Paper to be presented at the DRUID 2012

on

June 19 to June 21

at

CBS, Copenhagen, Denmark,

Coordination Experience and Team Performance

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Abstract

In cross-functional teams, team performance depends on how skillfully function managers carry out the cross-function coordination of team members' complementary expertise and activities. In this paper, we argue (i) that function managers' coordination skills develop in part through the coordination experience gained from interacting with managers from other function, (ii) that coordination experience has general and firm-specific dimensions, and (iii) that coordination experience leads to better team performance. Using data on development teams in the electronic games industry, we show that coordination experience and its general and firm-specific components have a positive impact on the commercial success of electronic games. Our results have implications for the theory of learning and coordination in teams and for the practice of team design in project-based organizations.

Coordination Experience and Team Performance

1 Introduction

Cross-functional teams are the prevalent organizational structure in knowledge and creative industries (Hobday 2000, Sydow et al. 2004), but also in innovation and new product development in traditional industries (Edmondson and Nembhard 2009). For instance, in the electronic games industry, the empirical context of our study, a game development team typically consists of team members working in one of the main functions – production, game design, art, or programming – and occupying a senior/managerial or a junior role within their respective functions (Chandler 2009). Here, team and ultimately firm performance depend partly on team members' experience and skills in their function-specific tasks and on function managers' experience and skills in directing their junior team members (Reagans et al. 2005, Huckman et al. 2009). However, team and firm performance also depend on how skillfully function managers perform the cross-function *coordination* of their complementary functional expertise and interdependent activities (Faraj and Sproull 2000, Gittell 2002, Faraj and Xiao 2006).

And yet, we know little about the experience underlying managers' coordination skills (Stevens and Campion 1994, Ellis et al. 2005) and its impact on team performance. One line of research argues that managers can accrue valuable coordination experience and skills when they work together repeatedly and develop team familiarity (Lewis 2004, Reagans et al. 2005, Espinosa et al. 2007, Huckman et al. 2009). However, team composition frequently changes from one project to another (Edmondson and Nembhard 2009, Huckman et al. 2009), which hampers the development of team familiarity (Lewis 2004) and limits its impact on team performance. Consequently, it remains an open question what, if any, other experience improves managers' coordination skills and if this can improve team performance.

In this paper, we seek to fill this gap. Drawing on Gittell's (2002) argument that coordination is fundamentally a process of interaction between individuals, and on the theory of managerial development, which argues that managerial skills develop through experience (Rosen 1972, McCall et al. 1988,

Castanias and Helfat 2001), we posit that function managers accrue *coordination experience* by interacting with managers from other functions, improving their coordination skills and team performance. Subsequently, based on the theory of managerial human capital which distinguishes between general and firm-specific managerial skills (Becker 1962, Castanias and Helfat 1991), we argue that coordination skills have general and firm-specific dimensions, and that the general and firm-specific coordination experience that enhances these skills is positively associated with team performance.

We test these hypotheses using a large sample of more than 3,700 electronic games developed by teams working in nearly 800 game developer firms over a 14-year period. Controlling for a wide range of factors that may influence team performance, including managers' team familiarity, task, and managerial experience, as well as game and firm related characteristics, we find that a game development team's coordination experience, captured by its managers' interactions with managers from other functions is positively associated with the revenues and the critical reception generated by the game. Moreover, this positive association results from both the general and firm-specific coordination experience accumulated through interactions with managers outside and inside the game developer firm hosting the team.

Our study complements prior work on experience and performance (Faraj and Sproull 2000, Reagans et al. 2005, Huckman and Pisano 2006, Espinosa et al. 2007, Groysberg et al. 2008, Huckman et al. 2009) in several ways. First, we propose a novel form of experience that helps individuals to learn to coordinate: while team familiarity suggests that effective coordination can be achieved by working with the same people we argue that coordination skills also improve by working with different people. Second, given the prevalence of cross-functional teams in many industries, we focus on managers' cross-functional rather than within-task coordination. Third, we conceptually and empirically separate experience gained within the team, within the firm, and outside the firm, and find that all three matter for team performance in distinct ways. Finally, complementing work on the effect of individuals' experience on their performance, we focus on all managers' coordination experience and investigate its impact on the team's commercial rather than operational performance, while controlling for other determinants of performance.

