



Network structure and team performance: The case of English Premier League soccer teams

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ABSTRACT

A defining feature of a work group is how its individual members interact. Building on a dataset of 283,259 passes between professional soccer players, this study applies mixed-effects modeling to 76 repeated observations of the interaction networks and performance of 23 soccer teams. Controlling for unobserved characteristics, such as the quality of the teams, the study confirms previous findings with panel data: networks characterized by high intensity (controlling for interaction opportunities) and low centralization are indeed associated with better team performance.

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1. Introduction

Although there is a consensus regarding the concept that a team is more than the sum of its parts, researchers focus on very different factors to explain why some teams are more successful than others. Some accounts stress the importance of the individual abilities and knowledge of group members, while others focus on group identification and consciousness or on leadership and the organization of work (see, e.g., Kozlowski and Bell, 2003; Sanna and Parks, 1997).

A growing body of evidence links the structural properties—e.g., network centrality—of interactions between group members to performance outcomes (see the reviews in Balkundi and Harrison, 2006; Katz et al., 2004; Flap et al., 1998; Borgatti and Foster, 2003). It has been argued that the orchestration of interactions and the relationships between team members are pivotal for team performance. The relevant unit of analysis is therefore the dyad between team members and not individual team members, per se. Such a social network approach suggests that interaction patterns matter for success. One team will be better than another because the individuals in that team interact in ways that members of the other team do not.

The rationale for this proposition is straightforward: some tasks require the involvement of different individuals or a combination of resources. Therefore, relationships between team members are important because they allow access to resources and facilitate the successful mobilization of these resources (Brass, 1984; Ibarra, 1993). Other researchers suggest that the structural properties of

interaction and relationship patterns in teams are related to social expectations, identity, and support (Podolny and Baron, 1997). In addition, these researchers provide insight into unobserved team characteristics, such as group cohesion or the integration of individual members (see, e.g., Baldwin et al., 1997).

A meta-analysis by Balkundi and Harrison (2006: 59) summarizes previous findings on the relationship between within-team network structure and team performance in the following way: teams with denser networks tend to perform better and remain more viable. Additionally, centralized network structures are found to be negatively associated with team performance (Cummings and Cross, 2003).

Drawing on the innovative setting of team sports, this study overcomes some difficulties of previous research and investigates the interaction network and performance of professional soccer teams in the English Premier League (EPL) using panel data. A dataset of 283,259 passes between individual players in 760 soccer matches allows for the investigation of the network structure and team performance of 23 soccer teams in up to 76 repeated observations. The soccer context is ideal for the following reasons: the game is governed by clear rules; teams are more comparable in a soccer setting than in other settings; the boundaries of the teams are well defined; no players are missing; and the strength of interaction within teams and team performance can be assessed objectively.

After a review of the literature on group performance, the three main limitations of the previous research are identified. Then, the hypotheses that are tested in this study are presented. The next section describes the setting and the data. Then, the variables and measurements for team performance and network structure are introduced. The methods section describes the analytical strategy and the mixed-effects modeling approach that is used. The results section follows the methods section. The article then concludes with a discussion of the findings.

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The main contribution of this article is to study the issue of within-team network structure and the performance of teams through an analysis of panel data. This study draws on an innovative setting, which allows for the analysis of 1520 different networks and performance outcomes. The article thereby contributes to existing debates about the role of embeddedness in the performance outcomes of teams and firms (see, e.g., Granovetter, 1985; Uzzi, 1996; Borgatti and Foster, 2003).

2. Literature

2.1. Previous research on network structure and team performance

One of the earliest empirical studies on interpersonal relations and team performance was conducted at the Hawthorne Works of Western Electric in the 1920s (see Roethlisberger and Dickson, 1939). While the Hawthorne studies were designed to find ways to increase workers' productivity, William Lloyd Warner and Elton Mayo probed interpersonal relations to describe group structures and used experiments to explore the impact of different work conditions on group productivity (Mayo, 1933).

A set of experiments conducted by Alex Bavelas in his Group Networks Laboratory aimed to investigate the role of communication structures in task performance. Participants were arranged in groups of five individuals, and each group had to solve a puzzle. The findings showed that "communication nets" with centralized structures (e.g., a wheel) improved the diffusion of information in simple tasks, whereas decentralized structures (e.g., a circle) delayed the diffusion of information (Bavelas, 1950: 730). Later research built on these experiments and demonstrated that decentralized communication structures are more efficient in solving complex tasks and lead to fewer errors (Leavitt, 1951; Guetzkow and Simon, 1955; Shaw, 1964).

