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Spatiotemporal coordination behaviors in futsal (indoor football) are guided by informational game constraints

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ABSTRACT

This report investigated the behavioral dynamics of teams in futsal game practice when the goalkeeper of the attacking team is substituted for an extra outfield player. To this end, the lateral and longitudinal displacements of the ball and both teams, as well as their kinematics expressed in angles and radial distances from the goal center, were obtained and subjected to relative phase analysis. The results demonstrated (a) stronger phase relations with the ball for the defending team than the attacking team for both coordinate systems, (b) phase relations between each team and ball, and, to a lesser extent, between teams themselves, produced greater stabilities in the lateral (side-to-side) direction than the longitudinal (forward-backward) direction, and (c) phase attractions were most pronounced for the defending team and ball when using angles as a measure of association, indicating ball position and goal location as key informational constraints for futsal game behavior. These findings advance understanding of self-organizing sports game dynamics with implications for sports practice.

1. Introduction

Team sports behaviors are predicated on the competing aims of the two teams, with the attacking team looking to keep ball possession and make a score (e.g., a goal, a basket, a point, etc.) and the defending team seeking to protect against a score and win ball possession. The playing behaviors that

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characterize these types of sports contests has been proposed to emerge as a self-organizing process consequence of the cooperating and competing coordination tendencies of players (see McGarry, Anderson, Wallace, Hughes, & Franks, 2002). This idea of game behavior as self-organizing means that ordered behaviors emerge from within the sports contest as a result of information exchanges among the players, instead of regularity being imposed on game behavior by any outside agency (e.g., a coach). This position does not deny the influence of coaching practice on game behavior however, which provides an important informational constraint by shaping individual and team objectives.

In sports contests, players and teams must constantly make decisions and actions based on changing game information derived from spatial-temporal relations with other players (teammates and opponents), positions on the field of play, ball kinematics and goal location, a continuous process regulated by localized dynamical interactions (McGarry et al., 2002). Thus, self-organized coordinated behaviors emerge under a variety of individual, task, and environmental constraints as players and teams seek to accomplish their game objectives (Araújo, Davids, Bennett, Button, & Chapman, 2004; Davids, Kingsbury, Bennett, & Handford, 2001). Self-organizing behaviors produce stable coordination patterns at the expense of other possible coordination states and offer a useful means for characterizing and investigating complex systems behavior (Beek, Verschoor, & Kelso, 1997).

Game dynamics has been investigated in various sports (Araújo, Davids, & Hristovski, 2006; Davids, Araújo, & Shuttleworth, 2005; McGarry et al., 2002; Palut & Zanone, 2005; Passos et al., 2009; Reed & Hughes, 2006) at various levels of analysis. As noted by McGarry et al. (2002), the emergent coordination patterns of team sports may be investigated from interactions between individual players (Bourbousson, Sève, & McGarry, 2010a) to interactions between teams (Bourbousson, Sève, & McGarry, 2010b; Frencken & Lemmink, 2008; Lames, Erdmann, & Walter, 2010). Previous research of game behavior at the team level has used relative phase to assess spatiotemporal coordination (Bourbousson et al., 2010b; Lames et al., 2010), with findings demonstrating general tendencies of synchronized displacements of teams in the lateral (i.e., side-to-side) and longitudinal (i.e., forward-backward) directions, particularly the latter. Noted already, these coordinated team dynamics are the hypothesized result of information exchanges between players and teams acting under game constraints (Marsh, Richardson, Baron, & Schmidt, 2006; McGarry et al., 2002).

The primary game objectives of team sports noted at the outset of this report necessitate that ball location with respect to the scoring targets (e.g., basketball hoops, football goals) constitutes an important constraint when considering dynamical game behavior, the ball furthermore providing a principal means for information exchange between players and teams (McGarry, 2009). In this study, we advance previous research by accounting for these important game constraints when investigating team dynamics produced in futsal game practice. Furthering understanding on game constraints and team dynamics may help coaches in designing appropriate tasks in sport practice by managing informational constraints with specific learning aims in mind, such as promoting self-adaptive behaviors within players and teams.

Futsal is a FIFA regulated five-a-side indoor association football game. In futsal competition, a common game strategy is for the trailing team towards the end of a game to substitute the goalkeeper for an extra outfield player when in possession of the ball. This game strategy, hereafter referred to as 5-v-4+GK, gives the trailing team a numerical advantage of outfield players, and is designed to increase the likelihood of generating goal scoring opportunities. In the final four of the UEFA Futsal Cup in Lisbon, 2010, half of the goals scored in the last five minutes occurred using this 5-v-4+GK game strategy, thereby demonstrating its importance to futsal competition.

In this report, we extend on an earlier investigation of the dynamical behaviors observed between players and ball, and between players themselves, in 5-v-4+GK futsal game practice (Travassos, Araújo, Vilar, & McGarry, 2011). As with player behaviors, we expect the team behaviors produced in 5-v-4+GK futsal game practice to conform to dynamical self-organizing principles, for the reasons outlined by McGarry et al. (2002). Furthermore, we account for game context by assessing positions of ball and teams with reference to goal location by using polar coordinates (i.e., angles and radial distance). The expectation is that ball dynamics and goal location are important constraints on game behavior, and, as such, are deserving of attention for advancing understanding of game behavior. The purpose of using polar coordinates, then, is to investigate the phase relations between each team and ball, and between teams, using displacement measures derived from specific reference to goal position.