The paper is organized as follows. First, we develop theoretical arguments relating coordination experience to the development of coordination skills and team performance, and present our hypotheses. We then sketch the electronic games industry and our data. Our methodology and a discussion of our results follow. Finally, we discuss the implications of our findings and give directions for future research.

2 Theory

2.1 Experience and Team Performance

A long line of research on the impact of organizational learning and experience on performance provides overwhelming evidence for the existence of an organizational learning curve, whereby firm performance improves as the firm gains production experience (Argote and Epple 1990, Argote et al. 1990, Epple et al. 1991, Hatch and Mowery 1998, Sinclair et al. 2000, Pisano et al. 2001). At the same time, this research recognizes that learning occurs at various levels: individual, group, and organizational (Edmondson 2002, Reagans et al. 2005, Boh et al 2007, Edmondson et al. 2007, Lewis et al. 2007), and more importantly, that learning and experience at the individual level represent the building block for higher-level learning (Argote and Miron-Spektor 2011).

Individual experience affects performance not only at organizational, but also at team level (Hackman 1987, Campion et al. 1993, Cohen and Bailey 1997, Hackman et al. 2000). A stream of this research has focused on the object of experience and it argues that learning and experience related to tasks and hierarchical roles (Anzai and Simon 1979, Argote et al. 1995, Littlepage et al. 1997, Reagans et al. 2005, Espinosa et al. 2007, Huckman et al. 2009) enhance individual- and team-level skills, and thereby improve team performance. Reagans et al. (2005) find that the number of times team members performed a medical procedure in the past reduced the completion time of future procedures. Espinosa et al. (2007) show that the number of software changes members of software development teams completed in the past reduces the completion time of future software changes. Huckman et al. (2009) find that the experience of junior-level software engineers and senior-level project manager measured as the number of days spent in their hierarchical role on prior projects is positively linked to operational performance on future projects.

However, in cross-functional teams typical in electronic game development and other creative and knowledge-intensive industries, where tasks and activities are highly function-specific, yet complexly interlinked, team members must coordinate and integrate activities effectively to accomplish team goals (Faraj and Sproull 2000, Gittell 2002, Faraj and Xiao 2006). Our key contention is that, similarly to learning and experience related to tasks and hierarchical roles, learning and experience related to coordination enhance individual- and team-level coordination skills, leading to improved team performance. Before turning to coordination experience or how coordination skills are acquired, we describe the coordination mechanisms and the actors that employ them to enact coordination, that is, what do coordination skills relate to and who needs these skills.

2.2 Coordination Mechanisms and the Role of Managers

In their review of the literature on coordination, Okhuysen and Bechky (2009) argue that, to achieve effective coordination, organizations and teams have to establish three integrating conditions for coordination: accountability, predictability, and common understanding. Accountability establishes the allocation of task-related responsibilities – who does what – and the flow of completed task work from team members to team members or from function to function – who hands off completed tasks to whom; predictability establishes the sequencing of tasks – in what order and timeframe should tasks be completed; and common understanding ensures that team members hold a shared view of the project that needs to be completed, including task responsibilities and sequencing. Organizations and teams establish these integrating conditions for coordination through various mechanisms like plans, objects, roles, organizational routines and proximity (Okhuysen and Bechky 2009).

Early organization design research considered formal mechanisms as key to enacting coordination. By contrast, recent research recognizes and emphasizes the active role of people in enacting coordination through these mechanisms (Okhuysen and Bechky 2009), i.e., that individuals are crucial in putting these mechanisms in place. For instance, Gittell (2002) argues that “coordination may be facilitated by design

elements but it is more fundamentally a process of interaction among participants" and that "coordination does not occur in a relational vacuum; rather coordination is carried out through a web of relationships."

In cross-functional teams, the responsibility for enacting coordination lies primarily with function managers (Kozlowski et al. 2008, Morgeson, DeRue, and Karam 2010, Okhuysen and Bechky 2009), who occupy, by design, a boundary-spanning role (Gittell 2002). Managers are responsible for setting up the plans and rules of the team, a process that is partly formal, but that also involves informal interactions between managers that solve conflicts and difficulties related to team-work (Bechky and Okhuysen 2011). Managers decide on the use of objects and representations as catalysts for informal interaction whereby they share information, express opinions, and decide on coordination enhancing actions. In their formal role of boundary-spanners, function managers are responsible for sharing and translating information about the progress of function-specific tasks with other managers working on interdependent tasks, and at its core, this process is one of informal interaction and relational coordination (Gittell 2002). In their coordination activities, managers use the organization's coordination routines, but there is growing recognition that formal coordination is unable to account for all the interdependencies involved in complex knowledge work (Feldman and Pentland 2003). In such environments, coordination is carried through tacit, emergent routines or practices arising through the interactions of managers (Birnholtz et al. 2007, Faraj and Xiao 2006). Finally, managers contribute to developing a climate of psychological safety and trust, ensuring that all team members, regardless of their formal power, communicate and provide their task-related information in a sufficient, accurate, and timely manner (Edmondson 2003).

