direct approach compared to the slower build-up of the game typical for possession-based play. Thus, instead of creating an advantage in each line before progressing to the next, the ball is immediately played as far up the field with teams trying to create advantage there. As noted earlier, the direct, long ball style was only identified in relation to 2018/19 data.

Finally, the investigation of isomorphism (Table 8) showed that the three-level structure is theoretically plausible, although empirically more difficult to justify at league level. Four (i.e., passes per possession, back and later passes as well as passes per minute) out of six items loaded onto the first component (i.e., possession-based style) with significantly higher loadings (between 0.91 and 0.95) compared to the team-level analysis. Forward and progressive passes loaded onto component two (i.e., constructive attacking), which is a theoretically plausible possibility of building attack through forward, progressive passing, culminating in the development of positional attacks that lie at the core of constructive attacking. The disappearance of recoveries in mid- and high-field from component two loadings (i.e., above 0.6) does not change the essence and, therefore, description of constructive attacking. At league level, most items loaded onto component three (i.e., 9 items out of 17), including losses and recoveries in high field, losses and recoveries in mid field and losses in low field. Importantly, the items most characteristic of defensive tactics interceptions, clearances and long-ball passes loaded onto component three, retaining high loading values. Thus, it can be concluded that at league level, the three-component structure is theoretically justifiable. In other words, styles retain their key characteristics represented by particular match events. Also, at league-level, the defensive style appears less distinct in terms of characteristics compared to the two types of attacking styles – possession-based and constructive. To this effect, losses and recoveries as match events, regardless of where (i.e., which areas of the pitch) they occur, do not particularly strengthen attacking styles, but rather signify where defensive pressure has been applied in more or less successful defensive actions. Albeit the aforementioned theoretical justification for the three-component structure at league level, the empirical plausibility (i.e., in terms of configural or metric isomorphism) is less compelling.

Table 3. Performance indicators used in analyses.

Performance indicators (type)	Description
Attacking performance indicators	
Shots per game	Total number of shots in a game.
Losses in high field	Total number of possession losses in the final third of the pitch.
Recoveries in high field	Total number of recoveries made in opponent's half of the pitch or the final third.
Positional attacks	Total number of positional attacks in a game.
Crosses	Total number of crosses in a game, when shots are directed from the side into the penalty area.
Forward passes	Total number of forward passes with pass direction from -45 to 45 degrees.
Back passes	Total number of passes in a 90 degree angle rortated by 45 degrees facing backwards.
Lateral passes	Total number of passes in two 90 degree angles rotated by 45 degrees facing sideways, longer than 12 meters.
Long passes	Total number of long passes.
Passes to final third	Total number of passes from outside the final third to the final third of the pitch.
Progressive passes	Total number of progressive passes, where the distance to the opponent goal decreased by 30 meters, if the start and finish was in own half; or by 15 meters, if the start and finish was in different halves of the pitch; or by 10 meters, if the start and finish was in the opponent half
Passes per minute / Match tempo	Total number of passes per minute of ball possession.
Average passes per possession	Average number of passes per possession of the ball.
Defensive performance indicators	
Losses in low field (in own half)	Total number of possession losses in own third of the pitch.
Recoveries in low field (in own half)	Total number of possession recoveries made in own third of the pitch.
Interceptions	Total number of interceptions in a game, when players intercept opponents shots, pases or crosses made by the opponent.
Clearances	Total number of clearances in a game.
Transitional play performance indicators	
Losses in mid field	Total number of possession losses in the mid-third of the pitch.
Recoveries in mid field	Total number of possession recoveries made in mid-third of the pitch.
Counterattacks	Total number of counterattacks where possession resulted in a shot.

Table 4. Mean values for all KPIs per league; per game unless otherwise stated (season 2018/19).

LEAGUE	Average passes / possession	Back passes total	Forward passes total	Lateral passes total	Passes per minute	Progres-sive passes	Losses in high field	Positional attacks	Recove-ries in high field	Crosses	Passes to final third total	Total shots per game	Recove-ries in low field	Losses in low field	Clearan-ces of the ball	Intercep-tions of the ball	Losses in mid field	Recove-ries in mid field	Long passes total	Counter-attacks
Argentinian Superliga	3,29	46,89	139,97	125,64	15,50	78,33	54,01	26,69	11,08	14,83	57,09	11,38	39,45	19,42	18,24	45,48	42,63	36,73	51,93	3,05
Australian A-League	3,77	62,74	149,95	148,25	16,71	81,65	52,43	30,14	12,30	16,86	60,25	12,70	37,06	20,04	18,84	47,56	41,55	35,51	47,26	3,02
Brazilian Serie A	4,12	55,15	136,96	154,32	15,96	72,84	45,78	26,60	10,30	15,10	53,97	12,68	33,01	17,33	17,08	38,69	31,95	27,96	37,79	3,25
Chinese Super League	3,76	50,94	133,43	133,68	15,88	72,20	47,50	25,93	10,85	15,05	53,22	12,31	34,44	18,16	17,73	40,43	33,75	29,11	44,71	2,91
Chroatian 1.HNL	3,39	51,45	141,70	138,55	15,65	76,34	53,62	27,92	11,36	15,58	56,30	12,01	38,91	18,82	19,11	46,02	41,97	35,67	48,45	3,16
Czech Fortuna Liga	3,12	50,03	144,85	116,66	15,70	81,64	57,06	28,13	12,61	17,23	57,57	12,06	42,14	21,26	19,41	46,68	41,25	35,39	56,56	2,94
Danish Super Liga	3,77	58,53	152,72	142,32	16,00	83,91	54,52	28,76	12,85	16,17	60,09	11,59	41,20	20,73	18,28	46,78	40,88	35,52	56,45	3,03
English Champion-ship	3,52	56,28	145,65	127,14	16,00	79,17	57,41	28,65	12,75	16,46	59,98	11,95	42,36	21,47	20,65	46,00	41,04	35,67	55,10	2,65
German Bundesliga 2	3,42	52,92	144,91	130,82	15,88	80,88	55,10	27,24	11,82	15,37	55,56	12,57	40,85	19,94	19,12	46,73	41,63	35,51	52,50	3,44
Italian Serie B	3,56	52,58	145,54	138,93	16,28	79,13	52,64	28,94	11,99	18,65	57,66	12,53	39,44	19,85	18,39	45,13	36,73	31,83	51,37	3,23
Japanese J1 League	4,74	69,92	154,27	163,15	17,55	78,88	47,44	27,60	12,06	15,25	59,13	11,88	35,50	19,36	17,33	41,18	32,85	29,51	41,11	3,34
Norwegian Elitserien	3,76	58,52	144,59	141,48	15,90	80,29	53,62	28,64	13,32	16,65	58,46	12,06	39,08	22,13	18,27	44,35	38,29	33,65	54,35	2,88
Polish Ekstraklasa	3,51	51,68	143,59	133,59	16,25	77,08	51,33	26,52	11,86	15,75	53,26	12,69	37,30	19,40	17,79	47,32	42,98	36,68	48,17	3,19
Portuguese Primeira Liga	3,30	48,78	131,03	126,17	15,60	71,26	50,19	25,78	11,45	15,85	51,91	11,73	37,12	19,46	19,29	44,26	37,08	31,42	45,23	2,97
Russian Premier League	3,90	59,98	148,34	149,13	16,56	81,68	53,26	28,73	13,04	14,83	58,97	12,13	40,23	20,59	18,89	44,78	40,47	36,03	50,77	3,40
Serbian Super Liga	3,13	47,32	143,09	116,55	15,30	76,41	52,83	26,68	10,78	14,79	55,58	11,38	38,92	18,38	16,96	44,05	42,36	35,06	50,02	2,56
South African Premier Division	3,43	53,84	147,28	130,86	16,14	79,93	55,77	28,83	10,14	15,50	60,30	12,43	39,61	19,18	18,50	43,37	36,14	29,70	51,26	2,88
Spanish Segunda Division	3,49	53,34	135,43	129,98	15,89	73,98	49,55	25,64	11,03	15,81	52,93	10,75	37,03	18,38	17,50	43,61	39,86	34,57	50,27	2,56
Swedish Allsvenskan	4,40	70,38	154,33	168,56	16,88	81,31	47,93	27,69	12,53	15,23	57,77	12,57	37,02	20,10	17,22	41,82	37,45	33,44	50,85	2,89
Turkish Super Lig	3,83	57,84	146,22	141,61	16,30	77,76	49,41	27,61	11,15	16,11	55,35	11,94	37,98	17,87	17,76	43,63	36,91	32,10	45,28	3,62
US Major League Soccer MLS	4,17	62,88	148,27	155,90	16,36	80,11	47,17	28,81	11,97	15,21	58,01	12,77	34,63	18,78	16,48	42,85	34,29	30,14	44,85	3,42

Table 5. Eigenvalues for components and total variance explained (2018/19).

Compo-nent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumula-tive %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumula-tive %
1	7.287	36.434	36.434	7.287	36.434	36.434	4.545	22.726	22.726
2	2.696	13.479	49.913	2.696	13.479	49.913	4.215	21.075	43.801
3	2.207	11.037	60.949	2.207	11.037	60.949	2.656	13.279	57.08
4	1.313	6.565	67.514	1.313	6.565	67.514	1.975	9.876	66.956
5	1.077	5.384	72.898	1.077	5.384	72.898	1.189	5.943	72.898
6	0.812	4.058	76.956						
7	0.649	3.246	80.202						
8	0.564	2.821	83.023						
9	0.515	2.575	85.597						
10	0.479	2.397	87.995						
11	0.450	2.251	90.245						
12	0.386	1.932	92.177						
13	0.340	1.701	93.878						
14	0.262	1.308	95.187						
15	0.234	1.170	96.357						
16	0.206	1.031	97.388						
17	0.190	0.950	98.338						
18	0.146	0.731	99.069						
19	0.131	0.655	99.724						
20	0.055	0.276	100.000						

Table 6. Eigenvalues for components and total variance explained (2020/21).

Compo-nent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumula-tive %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumula-tive %
1	6.751	33.757	33.757	6.751	33.757	33.757	4.449	22.247	22.247
2	2.844	14.221	47.978	2.844	14.221	47.978	3.921	19.607	41.854
3	1.999	9.997	57.975	1.999	9.997	57.975	2.788	13.938	55.792
4	1.181	5.903	63.878	1.181	5.903	63.878	1.581	7.906	63.697
5	1.010	5.051	68.929	1.010	5.051	68.929	1.046	5.231	68.929
6	0.963	4.813	73.742						
7	.870	4.352	78.094						
8	.803	4.016	82.111						
9	.553	2.766	84.876						
10	.528	2.638	87.515						
11	.463	2.315	89.830						
12	.383	1.914	91.744						
13	.347	1.735	93.479						
14	.309	1.544	95.023						
15	.237	1.186	96.209						
16	.218	1.089	97.298						
17	.210	1.051	98.349						
18	.143	.716	99.065						
19	.135	.677	99.742						
20	.052	.258	100.00						

Figure 3. Scree plot (2018/2019).

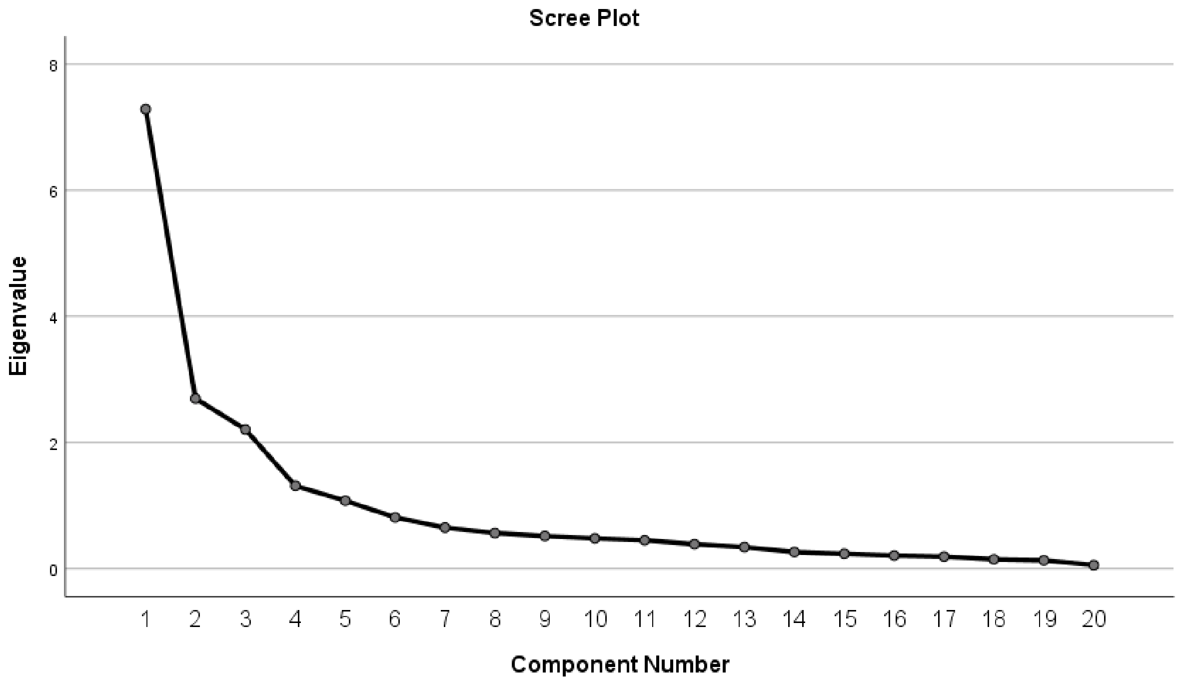


Figure 4. Scree plot (2020/2021).

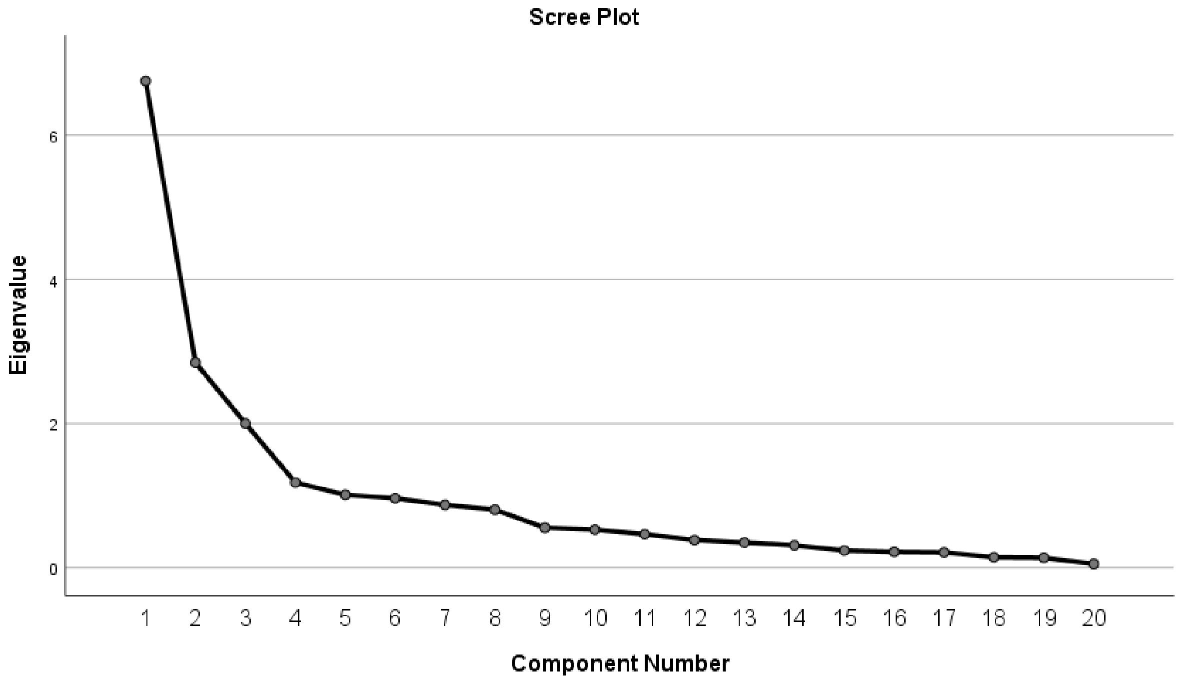


Table 7. Rotated component matrix for both data sets.

Performance Indicators (*N*=20)	**Component (2018/19)**				**Component (2020/21)**		
	Possession	Constructive attacking	Defensive	Direct, long ball	Possession	Constructive attacking	Defensive
Average passes per possession	**0,888**	0,092	-0,282	-0,200	**0,901**	0,088	-0,311
Back passes total	**0,872**	0,097	-0,125	-0,047	**0,872**	0,121	-0,124
Forward passes total	**0,817**	0,263	-0,260	-0,149	**0,786**	0,462	0,174
Lateral passes total	**0,814**	0,369	-0,320	0,251	**0,827**	0,254	-0,283
Passes per minute	**0,776**	-0,065	-0,095	0,058	**0,790**	-0,019	-0,002
Progressive passes total	**0,651**	0,542	0,035	0,202	**0,591**	0,564	0,226
Losses in high field	-0,027	**0,816**	-0,019	0,281	0,006	**0,901**	0,055
Positional attacks	0,334	**0,8**	-0,232	0,000	0,309	**0,791**	-0,226
Recoveries in high field	0,076	**0,779**	-0,124	-0,013	0,120	**0,772**	-0,196
Crosses	0,151	**0,753**	-0,235	-0,025	0,010	0,035	-0,010
Passes to final third total	0,542	**0,667**	-0,108	0,103	0,518	**0,714**	-0,084
Total shots per game	0,163	**0,553**	-0,265	-0,077	0,043	-0,137	-0,002
Recoveries in low field	-0,018	-0,004	**0,797**	0,183	-0,041	-0,048	**0,723**
Losses in low field	-0,182	-0,328	**0,770**	-0,082	-0,202	-0,369	0,537
Clearances of the ball	-0,301	-0,206	**0,664**	-0,102	-0,328	-0,233	0,374
Interceptions of the ball	-0,203	-0,171	**0,626**	0,211	-0,220	-0,105	**0,552**
Losses in mid field	-0,086	-0,289	0,250	**0,809**	-0,115	-0,068	**0,812**
Recoveries in mid field	0,072	0,338	-0,212	**0,777**	0,086	**0,618**	0,319
Long passes total	0,038	0,289	0,290	**0,594**	-0,009	0,385	**0,629**
Counterattacks	-0,016	-0,045	0,154	-0,024	-0,037	0,023	-0,038

Table 8. Rotated component matrix for team vs. league level PCA analyses.

Performance Indicators	Team level structure (2020/21)			League level structure (2020/21)		
	Possession	Constructive attacking	Defensive	Possession	Constructive attacking	Defensive
Average passes per possession	**0,90**	0,09	-0,31	**0,94**	-0,02	-0,29
Back passes total	**0,87**	0,12	-0,12	**0,95**	0,10	0,02
Lateral passes total	**0,83**	0,25	-0,28	**0,92**	0,14	-0,17
Passes per mintue	**0,79**	-0,02	0,00	**0,91**	0,09	0,09
Forward passes total	**0,79**	0,46	0,17	0,50	**0,64**	0,51
Progressive passes total	**0,59**	0,56	0,23	0,12	**0,83**	0,49
Losses in high field	0,01	**0,90**	0,06	-0,33	**0,62**	**0,70**
Positional attacks	0,31	**0,79**	-0,23	0,22	**0,80**	0,37
Recoveries in high field	0,12	**0,77**	-0,20	0,42	0,37	**0,73**
Passes to final third total	0,52	**0,71**	-0,08	0,16	**0,93**	0,16
Recoveries in mid field	0,09	**0,62**	0,32	-0,19	0,21	**0,90**
Losses in mid field	-0,12	-0,07	**0,81**	-0,28	0,15	**0,86**
Recoveries in low field	-0,04	-0,05	**0,72**	-0,37	**0,64**	**0,63**
Long passes	-0,01	0,39	**0,63**	-0,41	0,42	**0,74**
Interceptions of the ball	-0,22	-0,11	**0,55**	0,03	0,42	**0,85**
Clearances	-0,33	-0,23	0,38	-0,01	0,2	**0,85**
Losses in low field	-0,20	-0,37	0,54	0,20	0,35	**0,85**

2.6.3 Cluster Analysis

Cluster analyses were run on standardized data at team level rather than based on KPI values as in the PCA analysis. A two-step procedure was used to compare leagues in terms of utilization of the three playing styles identified in the course of PCA analysis. In step one, the hierarchical agglomerate method (Ward's method) with squared Euclidean distance was selected to explore the possible number of clusters. A visual inspection of the dendrograms (*Figure* 5) and agglomeration coefficients obtained with Ward's method indicated a three-cluster solution. The distribution of teams across clusters is shown in Table 9.

Figure 5. Cluster dendrogram (2020/21).

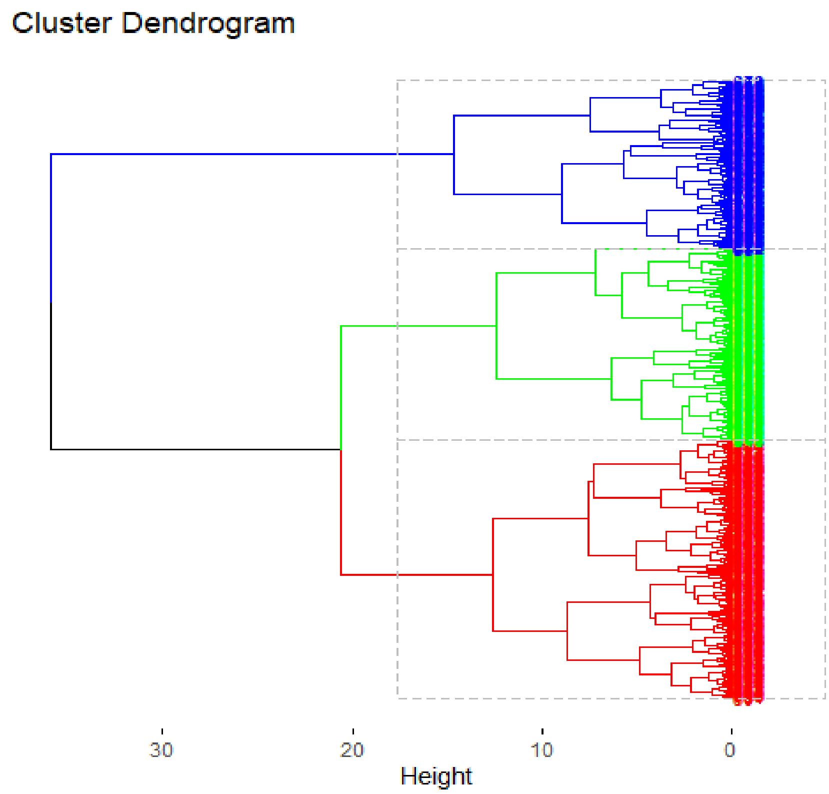


Table 9. Allocation of teams to three clusters.

League	Cluster nr	Nr teams	League	Cluster nr	Nr teams	League	Cluster nr	Nr teams
Argentinian Superliga			German Bundesliga 2			Portuguese Primeira Liga		
	1	16		1	8		1	5
	2	3		2	3		2	4
	3	5		3	7		3	9
Australian A-League			Greek Super League 1			Qatar Stars League (Q-League)		
	1	5		1	4		1	4
	2	3		2	3		2	3

	3	4
Belorussian Premier League		
	1	8
	2	3
	3	7
Belgian Pro League (Jupiler Pro League)		
	1	7
	2	3
	3	6
Brazilian Serie A		
	1	6
	2	4
	3	10
Bulgarian A League (Efbet Liga)		
	1	6
	2	3
	3	5
Chilean Primera Division		
	1	9
	2	3
	3	6
Chinese Super League		
	1	5
	2	4
	3	7
Colombian Primera A		
	1	10
	2	4
	3	6
Croatian 1.HNL		
	1	4
	2	2
	3	4
Czech Fortuna Liga		
	1	9
	2	3
	3	6
Danish Super Liga		
	1	6
	2	2
	3	4
English Championship		
	1	15
	2	4
	3	6
French Ligue 1		
	1	6
	2	5
	3	9
Georgian Erovnuli Liga		
	1	3
	2	3
	3	4
	3	7
Hungarian NB1		
	1	6
	2	2
	3	4
Israeli Premier League		
	1	5
	2	3
	3	6
Italian Serie B		
	1	8
	2	5
	3	7
Japanese J1 League		
	1	5
	2	5
	3	8
Kazach Premier League		
	1	3
	2	3
	3	5
Korean K League 1		
	1	5
	2	3
	3	4
Lithuanian A Lyga		
	1	3
	2	1
	3	2
Mexican Liga MX		
	1	9
	2	2
	3	7
Netherlands Eredivisie		
	1	7
	2	4
	3	7
Norwegian Elitserien		
	1	5
	2	4
	3	7
Paraguayan Primera Division		
	1	7
	2	1
	3	4
Peruvian Primera Division Peruana		
	1	6
	2	5
	3	9
Polish Ekstraklasa		
	1	8
	2	3
	3	5
	3	5
Romanian Liga I		
	1	2
	2	6
	3	9
Russian Premier League		
	1	8
	2	3
	3	5
Serbian Super Liga		
	1	7
	2	4
	3	9
Slovak Super Liga		
	1	6
	2	3
	3	3
South African Premier Division		
	1	12
	2	2
	3	12
Spanish Segunda Division		
	1	14
	2	3
	3	5
Swedish Allsvenskan		
	1	5
	2	5
	3	6
Swiss Super League		
	1	4
	2	2
	3	4
Turkish Super Lig		
	1	7
	2	5
	3	9
Ukrainian Premier Liha		
	1	8
	2	2
	3	4
United Arab Emirates (UAE) Pro League		
	1	4
	2	3
	3	7
Uruguayan Primera Division		
	1	9
	2	3
	3	4
US Major League Soccer MLS		
	1	13
	2	5
	3	8

As a second step, cluster memberships were determined through consecutive non-hierarchical K-means cluster analyses computed to identify an optimal three-group structure. The three-cluster solution was supported by Cramer's V test, which indicated good agreement between Ward's method and K-means clustering (Cramer's V = 0.69, $p < 0.05$). Cluster groups ranged in size, from 149 teams in cluster two, to 267 teams in cluster three and 312 teams in cluster one (Table 9). Each cluster exceeded 10% of the sample, as recommended by Hair et al. (2010). The density plots show that teams use a combination of playing styles, with the majority of teams relying on all three. The possession based style is most pronounced in teams allocated to the third cluster (*Figure* 6). Teams grouped in cluster one are more likely to utilize constructive attacking play (*Figure 7*), and teams in cluster three predominantly rely on the defensive style (*Figure 8*).

Figure 6. Density plot for possession based style.

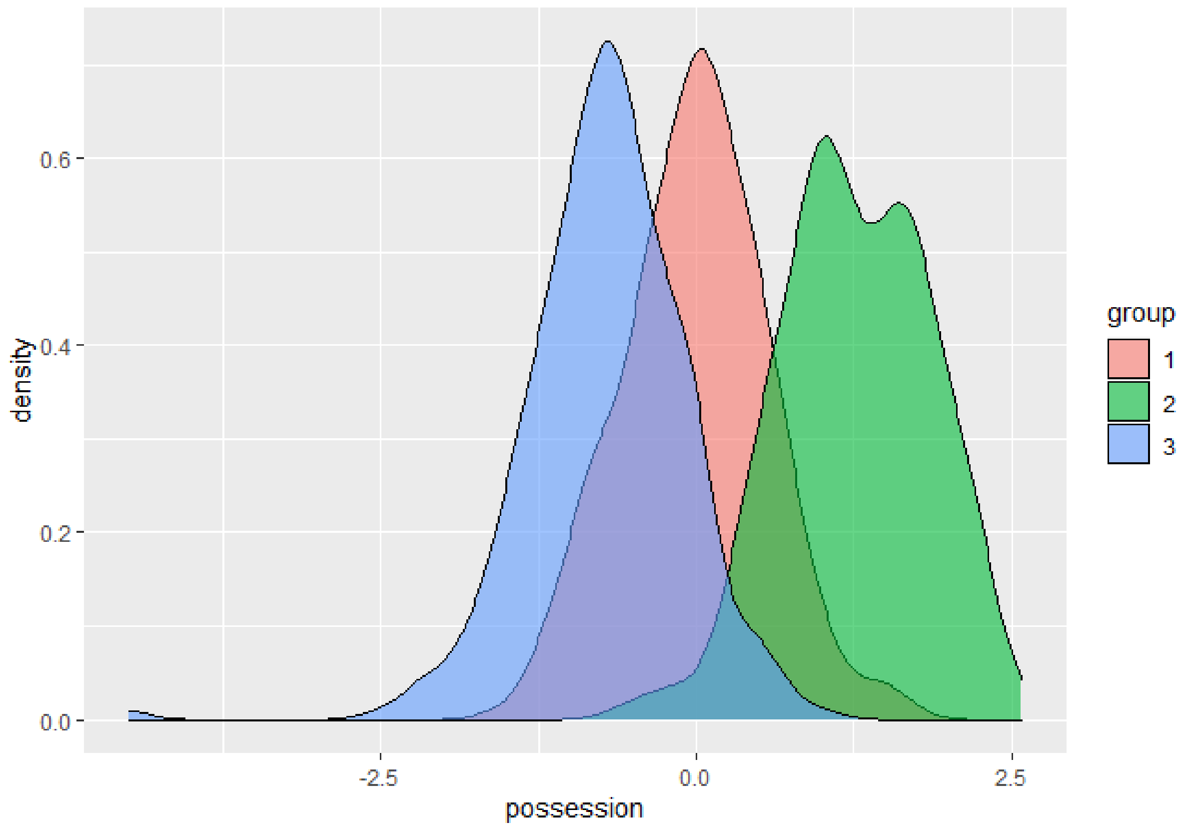


Figure 7. Density plot for constructive attacking style.

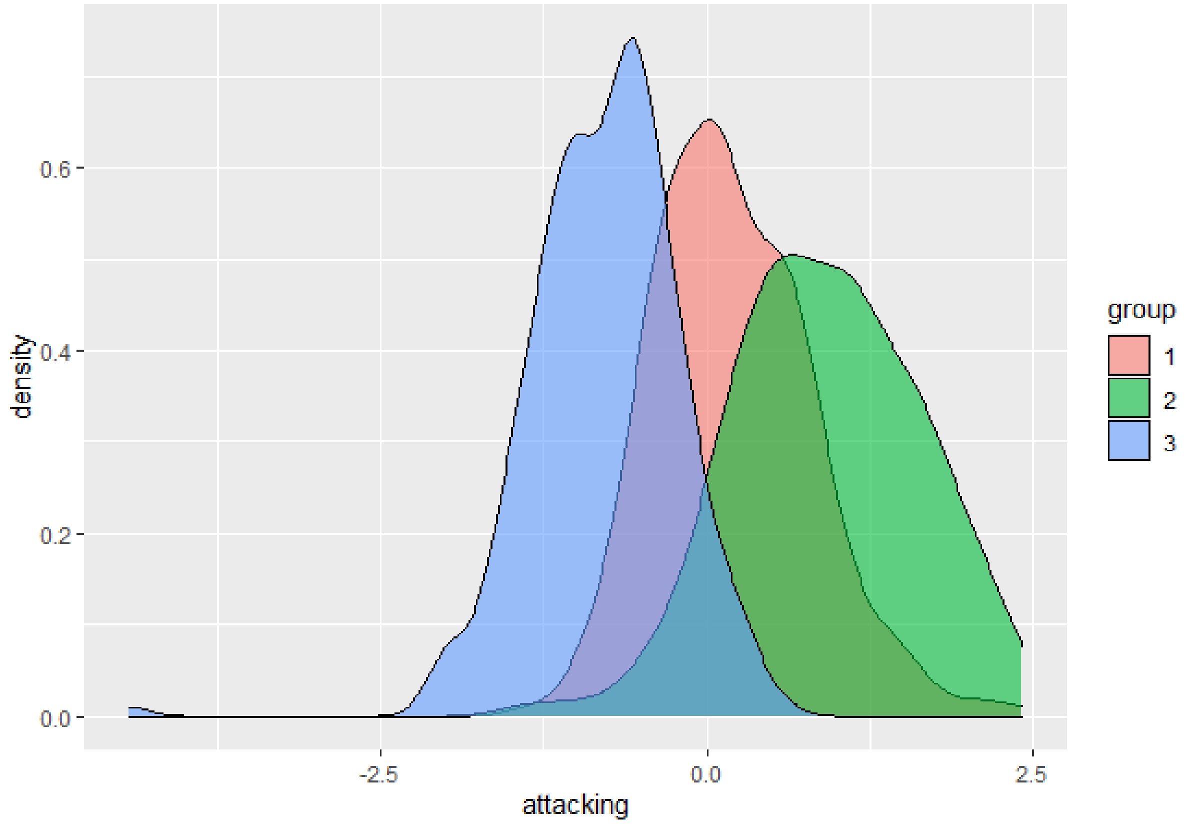
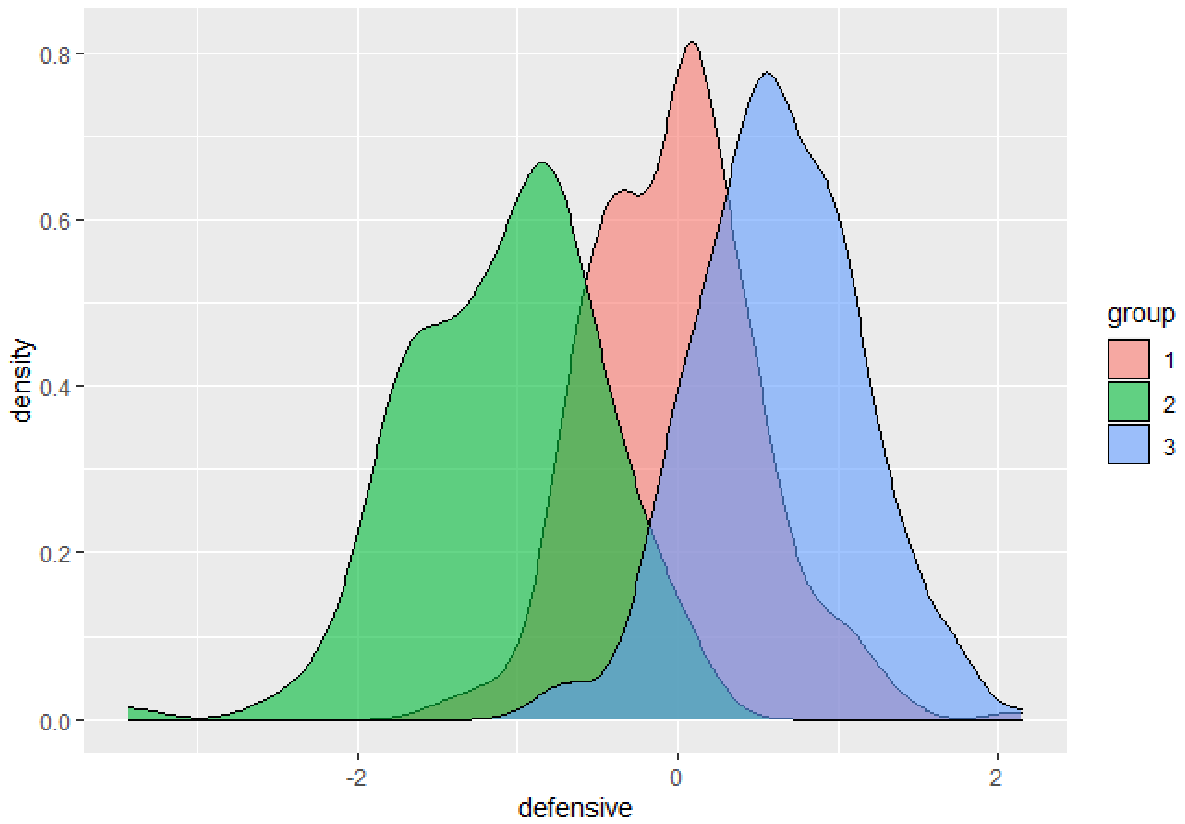


Figure 8. Density plot for defensive style.



An analysis of cluster means confirmed the results of visual density plot inspection (Table 10). In other words, the average team in cluster one has a mean value for attacking of 0.199, which is higher than the mean values for possession (*M* = -0.007) or defensive style (*M* = -0.021). Analogously, the average team in cluster two exhibits highest mean values for possession (*M* = 1.261), and the average team in cluster three is characterized by highest values for defensive style (*M* = 0.626).

Table 10. Cluster means of team level and league level data.

Cluster nr	Styles of play		
	possession	***attacking***	***defensive***
Team level data			
1 (*N* = 312)	-0.007	**0.199**	-0.021
2 (*N* = 149)	**1.261**	0.917	-1.080
3 (*N* = 267)	-0.716	-0.783	**0.626**
Aggregated league level data			
1 (*N = 7)*	-0.279	-0.265	-0.022
2 (*N* = 24)	**0.101**	-0.058	-0.139
3 (*N* = 14)	-0.005	-0.006	0.005

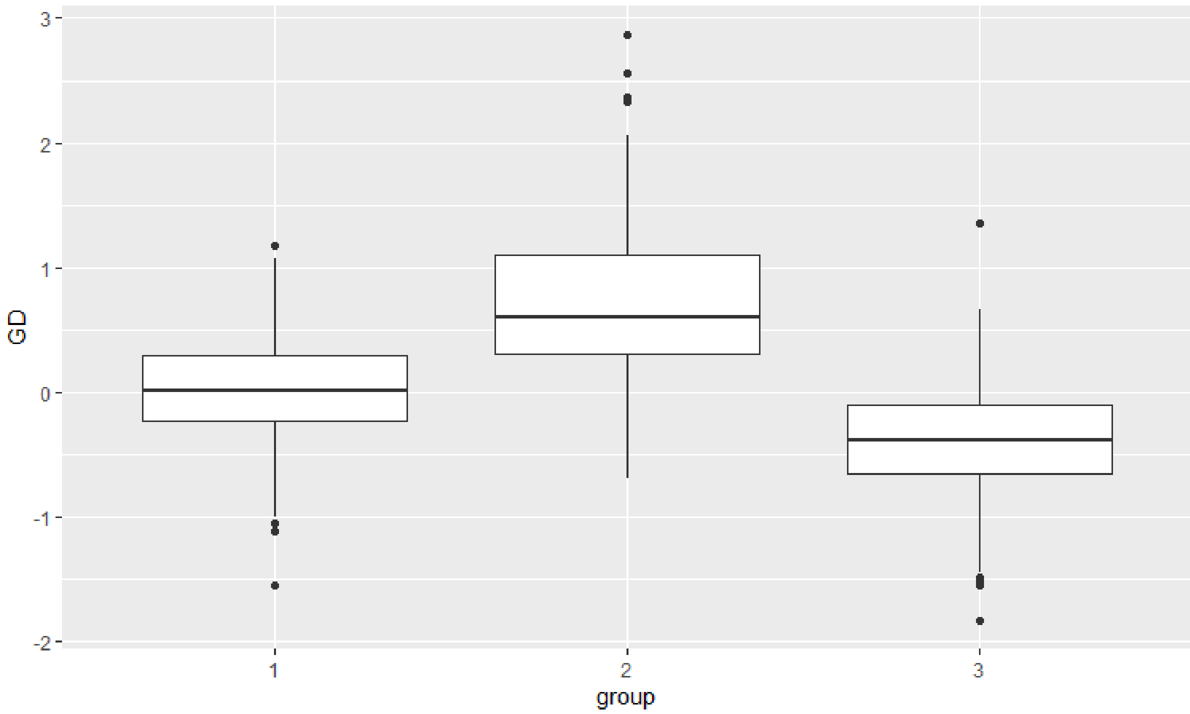
Comparison of clusters

Clusters were compared in relation to the sporting success achieved by teams within these clusters. The dependent variable of sporting success was operationalized as goal difference (GD), namely the difference between goals scored and goals conceded (see section 3.5.2 in Study 2 for more details). A one-way ANOVA revealed significant differences between the clusters relative to sporting results (F(2,725) = [237.83], $p < 0.001$). This provides further empirical evidence to the three-way cluster structure at team level. Tukey's post hoc tests found that the mean value of the dependent variable (i.e., goal difference) was significantly different between all clusters as summarized in Table 11. As shown graphically in ***Figure 9***, teams from the second cluster, where the possession based style dominates, appear to be most successful in terms of scoring, followed by cluster 1 (i.e., prevalence of teams with a constructive attacking orientation) and cluster 3 (i.e., defensively oriented teams).

Table 11. Tukey's test results of one-way ANOVA.

Cluster	Mean	Confidence Intervals		Median	*p*
		High	*Low*		
1	0.000	0.572	0.800	0.013	0.000
2	0.687	-0.497	-0.306	0.600	0.000
3	-0.401	-1.210	-0.971	-0.389	0.000

Figure 9. Median-based Tukey's host hoc results.



Testing cluster stability at league level

K-means clustering analysis was also run on the aggregated values for 45 leagues, using raw (unstandardized) team level data as input. The results showed reliance on a particular playing style (i.e., possession, $M = 0.101$) only in one cluster (Table 10), thus undermining the validity of the three-cluster structure at league level. Therefore, additional gap testing was performed to re-assess the optimal cluster structure. Whereas a three-cluster optimal solution (i.e., demonstrated by the line starting at one and peaking at three solutions) emerged from gap analysis conducted on team level data (*Figure 10*), the gap test produced a one-cluster optimal solution (i.e., demonstrated by the line starting at one and not reaching a peak) at league level (*Figure 11*). To sum up, the three-cluster structure for styles endorsed by football teams was confirmed by hierarchical clustering, K-means clustering and supplemental gap analysis. However, it appears that at league-level there are no distinct clusters within the 2-10 cluster range tested in gap analysis.

Figure 10. Team level gap analysis.

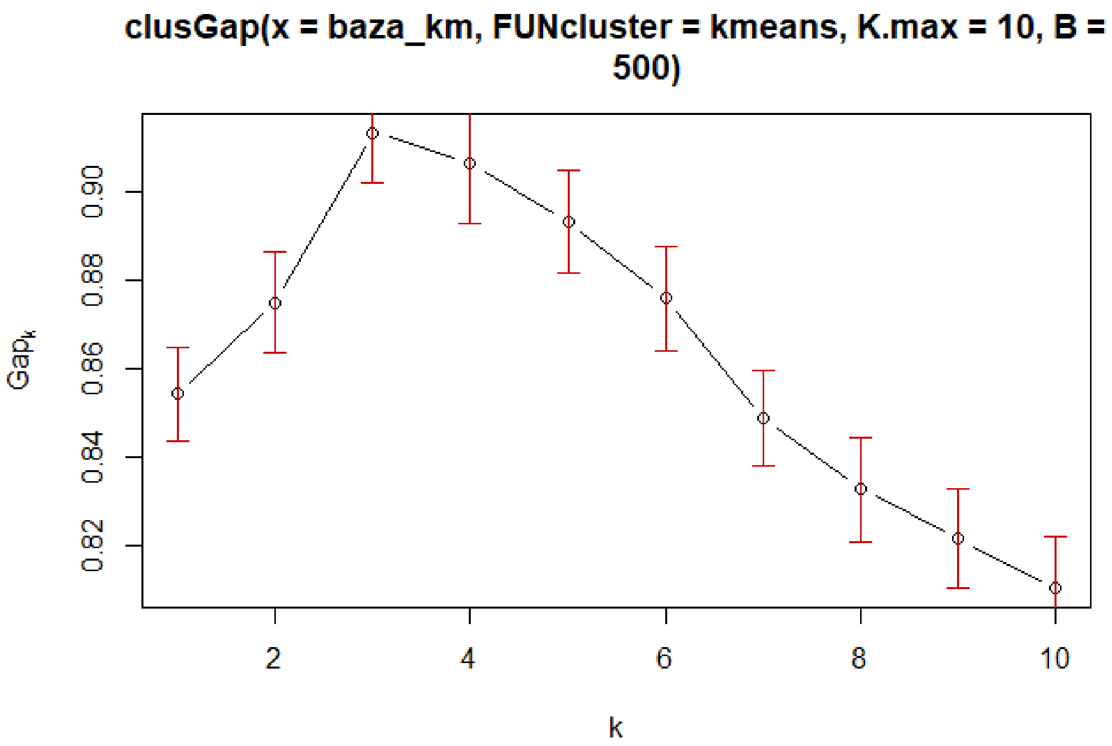
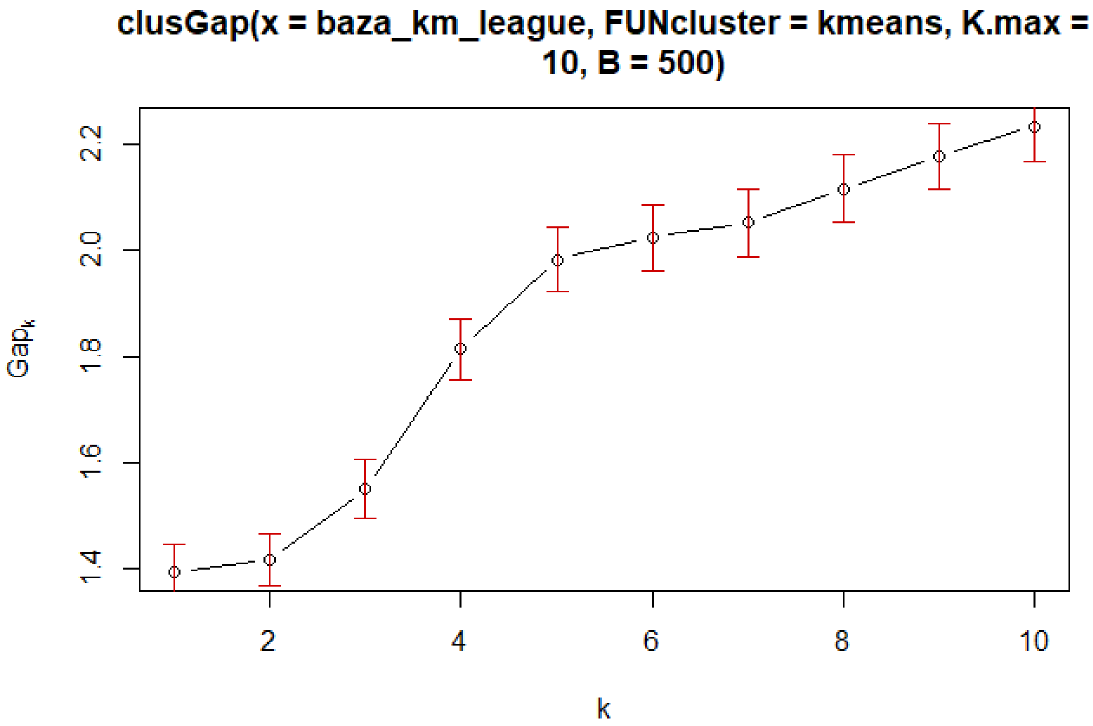


Figure 11. League level gap analysis.



2.7 Discussion

The current study explored the patterned behaviors of teams with the aim of identifying distinct styles of play, and comparing their utilization across teams and leagues. The findings were initially derived from a 21-league sample covering the 2018/19 footballing season, and were subsequently tested in a larger, 45-league sample based on 2020/21 match data across levels of analysis.

Four distinct styles of play were identified from the first data set (2018/19) following application of principal component analysis (PCA), which resulted in the extraction of four components respectively. The **possession-based** style, characterized by prevalence of various passing behaviors, explained the highest percentage of variance (21%). This categorization includes a wide variety of movements represented by corresponding variables, including lateral passes that typify game styles previously identified in the literature as “elaborate” play (Tenga & Larsen, 2003), as well as forward and progressive passes exemplifying long passing sequences (Bate, 1998; Hughes & Franks, 2005). “Possession maintenance” often involves high match tempo (e.g., passes per minute), but within a slower paced progression characterized by a greater number of defensive movements, lower risk when passing, and a greater emphasis on regaining possession (Hewitt et al., 2016; Lago-Peñas & Dellal, 2011). This playing style has also been referred to in the literature as “indirect play” contrasted with “direct play” accounted for in component 4 “long-ball” style.