Despite these early efforts and the increased use of work groups in organizations and firms (Guzzo and Salas, 1995; Hackman, 1990), research on network structures and team performance soon came to a halt. It was only recently that the topic of network structure and team performance resurfaced in academia (Katz et al., 2004). Less than ten years ago, Cummings and Cross (2003: 197) noted that "there has been relatively little social network research on the structural properties of natural work groups and their consequences for performance". Among the more recent research, Sparrowe et al. (2001) conducted a field study of 38 work groups in five organizations. The results are similar to those of Shaw (1964) and demonstrate that groups with decentralized communication patterns perform better than groups with centralized communication patterns. In another study, Cummings and Cross (2003) investigated 182 work groups performing complex tasks in a global organization and found that core–periphery and hierarchical group structures were negatively associated with performance. A study of 224 corporate R&D teams by Reagans and Zuckerman (2001) indicates that network density is positively related to productivity. Rulke and Galaskiewicz (2000) study the group network structure and performance of 39 teams of MBA students in management simulation games and find that decentralization is positively associated with stock price. Gloor et al. (2008) examined the number of e-mails sent between online team members and observed that balanced communication structures (e.g., an equal number of e-mails sent and received) are positively related to team performance. Studying 59 consulting teams, Carson et al. (2007) found that shared leadership predicts team performance. An additional overview on empirical studies that relate characteristics of team networks with team effectiveness can be found in

Henttonen (2010). An associated set of studies relates the position of individuals in networks (e.g., node centrality) to individual performance outcomes (see, e.g., Baldwin et al., 1997; Sparrowe et al., 2001).

2.2. Limitations of previous research

The most important limitation of the previous research concerns the issue of causality. Do network structures drive team performance, or does performance promote certain network configurations in a team? All previous studies apply a cross-sectional design because of the difficulty of collecting longitudinal network and performance data. The absence of longitudinal analysis makes it problematic to say whether the network or the hypothesized effects of the network is causally antecedent (Lazer, 2001).¹

Other limitations are related to general developments in social network research. First, social network scholars have long focused on friendships or advice relationships, rather than the interaction of individuals during the production process itself (for an exception, see Brass, 1981).² In many contexts, such a focus is appropriate (e.g., social-capital research), but in others it is less appropriate. While friendships and advice relationships are certainly pivotal for teams, they need to translate into the orchestration of a group production process to matter. Often, separating friendship, advice, and communication relationships is impossible because they are closely interwoven.

A second limitation is the focus on binary relationships. A large fraction of contemporary social network analyses treat network ties in a binary fashion—i.e., ties either exist, or they do not. In the context of network structure and team performance, for example, Cummings and Cross (2003) consider the strength of ties only together with a cutoff point to extract a binary projection of the "valued" relationship. Scholars have long questioned such a binary approach toward networks as it only encompasses qualitative relationships and neglects the strength of ties (see e.g., Festinger, 1949; Lévi-Strauss, 1963; Doreian, 1969; Peay, 1980). In the literature, there is consensus about the importance of variability in strength of interpersonal relationships (see Freeman et al., 1991). Consequently, several researches emerged which explicitly consider the values of social ties (e.g., MacKenzie, 1966; Peay, 1976; Freeman et al., 1991; Opsahl and Panzarasa, 2009). For example, a work relationship can be expected to vary depending on whether colleagues interact occasionally or all the time. Additionally, the intensity of interactions may be especially relevant in small teams, in which everybody is likely to be associated with everybody else.

Another intricate issue is the assessment and comparability of performance measures. Most commonly, team performance is assessed in a subjective manner. For example, Sparrowe et al. (2001) interviewed team leaders to rate the performance of their own team. Such an approach is often necessary because objective measures are unavailable. Furthermore, comparing the performance of different teams is not always a straightforward process, as teams are often involved in different types of work. As Sparrowe et al. (2001) have mentioned, it is also problematic that group leaders are commonly lenient and overrate group performance—especially because a group's effectiveness also reflects the performance of its leader.

¹ See also Aldrich (1991) and Reese and Aldrich (1995) concerning this issue in the context of entrepreneurial networks and business performance.

² Of course, many studies exist which focus on network relationships, which are not based on friendship. For example, scholars examined trust (Buskens, 2002) or gossip relationships (Ellwardt, 2011).

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