Consequently, managers must be competent in using the formal and informal, emergent elements of the coordination mechanisms at their disposal to effectively enact coordination, supporting the idea that managers' coordination skills are a key behavioral capability of a cross-functional team (Kozlowski and Bell 2003) that might lead to better team performance.

2.3 Coordination Experience and the Development of Coordination Skills

Schooling and training are important factors leading to improvements in human capital (Mincer 1958, Becker 1962), managerial skills (Hunt and Baruch 2003, Avolio et al. 2005, Riggio and Lee 2007), and teamwork skills (Ellis et al. 2005). However, there is increasing recognition that a significant component of managerial skills develops through experience (Rosen 1972, McCall et al. 1988, McCauley et al. 1994, Tesluk and Jacobs 1998, Castanias and Helfat 2001). For example, experience enables managers to learn skills such as handling relationships and agenda setting (McCall et al. 1988, McCauley et al. 1994). In addition to these, Stevens and Campion (1994) and Ellis et al. (2005) identify communication, task planning, and coordination as fundamental skills in achieving effective teamwork. Thus, our first main contention is that, similarly to broader managerial skills, coordination skills develop through experience.

Prior work has focused mainly on team familiarity, or experience working together (Goodman and Leyden 1991, Gruenfeld et al. 1996, Littlepage et al. 1997), as a form of experience that enhances coordination skills and hence team performance (Faraj and Sproull 2000, Lewis 2004, Reagans et al. 2005, Huckman et al. 2009). However, team composition often changes between projects (Edmondson and Nembhard 2009, Huckman et al. 2009), leading to low team familiarity (Lewis 2004), which raises the question if other experience, if any, develops managers' coordination skills and improves team performance?

Managerial experience and skills are affected by the developmental qualities of job assignments, that is, the extent to which particular work situations require the use of these skills over and beyond routine tasks (McCall et al. 1988, McCauley et al. 1994, McCauley and Brutus 1998, Dragoni et al. 2009). McCall et al. (1988) and McCauley et al. (1994) identify two qualities of work situations that are especially relevant for coordination skills: job transitions and nonauthority relationships. Job transitions disrupt entrenched managerial behaviors and routines and force managers to adjust their modus operandi, while nonauthority relationships force managers to negotiate, gain cooperation, and coordinate with each other rather than simply direct and supervise subordinates over whom they have formal authority.

By design, function managers operate in nonauthority relationships with other function managers, so that when defining coordination experience, our focus is on interactions between function managers. This kind of coordination experience is acquired in particular in the context of a job transition, i.e. when a function manager interacts with new function managers. A natural operationalization of job transitions would be the number of projects an individual worked on as function manager. However, this quantitative representation of work experience does not account for its qualitative aspects, in particular the novelty of projects (Tesluk and Jacobs 1998). Consequently, we propose a form of experience that is relevant to coordination skills, captures the novelty of projects an individual worked on as function manager, and most importantly, relates to the informal, relational aspects involved in coordination (Gittell 2002).

On each project, a key duty of function managers is the coordination of complementary expertise and interdependent activities particularly with managers from other functions, a process that entails extensive communication, negotiation, and collaboration. Completing a project with familiar managers is likely to generate coordination skills relevant mostly to the interaction with those familiar managers. In contrast, coordination with unfamiliar managers might render prior skills ineffective and require managers to develop alternative approaches. This is likely to help managers coordinate effectively in most teams and with most partners, rather than only in teams featuring familiar partners. Over a manager's career, the breadth of coordination challenges and opportunities is then represented by the number of distinct managers from other functions with whom a function manager coordinated, which we label *Coordination Experience*.[1] *Coordination Experience* helps function managers coordinate their expertise and activities more effectively even if they have not cooperated before.