The possession-based style re-emerged from the second data set (2020/21) with the same items loading onto the first component, except for forward passes (Table 7). The existence of a possession-based style was also confirmed by league-level analysis, which showed higher loadings for most items, with the exception of forward and progressive passes (Table 8). Progressive passes, which are essentially forward passes attempting to advance the ball significantly closer to the opponent’s goal, had highest loadings within the constructive attacking style, suggesting a greater overlap between possession-based and constructive attacking styles at the league level. Cluster analysis (based on 2020/21 data) revealed that the possession-based style dominated in the Argentinian Superliga (66.7% of teams), the Spanish Segunda Division (63.6% of teams) and the English Championship (60% of teams). This style appeared to prevail (over 50% of teams within leagues) in a number of Latin American leagues, including the Chilean Primera Division, the Colombian Primera A, the Mexican Liga MX, the Paraguayan Primera Division and the Uruguayan Primera Division. These results afford some support to the notion of "Latin" playing styles that rely on short and quick passing sequences, although it is more difficult to justify the prevalence of possession-based style in the US MSL or the Ukrainian Premier Liha, or the domination of defensive style in the remaining South American leagues such as the Brazilian Serie A, which has been traditionally associated with the "passing game" (Guilianotti, 1999), or the Colombian Primera A and the Peruvian Primera Division (over 50% of teams within leagues). One possible explanation is the globalization of the game, characterized by greater cross-border mobility of both coaches and players, resulting in the increased cultural diversity of football teams. The latter possibility, namely the effect of teams' cultural composition on playing styles, is investigated in Study 2. Overall, the possession-based style was the most widely used by teams across the 45-league sample, implying that regardless of the importance of context, high pace and superb technical skill (required for well-coordinated passing) are salient features of the modern game.

In the 2020/21 season, the **constructive attacking** style (explaining 19% of the variance) retained its most characteristic items, including positional attacks, passes to the final third and events (losses and recoveries) in high and mid-field. Surprisingly, crosses, which often facilitate the construction of diamond configurations, did not qualify for inclusion. The value loadings for shots also fell below the 0.6 threshold, but their relevance was questionable to start with even in the 2018/19 data set. Cluster analysis revealed that teams relied the least on **constructive attacking** compared to other styles, that is, only roughly 20% of teams exhibited a dominant preference for this style. Teams' comparatively low reliance on constructive attacking can be explained by a functional overlap with the possession based style. For example, attacking play with emphasis on positional attacks can be achieved with a fewer number of passes constructed in more vertical play that typifies direct approaches. In support of this argument, teams from South American leagues showed lower scores on the utilization of constructive attacking, provided they relied primarily on possession-based style. Although constructive attacking is fundamentally contingent on good quality passing and advanced team coordination ability, its characteristic feature is swift progressive action constructed through positional attacks, and aided by high pressing in the opponent's defensive third. It can be postulated that teams, which have been traditionally known to play possession-based football, have embellished their foundational "passing" game with other tactical elements that distinguish their style from cluster 1 teams (i.e., possession-oriented). The passing game has thus evolved and branched out into more sophisticated playing styles involving, for instance, modern positional attacking and high pressing tactics such as the "Gegen-press" (Bell-Walker et al., 2006; Fernandez-Navarro et al., 2016). To this effect, greater utilization of constructive attacking is demonstrated by highly ranked European teams within the Swedish, Norwegian, French, Italian, Slovak and Portuguese top divisions, although roughly a quarter of Australian, Chinese, Japanese, Turkish, Kazakh and Qatari teams also show a preference for it.

The **defensive style** (explaining 15% of the variance) also re-emerged from the 2020/21 data set, albeit modified to include long passes at the expense of clearances, and losses in mid-field vs. low field. This change serves to strengthen the defensive description of the underlying style, characterized by greater emphasis on the direct build-up of play with defensive players executing longer passes toward players in the attacking formation, whilst maintaining compactness and protecting space. Although, all teams across the 45-league sample relied on differing combinations of the three playing styles, the defensive style featured most prominently (in over 50% of teams within leagues) in the Brazilian Serie A, the Romanian Liga 1, the South African Premier Division, the Qatar Stars League and the United Arab Emirates League. Teams from the Argentinian Superliga, the English Championship, the Uruguayan Primera Division, the Slovak Super Liga and the Ukrainian Premier Liha were least reliant on defensive play. While referring to this style as defensive, it is important to underline that during matches teams utilize both attacking and defensive play. In this study, teams within leagues are classified as exhibiting a preference for defensive tactics, precipitating the prevalence of a defensive style of play. Teams in this cluster are largely and more or less equally reliant on possession-based and defensive play (i.e., both could be considered as building blocks of any game strategy), and least reliant on constructive attacking.

When comparing clusters, cluster 2 teams show the highest mean value for their dominant style (M=1.261 for possession) compared to cluster 1 teams (M=0.199 for attacking) and cluster 3 (M=0.626 for defensive style). Interestingly, the results of a one-way ANOVA and post hoc Tukey's tests showed that cluster 2 teams were most successful and cluster 3 teams were least successful, with success being measured as the difference between goals scored and goals conceded. Whereas, these finding provide some evidence that offensive styles may be more effective compared to defensive play[50], what is more important is that the results offer strong support for the existence of a three-cluster structure of playing styles at the team level ($p<0.001$).

[50] Drawing conclusions regarding the effectiveness of playing styles based on a one-way ANOVA, which does not account for between and within league variance, or any other factors/explanatory variables, would be empirically fallacious.

From the perspective of leagues rather than teams, cluster analyses revealed a different picture. The cluster and subsequent gap analyses run on aggregated team values to capture league-level grouping tendencies pointed to a one-cluster optimal solution. This finding questions the plausibility of profiling leagues based on prevalent playing styles. In other words, the concept of playing style only seems to exude relevance in relation to teams, not leagues. These results could not be directly supported by evidence from other comparable studies (e.g., Lago-Peñas, 2018 on Chinese league playing styles) due to differences in the methodological approach employed such as the computation of cross-level cluster (structural) invariance.

The **direct, long-ball style** identified in the 2018/19 season, did not re-emerge from the 2020/21 data set. Only one item (i.e. counterattacks) loaded onto the fourth component. This was considered insufficient to justify the quantification of a distinct playing style, and, therefore, a three-component structure was retained. One possible explanation for the absence of the direct, long ball style is the change in cultural composition of the league sample. Other reasons include the effect of various determinants such as teams' cultural diversity. These are further investigated in Study 2.

Although Study 1 is not methodologically grounded within ecological dynamics, a better understanding of playing styles can be glimpsed from this approach, given that the operationalization of styles derived under Study 1 is further adopted in Study 2 and Study 3, both of which are guided by embodied theorizing. Thus, from an ecological dynamics vantage point, the four playing styles constitute behavioral patterns that emerge under constraints at different levels of interaction. These levels are hierarchically ordered and nested, producing adaptive behaviors from dynamical interactions at individual (team member), team and league level. The emergence of patterns of behavior that characterize playing styles utilized to differing degrees across leagues is explained by the mechanism of self-organization that drives dynamical systems such as teams toward the achievement of optimal grip on multiple relevant affordances, referred to as a *field of affordances* (Kiverstein & Rietveld, 2014), influenced by macro- and micro-level factors referred to as constraints (see conceptualization in *Figure 1*). Examples of macro-level constraints (e.g. sociocultural, historical, climatic and other environmental) attributable to leagues/countries include the game's popularity, level of professionalization, national traditions/schools in coaching football or the philosophy of a particular coach. Micro-level constraints are associated with the immediate performance context, for instance a team's cultural composition (cultural heterogeneity) or its quality (measured in terms of market value and league rankings). Constraints at both levels interact to shape dynamical patters of behaviors in a bidirectional fashion, that is, *top-down* (i.e., global-to-local effects) and *bottom-up* (i.e., local-to-global effects), thus revealing the circular causality of self-organizing processes in teams as CAS (Kelso, 1995; Araújo & Davids, 2016) (see *Figure 2* for reference).

To conclude, strong evidence was found for the existence of three distinct playing styles across two different data sets, confirmed by team level PCA, cross-level equivalence testing (i.e., isomorphism) as well cluster comparison based on teams' sporting success. Although clustering analyses highlighted differences in style utilization between teams, the three-group structure was not supported at league level, suggesting that profiling leagues based on dominant styles of play of underlying teams is not a valid approach to investigating between-league differences. Moreover, clustering provided limited explanatory insight, thus illuminating the need for further exploration of the determinant of playing styles. Finally, one-way ANOVA testing in relation to team's sporting outcomes confirmed significant differences between the three clusters.

CHAPTER THREE: Determinants of Football Teams' Performance Success (Study 2)

3.1 Introduction

The interest of researchers and practitioners as to how football is played in terms of style, strategy and tactics is driven by the ultimate aim of achieving sporting success or winning games. Measuring and predicting player or team sport performance has been the domain of sport economics[51], performance analysis, sport sociology and sport psychology. Evidence from these multiple disciplines points to a number of determinants that influence sporting outcomes/results, also referred to in the literature as sporting efficiency. These determinants include the *economic/market value of teams* (e.g., Gerhards & Mutz, 2016; Herm et al., 2014; Kiefer, 2014), *macro-level indicators* (i.e., wealth, demography, access to facilities, quality of healthcare, climatic variables; Hoffmann et al., 2002; Gásquez & Royela, 2016), *team cultural compositio*n (e.g., Caruso et al. 2016; Bachan et al., 2014) or the effect of *coaches contribution* (e.g., Muehlheusser et al., 2018). *Player earning*s have attracted most scholarly interest, with examples from the Italian Serie A (e.g., Caruso et al., 2017), the English Premier League (e.g., Forrest & Simmons, 2002; Szymanski & Smith, 1997), the German Bundesliga 1 (e.g., Frick, 2013), the Spanish La Liga (e.g., Garcia-del-Barrio & Szymanski, 2006), the French Ligue 1 (e.g., Llorca & Teste, 2016), and for the Norwegian and Swedish championships (e.g., Madsen et al., 2018).

Extant research has primarily focused on the Big Five European leagues in relation to the economic value and remuneration of players. To date, scarce scholarly consideration has been given to the link between how the game is played or game styles and team sporting outcomes, or to the association between team level style of play and various determinants of sporting success at the micro (team) and macro (country/league) level. In fact, investigation of

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[51] The birth of sport economics is traced back Simon Rottenberg's 1956 study on baseball players' labor market (Noll, 2006).

the effect of cultural team composition has produced starkly conflicting results. Moreover, these lines of inquiry have often been pursued in isolation from existing theoretical frameworks that seek to explain team behaviors in sport. Lastly, sports groups (i.e., sports teams and organizations) have been largely ignored in cross-cultural research.

The current study addresses these gaps by (1) broadening the empirical base to 45 international leagues from different national divisions, (2) providing theoretical grounding that draws on ecological dynamics and social (cross-cultural psychology), and (3) offering new empirical insights into the relationship between teams' sporting outcomes and their economic/market value, dominant playing style and cultural composition. Specifically, the interaction effects of teams' reliance on playing styles and macroeconomic indicators (i.e., GDP based on purchasing power parity and budgetary spend on sport) are tested to examine the impact of country/league economic prosperity on sporting outcomes. Moreover, given the inconclusive evidence on the impact of team cultural composition on performance (discussed below), the moderating role of teams' cultural heterogeneity is explored. The remainder of Chapter 3 is structured in the following way. First, the two theoretical models guiding this study are presented and explained against the backdrop of sport-specific literature on the impact of cultural diversity on team performance, both with reference to wealth (e.g., market value, country income and budgetary expenditure on sport) and playing styles. On this basis, concrete hypotheses are formulated. Next, the measures used in the study are described along with the statistical analyses undertaken. Finally, results are presented and discussed in the final section.

3.2 Theoretical Framing

This study is grounded in ecological understandings of perception and action (i.e., in the Gibsonian tradition), and is guided by two theoretical models, namely the (1) skilled intentionality framework (Van Dijk & Rietveld, 2017) and the (2) integrative categorization-intentionality model (proposed by the author). Both models draw on the idea that affordances are properties of the environment taken with reference to an individual[52], in others words, they are *situated*.

While affordances are features[53] of the environment, they do not "cause" or elicit behavior, although they may prompt it. More importantly, affordances constrain what actions may be expressed in a setting, thus creating possibilities for particular behaviors or activities. The utilization of specific affordances in an environmental setting depends of the *intentional process of the receiver* (Heft, 1989). Further, intentional acts are not initiated by mental representation (schemas), but are always situated (Merleau-Ponty, 1963) with respect to two factors: the functional characteristics of the environment (i.e., its affordances as ecological resources of behavior), and the physical characteristics of the individual's body (e.g., height, agility, strength). In combination, these constrain the range of intentional acts that can be expressed (Heft, 1989). In that sense, the body of a football player is an instrument through which intentional acts (e.g., passing the ball to a particular teammate) that are directed toward environmental objects (e.g., the ball, the opponent or a teammate) are expressed. The situated nature of intentional acts implies that cultural context and history affect an individual's intentional repertoire. Moreover, the intentional acts that a person acquires within a sociocultural context, are situated with respect to particular objects or situations. For instance,

[52] Affordances have both objective (i.e., facts of the environment) and subjective (i.e., implicate a particular receiver, although they do not reside in the mind) qualities. As they do not fit within these two ontological categories, they are said to be *relational* in nature (Heft, 1989). Throughout this dissertation, the relational context of the environment and individual/group is contrasted with dualistic approaches. The dualistic approach draws sharp conceptual/ontological boundaries between the individual (group) and the environment, examining properties in isolation. Causality is viewed in purely mechanistic terms, with antecedents determining the directionality of influence. In contrast, relational conceptualizations refer to properties that emerge out of interactions with the environment, recognizing reciprocal and mutual influences in the on-going and synergetic transactions between the environment and the individual (group) as a system (Heft, 1989). Behaviorism, and its contemporary versions (i.e., cognitive information processing models in psychology), are transpositions of post-Renaissance, Lockean causality models that apply mechanistic explanations to observables actions and inferred mental operations.

[53] Chemero (2011) differentiates between properties and features of the environment, and argues that affordances are neither features nor properties of the environment alone, but they are essentially "relations between animals and features of situations" (p. 141).

a particular ball passing sequence affords field positioning that is characteristic of combinative play in attack in a given cultural context, but the functional meaning of such positioning can afford an alternative offensive action in a different cultural context. In other words, the meaning attached to passing is relative to the player's individual intentional repertoire. The history of interactions (between the individual and the environment) or the process of enculturation in general can be viewed as one of acquiring a repertoire of situated acts that reflect specific footballing and/or coaching practices. In this process, there is simultaneously a patterning of motor or coordination behaviors expressing a particular intention and an enhanced sensitivity / attunement to related affordances. Developmentally, players' intentional repertoire expands and differentiates, and concurrently attunement to new affordances is acquired as part of a *learning / enculturation* process. Intentional approaches provide an alternative to the two main manifestations of dualistic thinking in psychological theory: behaviorism and mentalism (Wild, 1963).

3.2.1 Skilled Intentionality Framework (SIF)

Ecological psychologists tend to engage with either the affordances offered by the material environment or affordances that entail social coordination. The Skilled Intentionality Framework (SIF) provides an integrative account based on the notion of *sociomateriality*. Social coordination is embedded in a "constellation of practices" (Van Dijk & Rietveld, 2017, p. 3) and entangled with the material aspects of the environment. For example, the coordination of offensive or defensive actions in football teams is entangled with material aspects such as pitch conditions during a match (e.g. artificial, grass, etc.) or material infrastructure as a whole (e.g., stadium facilities, access to high quality training, etc.). Thus, the affordances encountered in daily sports life in the footballing ecological niche, are formed within a constellation of situated (cultural) practices. Skilled individuals (professional football players) are entangled within a landscape of affordances and gain access to it, conditional on having the necessary skills (Noë, 2012). Experientially, the field of available affordances is made up of *relevant* affordances that “stand out” (De Haan et al., 2013; Kiverstein, 2016); they are also described as soliciting or inviting behavior (Dreyfus and Kelly, 2007; Withagen et al., 2012). Readiness to act on affordances is related to individuals’ history of engagement with sociomaterial practices (Rietveld, 2008). This gives rise to *skilled engagement* with and *selective responsiveness* to relevant affordances (Kiverstein and Rietveld, 2015). Finally, as proposed by the SIF, individuals experience actions, as they unfold, or in a *pre-reflective* manner, which is “intentional” (Heft, 1989).

Based on the SIF, the author postulates that materiality and standing practices within football clubs and teams constrain the field of relevant affordances for players, in both training and competitive contexts. Materiality is expressed in terms of wealth, the abundance and quality of material artefacts (e.g., training equipment, transport), places (e.g., number and quality of pitches), bodies (e.g., embodied talent and skill of players and coaching staff), and infrastructures (e.g., stadiums), and is nested within multiple levels. In other words, the interactions between players and their environments are nested within teams, clubs, leagues and countries. These transactional exchanges are reciprocal and entangled. The material aspects of the club/team environment (or possibly league environment, if stadiums are shared between teams within a particular league) partake in the constellation of sociocultural practices such as team leadership, player development and coaching philosophy, preferred tactical / strategic solutions, playing style, etc. in goal-directed action, that is, achieving sporting success. The material component is operationalized as *wealth*, both at team (i.e., team market value) and country level (i.e., league market value, country income based on PPP, annual budgetary expenditure on sport), with the expectation that the situatedness of wealth as a constraint will impact team success. Based on the extant literature (see section 3.3) from multiple disciplines, the directionality of the association with teams’ sporting success is hypothesized, as well as the moderating role of the material component relative to teams' patterned behavior as styles of play.

3.2.2 Integrative Categorization-Intentionality Model (ICIM)

The Integrative Categorization-Intentionality Model (ICIM) conceptualizes and integrates the ecological perspective of skilled intentionality and social categorization perspectives on sport team performance and diversity. The ICIM incorporates cultural diversity as a moderator variable, and embraces the view that decision making and categorization processes within teams converge at the point of complementary action intentionality. The author posits that teams' cultural composition (cultural diversity), while constraining the field of relevant affordances, also opens up new possibilities for tactical action by moderating the relationship between styles of play as patterned behavior and sporting outcomes as indicators of sporting efficiency. The direction of association in relation to particular styles of play is predicted based on sports performance research (see section 3.3). In the following paragraphs, the theoretical premises for the development of ICIM (*Figure 12*) are explicated.

Building on Gibson's nascent commitment to a psychology of values (Reed, 1988), and the proposition that affordances are realizable only if perception is *intentiona*l (Heft 1989; Reed, 1983; Turvey, 1990; Vedeler, 1991), Hodges and Baron (1992) conceptualized perceiving as a "value-realizing activity" and the "constitution and detection of affordances" as a "partial realization of values" (p. 263). In this sense, all intentional acts are value-directed. To exemplify the value-realization of affordances, Vaughan et al., 2021 discuss the design of a *rondo*, a training exercise that encourages players to maintain possession of the ball by coordinating their actions. In the rondo drill, an exterior circle of players is formed around a smaller number of interior players. The players on the perimeter of the circle engage in passing amongst themselves, whilst trying to keep the ball away from the players on the interior (López-Felip, M. (2019). The rondo creates passing and receiving opportunities within a relevant field of affordances that "stand out" and invite players to embody (i.e., partially realize) the value of teamwork and collaboration. Whilst the design of the exercise targets player decision making used in the detection of passing affordances, in natural settings (e.g., during a football match), the cultural context can facilitate or interfere with the value-realization of passing affordances. For instance, players enculturated to perceive affordances in a similar manner are more likely to demonstrate "skillful responsiveness" to the detection, selection and utilization of particular affordances. Their intentional exploration of efficient passing possibilities is constrained / framed by pre-reflective experiences of a distinct cultural socialization in football and relative to their intentional repertoire. Cognitively speaking, players' enculturated capacities influenced by their history of learning become integrated with their sensorimotor capacities in online-offline cognitive symbiosis. In this regard, network analysis in football has revealed the relative stability of patterns of passing behaviors characteristic of dyads and triads within teams, regardless of tactical changes in team organization (Clemente et al., 2015; Grund, 2012; Wäsche et al., 2017). The author thus posits that players with a similar footballing background exhibit common attunement to environmental properties, and are more likely to create affordances for each other as a way of *communication through action*. Footballing (cultural) practices are internalized through learning and training, and they manifest themselves cognitively in two ways, through *thought* (how players think) but most importantly, through *action* and *interaction* with the environment. As action embodies perceptual judgements and decisions (Araújo et at., 2006), and as such expresses a cognitive process, it is justifiable to draw on organizational and functional aspects of contextualized action in testing hypotheses about cognitions in behavior (Araújo et at., 2017). The design of the ICIM is based on this premise of cognitive connection to social processes within teams.

Social categorization is a cognitive process (i.e., presumed to be purely representational within social psychology) that affords explanations for behaviors within culturally diverse groups. There are two theoretical schools of thought that examine the association of group differences with subsequent outcomes. One views diversity as an impediment to performance (Milliken & Martins, 1996), as predicted by the *similarity-attraction paradigm* (Byrne, 1971) or *social categorization theory* (Tajfel & Turner, 1979; Turner et al., 1987). The former postulates that diverse teams are less productive than homogenous teams because of the mutual interaction among team members with similar characteristics. Although these perspectives have not been applied in the context of sport teams and in fact appear to be far removed from embodied sporting behaviors, the author seeks to demonstrate their utility in this study. Thanks to the mutual attraction and constructive interactions, homogenous teams could outperform heterogenous teams (Wiersema & Bantel, 1992). Likewise, the social categorization theory maintains that team members tend to categorize other members into subgroups, leading to in-group and out-group identification and ultimately to intergroup bias disfunction. Therefore, homogenous teams are more likely to cooperate with one another and subsequently outperform heterogenous teams (Horwitz & Horwitz, 2007), although some researchers suggest that this may be predicated on task complexity. Other theoreticians claim that differences among group members should be a source of learning and enrichment, eventuating in enhanced performance (Ely & Thomas, 2001). For instance, van Knippenberg et al.'s (2004) categorization-elaboration model suggests that group diversity can result in more ideas and perspectives brought to the group, and provided these are elaborated upon, performance can improve. This stance aligns with the information-decision-making model (Williams & O'Reilly, 1998), which predicts that diversity leads to information enrichment and thus positively contributes to decision-making capabilities.

The aforementioned models are grounded in information-processing and representational understandings of cognition. Contrastingly, ecological dynamics is an action-based, non-representational perspective that emphasizes the performer-environment relationship rather than an internalized knowledge structure. By combining both, the proposed ICIM adopts a moderate approach to embodied cognition to explain the impact of diversity on sporting performance through reliance on patterned behavior (i.e. styles of play). It also attempts to reconcile the conflicting theoretical assumptions regarding diversity as being either beneficial or detrimental to team performance by accounting for the effect of value-dimensionality.

The author proposes that social categorization processes within teams are likely to produce subgroups of players with a similar footballing socialization. These categorizations are not social[54] but motor-related, task-oriented and hence easier to access in a sporting context. Moreover, such skill-based social identification should not be conflated with the negative consequences of group categorization such as intergroup bias (Van Knippenberg et al., 2004). Although social theory often views diversity effects from the vantage point of conflict or dissent, it is suggested that social categorization processes facilitate the performance of task-oriented, motor behaviors (e.g. pitch actions) to the extent that specific tasks require better communication between team members. In this sense, communication is embodied in shared team affordances. As noted earlier, task-related communication is accomplished primarily through intentional actions. The inherent valued-directedness of intentions is where the pre-reflective property of intentions converges with the cognitive elements of categorization. Experientially, the history of players' footballing socialization

[54] Social categorization processes are considered in inter- and intra-group relations within a specific social context, such as group/sub-group isolation, marginalization, integration, conflict, etc. Contrastingly, the current model centers on cognitive processes that result in grouping based on a movement based and task oriented (self) categorization.

(i.e., their prior learning) may render some players less receptive to communication (primarily non-verbal) from "dissimilar" others, mobilization players' creative resources in the search for novel solutions, or disrupting the efficiency of team task coordination. Research evidence from football suggests that communication bears greater importance on the effectiveness of actions in defense than in offense (e.g. McLean et al., 2018; McLean et al., 2021)[55]. Individuals with a common footballing background are, therefore, more likely to enhance performance when playing in defense or if engaged in a greater number of actions characteristic of defensive style. Thus, diversity can have a positive effect on performance in more culturally homogenous teams that rely on defensive style, and a negative effect on sporting outcomes in highly heterogenous teams that rely on defensive style. Given that actions associated with attack are less dependent on efficient communication between team members, diversity is expected to enhance the performance of heterogenous teams, which can tap into the global talent pool to enrich their skill set and boost creativity (Rasmussen et al., 2017).

Finally, the author posits that cultural diversity and its effect on team processes and collective behaviors should be considered in a historical context. In today's global world, players are perennially exposed to the richness of footballing (cultural) practices accessible through the media (TV, internet or print), in direct contract with migrant players and coaches, or through first-hand experiences of relocation (domestic or international). It can be argued that the ubiquitous availability of footballing knowledge and resources has diminished the overall impact of cultural diversity on sporting outcomes compared what it was 30 or 50 years

[55] Network analysis has shown that defensive players are the most prominent contributors to passing networks (Clemente et al., 2015). They are often responsible for initiating the attacking phase of play, and creating the link between defensive and attacking positions through in-action communication. Contrastingly, offensive players are typically positioned higher up the pitch and are less often involved in offensive build-ups that require more complex coordination.

back. In effect, globalization processes have blurred the communication boundaries between domestic and foreign migrant players in multicultural teams. The historical repositioning of cultural diversity renders futile theorizing about its utility as value-creating or value-destroying (see section 3.3.3). Instead, emphasis should be placed on *when* and *why* cultural diversity effects sporting outcomes, as well as *how* historical changes forge new affordances. The same applies to social categorization and value-driven processes, which are both historically embedded.

The literature review (see section 3.3) provides an overview of football-specific evidence that corroborates the ICIM. The historical perspective is detailed in section 1.3.

Figure 12. Conceptual presentation of the Integrative Categorization-Intentionality Model (ICIM).

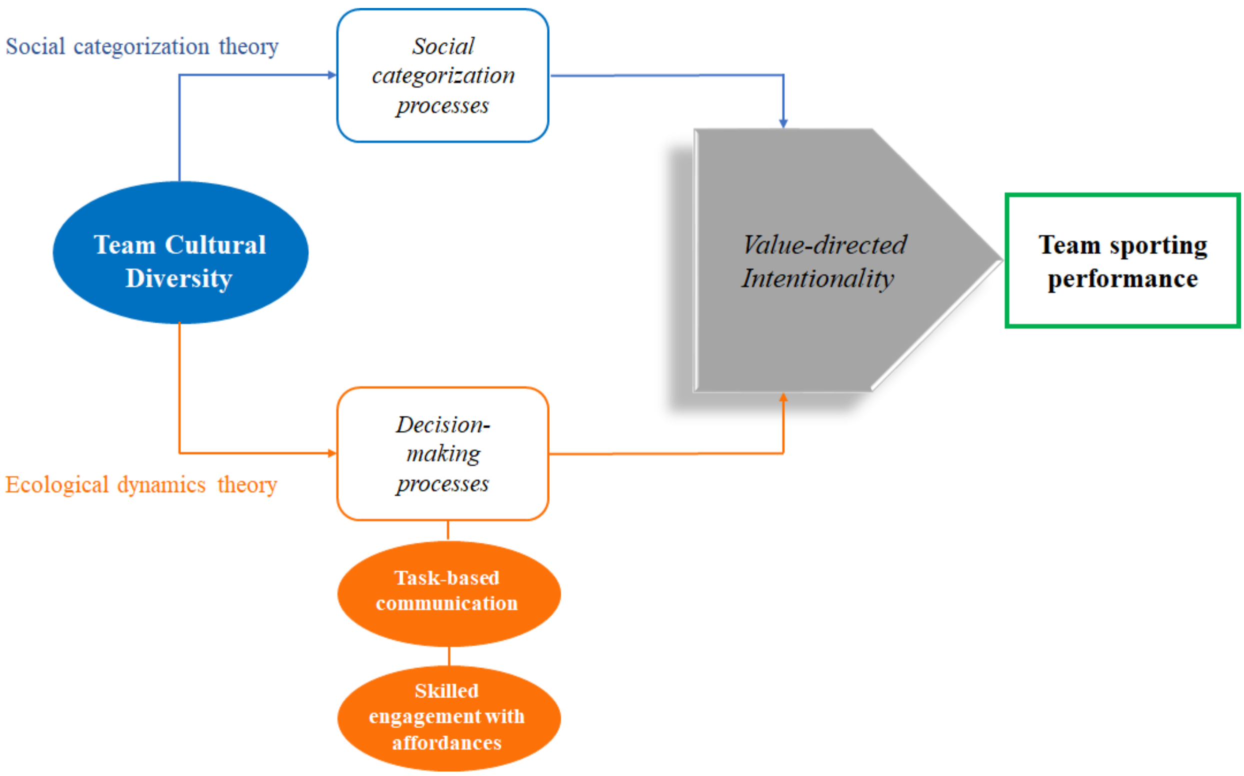
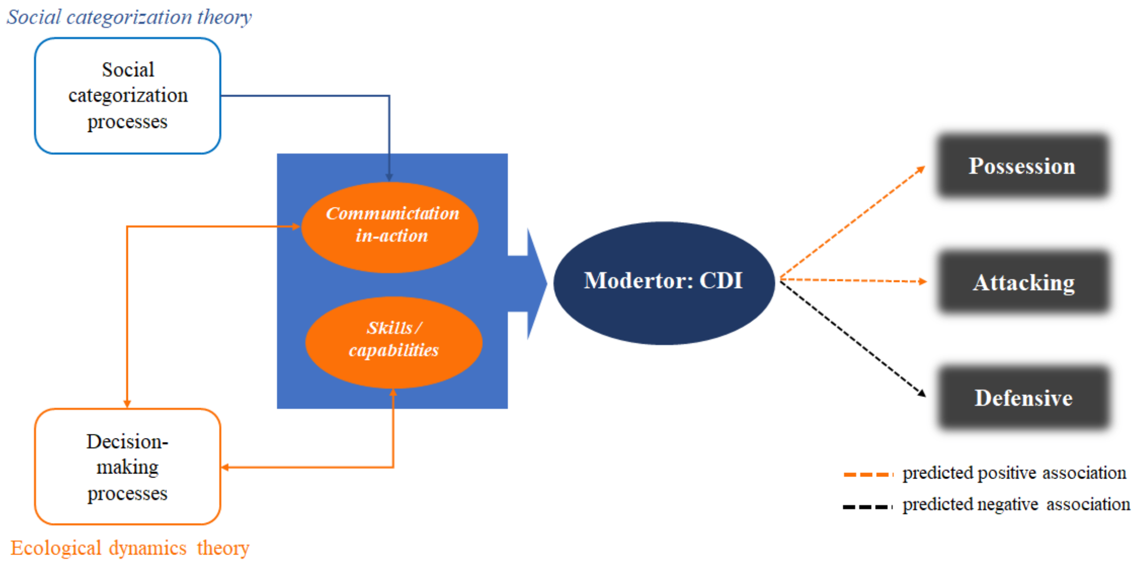


Figure 13. ICIM: Hypothesis-driven presentation.



3.3 Literature Review: the Effect of Market Value, Cultural Diversity and Playing Styles on Performance

The literature review elaborates on sport-specific research related to team performance with a focus on wealth (i.e., at the level of teams and country or leagues), playing styles and cultural diversity. Moreover, justification for specific hypotheses is provided in light of the empirical evidence discussed and the theoretical models described in section 3.2.

3.3.1 Market Value of Football Teams

Globalization, economization and commercialization[56] have profoundly affected not only societies in general but also professional sports (Guilianotti & Robertson, 2012). In football, these processes have contributed to the emergence of a global player market as a highly competitive arena for the recruitment of footballing talent. Consequently, the economic/monetary value of players and teams has become a valid indicator of their athletic ability (Gerhards & Mutz, 2016), deemed to translate (directly and indirectly) into sporting outcomes/success. By engaging the services of scouts, agents and large data bases, football clubs try to gather relevant information to assess players' skills and abilities[57]. Based on constant observation of matches and analysis of match statistics, football players' potential is evaluated and reflected in their market values. In sports economics, market value is defined as the value of a given good (i.e., player) at the time of the transaction. (i.e., transfer of a player to another club). Market values are commonly expressed in transfer fees that a buying club pays for a player when acquiring them (Herm et al., 2014). If the assumption holds true that the market value of a player reflects their athletic ability, then the most expensive players should be the best players. Even in the absence of transfer fees (e.g., players switching teams

[56] Commercialization in football has re-defined football players as globally traded goods (Frick, 2007; Kesenne, 2007).

[57] An independent industry of observers, evaluators, and agents has evolved to gather information on players.

as part of a "free transfer" when no fee is due to the purchasing club, as the player's contract simply expires), the *potential* market value of players is constantly subject to estimation by experts[58]. The market value is considered to be a better estimate of athletic ability than salary, as the former estimates future potential, whereas the latter is a reflection of past performance (Gerhards & Mutz, 2016). Analogous to player valuation, the strength of a whole team can be estimated on the basis of the market value of all players. Thus, as a measure of ability, teams' market value can be used to predict performance (*Hypothesis 1*).

Most of the existing literature has found that countries with better life conditions (i.e., GDP per capita, healthcare systems, facilities, sports infrastructure, etc.) and more resources have a higher ability to win at sport[59] when compared to developing countries with poor life conditions and less available resources (Andreff, 2006; Eber, 2003; Koning & McHale, 2012; Peeters eta al., 2019). Overall, empirical evidence has revealed a positive association between economic prosperity and football resource acquisition, which facilitates football performance (Omondi-Ochieng, 2015), and between country wealth and football success (Bredtmann et al., 2016; Hoffman et al., 2002). More recently, Klobučník et al. (2019) showed that GDP is significantly related to the success of football clubs in some European countries. Drawing on the aforementioned research, this study proposes that countries' GDP based on purchasing power parity (PPT) as well their annual spending on sport, both have a positive moderation effect on sporting outcomes (*Hypotheses 2.1 and 2.2*). Similarly, the market value of

[58] The website „transfermarkt.com", from which data was extracted for this study, provides information on players' market values, which are continuously adjusted to the anticipated transfer value by estimating the market value about every three to six months, even if players do not switch teams. Apart from transfer fees actually paid in the past, the "transfermarkt" ratings incorporate player performance, age and possible injuries. All potential market values are discussed by registered users and on that basis the website administrators estimate market values. This approach for determining market values follows the "wisdom of the crowds" principle (Surowiecki, 2005). Expert ratings correlate highly with real transfer fees (r>.90) and can thus be regarded as a valid measure (Herm et al., 2014).

[59] There are a number of examples when sporting success in specific disciplines is inversely related to country wealth such as track and field (e.g., Jamaican sprinters) or long-distance running (e.g., Kenyan and Ethiopian marathoners). Team sports tend to be more expensive than the majority of individual sports.

particular leagues significantly and positively moderates the relationship between styles and sporting results (*Hypothesis 2.3*). Wealthier leagues tend to attract more attention in terms of spectators and advertisers, thus availing of greater resources that can be distributed to teams playing in these leagues with spill-over financial effects (Batarfi & Reade, 2020).

3.3.2 Style of Play of Football Teams

In addition to skills or abilities of players, developing and designing an appropriate strategy that translates into game style (e.g., possession based, constructive attacking, defensive) is of paramount importance in winning matches. Despite increasing availability of match data and the rise in sophistication of analytical tools, empirical research on the existing differences among styles of play across leagues and the impact of styles on sporting outcomes is scarce. For example, McLean et al. (2017) examined the inter-continental playing styles of successful teams in EURO[60] 2016 and COPA[61] 2016, and did not find any differences. They proposed that this could be the result of globalization processes caused by increased player mobility and leading to the convergence of playing styles across the world. However, differences between teams from various leagues have been identified by a number of other researchers. In this regard, Boscá et al., (2012) found that the strategy, which offers the greatest chances of sporting success in the Spanish La Liga, is to improve offensive efficiency when playing away from home. Contrastingly, higher rankings in Italy's top division can be achieved by enhancing defensive rather than offensive efficiency. Further, Zambom-Ferraresi et al. (2018) employed Bayesian model averaging techniques to match statistics from the Big Five European leagues across three seasons (2012/13 to 2014/15), and discovered that the most remarkable performance indicator that differentiates the Premier League playing style from others is the consistency in finishing plays through shots (i.e., high effectiveness for

[60] EURO stands for the European football championship.
[61] COPA stands for the American football championship.

shots on target relative to overall shot attempts) by English teams. A separate analysis of the Spanish La Liga revealed that five performance indicators are responsible for sporting success, namely clearances, blocks and interceptions, as well as total fouls conceded. Four of these are defensive, thus challenging the common notion of the attractive attacking style associated with highly successful Spanish teams such as FC Barcelona. Similarly, analysis showed that higher ranking in the Italian Seria A is predicated on defensive rather than offensive efficiency. Based on the above research in support of interleague differences in playing style and drawing on the SIF theoretical framework introduced in section 3.2.1, the author hypothesizes the positive direction in the association between teams' playing style and their sporting outcomes (*Hypotheses 2.1, 2.2* and *2.3*). Moreover, the expectation is for this relationship to be moderated by macro level indicators (GDP based on PPT, budgetary spending on sport, and the league market value) as well as leagues' market value (see *Figure 13*).

3.3.3 Cultural Diversity of Football Teams

Although the migration of athletes has been on the rise over the past 25-30 years with the intensification of globalization processes, management of growing diversity in elite team sport still remains largely understudied. According to the Swiss-based International Centre for Sports Studies' Football Observatory, the proportion of foreign football (soccer) players, amongst the 31 top European divisions surveyed, increased from 34.7% in 2009 to 41.8% in 2019 (Poli et al., 2019). The influx of "expatriate" players in top European leagues has risen almost double-fold in the period 1995 (marking the end of the pre-Bosman era) to 2019 (see Table 11). Nowadays, the share of non-domestic players across European leagues averages approximately 40% (see Table 13), which is much higher than the corresponding proportions of immigrants in these countries. If accounting for the number of foreign-born (naturalized) players, the percentages would probably be considerably higher.

Table 12. Share (%) of foreign players in professional football (pre-Bosman[62] in 1995 and post-Bosman from 1999 to 2019).

First division championship	*1995*	*1999*	*2005*	*2019*
England	34	37	56	57,9
France	18	22	36	38,6
Germany	19	39	50	50,2
Italy	14	33	31	58
Spain	20	40	28	37,3

Source: CIES data base (Poli, 2008; Poli et al., 2019).

Table 13. Percentage of "expatriate" players in top-division leagues (2019).

Country	*%*
Serbia	14,8
Ukraine	23,2
Israel	25,2
Czech Republic	25,3
Norway	27,4
Austria	28,7
Sweden	31,2
Denmark	34,2
Slovenia	34,4
Finland	35,1
Croatia	36,6
Belorussia	36,9
Bulgaria	37,1
Spain	37,3
Netherlands	37,3
Romania	37,6
Russia	38,3
France	38,6
Hungary	38,8
Switzerland	39,5
Poland	41,4
Slovakia	44,3
Germany	50,2
Scotland	52,7
Greece	56,7
Belgium	57,6

[62] In 1995, the European Court of Justice issued a ruling, which banned restrictions on foreign EU players within national leagues and allowed players in the EU to move to another club at the end of a contract without a transfer fee being paid. This effectively deregulated the EU transfer market on ‘freedom of movement’ premises.

England	57,9
Italy	58,0
Turkey	62,4
Portugal	63,6
Cyprus	66,8

Source: CIES data base (Poli et al., 2019).

Past studies have primarily focused on the effects of racism and discrimination (Kahn, 2000; Preston & Szymanski, 2000; Wilson & Ying, 2003). There is a scarcity of research that investigates the impact of cultural diversity on the performance of multicultural teams[63] in elite football. Moreover, the related findings are starkly conflicting. An overview of most relevant studies is presented below.

As noted in section 3.2 on theoretical framing, researchers tend to assume one of two perspectives, largely drawn from social psychology (Kerr & Tindale, 2004) or labour and personality economics (Brandes et al., 2009; Earley & Mosakowski, 2000; Kremer, 1993; Prat, 2002,). This theoretical dichotomy is *ahistorical*, in other words, it is divorced from the historical context in which cultural diversity occurs. As argued earlier (see section 3.2.2), the impact of cultural diversity should be considered in its historical attire. The positive "value-in-diversity" perspective recognizes the benefits of access to a greater variety of task-relevant expertise, diverse talents, perspectives and experiences, especially in areas that require creative problem solving (Horwitz & Horwitz, 2007; Lazear, 1999). The negative perspective refers to higher transaction costs, which arise due to conflicting expectations of team members, different cultural traditions and communication deficiencies that expose multicultural teams to greater conflict and destabilizing in-group processes that hamper coordination and communication (De Jong & van Houten, 2014; Haas & Nüesch, 2012; Trax

[63] The term „multicultural" has been used in this dissertation interchangeably with "culturally diverse", "culturally heterogenous" teams. It is not intended to make a reference to multiculturalism as a phenomenon or a social policy.

et al., 2015). The empirical evidence for diversity in non-sport contexts is extremely mixed. Some studies claim that homogenous teams are more productive (e.g., Ancona & Caldwell, 1992), while others find that heterogeneous groups, especially when there is much uncertainty and the stakes are high, do better (e.g., Hamilton et al., 2003; Mello & Ruckes, 2006).

In sport, findings are also conflicting and inconclusive. Mayo-Smith et al. (2017) investigated the effects of employee heterogeneity on team performance using panel data from the 2002-2008 NBA (National Basketball Association) seasons and found that increases in diversity measured by the Herfindahl-Hirschman Index and international players' minutes (i.e., playing time) lead to higher win percentages. Using data from the National Hockey League (NHL), Kahane et al. (2013) discovered that teams that recruited a higher proportion of European players performed better, conditional on these players originating from the same country. In other words, evidence revealed that teams made up of mostly homogenous European players (e.g., mostly from Finland) appear to gain an advantage in team performance.

As regards football, based on data of 306 matches from the 2000/01 German Bundesliga season, Gaede et al. (2002, as cited in Maderer et al., 2014) discovered that culturally diverse teams achieve a higher average team performance. Team market value and the level of experience of players contributed most to favorable sporting results. The authors argued that the right mixture of experienced and inexperienced players is a prerequisite to team success. With reference to the positive impact of cultural heterogeneity, they concluded that football teams can benefit from diverse technical skills that come with cultural diversity and the creativity of imported talent.

Andersen and Altman (2006) confirmed the assumption of Gaede et al. (2002) by revealing a significantly positive relationship between national diversity and sporting success of professional football teams in the German Bundesliga. Based on five seasons (2001-2006) of the Bundesliga, Brandes et al. (2009) examined the relationship between team composition and relative success measured by end-of-season league rank. They could not confirm that national diversity significantly influenced performance. On the contrary, they found that increasing cultural diversity in the defensive block had a negative effect on team sporting success. Using data from the same league during seven consecutive seasons, Haas and Nüesch (2012) discovered that multinational football teams perform worse than teams with less ethnic diversity. Finally, relying on a large series of individual performance statistics for all players appearing in the Bundesliga between 2001 and 2007, Franck and Nüesch (2010) revealed that both average talent and talent disparity significantly increased team performance. Another interesting study was conducted by Addesa et al., (2017) on a data set, which included five Serie A (higher Italian professional men's football league) seasons from 2009/10 to 2013/14. The authors used indices of fractionalization (based on the Ethnolinguistic Fractionalization index (ELF); Alesina & La Ferrara, 2005) and polarization (Reynal-Querol, 2002) to measure the effect of diversity on performance[64]. Results showed that both measures of diversity had a strong and persistent negative effect on game scores and individual player performance ratings. The negative effect of diversity on team success was also confirmed by Maderer et al. (2014), based on analysis of 98 teams from the Big Five European leagues in the 2008/2009 season. Moreover, they found a negative relationship between favorable sporting outcomes and coaches' intercultural experience, operationalized in terms of years of international coaching. Conversely, Ingersoll et al. (2017) concluded that more heterogeneous teams outperform less diverse ones in the UEFA Champions League (seasons 2003-2012). Specifically, one-standard deviation increase in cultural diversity measured by linguistic

[64] The fractionalization index measures the probability of two randomly selected individuals in society belonging to different groups (Desmet et al., 2009), whereas the polarization index assesses how far the distribution of the groups is from a bipolar situation where there are two subgroups within the same team of equal size (Addesa et al., 2017).

distance can double a team's goal differential over the course of the tournament. These findings, however, are potentially disputable, as the researchers did not control for the teams' financial value.

In trying to explain the effects of cultural diversity on performance, some authors have decomposed teams into cultural sub-groups. Tovar (2019) found an U-shaped relation between the predominant nationality and team (individual) performance. The results of his study showed that the impact is stronger when the predominant nationality is weak or strong relative to other nationalities. When teams are highly heterogenous, that is, when the predominant nationality is particularly small, the ability to form sub-groups of self-categorize lacks strength. On the other end of the spectrum, when the team is highly homogenous, that is, a dominant nationality is apparent, an influential group culture is likely to develop facilitating successful performance. The moderate heterogeneity scenario (when the predominant nationality has around 13 members) appears least optimal in terms of potential for sporting success, as it is most likely to give rise to a strong sense of social categorization that interferes with the team's collective interests (Tovar, 2019).

Given the lack of empirical agreement on the direct impact of cultural diversity on performance, both in relation to direction or significance, and the latest attempts of researchers to seek alternative explanations such as group categorization effects, the author proposes a new theoretical model ICIM that seeks to reconcile the contradictory empirical evidence. The model awards centrality to cultural diversity as a cross-cultural moderator. In the ICIM, cultural diversity acts as a significant moderator of the positive relationship between teams' sporting outcomes and their market value (*Hypothesis 3.1*) as well as the market value of the leagues where teams play (*Hypothesis 3.2*). The significant positive effect is hypothesized drawing on *Hypothesis 1*.

Other scholars have conceptualized and measured *optimal* levels of cultural (birthplace) diversity for varying tasks (e.g. defensive and offensive)[65]. Specifically, Brox and Krieger (2019) provided evidence for the existence of a clear trade-off between the beneficial and adverse effects of diversity on sporting performance in that homogenous teams do not have sufficient diversity in perspectives and skills, whilst heterogenous teams face communication difficulties leading to potential coordination problems. As communication is less important in offense than in defense, the optimal level of birthplace diversity is lower for defensive vs. offensive performance. Task-specific performance can be related to game style. In line with this conceptualization, it has been hypothesized that cultural diversity will moderate the relationship between styles of play and sporting outcomes and the direction of association will differ between styles, given their primary task orientation. Thus, drawing on research and in line the premises of ICIM, the author proposes a significant negative relationship with defensive style (*Hypothesis 3.5*) and a significant positive relationship with the remaining two attack-oriented styles, that is, possession (*Hypothesis 3.3*) and constructive attacking (*Hypothesis 3.4*).

3.4 Hypotheses

Based on the theoretical framing (section 3.2) and the foregoing review of the literature (section 3.3), the following hypotheses were postulated:

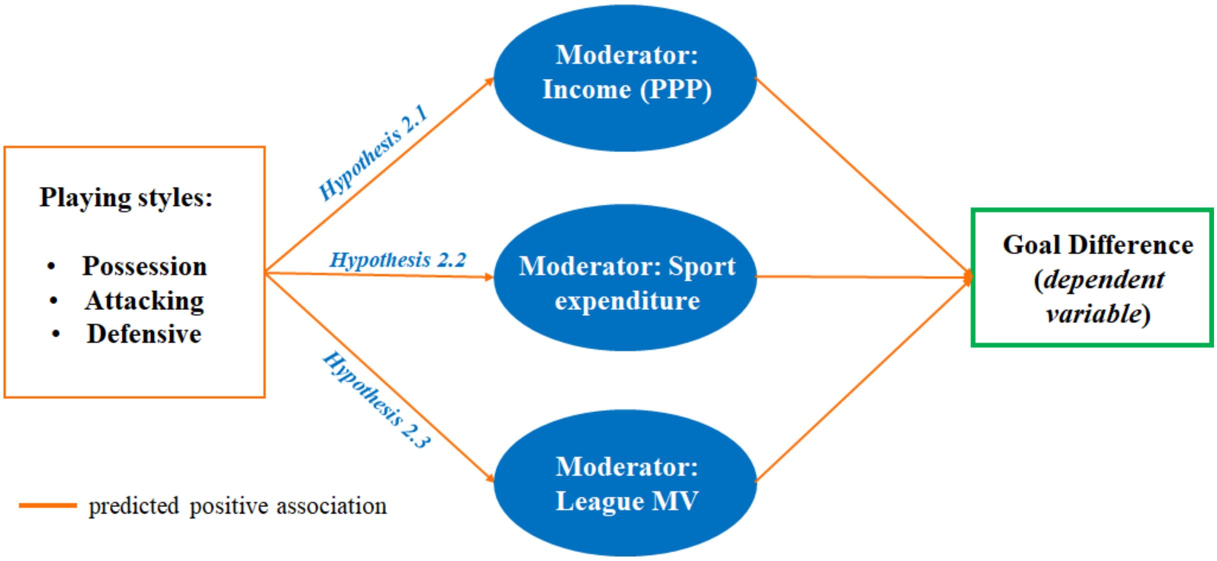
(1) There is a significant positive association between teams' market value and sporting outcomes (*Hypothesis 1*).

(2) There are three statistically significant moderators of the positive association between teams' playing styles and their sporting outcomes: countries' wealth

[65] National immigration statistics typically differentiate between birthplace and nationality.

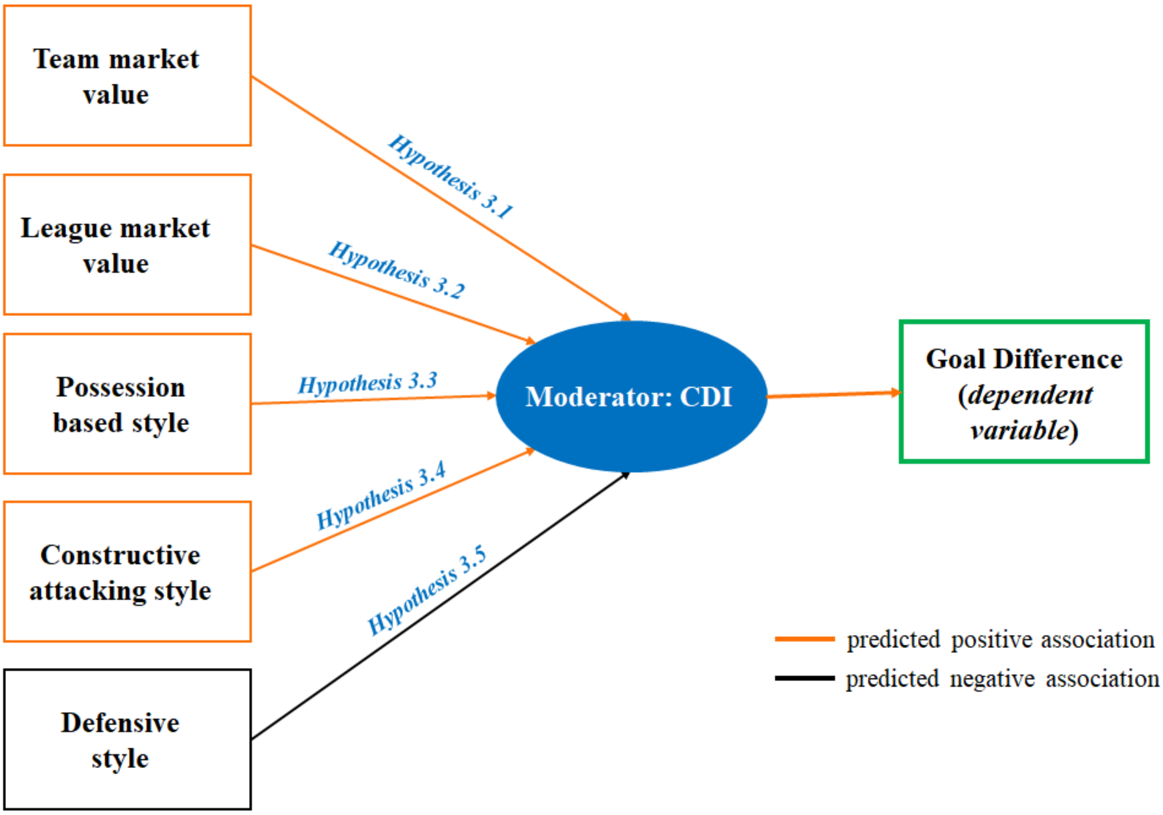
(*Hypothesis 2.1*), countries' budgetary spending (*Hypothesis 2.2*) and leagues' market value (*Hypothesis 2.3*) [see *Figure 14*]

Figure 14. Hypothesized moderation model for country income, sport expenditure and league market value.



(3) Teams' cultural composition, measured by the Cultural Diversity Index (CDI; see operationalization note below), significantly moderates the positive association between teams' market value and their sporting outcomes (*Hypothesis 3.1*), the market value of leagues and teams' sporting outcomes and (*Hypothesis 3.2*), possession style and teams' sporting outcomes (*Hypothesis 3.3*), attacking style and teams' sporting outcomes (*Hypothesis 3.4*), and the negative association between defensive style and teams' sporting outcomes (*Hypothesis 3.5*) [see *Figure 14*].

Figure 15. Hypothesized moderation model for CDI.



3.5 Measures

The study was based on a sample of 23 186 matches played by 728 teams in 45 leagues during the 2020-2021 football season (Table 1 in Study 1). The measures used are outlined below.

3.5.1 Cultural Diversity Index (CDI)

This measure was operationalized by employing the Herfindahl-Hirschman Index (HHI), which is a statistical measure of inequality or concentration such as the Gini coefficient or relative entropy. The HHI has been applied in sports contexts to measure competitive balance in professional sports leagues, and to examine the effects of variation in the number of teams in the league on the HHI applied to wins (Owen et al., 2007). It has also been instrumental in quantifying the effects of cultural diversity on sports performance (e.g., Mayo-Smith et al., 2017). Two sets of algebraic formulae were used to calculate CDI, at team and league level respectively:

(1) Team level HHI_t

$$HHI_t = \mathit{\Sigma(MS_i)^2} \text{ where } MS = P_i \ / P_{total}$$

(2) League level HHI_l

$$HHI_l = \Sigma\, (HHI_t \ / n),\ n = \text{number of teams in league}$$

MS, or market share, is the percentage of players (P) on team *t* from countries *i* in a given year. Therefore, a team with no diversity, where all players originate from one country, would have an HHI=1, whereas a team with greater proportions of players from different countries would have a value closer to zero. In other words, higher CDI values indicate higher cultural homogeneity, whereas lower CDI values point to greater cultural heterogeneity. This interpretation stems from the way HHI is constructed to measure concentration. The results of Study 2 as well as Study 3 are interpreted analogously, although in certain cases (e.g., interaction effects) it may have been easier to use reverse scaling of smaller values for cultural homogeneity and higher value for heterogeneity. Nevertheless, the author has chosen to follow the HHI convention.

As an example, during the 2018/19 season, Polish Club *Legia Warszawa* had 48 players in total, of which 27 Polish and 21 foreign from 16 different countries, resulting in HHI_t = 0.33 to which Polish players contributed 0.21 = $(27/48)^2$. To compare, Polish club *Lech Poznań* averaged a lower HHI_t = 0.25, given the relatively higher concentration of foreign players (18 foreigners from 14 countries), with the Polish players (16 players) contributing 0.22 = $(16/34)^2$ toward HHI_t.

The HHI is typically used to provide a more accurate depiction of diversity than simply introducing dummy variables, as has been commonly practiced in sports performance analysis (Eschker et al., 2004). A more valid representation of diversity should be achieved by this country-based approach rather than simply classifying players as either international or domestic. The HHI is calculated for every team in each league in the 2020/2021 playing season. The data on players' nationality was retrieved from the web-based collaborative database *Football-Lineups* and supplemented by information from www.transfermarkt.com. The two databases are regarded by leading sports economists as reliable sources of information pertaining to football (Müller et al., 2017).

3.5.2 Goal Difference (GD)

This measure of sporting outcome/sporting performance/sporting success was operationalized as the goal difference (goals scored minus goals conceded), an approach recommended by a number of authors (e.g., Ben-Ner et al., 2013; Haas & Nüesch, 2012; Ingersoll et al., 2017). Other widespread methods to measure team performance include placement of a team in league tables (i.e., points attained), individual performance ratings of players or financial indicators such as revenues from ticket sales, TV rights, proceeds from transfers, payroll diversity, etc. As most football games are rather low-scoring and close, the differences between win, loss, or draw may be arbitrary, caused by minor mistakes or luck. Therefore, to mitigate against possible statistical fallacy and to achieve greater accuracy, for the purposes of this study the goal differential measure was adopted. The relevant data for season 2020/21 was retrieved from www.transfermarkt.com.

3.5.3 Other Measures

Other measures used in the study include the following:

(1) *Market value (MV) of teams*, operationalized as the aggregate score of individual player market values per team. Data on player market values was retrieved from www.transfermatkt.com.

(2) Weighted average MV of leagues, operationalized as the average of league level MV weighed by the number of teams in a league. This measure was used in all regression analyses.

(3) *Income*. This measure of wealth/economic prosperity, denotes countries' income per capita (PPP)[66] reported for 2019 by the World Bank, retrieved from https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD.

(4) *Sport expenditure*. This measure denotes countries' annual budgetary spending on sport in 2019, reported by the International Monetary Fund, retrieved from https://www.imf.org/en/Data.

(5) *Styles of play*: possession based, constructive attacking and defensive, operationalized in Study 1.

3.6 Statistical Analyses

All data handling and statistical analyses were conducted in R (R Core Team, 2020) and R Studio (RStudio Team, 2019). Prior to proceeding with the statistical analyses, data were visually inspected for linearity, normality and outliers. Additionally, frequency distributions showed skew and kurtosis values to be within ranges deemed acceptable in terms of meeting the base assumptions for correlational and regression testing (Field, 2017). Whereas no violations of linearity were found, lack of normality in the distribution of some data was discovered resulting in the log-transformation of all financial and macroeconomic variables, namely market value of teams and leagues, national income (PPP) and country spend on sport. A small number of outliers (three teams) were also removed from analyses. Missing data varied from 2% to 4,5%. Multiple imputation (Rubin, 1987) was employed to deal with missing data using the MICE package (van Buuren & Groothuis-Oudshoorn, 2011) in R. All

[66] In macroeconomic terms, this is GDP per capita based on **purchasing power parity** (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates.

variables, with the exception of the dependent variable GD, were grand mean centered prior to conducting the ordinary least squares (OLS) regressions.

Power analyses

An a priori power analysis was conducted using the R package "WebPower" (Zhang & Yuan, 2018) based on a sample of 728 observations (teams), setting alpha levels at 0.05, assuming two predictors and a range of effect sizes: small (f_2 = 0.02), medium (f_2 = .15), large (f_2 = .35) (see Cohen, 1988). Results revealed that the statistical power for this study was more than adequate, equal to 0.94 for small effect and 1 for both medium and large effect sizes. Additional computations were run to determine power demands for within-league analysis using two predictors and alpha set at 0.05, for the league with the lowest (*N*=6) and the highest (*N*=26) number of teams as well as the average teams per league (*M*=16.18). As shown in Table 14, there is insufficient power to conduct within league correlation or ordinary least squares regression analyses.

Table 14. Within-league power analysis.

Teams (N)	**Power**	
	Effect size (0.15)	Effect size (0.35)
6	0.080	0.120
16.18	0.217	0.455
26	0.716	0.362

To explore relationships between variables and test *Hypothesis 1*, bivariate correlations using Pearson correlation were conducted. Drawing on the correlation results, the hypothesized moderation effects of CDI in relation to teams' (*Hypothesis 3.1*) and leagues' market value (*Hypothesis 3.2*) were further investigated using ordinary least squares (OLS) regressions. For this purpose, five models were tested, starting with the most simple model without interactions (M1) as the baseline model, to which interactions (M2 & M3) and country(league) level variables were added (M4 & M5), represented by the following regression equations:

M1: $Y_i(GD) = \beta_0 + \beta_1 CDI + \varepsilon_i$
M2: $Y_i(GD) = \beta_0 + \beta_1 CDI*\text{team MV} + \varepsilon_i$
M3: $Y_i(GD) = \beta_0 + \beta_1 CDI*\text{league MV} + \varepsilon_i$
M4: $Y_i(GD) = \beta_0 + \beta_1 CDI*\text{team MV} + \beta_2 \text{income} + \varepsilon_i$
M5: $Y_i(GD) = \beta_0 + \beta_1 CDI*\text{team MV} + \beta_2 \text{sport expenditure} + \varepsilon_i$

The dependent variable GD (predicted goal difference) is denoted by Y_i , where *i* stands for *i*th team, β_0 is the equation intercept, β_1 and β_2 are the regression coefficients of the two explanatory variables (i.e., the interaction and the country/league level variable), and ε_i is the model error or the variation in the estimation of the goal difference per team.

Additional hierarchical regression analyses were run to explore possible moderation effects of country wealth (i.e., PPP income), sports spending and league market value, including three-way interactions, on the relationship between teams' sporting outcomes and the adopted styles of play. Six models were tested for each style of play (possession based, constructive attacking and defensive), totaling 18 models represented by the following regression equations:

M1(possession): $Y_i(GD) = \beta_0 + \beta_1 \text{possession*league MV} + \varepsilon_i$
M2(possession): $Y_i(GD) = \beta_0 + \beta_1 \text{possession*income} + \varepsilon_i$
M3(possession): $Y_i(GD) = \beta_0 + \beta_1 \text{possession*sport exp.} + \varepsilon_i$
M4(possession): $Y_i(GD) = \beta_0 + \beta_1 \text{possession*income} + \beta_2 CDI + \varepsilon_i$
M5(possession): $Y_i(GD) = \beta_0 + \beta_1 \text{possession*CDI} + \beta_2 \text{income} + \varepsilon_i$
M6(possession): $Y_i(GD) = \beta_0 + \beta_1 \text{possession*CDI*income} + \varepsilon_i$

M1(attacking): $Y_i(GD) = \beta_0 + \beta_1 \text{attacking*league MV} + \varepsilon_i$
M2(attacking): $Y_i(GD) = \beta_0 + \beta_1 \text{attacking*income} + \varepsilon_i$
M3(attacking): $Y_i(GD) = \beta_0 + \beta_1 \text{attacking*sport exp.} + \varepsilon_i$
M4(attacking): $Y_i(GD) = \beta_0 + \beta_1 \text{attacking*sport exp.} + \beta_2 CDI + \varepsilon_i$
M5(attacking): $Y_i(GD) = \beta_0 + \beta_1 \text{attacking*CDI} + \beta_2 \text{sport exp.} + \varepsilon_i$
M6(attacking): $Y_i(GD) = \beta_0 + \beta_1 \text{attacking*CDI*sport exp.} + \varepsilon_i$

M1(defensive): $Y_i(GD) = \beta_0 + \beta_1 \text{defensive*league MV} + \varepsilon_i$
M2(defensive): $Y_i(GD) = \beta_0 + \beta_1 \text{defensive*income} + \varepsilon_i$
M3(defensive): $Y_i(GD) = \beta_0 + \beta_1 \text{defensive*sport exp.} + \varepsilon_i$
M4(defensive): $Y_i(GD) = \beta_0 + \beta_1 \text{defensive*income} + \beta_2 CDI + \varepsilon_i$
M5(defensive): $Y_i(GD) = \beta_0 + \beta_1 \text{defensive*CDI} + \beta_2 \text{income} + \varepsilon_i$

M6(defensive): $Y_i(GD) = ß_0 + ß_1 defensive*CDI*income + \varepsilon_i$

The moderated regression models were compared using the deviance and AIC statistics as shown in Table 16 for the first set and Table 17 for the second set of regressions. Based on fit statistics and analyses of explained variance, an optimal model was selected, analyzed in the context of effect sizes, and tested for meeting OLS assumptions.

Finally, to disentangle the effects of CDI on sporting results whilst seeking to confirm *Hypothesis 3.3*, *Hypothesis 3.4* and *Hypothesis 3.5*, a third set of regressions were run testing the impact of functional task distribution between offensive and defensive players depending on their cultural origin (domestic vs. foreign player). Based on the information available from the Wyscout data base, each player's default position (most often played) was determined and assigned to either an offensive or a defensive category as shown in Table 15. Moreover, players with double nationality were considered on a case-by-case basis, and most often categorized as "domestic" based on their first nationality.

Table 15. List of offensive and defensive positions.

Offensive positions	Defensive positions
striker	left/right backs
center forward	left/right wing backs
attacking midfielder	center back
left/right wingers	sweeper
central midfielder	Goalie

For the purposes of conducting regression analyses, players were assigned to one of four categories: domestic offensive, domestic defensive, foreign offensive and foreign defensive. The respective input values / explanatory variables were computed as a proportion of players (within each of four categories) relative to the total number of players on a team. For each style of play, four models were run or 12 in total (see Table 19). The regression models tested the predictive power of the interaction between styles of play and the four categories of playing positions. Given the nested structure of the data, multilevel modeling was considered and consequently rejected due to the absence of between league variability in sporting outcomes. Therefore, it was concluded that OLS would serve most reliable in testing the study's hypotheses.

3.7 Results

3.7.1 Bivariate Correlations

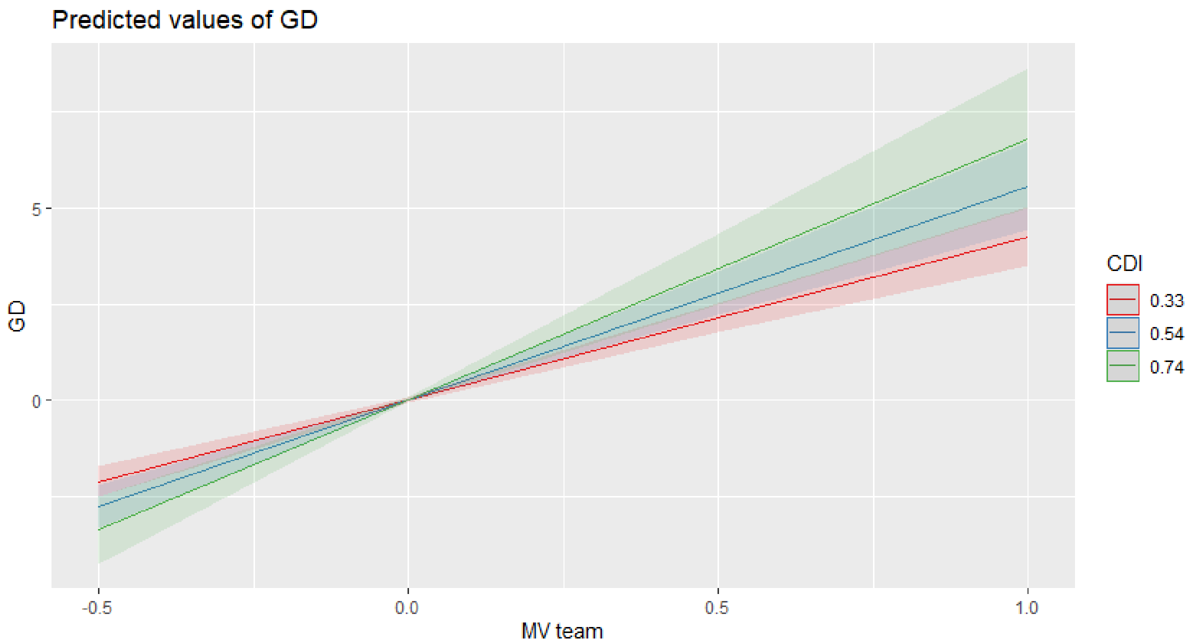
The results of bivariate correlations (Table 18) confirmed *Hypothesis 1* on the existence of a significant positive correlation between teams' market value and sporting outcomes ($r(726)=0.383$, $p< 0.001$). As evidenced in prior studies, teams with a higher estimated market value are more likely to achieve positive sporting results, measured in terms of goal difference (i.e., scoring more goals than conceding goals). The higher valuation implies that these teams avail of greater financial resources to purchase and remunerate players. In other words, teams with a higher market value can be said to be wealthier and more successful. Moreover, bivariate correlations confirmed the expected positive direction of the association between styles of play and performance. The hypothesized significant moderation effect was further tested via regression analyses. Although not specifically hypothesized, CDI was found to negatively correlate with sporting outcomes ($r(726) = 0\text{-}0.0886$, $p< 0.05$), team MV ($r(726) = -0.225$, $p< 0.001$), and weighted average league MV ($r(726) = -0.225$, $p<0.001$), implying that more culturally homogenous teams are less likely to score well compared to culturally heterogenous teams (i.e., with a lower CDI value). Moreover, culturally homogenous teams are less likely to have a higher market valuation compared to culturally heterogenous teams. Given that these correlations are weak but significant, further moderation analysis is warranted, so as to better understand the relationships between these variables. As noted earlier, within league-correlation analyses were not performed due to very low power.

3.7.2 Regression Analyses

The **first set** of regressions tested whether CDI moderates the relationship between teams' sporting outcomes and teams' market values (*Hypothesis 3.1*) as well as the market value of leagues where teams play (*Hypothesis 3.2*). As the interaction effect between CDI and league market value (weighted) was not significant ($p>0.05$), *Hypothesis 3.2* was rejected

(M3 in Table 16). However, the effect was found to be significant for teams' market value (M2 in Table 16; $p<0.01$). Simple slope analysis of the interaction showed a strengthening relationship between sporting outcomes GD and MV for teams lower CDI values (i.e., more culturally homogenous) (*Figure 16*). In other words, with the increase in the concentration of domestic players, sporting outcomes of wealthier teams tend to improve. The reverse is true for more culturally heterogenous teams (i.e., expressed in lower CDI values), where wealth tends to impact sporting results negatively. In other words, in less affluent teams greater cultural heterogeneity raises the likelihood of achieving positive sporting outcomes.

Figure 16. Effect of the interaction between **teams' market value** and **CDI** on sporting GD.



As expected, the effect of the interaction in model M2 was found to be positive, significant but low (B=6.18, β=0.15, $p<0.01$), thus confirming *Hypothesis 3.1*. In other words, CDI stands to moderate the relationship between teams' market value and their sporting outcomes. Comparison of the baseline model M1 to M2 also supports this conclusion, in that M2 (R^2 *adj.*=0.154, $F(3,722)=45.11$, $p<0.001$) provides a significantly better fit for the data compared to M1 (R^2 *adj.*=0.006, $F(1,724)=5.37$, $p<0.05$). Adding country income and spending on sport (Model 3 and Model 4 respectively) did not increase the explanatory power of Model 2, as R^2 adjusted remained at the same level for all three models, explaining 15.4% of the variance. As noted earlier, *Hypothesis 3.2* represented by M3 was rejected due to the lack of significance of the interaction between CDI and league market value (R^2 *adj.*=0.005, F(3,722)=2.11, p=0.410). Assuming that M2 provides optimal fit for the data, tests for normality of distribution did <u>not</u> flag any violations.

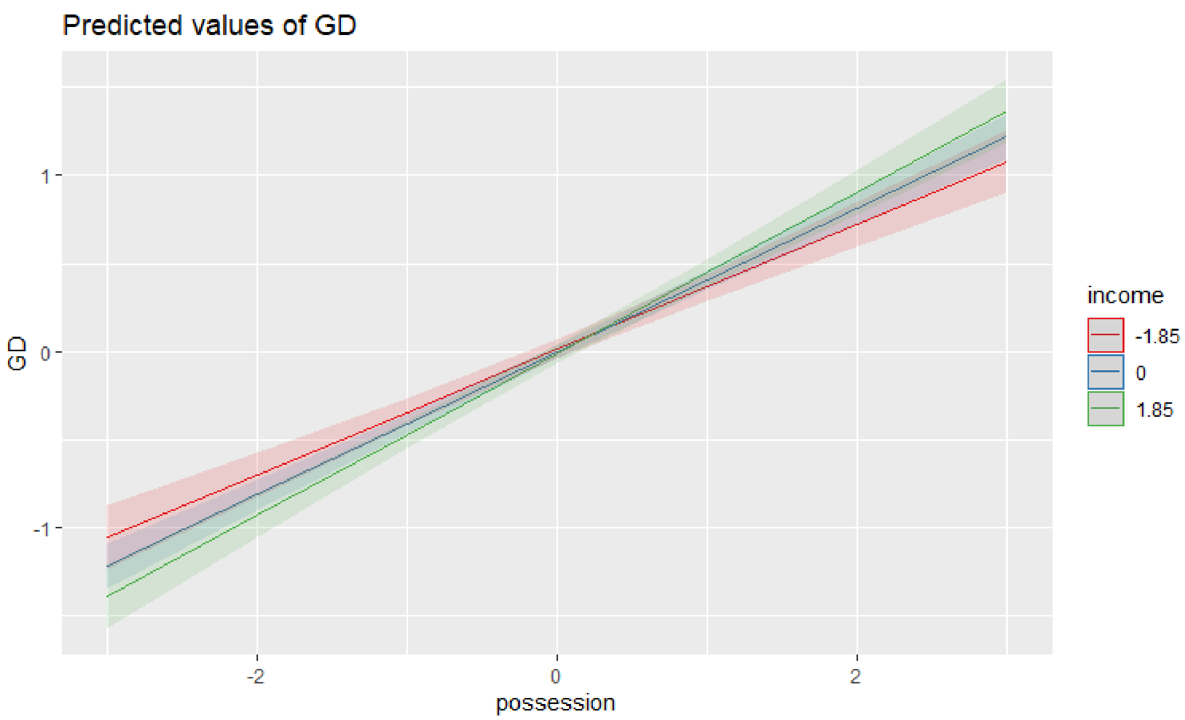
The **second set** of moderated regression analyses tested the plausibility of *Hypothesis 2.1, Hypothesis 2.2* and *Hypothesis 2.3* (see Figure 13), namely the effect on sporting outcomes (GD) of various cross-level interactions with playing styles, as well the moderation effect of CDI (see Figure 14) in relation to the three styles of play (*Hypotheses 3.2*, *3.3* & *3.4*). All optimal models were checked to confirm meeting regression assumptions, and no violations were found. The presence of multicollinearity for both sets of regressions was excluded based on variance inflation factor (VIF) analyses, which showed that the VIF values computed for all explanatory variables were below 2.5 or well within the acceptable threshold of five (Fox, 2016).

Testing country income and sporting expenditure as moderators (Hypotheses 2.1-2.3)

As hypothesized, country income (*Hypothesis 2.1*) interacted significantly with both possession (B=0.03, β=0.07, p<0.05) and constructive attacking styles (B=0.02, β=0.06, p<0.05), but was included in the optimal model (M6) only for possession due to the higher explanatory power of the model. Sporting expenditure (*Hypothesis 2.2*) also entered into a statistically significant interaction with both possession (B=0.36, β=0.06, p<0.05) and attacking styles (B=0.57, β=0.09, p<0.01), however, was included in the optimal model (M4) only for constructive attacking due to the higher explanatory power of the model. Lastly, *Hypothesis 2.3* was rejected, as none of the interactions between league market value and the three playing styles produced significant effects (M1 in Table 16; *p*=0.282 for possession; *p*=0.339 for attacking and *p*=0.324 for defensive).

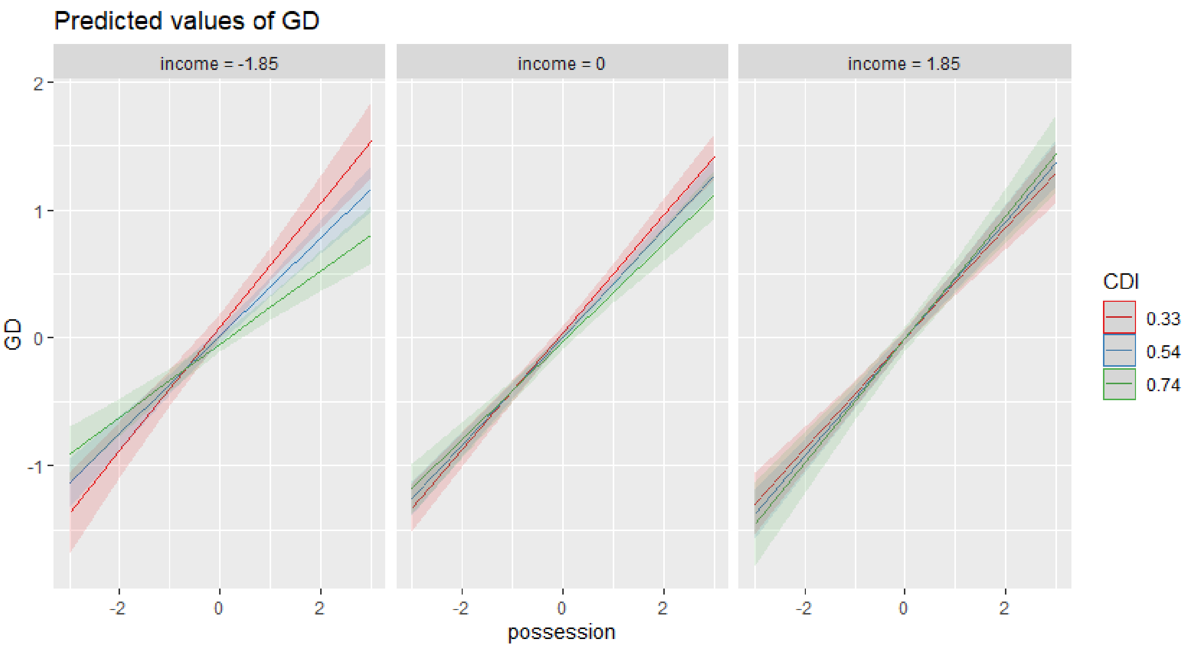
As shown in *Figure 17*, teams with greater reliance on possession are more likely to score effectively, if they are from richer countries. Teams that utilize possession style the least, tend to score better, if they originate from leagues in poorer countries, although these teams are much less effective overall at achieving positive sporting results. Thus, it could be concluded that sporting results are increasingly dependent on countries' income for teams that rely primarily on possession style.

Figure 17. Simple slopes analysis for M4 (possession).



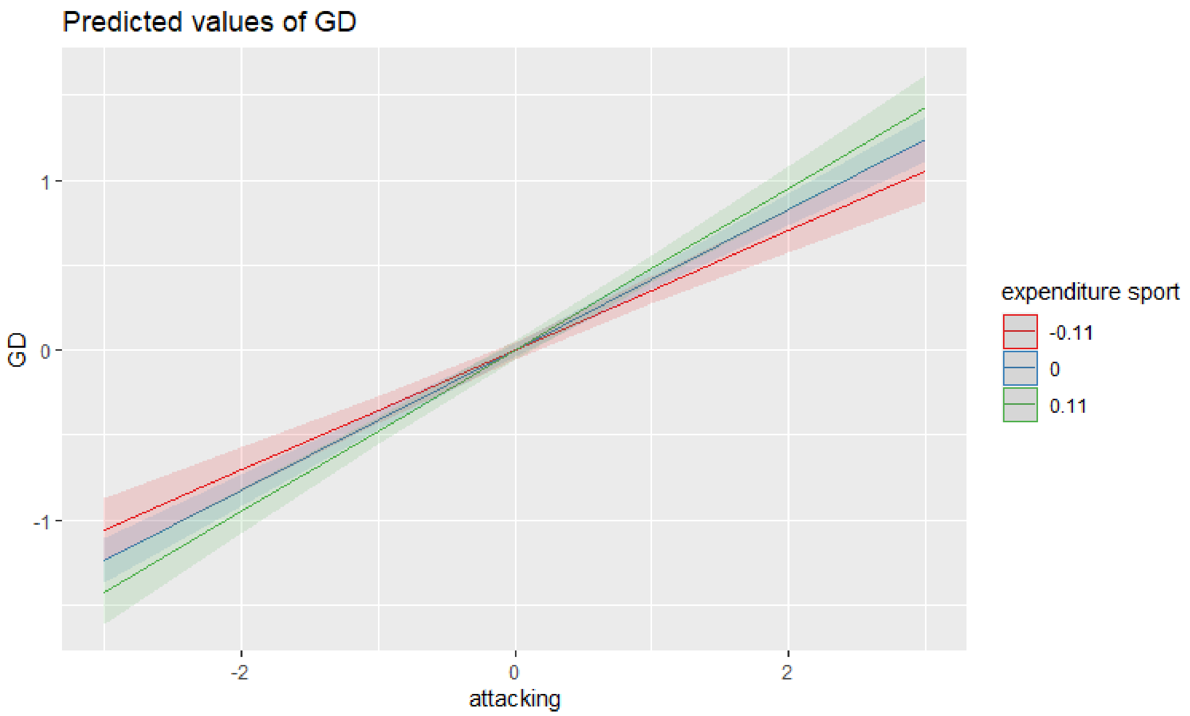
Testing of the three-way interaction in Model 6 revealed a significant effect (*B*=0.16, *ß*=0.08, *p*<0.01). Analysis of the simple slopes (*Figure 18*) suggests that possession-oriented teams become more successful as their cultural heterogeneity increases but only in poorer countries. In richer countries, possession-oriented teams are more likely to score better, if they are more culturally homogenous, although the slope is not as steep as in the case of teams from poorer countries. As shown in Table 17, compared to M4 or M5, the three-way interaction model (M6) provided a better fit for the data (R^2 *adj.*=0.364, $F(7,718)=60.38$, $p<0.01$), implying that the effect of affluence on macro level is closely linked to CDI and teams' wealth.

Figure 18. Effect of the three-way interaction between teams' market value, CDI and country wealth (income PPT) for **possession based** style.



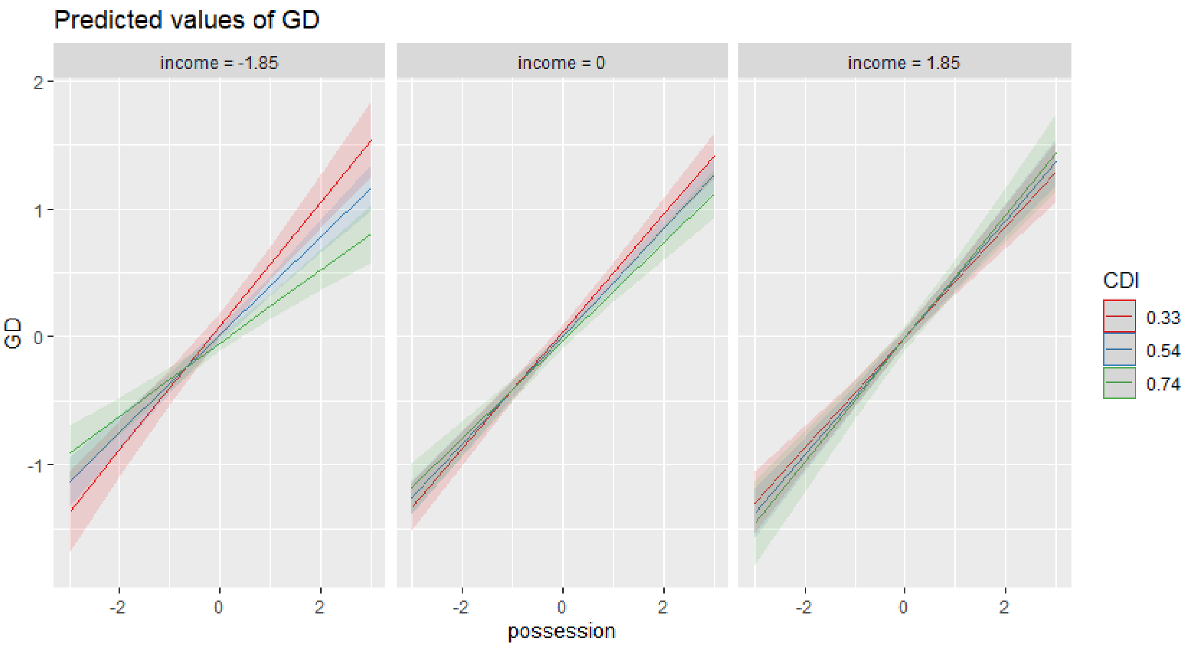
As illustrated in *Figure 19* , teams with a dominant **constructive attacking** style demonstrate increasing sporting efficiency in countries with higher levels of expenditure on sport, whereas teams less reliant on constructive attacking tend to perform better, if they come from countries with a lower budgetary spend on sport. Three-way interaction testing for constructive attacking in M6 did not produce significant effects (p=0.81).

Figure 19. Simple slopes analysis for M4 (constructive attacking).



Interestingly, country income or sporting expenditure in interaction with defensive style did not produce significant effects (p=0.105; p=0.145), but these emerged in a three-way interaction (M6). As shown in *Figure 20*, defensively oriented teams tend to score better with increasing cultural homogeneity but only in poor countries. Conversely, in rich countries enhanced performance is linked to cultural heterogeneity, although the dependency is not as substantial (demonstrated by the flatter line) as in the case of teams from poorer countries.

Figure 20. Effect of the three-way interaction between teams' market value, CDI and country wealth (income PPT) for **defensive** style.



To sum up, the moderator roles were confirmed for country income in relation to possession and for sporting expenditure in relation to attacking, supporting *Hypothesis 2.1 and Hypothesis 2.2*. However, three-way interaction testing showed that the moderation effect for possession is further strengthened by CDI, evidenced by the higher explanatory power of M6 (see Table 17). Moreover, a moderation effect for country income, strengthened by CDI in a three-way interaction, was also found for defensive style in line with *Hypothesis 2.1*. As noted earlier, *Hypothesis 2.3* was rejected as league market value (the weighted average thereof), did not enter into significant interactions with any of the three styles.

Testing CDI as a Moderator (Hypotheses 3.3-3.4)

In the course of hypotheses testing, the author sought to derive optimal models for the sporting efficiency of all playing styles. As shown in Table 17, the sporting success of teams relying on **possession based style** can be predicted by three models (M4, M5 & M6) with comparable explanatory power, expressed algebraically as follows:

$$\textbf{M4: } Y_i(GD) = ß_0 + ß_1 possession*income + ß_2 CDI + \varepsilon_i$$

$$\textbf{M5:}\ Y(GD) = ß_0 + ß_1 possession*CDI + ß_2 income + \varepsilon_i$$

$$\textbf{M6:}\ Y(GD) = ß_0 + ß_1 possession*CDI*income + \varepsilon_i$$

In M4, team performance (goal difference) is explained by the interaction between possession and income, which is statistically significant (B=0.03, β=0.07, p<0.05), as well as by team cultural diversity (CDI), the effect of which is not significant (B=-0.19, β=-0.06, p=0.05). The regression results indicate that the predictors explain 35.6% of the variance (R^2 *adj.*= 0.36 , $F(4,721)=101.2$, $p<0.001$), of which only 8.6% is attributable to the interaction term and 5.2% to CDI. In M5, when CDI enters into an interaction with possession, the total model variance (R^2 *adj.*=0.36 , $F(4,721)=101.2$, $p<0.001$) and the proportion attributable to the interaction term (8.8%) and to income acting as an explanatory variable (0.2%) remain at very similar levels. The interaction between possession and CDI in M5 is statistically significant (B=-0.25, ß=-0.08, p<0.05) unlike the explanatory variable of income, which is not a significant contributor to team performance (B=-0.004, ß=-0.01, p=0.7). In M6, team performance is explained in terms of a three-way interaction between possession, CDI and countries' income. The interaction is statistically significant (B=0.16, ß=0.08, p<0.01), explaining 36,4% of the variance (R^2 *adj.*= 0.364 , $F(7,718)=60.38$, $p<0.001$), with the proportion attributable to the interaction term equal to 8.8%. All three models (M4, M5 & M6) are comparable in terms of model fit. However, M6 holds a slightly higher explanatory power, and is, therefore, treated as optimal. The significance of the positive interaction with CDI supports *Hypothesis 3.3*.

As shown in Table 17, the **constructive attacking style** is best predicted by two models (M4 and M5), both of which are comparable in terms of explanatory power, expressed algebraically as follows:

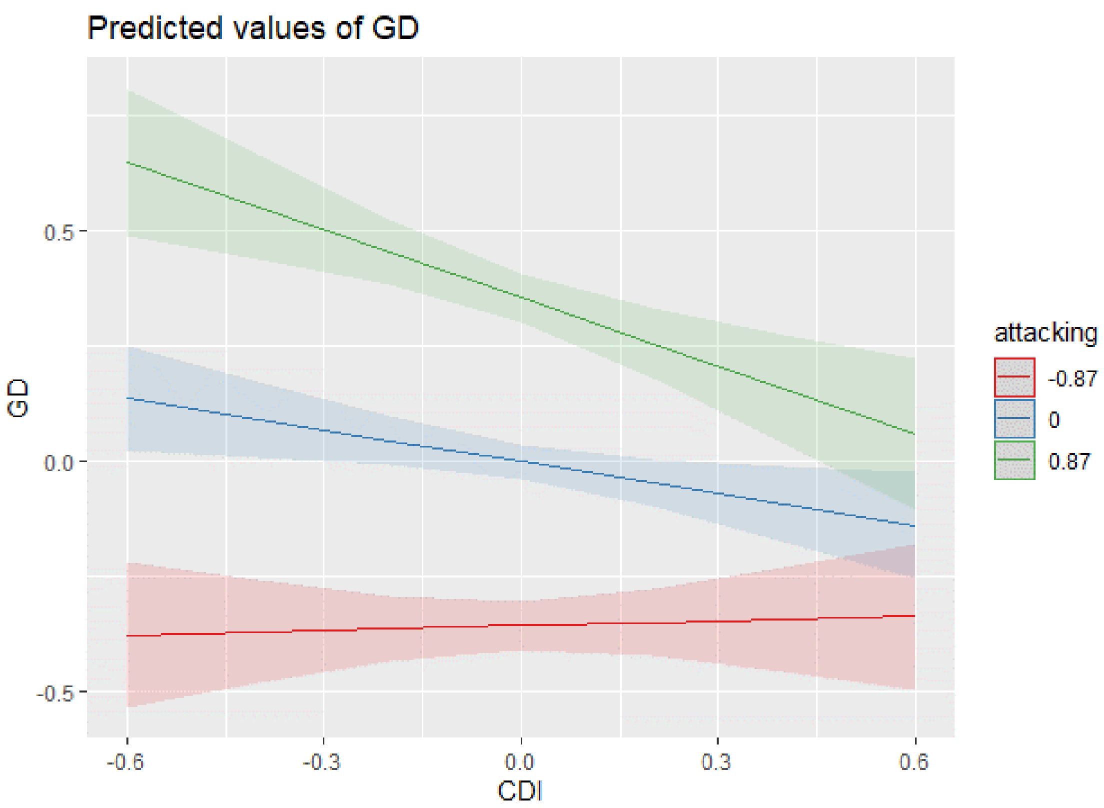
$$\textbf{M4}: Y_i(GD) = ß_0 + ß_1 attacking*sport\ expenditure + ß_2 CDI + \varepsilon_i$$

$$\textbf{M5}: Y_i(GD) = ß_0 + ß_1 attacking*CDI + ß_2 sport\ expenditure + \varepsilon_i$$

In M4, team performance (goal difference) is explained by the interaction between attacking and sport expenditure, which is statistically significant (*B*=0.56, *ß*=0.08, *p*<0.01), as well as by team cultural diversity (CDI), the effect of which is also significant (*B*=-0.22, *ß*=-0.07, *p*<0.05). The regression results indicate that the two predictors explain 34.3% of the variance (R^2 *adj*.= 0.34 , *F*(4,721)=94.39, *p*<0.001), of which only 1.2% is attributable to the interaction term, and 0.8% to expenditure on sport. In M5, when CDI enters into an interaction with attacking, the total model variance (R^2 *adj*.=0.34 , *F*(4,271)=94.41, *p*<0.01) and the proportion attributable to the interaction term (1.2%) and to sport expenditure (i.e., amount negligible) remain at very similar levels. The interaction between attacking and CDI in M5 is statistically significant (B=-0.30, ß=-0.09, p<0.01) unlike the explanatory variable of sport expenditure, which is not a significant contributor to team performance (B=0.05, ß=0.001, p=0.97). M4 and M5 are comparable in terms of model fit, so either can be treated as optimal. The three-way interaction tested in M6 was not significant (p=0.805).

Simple slopes analysis (*Figure 21*) shows that the relationship between team performance and attacking strengthens as CDI decreases for teams that predominantly rely on attacking. Contrastingly, teams that are less reliant on attacking enhance their performance as they become more homogenous reflected in increasing CDI values. These tendencies are similar to the ones exhibited by teams in relation to possession. The scoring efficiency of teams that are less reliant on attacking is also less dependent on the cultural composition of their teams as illustrated by the steepness of the slope (i.e. the line for the linear relationship is much flatter than the one capturing teams with a high reliance on attacking). However, the overall significance and the positive direction of the two-way interaction supports *Hypothesis 3.4*.

Figure 21. Simple slopes analysis for M5: interaction between **CDI** and **attacking**.



Significant interaction effects for CDI and defensive transpired in model M5 (B=0.28, ß=0.07, p<0.05) and in a three-way interaction with income in M6 (B=-0.29, ß=-0.13, p<0.001) transpired in model M6, algebraically expressed as:

M5: $Y_i(GD) = ß_0 + ß_1\text{defensive*CDI} + ß_2\text{income} + \varepsilon_{i\backslash}$

M6: $Y_i(GD) = ß_0 + ß_1\text{defensive*CDI*income} + \varepsilon_i$

The country level predictors (i.e., income and sport expenditure) did not produce statistically significant results in M3, M4 or M5. Interestingly, however, the three-way interaction between income, CDI and defensive style emerged as statistically significant and strong (Table 17), explaining 37% of the M6 variance (R^2 *adj.*= 0.364 , $F(7,718)=60.14$, $p<0.001$), of which 15 % was attributable to the interaction term. In line with *Hypothesis 3.5*, there is an inverse (negative direction of the association), statistically significant relationship between team performance and the utilization of defensive style. As shown in *Figure 20*, teams with a more pronounced preference for defensive play tend to perform better as their cultural homogeneity increases, but only in poorer countries. In richer countries, enhanced performance is linked to greater cultural heterogeneity.

3.7.3 Moderated Regression Analyses for Playing Positions

The **third set** of moderated regressions, which investigated the impact of cultural diversity in relation to playing positions, provided further empirical evidence for the plausibility of *Hypotheses 3.3-3.5*. Four models for each style of play tested the contribution to sporting results of domestic vs. foreign players depending on their playing position (Table 19).

The results revealed a significant negative interaction between the utilization by teams of possession style and the proportion of domestic defensive players compared to the total number of players (B=-0.486, β=-0.265, p<0.01), with M2 explaining 35.7% of the variance [R^2 *adj.*=0.35 , F(3,722)=133.8, p<0.001]. As shown in the simple slopes analysis (*Figure 22*), teams with greater reliance on possession score higher, if the proportion of domestic defensive players on the rooster is lower. In other words, higher numbers of domestic defensive players contribute negatively to sporting outcomes, implying that inverse proportions of diversity, or greater cultural heterogeneity of defensive players is more advantageous for teams where the possession style prevails. In the case of teams with a propensity for constructive attacking, interaction effects were not significant, however, significant and complementary main effects surfaced. It was found that the proportion of domestic offensive players is negatively associated (p<0.05) with sporting results, whilst the proportion of offensive players who are foreign is positively associated with performance (p<0.05). These results further strengthen the argument that cultural heterogeneity, expressed in functional terms of playing position, **significantly contributes to improved performance in teams reliant on constructive attacking** (*Hypothesis 3.4*). Contrastingly, and in line with

Hypothesis 3.5, a **significant and positive interaction was found between the proportion of domestic defensive players and defensive style in terms of performance impact** (*B*=0.437, *ß*=-0.209, *p*<0.05), with M2 explaining 35% of the variance [R^2 *adj.*=0.35 , *F*(3,722)=129.4, *p*<0.001]. This effect was further reinforced by the complementary finding that the proportion of foreign defensive players in interaction with defensive style weakens the performance of defensively oriented teams (*B*=-0.470, *ß*=-0.110, *p*<0.05), with M4 explaining 35% of the variance [R^2 *adj.*=0.35 , *F*(3,722)=130, *p*<0.001]. In other words, defensively oriented teams tend to score higher as the proportion of domestic defense players increases (*Figure 23*) whilst the proportion of foreign defensive players decreases (*Figure 24*).