All managers' coordination skills are relevant for effective team coordination, which in turn affects team performance (Faraj and Sproull 2000). Accordingly, at the team level, we define coordination experience as the average of function managers' individual coordination experience, and propose that:

HYPOTHESIS 1 (H1). *Coordination experience is positively associated with team performance.*

[1] Our measure of coordination experience is similar to the concept of teaming experience proposed by Edmondson and Nembhardt (2009).

Becker (1962) distinguishes between the general and firm-specific dimensions of human capital: general human capital improves an individual's productivity in any organizational context, whereas firm-specific human capital helps only in a specific organization. This also applies to managerial human capital, or the skills and abilities of managers at various hierarchical levels (Castanias and Helfat 1991, 2001, Huckman and Pisano 2006). Thus, our second main contention is that, similarly to the broader managerial skills, the coordination skills relevant for effective teamwork can be general or firm-specific. General coordination skills are portable and enable managers to coordinate more effectively in any team and with any partner. By contrast, firm-specific coordination skills are not fully portable and enable managers to coordinate more effectively predominantly with partners from the same firm.

General coordination skills develop through experience with coordination mechanisms in general, i.e. of any firm. In this sense, it is similar to partnering experience in the alliance literature (Anand and Khanna 2000, Kale et al. 2002, Hoang and Rothaermel 2005, Sampson 2005, Kale and Singh 2007, Goerzen 2007, Gulati et al. 2009), which theorizes that firms accumulate experience with various partners through developing relational capabilities (Dyer and Singh 1998, Gulati 1999, Kale et al. 2002). In our context, by coordinating with distinct managers from any firm, function managers become familiar with the best practices involved in the planning process, using objects and representations, and they gain *general coordination experience*, that is, experience with, and skills related to informal, relational coordination, such as negotiation and communication skills, or skills in establishing a climate that enhances communication in the team. In its most intuitive operationalization, general coordination experience results from coordinating with distinct managers from other firms, because in the transition to the current firm, function managers can use only the portable, general coordination skills they gained in other firms. While in the context of cardiac surgery Huckman and Pisano (2006) find that experience at other hospitals has no effect on the performance of a surgeon in a particular hospital, it is an empirical question if this result generalizes to other contexts. Consequently, we propose that:

HYPOTHESIS 2 (H2). *General coordination experience is positively associated with team performance.*

Conversely, firm-specific coordination skills develop only through experience with the firm-specific aspects of a firm's coordination mechanisms. By working in a firm, function managers become familiar with the firm's formal planning process, its particular approach to using objects and representations, or its coordination routines. Most importantly, by coordinating with distinct managers in the firm, function managers gain firm-specific coordination experience, that is, experience with, and skills related to the firm's informal coordination mechanisms, such as the interpersonal dynamics involved in negotiating the allocation of resources in the planning process or using the tacit, people-embedded aspects of a firm's coordination routines (Argote and Miron-Spektor 2011). Huckman and Pisano (2006) and Groysberg et al. (2008) provide evidence that individual performance is partly organization specific, suggesting that individuals indeed develop familiarity with organizationally embedded knowledge and routines. We extend this argument to team performance and the role of all managers' experience and propose that:

HYPOTHESIS 3 (H3): *Firm-specific coordination experience is positively associated with team performance.*

3 Empirical Context: Game Development Teams in the Electronic Games Industry

We study the electronic games industry, which includes three types of players: game developers ("developers"), publishers, and hardware manufacturers. Developers are firms that create electronic games, based either on original content conceived by the developers or on licensed content from movies, books, or sports leagues. Game developers can be either independent or owned by publishers. Publishers fund the development of electronic games and manage the relationship with hardware manufacturers and retailers, including the packaging and marketing of games to consumers. Finally, hardware manufacturers develop and sell hardware on which the games are played, which includes dedicated game consoles, computers, and mobile phones. In 2010, the industry reached total sales of $15.6 billion, out of which $10.1 billion represented sales of electronic games (NPD 2011), on par with the $10.6 billion in U.S. box office receipts for the same year (MPAA 2011).