Figure 22. Simple slopes analysis for M2 (possession).

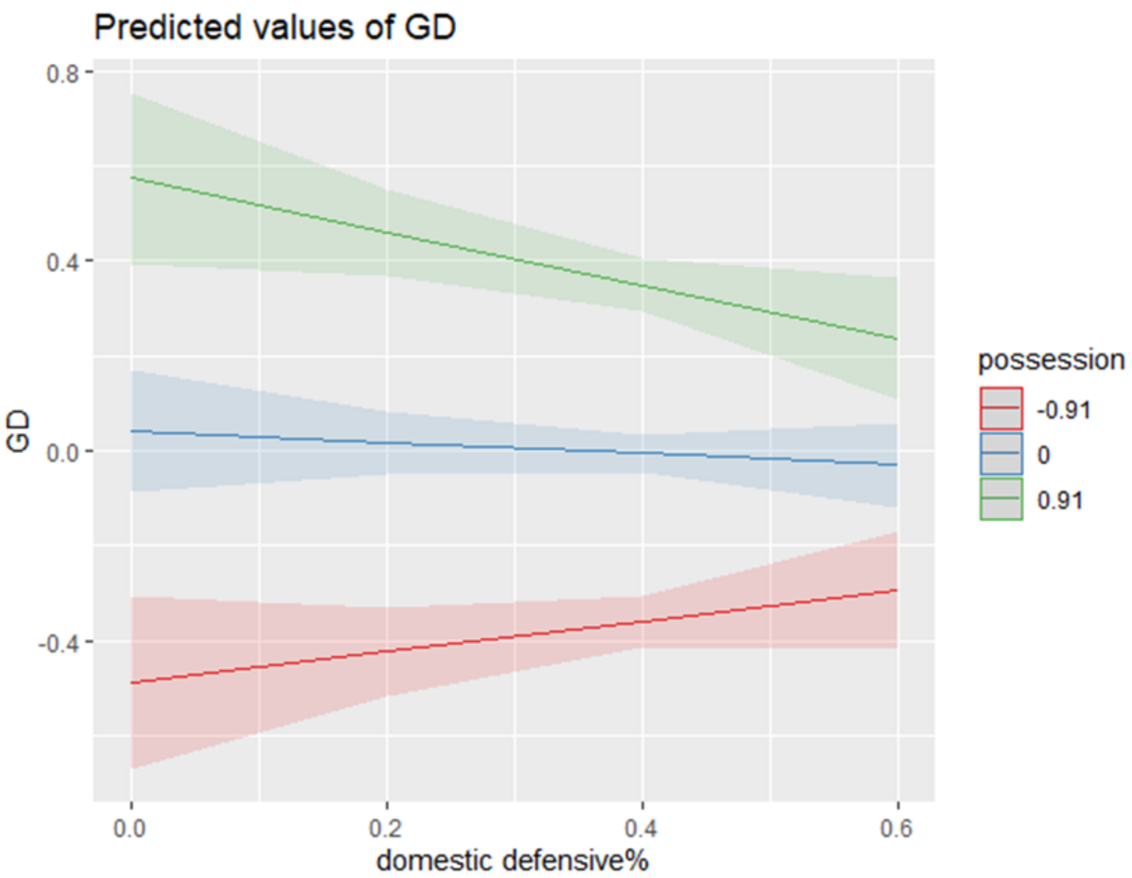


Figure 23. Simples slopes analysis for M2 (defensive).

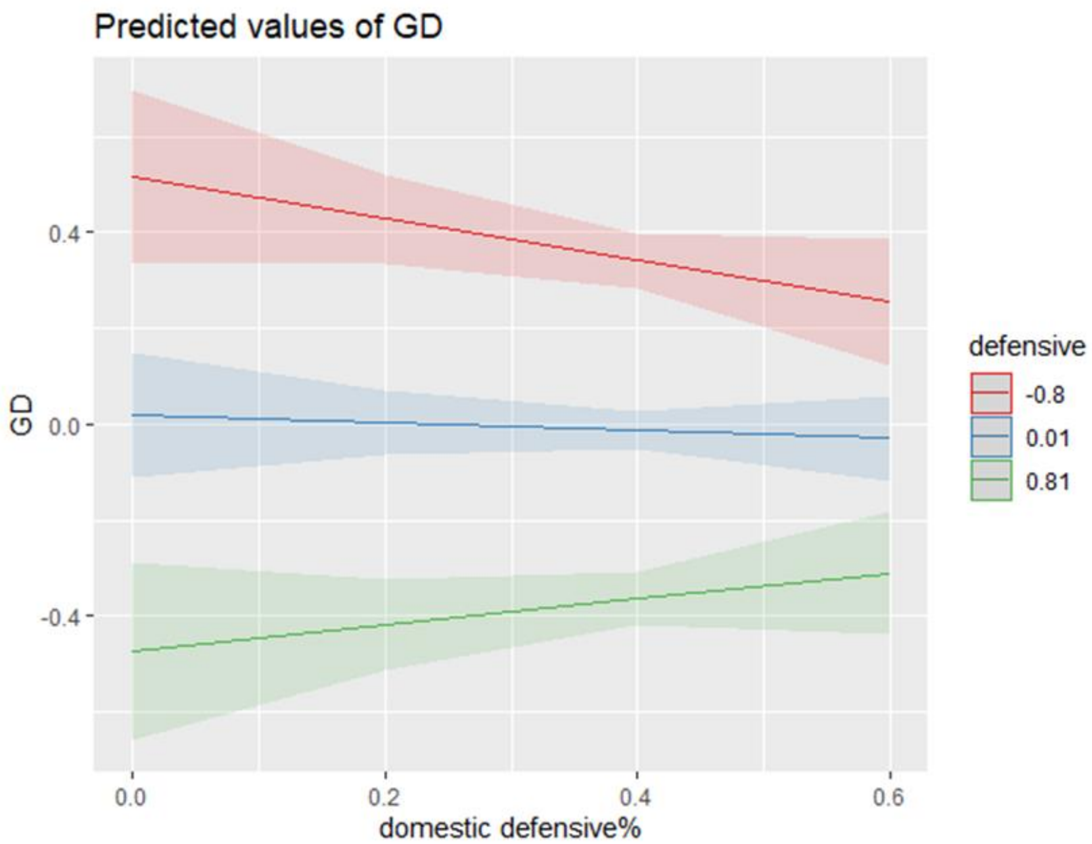
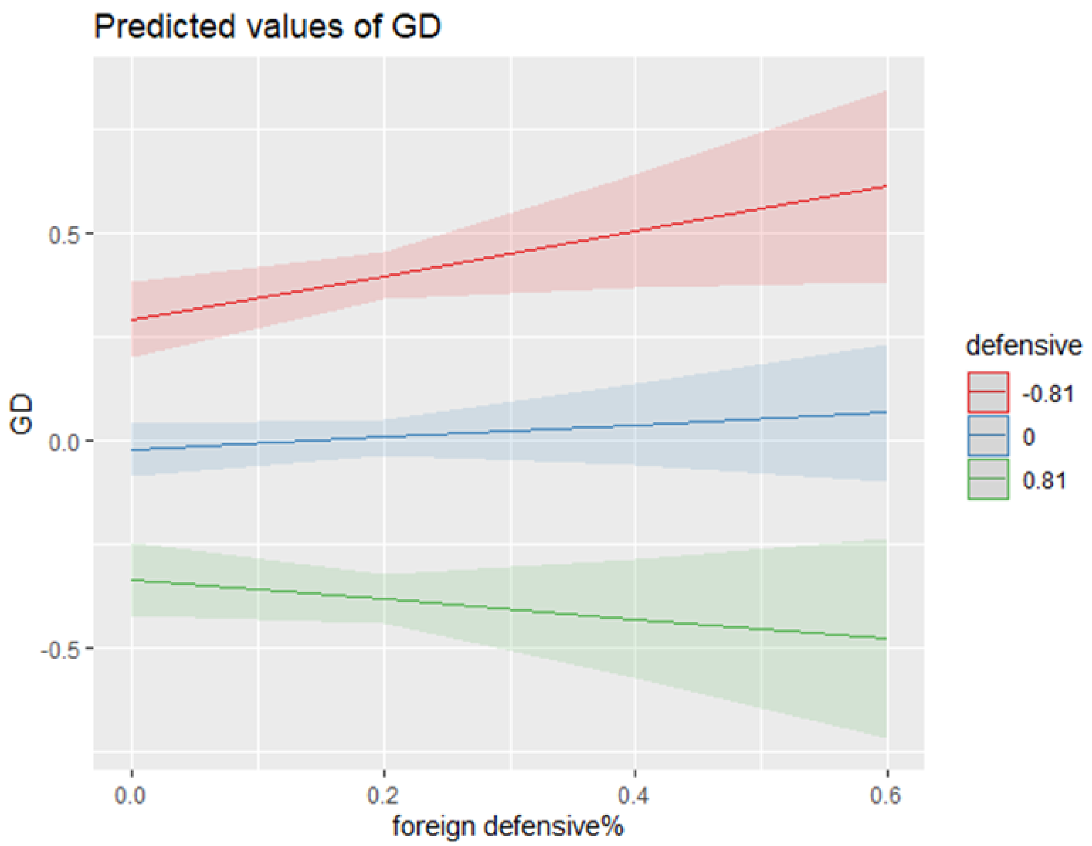


Figure 24. Simple slopes analysis for M4 (defensive).



To conclude, in line with the predictions of *Hypothesis 3.3, 3.4 & 3.5*, CDI was found to moderate in a statistically significant manner the association between sporting outcomes and each style of play in distinct ways, *that is*, positively in the case of possession and constructive attacking, and negatively in the case of defensive style. In other words, greater cultural diversity enhanced the performance of teams particularly reliant on possession and constructive attacking, whereas greater cultural homogeneity supported the sporting efficiency of defensively oriented teams. For possession- and defensively-oriented teams, the aforementioned relationships were found to hold true conditional on country wealth. The results provide compelling evidence that cultural diversity impacts not only sporting outcomes, but also how they are achieved (i.e., utilization of styles) within a larger contextual framework of higher level factors such as country wealth and budgetary spending on sport.

Table 16. Regression models testing CDI as a moderator.

Model:	*M1*	*M2*	*M3*	*M4*	*M5*
Team level predictors:					
team MV(market value)		**5.52*** **		**5.51*** **	**5.55*** **
CDI	**-0.26***	0.03	**-0.27***	0.01	0.04
Team level interaction:					
CDI * team MV		**6.18** **		**6.15** **	**6.13** **
CDI * league MV (weighted average)			-2.93		
Country(league) level predictors:					
league MV (weighted average)			-0.60		
income				-0.00	
sport expenditure					-0.19
Deviance	283.13	240.20	282.75	240.04	239.88
AIC	1382.66	1267.29	1385.7	1268.79	1268.32
R^2 adjusted	0.006	0.154	0.005	0.154	0.154
F statistic	**5.367***	**45.11*** **	2.11	**33.93*** **	**34.07*** **

Notes: *p < 0.05; **p < 0.01; ***p < 0.001

Legend:

M1: $Y_i(GD) = ß_0 + ß_1 CDI + \varepsilon_i$

M2: $Y_i(GD) = ß_0 + ß_1 CDI * \text{team MV} + \varepsilon_i$

M3: $Y_i(GD) = ß_0 + ß_1 CDI * \text{league MV} + \varepsilon_i$

M4: $Y_i(GD) = ß_0 + ß_1 CDI * \text{team MV} + ß_2 \text{income} + \varepsilon_i$

M5: $Y_i(GD) = ß_0 + ß_1 CDI * \text{team MV} + ß_2 \text{sport expenditure} + \varepsilon_i$

Table 17. Results of moderated hierarchical regression (unstandardized B values).

Model:	**Possession**						**Attacking**						**Defensive**					
	M1	*M2*	*M3*	*M4*	*M5*	*M6*	*M1*	*M2*	*M3*	*M4*	*M5*	*M6*	*M1*	*M2*	*M3*	*M4*	*M5*	*M6*
Team level predictors																		
possession	**0.41*****	**0.41*****	**0.41*****	**0.41*****	**0.40*****	**0.42*****												
attacking							**0.41*****	**0.41*****	**0.41*****	**0.41*****	**0.41*****	**0.41*****						
defensive													**-0.46*****	**-0.46*****	**-0.46*****	**-0.45*****	**-0.45*****	**-0.48*****
CDI				-0.19	-0.16	-0.18				**-0.22***	**-0.23***	**-0.22***				-0.12	-0.11	-0.11
Team level interactions:																		
[style variable] * CDI					**-0.25***	-0.18					**-0.30****	**-0.31****					**0.28***	0.21
Country level predictors:																		
league MV (weighted average)	0.00												-0.00					
income		**-0.02***		-0.01	-0.00	-0.01	-0.03	0.00						-0.02		-0.00	-0.00	-0.03
sport expenditure			-0.01						-0.01	0.01	0.05	0.05			-0.01			
Cross-level interactions:																		
[style variable] * league MV	0.61						0.58						-0.63					
[style variable] * income		**0.03***		**0.03***		0.02		**0.02***						-0.02		-0.02		-0.01
[style variable] * sport expenditure			**0.36***						**0.57****	**0.56****		**0.62****			-0.30			
CDI*income						0.08												0.07
CDI*sport expenditure												0.55						
[style variable]*CDI*income						**0.16***												**-0.29*****
[style variable]*CDI*sport expenditure												0.24						
Deviance	184.82	183.65	184.13	182.69	182.66	179.537	190.68	189.79	186.67	187.200	187.19	184.719	186.28	185.86	185.98	185.45	184.64	179.799
AIC	1077.01	1072.4	1074.30	1070.58	1070.48	1063.956	1099.66	1096.28	1091.96	1088.30	1088.24	1084.612	1082.73	1081.07	1081.57	1081.49	1078.29	1065.013
R2 adjusted	0.353	0.353	0.352	0.356	0.356	0.364	0.329	0.332	0.336	0.340	0.340	0.346	0.344	0.346	0.345	0.346	0.350	0.364
F for change in R2	**130.7*****	**101.2*****	**132.1*****	**101.2*****	**101.2*****	**60.38*****	**119.3*****	**121*****	**123.2*****	**94.39*****	**94.41*****	**55.81*****	**127.8*****	**128.7*****	**128.4*****	**96.97*****	**98.2*****	**60.14*****

Notes: **p* < 0.05; ***p* < 0.01; ****p* < 0.001.

Legend:

M1(possession): Yi(GD) = ß0 + ß1possession*league MV + εi
M2(possession): Yi(GD) = ß0 + ß1possession*income + εi
M3(possession): Yi(GD) = ß0 + ß1possession*income + εi
M4(possession): Yi(GD) = ß0 + ß1possession*income + ß2CDI + εi
M5(possession): Yi(GD) = ß0 + ß1possession*CDI + ß2income+ εi
M6(possession): Yi(GD) = ß0 + ß1possession*CDI*income+ εi

M1(attacking): Yi(GD) = ß0 + ß1attacking*league MV + εi
M2(attacking): Yi(GD) = ß0 + ß1attacking*income + εi
M3(attacking): Yi(GD) = ß0 + ß1attacking*sport exp. + εi
M4(attacking): Yi(GD) = ß0 + ß1attacking*sport exp. + ß2CDI + εi
M5(attacking): Yi(GD) = ß0 + ß1attacking*CDI + ß2sport exp. + εi
M6(attacking): Yi(GD) = ß0 + ß1attacking*CDI*sport exp. + εi

M1(defensive): Yi(GD) = ß0 + ß1defensive*league MV + εi
M2(defensive): Yi(GD) = ß0 + ß1defensive*income + εi
M3(defensive): Yi(GD) = ß0 + ß1defensive*income + εi
M4(defensive): Yi(GD) = ß0 + ß1defensive*income + ß2CDI + εi
M5(defensive): Yi(GD) = ß0 + ß1defensive*CDI + ß2income+ εi
M6(defensive): Yi(GD) = ß0 + ß1defensive*CDI*income+ εi

Table 18. Correlation matrix.

Variables	CDI	GD	team MV	wa league MV	possession	attacking	defensive	income (PPT)
GD	**-.086***							
team MV	**-.225*****	**0.383*****						
league MV (weighted average)	**-.225*****	-.000	**.630*****					
Possession	-.058	**.592*****	**.340*****	-.001				
Attacking	-.023	**.575*****	**.263*****	.002	**.474*****			
Defensive	**.092***	**-.588*****	**-.336*****	.000	**-.594*****	**-.526*****		
income (PPT)	**-.352*****	.004	**.074***	**.115****	.002	.001	**-0.005***	
country sport expenditure	.045	-.002	**.088***	**.146*****	-.001	-.001	0.002	**0.174*****

Notes: *p < 0.05; **p < 0.01; ***p < 0.001.

Table 19. Moderated regression analyses for playing styles (unstandardized B values).

Model:	Possession				Attacking				Defensive			
	M1	*M2*	*M3*	*M4*	*M1*	*M2*	*M3*	*M4*	*M1*	*M2*	*M3*	*M4*
Styles of play:												
Possession	**0.440*****	**0.583*****	**0.363*****	**0.356*****	**0.515*****	**0.486*****	**0.358*****	**0.373*****	**0.535*****	**0.613*****	**0.402*****	**0.386*****
Attacking												
Defensive												
Players functional roles:												
domestic offensive (%)	-0.300				**-0.403***				-0.195			
domestic defensive (%)		-0.125				-0.271				-0.084		
foreign offensive (%)			0.340				**0.423***				0.168	
foreign defensive (%)				0.143				0.348				0.149
Interaction effects:												
[style variable] * domestic offensive	-0.094				-0.325				0.257			
[style variable] * domestic defensive		**-0.486****				-0.203				**0.437***		
[style variable] * foreign offensive			0.253				0.307				-0.289	
[style variable] * foreign defensive				0.352				0.274				**-0.479***

Notes: *p < 0.05; **p < 0.01; ***p < 0.001.

3.8 Discussion

The current study tested a number of hypotheses that afford new empirical insights into the determinants of sporting performance in football teams. The statistical analyses were run on a large sample comprising 728 observations (teams) from 45 leagues across the world, based on performance data from the 2020/21 season. Findings concerned three categories of variables, that is, market value, macro-economic indicators and cultural diversity. As suggested by numerous researchers, the strong, positive association of teams' market value with their sporting results was confirmed in bivariate correlation analyses. Recruiting players with a higher market value (i.e., typically higher quality and more expensive) leads to higher returns for clubs or increases the chances of sporting success for teams. Unsurprisingly, wealthier teams were found to be more successful. Teams' market value also emerged as a strong predictor of sporting success. The wealthiest teams were most likely to achieve favorable sporting outcomes in their national leagues due to the availability of more abundant financial resources, which allow them to tap into a wider (international) talent pool of players and coaches. Greater access to resources strengthens teams competitive advantage as they are able to invest in higher quality facilities, sport-specific know how, or player/coaching talent in line with the premise of sociomaterial entanglement proposed by the Skilled Intentionality Framework (SIF; Van Dijk & Rietveld, 2017). Wealthier teams avail of greater sociomaterial resources, and are thus more likely to establish sophisticated player development practices to maximize skill / expertise enhancement. Performance environments offer a range of more or less inviting affordances (Withagen et al., 2012), which are only accessible to players and teams with the necessary skills, abilities and expertise to act on them.

Based on the conceptualization of sociomateriality as being hierarchically nested, it was further hypothesized that materiality/wealth, expressed in terms of macroeconomic measures such as countries' economic prosperity (measured by income PPP) and spending on sport, will contribute to the enhancement of sporting efficiency. Evidence to this effect has been provided by a number of studies, albeit in relation to national teams rather than association sport. Contrary to expectations, these two macroeconomic variables did not affect sporting outcomes directly, but indirectly as moderators of the relationship between performance and possession-based or constructive attacking styles respectively.

The results of a hypothesized two-way interaction showed a significant and positive association between sporting results and country wealth for teams reliant on *possession* (Table 16). This positive effect was strengthened in the three-way interaction with CDI (*Figure 18*), revealing that possession-oriented teams are more likely to achieve sporting success as they become more culturally heterogenous, but only if they originate from poorer countries. In richer countries, greater reliance on possession increases the chances of scoring, provided teams are more culturally homogenous. Also, the three-way relationships proved stronger in the case of teams from poorer countries. It appears, therefore, that the utilization of possession style affords greater chances of sporting success in wealthier countries, however, conditional on the lower cultural heterogeneity of teams. The three-way interaction (i.e., with CDI) tested for *attacking* style did not yield significant results. However, attacking style was found to be indirectly (i.e., in a two-way interaction) associated with countries' sport-related spending on infrastructure (e.g., stadiums), health programs, financing grassroots sports, etc. (*Figure 19*). Specifically, teams with an attacking orientation originating from countries that have a higher sports budget, tended to be more successful. For defensive style, significant effects emerged only from the three-way interaction (*Figure 20*). Namely, teams reliant on defensive style scored higher with increasing cultural homogeneity but only in poorer countries. In richer countries, heterogenous teams were found to perform better, although the dependency was weaker. In other words, the macro-level wealth variables (country income or budgetary spending on sport) produced significant effects ($p<0.001$) on performance only when CDI was introduced as a second moderator.

Drawing on the Skilled Intentionality Framework (CIF), one possible explanation for the positive association between macro measures of wealth and team performance is the impact of material resources (i.e., more pronounced in countries with lower GDP or PPT income), which afford enhanced opportunities for the development of fast-paced, technically-advanced and dynamic pitch behaviors characteristic of possession play. Using an ecological dynamics lens, it could be postulated that teams from wealthier countries are less "constrained" within their forms of life, and hence become attuned to affordances that invite a greater diversity of pitch actions. Targeted budgetary spending on sport creates opportunities for action that facilitate other specific behaviors. For instance, better quality stadiums and pitches, can invite behaviors where speed, precision and particular ball handling skills are prerequisites to constructing effective attacking actions. It can, therefore, be argued that teams originating from countries with a higher spend on sport are more likely to demonstrate sport efficiency in attacking, which is arguably more demanding in terms of perceived conditions for play. The strength of the positive association between wealth and sporting results is stronger in the case of targeted spending (i.e., higher sport-specific expenditure, $p<0.01$) rather than country income in general ($p<0.05$). Henceforth, possession style appears less dependent on country wealth, thus making it more accessible for utilization by teams from poorer countries. Regarding defensive style, the significance of the material component only surfaces in relation to teams' cultural diversity. In other words, the sporting success of defensively oriented teams is primarily dependent on cultural diversity rather than the wealth of the country of origin. The impact of CDI on the efficiency of defensive style was further tested in the second set of analyses in relation to *Hypothesis 3.5*.

The above interpretation of findings is rather speculative in nature. The connection revealed between styles of play and macroeconomic indicators is difficult to justify, given the dearth of studies and more directly applicable theoretical frameworks. However, the study's results provide compelling evidence as to the nested nature of affordances and constraints, which are hierarchically organized at individual/group as well large country level, in an on-going reciprocal transactional processes, although the latter was not specifically tested in Study 2. Moreover, the moderating effects signify non-linearity, which typifies dynamical systems (Nowak & Vallacher, 1998).

The wealth hypotheses on the association of team performance with league market value were rejected, both in relation to direct and indirect effects. This finding supports the conception of the player market as global vs. local, despite the fact that most transfers of players happen within leagues rather than between leagues/divisions or internationally. In other words, the market value of the league where teams play has little relevance to sporting success, as teams are not limited to the local player talent pool but can tap the global transfer market to serve their diverse needs. To that effect, a number of leagues in this study (e.g., Portuguese, Brazilian, Argentinian, Dutch) comprise of very rich teams that consistently rank in the top 5 and much poorer teams "scraping" the bottom of the league table.

The most novel findings of this study concern cultural diversity. First, bivariate correlations revealed that cultural diversity (operationalized as CDI) was negatively related to sporting outcomes and the market value of players, teams and leagues, implying that culturally homogenous teams are less likely to achieve sporting success or higher market valuations. However, bivariate correlations assume linearity, and afford limited insight into the complex relationships between variables that affect the sporting performance of teams conceptualized as complex dynamical systems. Therefore, moderated hierarchical regressions were conducted to tease out the nuances in the relationship between CDI and other determinants of teams' sporting success/efficiency. Whereas the majority of past research has focused on the direct effects of cultural diversity on performance, thus producing starkly inconclusive results, this study explored and confirmed the moderating role of CDI. All interactions of CDI with teams' market value and the three playing styles were statistically significant. In line with the value-in-diversity perspective (Ely & Thomas, 2001), it was discovered that greater cultural heterogeneity contributed to sporting efficiency only in poorer teams. Contrastingly, richer teams showed decreasing sporting performance as the concentration of non-domestic players on the rooster increased, thus corroborating the applicability of the similarity-attraction paradigm (Byrne, 1971). A possible explanation is that the sporting benefits of importing "foreign" talent in less affluent teams *exceed* the potential detrimental effects of cross-border transfers/transitions. Adverse effects typically involve, amongst other, communication/coordination challenges stemming from players' different learning histories and footballing enculturation, as proposed by ICIM, as well as teams' varied capacities to utilize of sociomaterial resources, as posited by SIF. One counter argument to the contextualization of sociomaterial entanglement is that multicultural societies tend to be wealthier, regardless of the drawbacks associated with integrating culturally diverse people within larger society. On this point, the author argues that the accrual of wealth at the macro level is the product of historically and economically driven social processes, which have no direct impact on small groups. Contrarily, the social dynamic within football teams develops within an environment marked by "short-termism" (Nesti, 2010) and a high rotation amongst players and coaching staff (Roderick, 2006). In football, the team context can be said to be stripped of the diversity-related historicity, which manifests itself more perceptibly at the societal level. That being said, players' perceptions of cultural diversity and its implications for how football is played must be interpreted with a historical perspective in mind as argued in section 1.3.

Furthermore, the study results highlight the nonadditive and nonlinear nature of relationships within dynamical systems, where threshold values[67] represent critical points of interaction between variables. In wealthier teams, the adverse effects perhaps exceed (i.e., over a certain threshold) the presumed benefits more often than not, raising the question of whether an *optimal* level of heterogeneity exists. Support for the notion of optimal cultural diversity is provided by ICIM, but also in research that links sporting results to self-categorization of sub-groups within a team. For instance, Tovar (2019) found that when teams are highly heterogenous (i.e., when the predominant nationality is relatively small, so self-categorization of groups is weak) or highly homogenous (i.e., when the predominant nationality is high, so that one-group culture dominates), the influence on performance is positive. He suggested that sporting outcomes become adversely affected by moderate heterogeneity, which promotes a strong sense of self-categorization that is detrimental to team cohesion and coordination processes. Tovar's study estimated an optimal number of players (i.e. 13) as the cut-off point between detrimental vs. beneficial effects of cultural diversity on sporting efficiency. In that sense, it is possible that affluent teams are more likely to achieve "moderate heterogeneity" that facilitates the formation of strong cultural sub-groups, thus negatively influencing sporting outcomes. However, the aforementioned argumentation assumes a Euro-centric or "Western" interpretation of cultural diversity, which disregards within-societal ethnic heterogeneity. For instance, a Nigerian team comprised of players from different ethnic and religious minorities may be, for all practical purposes (i.e., diversity management, footballing socialization), more culturally diverse compared to a culturally

[67] A threshold relation is one in which changes in variable A do not have an effect on variable B until a critical value of A is achieved. This value consequently triggers variable B, and no further increments in the value of A affect the value of B (Nowak & Vallacher, 1998).

homogenous European team with a similar CDI score. Another possible explanation for the effects of cultural diversity on performance may be the diversity of the local context, i.e., the cultural heterogeneity of the towns/cities or countries, where teams/clubs are situated. The potential impact of the wider diversity context is worth exploring in future research.

Analyses of the effect of CDI on performance in relation to styles of play produced interesting insights, which had not been previously investigated. It was discovered that teams with a high reliance on possession are more likely to improve sporting performance as their cultural heterogeneity increases (i.e., when they become more culturally diverse). The same holds true for teams, who opt for greater reliance on constructive attacking, that is, their performance tends to improve as the concentration of non-domestic players on their rooster goes up. Contrastingly, defensively oriented teams tend to perform better when their cultural composition is more homogenous, although, on balance, their sporting results are least favorable compared to teams that rely primarily on possession and attacking.

All of the above findings were corroborated and strengthened by the third set of regressions, which aimed to disentangle the effects of CDI on sporting performance in relation to playing positions. Specifically, it was confirmed that the sporting success of possession-oriented teams depends on the low proportion of domestic players in defense, implying the inverse, that greater positional dilution (i.e., greater cultural heterogeneity in defense) is more likely to produce favorable sporting outcomes. Similarly, support was found for the association of the constructive attacking style with a higher ratio of foreign offensive players in line the cultural heterogeneity prediction (*Hypothesis 3.4*). Conversely, the sporting performance of defensively-oriented teams depends to a greater extent on cultural homogeneity amongst defensive players.

The aforementioned results align with the proposed ICIM model, which predicts that players with a similar footballing socialization (typically coinciding with their cultural background) are more likely to create affordances for each other through on-pitch action, specifically in relation to tasks that require greater communication. Research evidence suggests that communication (primarily action-based, non-verbal) is particularly important in defense (Brox & Krieger, 2019), and therefore the performance of culturally heterogenous teams is more likely to suffer in defense than offense. Thus, the ICIM model along with extant research provides plausible justification for the study’s findings that defensively oriented teams tend to perform better, if their cultural composition is more homogenous. The possession based and constructive attacking style fall under the broader “offensive” category in terms of how their utilization is affected by cultural diversity. From an ecological dynamics perspective, a common or similar socialization of defense players serves to enhance their communication-in-action. In other words, they can be more effective in presenting affordances for each other, both consciously or unconsciously, by marking and tackling opponent players, putting pressure on the ball, or acting on any other defensive tactic. Similar perception and utilization of *affordances for* (i.e., for teammates) and *affordances of* (i.e., of opponents) others appears to matter more for defensive players in relation to achieving favorable sporting results by teams, although the importance of communication for offensive players should not be downplayed. Finally, the results provide support for the moderate embodiment stance, which embraces the notion of cognitive influence on collective pitch actions through (1) more complex social cognitive elements of representation manifested in pattern recognition and anticipatory behavior, as well as (2) primitive forms of representation expressed in sensorimotor actions.

To conclude, this study provides rich evidence on the link between team sporting performance and a number of variables, including market value, country level income and expenditure on sport as well as CDI. It also affords new empirical insights into the role of CDI as a moderator of the relationship between sporting outcomes and its determinants, that is, team market value and styles of play. The author makes a theoretical contribution to embodied sport psychology by proposing the Integrative Categorization-Intentionality Model (ICIM), which integrates social psychological perspectives and ecological dynamics, illuminating cultural diversity as an important cross-cultural variable. Finally, the study's findings signpost the situatedness and cultural embeddedness of football necessitating a deeper understanding of footballing context, which represents the underlying theme of inquiry in Study 3.

CHAPTER FOUR: Determinants of Playing Styles in Football (Study 3)

4.1 Introduction

Whereas Study 2 focused on the determinants of sporting success (team sporting results), the current study examines the determinants of teams' playing styles, which were operationalized in Study 1. Specifically, the overarching aim of Study 3 is to provide empirical evidence illustrating the extent to which environmental and sociocultural aspects of life are embodied in the way that football is played across the world. Using an ecological dynamics lens, the author argues that environmental and sociocultural factors affect how players learn to perceive and utilize available affordances of the performance environment. The process of learning is inadvertently related to skill acquisition and development, conceptualized as *skill adaptation* or enhanced attunement to the surrounding information in a practice or performance environment (Button et al., 2020; Chow et al., 2020). In football, skills develop as players become perceptually attuned to the opportunities for action (affordances) presented by properties of the playing environment such as weather, field markings, ball position, etc. (Coutinho et al., 2016). However, environments vary in terms of their underlying properties and their composition. Some properties solicit greater attention or "stand out" to be more readily perceived (van Dijk & Rietveld, 2017). For instance, certain positioning of players on the field can invite deceptive behaviors from opponents, embodying a style of play (Ginga) that draws on Brazilian cultural heritage (Uehara et al., 2018). This example shows how affordances are entangled within a sociocultural and historical context of practices (van Dijk & Rietveld, 2017). Analogously, prevalent weather or climate conditions can invite affordances that promote the development of specific skills. Whereas insufficient empirical evidence exists to this effect, there is abundant anecdotal evidence linking wet and muddy pitch conditions (e.g., in England) with physicality, direct play and long passes; sunshine and warm, dry weather (Spain and Brazil) to superior ball handling skills, short, technical passes and creative play; or technical skills of Finnish F1 racing drivers with dangerous icy track conditions. Using ecological dynamics terminology, environmental factors and more specifically temperature, precipitation and thermal heat are conceptualized as constraints that influence skill adaptation and consequently patterned behavior (i.e., styles of play).

Additionally, Study 3 proposes that cultural values solicit particular ways of affordance detection, selection and utilization. As proposed in the Integrative Categorization-Intentionality Model (ICIM; section 3.2.2), the author posits that affordance utilization is inextricably linked with intentionality, which in turn is inherently value-directed. In other words, players direct their actions toward certain aspects of the world, and in their interactions with the environment are guided by value-directed intentions that determine which aspects of life are targeted and which affordances are discovered (Rasmussen et al., 2017). They can be said to develop and adapt skills in relation to relevant affordances that stand out in their footballing context (i.e., footballing form of life), while inviting the realization of cultural values in a context-sensitive and embodied way (Vaughan et al., 2021). Finally, footballing forms of life can be equated to playing styles, or even sociocultural artifacts (Rossing & Skrubbeltrang, 2017). While Vaughan et al. (2021) link intentionality to cultural changes such as the emergence of neoliberalism and competitive individualism, the rise of meritocracy and controlling parental practices, the author proposes an alternative perspective guided by theories of modernization and emancipation (Welzel, 2013; Welzel & Inglehart, 2005). Their applicability to playing styles is discussed in section 4.1.2.4 below.

The remainder of the Introduction (4.1) is organized in the following manner. First, an extended review is presented of the literature covering respective research and theory on environmental (section 4.1.1) and sociocultural (section 4.1.2) factors/constraints. Second, a summary is provided of the pilot study conducted prior to Study 3. Third, the relevance of literature and theories to sport and football in the context of the current study is detailed in a dedicated subsection, which also highlights the theoretical framing of the preliminary hypotheses and for inclusion of particular variables/predictors in the analyses.

4.1.1 Environmental Constraints: Climatic Variables

The present subsection is concerned with climate and weather as predictor variables applied to cross-cultural / population-level research. First, a general review of the relevant literature and theory is presented. Next, environmental constraints are considered with relevance to sport/football and the current study (section 4.1.1.3).

> *"No person who examines and reflects, can avoid seeing that there is but one race of people on the Earth, who differ from each other only according from the soil and the climate in which they live." – J. G. Stedman (1790).*

Climates are commonly analyzed using temperature, precipitation, wind, humidity, pressure and other meteorological variables. To reduce complexity, they are often classified using a combination of the two most important factors: average temperature (frigid, temperate, torrid) and average precipitation (arid, semi-arid, subhumid, humid, wet). In the psychological literature, a distinction is made between weather (i.e., indicates what is happening in the atmosphere at any given time) and climate (i.e., generalized weather of a geographic area over a prolonged period, typically 30-years), with the former triggering *physical* and *psychological* effects, primarily at the individual level, whereas the latter producing *psychological* and *sociological* effects in the longer run at the societal level (Van de Vliert & Van Yperen, 1996).

The link between climate and weather on the one hand, and mood, emotions, behavior and psychological processes on the other, has been evidenced across disciplines in the social and environmental sciences. This connectedness can be traced to Hippocrates and Ibn Khaldun, but was more articulately formulated by 18th century philosophers (e.g., Montesquieu and other Encyclopedists[68]. Montesquieu argued that climate and physical terrain (marine biology, mineral resources, and topology) has a profound effect on culture, work ethic, suicide, alcoholism, aggressiveness, religions, mortality, fertility, obesity, sexism and industrial development (income, labor productivity, agriculture, trade and commerce). He proposed that meeting basic/survival needs for food, safety, reproduction and enjoyment of life varies across cultures based on exogenous environmental conditions that populations undergo in the process of so called *cultural adaptive radiation.* Such adaptive forces lead countries with similar natural environments to develop in similar ways maximizing their utilities, which are constrained by natural endowments. Montesquieu's key breakthrough insight was that the satisfaction of climate-related necessities in life is predicated on the availability of money (cash) resources. At the beginning of the 20th century, the proponents of the so-called geographical schools also postulated the association between climate and various psychological phenomena (for an overview, see Sorokin, 1928). The idea of cultural adaptation at the population level was incorporated in Berry's (1976, 2001) ecocultural framework, which considers human diversity, both cultural and psychological, to be a set of collective and individual adaptations to context. A more detailed exploration of the culture-climate link is provided below.

4.1.1.1 Cross-cultural perspective

Research investigating the culture-climate link has historically focused on *cold-hot* (e.g., Van de Vliert, 2009; Van de Vliert & Murray, 2018) and *dry-wet* (House et al., 2004; Van Vliert & Tol, 2014) contexts, and more recently on the *latitudinal* perspective (e.g., Van de Vliert, 2019; Van de Vliert & Conway, 2018; Van de Vliert & Van Lange, 2019). Within the *cold-hot* context, Van de Vliert and colleagues (2000) observed an association between

[68] The Encyclopedists include, among others, Montesquieu, Voltaire, Rousseau, Melchior and Baron von Grimm.

increasing temperature and increasing citizenship competitiveness[69]. Similarly, Hofstede (2001) showed that a country's decreases in geographic latitude as a global indicator of a country's warmer climate go hand in hand with greater differences in power between individuals or groups. On a different note, research conducted by Fought et al. (2004) compared the languages used by 21 societies in cooler climates and 39 societies in hotter climates. They proposed that people in cooler climates who have to speak in sheltered and indoor settings can easily make themselves heard even if they use words that contain many consonants, fricatives, and nasal sonorants. By contrast, in hotter climates, where people spend more time outdoors, they need to communicate over longer distances in noisier environments, with the consequence that they use words with more sonorous phonetic segments in the form of vowels and semi-vowels. More recently, Van de Vliert and Murray (2018) found that higher thermal demands hinder creativity in poorer populations but promote creativity in richer populations, demonstrating that creativity accounted for 79% of the variation in creative culture across 155 countries.

In the influential GLOBE study (House et al., 2004), multiple temperature-precipitation combinations were used to arrive at a seven-cluster topology of climates (i.e., tropical humid, savanna, desert, subtropical humid, mediterranean, maritime and continental). Rather than using a topological approach to investigate culture-climate links, Van de Vliert and Tol (2014) decoupled temperature from precipitation, and revealed that demandingly cold-dry climates promote autocracy in poor countries but democracy in rich countries, whilst demandingly hot-dry climates promote autocracy everywhere, irrespective of the country's level of income.

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[69] Classical ecocultural models connect a cluster of factors with different subsistence economies (i.e., agricultural, nomadic, hunter-gatherer), which in turn shape different psychological-adaptive profiles. Comparatively, Van de Vliert's studies are not based on syndromes of cultural characteristics but use separate variables.

Finally, the latitudinal perspective has gained traction over the past few years. It aims to explain variations of psychological phenomena along the north-south rather than east-west axis of the Earth by focusing on latitudinal gradients. Van de Vliert and Van Lange (2019) provided empirical support to the idea that human functioning – at least for creativity, aggressiveness, life satisfaction, and individualism – varies along latitude rather than longitude and in opposite directions above and below the equator. The same pattern of results has been observed for in-group favoritism, out-group rejection, political oppression, legal discrimination, and communication bullying (Van de Vliert, 2019; Van de Vliert & Conway, 2019).

4.1.1.2 Other population-level perspectives

The association between meteorological variables (e.g., temperature, humidity, precipitation, levels of sunlight, seasonality, barometric pressure) on the one hand, and mood, emotions and behavior on the other, was investigated primarily in the last three decades of the 20th century (e.g., Cunningham, 1979; Howarth & Hoffman, 1984; Parrott & Sabini, 1990; Sanders & Brizzolara, 1982; Schwarz & Strack, 1991; Watson, 2000). Given the inconclusiveness of results, the debate is still on-going as regards the influence of weather on various psychological processes. Population-wide behavior studies in psychology and psychiatry provide more compelling evidence on the association between weather and certain behavioral disorders. For instance, researchers have found that exposure to sunlight improves mood and diminishes the occurrence of seasonal affective disorders (SAD; Kripke, 1998; Lambert et al., 2002; Leppämäki et al., 2002). More recently, strong associations have been reported between suicides/suicide attempts and climate effects, including ambient temperature (Aguglia et al., 2021; Serafini et al., 2020), seasonality (Aguglia et al., 2016; Rumble et al., 2018; Yu et al., 2020) and sunlight exposure (Dixon, et al., 2018; Gao et al., 2019). On a similar note, Bullock et al. (2017) showed that daily maximum temperature predicts clinically-relevant mood change in patients with bipolar disorder, with increases in temperature associated with greater odds of a transition into manic mood states. Scholars have also examined how weather influences mood-induced decision-making in the context of investment and consumer behaviors (e.g., Parsons, 2001). For instance, the impact of sunlight and, more generally, weather conditions on economic activity and the stock market has been documented by several studies (e.g., Bassi et al., 2013; Goetzmann et al., 2015; Hirshleifer & Shumway, 2003; Kamstra et al., 2003; Saunders, 1993).

Violence and aggression

Considerable research (i.e., correlational studies, field experiments and archival studies), dating as late as the 1800s (e.g., Brearly, 1932; Dexter, 1899; Falk, 1952; Lombroso 1899/1911;), has demonstrated the positive association between the rise in temperatures and the increase in violent crime (e.g., murder, rape, assault, violent riots; Anderson, 1987, 1989; Michael & Zumpe, 1986; Simister & Van de Vliert, 2005; Van de Vliert, 2009) and aggressive behaviors (e.g., horn honking, prison inmate violence, baseball batters hit by pitched balls; Haertzen et al., 1993; Kenrick & MacFarlane, 1984; Reifman et al., 1991). In the literature, this phenomenon is often referred to as the "heat effect." A number of contemporary theories account for the *heat effect*. Van de Vliert et al.'s (1999) model predicts a curvilinear ambient temperature-cultural masculinity[70] relation and a subsequent linear relation between cultural masculinity and violence. The General Aggression Model (e.g., Anderson & Bushman, 2002) explains aggressive behavior in terms of personal (e.g., genetic predispositions, gender, attitudes toward violence) and situational variables (e.g., hot temperatures, provocation, violent media, alcohol). The Routine Activity Theory (Cohen &

[70] Masculinity as a cultural dimension was identified by Hofstede (1980, 1991). High cultural masculinity characterizes societies in which men are expected to be dominant, assertive, tough, and focused on material success, whereas women are expected to be subordinate, modest, tender, and concerned with ensuring a high quality of life. Although cultural masculinity as a construct has been highly criticized in the cross-cultural literature, Van de Vliert et al.'s study is only mentioned to showcase scholarly attempts at demonstrating the empirical link, linear and curvilinear, between aggression and temperature.

Felson, 1979; Rotton & Cohn, 2001) predicates the heat effect on the amount of social contact indoors vs. outdoors depending on weather conditions. The model of Climate, Aggression, and Self-Control in Humans (CLASH; Van Lange et al., 2016) seeks to explain differences within and between countries in terms of temperature, and especially seasonal variation in temperature, with reference to time-orientation (present vs. the future; cf. Boniwell & Zimbardo, 2004) and self-control (ability to resist and manage "temptations" and "impulses"; Baumeister & Tierney, 2011). The CLASH model postulates that lower temperatures, and especially larger degrees of seasonal variation in climate, facilitate the adoption of a slower life history strategy with a greater focus on the future (vs. present), and a stronger focus on self-control. It also proposes that slow life strategy, future orientation, and strong self-control are important determinants of inhibiting aggression and violence (Van Lange et al., 2016).

4.1.1.3 Environmental constraints: Relevance to this study

Drawing on the extensive body of research reviewed above, it is proposed that environmental factors can affect human psychological processes and habitual behavioral patterns (Oishi, 2014; Rentfrow & Jokela, 2016) within the sporting domain in relation to team performance, coaching and training practice. In this study, the impact of **temperature** and **precipitation** (i.e., team level variables) as well as **thermal heat** (i.e., climatic country level variable) is explored to identify how these contribute to the utilization of particular styles of play within and between selected football leagues.

In football, practice sessions and games frequently take place outdoors, which exposes players to different environmental conditions. Historically, in investigating the effect of environmental variables, the focus has been on the players' physical performance (Ekblom, 1986; Reilly & Williams, 2003; Trewin et al., 2017) during match-play rather than regular practice. For instance, Ekblom observed that the total distance covered in high intensity decreased during games played in temperatures of 30 degrees C compared to games played at

20 degrees C. However, findings are controversial as regards the impact of temperature on total distance covered by players during games; some studies provide evidence for links (Mohr et al., 2010) while others do not (Link & Weber, 2017; Carling et al., 2011). A large body of research has investigated the effect of situational variables such as home advantage, team ranking, altitude, heat/cold, humidity, precipitation and air quality on match-play performance of players or performance efficiency/sporting results (e.g., Brewer & Warren, 2014; ; Brocherie et al., 2015; Chmura et al., 2012; Dvorak & Racinais, 2010; Grantham et al., 2010; Ozgünen et al., 2010; Zhou et al., 2019). Temperature (average and ambient) has been consistently associated with player and team performance, with mixed results on the explanatory power of precipitation/humidity and climate (hot/cold). Recently, Chmura et al., 2021 found that situational variables (match location, match outcome and strength of team/opponent) had major effects on players' technical performance (especially with regard to passing), but minor effects on their physical performance. Compared to other environmental variables (i.e., relative humidity, ground and weather conditions, heat impact), temperature emerged to be most sensitive thus affecting total distance covered by players as well as sprint efforts in all field positions (Chmura, 2021). In terms of players' physical performance, Chmura et al. (2017), corroborated by Zhou et al. (2019), found that ambient temperatures below 22 degrees C create optimal thermal conditions for play. As regards technical performance, higher temperatures have been linked to passing efficiency (e.g., Mohr et al., 2012; Nassis et al., 2015). Finally, in terms of tactical behaviors, Dambroz et al. (2021) showed that higher temperatures (ranging between 21 – 30 degrees C) are associated with longer ball possession in the defensive sector, whereas cooler temperatures (less than 10 degrees and between 11 – 20 degrees C) contributed to longer ball possession in the offensive sector.

In sum, there is compelling evidence for the association of environmental variables, primarily **temperature**, with performance (predominantly during competitive events/matches). Although researchers have extended their analysis to tactical behaviors, there are no studies, to the best of the author's knowledge, examining habitual patterned behaviors such as the propensity to rely on particular styles of play at the league/country level as a reflection of cultural heritage, and idiosyncrasies in coaching, training practice and game-play. Analogously, it can be hypothesized that the effect of environmental factors is equally applicable to patterned behaviors that characterize particular playing styles. Adverse environmental conditions such as cold temperature, heavy precipitation (muddy/frozen pitches; Watanabe et al., 2017), strong winds (wind-affected kicks; Carmichael et al., 1999), and thermal heat affect playing skills, how these develop and which ones are sustained to adapt to the environment. Playing skills in turn affect playing styles by shifting the balance from longer to shorter passes and interceptions (Brito et al., 2017), or from greater to lesser physicality in play. Following this logic and based on the aforementioned findings regarding the effect of temperature on tactical behaviors, it can be hypothesized that higher average temperatures (L1; team level variable) are linked to defensive based play, whereas offensive game styles are more likely to be exhibited by teams in cooler temperatures. Given that footballers spend considerable time outdoors training and competing, in addition to temperature, the effect of **precipitation** (rain and snow) on playing styles can also be hypothesized. Although there are fewer studies that report a strong association of precipitation/humidity with sports performance, precipitation is a key climatic variable influencing human behavior in general (Van de Vliert & Tol, 2014). It can, therefore, be argued that higher levels of precipitation (L1; team variable) are associated with the development of more technical and skill-based play required in attacking-type styles (i.e., possession and constructive attacking), whereas lower levels of precipitation contribute to reliance on defensive play.

To account for the specific conditions under which teams perform in trainings and home-matches, the climatic variables of average temperature and precipitation were taken at the micro-level (i.e., from data by city or team location). This approach also recognizes the intra-group variability, which is considerable in countries covering large geographical areas such as China, USA or Russia. The mean level of temperature is commonly used as a predictor of human behavior and cultural features (Carleton & Hsiang, 2016; De Dreu & Van Dijk, 2018; Georgas et al., 2004). However, average temperatures ignore variability such as in seasonal variations. To address this shortcoming, the current study draws on Van de Vliert's conceptualization of thermal *climate* (as opposed to reliance on single meteorological variables) with the aim of exploring the effects of cross-national variation, specifically **thermal heat.** The latter is a measure of heat mean deviations from 22 degrees C for the average highest temperature in the hottest month. By accounting for variability in temperature it recognizes the bipolarity of thermal livability (Van Lange et al., 2016). The 22 degrees C mark affords optimal human livability as suggested by physiological (Parsons, 2003), psychological (Van de Vliert, 2009), and agricultural (Cline, 2007) evidence. Thermal heat (L2; country(league) level variable) was used in this study to test the hypothesis that teams in warmer climates are more likely to utilize defensive play.

Violence and aggression

Application of mainstream psychological understandings to the concepts of aggression and violence in sport has been criticized on the grounds that these activities take place in a unique context that often legitimizes and sanctions aggression and violent actions that may be deemed illegal outside of sport. To this end, Smith (1983) wrote that "outside of wartime, sports is perhaps the only setting in which acts of interpersonal aggression are not only tolerated but enthusiastically applauded by large segments of society" (p. 10). Combat sports like karate, fencing, boxing, as well as team contact sports like rugby, soccer, American football or ice hockey are characterized by high levels of aggression and often violent physical contact, which is intrinsic to the sport, accords with the rules of the game and is not intended to injure. To distinguish between different forms of aggression and violence in sport[71], some authors have used the terms "sanctioned" and "unsanctioned" actions, referring to actions that fall within or outside of written rules and informal player norms (Bakker et al., 1990). The term "violence" is typically used in the negative sense to denote a mean violent action (e.g., severe or violent collision or tackle) aimed to damage or injure (Kerr, 2005; Smith, 1983). In soccer (football), aggressive play and dangerous contact, which poses a considerable risk for injuries, typically takes place in grappling duels, aerial duels, standing/lunging tackles and sliding tackles (Anderson et al., 2004). Fouls are given by referees for unfair or unsportsmanlike play, which is typically associated with unnecessarily aggressive or dangerous contact. Players receive yellow cards as warnings for dangerous play, or accumulated fouls, while red cards are shown for accumulation of two yellow cards, or more serious offenses such as an excessively reckless challenge or violent conduct[72].

Cross-cultural differences have been identified in how norms/regulations are interpreted and endorsed. Dawson and Dobson (2010) found that the number of cautions

[71] There are a number of conceptualizations of aggression/violence in sport. For instance, Silva (1983) differentiated between hostile (i.e., aiming to cause harm or injury to the opponent) and instrumental aggression (i.e., aiming to achieve a specific goal). Frączek (2002) referred to sport aggression as instrumental as opposed to cognitive or intrinsic.

[72] According to Fédération Internationale de Football Association (FIFA), a player receives a **yellow card** for committing any of the following offenses: unsporting behavior; shows dissent by word or action; persistently infringes FIFA's Laws of the Game; delays the restart of play; fails to respect the required distance when play is restarted with a corner-kick, free kick, or throw in; enters, re-enters or deliberately leaves the field of play without the referee's permission; or takes off his jersey to celebrate a goal, or celebrates a goal approaching the spectators in a manner which causes safety and/or security issues. A player receives a **red card** for committing any of the following offences: violent conduct; serious foul play; bites or spits at an opponent or any other person; denies the opposing team a goal or an obvious goal-scoring opportunity by deliberately handling the ball; denies an obvious goal-scoring opportunity to an opponent whose overall movement is towards the player's goal by an offence punishable by a free kick; uses offensive, insulting or abusive language and/or gestures; or receives a second yellow card in the same match (FIFA, 2019).

awarded in UEFA Champions League matches differed according to referee nationality. Interestingly, the English Premier League is considered the most aggressive of the top five European football leagues (Barnes et al., 2014; Buraimo et al., 2010), in that on average there are more dangerous/reckless tackles that are less often punished, presumably pointing to the endorsement by English referees of a more liberal interpretation as to which actions warrant a foul or a card (Sapp et al., 2017). In this dissertation, the number of yellow cards booked by teams is taken to predict a more aggressive style of play, although the more conservative measure of red cards was used in the pilot study. As most fouls, for which cards are awarded, tend to be committed by defenders in the high areas of the pitch close to the ball line (CIES Football Observatory, 2020), it can by hypothesized that the number of yellow and red cards partially explains teams' utilization of defensive tactics and a defensive playing style. Conversely, the expectation is for the existence of a significant negative association between yellow cards and the two offensive styles (possession and constructive attacking).

Although scholars have investigated various aspects of aggressive/violent behavior in team sports, ranging from the effect of aggressiveness on performance[73], determinants of aggressive behavior such as personality (e.g., Anderson & Bushman, 2002), competition, age and sport type (Coulomb & Pfister, 1998; Coulomb-Cabagno & Rascle, 2006; Traclet et al., 2015), or "aggressive style" as the outcome of a socialization process (e.g., Moret et al., 2018), there are no empirical investigations on how aggression and violence relate to styles of play. The claim made in this dissertation is that sporting activities, including football, are not isolated from social dynamics, and as such constitute a "natural experiment" that affords important insights about society at large. This idea draws on research that depicts sports as

[73] Results are mixed. Some researchers have revealed a positive association of aggression with performance, as in basketball (e.g., Zitek & Jordan, 2011), ice hockey (e.g., McCarthy & Kelly, 1978a, 1978b) and handball (e.g., Grange & Kerr, 2010). García-García et al. (2014) reported negative effects on performance in the first division of the Spanish football league.

natural experiments (Levitt, 2002; Saravia, 2021; Smith, 1979a, 1979b; Weinsten et al., 1995). Therefore, the way football is played should mirror to some extent the propensity of societies to aggressive behaviors. This notion has recently found support in a study conducted by Antonio Saravia (2021). Based on an examination of aggressive behavior across 86 different professional leagues, he proposed that the social environment that footballers navigate on a day-to-day basis translates into match behaviors as evidence that players play the way the live. Guided by this logic, the national homicide rate index was used in this study as a measure of a country's aggression levels and as a predictor of the positive relationship with defensive style.

4.1.2 Sociocultural Constraints: Cultural Value Dimensions

This subsection elaborates on cultural value dimensions as sociocultural constraints shaping the development of playing styles in football. First, an overall theoretical review of the relevant concepts is provided, followed by a discussion of their applicability to sport/football and the current study (4.1.2.4)

There is abundant research in cross-cultural and cultural psychology on the importance of values in shaping culture (Roccas & Sagiv, 2010) and conversely, of culture influencing the development and endorsement of values. Values are inferred constructs in that they are not directly observed, but manifest themselves in social organization, practices, symbols, and self-reports (Berry et al., 2013). In that sense, values are eminently psychological, influencing behaviors and decision-making. The underpinning psychological processes are strongly affected by the sociocultural context, in which people operate. In other words, these processes are said to be culturally bound. By the same token, in a sporting context cultural values can be said to affect performance, both in terms of patterned behavior (e.g., playing style, strategy or tactics), or efficiency (e.g., sporting results).

Cultural (societal level) values were first framed within a parsimonious national culture framework by Geert Hofstede (1980/2001). Although it has drawn considerable criticism (Boski 2009/2022; Javidan et al., 2006; Minkov, 2018; Oyserman et al., 2002), Hofstede's findings led to a surge in empirical studies on the impact of culture on various aspects of human existence across multiple disciplines including cross-cultural psychology, cross-cultural management, comparative sociology and economics (for overviews, see Beugelsdijk et al., 2018; Gorodnichenko & Ronald, 2011; Kirkman et al., 2006; Klasing, 2013; Taras et al., 2012). In response to criticism, alternative multidimensional value-based frameworks have been developed such as the GLOBE study (House et al., 2004), the Schwartz Personal Values Inventory (Schwartz, 1994, 2004) and Inglehart's two-dimensional framework guided by his dynamic theory of cultural change (Inglehart, 1971, 1990, 1997; Inglehart & Welzel, 2005). Not surprisingly, there is substantial overlap between the underlying dimensions across all of the aforementioned influential frameworks (Beugelsdijk & Welzel, 2018). For instance, autonomy vs. embeddedness and self-enhancement vs. self-transcendence dimensions underlying the Schwartz value space are depicted in the two dimensions of the Inglehart-Welzel world map of cultures in a 45 degree rotated manner (Welzel, 2013). Notably, however, the individualism-collectivism dimension can be found in most cultural frameworks. With its emphasis on autonomous human choice, individualism-collectivism as quantified by Hofstede (2001) and Triandis (1995), as well as autonomy-embeddedness as measured by Schwartz (1994, 1999) tap the same dimension of cross-cultural variation as survival vs. self-expression values identified by Inglehart (1990, 1997; Inglehart et al., 2004; Inglehart & Welzel, 2005).

4.1.2.1 Individualism-collectivism

The individualism-collectivism dimension has received wide recognition as the quintessential marker of a society's prevalent mentality and culture (Oyserman et al., 2002;

Triandis, Bontempo, et al., 1988; Triandis & Gelfand, 1998). Conceptually, it describes "the relationship between the individual and the collectivity" (Hofstede, 2001, p. 209), in particular the "extent to which people are autonomous individuals or embedded in groups" (Triandis & Gelfand, 2012, p. 499). In collectivist cultures, people perceive themselves as closely linked to their in-group, they focus on the maintenance of harmonious interpersonal relations within the group, and are guided by norms and duties prevalent in the in-group. In individualist cultures, individual's dependence on support groups, especially family and acquaintances, is replaced by greater reliance on impartial institutions and universal norms, thus affording liberation from obligations to the extended family. Communal affiliations and commitments are no longer imposed but rather chosen. Analogously, instead of fulfilling the expectations of others, people focus on their individual goals and independence (Hofstede, 2001; Oyserman et al., 2002; Triandis, 1995; Welzel, 2013). Individualistic societies exhibit high tolerance of deviation from specific in-group norms, and tend to deemphasize conformity and obedience (Hofstede, 2001; Triandis, 2001). In collectivistic cultures, the ingroup-outgroup distinction is relatively stronger than in individualistic cultures (Markus & Kitayama, 2010). For this reason, collectivism can be characterized, at face, by positivity towards the ingroup (ingroup favoritism) and negativity towards outgroups (outgroup discrimination). The relationship between ingroup favoritism and the individualism-collectivism dimension is pertinent to this study and discussed in greater detail in subsequent parts of the current dissertation.

4.1.2.2 Ingroup favoritism

Societies and smaller groups, including sport organizations and sport teams, differ in how they discriminate between ingroup and outgroup members (Hewstone et al., 2002). Discrimination between ingroups and outgroups was already revealed in classic social psychology studies (e.g., Allport, 1954; Sherif et al., 1961; Summer, 1906; Tajfel et al., 1971). More specifically, research has found that people tend to evaluate ingroup members more positively than outgroup members. (Brewer, 1979; LeVine & Campbell, 1972; Mullen et al., 1992), tend to reward ingroup members more favorably (Tajfel et al., 1971), and work harder to accomplish ingroup goals (Ellemers et al., 2004; Worchel et al., 1998).

Ingroup favoritism has been profusely investigated in cross-cultural psychology, but the work of Van de Vliert appears particularly pertinent to this dissertation in that it offers theoretically grounded links to climate. In a series of studies, Van de Vliert (2011) showed that national cultures differ in baseline levels of ingroup favoritism. Specifically, in a 73-nation study of *compatriotism* (i.e., the social branch of patriotism), a 116-nation study of *nepotism* (i.e., the appointment of relatives as holders of senior management positions), and a 57-nation study of *familism* (i.e., the mutual identification and reciprocal housing of parents and children from GLOBE), all three measures/variables (compatriotism, nepotism and familism) were found to be stronger in lower-income countries with demanding cold or hot climates, moderate in countries with temperate climates irrespective of income per head, and weakest in higher-income countries with demanding cold or hot climates (Van de Vliert, 2011). Subsequent factor analysis revealed that these three variables represent the latent variable of *cultural ingroup favoritism* used in this study. More recently, Van de Vliert (2018) demonstrated that ingroup-outgroup discrimination and intergroup conflict management vary more along the north-south (latitudinal) axis than along the east-west axis of the Earth. His latitudinal theory of intergroup differentiation was further supported by evidence from five studies, which explored the extent of differentiation between “we-groups” (*us*) and “they-groups” (*them*) along latitude rather than longitude (Van de Vliert, 2019). Van de Vliert’s research proved instrumental for the design of this study in affording the means to operationalize ingroup favoritism as a country level predictor.

4.1.2.3 Self-expression and traditionalism

The values of *self-expression* and *traditionalism* were first coined by Inglehart within his theory of cultural change (Inglehart, 1990, 1997). This theory illuminates two key social processes, peaceful (vs. in the course of war) accumulation of wealth by societies and their secularization. Inglehart postulated that society's prevailing value orientations reflect an interaction between the driving forces of modernization, reflected in the shift from industrial to postindustrial society, and the retarding influence of tradition (Inglehart & Welzel, 2005). While industrial structures require rational, hierarchical forms of organization and deferential attitudes toward authority, in a service-dominated, postindustrial economy, information processing and communication gain more central ground (Beugelsdijk & Welzel, 2018; Inglehart, 1997; Inglehart & Welzel, 2005). As a result, values such as self-expression and autonomy advance to replace self-restraint and obedience (Inglehart, 1990, 1997; Inglehart & Welzel, 2005). The increased importance of individual self-determination brings along emphasis on freedom of choice and equal opportunities, consequently promoting the rise of emancipative values (Welzel, 2013). The Inglehart-Welzel world map of cultures encompasses two orthogonal dimensions: (1) survival vs. self-expression and (2) traditional vs. secular/rational. The original orthogonality of these dimensions has dissipated over time, specifically following the political transformation of post-communist countries (Boski, 2022). Currently, self-expression and rational power are correlated. The first dimension taps a humanistic ethos emphasizing autonomy and choice, tolerance and trust, subjective well-being, civic activism and self-expression that emerges in postindustrial societies with high levels of existential security and individual autonomy. At the opposite pole, societies characterized by existential insecurity and rigid social constraints in human autonomy tend to emphasize economic and physical security above all, inadvertently leading to greater intolerance toward outgroups, insistence on traditional conceptions of social functioning (e.g., traditional gender roles) and an authoritarian political outlook (Inglehart-Welzel, 2005). As survival becomes less relevant, cultural diversity gains greater acceptance to the extent that it is not merely tolerated but, beyond a certain point, becomes positively valued for its stimulating novelty (Inglehart-Welzel, 2005).

Connecting the WVS cultural dimensions to *thermal climate*, Van de Vliert (2009) proposed a tripolar perspective encompassing the original WVS values of survival vs. self-expression as salient points of culture, and added a third mid-point titled *easygoingness*. He suggested that survival and self-expression cultures tend to be secular-traditional in more demanding climates, whereas easy-going cultures tend to be religious-traditional in more temperate climates (Van de Vliert, 2009). He further explored cooperative behaviors claiming that societies faced with climatic demands matched by abundant money resources will evolve less selfish and more prosocial (helping, altruistic behaviors) ways of interaction, striving to turn threats into opportunities and stress into relief. However, Van de Vliert's model fails to explain why some of these countries are wealthy whilst others remain poor. The cooperative orientation of societal members is a reflection of overall self-expression, and is more likely to produce cooperative enculturation of the following generations. In line with this framework, research on leadership behaviors has found that less cooperative teamwork is exhibited in poorer countries in more demanding climates, but more cooperative teamwork in richer countries in the same climates (Wendt et al., 2003). Cooperative behaviors are also a pervasive feature of sports teams, and as such present a point of interest in this study. They are also linked to notions of cultural ingroup favoritism and intragroup discrimination as outlined above.

4.1.2.4 Sociocultural constraints: Relevance to this study

Four cultural value dimensions/values were used in this study as predictors of different styles of play in football: **ingroup collectivism**, **ingroup favoritism**, **self-expression** and

traditional values. The overarching rationale for doing so is grounded in three theoretical perspectives. First and foremost, ecological dynamics offers compelling arguments to the effect that macro-level sociocultural constraints imprint on collective behaviors in sport (*see* 4.1. Introduction). Second, a number of research approaches within cross-cultural psychology, including Berry's ecocultural framework[74] (1976), emphasize the role of the physical and social context, in which humans operate, and illuminate the ecological and sociocultural factors that affect psychological outcomes such as values, attitudes and observable behaviors as well as specific competences adaptive to ecological niches. Third, approaching the context of sport as a natural experiment, as described above[75], affords ecological reasoning for transposing sociocultural orientations to group-level behavioral patterns. Finally, extant research and related empirical evidence provide ample opportunities for bridging psychological phenomena in terms of levels of analysis. Whereas the first two positions were presented in the preceding sections of this dissertation, the remainder of the current subsection elaborates on relevant literature to illustrate how cultural dimensions can be related to team behaviors in sport.

Ingroup collectivism

In general, there is a scarcity of studies in sport science that explore the impact of cultural dimensions on sporting activity. Related research focuses exclusively on Hofstede's (2001) individualism-collectivism[76] dimension in the context of performance. In light of criticism of Hofstede's data, the author uses the *ingroup collectivism* measure from the GLOBE study. This measure of cultural practices demonstrates high construct validity, and is

[74] The ecocultural framework has been influenced by various ways of thinking about how behavioral, cultural and ecological phenomena might be related, as in the works of Malinowski (1922) and Rivers (1924).
[75] Refer to the section titled „Environmental constraints: Relevance to this study", subsection "Aggression and violence."
[76] In addition to literature on sports performance, research on football fandom has supplied empirical evidence on the association of national cultural and social characteristics and home advantage. It has been found that home advantage tends to be elevated in countries with high levels of collectivism and ingroup favoritism, where the rule of law is not strictly adhered to (Gelade, 2014; Kossakowski & Besta, 2018).

strongly negatively correlated with Hofstede's individualism (*r*=-.82; p<.01), positively correlated with Schwartz's (1994) embeddedness (*r*=.66, *p*<.01) and negatively correlated with Schwartz's intellectual / affective autonomy (*r*=-.59 / *r*=-.67 ; p<.01) (Gelfand et al., 2004).

Moreover, extant research in sport is guided by reductionist understanding of collectivity as a cultural value that is intrinsic to and imperative for team performance. To this effect, Maderer et al. (2014) argued that the importance of the group is paramount in football, exemplified in how the contemporary game has rendered strongly individualist positions such as the playmaker or sweeper completely obsolete due to their predictability. This stance resonates somewhat with recent findings by Lago and Lago-Peñas (2020), who showed that country-level collectivism and religiosity increase the number of penalties in the corresponding national soccer league. They proposed that the variation in the number of penalties across 30 national leagues in Europe from 2017 to 2020 is largely explained by the differing levels of tolerance toward individualized deception on the pitch. In other words, the more (less) collectivistic (individualistic) their culture, the higher the likelihood of footballers falling intentionally in the penalty area, so as to increase the chance of a foul being called. Drawing on the above research, the link between individualized pitch actions (e.g., duels/fouls, playmaker's passes, winger dribbling) and more individualistic game play can be hypothesized. Thus, theoretical arguments exist for testing the positive association between Hofstede's individualism (in the pilot study) or correspondingly the negative association between GLOBE's ingroup collectivism (in Study 3), on the one hand, and the two attacking-oriented styles (i.e., possession and constructive attacking), which are both characterized by prolific utilization of individualized player actions such as passes, crosses, and dribbling. It can also be argued that the constructive attacking style involving more sophisticated positional attacking would be dependent on the negative relationship with ingroup collectivism to a greater extent compared to the possession-based style.

Ingroup favoritism

As noted earlier, ingroup collectivism has been traditionally conceptualized as the anti-pole of individualism (Hofstede, 2001; Triandis, 1995). Closed groups are seen to develop conformity amongst insiders, which has disindividualizing effects. This is particularly pertinent to professional football, characterized by high levels of player migration between and within leagues (Poli et al., 2019). As a result, the tapestry of football on a global scale is woven with cultural diversity. Within a sports team, positive bias toward one's ingroup may promote the functioning and performance of one's group, translating into collaborative sporting behaviors (i.e., on-pitch tactical coordination). On the other hand, intergroup bias may create feelings of resentment in outgroups, resulting in conflict and hostility toward the discriminating outgroup. The latter can undermine not only social cohesion in a culturally diverse sports team, but also task-based performance in terms of accomplishing tactical goals. It can thus be hypothesized that ingroup favoritism as a cultural orientation can imprint on the behavioral repertoires of players and teams as the propensity to utilize particular collective behaviors. Depending on the baseline national level of ingroup favoritism, teams across leagues may be less prone to relying on styles of play that accentuate individualistic tactical behaviors, instead resorting to field behavioral patterns that involve increased cooperative decision making, with varying degrees of structural rigidity in endorsement. Thus, it can be theoretically justifiable to predict that ingroup favoritism will negatively affect styles of play typified by more role fluidity and flexibility on the pitch (i.e., possession and constructive attacking), and will positively affect playing styles with a more rigid and hierarchical organization of tactical behaviors (i.e., defensive and direct). Finally, and with reference to the following paragraph, it can be postulated that because behaviors and decisions are shaped by perceptions, or how people assess/value and perceive groups, theirs and others', cultural value orientations, such as those examined within the WVS, are central to how people define their groups.

WSV values: Self-expression and traditionalism

The WSV values have not been specifically examined in the context of sport. Cultural values/dimensions have generally attracted limited attention from sport scholars across disciplines. The only notable exceptions are sociological investigation of hegemonic masculinity in sport (e.g., Cleland, 2016; Magrath et al., 2020) or the impact of modern/postmodern values on football (Giulianotti, 1999). Notwithstanding the scarcity of relevant research, theoretically justifiable connections can be drawn between styles of play as patterned behavior and the two cultural dimensions identified by Inglehart, namely survival vs. self-expression and traditional vs. secular/rational[77]. Inglehart's modernization theory (Inglehart & Baker, 2000; Inglehart & Welzel, 2005) conceptualizes the prevalence of societal value orientations as reflecting the two-staged process of cultural modernization characterized first by growth of the industrial sector at the expense of the agrarian, and second, by growth of the service sector at the expense of the industrial or the rise of post-industrial society. With their emphasis on autonomous human choice, equality of opportunity and individual freedom, self-expression values illuminate the emancipation from authority, hierarchical rigidness, normativity of behavior and conformity, which are associated with more traditional values.

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[77] In 2013, Welzel proposed his emancipative theory founded on the conception of human empowerment, a process driven by emancipative values toward the liberation of people's agency. In their essence, emancipative values are meta values that have other values under their umbrella, including self-expression values. Overall, emancipative values are reminiscent of self-expression values in their emphasis on autonomy, freedom of choice and equality of opportunities. Methodologically, emancipatory values are organized in a *compository logic* that dictates combining elements not because they overlap empirically but because they complement each other conceptually (Welzel, 2013). In that sense, *compository logic* is more fitting to meta values, which are broader. Self-expression and traditional values, on the other hand, are constructed by combining elements into a summary scale, because elements are perceived as manifestations of an underlying dimension (Welzer, 2013), in other words, on the basis of *dimensional logic*. Given the dimensional design of this study, that is, combining elements from other influential frameworks (i.e., Hofstede's individualism and Van de Vliert's ingroup favoritism index), it was deemed as more methodologically appropriate to adopt measures organized according to a dimensional logic (i.e., self-expression and traditionalism).

The shifting balance between modernization and tradition can be observed in the way the game of football has historically evolved. As described earlier in this dissertation (see 1.3.2 Historical overview), industrialization brought about Fordist and Taylorist conceptions of game play organization, based on prescriptive tactical solutions both in defense and offense, naturally accompanied by rigid role specification that reduced personal autonomy. The origins of English “direct” football with teams instructed to play “the long ball” can be traced to this time period (Wilkinson, 1996). Similar tendencies were observed in other sports such as rugby. Industrialization brought about the adoption by British rugby clubs of production line principles, Taylorist methods as well as values associated with industrial labor such as physicality and masculinity (Collins, 2006), thus imprinting on how rugby was coached and played (Day & Carpenter, 2015; Smith & Davids, 1992). Analogously, the transition to post-industrial, service-oriented societies, has triggered the evolution of game styles to accommodate for the self-expression driven demands for increased autonomy, flexibility and role fluidity. Dutch total football, characterized by constant movement, positional realignment of players, an egalitarian organization of play, as well as greater opportunities for creativity and individual expression, is a prime example of the modernization of football. It can thus be hypothesized that the contemporary game has been shaped in part by sociocultural forces that hinge on value directedness along the two dimensions: (1) traditional vs. secular-rational and (2) survival vs. self-expression. In view of the above, theoretical merit can be claimed for the proposition that the defensive and direct, long ball styles identified in Study 1 are influenced by a prevailing societal orientation toward traditional values. Similarly, the possession based and constructive attacking styles are determined to a greater extent by self-expression values.

Cultural diversity

Despite societies and football teams becoming increasingly heterogenous in terms of cultural composition, the majority of research that examines the relationship between cultural dimensions and behavior has been conducted in relatively homogenous social contexts. Evidence on the impact of teams’ cultural diversity on sporting success can be found in the literature (see Study 2), yet the implications for the utilization of playing styles have not been empirically analyzed in published research. The findings of Study 2 provide compelling evidence for the role of CDI as a moderator of the relationship between styles of play and sporting outcomes, *that is*, positive for possession and attacking, and negative for defensive style. On this basis, it can be hypothesized that CDI is likely to moderate the relationship between styles of play as outcome variables, on the one hand, and cultural value dimensions on the other. The rationale for this reasoning is that the degree of teams’ cultural heterogeneity can strengthen or weaken the extent to which cultural orientations impact the utilization of particular styles of play. Migrant players, who transition between teams and leagues can simply replicate their repertoire of sporting behaviors shaped by cultural values that pertain to different social contexts, thus weaking dominant cultural practices (i.e., within the footballing domain) in the host location.

Thus, team cultural diversity can give rise to either stronger or weaker relationships between cultural values and styles of play (patterned behavior). Based on the literature (see section 4.1.2.4), the findings from Study 2, and the pilot study (see section 4.3), several hypotheses can be put forward. First, it can be hypothesized that CDI will negatively moderate the relationship between ingroup collectivism, on the one hand, and possession based and constructive attacking styles, on the other, and will positively moderate the relationship between ingroup collectivism and defensive style. Similarly, it is expected that CDI will moderate the negative relationship between ingroup favoritism, on the one hand, and the two offensive styles, on the one other, whilst moderating the positive relationship with defensive style. Lastly, CDI is likely to moderate the positive relationship between a traditional value orientation and defensive style, characterized by a more structured vs. fluid play. Likewise, CDI is expected to moderate the positive relationship between self-expression values and the two offensive playing styles. Given that teams' cultural diversity is significantly higher than that of the societies, in which they are nested, in this this study CDI (Cultural Diversity Index) is also introduced as a controlling variable or a multilevel moderator. In other words, the moderating role of CDI is expected to emerge directly in cross-level interactions with second level variables (e.g., ingroup collectivism, ingroup favoritism and traditional) or indirectly, with CDI being a first-level controlling variable in a two-level model. Concurrently, CDI's moderator role is hypothesized to materialize in the random slope variance for each style of play.

4.2 Research Aims

Extant research affords sufficient theoretical justification for embarking on a quest to seek out sociocultural explanations for cross-national variation in footballing styles of play. As previously noted, no studies to date have examined the impact of climatic and sociocultural variables, or cultural diversity on patterned behavior in football. For this reason, the current study is designed as an exploration rather than a hypotheses-driven confirmatory investigation. The theoretical frameworks on climate and culture described in section 4.1 "Introduction" as well as the pilot study results provide some support for tentative and preliminary hypothesizing regarding the choice of variables to be modeled as part of the two-level study design, with relevant justification detailed in the preceding section. The actual modeling procedure is outlined in greater detail in section 3.3 (Methodology). In summary, due to its scholarly novelty, the exploratory multilevel design of this study warrants the postulation of research questions of a more general nature, namely:

- *Research Question 1*: Does the average utilization of specific styles of play by teams vary across contexts (leagues)?
- *Research Question 2*: Does team cultural diversity (CDI) affect the variance in the utilization of particular styles of play across leagues? Or is there variability across leagues in the relationship between cultural diversity and reliance on particular styles of play?
- *Research Question 3*: Do climatic variables affect the utilization of particular styles of play across contexts (leagues)?
- *Research Question 4*: Do environmental or cultural features of the context (leagues) affect the relationship between team level variables and the utilization of particular styles of play? Or can contextual constraints explain the between-league variability?

In the following section, the pilot study is described, and its results are discussed solely in the context of hypothesis formulation for Study 3. Next, the methodological approach of Study 3 is fully explained. Specifically, justification for the study's two-level design is provided along with a description of the preliminary hypotheses driving the exploration into each of the three playing styles. Finally, the analytical plan is outlined along with a detailed specification of the modeling procedure including an algebraic representation of the final three models.

4.3 PILOT STUDY

4.3.1 Methodology: Sample, Measures, Procedure

The pilot study addressing the aforementioned research aims was conducted on the 21-league sample (Table 1), using MLM (hierarchical linear model), a technique that takes into account and controls for hierarchically nested data, and permits team- and league (country)-level predictors to explicate variance in the utilization of playing styles. Prior to MLM modeling, preliminary analysis was carried out to explore possible interaction effects between team level and league (country) level variables using the "slopes-as-outcomes" statistical procedure (Burstein et al., 1978). This two-step analytical approach is considered by some as the precursor of MLM. As a first step, the team level parameters were estimated within each league and used in a second step as response (dependent) variables predicted by league-level variables. Ordinary least squares was the estimation method applied in both steps. This preliminary analysis included a larger number of variables at both levels compared to what was ultimately selected for Study 3, such as Van de Vliert's *Us-Them Index* (2019), Gelfand's country scores for loose and tight cultures (Gelfand et al., 2011; Eriksson, 2021), Schwartz's cultural dimensions (i.e., embeddedness-autonomy and hierarchy-egalitarianism) as second level predictors. The results provided a general idea of the predictors of interest likely to produce statistically significant interaction effects. These predictors were consequently tested in the MLM models as explained below. The only significant interaction effect was found between HRI (country homicide rate index) and CDI (team cultural diversity index) in relation to defense style. Namely, HRI, after controlling for CDI, predicted greater reliance on defense style ($p<.05$).

Four dependent variables, representing the four styles of play identified in Study 1 on the smaller, 21-league sample, were tested, namely: (1) possession based, (2) constructive attacking, (3) defensive, and (4) direct, long-ball style. Four team level measures were specified: Cultural Diversity Index (CDI operationalized in Study 2), temperature, precipitation, and red cards booked per team in the 2018/19 season. Additionally, six league (country) level measures were selected: thermal heat (Van de Vliert, 2013), Homicide Rate Index (HRI), individualism (Hofstede, 2001), ingroup favoritism (Van de Vliert, 2011), self-expression and traditional values (WVS; Inglehart et al., 2014). A priori power calculations indicated that the pilot study is most probably underpowered. All data management (i.e., missing data imputation, grand mean centering) and statistical testing / REML-based modeling was conducted in R (R Core Team, 2020) and R Studio (RStudio Team, 2019). For each dependent variable (style of play) a bottom-up modeling strategy, comprised of four steps, was adopted. At the start, an intercept-only (null model) was run, and subsequently fixed and random parameters were added in each of the three steps. All models were tested for random slope effects of CDI, but none converged, possibly due to low statistical power. The same step-by-step procedure was used in Study 3 and is described in greater detail in section 4.4.5 (Analytical plan).

4.3.2 Results

Given the lack of strong theory and empirical evidence for the association between styles of play and various constraints (i.e., climatic and sociocultural), the pilot study was designed as exploratory. The moderating role of CDI was not specifically hypothesized, but surfaced in the course of modeling. Thus, the modeling procedure was not driven by, but merely informed by a number of hypothetical assumptions, or tentative and preliminary hypotheses. All models were compared using fit statistics and a final, optimal model for each style of play was selected. The results per style of play are detailed below.

Possession based style (Table 20)

Contrary to expectations, temperature and precipitation were found to be positively associated with the utilization of possession play. In other words, the higher average temperatures and levels of precipitation in the teams' main location, the greater the chance of these teams adopting a possession based playing style. Contrarily, the association between possession based style and CDI was found to be significant (p<.05) and negative, and this effect was sustained throughout all modelling stages. The cultural diversity of teams appeared as a significant contributor to the possession playing style in that teams, which were more culturally homogenous were also less likely to rely on this style. This was also in line with Study 2 findings. Contrary to predictions, no association between ingroup favoritism and possession based play was revealed, whereas a positive connection was confirmed with the cultural value dimensions of individualism and self-expression values. Although only the relationship between playing style and individualism carried statistical significance, the effect of these level two predictors was stronger when combined, increasing the explanatory power of the final model (Model 2). It could, therefore, be postulated that teams from countries with a predominant individualist orientation that lean towards the endorsement of self-expression values are more likely to utilize possession based play. The cross-level interactions tested (e.g., Model 3) neither illuminated significant relationships with possession based style, nor provided a better model fit for the data, although the difference between Model 2 and Model 3 was found to be insignificant (χ^2=0.538, p=0.463).

Constructive attacking style (Table 21)

Although climatic variables on their own did not significantly affect the utilization of constructive attacking, the presence of a signification interaction effect (p<.01) was discovered between the team level explanatory variables of CDI and precipitation. CDI was found to moderate the relationship between teams' propensity to rely on constructive attacking depending on whether their primary location is in regions with higher or lower precipitation. In other words, teams from cities/towns with higher annual levels of precipitation (i.e., rain and snow) were more likely to adopt a constructive attacking style, provided they were more culturally homogenous (less culturally diverse). In line with predictions, ingroup favoritism was negatively related to constructive attacking, although the relationship was rather weak. The effect of this explanatory variable was notably greater in constructive attacking (p=0.099) compared to possession based style (p=0.925), and was therefore retained in the final model equation. Finally, a negative but insignificant association was found between self-expression values and constructive attacking style.

Defensive style (Table 22)

As hypothesized, the use of defensive style significantly predicted the number of red cards booked by teams (p<.05), although surprisingly the direction of the relationship was contrary to expectations. Specifically, teams with a greater number of red cards were less likely to rely on defensive style. Moreover, in line with predictions, a positive association was discovered between thermal heat as a climatic variable and the utilization of defensive style (p<.05). That is, reliance on defensive style typified teams from countries with higher levels of thermal heat. Although a positive link was revealed between ingroup favoritism and defensive style, the underlying relationship was stripped of explanatory power when combined with traditional values. The latter negatively affected the use of defensive style, but the association was not statistically significant (p=0.062), and was only retained in the final model due to its contribution to explaining variance. The proportion of the variance explained by both fixed and random effects (conditional R^2) increased from 0.040 (Model 2) to 0.062 for (Model 3). Interestingly, the larger proportion of explained variance was found to be attributable to random effects, which identify between-league differences (random slope).

In line with predictions, CDI acted as a moderator of the positive relationship between defensive style and country-level aggressiveness operationalized as HRI (p<.01). Results showed that teams from countries with greater aggression levels, measured by means of HRI, were more likely to adopt a defensive style, provided their cultural composition leaned towards greater homogeneity. To sum up, results showed that greater reliance on defensive style is linked to teams that play in countries (leagues), which score lower on traditionalism, as well as those characterized by higher levels of thermal heat and aggression. However, the number of red cards booked per season by teams emerged as a negative predictor of defense style utilization. Finally, the connection between defensive style and aggression was moderated by CDI, implying that it is more relevant to culturally homogenous vs. culturally heterogenous teams. Cultural diversity, therefore, weakened the predictive effect of country level explanatory variables such as annual homicide rate.

Direct, long ball style (Table 23)

When testing the effect of climatic variables on the use of direct, long ball style, temperature was dropped from Model 1, given its lack of association with the outcome (p=0.866), whilst precipitation was retained due to its greater predictive power. Contrary to expectations, a negative relationship was revealed between direct, long-ball style and the country level cultural dimensions of traditionalism (p=0.051) and ingroup favoritism (p<.05). Results suggested that teams from countries with a greater inclination towards the endorsement of traditional values and a stronger orientation towards ingroup favoritism, are less likely to rely on direct, long ball style. Interestingly, an interaction effect surfaced between ingroup favoritism and precipitation. It was found that precipitation acted as a moderator of the relationship between the use of direct, long-ball style and ingroup favoritism. In other words, teams from countries with lower scores on ingroup favoritism were more likely rely on direct, long ball play, however, this being conditional on precipitation. Namely, less precipitation seems to decrease the likelihood of adopting a more pronounced long ball style. As noted earlier, the positive association between direct, long ball style and precipitation appeared greater in countries with a less traditional orientation. The relationships between the outcome (i.e., style) on the one hand, and the combined effect of the cross-level interaction (i.e., ingroup favoritism and precipitation) and the second level predictor (i.e., traditionalism) on the other, was moderated by the effect of CDI. In other words, the aforementioned relationships were stronger in the case of culturally homogenous teams, although the overall controlling effect was not statistically significant. Compared to other styles, the final model for direct, long ball play provided the highest explanatory power, with 10.4% of the variance explained by fixed and random effects, and 5.3% of the variance explained solely by random effects.

Table 20: Modeling results for **possession based** style

Model:	**Null Model**	**Model 1: add fixed effects (L1)**	**❋Model 2: add fixed effects (L2)**	**Model 3: add cross-level interactions**
Level 1: team level				
Intercept (γ_{00})	0.621*** (0.123)	0.621*** (0.023)	0.620*** (0.022)	0.619*** (0.022)
CDI (γ_{10})		**-0.270* (0.133)**	**-0.270* (0.133)**	**-0.260* (0.133)**
Level 2: league(country) level				
Individualism (γ_{01})			**0.003* (0.001)**	0.003 (0.001)
Self-expression values (γ_{02})			-0.031 (0.033)	-0.031 (0.033)
Cross-level interaction				
CDI*Self-expression				-0.112 (0.153)
Residual variance				
Level 1 variance (ε_{ij})	0.065 (0.256)	0.065 (0.255)	0.065 (0.025)	0.065 (0.254)
Level 2 variance (u_{0j})	0.005 (0.071)	0.005 (0.065)	0.004 (0.066)	0.004 (0.065)
Number of teams	375	375	375	375
Number of leagues	21	21	21	21
AIC	66.348	65.286	51.142	52.545
BIC	78.128	84.921	77.068	82.175
logLik	-30.2	-21.3	-19.0	-18.8
Deviance	60.4	42.6	38.1	37,5
R^2 conditional	0.054	0.068	0.083	0.085
R^2 marginal	0.000	0.013	0.043	0.045
ICC(adj.)	0.054	0.056	0.042	0.043

Notes: *p<0.05*;* **p<0.01***;* ***p<0.001; ❋optimal model.

Table 21: Modeling results for **constructive attacking** style

Model:	**Null Model**	**Model 1: add fixed effects (L1)**	**Model 2: add fixed effect interactions (L1)**	**❈Model 3: add fixed effects (L2)**
Level 1: team level				
Intercept (γ_{00})	0.584*** (0.015)	0.584*** (0.015)	0.582*** (0.014)	0.582*** (0.014)
CDI		-0.122 (0.110)	-0.138 (0.109)	-0.138 (0.109)
Precipitation		-0.600 (0.523)	-0.597 (0.519)	-0.600 (0.519)
Level 1: team level interactions				
CDI* Precipitation (γ_{10})			**15.039** (5.806)**	**14.991** (5.809)**
Level 2: league(country) level				
Ingroup favoritism (γ_{01})				-0.013 (0.014)
Residual variance				
Level 1 variance (ε_{ij})	0.060 (0.245)	0.060 (0.245)	0.059 (0.243)	0.059 (0.243)
Level 2 variance (u_{0j})	0.001 (0.032)	0.001 (0.032)	0.001 (0.032)	0.000 (0.030)
Number of teams	375	375	375	
Number of leagues	21	21	21	
AIC	20.490	21.867	17.144	18.189
BIC	32.270	41.501	40.706	45.677
logLik	-7.245	-5.933	-2.572	-2.0943
Deviance	14.490	11.867	5.144	4.187
R^2 conditional	0.017	0.024	0.041	0.042
R^2 marginal	0.000	0.007	0.024	0.027
ICC(adj.)	0.017	0.017	0.017	0.015

Notes: *p<0.05; **p<0.01**; ***p<0.001; ❈optimal model.

Table 22: Modeling results for **defensive** style

Model:	**Null Model**	**Model 1: add fixed effects (L1)**	**Model 2: add fixed effects (L2)**	**❋Model 3: add cross-level interactions**
Level 1: team level				
Intercept (γ_{00})	0.645 (0.016)***	0.645*** (1.698)	0.645*** (0.014)	0.645*** (0.014)
Red cards (γ_{10})		-0.234 (0.202)	-0.386 (0.202)	**-0.423* (0.202)**
Temperature		-0.806 (0.559)		
CDI				0.074 (0.123)
Level 2: league(country) level				
Homicide Rate Index (HRI)			-0.025 (0.014)	-0.025 (0.014)
Traditional values (γ_{01})			-0.037 (0.020)	-0.037 (0.020)
Thermal heat (γ_{02})			**0.009* (0.004)**	**0.009* (0.004)**
Cross-level interaction				
CDI*HRI (γ_{20})				**0.0308** (0.111)**
Residual variance				
Level 1 variance (ε_{ij})	0.069 (0.263)	0.069 (0.262)	0.068 (0.261)	0.067 (0.260)
Level 2 variance (u_{0j})	0.002 (0.040)	0.002 (0.046)	0.000 (0.019)	0.000 (0.021)
Number of teams	375	375	375	375
Number of leagues	21	21	21	21
AIC	73.381	76.101	71.547	64.475
BIC	85.162	95.736	95.109	99.818
logLik	-33.691	-33.051	-29.774	-23.238
Deviance	67.381	66.101	59.494	46.475
R_2 conditional	0.023	0.034	0.040	0.062
R_2 marginal	0.000	0.004	0.023	0.055
ICC(adj.)	0.023	0.030	0.018	0.006

Notes: *p<0.05; **p<0.01**; ***p<0.001; ❋optimal model.

Table 23: Modeling results for **direct, long ball** style

Model:	**Null Model**	**Model 1: Add fixed effects (L1)**	**Model 2: add fixed effects (L2)**	**❋Model 3: add cross-level interactions**
Level 1: team level				
Intercept (γ_{00})	0.587 (0.020)***	0.587*** (0.020)	0.588*** (0.020)	0.589*** (0.018)
CDI (γ_{10})		0.174 (0.112)	0.173 (0.112)	0.177 (0.112)
Precipitation		0.929 (0.534)	0.929 (0.534)	0.085 (0.532)
Level 2: league(country) level				
Traditional/Secular values (γ_{01})			-0.023 (0.020)	-0.040 (0.021)
Ingroup favoritism				**-0.042* (0.020)**
Cross-level interaction				
Precipitation*Ingroup favoritism (γ_{20})				**1.410* (0.632)**
Residual variance				
Level 1 variance (ε_{ij})	0.063 (0.252)	0.063 (0.250)	0.063 (0.250)	0.062 (0.249)
Level 2 variance (u_{0j})	0.005 (0.067)	0.005 (0.068)	0.004 (0.067)	0.003 (0.006)
Number of teams	375	375	375	375
Number of leagues	21	21	21	21
AIC	51.405	49.815	50.462	44.870
BIC	63.186	69.449	74.024	76.286
logLik	-22.703	-19.907	-19.231	-14.435
Deviance	45.405	39.815	38.462	28.870
R^2 conditional	0.067	0.081	0.086	0.104
R^2 marginal	0.000	0.014	0.021	0.053
ICC(adj.)	0.067	0.068	0.067	0.053

*Notes: *p*<0.05*; **p*<0.01**; ***p*<0.001; ❋optimal model.

4.3.3 Conclusions

The pilot study tested tentative and preliminary hypotheses with the aim of facilitating the process of hypotheses formulation for Study 3 rather than providing explanations for the results. For each playing style (i.e., dependent variable), four optimal model equations were developed as follows:

(1) Possession style

$Y_{\text{ij}} = \gamma_{00} + \gamma_{10}\boldsymbol{CDI}_{ij} + \gamma_{01}\boldsymbol{individualism}_{ij} + \gamma_{02}\boldsymbol{self\ expression}_{ij} + u_{0j} + \varepsilon_{ij}$

(2) Constructive attacking

$Y_{\text{ij}} = \gamma_{00} + \gamma_{10}\boldsymbol{CDI*precipitation}_{ij} + \gamma_{01}\boldsymbol{ingroup\ favoritism}_{ij} + u_{0j} + \varepsilon_{ij}$

(3) Defensive style

$Y_{\text{ij}} = \gamma_{00} + \gamma_{10}\boldsymbol{red\ cards}_{ij} + \gamma_{20}\boldsymbol{CDI*HRI}_{ij} + \gamma_{01}\boldsymbol{traditionalism}_{ij} + \gamma_{02}\boldsymbol{thermal\ heat}_{ij} + u_{0j} + \varepsilon_{ij}$

(4) Direct, long-ball style

$Y_{\text{ij}} = \gamma_{00} + \gamma_{10}\boldsymbol{CDI}_{ij} + \gamma_{20}\boldsymbol{precipitation*ingroup\ favoritism}_{ij} + \gamma_{01}\boldsymbol{traditionalism}_{ij} + u_{0j} + \varepsilon_{ij}$

The results of hypotheses testing are summarized in Table 24. Most notably and in line with Study 2, the moderating role of CDI was confirmed in relation to all playing styles. This role transpired when CDI entered into interactions with other level 1 (i.e., precipitation) and level 2 (i.e., HRI) variables, as well as when CDI acted as a control variable in a two-level model design. CDI’s indirect effect was also tested by introducing random slope parameters for CDI, but none of the models converged due to low power. Therefore, further testing of CDI’s direct (as a first level predictor) and indirect (in cross-level interactions and in varying/random slopes) moderating role is warranted in Study 3. A number of other hypotheses require further testing due to inconsistent results or difficulties in offering compelling explanations. For instance, the direction of effects for temperature, precipitation and red cards on playing styles did not align with expectations, necessitating renewed testing on a larger sample. The effects of second level predictors were fully (i.e., individualism) or partially confirmed (e.g., ingroup favoritism, traditional values), thus legitimizing further analysis. The specific hypotheses tested in Study 3 are detailed in section 4.4.3 of the dissertation. They were derived based on the results of Study 2, specifically in relation to CDI’s moderating role, the findings of the pilot study, and related research summarized in section 4.1.

Table 24. Pilot study hypotheses, findings and suggestions for further testing.