Game developers structure and manage the development of a fundamentally complementary end product around cross-functional game development teams. Team members work in one of the four main functions – production, game design, art and programing – and occupy a senior/managerial or junior role within their respective functions (Chandler 2009). The primary task of producers is to ensure the general efficiency of the game development process, particularly that the project is finished on time and within budget. They work closely with senior team members in game design, art, and programming, and mediate between the development team, the management of the game developer, and the publisher (Chandler 2009). Game designers develop the idea, the characters, and the plot of a game, and set its visual design and rules. The industry considers them the "keeper[s] of the creative vision of the game" (Novak 2008). Game designers work closely with artists and programmers to develop the art and technology needed for compelling and immersive play (Chandler 2009). Artists develop and implement the concept art and graphical assets of the game, such as characters, vehicles, and buildings. Their tasks include drawing, modeling, texturing, and animation. Besides programmers they are usually the largest part of the team. Artists work with designers on what assets are needed and with programmers on how to use the technology effectively to support art production (Chandler 2009). Programmers code the game and develop software needed by designers and artists (Novak 2008). Because the goal of the game development process is to create entertainment software, programmers must be able to work well with both creatives and other programmers to implement the vision of the game (Chandler 2009). In other words, coordination across functions is a key factor to the success of development teams since the degree to which functional domains implement the specifications of other domains eventually determines the gaming experience. This is evident in the words of a senior game developer who stressed that "a game is only as strong as its weakest part." In addition to the four main roles mentioned above there are other roles involved in the game development process like audio design, game testing, and quality assurance. As these are often outsourced or decoupled from other functions (Novak 2008) we do not include them.

In the early years of the industry, the development of a game was usually done by small teams, consisting of a designer and a programmer, at costs ranging from $1,000 to $10,000 (Hight and Novak

2008). Aided by tremendous technological change like the introduction of 3D graphics or compact discs as storage medium, game developers now create graphically more realistic and immersive games but also more complex ones in terms of game play and code. To fully realize the potential of new technologies, larger teams of 30 to 80 people and occasionally even more are necessary and game development costs increased, ranging now from $5 million to $30 million (Hight and Novak 2008). As larger teams require more supervision and coordination, the increase in the team size led to the hierarchical separation of roles, so that within each function, there exist both senior roles, occupied by directors and leads (managers, in our terminology), and junior roles. Directors are responsible for setting the creative, artistic, and technological standards for the game, and they are in charge of the overall coordination across functions. Directors are supported by leads, who ensure that standards are maintained throughout the development process (Chandler 2009). Leads also act as intermediaries between the directors and the rest of the team, and they are in charge of day-to-day supervisory and coordination activities within and across functions. Junior team members are in charge of the implementation of functional tasks. Figure 1 shows the typical organizational chart for a game project of moderate or high complexity.[2]

INSERT FIGURE 1 ABOUT HERE

We focus on the effective coordination of expertise and activities across functions, an activity carried out by function managers. Consequently, in constructing our measures of coordination experience, we restrict our attention to managers, that is, team members who hold a director or lead position in production, game design, art, or programing.

[2] This structure and the qualitative features of the industry have been confirmed in a number of in-depth interviews with leading individuals in the industry. Our interviewees worked in different functions (such as game designer and producer) and both in large (such as Electronic Arts and Ubisoft) and smaller firms.

4 Method

4.1 Data and Sample

We combine data from the MobyGames and NPD databases for our study. MobyGames is the world's largest and most detailed electronic game documentation project, containing information on more than 49,000 games published from 1972 up to date. The website that hosts MobyGames is operated by four industry veterans with the purpose of preserving the history of electronic games by constructing references to all games and their creators. The information on each game is entered by gamers with the game box and manual or credits used as a reference, and according to a strict set of coding standards and instructions. Users get rewarded with a contribution rating for the information entered. To ensure accuracy, MobyGames requires all entries to be peer reviewed before they are published. For more than 19,000 games featured in MobyGames we have full information on the game's genre, its platform, its release date, the individuals who worked on the game (credits) and their job titles, as well as on the game developer and the publisher. Thus, we can track individual careers across different teams and game developers, and construct our coordination experience measures from the beginning of the industry. To do so, we followed the standard reference on occupations and career paths in the electronic games industry, Mencher (2003), and classify job titles from MobyGames into four different functions – production, game design, art, and programing – and two different hierarchical roles – senior/managerial and junior roles.