	Pilot stydy hypotheses	**Status**	**Findings**	**Further testing in Study 3**
(1)	Temperature (L1) is negatively associated with possession and constructive attacking styles.	Rejected	***Possession***: (1) positive association; (2) not significant (*p*=0.365); ***Constructive attacking***: (1) positive association; (2) not significant (*p*=0.159)	Temperature (L1) is negatively associated with possession and constructive attacking styles, and is positively associated with defensive style.
(2)	Precipitation (L1) is positively associated with defensive and direct, long-ball styles.	Rejected	***Defensive***: (1) negative association; (2) not significant (*p*=0.882); ***Direct***: (1) positive association; (2) not significant (*p*=0.082)	Precipitation (L1) is positively associated with possession and attacking styles, and negatively associated with defensive style.
(3)	Thermal heat (L2) is positively and significantly associated with defensive style.	Confirmed	***Defensive***: (1) positive and significant (*p*<0.05) association	Thermal heat (L2) is positively and significantly associated with defensive style.
(4)	The number of red cards (L1) booked per team is positively associated with defensive style.	Rejected	***Defensive***: (1) negative and significant (*p*<0.05) association	The number of yellow cards (L1) is negatively and significantly associated with possession and constructive attacking styles, and positively and significantly associated with defensive style.
(5)	Cultural heterogeneity (low CDI; L1) is negatively associated defensive and direct, long-ball style and positively associated with possession and constructive attacking styles.	Confirmed	**Defensive & direct**: (1) negative association; (2) not significant (*p*=0.547; *p*=0.112); **Possession & constructive attacking**: (1) positive association; (2) significance (*p*<0.05; *p*=0.207)	Cultural heterogeneity (L1; lower CDI) is significantly and positively associated with reliance on possession and constructive attacking styles, and significantly and negatively associated with reliance on defensive style.
(6)	Aggression and violence levels per country, measured by HRI (L2), are positively associated with defensive style.	Rejected	**HRI:** (1) negative association; (2) not significant (*p*=0.078) but **CDI*HRI**: (1) positive association; (2) significant (*p*<0.01)	CDI (L1) significantly and positively moderates the effect of HRI (L2) on defensive style.
(7)	Individualism (L2) significantly and positively contributes to the utilization of possession based style.	Confirmed	**Individualism**: (1) positive association; (2) significant (*p*<0.05)	Ingroup collectivism (L2) has a significant negative impact on the utilization of possession and attacking styles, either as a single-variable predictor or in interaction with CDI.
(8)	Ingroup favoritism (L2) significantly and negatively contributes to the utilization of possession and constructive attacking styles.	Partially confirmed	***Possession***: (1) negative association; (2) not significant (*p*=0.925); ***Constructive attacking***: (1) negative association; (2) not significant (*p*=0.099)	Ingroup favoritism (L2) negatively impacts reliance on possession and constructive attacking styles, but is not a significant predictor.
(9)	Ingroup favoritism (L2) significantly and positively contributes to the utilization of defensive and direct, long-ball styles.	Partially confirmed	***Defensive***: (1) positive association; (2) not significant (*p*=0.083); ***Direct***: (1) negative association; (2) significant (*p*<0.05)	Ingroup favoritism (L2) significantly and positively contributes to the utilization of defensive style as a single-variable predictor or in interaction with CDI.
(10)	Self-expression values (L2) significantly and positively contribute to the utilization of possession based and constructive attacking styles.	Partially confirmed	***Possession***: (1) negative association; (2) not significant (*p*=0.406); ***Constructive attacking***: (1) negative association; (2) not significant (*p*=0.164)	Self-expression values (L2) negatively contribute to the utilization of possession-based and constructive attacking styles but are not significant predictors.
(11)	Traditional values (L2) significantly and positively contribute to the utilization of defensive and direct, long-ball styles.	Partially confirmed	***Defensive***: (1) negative association; (2) not significant (*p*=0.226); ***Direct***: (1) negative association; (2) significant (*p*=0.051)	Traditional values (L2) significantly and positively contribute to the utilization of defensive style as a single level predictor or in interaction with CDI.

4.4 METHODOLOGY

4.4.1 Method

Analyses were conducted with MLM (hierarchical linear model), which allows for team- and league(country)-level predictors to explicate variance in the utilization of playing styles, thus addressing the study's aims outlined in section 4.2. The use of MLM is substantiated below.

The traditional alternatives to MLM are typically based on some type of ordinary least squares analysis (OLS) involving *complete pooling*, which ignores differences between groups (i.e., typically some type of ordinary least squares analysis (OLS)), and *no-pooling*, in which data from different sources are analyzed separately (Gelman & Hill, 2020). The latter disregards information and can give unacceptably variable inferences, while complete pooling suppresses variation that can be important or even constitute the main goal of a study. The extreme alternatives can in fact be useful as preliminary estimates, but ultimately partial pooling inherent in MLM is most appropriate for cross-cultural studies. To this effect, it has been argued that it is inappropriate to draw conclusions about within-culture relationships from between-culture analysis (Nezlek, 2010). Moreover, in classical regression, estimates of varying effects can be noisy, especially when there are few observations per group as in the case of the limited number of teams per league. Multilevel modeling allows the estimation of group averages and group-level effects, compromising between the overly noisy within-group estimates and the oversimplified regression estimate that ignores group indicators (Gelman & Hill, 2020). Finally, statistical theory postulates that if data sets are collected within an inherent multilevel structure (e.g., teams nested in leagues), MLM analysis techniques should be the preferred choice, especially if the focus of the research questions is on the between-group differences as outlined in the present research aims. In this regard, simulation studies suggest that when the number of groups is small, it may be difficult to estimate the between-group variation, resulting in MLM performing similarly to OLS models (Geland & Hill, 2020). However, MLM affords greater flexibility and a nuanced interpretation that accounts for cross-cultural differences between groups (i.e., leagues) rather than simple generalization based on selecting one group as a baseline category.

MLM traditionally involves two types of research strategies: data-driven and theory-driven. In the absence of strong theories, a data-driven exploratory procedure can be employed to select a model (Hox et al., 2018). Given the lack of prior quantitative research examining the impact of climatic and cultural factors/constraints on the utilization of playing styles in football, the author opted for a data-driven exploratory analysis to test their potential effects (i.e., fixed, random and interactions) on dominant playing styles across selected leagues.

To conclude, in this study MLM allows to disentangle relationships between styles of play and various measures (e.g., ecological, cultural, etc.) at multiple levels of analysis. For example, why are teams from league A more likely to play defensive football? In other words, to what extent the hypothesized determinants of playing styles, affect their utilization within and between leagues. For example, is it because they have greater exposure to higher ambient temperatures, or is it because they are located in societies with a more traditional value orientation? The relationships may be stronger in some leagues than in others. As outlined in the study’s aims (section 4.2), the author’s primary interest is in explaining between-league differences in collective team behaviors. In this way, the author seeks to garner empirical evidence illustrating the embodiment of environmental and sociocultural aspect of life in the way football is played.

4.4.2 Measures

Dependent variable

Three dependent variables were used, each denoting the playing style identified in Study 1, namely (1) possession-based, (2) constructive attacking, and (3) defensive.

Team level measures

Cultural Diversity Index (CDI). This measure was taken from Study 1. CDI values range from 0 to 1, with values closer to 0 reflecting higher cultural heterogeneity of teams (greater concentration of non-domestic players) and values closer to 1 reflecting greater cultural homogeneity (greater concentration of domestic players).

Temperature and precipitation. These two measures were operationalized as the average temperature and average precipitation (averaged across 2020 and 2021) in the primary location (city/town) of particular clubs (teams). It was assumed that teams spend most of their time training there and, therefore, are most likely to be affected by the climatic factors that prevail in that location. Relevant data was retrieved from https://power.larc.nasa.gov/data-access-viewer/, containing data from the National Aeronautics and Space Administration (NASA) funded Prediction of Worldwide Energy Resource (POWER) project. Missing data for specific locations (e.g., certain cities in China) were substituted with available data in locations in close geographic proximity.

Yellow cards. This measure was obtained by aggregating the total number of yellow cards booked per team in the 2020/2021 season. The relevant information was retrieved from the Wyscout platform referred to in Study 1 of this dissertation. A number of authors have used red and yellow cards to asses if violent and aggressive behavior in society is reflected in the soccer field (e.g., Caruso & Di Domizio, 2013; Caruso et al., 2017; Cuesta & Bohórquez, 2012; Miguel et al., 2008)

League(country) level measures

Thermal heat. Sum of the upward deviations from 22 degrees C for the average lowest and average highest temperature in the coldest month, and the average lowest and highest temperatures in the hottest month (source: Van de Vliert, 2013; downloadable from www.rug.nl/staff/e.van.de.vliert, Projects).

Homicide Rate Index (HRI). HRI measures the number of victims of intentional homicide per 100.000 population (2018). Relevant information was retrieved from the United National Office on Drugs and Crime (https://dataunodc.un.org/content/data/homicide/homicide-rate). The missing value for the Czech Republic was substituted with 2017 data. The HRI was log transformed to reduce skewed distribution.

In-group collectivism. National scores for in-group collectivism were taken from the GLOBE study of 62 societies (House et al., 2004).

In-group favoritism. It is an integrated index derived by Van de Vliert (2011) based on survey data across 120 countries from three studies on compatriotism, familism and nepotism (Cronbach's α = .89). Country scores were assigned to each league depending on location (see section 4.1.2.2).

Self-expression and traditional values (WVS). Data were retrieved from the 6th wave of the WVS (Inglehart et al., 2014).

4.4.3 Hypotheses

Despite the dearth of relevant past research, the modeling procedure was guided and informed by the theoretical frameworks and non-sport related research described in the Introduction (4.1), in addition to the results of Study 2 and the pilot study. On this basis and in view of the exploratory vs. confirmatory nature of the study, tentative and preliminary hypotheses were postulated to address the four research questions, with corresponding theoretical justification provided in the subsections, which highlight relevance to this study (see 4.1.1.3 and 4.1.2.4). These are summarized in Table 25, and the hypotheses models are illustrated in *Figures 25*, *26* and *27*. Note that the directional hypotheses regarding temperature and precipitation do not specify significance, as there was no basis to assume significance pursuant to the results of the pilot study (see pilot study result summarized in Table 24).

Another clarification is warranted regarding the formulation of the CDI moderation hypotheses 5.7 up to 5.14 and 6. In multilevel designs, it is most usual for the contextual (i.e., higher-level) variable to moderate the relationship between lower level variables (Aguinis et al., 2013). From a purely statistical viewpoint, it is just as appropriate to label the L2 predictor as the moderator of the effect of the L1 predictor *X* on the L1 outcome *Y*, as it is to label the L1 predictor *X* as the moderator of the effect of the L2 predictor *W* on the L1 outcome *Y*. In this study, the latter, less common option was adopted to formulate hypotheses and interpret the findings. Specifically, hypotheses 5.7 through 6 tested the moderation effect of the L1 variable CDI on the relationship between different L2 predictors (i.e., ingroup collectivism, ingroup favoritism, HRI, self-expression and traditional values) and team's reliance on particular styles of play. While the empirical results are the same, the theoretical implications of causality are not equivalent (Andersson et al., 2014). Whereas there are no hard and fast rules, methodologists have recommended stipulation of direct effects in addition to the indirect moderation effects. For instance, the baseline hypothesis (for direct effects) may be grounded in well-known cross-cultural theory, with the contribution to the literature coming from a modification of the expected relationship based on insights from diversity theory, which operates at the lower level. In this study, the direct effects are tested by hypotheses 7.1 through 9.3, whereas the indirect, moderation effects are posited in hypotheses 5.7 through 6. In other words, the choice of interpreting *W* (e.g., ingroup collectivism) or *X* (i.e., CDI) as the moderator is based on conceptual reasons. The author argues that, if conceptualized as a contingency hypothesis, moderation can be used to examine the boundaries and limitations of a theory (Boyd et al., 2012). Thus, the constraints of various cross-cultural theories, such as those described in section 4.1 (e.g., theory of modernization and emancipation; Welzel, 2013) can be tested by investigating how the interaction with CDI changes the *mechanisms* (i.e., strengthening/weaking the main effect) that explain the direct relationship with the outcome, *that is*, playing style utilization. Therefore, the study's hypotheses, interpretation and graphic representation of the CDI interactions are consistent with the theoretically grounded direction of the moderating relationship (Aguinis et al., 2013).

Table 25. List of Study 3 hypotheses.

Study 3 hypotheses	
(1.1)	Temperature (L1) is negatively associated with possession style.
(1.2)	Temperature (L1) is negatively associated with constructive attacking style.
(1.3)	Temperature (L1) is positively associated with defensive style.
(2.1)	Precipitation (L1) is positively associated with possession and attacking styles, and negatively associated with defensive style.
(2.2)	Precipitation (L1) is positively associated with constructive attacking style.
(2.3)	Precipitation (L1) is negatively associated with defensive style.
(3)	Thermal heat (L2) is positively and significantly associated with defensive style.
(4)	The number of yellow cards (L1) is negatively and significantly associated with possession and constructive attacking styles, and positively and significantly associated with defensive style.
(5.1)	Greater cultural heterogeneity (lower CDI; L1) is significantly and positively associated with possession style (direct effect).
(5.2)	Greater cultural heterogeneity (lower CDI; L1) is significantly and positively associated with constructive attacking style (direct effect).
(5.3)	Greater cultural homogeneity (lower CDI: L1) is significantly and negatively associated with defensive style (direct effect).
(5.4)	There is significant variability across leagues in the effect of cultural diversity (CDI; L1) on the utilization of possession style (indirect effect, random slope).
(5.5)	There is significant variability across leagues in the effect of cultural diversity (CDI; L1) on the utilization of constructive attacking style (indirect effect, rando slope).
(5.6)	There is significant variability across leagues in the effect of cultural diversity (CDI; L1) on the utilization of defensive style (indirect effect, random slope).
(5.7)	Cultural diversity (CDI; L1) moderates the negative association between ingroup collectivism and possession style.
(5.8)	Cultural diversity (CDI; L1) moderates the negative association between ingroup favoritism and possession style.

(5.9)	Cultural diversity (CDI; L1) moderates the positive association between self-expression values and possession style.
(5.10)	Cultural diversity (CDI; L1) moderates the negative association between ingroup collectivism and constructive attacking style.
(5.11)	Cultural diversity (CDI; L1) moderates the negative association between ingroup favoritism and constructive attacking style.
(5.12)	Cultural diversity (CDI; L1) moderates the positive association between self-expression and constructive attacking style.
(5.13)	Cultural diversity (CDI; L1) moderates the positive association between ingroup favoritism and defensive style.
(5.14)	Cultural diversity (CDI; L1) moderates the positive association between traditional values and defensive style.
(6)	Cultural diversity (CDI; L1) moderates the positive association between HRI and defensive style.
(7.1)	Ingroup collectivism (L2) has a negative impact on the utilization of possession style.
(7.2)	Ingroup collectivism (L2) has a negative impact on the utilization of constructive attacking style.
(8.1)	Ingroup favoritism (L2) has a negative impact on the utilization of possession style.
(8.2)	Ingroup favoritism (L2) has a negative impact on the utilization of constructive attacking style.
(8.3)	Ingroup favoritism (L2) has a positive impact on the utilization of defensive style.
(9.1)	Self-expression values (L2) have a positive impact on the utilization of possession style.
(9.2)	Self-expression values (L2) have a positive impact on the utilization of constructive attacking style.
(9.3)	Traditional values (L2) have a positive impact on the utilization of defensive style.

Figure 25. Hypotheses involving team level (L1) variables (hypotheses 1.1 through 2.3).

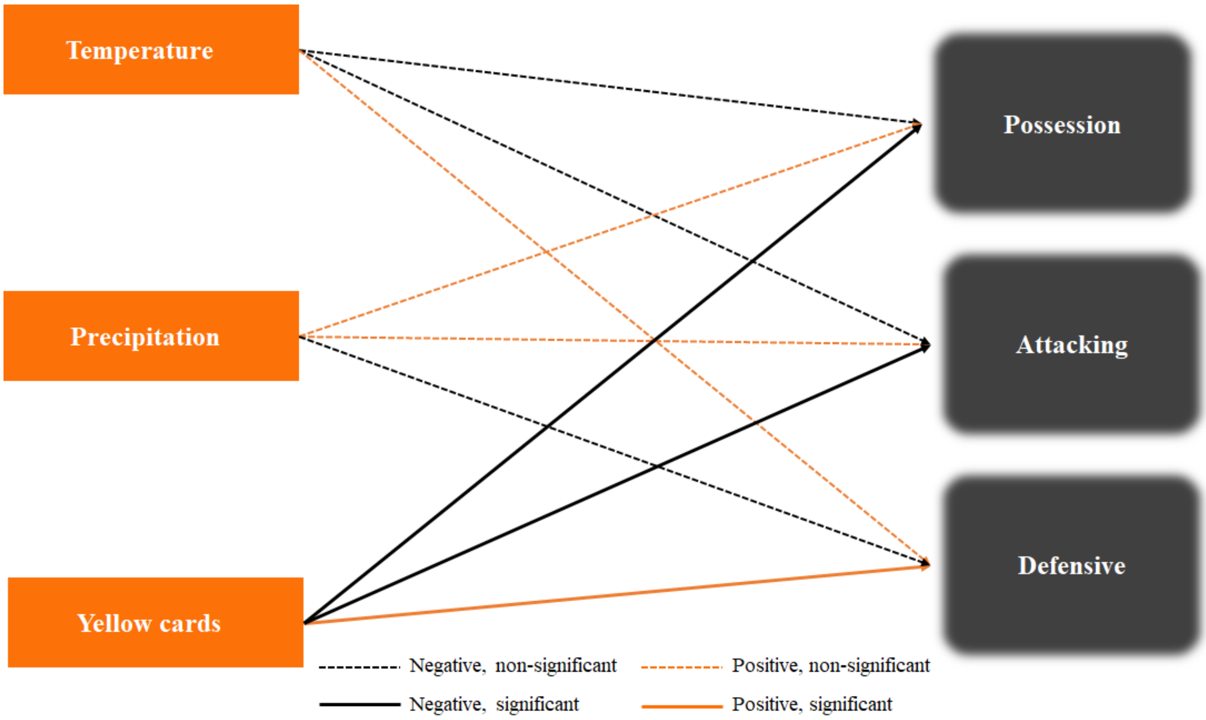


Figure 26. Hypotheses involving CDI illustrating direct (hypotheses 5.1 – 5.3) and indirect effects (hypotheses 5.4 – 5.15).

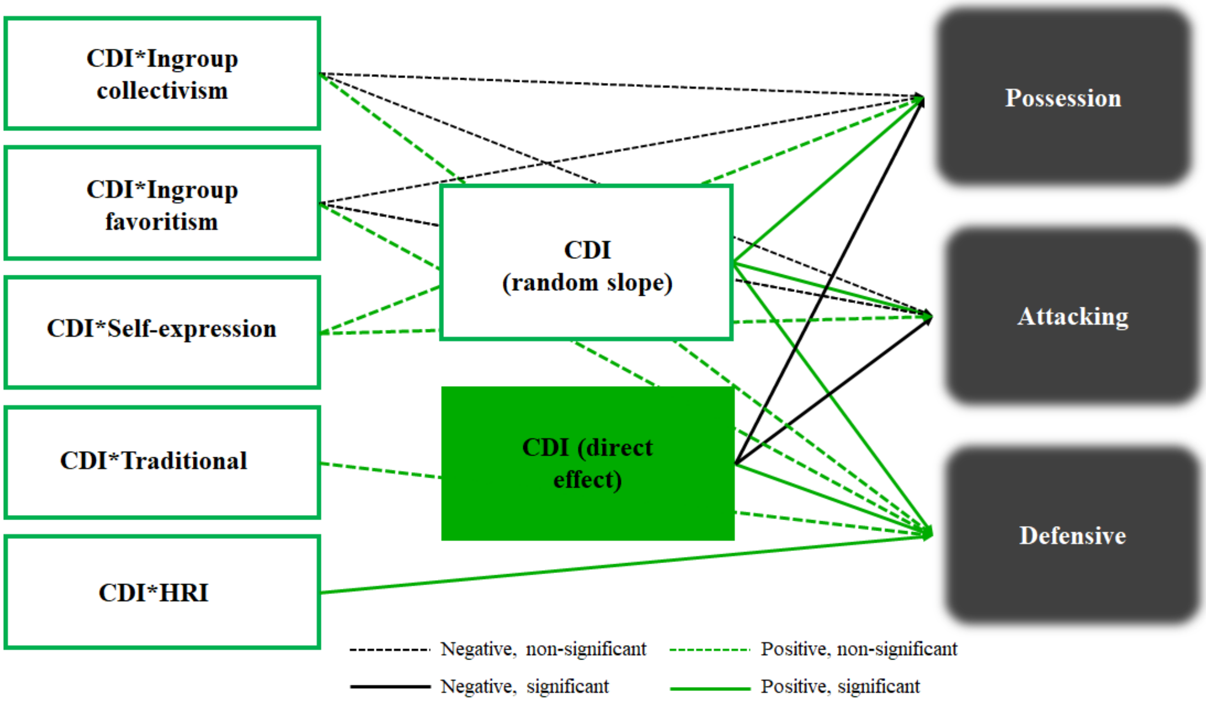
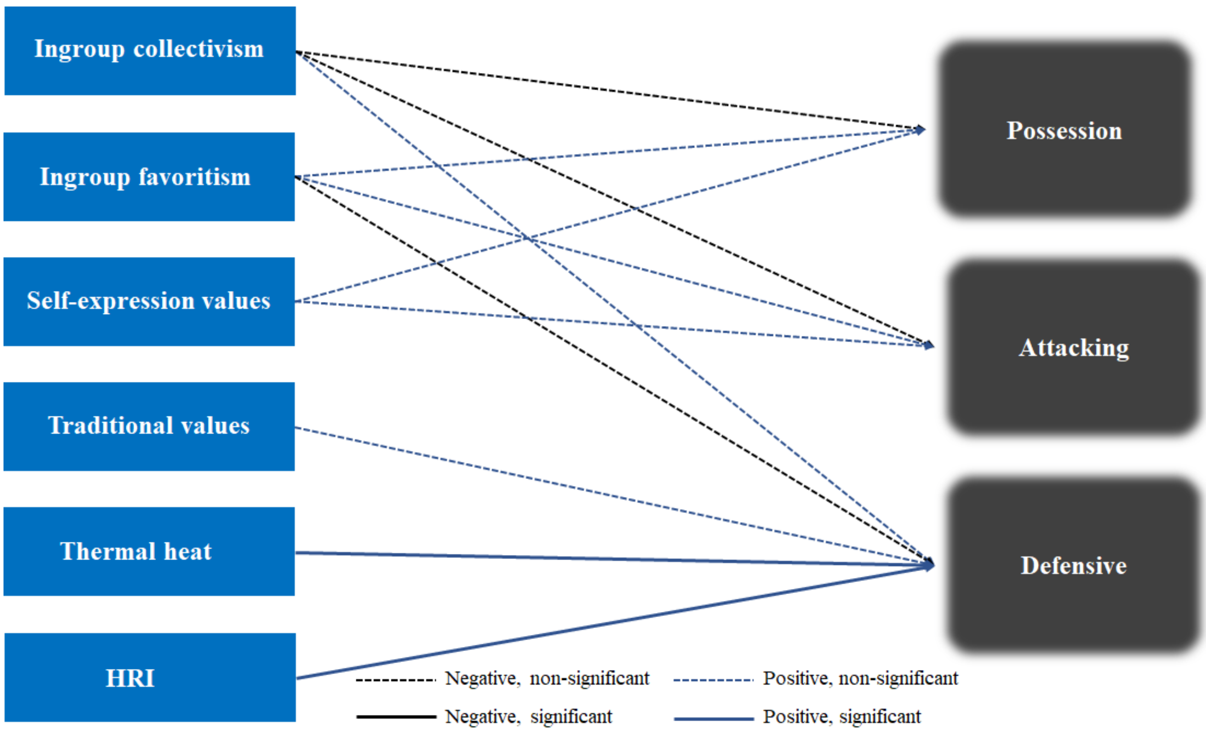


Figure 27. Hypotheses involving league (country) level (L2) variables (hypotheses 6 through 9.3).



4.4.4 Sample: Power, Missing Data, Centering

The sample used for this study is identical to that of Study 1 and Study 2, namely 23 186 matches played by 728 teams in 45 leagues across the world during the 2020/2021 football season (Table 1).

Power considerations

Compared to single level regression models, the computation of power for multilevel models is complicated and presents a number of difficulties. In MLM, power considerations can apply to multiple parameters, and will differ for fixed effects, variance components, and cross-level interactions (Bryk & Raudenbush, 1992). Likewise, for a given level of statistical power, the required sample sizes will differ for these parameters. As a general rule of thumb, increasing the sample size at the highest level (i.e., sampling more leagues) will do more to increase power than increasing the number of teams in the leagues. To detect cross-level interactions, a minimum of 30 groups and 30 observations has been recommended (Busing, 1993; van der Leeden & Busing, 1994). Based on a review of simulation studies, Kreft and Yoon (1994) offered a 30/30 rule of thumb for each type of effect. Hox (1998) proposed an even larger sample size with the 50/20 rule (i.e., 50 groups with 20 individuals per group). For estimates involving the intercept, smaller sample sizes may be possible, because the intercept is estimated more precisely than the slopes (Hofmann, 1997). For estimates of level 2 variance components, samples larger than 30 at the second level are necessary (Maas & Hox, 2004, 2005). As is true for power in single-level designs, a priori power calculations require the researcher to estimate parameter values from previous research or to utilize rules of thumb. A few equations have been developed to estimate statistical power for MLM, primarily based on the work of Raudenbush and Liu (2000) as well as Snijders and Bosker (1993; 1999). These require a large number of factors to be estimated, including the means, variances and covariances of the explanatory variables at both levels, the sample sizes at each level, and the variance and covariances of the random effects. Unfortunately, these values are notoriously difficult to estimate apriori (Scherbaum & Ferreter, 2009). Due to the lack of prior research, power for the pilot study was determined by applying rules of thumb, which can be highly inaccurate. Post hoc power analysis[78] conducted using the Power SIMR package in R (Green & MacLeod, 2016) showed that power for fixed effect parameters ranged between 34% - 43.8% for first level variables and below 10% for second level variables. It can, therefore, be concluded that the pilot study was underpowered due to the limited number of observations within groups (i.e., number of teams per league), and the number of groups/league falling below the minimum 30-group threshold.

In Study 3, approximate multilevel power computations for simple fixed effects were performed using two methods: (1) simulations (SIMR package in R), and (2) formula-based power computations (Microsoft Excel). The simulations (n=1000) were run for fixed effect parameters following three steps: (a) simulation of new values for the outcome variable (style of play) within a specific model (i.e., simple model involving one fixed effect), (b) refitting the model to the simulated outcome, and (c) applying a statistical test to the simulated fit. The results derived under both methods cover solely fixed effect parameters, which were hypothesized and tested. Random parameters and fixed effects for cross-level interactions were not included in the a priori power analysis, given related computational complexity. Notably, Snijders and Bosker's (1993) derivation of formulas for estimating statistical power of cross-level interactions requires more than 30 equations in matrix algebra. Empirical evidence suggests that random effects, variance components and cross-level interactions are more demanding in terms of statistical power compared to fixed effects. As shown in the summary (Table 26), using the computation method, the statistical power for first level fixed

[78] It should be noted that several authors have argued against the usefulness of assessing power based on observed effect sizes (i.e., post hoc power calculations; Goodman & Berlin, 1994; Hoenig & Heisey, 2001). However, the author opted for running the post hoc analyses to serve as starting points for the Study 3 power computations.

effects ranged from high (i.e., exceeding 80%) to moderate (above 50%). Both methods produced very low power values for second level fixed effects, suggesting that the multilevel study is generally underpowered, although much improved compared to the pilot study. Curve analysis in SIMR showed that power would increase by 10% for second level fixed effects, if the number of leagues is increased to 100. Given that the number of teams per league is fixed, and data availability for 100 leagues is either limited or dubious in quality, these types of studies involving sports teams are bound to be underpowered. The second, formula-based approach used to estimate statistical power, is explained in greater detail in Appendix B.

Table 26. Summary of power analysis results using the computational and simulation methods.

	A priori power analysis	
	computation (%)	*simulations % (CI)*
Temperature	63.4	75.31 - 81.24
Precipitation	55.6	73.13 - 79.78
Yellow cards	80.2	85.92 - 95.15
CDI	85.4	88.72 - 92.34
Ingroup collectivism	13.3	23.16 - 34.50
Ingroup favoritism	10.2	18.23 - 25.87
Self-expression values	6.82	12.10 - 15.03
Traditional values	7.55	10.12 - 22.08
Thermal heat	8.02	15.40 - 23.97
HRI	7.03	16.20 - 22.15

Missing data and centering

All data handling as well as statistical analyses were conducted in R (R Core Team, 2020) and R Studio (RStudio Team, 2019). The R packages used in MLM are listed in Appendix A. Multiple imputation (Rubin, 1987) was employed to deal with the missing data using the R package MICE (Van Buuren & Groothuis-Oudshoorn, 2011). As opposed to direct imputation techniques, which are based on simple regression predictions that can be highly inaccurate, multiple imputation combines a number of methods to increase predictability power.

All variables were inspected for normality of distribution and outliers. As a result, the Homicide Rate Index (HRI) was log transformed. The assumptions (normality, multicollinearity, heteroscedasticity) for MLM were checked at the modeling stage, and further discussed in detail in relation to each final model.

All predictors were grand mean centered. Namely, the overall or grand mean was subtracted from all values of a variable/predictor. Grand mean centering is instrumental for interpreting results, specifically the variances of the intercept and slopes. Also, grand mean centering speeds up calculations and is helpful in dealing with convergence problems, which often occur when explanatory variables vary widely in their means and variances. The variable CDI was de-centered for the purposes of generating graphs of interaction effects.

4.4.5 Analytical Plan

The restricted maximum likelihood (REML) estimation for second-level sample sizes smaller than 50, as recommended by Hox et al. (2018), was used. Three separate MLM analyses were run for each of the dependent variables. The exploratory procedure comprised four steps as advocated by a number of authors, including Hox et al. (2018) and Finch et al. (2019). A bottom-up strategy was adopted, starting with a simple model and proceeding by adding parameters, which were tested for significance after having been added. This explorative strategy was executed in four steps represented by four models. Models were built hierarchically, increasing in complexity and explanatory potential as more predictor variables were added.

First, an intercept-only (i.e., without explanatory variables) or *null* model was tested, and then fixed and random parameters were added in the subsequent three models. The first model tested the effects of the team level explanatory variables on the utilization of playing style. In the second model, higher level predictors were added, allowing the author to examine whether country level explanatory variables explain between-league variation in the use of a particular playing style. Cross-level interaction effects were included in the third model. Whereas the first three models tested fixed effects (i.e., with corresponding variance components of the slopes fixed at zero), in the third model, referred to as the random coefficient model, the author assessed whether the slope of CDI has a significant variance component between leagues. At each modeling step, the estimates and standard errors were inspected to see which regression coefficients or (co)variances produce significant results, and how much residual error is left at the distinct levels. The variance of the residual errors (i.e., random terms), and their covariances at both levels emerged as statistically insignificant[79], probably due to the study being underpowered. Consequently, these residual variance terms, with the exception of the random regression slope for CDI discussed later, were removed from the models. Additionally, the four nested models were compared based on fit statistics such as AIC, BIC, as well as adjusted R^2 showing how much variance is explained by the model within and between groups. The decision regarding retaining or removing particular explanatory variables at each step was taken by considering all of the above (i.e., model fit, significance of parameters, residuals).

As leagues were expected to vary in the starting values, the intercepts for all models depicting particular styles of play were set as random, and tested for expected random slope variation in CDI. In the pilot study, considerable convergence problems were experienced with random slope models, which appeared rather unstable, presumably due to the relatively small sample size that does not allow for such effects to surface. In Study 3, convergence was less problematic possibly due to increased power of effect sizes, with two out of three models converging. The statistical significance for all parameters was estimated using the Satterthwaite approximation (Satterthwaite, 1946) for denominator degrees of freedom, with

[79] As recommended by Nezlek (2020), the more generous significance level of .015 was used, when making decisions regarding the inclusion of error terms.

all results being re-checked based on the more conservative Kenward-Roger method (Kenward & Roger, 1997).

To calculate a statistic analogous to the multiple R^2 (R^2_m) in ordinary least squares regression, the author followed the approach for mixed multilevel analysis recommended by Raudenbush and Bryk (2002) for computing the variance explained at the first and at the second level. The respective equations are as follows:

(a) Team level: $R_1^2 = \left(\frac{\sigma^2_{e|b} - \sigma^2_{e|m}}{\sigma^2_{e|b}}\right)$,

where $\sigma^2_{e|b}$ is the team level residual variance for the null model, which is the intercept-only model, and $\sigma^2_{e|m}$ is the team level residual variance for the comparison model. For the utilization of a particular playing style, this calculates the proportion explained variance at the team level.

(b) League level: $R_2^2 = \left(\frac{\sigma^2_{u0|b} - \sigma^2_{u0|m}}{\sigma^2_{u0|b}}\right)$,

where $\sigma^2_{e|b}$ is the league level residual variance for the null model, and $\sigma^2_{u0|m}$ is the league level residual variance for the comparison model. For the utilization of a particular playing style, this calculates the proportion of explained variance at the league level. The residual variance at the first level does not change as second level variables are added to the model, because team level variables cannot predict league level variation. In addition to the above method for computing R^2_m , the author used the Performance package for R (Lüdecke et al., 2021), which is based on the approach developed by Nakagawa and Schielzeth (2013) for identification of marginal R^2 (variance explained by only fixed effects) and conditional R^2 (variance explained by both fixed and random effects)[80] in mixed effects models. The step-by-

[80] Caution should be taken when interpreting the R^2_m term for the interaction between two variables in a multilevel model. This is because R^2_m does not estimate the effect size for the interaction term per se. Rather, it estimates the effect size of the whole model, which includes the main effects. Therefore, to clarify the incremental effect of interactions, the Akaike's information criterion (AIC) is used, as it allows for model comparisons (Hox, 2018). A lower AIC value indicates a better model.

step implementation of the analytical plan for each style of play is detailed below. The models at each step are summarized in tabular format (Tables 27, 28 and 29) in the section on results (4.5).

4.4.4.1 Possession based style

In step one, the null model was run.

Step 1: Null Model

	Effects on possession style		
Predictors	*Estimates*	*CI*	*P*
Intecept	72.66	71.33 – 73.99	**<0.001**
Random Effects			
σ^2	92.82		
$\tau_{00\ \text{LEAGUE}}$	14.67		
ICC	0.14		
N_{LEAGUE}	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.000 / 0.136		

The null model for the team *i* in league *j* is represented as:

$$Y_{ij} = \beta_{0j} + \varepsilon_{ij}$$

where β_0 is the intercept ε_i represents variation in estimating the sporting outcome (i.e., goal difference) *within* leagues, whereas *between* leagues, variation in intercepts is denoted as:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

Through substitution, the null model is written as:

$$Y_{ij} = \gamma_{00} + u_{0j} + \varepsilon_{ij}$$

The interclass correlation equation was computed based on the following equation (Hox, 2018):

$$ICC = \frac{\sigma^2_{u_0}}{\sigma^2_{u_0} + \sigma^2_{\varepsilon}},$$

where σ_{ε}^2 is the variance of the team level errors ε_{ij} and $\sigma_{u_0}^2$ is the variance of the league level errors u_{0j}. The ICC of 0.14 implies that 14% of the proportion of the total variance is explained by the grouping structure. It can also be interpreted as the expected correlation between two randomly drawn units (i.e., teams) from the same group (i.e., league) (Hox, 2011). Although the ICC is relatively low, it nonetheless justifies the adoption of a mixed model design for the analysis of variance in the utilization of possession style[81].

In step two, fixed effects for the hypothesized level 1 predictors, i.e. *temperature, precipitation, CDI* and *yellow cards* were added to the null model. Given that CDI and yellow cards showed significant effects, they were retained in the model going forward. The *starting model equation* in Step 2 was:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\boldsymbol{CDI}_{ij} + \gamma_{20}\boldsymbol{temperature}_{ij} + \gamma_{30}\boldsymbol{precipitation}_{ij} + \gamma_{40}\boldsymbol{yelow\ cards}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 2: Adding fixed effects for L1 predictors

	Effects on possession style		
Predictors	*Estimates*	*CI*	*P*
Intecept	72.70	71.56 – 73.84	**<0.001**
Temperature	-0.04	-0.23 – 0.15	0.697
Precipitation	1.34	-0.67 – 3.36	0.191
CDI	-8.69	-13.14 – -4.24	**<0.001**
Yellow cards	-8.03	-9.82 – -6.24	**<0.001**
Random Effects			
σ^2	83.74		
τ_{00} LEAGUE	9.82		
ICC	0.10		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.176 / 0.262		

In step three, fixed effects were added for level 2 predictors, i.e., *ingroup collectivism, ingroup favoritism* and *self-expression* values. Self-expression values produced

[81] A common assumption is that if ICC falls below the 5% threshold, MLM is not justified and an OLS approach should be followed (Heck et al.). However, some scholars argue that the nested nature of data justifies the use of MLM, regardless of ICC levels (Nezlek, 2020).

significant effects but only combined with ingroup collectivism. Although ingroup collectivism did not emerge as a statistically significant predictor, it was retained in the model due to its strengthening effect on self-expression values. The *starting model equation* in Step 4 was:

$$Y_{\mathrm{ij}} = \gamma_{00} + \gamma_{10}\boldsymbol{CDI}_{ij} + \gamma_{20}\boldsymbol{yellow\ cards}_{ij} + \gamma_{01}\boldsymbol{self\ expression} + \gamma_{02}\boldsymbol{ingroup\ collectivism} + \gamma_{03}\boldsymbol{ingroup\ favoritism}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 3: Adding fixed effects for L2 predictors

	Effects on possession style		
Predictors	*Estimates*	*CI*	*P*
Intercept	72.58	71.42 – 73.74	**<0.001**
CDI	-8.64	-13.07 – -4.22	**<0.001**
Yellow cards	-8.02	-9.93 – -6.11	**<0.001**
Ingroup collectivism	-2.37	-6.03 – 1.29	0.204
Ingroup favoritism	-0.36	-3.01 – 2.29	0.792
Self-expression	-2.48	-4.25 – -0.71	**0.006**
Random Effects			
σ^2	83.02		
$\tau_{00\ \mathrm{LEAGUE}}$	10.23		
ICC	0.11		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.197 / 0.285		

In step four, the cross-level interactions between CDI and self-expression values, CDI and ingroup collectivism and CDI and ingroup favoritism were tested. None of these showed significant effects, so none were retained in the final model. The *starting model equation* in Step 4 was:

$$Y_{\mathrm{ij}} = \gamma_{00} + \gamma_{10}\boldsymbol{CDI}_{i} + \gamma_{20}\boldsymbol{yellow\ cards}_{ij} + \gamma_{01}\boldsymbol{self\ expression} + \gamma_{02}\boldsymbol{ingroup\ collectivism} + \gamma_{30}\boldsymbol{CDI{*}ingroup\ collectivism}_{ij} + \gamma_{40}\boldsymbol{CDI{*}ingroup\ favoritism}_{ij} + \gamma_{50}\boldsymbol{CDI{*}self\ expression}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 4: Adding fixed effects for cross-level interactions

	Effects on possession style		
Predictors	*Estimates*	*CI*	*P*
Intercept	72.60	71.42 – 73.79	**<0.001**
CDI	-8.52	-12.99 – -4.05	**<0.001**
Yellow cards	-8.10	-10.04 – -6.17	**<0.001**

Self expression	-2.53	-4.34 – -0.71	**0.006**
Ingroup collectivism	-2.27	-5.96 – 1.42	0.228
Ingroup favoritism	-0.52	-3.25 – 2.21	0.709
CDI * Ingroup collectivism	0.73	-13.07 – 14.54	0.917
CDI * Ingroup favoritism	1.20	-9.50 – 11.90	0.826
CDI * Self-expression	2.34	-4.21 – 8.90	0.484
Random Effects			
σ^2	83.28		
τ_{00} LEAGUE	10.36		
ICC	0.11		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.194 / 0.283		

In step five, the random slope for CDI was tested and retained, as it increased the explanatory power of the model, although the change was not statistically significant. The *starting model equation* in Step 5 was also **the final model equation**:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\boldsymbol{CDI_i} + \gamma_{20}\boldsymbol{yellow\ cards_{ij}} + \gamma_{01}\boldsymbol{self\ expression} + \gamma_{02}\boldsymbol{ingroup\ collectivism} + u_{1j}\boldsymbol{CDI_{ij}} + u_{0j} + \varepsilon_{ij}$$

Step 5: Adding random effects for slope

	Effects on possession style		
Predictors	*Estimates*	*CI*	*P*
Intercept	72.57	71.42 – 73.71	**<0.001**
CDI	-8.69	-13.07 – -4.30	**<0.001**
Yellow cards	-8.04	-9.93 – -6.15	**<0.001**
Self-expression	-2.43	-4.14 – -0.71	**0.006**
Ingroup collectivism	-2.70	-5.44 – 0.03	0.053
Random Effects			
σ^2	83.00		
τ_{00} LEAGUE	9.93		
τ_{11} LEAGUE.CDI	0.02		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.215 / 0.284		

4.4.4.2 Constructive attacking style

In **step one**, the null model was run. The moderately high ICC value of 20% justifies the adoption of a mixed methods approach to the analysis of variance in the utilization of defense style.

Step 1: Null Model

	Effects on attacking style		
Predictors	*Estimates*	*CI*	*p*
Intecept	34.97	34.39 – 35.54	**<0.001**
Random Effects			
σ^2	12.10		
$\tau_{00\ \text{LEAGUE}}$	3.11		
ICC	0.20		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.000 / 0.205		

In step two, fixed effects for the level 1 predictors, i.e. *CDI*, *temperature, precipitation* and yellow cards were added to the null model. Temperature and yellow cards were retained, given their significant effect, the remaining first level predictors were dropped. The *starting model equation* in Step 2 was:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\boldsymbol{CDI}_{ij} + \gamma_{20}\boldsymbol{temperature}_{ij} + \gamma_{30}\boldsymbol{precipitation}_{ij} + \gamma_{40}\boldsymbol{yellow\ cards}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 2: Adding fixed effects for L1 predictors

	Effects on attacking style		
Predictors	*Estimates*	*CI*	*p*
Intercept	34.97	34.44 – 35.50	**<0.001**
Temperature	-0.13	-0.22 – -0.05	**0.001**
Precipitation	0.27	-0.54 – 1.07	0.518
CDI	-0.73	-2.51 – 1.05	0.422
Yellow cards	-1.38	-2.10 – -0.66	**<0.001**
Random Effects			
σ^2	11.84		
$\tau_{00\ \text{LEAGUE}}$	2.50		
ICC	0.17		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.071 / 0.232		

In step three, fixed effects were added for level 2 predictors, i.e., *ingroup collectivism, ingroup favoritism* and *self-expression* values. Only ingroup collectivism showed statistical significance, and further tested in interactions with CDI. The *starting model equation* in Step 3 was:

$$Y_{\mathrm{ij}} = \gamma_{00} + \gamma_{10}\boldsymbol{temperature}_{ij} + \gamma_{20}\boldsymbol{yellow\ cards}_{ij} + \gamma_{01}\boldsymbol{ingroup\ collectivism}_{ij} + \gamma_{02}\boldsymbol{ingroup\ favoritism}_{ij} + \gamma_{03}\boldsymbol{self\ expression}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 3: Adding fixed effects for L2 predictors

	Effects on attacking style		
Predictors	*Estimates*	*CI*	*p*
Intercept	34.89	34.37 – 35.41	**<0.001**
Yellow cards	-1.40	-2.14 – -0.65	**<0.001**
Temperature	-0.12	-0.21 – -0.04	**0.004**
Ingroup collectivism	-2.07	-3.74 – -0.41	**0.015**
Ingroup favoritism	1.07	-0.11 – 2.26	0.076
Self expression	-0.67	-1.49 – 0.16	0.112
Random Effects			
σ^2	11.77		
τ_{00} LEAGUE	2.40		
ICC	0.17		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.102 / 0.254		

In step four, the interactions between CDI and ingroup collectivism, CDI and ingroup favoritism as well as CDI and self-expression values were tested. Only the first interaction term was retained going forward, given its significant effect on the outcome in the final model. The *starting model equation* in Step 4 was:

$$Y_{\mathrm{ij}} = \gamma_{00} + \gamma_{10}\boldsymbol{temperature}_{ij} + \gamma_{20}\boldsymbol{yellow\ cards}_{ij} + \gamma_{30}\boldsymbol{CDI*ingroup\ collectivism}_{ij} + \gamma_{40}\boldsymbol{CDI*ingroup\ favoritism}_{ij} + \gamma_{50}\boldsymbol{CDI*self\ expression}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 4: Adding fixed effects for cross-level interactions

	Effects on attacking style		
Predictors	*Estimates*	*CI*	*p*
Intercept	34.97	34.43 – 35.51	**<0.001**

Yellow cards	-1.45	-2.21 – -0.70	**<0.001**
Temperature	-0.11	-0.20 – -0.03	**0.008**
CDI	-0.72	-2.53 – 1.08	0.432
Ingroup collectivism	-2.05	-3.74 – -0.35	**0.018**
Ingroup favoritism	0.93	-0.30 – 2.16	0.138
Self expression	-0.72	-1.56 – 0.13	0.097
CDI * Ingroup collectivism	-2.03	-7.52 – 3.46	0.469
CDI * Ingroup favoritism	sty.25	-2.98 – 5.47	0.563
CDI * Self expression	sty.94	-0.65 – 4.53	0.142
Random Effects			
σ^2	11.69		
τ_{00} LEAGUE	2.50		
ICC	0.18		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.111 / 0.268		

In step five, the random slope for CDI was tested, but the model failed to converge.

The *starting model equation* in Step 5 was:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\boldsymbol{temperature}_{ij} + \gamma_{20}\boldsymbol{yellow\ cards}_{ij} + \gamma_{30}\boldsymbol{CDI*ingroup\ collectivism}_{ij} + u_{1j}\boldsymbol{CDI}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 5: Adding random effects for slope

	Effects on attacking style		
Predictors	*Estimates*	*CI*	*p*
Intercept	35.07	34.53 – 35.61	**<0.001**
Yellow cards	-1.38	-2.14 – -0.63	**<0.001**
Temperature	-0.14	-0.22 – -0.06	**0.001**
CDI	-0.53	-2.61 – 1.54	0.616
Ingroup collectivism	-0.13	-0.96 – 0.70	0.765
CDI * Ingroup collectivism	-3.03	-6.19 – 0.13	0.060
Random Effects			
σ^2	11.57		
τ_{00} LEAGUE	0.97		
τ_{11} LEAGUE.CDI	12.00		
ICC	0.11		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.091 / 0.194		

The **final model** for constructive attacking style was therefore derived from Step 4:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\textbf{\textit{temperature}}_{ij} + \gamma_{20}\textbf{\textit{yellow cards}}_{ij} + \gamma_{30}\textbf{\textit{CDI*ingroup collectivism}}_{ij} + u_{0j} + \varepsilon_{ij}$$

4.4.4.4 Defensive style

In step one, the null model was run. The relatively high ICC value of 40% justifies the adoption of a mixed methods approach to the analysis of variance in the utilization of defense style.