The MobyGames data is matched with revenue data collected by NPD, a market research firm that covers the industry since 1995. NPD's retail tracking service monitors retail sales of electronic games and consoles in the U.S., covering all distribution channels, including online sales.[3]

Combining both datasets yields 5,369 unique games for which we have complete information on the members of the game development team, the developer, the publisher, the characteristics of the game and its revenues. We control for developer and publisher performance in the year prior to the introduction of the focal game, which results in a loss of about 1,695 games released either by a developer or a publisher

[3] Online sales are covered as their importance has grown. However, because Wal-Mart stopped providing data to all research companies in 2002, NPD projects Wal-Mart sales after 2002.

that has not produced a game before the introduction of the focal game. Thus, our final sample consists of 3,710 games.

4.2 Dependent Variables

Like in other creative industries, the success of an electronic game can be measured in terms of both financial and critical performance. Our main dependent variable, *Game Revenue*, is the natural logarithm of the revenues generated by a game in the first year after its release. We focus on revenues generated in the first year after the game's release in order to make the games more comparable to each other, as there exists variation in the time that games spend on the market, and more importantly, to avoid censoring the games released in the last year covered by our data. This approach is further justified by the L-shaped sales pattern of an electronic game. Games in our sample generate more than 80% of their sales in the first twelve months after release. Moreover, the pairwise correlation between the sales generated in the first year after release and the sales generated in the first two years after release is about 99%.

We use the natural logarithm to reduce skewness in the sales data because the electronic games industry, like other creative industries, is hit-driven. While so-called blockbuster games like "*Grand Theft Auto: San Andreas*" or "*Super Mario 64*" each generated more than $300 million in the U.S. alone, sales of other games were a small fraction of that (see Figure 2).

INSERT FIGURE 2 ABOUT HERE

4.3 Independent Variables

Coordination Experience, General Coordination Experience and *Firm-Specific Coordination Experience* are the variables of central interest to our study. Each variable is measured at the managerial team level, which comprises all team members who hold a director or lead position in one of the four main occupational roles: production, game design, art, or programing. While we have revenue data only for games released between 1995 and 2008, all human capital variables are constructed from the MobyGames database, which lets us track the careers of managers from their entry into the industry until 2008.

For each manager on a game development team, *Coordination Experience* is computed as the total number of distinct individuals the focal manager worked with on prior game development teams, and who, at the time of the relationship were:

(i) in a managerial role – to ensure that the relationship focused on coordination rather than supervision;

(ii) on the same team but in a different function than the focal manager – to ensure that the relationship provided opportunities for learning about cross-functional coordination rather than function-specific knowledge.

To construct our team-level metric, we average the coordination experience of all managers on the game development team, and take the natural logarithm of one plus this average to reduce skewness. In constructing our measure, we focus on distinct individuals to distinguish coordination experience from team familiarity arising from repeated interactions with the same individuals.

Similarly, for each manager, *General Coordination Experience* (respectively *Firm-Specific Coordination Experience*) is computed as the total number of distinct individuals the focal manager worked with on prior game development teams, and that, at the time of the relationship were:

(i) in a managerial role;

(ii) on the same team, but in a different function than the focal manager; and

(iii) on the same team with the focal manager, but in a *different* (respectively *the same*) game developer than the one developing the focal game.

To construct our team-level metrics, we average the general and the firm-specific coordination experience of all managers on the game development team, and take the natural logarithm of one plus this average.

To summarize, we construct overall coordination experience and decompose it in general and firm-specific coordination experience by distinguishing between cross-functional nonauthority relationships within and outside the focal firm. Our measures have an important advantage over other measures based on industry or firm tenure (Joseph et al. 2006), or the number of teams worked on (Huckman et al., 2009). In particular, by focusing on coordination relationships we can control for other forms of experience that

are accumulated during an individual's tenure or projects with a firm, which lets us isolate the impact of coordination experience on team performance.

4.4 Control and Indicator Variables

In our empirical analysis, we control for a wide range of team-, developer-, publisher-, and game-specific characteristics expected to affect the commercial success of a game. More importantly, however, as we seek to assess the effect of general and firm-specific coordination experience over and above other forms of experience that could enhance managers' coordination skills, we control for *Team Familiarity*, which is a measure of partner-specific coordination experience. In addition, as our measures of general and firm-specific coordination experience could potentially proxy for other forms of experience, we control for both function-specific *Task Experience* and for supervisory *Managerial Experience*.

Team Familiarity captures managers' experience with other managers with whom they currently cooperate. We construct *Team Familiarity* similarly to Reagans et al. (2005) and Huckman et al. (2009), by calculating the number of times each couple of managers *i* and *j* on the current game development team have worked together as managers on prior game development teams over the past six years. We sum this value, PW_{ij}, over every unique dyad, and divide the sum $\sum_{i=1}^{N}\sum_{j=1}^{N} PW_{ij}$ by the number of all possible dyads, N*(N-1)/2, where N is the size of the managerial team. In line with prior literature, we aim to allow managers the possibility of working together on at least three different projects. Given that most electronic games take between one and two years to develop, we consider a six-year window in constructing our team familiarity measure. We differ from prior work in that we can observe dyads both within the focal firm and across the industry. As our measure of team familiarity is highly skewed we take the natural logarithm after adding one to each value.

Task Experience captures a function manager's experience with the specific activities of junior team members working in that function and is measured as the number of times a function manager worked in that respective function before being promoted to a lead role. This resembles the key individual

experience measure in Huckman and Pisano (2006). We average the individual task experience of the relevant managers and take the natural logarithm of one plus this average for our team level metric.

Managerial Experience captures a function manager's experience with supervising and coordinating the work of junior team members working in that function and is measured as the average number of junior team members previously supervised by each manager in their respective function. Again, we average the individual managerial experience of all managers on the game development team and take the natural logarithm of one plus this average to construct our team level metric.

The size of the development team varies with the complexity of the game. Additionally, as labor costs account for the highest proportion of the game development costs, the size of the development team is also a good proxy for costs associated with the development of the game,. Therefore, we control for *Team Size*, defined as the overall number of team members.

Some games use copyrighted content from outside sources, such as books, movies, or sports. To account for the possibility that a well-known name or brand in another field drives the commercial success of electronic games, we construct a dummy variable, *Licensed Game*, which takes on value one if the game includes licensed content and zero otherwise.

As successful games are often turned into a series especially if they rely on intellectual property developed in-house by the developer, we include a dummy *Series* that equals to one if a game is part of a series and zero otherwise.

There are numerous developer and publisher-specific factors that drive the commercial success of a game, such as culture or routines, which we cannot observe or measure. However, such factors are likely to be reflected in game developers' and publishers' past commercial success. We therefore construct the variables *Developer's Past Performance* and *Publisher's Past Performance*, defined as the natural logarithm of sales of the developer and, respectively, the publisher, in the year before a game's release.

Some firms comprise both a game development and a publishing arm. To capture the potential benefits from such a relationship, we construct a dummy variable, *Vertical Integration*, which takes on value of one if the developer and publisher belong to the same firm, and zero otherwise.

As some platforms attract more gamers but also more developers who want to release a game on the specific platform, we include the variable *Games Released on Platform* that is the natural logarithm of the number of games released on the same platform in the same year as the focal game.

Similarly, some genres are more popular than others, and thus might be more successful commercially. Accordingly, we use 8 indicator variables for the *Genre* of the game. Most games are classified in more than one genre and we assign a 1 for each genre in which they are classified.

Due to the industry's high seasonality, with peak demand and supply between Thanksgiving and Christmas, and during the large fair trades, we include dummy variables for the introduction *Month*.

Game Revenue may not only be determined by within-year seasonality, but also by longer-term macroeconomic and technological factors. Thus, we include 14 *Year* indicator variables.

Given the large-sample, multi-year, multi-firm nature of our data, we include *Developer and Publisher Dummies* in some of our specifications to control for unobserved, time-invariant heterogeneity that may affect the commercial performance of electronic games but is not captured by past performance.

Descriptive statistics and correlations between variables are presented in Table 1.

INSERT TABLE 1 ABOUT HERE

4.5 Estimation Method

To test our hypotheses, we estimate ordinary least squares (OLS) regression models with standard errors clustered at the game developer level and robust to heteroskedasticity. Because the correlations between some of the independent variables are above .4, we derived the variance inflation factors (VIF) to assess whether multicollinearity affects our estimates. However, the highest VIF value was 3.72 and the average value was 2.03, indicating that multicollinearity is not a concern (Kutner et al. 2004).

To investigate how the effects of general coordination experience and firm-specific coordination differ according to different levels of team familiarity, and to see if these forms of experience complement or substitute each other, we use a set of interaction terms (Aiken and West 1991; Brambor et

al. 2006). To avoid the potentially high correlations between the main effects of general and firm-specific coordination experience and the interaction effects, we standardized these three variables by subtracting the mean and dividing by the standard deviation (Kutner et al. 2004).