Step 1: Null Model

	Effects on defensive style		
Predictors	*Estimates*	*CI*	*p*
Intecept	30.62	30.01 – 31.22	**<0.001**
Random Effects			
σ^2	4.86		
τ_{00} LEAGUE	4.02		
ICC	0.45		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.000 / 0.452		

In step two, fixed effects for the level 1 predictors, i.e. *yellow cards, temperature, precipitation and CDI*, were added to the null model. Only precipitation was dropped from the model, as it did not enhance the model's explanatory power. The *starting model equation* in Step 2 was:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\textbf{\textit{yellow cards}}_{ij} + \gamma_{20}\textbf{\textit{temperature}}_{ij} + \gamma_{30}\textbf{\textit{CDI}}_{ij} + \gamma_{40}\textbf{\textit{precipitation}}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 2: Adding fixed effects for L1 predictors

	Effects on defensive style		
Predictors	*Estimates*	*CI*	*p*
Intercept	30.60	30.04 – 31.15	**<0.001**
Yellow cards	1.49	1.00 – 1.98	**<0.001**
CDI	2.49	1.28 – 3.71	**<0.001**
Temperature	-0.12	-0.19 – -0.06	**<0.001**
Precipitation	-0.13	-0.68 – 0.42	0.647
Random Effects			
σ^2	4.55		
τ_{00} LEAGUE	3.29		
ICC	0.42		
N LEAGUE	45		

Observations	729
Marginal R^2 / Conditional R^2	0.114 / 0.486

In step three, fixed effects were added for second level predictors, i.e., *HRI*, *thermal heat*, *ingroup favoritism* and *traditional values*. Unlike previously (in the 21-league sample), HRI and thermal heat did not significantly impact the outcome. In fact, none of the level 2 predictors enhanced the explanatory power of the model, and were, therefore, dropped. The *starting model equation* in Step 3 was:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\textbf{\textit{yellow cards}}_{ij} + \gamma_{20}\textbf{\textit{temperature}}_{ij} + \gamma_{30}\textbf{\textit{CDI}}_{ij} + \gamma_{01}\textbf{\textit{traditional values}}_{ij} + \gamma_{02}\textbf{\textit{HRI}}_{ij} + \gamma_{03}\textbf{\textit{thermal heat}}_{ij} + \gamma_{04}\textbf{\textit{ingroup favoritism}}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 3: Adding fixed effects for L2 predictors

	Effects on defensive style		
Predictors	*Estimates*	*CI*	*p*
Intercept	30.59	30.04 – 31.13	**<0.001**
Yellow cards	1.66	1.16 – 2.16	**<0.001**
Temperature	-0.10	-0.17 – -0.03	**0.006**
Traditional	0.41	-0.37 – 1.18	0.304
CDI	2.72	1.50 – 3.93	**<0.001**
HRI	-1.03	-2.25 – 0.18	0.096
Thermal heat	-0.03	-0.13 – 0.07	0.608
Ingroup favoritism	-0.42	-1.09 – 0.26	0.227
Random Effects			
σ^2	4.50		
τ_{00} LEAGUE	3.10		
ICC	0.41		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.184 / 0.517		

In the fourth step, several cross-level interactions involving CDI were tested, namely with HRI, ingroup favoritism and traditional values. CDI entered into a statistically significant interaction only with ingroup favoritism, but the interaction between CDI and traditional values was retained due to its contribution to strengthening the effect of the former (first) interaction. The *starting model equation* in Step 4 was:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\textbf{\textit{yellow cards}}_{ij} + \gamma_{20}\textbf{\textit{temperature}}_{ij} + \gamma_{30}\textbf{\textit{CDI}}_{ij} + \gamma_{40}\textbf{\textit{CDI*HRI}}_{ij} + \gamma_{50}\textbf{\textit{CDI*ingroup favoritism}}_{ij} + \gamma_{60}\textbf{\textit{CDI*traditional}}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 4: Adding fixed effects for cross-level interactions

	Effects on defensive style		
Predictors	*Estimates*	*CI*	*p*
Intercept	30.45	29.91 – 30.99	**<0.001**
Yellow cards	1.58	1.08 – 2.08	**<0.001**
Temperature	-0.10	-0.17 – -0.04	**0.002**
Traditional	0.55	-0.17 – 1.28	0.135
CDI	2.33	1.06 – 3.60	**<0.001**
Ingroup favoritism	-0.32	-0.97 – 0.33	0.339
HRI	-0.93	-2.10 – 0.24	0.118
CDI * Traditional values	1.76	-0.07 – 3.59	0.060
CDI * Ingroup favoritism	2.28	0.87 – 3.68	**0.002**
CDI * HRI	2.55	-0.60 – 5.70	0.112
Random Effects			
σ^2	4.43		
τ_{00} LEAGUE	2.96		
ICC	0.40		
N LEAGUE	45		
Observations	729		
Marginal R^2 / Conditional R^2	0.192 / 0.516		

In the final fifth step, the slope of CDI was allowed to vary. The *starting model equation* in Step 5 was:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\textbf{\textit{yellow cards}}_{ij} + \gamma_{20}\textbf{\textit{temperature}}_{ij} + \gamma_{30}\textbf{\textit{CDI}}_{ij} + \gamma_{40}\textbf{\textit{CDI*ingroup favoritism}}_{ij} + \gamma_{50}\textbf{\textit{CDI*traditional}}_{ij} + u_{1j}\textbf{\textit{CDI}}_{ij} + u_{0j} + \varepsilon_{ij}$$

Step 5: Adding random effects for slope

	Effects on defensive style		
Predictors	*Estimates*	*CI*	*P*
Intercept	30.45	29.91 – 30.99	**<0.001**
Yellow cards	1.58	1.08 – 2.08	**<0.001**
Temperature	-0.10	-0.17 – -0.04	**0.002**
Traditional values	0.55	-0.17 – 1.28	0.135
CDI	2.33	1.06 – 3.60	**<0.001**
Ingroup favoritism	-0.32	-0.97 – 0.33	0.339
HRI	-0.93	-2.10 – 0.24	0.118
CDI * Traditional values	1.76	-0.07 – 3.59	0.060
CDI * Ingroup favoritism	2.27	0.87 – 3.68	**0.002**
CDI * HRI	2.55	-0.60 – 5.70	0.112

Random Effects	
σ^2	4.43
τ_{00} LEAGUE	2.96
ICC	0.40
N LEAGUE	45
Observations	729
Marginal R^2 / Conditional R^2	0.192 / 0.516

Given that adding random slope effects for CDI did not increase the model's explanatory power (i.e., the difference between the final models in Step 4 and Step 5 was not statistically significant, $\chi^2 = 0.757$; $p = 0.860$), the optimal and **final model** equation for defensive style can be expressed as follows:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\textbf{\textit{yellow cards}}_{ij} + \gamma_{20}\textbf{\textit{temperature}}_{ij} + \gamma_{30}\textbf{\textit{CDI}}_{ij} + \gamma_{40}\textbf{\textit{CDI*ingroup favoritism}}_{ij} + \gamma_{50}\textbf{\textit{CDI*traditional}}_{ij} + u_{0j} + \varepsilon_{ij}$$

4.5 RESULTS

4.5.1 Descriptive Statistics

Screening showed that the majority of data, with the exception of precipitation and HRI, were normally distributed. The means, median, standard deviation, minimum and maximum values, Q3, skewness and kurtuosis are reported in Table 27.The HRI values were transformed using the log10 function to achieve normality. The remaining variables were normally distributed, and thus did not require additional transformation. The data missing rate was very low with an average of 1.8-0.3%. Multiple imputation was employed using the R MICE package (Van Burren & Groothuis-Oudshoorn, 2011). The intercorrelations between variables are summarized in Table 28. Confirming expectations, most study variables were found to be highly intercorrelated. The assumptions for MLM mixed and random effects (e.g., normal distribution of random coefficients, multicollinearity, etc.) were checked in relation to the final models, and accordingly reported within model results (see 4.5.3).

Table 27. Descriptive analyses results.

Variables	Min	Q1	Median	Q3	Max	Mean	SD	Skewness	Kurtosis
Temperature	1.625	10.819	13.792	17.358	29.308	14.658	5.234	0.729	0.566
Precipitation	0.000	519.000	650.000	935.250	3091.000	776.881	444.557	1.114	1.807
Yellow cards	0.647	1.778	2.117	2.423	3.455	2.111	0.491	-0.093	-0.128
CDI	0.125	0.382	0.546	0.699	1.000	0.535	0.207	-0.027	-0.873
HRI	0.263	0.621	1.227	5.061	35.900	5.159	8.548	2.349	4.370
Thermal heat	2.000	13.000	17.000	20.000	36.000	17.559	6.183	0.641	1.683
Ingroup collectivism	3.450	4.660	5.300	5.530	6.180	5.045	0.674	-0.887	-0.198
Ingroup favoritism	-2.320	-0.920	0.050	0.430	1.850	-0.206	0.886	-0.517	-0.324
Self-expression values	-1.550	-0.330	0.380	1.030	2.350	0.316	1.020	-0.010	-0.751
Traditional values	-1.870	-0.810	0.090	0.710	1.960	0.015	0.957	-0.003	-0.869
Possession style	34.927	65.196	71.459	79.203	110.760	110.760	72.563	0.233	-0.555
Constr. attacking	16.800	32.212	34.661	37.559	37.559	47.970	34.937	0.012	-0.416
Defensive style	22.216	28.647	30.679	32.576	32.576	38.727	30.609	0.067	-0.657

Table 28. Correlation matrix for independent and dependent variables.

Variables	Tempe-rature	Precipi-tation	Yellow cards	CDI	HRI	Thermal heat	Ingroup collect.	Ingroup favoritism	Self expression	Tradi-tional	Posse-ssion	Construct. attacking	Defensive style
Temperature	N/A	0.155***	0.081*	0.259***	0.176***	0.603***	0.244***	0.230***	0.003	-0.541***	-0.105*	-0.272***	-0.423***
Precipitation	0.155***	N/A	-0.011	0.251***	0.225***	-0.033	0.068	0.117**	0.054	-0.082*	0.046	-0.016	-0.138***
Yellow cards	0.081*	-0.011	N/A	0.080*	0.310***	0.026	0.456***	0.461***	-0.299***	-0.259***	-0.345***	-0.105**	0.130***
CDI	0.259***	0.251***	0.080*	N/A	0.231***	0.119***	0.200***	0.253***	-0.186***	-0.094**	-0.155***	-0.037	-0.045
HRI	0.176***	0.225***	0.310***	0.231***	N/A	-0.033	0.329***	0.294***	-0.077*	-0.606***	-0.133***	-0.089*	-0.179***
Thermal heat	0.603***	-0.033	0.026	0.119***	-0.033	N/A	0.092**	0.227***	-0.077*	-0.272***	-0.025	-0.061	-0.148***
Ingroup collectivism	0.244***	0.068	0.456***	0.200***	0.329***	0.092**	N/A	0.865***	-0.764***	-0.432***	-0.202***	-0.123***	-0.146***
Ingroup favoritism	0.230***	0.117**	0.461***	0.253***	0.294***	0.227***	0.865***	N/A	-0.740***	-0.349***	-0.209***	-0.054	-0.076*
Self expression	0.003	0.054	-0.299***	-0.186***	-0.077*	-0.077*	-0.764***	-0.740***	N/A	0.059***	0.061	-0.010	0.008
Traditional values	-0.541***	-0.082*	-0.259***	-0.094**	-0.606	-0.272***	-0.432***	-0.349***	0.059	N/A	0.219***	0.230***	0.319***
Possession style	-0.105*	0.046	-0.345***	-0.155***	-0.133***	-0.025	-0.202***	-0.209***	0.061	0.219***	N/A	0.461***	-0.384***
Constructive attacking	-0.272***	-0.016	-0.105**	-0.037	-0.089*	-0.061	-0.123***	-0.054	-0.010	0.230***	0.461***	N/A	0.005
Defensive style	-0.423***	-0.138***	0.130***	-0.045	-0.179***	-0.148***	-0.146***	-0.076*	0.008	0.319***	-0.384***	0.005	N/A

Pearson correlation *r*; *$p < .05$, **$p < .01$, ***$p < .001$

4.5.2 MLM Exploration

The following subsection summarizes the empirical results of MLM modelling, divided into distinct styles representing the three dependent variables. These are shown in Tables 29, 30 and 31. In the bottom section, indicators of model fit are reported as well as the intra-class correlation (ICC), which shows the proportion of the total variance explained by the grouping structure or simply the proportion of league-level variance compared to total variance[82]. The higher the ICC, the more variability exists between leagues. The marginal R^2 refers to the proportion of variance explained by the fixed effects in the model, and the conditional R^2 reflects the proportion of variance explained by both fixed and random effects (Nakagawa & Schielzeth, 2013). The three models for each style of play mirror the step-by-step modelling process described earlier. These models are *final* at each particular step compared to the *starting* models shown in the analytical plan in section 4.4.5. Additionally, the results are related to the tentative hypotheses formulated in section 4.4.3.

4.5.2.1 Possession based style (Table 29)

As predicted, a negative association was found with temperature and a positive association with precipitation, although the respective effects were not statistically significant ($p_{temperature}$=0.697; $p_{precipitation}$=0.191), and, therefore, were not included in the final model. In other words, lower average temperatures and higher levels of precipitation in the teams' main location increase the likelihood of teams adopting a possession based style of play. In line with expectations, the number of yellow cards was significantly and negatively related to the utilization of possession play. Additionally, the direct negative effect of CDI on possession style was confirmed, or culturally homogenous teams (with greater CDI values) were less likely to rely on possession. In this regard, Study 2 found culturally homogenous teams with a possession orientation to be less effective. However, CDI did not enter into statistically

[82] The ICC can also be interpreted as the expected correlation between two randomly chosen teams that are in the same league (Hox et al., 2018).

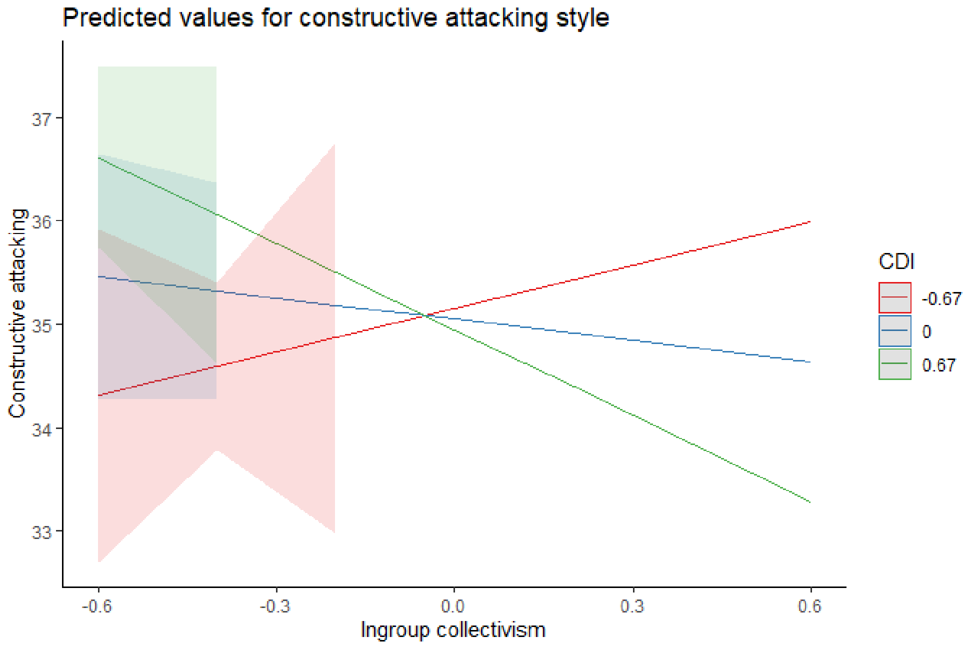
significant interactions with any of the level 2 explanatory variables, namely ingroup collectivism, ingroup favoritism or self-expression values. Although self-expression values contributed significantly to the utilization of possession style, the direction of the association was negative vs. the hypothesized positive relation. As expected, ingroup collectivism and ingroup favoritism both impacted negatively on the use of possession, although only the former was retained in the final model. Specifically, ingroup collectivism strengthened the effect of self-expression values as significant predictors of possession style, and increased the explanatory power of the final model (Model 3). It could, therefore, be postulated that teams most likely to rely on possession based style originate from countries more individualistically oriented (represented by negative values for ingroup collectivism), although with lower endorsement of self-expression values, provided these teams are more culturally heterogenous and characterized by a small number of yellow cards booked per season. Interestingly, the slope of CDI showed notable variance between leagues (τ_1^2=0.024; *SE*=0.155), thus providing empirical support for the hypotheses that the regression coefficient for CDI varies across leagues. This random slope variation can be interpreted in terms of the moderating cross-level effect of CDI, and was only found in relation to possession-based play, but not in the case of constructive attacking (i.e., model did not converge) or defensive style (i.e., model did not enhance explanatory power). Although this effect is not significant or strong, the overall effect of CDI is strengthened by CDI’s direct effect on possession style described earlier.

The baseline estimate (i.e., from the null model) of the within-league (between teams in a league) variance τ^2 (92.82) was found to be greater than the between-league variance σ^2 (14.67). Based on the Raudenbush and Bryk (2000) equations, for comparison Model 1, the first level R^2 was found to be 0.10, suggesting that 10% of the variance in possession utilization at the team level can be explained by the two team level predictors CDI and yellow cards. The league level R^2 was considerably larger, that is, 29.24% of the variance at league level could be explained by these two parameters (CDI and yellow cards). This amount of variance explained at the league level is fairly high, implying that the two variables are divided selectively across groups and thus reflect unequal league composition. Furthermore, the interpretation of the separate R^2 values is dependent on ICC. Specifically, the R^2 at the league level was 0.292 and the ICC 0.136, suggesting that out of the 13.6% of the total variance, 29.2% is explained. As expected, for Models 2 and 3, the residual variance at the lower level did not change, given that league level variables cannot predict team-level variation. A small change in the residual variance at the higher level was recorded, namely 4.17% (for comparison Model 2) and 0.2% (for comparison Model 3), with ICC decreasing to 0.107. Compared to the first R^2 computation (Model 1) of 29.24%, the smaller increase of 4.17% indicates that most of the predictive power stems from CDI and yellow cards rather than the higher level variables of self-expression and group collectivism. To conclude, it appears that leagues are more heterogenous than homogenous, and the proportion of variance in the utilization of possession style across leagues is explained mostly by the fixed team level parameters CDI and yellow cards. The variance component for the regression coefficient of CDI, although included in the final model equation, accounts for a relatively small proportion of the variance (0.024). This is confirmed by considering the marginal R^2 value of 0.215, which accounts for the fixed effect parameters, compared to the conditional R^2 of 0.282, which accounts for both, the fixed and random effect parameters. The relatively low and progressively decreasing ICC across modeling stages suggests that groups (leagues) are rather heterogenous (within-league), but likely similar (between-leagues) to each other.

4.5.2.1 Constructive attacking style (Table 30)

As hypothesized, the constructive attacking style showed a negative association with temperature and a positive one with precipitation, although only the effect of temperature was found to of statistical significance ($p_{temperature}$<0.001; $p_{precipitation}$=0.518). In other words, lower average temperatures and higher levels of precipitation in the teams' main location contributed to teams' utilization of constructive attacking. Similar to possession style, the number of yellow cards was significantly and negatively related to possession play. Additionally, analysis supported the direct negative effect of CDI on constructive attacking style. In line with Study 2 results, culturally homogenous teams (with greater CDI values) were found less likely to rely on constructive attacking, although the effect was not significant (p=0.422). Importantly and in line with predictions, CDI entered into an interaction with ingroup collectivism, producing statistically significant effects (p<0.05). The simple slope analysis in *Figure 28* shows that culturally heterogenous teams (i.e., with negative CDI scores in red) are more likely to rely on constructive attacking, if they originate from countries with higher ingroup collectivism scores. Culturally homogenous teams (i.e., with positive CDI scores in green) are more likely to adopt a constructive attacking style, if located in more individualistically vs. collectivistically oriented countries. In other words, the utilization of constructive attacking is inversely associated with the collectivist dimension, but only in the case of culturally homogenous teams. Higher heterogeneity neutralizes the effect of the collectivist dimension on the use of constructive attacking.

Figure 28. *Constructive attacking*: interaction effect between CDI and ingroup collectivism.



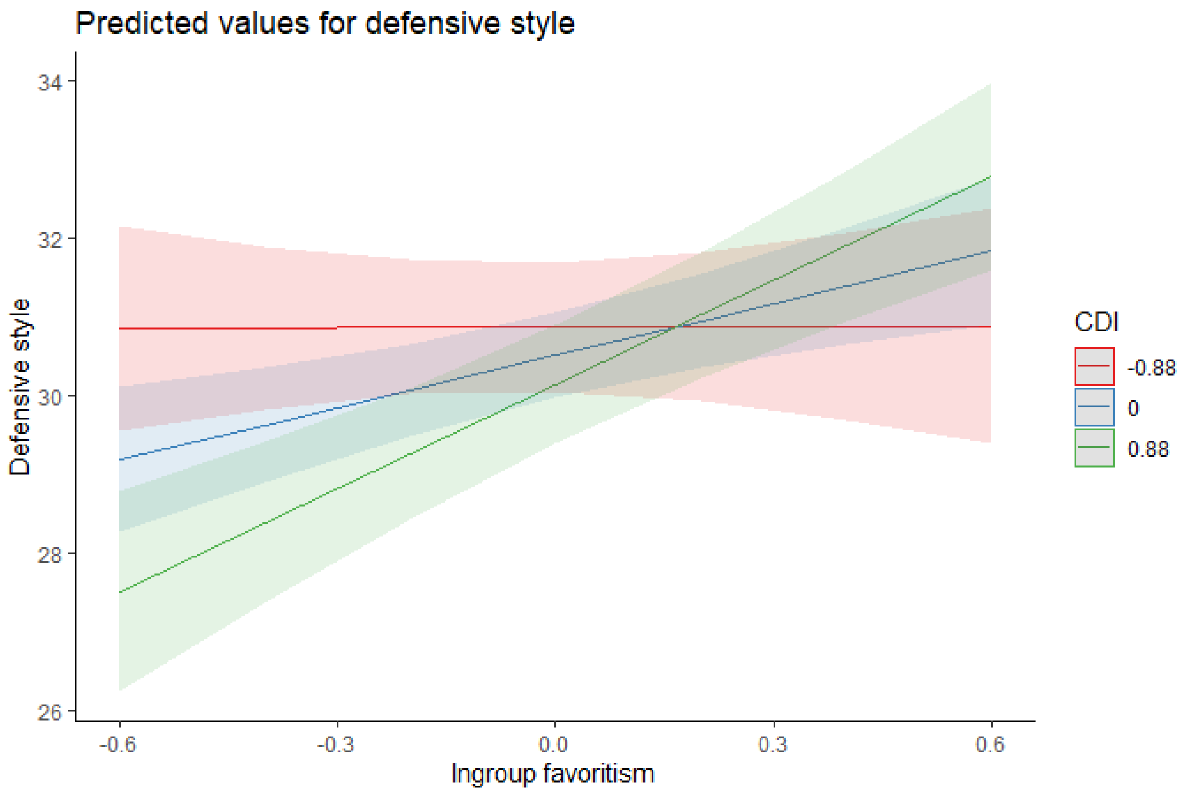
As hypothesized, constructive attacking appeared in a negative relationship with ingroup collectivism and, contrary to predictions, in a positive relationship with ingroup favoritism. Finally, the analysis failed to support the prediction regarding the positive impact on the utilization of constructive attacking on self-expression values. Based on the optimal Model 3, it can be concluded that culturally homogenous teams are most likely to adopt a constructive attacking style, if located in geographical places with relatively low average yearly temperatures, and provided they originate from countries with a more individualist orientation. Additionally, their style of play is characterized by low numbers of yellow cards booked per season.

In terms of variance explained, the results were similar to those reported for possession style, although related values were lower. The first level R^2 for comparison Model 1 was found to be 0.021, suggesting that only 2.1% of the variance in the use of constructive attacking at the team level can be explained by the two team level predictors temperature and yellow cards. At the league level, the proportion of the variance R^2 modeled by the explanatory variables (temperature and yellow cards) was 0.232. Given ICC of 0.205 in the null model and 0.190 in Model 2, it appears that out of the 19% of the total variance, 23.2% is explained. This proportion of explained variance at the league level reflects the fact that temperature and yellow cards are distributed selectively across groups, suggesting the heterogeneity of leagues. Unlike the results for possession style, the variance is explained primarily by random rather than fixed effects, with R^2 conditional (combined fixed and random) at 0.254 and R^2 marginal (fixed effects) at 0.079. The random effects are attributable to random intercepts, as the regression coefficient for CDI was removed from the final model due to convergence problems. Overall, the relatively low ICC indicates that groups (leagues) are rather heterogenous (within-league), but likely similar (between-leagues) to each other.

4.5.2.2 Defensive style (Table 31)

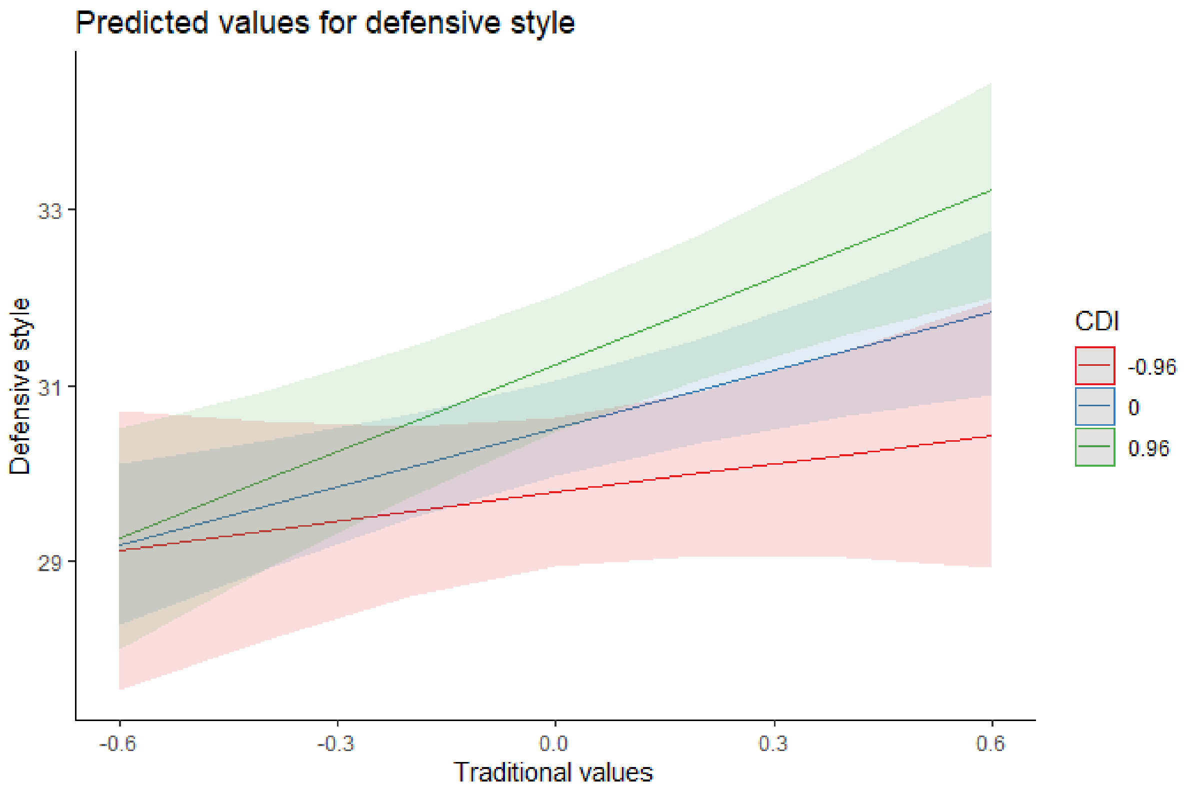
Defensive style was found to be negatively associated ($p<.001$) with temperature contrary to the hypothesized positive relationship, and positively associated with precipitation ($p= 0.647$) in line with predictions. As expected, yellow cards, CDI and traditional values produced significant positive effects ($p_{yellow\ cards}<.001$; $p_{CDI}<.001$; $p_{traditional\ values}<.05$). Moreover, CDI interacted with ingroup favoritism ($p<0.01$) and with traditional values ($p=0.060$). Although the second interaction was not statistically significant, it serves to reinforce the significant effect of traditional values on defensive style utilization. The simple slopes analysis in *Figure 29* below shows that culturally homogenous teams (with positive CDI values in green) are more likely to rely on defensive style, if they originate from countries that score higher on ingroup favoritism. For culturally heterogenous teams (with negative CDI values in red), the dependency between reliance on defensive style and ingroup favoritism is very small, practically nonexistent. In other words, defensive style is linked to ingroup favoritism as a societal orientation but only in the case of culturally homogenous teams. The sporting efficiency of defensively oriented teams in relation to their cultural composition, or the positive association between results and cultural homogeneity was evidenced in Study 2.

Figure 29. Defensive style: interaction effect between CDI and ingroup favoritism.



The simple slopes analysis in *Figure 30* below illustrates that culturally homogenous teams (with positive CDI values in green) increasingly rely on defensive style, if they originate from countries with a traditional value orientation. The same tendency, although weaker, characterizes culturally heterogenous teams with a prevalent preference for defensive play. Although not statistically significant, this interaction effect illuminates the strong connection between defensive style and traditional values.

Figure 30. Defensive style: interaction effect between CDI and traditional values.



Contrary to the compelling findings of the pilot study and the corresponding hypothesis, the second level predictor thermal heat showed a negative relation to defensive style (*p*=0.608). Similarly, no empirical support was found for the predicted moderating role of CDI in the relationship between HRI and defensive style or for the direct effect of HRI on defensive style. Also, ingroup favoritism had a negative rather than the hypothesized positive effect on defensive style. Only the positive association between defensive style and traditional values was confirmed (*p*=0.135). In view of the above results and based on the optimal Model 2, it can be concluded that reliance on defensive style is determined in part by lower average temperature in the geographical places, where teams are located, team's cultural homogeneity, and style of play, characterized by high number of yellow cards booked per season. Additionally, these teams are likely to originate from countries that demonstrate ingroup favoritism and endorse traditional values, predicated on the teams' cultural homogeneity.

Regarding explanation of variance, the baseline estimates of the within-league (τ^2=4.863) and between-league (σ^2=4.018) variance were found to be fairly similar compared to the considerable difference in corresponding values for possession and constructive attacking. The first level R^2 for comparison Model 1 was computed as 0.065, suggesting that 6.5% of the variance in possession utilization at the team level can be explained by the three team level predictors CDI, temperature and yellow cards. The league level R^2 was estimated at 0.175, or 17.5% of the variance at league label that could be explained by the three lower level parameters. Given cross-level interaction effects, the residual variance at team level changed, that is, R^2 dropped down to 2.2% for comparison Model 2. The league level R^2 also decreased to 9.9%. The difference between the residual variance for comparison Model 1 (0.175) and Model 2 (0.09) indicates that most of the predictive power is derived from the team level variables, but still over 7% of the predictive power stems from the involvement of league level variables in cross-level interactions. The total variance explained (null model ICC=0.452; Model 2 ICC=0.403) is significantly larger for defensive style compared to the two offensive styles. Out of the total variance of 45.2%, 17.5% is explained, with 27.4% attributable to fixed effects and 50.2% to fixed and random effects combined. To conclude, the final model for defensive style explains a substantially higher percentage of the total variance. The lower coefficient estimates and the smaller difference between them at team and league level indicates that in the utilization of defensive style leagues are relatively more homogenous compared to offensive styles. In other words, the contextual effects are less pronounced, although higher level variables in interaction with CDI, both in terms of fixed as well as random effects, significantly contribute to defensive style, explaining almost 10% of the variance at league level.

4.5.3 Testing Model Assumptions

The appropriate use of MLM requires meeting several assumptions about the data, and these differ somewhat from the assumptions that apply to single-level linear regressions. The first assumption is that the second level residuals are independent between groups (i.e., leagues). In other words, it is assumed that the random intercept and slope(s) at the group level are independent of one another across groups. Second, the level two intercepts and coefficients are assumed to be independent of the level one residuals (Field, 2013), in this case the errors for the league-level estimates being unrelated to the errors at the team level. Third, the first level residuals are normally distributed and have a constant variance. Fourth, the second level intercept and slope(s) have a multivariate normal distribution with a constant variance matrix (Finch et al., 2019).

Each of these assumptions was directly assessed in relation to the final models depicting the three distinct styles of play, using the “effects” (Fox & Weisberg, 2018) and “sjPlot” (Lüdecke, 2021) packages in R. A visual inspection of the plots confirmed the absence of violations in terms of linearity, normality of residuals, and homogeneity of residual variance. The presence of multicollinearity was investigated and excluded on the basis of variance inflation factor (VIF) analyses for each model. A conventional rule of thumb is that collinearity is considered to be a problem, if VIF>5 (Fox, 2016), and none of the model variables exceeded this threshold (Table 32). Using the “robustllm” package (Koller, 2016), all models were also re-estimated with robust errors to check for homoscedasticity, and again, no violations were found.

Table 32. Summary of VIF analyses.

Style of play	**VIF**
Possession based style	
CDI	1.028
Yellow cards	1.123
Self expression	2.469
Ingroup collectivism	2.639

Constructive attacking	
Temperature	1.049
Yellow cards	1.088
CDI	1.041
Ingroup collectivism	1.147
CDI*Ingroup collectivism	1.020
Defensive style	
Temperature	1.146
Yellow cards	1.055
CDI	1.180
Ingroup favoritism	1.207
Traditional values	1.287
CDI*Ingroup favoritism	1.126
CDI*Traditional values	1.209

4.5.4 Summary of MLM

Table 33 provides a summary of the results in relation to the tentative hypotheses formulated on the basis of relevant research and theories, the results of Study 2 and the pilot study. Unlike the pilot study, in which most hypotheses were rejected, in this study 16 out of 31 hypotheses were confirmed. With regard to climatic variables, the majority of Study 3 hypotheses were supported (i.e., *Hypotheses 1.1, 1.2, 2.1, 2.2 & 2.3*); the only exceptions related to the predicted positive association of defensive style with average temperature (*Hypothesis 1.3*) and thermal heat (*Hypothesis 3*), both of which were rejected. As anticipated, the number of yellow cards exhibited a strong positive connection with defensive style, and a strong negative connection with both offensively oriented styles (*Hypothesis 4*).

Team cultural diversity (measured by CDI) played an important role in the prediction of all three playing styles. Importantly, the moderator role of CDI was reinforced in terms of direct effects (*Hypothesis 5.1, 5.2 partially & 5.3*), indirect effects for CDI slope in possession style (*Hypothesis 5.4*), and indirectly in cross-level interactions with ingroup collectivism for constructive attacking (*Hypothesis 5.10*) and with ingroup favoritism and traditional values for defensive style.

Regarding cultural variables, ingroup collectivism emerged as a significant predictor only in relation to possession based style (*Hypothesis 7.1*), but the hypothesized direction of the relationship was also confirmed for constructive attacking (*Hypothesis 7.2*). Whereas the effect of ingroup favoritism was confirmed for possession based style (*Hypothesis 8.1*), the results of testing failed to substantiate the direction of the association for the remaining two styles (*Hypotheses 8.2 & 8.3*). Although self-expression values contributed to the utilization of possession play (i.e., the explanatory variable was retained in the final model), the relationship's direction or its significance were not confirmed (*Hypothesis 9.1*). *Hypothesis 9.2* on the link of self-expression values and constructive attacking was also rejected. Contrastingly, the impact of traditional values on defensive style was reinforced (*Hypothesis 9.3*). Overall, the effect of higher level predictors appeared stronger in cross-level interactions with CDI rather than as single level explanatory variables (i.e., direct effects). Surprisingly, the cross-level interaction of CDI with HRI did not produce the hypothesized significant effects as it did in the pilot study.

The results of MLM are discussed in the context of extant research and theories in the following section 4.6.

Table 29: Modeling results for **possession based** style

Model:	**Null Model**	**Model 1: add fixed effects (L1)**	**Model 2: fixed effects (L2)**	**֍Model 3: add random slope**
Level 1: team level				
Intercept (γ_{00})	**72.657*** (0.678)**	**72.690*** (0.600)**	**72.570*** (0.585)**	**72.5670*** (0.585)**
CDI (γ_{10})		**-8.454*** (2.224)**	**-8.674*** (2.237)**	**-8.687*** (2.236)**
Yellow cards (γ_{20})		**-8.116*** (0.915)**	**-8.031*** (0.963)**	**-8.037*** (0.964)**
Level 2: league (country) level				
Self-expression (γ_{01})			**-2.416** (0.875)**	**-2.426** (0.875)**
Ingroup collectivism (γ_{02})			-2.691 (1.396)	-2.702 (1.395)
Residual variance				
CDI slope variance (u_{1j})				0.024 (0.155)
Level 1 variance (ε_{ij})	92.82 (9.634)	83.53 (9.139)	82.998 (9.110)	82.997 (9.110)
Level 2 variance (u_{0j})	14.67 (3.83)	10.38 (3.222)	9.947 (3.154)	9.930 (3.151)
Number of teams	729	729	729	729
Number of leagues	45	45	45	45
AIC	5431.897	5344.791	5337.911	5343.908
BIC	5344.672	5367.749	5370.053	5389.825
logLik	-2713.500	-2670.300	-2666.400	-266.400
Deviance	5426.900	5340.600	5332.800	5332.800
R2 conditional	0.136	0.266	0.282	0.282
R2 marginal	0.000	0.175	0.196	0.215
ICC(adj.)	0.136	0.111	0.107	0.107

Notes: *p<0.05*;* **p<0.01***;* ***p<0.001; ֍optimal model.

Table 30: Modeling results for **constructive attacking** style

Model:	**Null Model**	**Model 1: add fixed effects (L1)**	**❈Model 2: add cross level interactions**	**Model 3: add random slope**
Level 1: team level				
Intercept (γ_{00})	**34.965*** (0.295)**	**34.967*** (0.265)**	**35.050*** (0.282)**	**35.068*** (0.274)**
Temperature (γ_{10})		**-0.138*** (0.040)**	**-0.126** (0.042)**	**-0.139** (0.042)**
Yellow cards (γ_{20})		**-1.366*** (0.364)**	**-1.381*** (0.383)**	**-1.383*** (0.385)**
CDI			-0.687 (0.917)	-0.532 (1.059)
Level 2: league (country) level				
Ingroup collectivism			-0.150 (0.439)	-0.127 (0.424)
Level 2: league(country) level interactions				
CDI * Ingroup collectivism (γ_{30})			**-3.114 * (1.415)**	**-3.030 * (1.612)**
Residual variance				
CDI slope variance				12.002 (3.464)
Level 1 variance (ε_{ij})	12.102 (3.479)	11.846 (3.442)	11.73 (3.425)	11.571 (3.402)
Level 2 variance (u_{0j})	3.114 (1.765)	2.393 (1.547)	2.75 (1.658)	1.364 (1.168)
Number of teams	729	729	729	729
Number of leagues	45	45	45	45
AIC	3964.967	3947.894	3944.315	3950.621
BIC	3978.742	3970.852	39.81.049	39.87.354
logLik	-1979.200	-1966.100	-1963.600	-1963.900
Deviance	3958.400	3932.300	3927.100	3927.800
R2 conditional	0.205	0.224	0.254	0.250
R2 marginal	0.000	0.068	0.079	0.083
ICC(adj.)	0.205	0.168	0.190	0.189

Notes: *$p<0.05$; **$p<0.01$**; ***$p<0.001$; ❈optimal model.

Table 31: Modeling results for **defensive** style

Model:	**Null Model**	**Model 1: add fixed effects (L1)**	**❈Model 2: add cross level interactions**	**Model 3: add random slope**
Level 1: team level				
Intercept (γ_{00})	**30.615*** (0.311)**	**30.601*** (0.284)**	**30.509*** (0.274)**	**30.530*** (0.271)**
Yellow cards (γ_{10})		**1.497*** (0.250)**	**1.584*** (0.251)**	**1.584*** (0.252)**
Temperature (γ_{20})		**-0.124*** (0.032)**	**-0.091** (0.033)**	**-0.091** (0.033)**
CDI (γ_{30})		**2.484*** (0.619)**	**2.202*** (0.642)**	**2.142*** (0.644)**
Level 2: league(country) level				
Ingroup favoritism			-0.412 (0.331)	-0.394 (0.328)
Traditional values			**0.762* (0.324)**	**0.777* (0.320)**
Cross-level interaction				
CDI*Ingroup favoritism (γ_{40})			**2.475*** (0.711)**	**2.458*** (0.715)**
CDI*Traditional values (γ_{50})			1.156 (0.767)	1.135 (0.765)
Residual variance				
CDI slope variance				0.250 (0.500)
Level 1 variance (ε_{ij})	4.863 (2.205)	4.547 (2.132)	4.445 (2.108)	2.919 (1.709)
Level 2 variance (u_{0j})	4.018 (2.004)	3.317 (1.821)	3.004 (1.733)	4.448 (2.110)
Number of teams	279	279	279	279
Number of leagues	45	45	45	45
AIC	3345.844	3300.133	3283.087	3288.55
BIC	3359.619	3327.683	3329.004	3348.147
logLik	-1669.700	-1641.100	-1629.200	-1628.800
Deviance	3339.300	3282.300	3258.300	3257.600
R2 conditional	0.452	0.488	0.513	0.502
R2 marginal	0.000	0.115	0.184	0.274
ICC(adj.)	0.452	0.422	0.403	0.404

Notes: *p<0.05; **p<0.01**; ***p<0.001; ❈optimal model.

Table 32. Summary of tentative hypotheses tested.

	Study 3 hypotheses	**Status**
(1.1)	Temperature (L1) is negatively associated with possession style.	Confirmed
(1.2)	Temperature (L1) is negatively associated with constructive attacking style.	Confirmed
(1.3)	Temperature (L1) is positively associated with defensive style.	Rejected
(2.1)	Precipitation (L1) is positively associated with possession and attacking styles, and negatively associated with defensive style.	Confirmed
(2.2)	Precipitation (L1) is positively associated with constructive attacking style.	Confirmed
(2.3)	Precipitation (L1) is negatively associated with defensive style.	Confirmed
(3)	Thermal heat (L2) is positively and significantly associated with defensive style.	Rejected
(4)	The number of yellow cards (L1) is negatively and significantly associated with possession and constructive attacking styles, and positively and significantly associated with defensive style.	Confirmed
(5.1)	Greater cultural homogeneity (higher CDI; L1) is significantly and negatively associated with possession style (direct effect).	Confirmed
(5.2)	Greater cultural homogeneity (higher CDI; L1) is significantly and negatively associated with constructive attacking style (direct effect).	*Partially confirmed
(5.3)	Greater cultural homogeneity (higher CDI: L1) is significantly and positively associated with defensive style (direct effect).	Confirmed
(5.4)	There is significant variability across leagues in the effect of cultural diversity (CDI; L1) on the utilization of possession style (indirect effect, rando slope).	Confirmed
(5.5)	There is significant variability across leagues in the effect of cultural diversity (CDI; L1) on the utilization of constructive attacking style (indirect effect, rando slope).	Rejected
(5.6)	There is significant variability across leagues in the effect of cultural diversity (CDI; L1) on the utilization of defensive style (indirect effect, rando slope).	Rejected
(5.7)	Cultural diversity (CDI; L1) moderates the negative association between ingroup collectivism and possession style.	Rejected

(5.8)	Cultural diversity (CDI; L1) moderates the negative association between ingroup favoritism and possession style.	Rejected
(5.9)	Cultural diversity (CDI; L1) moderates the positive association between self-expression values and possession style.	Rejected
(5.10)	Cultural diversity (CDI; L1) moderates the negative association between ingroup collectivism and constructive attacking style.	Confirmed
(5.11)	Cultural diversity (CDI; L1) moderates the negative association between ingroup favoritism and constructive attacking style.	Rejected
(5.12)	Cultural diversity (CDI; L1) moderates the positive association between self-expression and constructive attacking style.	Rejected
(5.13)	Cultural diversity (CDI; L1) moderates the positive association between ingroup favoritism and defensive style.	Confirmed
(5.14)	Cultural diversity (CDI; L1) moderates the positive association between traditional values and defensive style.	Confirmed
(6)	Cultural diversity (CDI; L1) moderates the positive association between HRI and defensive style.	Rejected
(7.1)	Ingroup collectivism (L2) has a negative impact on the utilization of possession style.	Confirmed
(7.2)	Ingroup collectivism (L2) has a negative impact on the utilization of constructive attacking style.	Confirmed
(8.1)	Ingroup favoritism (L2) has a negative impact on the utilization of possession style.	Confirmed
(8.2)	Ingroup favoritism (L2) has a negative impact on the utilization of constructive attacking style.	Rejected
(8.3)	Ingroup favoritism (L2) has a positive impact on the utilization of defensive style.	Rejected
(9.1)	Self-expression values (L2) have a positive impact on the utilization of possession style.	Rejected
(9.2)	Self-expression values (L2) have a positive impact on the utilization of constructive attacking style.	Rejected
(9.3)	Traditional values (L2) have a positive impact on the utilization of defensive style.	Confirmed

*A negative association was found, but it was not statistically significant.

4.6 DISCUSSION

The current MLM study sought to provide sociocultural and ecological explanations for teams' collective behaviors operationalized as styles of play. With the overall exploratory nature of the study in mind, the author tested a number of tentative hypotheses pertaining to both levels of analysis, that is, teams (*n*=728) and leagues (*n*=45), and associated with the three playing styles quantified in Study 1. The hypotheses were developed based on (1) relevant research and theory, albeit these being distally related to playing styles in football or to possible determinants of style, (2) the findings of the preceding Study 2 as well as (3) the 21-league pilot study. Three optimal models were derived that best explained the utilization of each of the three distinct styles. Related findings are discussed through the lens of ecological dynamics and cross-cultural psychology.

Environmental constraints

The hypothesized effect of climatic variables on the use of particular styles of play was largely supported by the data. As for the two offensive styles, a negative relationship was confirmed with temperature, and a positive relationship with precipitation. The former was evidenced in prior research linking lower temperatures to longer ball possession in the offensive sector (Dambroz et al. 2021). As the offensive style is characterized by greater levels of physical exertion, cooler temperatures create inviting conditions (affordances) for faster and more dynamic play. This line of argumentation appears in studies by Chmura et al., (2012; 2017; 2021) as well as other sports scholars (e.g., Brewer & Warren, 2014; Zhou et al., 2019). Given that the effect of precipitation on playing styles has not been previously investigated, one possible explanation for the association between higher precipitation and offensive styles draws on ecological explanations. Perhaps challenging physical conditions (e.g., muddy and slippery pitches) solicit actions that require greater precision in attacking and a higher level of sophistication in the organization of play such as in building positional attacks. Nevertheless, further research is needed to verify this or any such hypothetical explanations. Drawing on the findings of Dambroz et al. (2021) that higher temperatures are associated with greater ball possession in the defensive sector, the author predicted a positive relationship between temperature and defensive style. Yet, this hypotheses was rejected, possibly suggesting that optimal temperatures (ranging from 16 to 22) degrees C are conducive to all styles of play, regardless of tactical orientation (i.e., offensive vs. defensive). Similarly, the hypothesized connection between hotter climates (vs. warmer weather), expressed as thermal heat, and defensive style was not substantiated, raising the possibility that rather than climate, it is optimal weather conditions that most significantly impact on all playing styles. Nevertheless, the above results provide empirical evidence for the importance of environmental constraints in contextualized learning and subsequent shaping of habitual collective behaviors as posited in a number of theoretical models/frameworks within sport (e.g., Chmura and colleagues) and ecological (e.g., Berry, 1976; 2001; Van de Vliert, 2009) approaches, and it appears that the sporting behavior of football teams is no exception.

Sociocultural constraints

The study's results provide justification for the idea that cultural dimensions as sociocultural constraints affect how players and teams utilize affordances present within the macro environment, in which teams operate, or within the larger, macro-field of affordances. Drawing on the conception of intentional actions as inherently value-driven[83], and the utilization of affordances as the partial realization of values (Hodges & Baron, 1992; Vaughan et al., 2021), the author hypothesized the association of societal level (i.e., cultural dimensions) values with reliance on particular playing styles. This theoretical stance was further fortified by the endorsement of the understanding of sports as natural experiments (e.g., Saravia 2021), in that performance styles in sport mirror prevalent cultural orientations

[83] See description of the Integrative Categorization-Intentionality Model (ICIM) in section 3.2.2 within Study 2.

and dynamics in a given society. Lastly, the salience of the sociocultural context, which encompasses cultural value orientations, is integrated within ecocultural conceptualizations of group behaviors (e.g., Berry, 1976). In line with the aforementioned theoretical positions, the cultural dimensions of ingroup collectivism, ingroup favoritism and societal values (i.e., self-expression and traditional) afforded notable explanatory power to the three models, which sought to describe playing styles. Specifically, an inverse relationship was revealed between ingroup collectivism and possession style, suggesting that greater reliance on this style is more typical for teams originating from countries with an individualist orientation. Similarly, ingroup collectivism in interaction with CDI appeared as a significant (p<0.05) and negative predictor of constructive attacking. These two findings support the notion of the association of offensive tactics with more individualized play, which is less dependent on collective team effort. Conversely, ingroup favoritism characterized by conformity and disindividualizing effects, was expected to surface in defensive play. This prediction was confirmed, albeit accounting for the moderation role of CDI discussed below. The results suggest that teams originating from countries with higher baseline scores for ingroup favoritism are more likely to shy away from styles that accentuate individualistic tactical behaviors and shift toward reliance on more cooperative play, which deemphasizes individualistic actions. Given that the constructs of ingroup favoritism and ingroup collectivism are highly correlated, the effect of ingroup favoritism on defensive play further strengthens the link between offensive styles and individuality contrasted with defensive style and collectivity. Although the culture-climate connection as proposed by Van de Vliert (2011) in his study on ingroup favoritism was not directly substantiated in relation to styles of play, further research in the context of performance or style of play is warranted.

The author's postulation framed within Inglehart's theory of cultural change (1990, 1997) regarding the positive association between self-expression values and offensive styles, on the one hand, and traditional values with defensive play, on the other, received promising, albeit partial empirical support. Contrary to the hypothesized positive relationship between offensive styles and self-expression values, a negative but considerably strong ($p<.01$) relationship emerged with respect to the utilization of possession based style and a negative relationship with respect to constructive attacking ($p=0.097$). In view of the broadness of applicable theoretical concepts, it is difficult to provide a plausible interpretation of these findings. One possible explanation could be that football as a game, regardless of style, is less dependent on autonomy of choice, self-determination and emancipative values overall. The significant interaction of CDI with traditional values somewhat supports the stance that conformity, an hierarchical and authoritarian orientation, as well as rigid collectivity are more characteristic of how the game is organized and played. It could, therefore, be argued that emancipative and post-modern values, expressed in greater self-expression, flexibility and fluidity of movement /positional roles, as well as the unconventional use of space has not penetrated football in a pervasive manner detectable by empirical methods. Perhaps the collective origins and essence of the game truncate all other influences.

Cultural diversity (CDI)

Drawing on the results of Study 2, the importance of CDI as a cross-cultural moderator of the relationships between styles of play and macro-level variables was further substantiated in Study 3. In an MLM design, moderation is achieved by way of (1) direct effects, when CDI acts as a controlling/moderating variable at the lower (team) level of analysis, (2) in cross-level interactions with higher (league) level predictors, and (3) indirect effects, when expressed by its slope coefficient or random slope in a model equation. The direct effects ($p<0.001$) of CDI appeared in relation to possession style, along with indirect effects for CDI's random slope. In other words, controlling for the effect of CDI, the significant and negative association with yellow cards for teams originating from countries that score low on self-expression values ($p<0.01$) and ingroup collectivism, is likely to increase reliance on possession style. The random slope effect indicates that the utilization of possession style relative to CDI varies significantly across leagues. As for constructive attacking, CDI emerged as a significant moderator of the inverse relationship with ingroup collectivism. In other words, utilization of constructive attacking is more likely to occur for culturally homogenous teams from countries with a more individualistic orientation. In culturally heterogenous teams the effect of ingroup collectivism is negligible. Consequently, it can be plausibly claimed that increased cultural diversity within sport teams counterbalances the effect of sociocultural constraints on how the game is played or which styles are adopted. Namely, the effects of individualism are strengthened through CDI (i.e., increased cultural homogeneity) in teams with a dominant constructive attacking style, whereas the reverse applies to defensive style. Comparing both offensive styles, the impact of CDI transpires through different means of moderation, i.e., directly (for possession) and indirectly through interaction with ingroup collectivism for constructive attacking. Finally, CDI’s moderating role was also empirically supported for defensive style in interactions with ingroup favoritism and traditional values. Results showed the connection between defensive style, on the one hand, and ingroup favoritism plus traditional values, on the other, but only for culturally homogenous teams. The positive association between defensive style and cultural homogeneity was also revealed in Study 2.

Finally, contrary to predictions made under the pilot study, the expected positive and significant association between HRI and CDI was not confirmed. This finding undermines related theories (i.e. the CLASH model) and argumentation used to justify hypothesis formulation in that the defensive style is linked to higher aggression at the country level operationalized using the Homicide Rate Index (HRI). It also challenges notions of association between aggression levels and higher temperatures with reference to sporting behaviors in general and collective performance behaviors in particular. However, the strong positive association ($p<0.001$) of yellow cards with defensive style and their strong negative association ($p<0.001$) with both offensive styles, provides solid contra arguments for the existence of a theoretically plausible connection between aggressive behaviors and defensive style.

Research aims

The study was designed to address four central research questions. First, the modeling results showed that the average utilization of specific styles of play by teams varied across contexts (i.e., leagues), thus providing justification for the use of MLM analysis. To that effect, the null model indicated ICC values ranging from 13.6% for possession style, 20.5% for constructive attacking and 45.2% for the defensive style. Second, CDI affected the variance in the utilization of all three playing styles either directly as a first level explanatory variable for possession style or indirectly, that is, in interactions with higher level predictors such as ingroup collectivism for constructive style or with ingroup favoritism and traditional values for defensive style. If fact, R^2 analysis revealed that team level variables accounted for most of the explained league level variance, namely 29.24% (CDI and yellow cards) for possession, 23.2% (CDI, temperature and yellow cards) for constructive attacking, and 17.5% for defensive style. Third, only temperature was found to affect league-level variability in the utilization of constructive attacking and defensive styles. No significant relationship was discovered between thermal heat as a higher level climatic variable and defensive play. Fourth, it was found that certain features of the context (leagues) affect the relationship between team level variables and the utilization of particular styles of play directly (i.e., ingroup collectivism in possession based style) and indirectly in interactions with CDI (i.e., ingroup collectivism in constructive attacking and traditional values along with ingroup favoritism in defensive style).

To conclude, this study provided novel empirical evidence linking footballing styles of play to the ecological and sociocultural aspects of the environments, in which the game is practiced. The results of modeling suggested that the two offensive styles (i.e., possession and constructive attacking) are associated with a more individualistic societal orientation in environments characterized by lower temperatures and higher precipitation levels. Contrarily, the defensive style appeared less dependent on specific climatic/weather conditions, but emerged as strongly related to conformity and disindividualization that typifies ingroup favoritism as well as to traditional values, which reinforce a more hierarchal and authoritarian cultural orientation. These findings strengthen the argument, which stems from ecological dynamics, that environments solicit certain behaviors that are consequently reflected in pervasive patterns of collective behaviors. These behaviors are embodied in sociocultural practices that shape footballing skill development and adaptation. However, the effect of contextual constraints is altered, *that is*, weakened or strengthened, depending on the cultural composition of football teams. In other words, the moderating role of cultural diversity initially hypothesized in Study 2, was further supported in this study. Finally, MLM modeling indicated that the contextual effects are less pronounced in leagues with greater reliance on defensive style than in leagues where the offensive styles dominates. By way of explanation, defensive leagues were found to be more homogenous (i.e., within-league) but less similar to each other (between-league) compared to offensive leagues. The latter finding indicates that there are potentially a greater number of defensive sub-styles that are shaped by second level explanatory variables, which are not accounted for in the current models. Overall, the relatively low explanatory power of the second level variables warrants further exploration into the societal (macro) level determinants of playing styles.

CHAPTER FIVE: General Discussion

The idea about researching styles of play was conceived during my applied practice as a sport psychologist working in professional football. Prior to arriving at a more concrete conceptualization of the doctoral project, I was engaged in a two-year ethnographic study focused on the acculturation experiences of migrant players, and their functioning within culturally diverse football teams. I found that the adaptation of players to new contexts was highly dependent on their relations with the receiving environment (i.e., represented by teammates, coaching staff, and club officials). Importantly, these relations were being shaped in transnational spaces through an interconnected system of micro and macro level structural matrices (Darpatova-Hruzewicz & Book, 2021). The transnational situatedness of the player transfer process led me to examine the global and local constraints affecting footballers' migratory trajectories, specifically in relation to player selection. Auspiciously, my researcher-practitioner role allowed to glean insights on player recruitment and training. Whilst working closely with coaching and scouting staff, I was intrigued by an interesting aspect of multicultural team management, namely the possibilities for optimizing player selection strategy, so as to maximize the success of clubs' international transfers. Having spent many hours working with players, coaches, scouts and other club employees, I was convinced that key to the smooth transition of international players to new environments (i.e., country and club/team) was the achievement of individual sporting success. What steps, then, could be taken to ensure that migrant players are optimally suited to the local sporting context? In this regard, which leagues provide the best fit in terms of supplying players with a particular skill set that is likely to create the highest value in the local context while maximizing chances of individual success? This concern is equally applicable to clubs and agents seeking international placements for domestic players, especially those at the start of their careers. Which league would afford the highest chances for realization of footballing potential?

In seeking answers to these questions, one inevitably stumbles over the differentiating characteristics of leagues, with teams' dominant playing styles being one of them. It is no coincidence that historically the most traditional destination for Polish players has been the Bundesliga, considered to be more physical and less technical than, for instance, the Spanish La Liga. These deliberations guided my scholarly journey in gaining a more comprehensive understanding of playing styles as a central conceptual frame. Consequently, the doctoral project was designed to address six specific aims:

(1) to gain a more nuanced understanding of playing styles from a historical perspective;
(2) to identify and measure playing styles across a wider selection of leagues covering six continents;
(3) to compare teams across leagues depending on their reliance on particular styles of play;
(4) to investigate teams' sporting success in relation, amongst others, to the utilization of playing styles;
(5) to seek socio-cultural explanations for footballing styles of play;
(6) to provide novel theoretical insights on the combined deployment of ecological dynamics and cross-cultural psychology to explain collective team behaviors.

The general discussion below is structured around these six aims, and integrates the interpretation of empirical results across all three dissertation studies against the backdrop of relevant history and theory. The final two sections identify the studies' limitations and perspectives for future research, concluding with an overview of the practical application of findings.

5.1 Playing styles: Historical Overview, Identification and Comparison (Aims 1-3)

The historical overview of football provided in section 1.3 elicits the link between culture and national playing styles. Prior to delving into an empirical investigation of culture-driven relationships, I sought to operationalize game styles. Principal component analysis produced three distinct styles of play, two offensive and one defensive, explaining 55.8% of the variance. Methodologically, I was faced with the predicament of maximizing explanatory power (i.e., opting for 6 components explaining close to 69%) or yielding to considerations of parsimony. Recent research on game styles tends to veer on the side of measuring greater variability in styles. For instance, in the Spanish La Liga and the English Premier League, Fernandez-Navarro et al. (2016) identified 12 different styles, split into eight attacking and four defending, Gómez et al. (2018) quantified 8 styles in the Greek Superleague, and Lago-Peñas et al. (2018) found five styles in the Chinese Soccer Super League. Given the dissertation's focus on culture, historical rootedness and ultimately on inter-league comparisons, I chose to resort to parsimony. However, the resulting differentiation between two offensive and one defensive style exposes to criticism the approach I adopted. Namely, traditional football theory is founded on the premise of the attack-defense dualism[84] (López-Felip, 2019), or the game's constitution of attacking and defensive phases as two ontological entities. The direct transposition of this dualism onto game styles is arguably simplistic and reductionist. On the other hand, traditional notions of the game, where the act of attacking is ontologically separated from the act of defending, and only linked via transitions, is reminiscent of structuralist-functional approaches (see section 1.4.1) involving functional role appropriation (e.g., defensive vs. offensive player roles) within a static environment. Contrastingly, "ecologized" conceptions of football assume the coupling of both phases, *that*

[84]The attack-defense dualism is analogous to other dualisms such as the organism-environment dichotomy. Western dualisms, which have adversely affected sport science and coaching practice (Baggini, 2018), have created an organismic asymmetry of sorts, described by Araújo and Davids (2011) as the inherent bias toward explaining individual athlete behaviors by relying on behavioral arguments.

is, being in possession of the ball and attempting to recover the ball, with players interacting with dynamically changing properties of the environment to elicit specific patterns of collective behaviors manifesting as styles of play. In addition to this theoretical justification, the statistical analysis conducted within Study 1 and Study 3 provided solid empirical evidence for the viability of parsimony-driven arguments. The results of Study 1 suggested that teams across the 45-league sample utilize all three playing styles, albeit to differing degrees. Moreover, clustering analysis generated three groups of teams, depending on their reliance on each of three styles. Therefore, most teams could be characterized in relation to a dominant playing style, either offensive or offensive.

The history of football (see section 1.3) corroborates style development in terms of periodic oscillations between a defensive and an offensive orientation. During the early stages of association football up to World War I, attacking football anchored on individualistic actions (e.g., the "kick and rush" approach in England) prevailed. Tactical orientation shifted towards defensive pragmatism with the introduction of the first and the second offside rule (Meisl, 1995; Teoldo et al., 2021). Greater emphasis on attacking tactics resurfaced in the 1930s and early 1940s, initially exemplified in the "WM" formation and later incorporated into the game philosophy of the Danubian school. After Word War II, the invention of the "Swiss Bolt" and the Italian *catenaccio* marked the comeback of the defense hegemony. Defensive models lost their ubiquitous appeal in the 1970s and early 1980s, yielding to the pressure of modern attacking styles such as the Dutch *total football*. Arguably, the offensive focus is still ripe in contemporary football, and this could explain the identification of two distinct offensive styles in Study 1. Relatedly, Study 3 found that teams within offensively-oriented leagues were characterized by reliance on a greater variability of styles compared to teams within defensively-oriented leagues, although offensively-oriented leagues were more similar to each other. Additionally, the existence of three distinct styles was supported by analysis of 2018/2019 data from the smaller, 21-league sample, as well as by cross-level equivalence testing. In sum, the offense-defense dichotomy identified empirically in Study 1 appears justifiable against the historical back-drop of style evolution, and the statistical analysis performed in Study 1 and Study 3.

Limitations & Future Research

The main limitation of Study 1 concerns data. First, the results are dependent on the choice of key performance indicators (KPIs). Although the use of specific KPIs was justified on the basis of prior research, another set of parameters (e.g., dribbles, aerials, set pieces, etc.) could have produced different results. Also, the component structure was found to be stable for three styles (i.e., two offensive and one defensive) across both data sets (2018/19 and 20/21), albeit with nuances present in the composition of the three components. Nevertheless, generalizations to other leagues and seasons should be considered with caution (Mackenzie & Cushion, 2013). Additionally, the study employs isolated event data, which provides limited insight into the dynamics of pitch interactions and related patterns of collective team behaviors. Therefore, the use of spatiotemporal data on KPIs can afford richer information on coordinated movement, thus enabling analyses of competitive performance not only in terms of *what* each team and player do (i.e., in a discrete way) but also *how* and *why* they interact in the pursuit of performance goals (Travassos et al., 2013). Rather than relying on notational analysis (i.e., a statistical summary of events based on video footage), future research should make greater use of technological advances to gather and analyze more complex, positional/spatiotemporal data via new methods such as machine learning (Herold et al., 2019). Spatiotemporal data affords congruence with ecological dynamics principles, and allows for increased flexibility in designing studies. For instance, scholarly focus can shift from constraints-led approaches to affordance-driven inquiries.

5.2 Playing styles: Association with Team Success (Aims 4 & 6)

The connection between culture and playing styles further transpired in empirical analysis relative to performance outcomes. Namely, teams' cultural diversity (i.e., operationalized as CDI) was found to be a significant predictor of their sporting success. Moreover, the offense-defense dichotomy resurfaced in the results of Study 2. It was revealed that cultural heterogeneity positively contributed toward the sporting performance of teams with an attacking orientation (i.e., reliant on possession and constructive attacking styles). Conversely, the sporting success of defensively oriented teams appeared to be contingent on greater cultural homogeneity. Interestingly, these findings were corroborated and strengthened by the results of analysis centered on players' defensive vs. offensive position within teams. Namely, it was discovered that the sporting success of teams utilizing the possession-based style depends on the low proportion of domestic players in defense. In line with the offense-defense dichotomy, support was found for (1) the association of the constructive attacking style with a higher ratio of foreign offensive players, and for (2) the greater reliance of defensively oriented teams on cultural homogeneity in defense for improving performance.

The proposed Integrative Categorization-Intentionality Model (ICIM) provides an embodied cognitive explanation of the Study 2 results. The model essentially integrates social cognitive (i.e., representational) with embodied approaches. It posits that the influence of cognition on collective pitch behaviors manifests itself through the inherently representational categorization processes at play during task-related decision making, which demands greater reliance on communication in-action. Access to schemas of learned and internalized motor behaviors through enculturation is more readily available to players with a similar footballing socialization, who are able to recognize, categorize, and hence better anticipate their teammates' actions. In ecological dynamic terms, it can be said such players are more likely to detect, select and utilize comparable affordances, but more importantly, to create affordances for each other through action-based, nonverbal communication. The potential point of contention in this line of reasoning is the role of cognition, if any, in collective sporting behaviors. In ICIM, the author argues that representational decision making accounts for certain performance-related behaviors (e.g., passing preferences, field positioning in attack/defense building, etc.) that cannot be explained purely in terms of direct perception. In this regard, constraints-led approaches in sport pedagogy propagate training and development practices aimed at synchronizing player's perceptions of the environment, recognizing that pre-reflective experiences of learning resulting from enculturation (amongst others) have a substantial share in team coordination. Enculturated, self-stored experiences of movements affect "online" decision-making, which occurs during movement (e.g., to pass or to shoot the ball), but also shape "offline" player capacities in deeply constitutive ways that are often ignored at the peril of oversimplification. Contrastingly, proponents of more radical embodiments approaches claim that past experiences (i.e., stored as memories) constrain the landscape of available affordances, yet memory need not be based on representations (Reed, 1996). On this point, the author concurs with moderate embodiment scholars in that athletes draw on declarative memory to help resolve perceptual ambiguities in more complex performance situations such as anticipation and its consequences[85]. Moreover, sensorimotor behavior is likely stored in memory as movement schemas; however, these sensorimotor representations have non-conceptual content and are more primitive than other perceptual representations (Butterfill & Sinigagli, 2014; Jacob & Jeannerod, 2003). Also, representation decision making has been shown to be fast and frugal[86] (Gigerenzer & Gaissmaier, 2011; Schultz, 2018), or compatible with dynamic competitive contexts. To conclude, the author

[85] Additionally, fatigue and other body-related factors are likely to alter the perception of affordances.
[86] Fast and frugal heuristics have been shown to be quick and accurate (Gigerenzer & Gaissmaier, 2011) vs. costly and slow as typically associated with representational decision making.

believes collective behaviors are perhaps best explained by the complementarity of representational and nonrepresentational decision-making.

Relating to the hypothesized culture-performance link, the study provided empirical evidence that teams' cultural diversity (homogeneity or heterogeneity) significantly impacts their sporting efficiency. Based on ICIM, the difference between defensively vs. offensively oriented teams can be explained in terms of reliance on tactics that require greater coordination through in-action communication (i.e., in defense) contrasted with tactics that rely to a lesser degree on highly synchronized pitch maneuvers (i.e., in offense). In turn, efficiency in communication is facilitated by players' common footballing socialization, which impacts their decision making within competitive performance contexts. Most surprisingly, the study found that cultural diversity was a better predictor of favorable sporting outcomes than teams' wealth, although only in defensively oriented teams. Overall, wealthier teams were found to be more successful. This aligns with common beliefs that affluent teams can afford higher quality players, who are critical to the achievement of sporting success. Analogously, expectations were confirmed that in terms of sporting efficiency, poorer teams regardless of their tactical orientation, benefitted from cultural heterogeneity to a greater extent compared to wealthier teams. However, the examination of playing styles illuminated a different angle of the wealth-performance relationship. The author discovered that other factors such as players' cultural background, their in-action communication efficiency, be it within the team as a whole or the defense formation in particular, can play an equally, if not more, important role in determining sporting success.

In further testing of wealth-related hypotheses, cultural diversity emerged as a significant predictor of performance in interactions with two macro level moderators – PPP-based country income and budgetary spend on sport. Notably, the effect of cultural diversity was found to be stronger than the effect of country affluence on the sporting results of defensive teams. The explanation of related findings draws on the Skilled Intentionality Framework (SIF; Van Dijk & Rietveld, 2017), which postulates the sociomaterial entanglement of cultural practices within a landscape of affordances situated in a given ecological niche (e.g., football as an ecological niche). Although the interpretation of results can be perceived as highly speculative due to the relational abstraction of team level playing styles vis-à-vis macroeconomic indicators (see Study 2 discussion), they provide empirical support to the defense-offense dichotomy in collective behaviors. Specifically, it was discovered that offensively-oriented teams (i.e., employing possession-based and constructive attacking styles) are more likely to achieve favorable sporting outcomes, if they originate from countries with a higher PPT-based income and budgetary spend respectively, with the first group being conditional on greater cultural homogeneity. Conversely, teams' reliance on defensive style tended to improve their performance with increased cultural homogeneity, but only in poorer countries. The significance of CDI as a cross-cultural moderator of the relationship between macro level variables and styles of play (i.e., dependent variable in Study 3) was further reinforced in Study 3. Given the multi-level design of Study 3, CDI's moderating effect was evidenced with respect to all three styles in different types of relationships: (1) *directly*, acting as a controlling variable at the team level of analysis (i.e., in constructive attacking and defensive styles), (2) *indirectly*, in cross-level interactions with higher (league) level predictors (e.g., in constructive attacking and defensive styles), and (3) *indirectly*, when expressed by its slope coefficient or random slope (i.e., in possession style). In sum, the salience of CDI as a predictor of patterned team behavior is indubitable, and its consideration is strongly called for in any type of psychological, sociological or performance analysis research in football, and team sports in general.

Limitations and Future Research

The effect of CDI is contingent to a certain extent on its operationalization as a measure of concentration (i.e., based on HHI); other computational methods and indices could have been used. Analogously, an alternative conception of sporting success, or measures of team/league wealth and macro level prosperity indices may have produced different results and conclusions on the association between sporting results, culture and various team/country predictors. Another limitation is that CDI does not account for the cultural diversity of ethnic minorities within countries. As noted earlier, a Nigerian football team may be more culturally diverse due to its diverse ethnic composition than a Polish team with a similar CDI score. Also, the study was conducted within professional football, and its generalizability to other teams sports and across time (i.e., longitudinally) may be limited but certainly warrants further investigation. Other team level as well as higher level variables should be examined to raise the explanatory power of models testing the culture-performance and wealth-performance relationship. The cultural diversity of the geographical location (i.e., town, city, etc.), in which teams are situated is one such example. Finally, the historical effect of "cultural diversity" should be considered when providing interpretations. In today's globalized world, players are exposed to and socialized into footballing environments, which are immanently more diverse. Consequently, the impact of cultural diversity is intrinsically smaller compared to what it may have been 50 years ago. Finally, the study's findings on defensive vs. offensive tactics can be theorized and tested in other sub-disciplines of psychology and sociology, including social psychology, conflict resolution (i.e., on a macro or meso scale), including military tactics, strategic management, etc.

5.3 Playing styles: Sociocultural and Ecological Determinants (Aims 5 & 6)

Study 3 was designed to seek sociocultural and ecological explanations for the development and utilization of styles of play, thus extending the link between culture and playing styles. Guided by the ecological premise that the footballing playing field/niche mirrors, to a certain extent, higher level (i.e., societal) social processes and dynamics, the author postulated that the environmental and sociocultural aspects of life are embodied in the way football is played, or in styles of play. Translated into the language of ecological dynamics, environmental and sociocultural factors are said to affect how players learn to perceive and utilize affordances in the performance environment. The results of Study 3 empirically supported the idea that ecological (i.e., temperature, precipitation) and sociocultural (i.e., cultural orientations and values) constraints affect how players and teams utilize available affordances. For each style of play, an optimal model was derived to explain the association with styles of play. All three models incorporated variables representing ecological as well as sociocultural constraints to denote the most fitting combination of multilevel relationships, including cross-level interactions, which provided highest explanatory power for the utilization of styles of play. Whereas the contribution of ecological factors to the use of playing styles was found to be significant for the most part but less pronounced overall, the effect of cultural dimensions and values on styles presented the author with more intriguing opportunities for interpretative and theoretical deliberation. First, the offense-defense dualism surfaced yet again. Specifically, teams' offensive orientation was found to be associated with more individualized play (i.e., negative values for ingroup collectivism), whereas ingroup favoritism characterized by conformity was revealed as predicting greater reliance on defensive tactics. In other words, attacking can be individualized and isolated, whereas defending is associated with group effort. Although the hypothesized positive relationship between offensive styles and self-expression values was not confirmed, the dichotomy of styles partially emerged in the interaction of CDI with traditional values as a function of defensive style utilization. Second, the findings of Study 3 complement Study 2 results in corroborating the ICIM model, which postulates the value-realizing nature of affordances and the value-directedness of intentional behaviors. In Study 2, the sporting success of teams was explained in terms of players' value-driven exploration of shared affordances within a common field constrained or framed by pre-reflective experiences of a particular cultural socialization relative to their skill-based intentional repertoire. The findings of Study 3 reinforce the sociocultural embeddedness of affordances and their value-realizing quality, specifically in relation to skill development. The detection, selection and utilization of affordances is predicated on attunement to relevant properties of the environments, and as suggested by Vaughan et al. (2021), these properties are "weighted" with social and cultural significance, or "stand out" to exhibit a more immediate readiness for perception and action during competitive performance. Theoretically speaking, footballers develop skills related to the relevant affordances that are most prominent in their particular footballing environment. In this sense, affordances and skills are said to be two sides of the same coin (Vaughan et al., 2021). When applied to the model equations derived in Study 3, the above explanation suggests that playing styles emerge as stable patterns of collective team behaviors, within environmental contexts constrained by sociocultural and ecological explanatory factors/variables. It should be noted that yellow cards[87], which are neither sociocultural nor ecological, are in fact directly attributable to game styles. As such, they reinforce the distinctiveness of styles (i.e., including the offense-defense dichotomy) but bear little relevance in context of ICIM. Within constrained environments, players become habitually (i.e., in representational terms) or at least more readily attuned to particular affordances, which stand out as culturally significant and solicit specific types of motor behaviors. The resulting interpretation draws on ICIM and concurrently aligns with dynamical understandings of teams as complex adaptive systems (CAS) endowed with self-organizing capabilities and operating under constrains. It also produces an empirically and theoretically driven conceptualization of playing styles that accords with the working definition proposed

[87] The variable titled „yellow cards" can be directly attributed to playing styles. Contrastingly, other variables such as CDI are distinct from playing styles and differ in qualitative terms.

in section 1.5.4, but also extends it to embrace the cognitive aspects of affordance perception. In this sense, the findings of Study 2 and Study 3 showcase the sociocultural embeddedness of patterned team behaviors, manifested through enculturated representation and non-representation at multiple explanatory levels, as well as the distinctiveness of cultural expressions. The historical review in section 1.3 also supports the value-directedness in the evolution of playing styles, from ancient times when religious and entertainment values shaped how the game was played, to modernity with its prevailing Fordist-based hierarchical organization, order and discipline (e.g., WM, catenaccio), to post-modernity characterized by greater fluidity of movement and tactics (e.g., total football). Interestingly, Study 3 found a link between defensive style and traditional values, whereas the hypothesized association of postmodern, emancipative values of self-expression with attacking styles, deemed to embody more progressive contemporary orientations, was not confirmed. As noted in the discussion of Study 3, one possible explanation lies in the essentially collectivistic nature of the game that obscures other cultural/value aspects and/or diminishes their impact.

Finally, it can be argued that the aforementioned conceptualization of playing styles complements ecological theorizing in cross-cultural research. The ecocultural framework developed by Berry (1976, 2001) explains human diversity, both cultural and psychological, in terms of collective and individual adaptations to context, either biological or cultural. These adaptations link to observable behaviors and inferred characteristics through ecological influences, genetic and cultural transmission as well as acculturation processes (Boski, 2009/2022). The evolution of playing styles can also be expounded within a framework of ecological influences (e.g., effects of temperature, precipitation, altitude, etc.), biological factors (e.g., genetic make-up and epigenetic expression[88]), transmission of cultural values

[88] Epigenetic expression refers to heritable changes caused by the activation and deactivation of genes without any change in the underlying DNA sequence. Epigenetic mechanisms help answer the question of how nurture shapes nature. Behavioral epigenetics investigates how signals from the environment (e.g., social life, nutrition, childhood experiences, etc.) trigger molecular biological changes (Powledge, 2011).

(e.g., individualistic/collectivistic, traditional/emancipatory, etc.) and acculturation (e.g. psychological but also behavioral/motor/skill adaptation to new sporting contexts). Although cross-cultural psychology embraces representational notions of cognition, Berry's ecocultural framework (which is not a theoretical model *per se*) can comfortably accommodate the application of embodied principles to action / movement behaviors, which underpin styles of play.

Limitations and Future Research

The most notable limitation of Study 3 concerns statistical power as discussed in section 4.4.4. For this reason, its findings are highlighted primarily in relation to Study 2 and associated theoretical considerations rather than specific hypothesis-driven results. Given the difficulty of increasing statistical power at team level (i.e., there are a limited number of teams and hence observations per league), researchers can consider employing three-level models of teams being nested within matches to capture spatiotemporal data, which is more abundant, or longitudinal modeling. Given the low contribution of second-level variables to the explanatory power of models, the use of alternative macro level constraints is warranted. In this regard, Van de Vliert's (2011) thermal cold measure could be tested to further explore the culture-climate link, which was not confirmed with thermal heat. The exploratory nature of Study 3 also invites new hypothesis generation and potential confirmatory analysis. For instance, researchers can explore various wealth-related hypothesis to elicit affluence-culture relationships as evidenced in Van de Vliert's climate research or in theories of cultural change (e.g., Inglehart, 1990, 1997). Future research on the impact of sociocultural constraints in sport performance or pedagogy can be specifically fitted within Berry's ecocultural model. In this regard, the investigation of biological adaptations of player and/or movement behaviors in general using an epigenetic lens appears to be a promising line of inquiry. Another fertile avenue for further scholarly investigation lies within the qualitative methodological space. Given the difficulty in operationalizing styles of play in a way that captures sufficient cultural variability yet adheres to the principle of parsimony, phenomenologically grounded enactive as well as ethnographic approaches can offer the contextual richness much needed to embrace patterned (cultural) practices of forms of life (Van Dijk & Rietveld, 2017).

5.4 Practical Application of Findings

In the dissertation, the author assigned similar importance to empirical findings and to new theoretical insights. Although both bear relevance for sport scholars, this section focuses primarily on their applicability to sport practitioners.

The results of Study 1 allow the broad profiling of teams depending on their prevalent reliance on either offensive (i.e., possession-based and constructive attacking) or defensive tactics. The empirical approach adopted assumes that the effect of contextual factors (e.g., match venue or home/away game, quality of opposition) on sporting success (Study 2) or the utilization of playing styles (Study 3) levels out across a full season. This parsimonious classification of styles, based on only three components (see parsimony considerations in section 5.1), affords convenient means for coaches and football analysts to conduct high-level, strategic assessments of team needs, and to identify most suitable sources for scouting and talent recruitment. In practice, day-to-day scouting efforts tend to have a short-term horizon (i.e., the forthcoming transfer window) and are frequently detached from the long-term goals of the club or from the realities of the dressing room. The extent to which a player fits the team's playing profile and their potential to adapt to new sporting contexts, is often downplayed by stakeholders engaged in the recruitment/transfer process. Given evidence of the advantages presented by greater homogeneity amongst defensive players and/or defensively oriented teams in general (Study 2), it is advisable that scouting and coaching staff determine recruitment benchmarks for the first and second squads in relation to the overall concentration of domestic players on the rooster. Also, the footballing enculturation of players can impede their repositioning on the pitch or their successful completion of atypical tasks. If coaches require their offensive players to take on additional defensive tasks (e.g., systematically fall back into midfield), they should consider the training effort/cost involved in modifying enculturated motor behaviors of individual players and their perceptual attunement to specific affordances. In other words, would it be worthwhile for a Polish team to invest (time and money) in a Spanish offensive player socialized into attacking football, if he/she is expected to carry out physically-demanding defensive tasks in addition to the primary forward role? Practitioners, who are unaware that social, cultural and historic aspects of life influence skill development through skilled intentionality (i.e., demonstrated in Study 2 and Study 3), are more likely to trivialize this aspect when selecting players or designing training sessions that prioritize solicitations of some affordances over others. The latter naturally assumes that practitioners are knowledgeable about and choose to adopt to embodied approaches in training and football pedagogies versus adhering to traditional methods based on the implementation of game models, tactical plans and verbal instruction (Ribeiro et al., 2019). More conventional methods of training rely on representational understandings of cognition. Contrastingly, ecologically and dynamically driven practices that recognize the centrality of sociocultural factors/constraints in skill development, appear especially well suited to the management/coaching of multicultural teams. Although cultural composition is a crucial aspect of managing multicultural teams (i.e., evidenced by CDI's strong impact on results and style utilization), it is often pushed to the sidelines by footballing stakeholders and practitioners. In this regard, assumptions prevail that the availability of financial resources is the ultimate panacea to all ills. However, as shown in Study 2, the cultural composition of less affluent teams is actually a stronger predictor of enhanced performance than their financial prowess.

Game styles profiling can also serve to identify dominant playing patterns on a seasonal basis (or shorter time periods) to evaluate teams' performance against strategic and tactical performance indicators. Continuous performance evaluation is concerned with longer-term, strategic goals and decisions as opposed to tactical planning for a specific game. Such strategic decisions can impact the profiling of existing players, assessing their developmental needs, goals and team roles, but can also parlay into the training and development of young Academy level players transitioning into the senior team. Finally, team profiling in terms of prevalent style can be used in designing training methodologies to maximize player potential, or simply as tactical preparation for games by determining an opponent's dominant playing style.

Concluding Remarks

Reflecting back on my doctoral journey, I am left with a feeling of wonder at how this project evolved in ways that I had never anticipated. It started off as an ethnographic study on cultural transitions, and eventually developed into a multifarious and empirically complex quantitative investigation into academically barren terrain. While pursuing my goal of establishing an empirical link between sporting performance and culture, and more specifically between patterned action behaviors of teams and sociocultural aspect of life, I came across several intriguing discoveries. The most important empirical finding concerns the functioning of multicultural teams in football. Study 2 and Study 3 showed that teams' cultural composition affects their sporting success and the way they play in a statistically significant manner, even minimizing, in specific circumstances, the ubiquitous impact of wealth at a micro or macro scale. Moreover, multilevel modelling (Study 3) suggested that certain combinations of variables (constraints) predict the utilization of particular footballing styles, including ecological (i.e., climatic) and sociocultural (i.e., cultural dimensions and values), in addition to cultural diversity (i.e., operationalized as CDI). Finally, the dissertation makes a theoretical contribution by proposing an integrated embodied cognition approach, exemplified in ICIM, and demonstrates how cross-cultural psychology can complement ecological dynamics in gleaning new insights on collective behaviors in sport. Cognizant of the dissertation's limitations, I am hopeful that upon completion of this rather cumbersome work readership will remain optimistic regarding the prospects for future research based on the foundations laid in the dissertation.

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GLOSSARY OF TERMS

Affordances: Coined by Gibson (1979), these are opportunities for behavior / actions or options. In a sporting context, affordances are possibilities for action that a player / team perceives and can undertake to achieve a specific goal within a dynamically changing environment.

Cultural Diversity Index (CDI): This measure was operationalized by employing the Herfindahl-Hirschman Index (HHI), which is a statistical measure of inequality or concentration. A team with no diversity, where all players originate from one country, would have CDI=1, whereas a team with greater proportions of players from different countries would have a value closer to zero. In other words, higher CDI values indicate higher cultural homogeneity, whereas lower CDI values point to greater cultural heterogeneity.

Complex Adaptive Systems (CAS): Dynamical systems (such as sport teams) with many interacting components (e.g., players, ball, referees, pitch dimensions), whose interaction potential leads to the emergence of rich adaptive behaviors (Davids et al., 2013).

Constraints: Environmental conditions that give rise to variability of behavioral outcomes. Examples of *macro-level* constraints (e.g. sociocultural, historical, climatic and other environmental) attributable to leagues/countries include the game's popularity, level of professionalization, national traditions/schools in coaching football or the philosophy of a particular coach. *Micro-level* constraints are associated with the immediate performance context, for instance a team's cultural composition (cultural heterogeneity) or its quality (measured in terms of market value and league rankings). Constraints can also be defined at an individual level such as a player's height, speed, size of the pitch, distance from the goal, etc. Constraints at all levels interact to shape dynamical patterns of behaviors.

Constructive attacking style: Identified in Study 1; characterized by prevalence of positional attacks, a higher number of passes to the final third, as well as actions in high (i.e., closer to the opponent's goal) and mid-field.

Defensive style: Identified in Study 1; characterized by greater emphasis on direct build-up of play with defensive players executing longer passes and more actions in low (i.e., closer to own goal) and mid-field.

Ecological dynamics: A theoretical perspective, which combines concepts from dynamical systems theory (i.e., originating from thermodynamics and synergetics) and ecological psychology, specifically the embodied, embedded and nonrepresentationalist approach to cognition pioneered by J. J. Gibson (1904-1979).

Embodied cognition theory rests on a number of theses related to the mental functioning of organisms (Gallagher, 2011):

- *Constitutive thesis* stating that cognitive systems are realized in patterns of sensorimotor activity nonlinearly coupled with the embedding environment.
- *Cognitive-affective inseparability thesis*, which postulates the inseparability of perception, action and thinking.
- *Meta-plasticity thesis*, according to which mentality emerges over and is situated in a network of processes spanning brain, body and the world.
- *Nonrepresentational thesis*, which is not endorsed in equal strength by all trends of embodied cognition theory, but posits that the sensorimotor profile of organisms in itself suffices for some cognitive activities, thus replacing the need for construction of complex internal mental representations.

Integrative Categorization-Intentionality Model (ICIM): Proposed by the author, the model integrates the ecological orientation of skilled intentionality with the social categorization perspective on team performance in sport.

Performance analysis: A discipline within sport science, rooted in biomechanics and notational analysis, offering the tools to describe sporting (performance) behaviors in qualitative terms using quantitative match data.

Playing style: Collective team tactical behaviors aimed at achieving the game's attacking and defense objectives; in this dissertation defined as collective behavioral patterns emerging under constraints pertaining to the immediate performance context (e.g. quality of opposition, weather, cultural composition) or macro-scale constraints (e.g. sociocultural factors, climate), predicated on collective capabilities and shaped by shared affordances.

Skilled engagement: An individual's / athlete's engagement of their unique skill set to utilize the affordances that a specific environment offers to them.

Skilled intentionality: An individual's selective openness and responsiveness to a rich landscape of affordances. The intention to use an affordance emerges out of a process of variation and selection, where people being "drawn into" interactions with affordances offered by the performance environment.

Skilled Intentionality Framework (**SIF**; Van Dijk & Rietveld, 2017): This theoretical model places emphasis on the sociomaterial aspects of the environment.

Perceptual attunement: An individual's / athlete's openness to affordances, accessible due the existence of specific skills / expertise.

Possession-based style: Identified in Study 1; characterized by prevalence of various passing behaviors involving a higher match tempo (i.e., higher number of passes per minute) but within a slower paced progression toward the goal.

LIST OF FIGURES

Figure 29. Defensive style: interaction effect between CDI and ingroup favoritism.

Figure 30. Defensive style: interaction effect between CDI and traditional values.

LIST OF TABLES

LIST OF APPENDICES

Appendix A: R packages

R package	Reference
Car	Fox, J., & Weisberg, S. (2019). *An R Companion to Applied Regression (3rd ed.).* Sage. https://socialsciences.mcmaster.ca/jfox/Books/Companion/
Cluster	Maechler, M., Rousseeuw, P., Struyf, A., Hubert, M., & Hornik, K. (2021). cluster: Cluster analysis basics and extensions. R package version 2.1.2. https://CRAN.R-project.org/package=cluster
Corrplot	Wei, T., & Simko, V. (2021). R package 'corrplot': Visualization of a correlation matrix. (Version 0.92). https://github.com/taiyun/corrplot
Dendextend	Galili, T. (2015). dendextend: an R package for visualizing, adjusting, and comparing trees of hierarchical clustering. Bioinformatics. doi:10.1093/bioinformatics/btv428. https://academic.oup.com/bioinformatics/article-pdf/31/22/3718/17122682/btv428.pdf
Dplyr	Wickham, H., Francois, R., Henry, L., & Mueller, K. (2018). dplyr: A grammder of data manipulation. R package version 0.7.6. https://CRAN.R-project/package=dplyr
Effects	Fox, J., & Weisberg, S. (2018). Visualizing fit and lack of fit in complex regression models with predictor effect plots and partial residuals.” *Journal of Statistical Software*, *87*(9), 1–27. doi:10.18637/jss.v087.i09

ggplot2	Wickham, H. (2016). ggplot2: Elegant graphics for data analysis. Springer-Verlag New York. https://ggplot2.tidyverse.org
Ggeffects	Lüdecke, D. (2018). ggeffects: Tidy data frames of marginal effects from regression models. *Journal of Open Source Software, 3*(26), 772. doi:10.21105/joss.00772
glmmTMB	Brooks, M. E. et al. (2017). glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modeling.” T*he R Journal, 9*(2), 378–400. https://journal.r-project.org/archive/2017/RJ-2017-066/index.html
Interactions	Long, J.A. (2019). interactions: Comprehensive, user-friendly toolkit for probing interactions. R package version 1.1.0. https://cran.r-project.org/package=interactions
Lattice	Sarkar, D. (2008). Lattice: multivariate data visualization with R. Springer. http://lmdvr.r-forge.r-project.org
Lavaan	Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2), 1–36. doi:10.18637/jss.v048.i02
lmerTest	Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software, 82*(13), 1–26. doi:10.18637/jss.v082.i13
lme4	Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67*(1), 1–48. doi:10.18637/jss.v067.i01

Lsr	Navarro, D. (2015). Learning statistics with R: A tutorial for psychology students and other beginners. (Version 0.6). University of New South Wales, Sydney, Australia. R package version 0.5.1. https://learningstatisticswithr.com
MASS	Venables, W. N., & Ripley, B. D. (2002). Modern applied statistics with S (4th ed.). Springer. https://www.stats.ox.ac.uk/pub/MASS4/
Matrix	Hargarten. P. (2022). matrixNormal: The Matrix Normal Distribution. R package version 0.1.0. https://CRAN.R-project.org/package=matrixNormal
Mosaic	Pruim, R., Kaplan, D. T., & Horton, N. J. (2017). The mosaic package: Helping students to 'think with data' using R. *The R Journal, 9*(1), 77–102. https://journal.r-project.org/archive/2017/RJ-2017-024/index.html
Nasapower	Sparks, A. H. (2018). “nasapower: A NASA POWER global meteorology, surface solar energy and climatology data client for R. *The Journal of Open Source Software, 3*(30), 1035. doi:10.21105/joss.01035
Pbkrtest	Halekoh, U., & Højsgaard, S. (2014). A Kenward-Roger approximation and parametric bootstrap methods for tests in linear mixed models – The R Package pbkrtest. *Journal of Statistical Software, 59*(9), 1–30. https://www.jstatsoft.org/v59/i09/
Performance	Lüdecke, D., Ben-Shachar, M., Patil, I., Waggoner, P., & Makowski, D. (2021). performance: An R package for assessment, comparison and testing of statistical models. *Journal of Open Source Software, 6*(60), 3139. doi: 10.21105/joss.03139
Psych	Revelle, W. (2021). psych: Procedures for psychological, psychometric, and personality research. Northwestern University, Evanston, Illinois. R package version 2.1.9. https://CRAN.R-project.org/package=psych

psychTools	Revelle, W. (2021). psychTools:Tools to accompany the 'psych package for psychological research . Northwestern University, Evanston, Illinois. R package version 2.1.6. https://CRAN.R-project.org/package=psychTools
r2mlm	Shaw, M., Rights, J., Sterba, S., & Flake, J. (2020). r2mlm: R-Squared Measures for Multilevel Models. doi: 10.31234/osf.io/xc4sv. https://psyarxiv.com/xc4sv/
reshape2	Wickham, H. (2007). Reshaping data with the reshape package. *Journal of Statistical Software*, *21*(12), 1–20. http://www.jstatsoft.org/v21/i12/
Robustllm	Koller, M. (2016). robustlmm: An R Package for robust estimation of linear mixed-effects models. *Journal of Statistical Software*, *75*(6), 1–24 doi:10.18637/jss.v075.i06
See	Lüdecke, D. et al., (2021). see: An R Package for Visualizing Statistical Models. *Journal of Open Source Software, 6*(64), 3393. doi:10.21105/joss.03393
semTools	Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A. M., & Rosseel, Y. (2021). semTools: Useful tools for structural equation modeling. R package version 0.5-5. https://CRAN.R-project.org/package=semTools
Simr	Green, P., & MacLeod, C. J. (2016). simr: an R package for power analysis of generalised linear mixed models by simulation. Methods in Ecology and Evolution, **7**(4), 493–498. doi:10.1111/2041-210X.12504, https://CRAN.R-project.org/package=simr
Sjmisc	Lüdecke, D. (2018). sjmisc: Data and variable transformation functions. *Journal of Open Source Software, 3*(26), 754. doi:10.21105/joss.00754

sjPlot	Lüdecke, D. (2021). sjPlot: Data visualization for statistics in social Science. R package version 2.8.10. https://CRAN.R-project.org/package=sjPlot
Tidyverse	Wickham, H et al. (2019). Welcome to the tidyverse. Journal of Open Source Software, 4(43), 1686. doi: 10.21105/joss.01686

Appendix B: Power calculations (Study 3)

The formula-based estimation of statistical power is shown below.

First, the desired level of power [$Z_{1-ß}$] was determined from the effect size (δ), the level of α, and the standard errors, using the following formula (Snijders & Bosker, 1993; 1999):

Equation 1

$$Z_{1-ß} \leq \frac{Effect\ size\ (\delta)}{Standard\ error\ (S.E.)} - Z_{1-\alpha/2}$$

The alpha value (α) was set to α 0.05 [$Z_{1-\alpha/2} = 1.96$], and a medium effect size (δ=0.50) was taken for all fixed effect parameters. Next, the variance for the parameters of interest (simple fixed parameters) was estimated, followed by computation of the values of the level 1 and level 2 sample sizes needed to achieve a minimal or a desired value for the standard error given the variance. The variance for the fixed effects of the slope term in the level 2 equation predicting level 1 intercepts (i.e., Υ_{01}) was calculated based on Raudenbush (1997):

Equation 2

$$var(\Upsilon_{01}) = \frac{4(\tau_{00} + \sigma^2\ /\ n)}{J}$$

The value of σ^2 is equal to (1-*p*), where *p* is the model's ICC, computed based on the values of τ and σ^2. The ICC values were taken from the pilot study.

The standard error of Υ_{01} was computed by taking the square root of var(Υ_{01}),

Equation 3

$$S.E.(\Upsilon_{01}) = \sqrt{var(\Upsilon_{01})},$$

where τ_{00} is the variance of the level 2 intercept term, σ^2 is the level 1 variance, *J* is the level 2 sample size, and *n* is the level 1 sample size. For estimating the fixed effect of precipitation, the medium effect size (δ=0.50), a two-tailed σ of 0.05, and ICC to be *p*=0.25 was taken for *J*=45 (leagues) and *n*=16 (i.e., the average number of 16 teams across all leagues). Plugging these values into Equation 2 and Equation 3 yielded an estimated standard error of 0.161 for Υ_{01}

$$\left(i.e., \sqrt{\left(\frac{4\left(0.25 + \frac{1 - 0.25}{16}\right)}{45}\right)}\right)$$

Using these values in Equation 1 produces a value of 1.245 for $Z_{1-ß}$

$$\left(i.e., \left(\frac{0.50}{0.156}\right) - 1.96\right)$$

The statistical power is the probability associated with this Z-score, and in this case the probability associated with a Z of 1.146 was 0.556, which is a modest level of statistical power.