5 Results

5.1 Main Analysis

We first present our baseline model with only the control and indicator variables. We then introduce our measure of overall coordination experience before successively introducing general and firm-specific coordination experience. These models allow us to examine the overall performance effects of coordination experience in its various forms.

Table 2 Column 1 gives the results from OLS regression of *Game Revenue* on our control variables.

INSERT TABLE 2 ABOUT HERE

Most control variables are highly significant. Of particular interest and in line with prior research (Reagans et al. 2005; Espinosa et al. 2007; Huckman and Staats, 2011), we find that *Team Familiarity* – one form of coordination experience – has a positive and significant ($p<0.01$) impact on revenues, suggesting that teams with managers who worked with each other more often tend to develop games that are more commercially successful. In addition, both *Task Experience* and *Managerial Experience* – which account for managers' experience with team activities other than cross-functional coordination – have positive and significant ($p<0.01$) effects on revenues, reinforcing prior findings (Huckman et al. 2009). Thus, teams with managers that have more experience with the function-specific activities of the juniors they supervise, and that have coordinated and supervised larger groups of junior team members develop games that generate more revenues. Note that the coefficients on *Team Familiarity* and *Task Experience* become insignificant once our key independent variables are included, however.

The size of the game development team (*Team Size*) has a positive and significant ($p<0.01$) impact on the financial performance of a game, suggesting that complex games developed by larger teams

generate more revenue. We further find that, as expected, games based on licensed content (*Licensed Game*) and games that are part of a series (*Series*) perform significantly ($p<0.01$) better. At the firm level, *Developer's* and *Publisher's Past Performance* have both a positive and significant ($p<0.01$) impact on the commercial success of a game meaning that developers and publishers who produced commercially successful games in the prior year are also successful with the focal game. The *Vertical Integration* dummy is positive but only marginally significant ($p<0.1$), providing some evidence that games developed and published by the same firm (in-house) are more successful. The coefficient for *Games Released on Platform* is negative and significant ($p<0.01$) suggesting that the negative effect of platform competition in terms of the number of games released outweighs the positive effect of a larger installed base in terms of potential gamers.

In Column 2 we include *Coordination Experience* and find a positive and significant ($p<0.01$) effect of *Coordination Experience* on *Game Revenue*. This strongly supports our first hypothesis (H1) indicating that teams led by managers who worked with a large number of different managers occupying distinct functions develop better performing games. In terms of economic magnitude, our results suggest that for a game with average game revenue ($1.49 million), developed by a team with average coordination experience (8.21), a 10% increase in *Coordination Experience* results in a 1.9% increase in expected revenues, equivalent to about $28,403.

To differentiate between the general and the firm-specific component of coordination experience, we drop *Coordination Experience* in Column 3 and include only *General Coordination Experience.* The positive and significant ($p<0.01$) effect of *General Coordination Experience* on a game's financial success indicates that teams with managers who worked with a larger number of managers in distinct functions before they joined the developer of the focal game will develop more (commercially) successful games. This strongly supports our second hypothesis (H2). Specifically, a 10% increase in *General Coordination Experience* results in a 1.8% increase in expected revenue, equivalent to about $26,908.

Finally, in Column 4, we add *Firm-Specific Coordination Experience* to the regression in Column 3. The coefficient is positive and statistically significant ($p<0.01$), suggesting that teams with managers who

worked with a larger number of managers in distinct functions within the focal firm are more effective in using the developer's routines and processes for cross-functional coordination. This leads to superior commercial success, and provides strong support for our third hypothesis (H3). Our results indicate that a 10% increase in *Firm-Specific Coordination Experience* results in a 1.1% ($16,444) increase in expected revenues. At the same time, the coefficient on General Coordination Experience maintains its statistical significance and economic magnitude.

5.2 Interaction Effects

We further investigate whether the three forms of coordination experience, i.e., *General Coordination Experience*, *Firm-Specific Coordination Experience*, and *Team Familiarity*, substitute or complement each other. We do so by introducing pair-wise interactions between these forms of coordination experience. The results are given in Table 3.

INSERT TABLE 3 ABOUT HERE

Colum 1 in Table 3 reproduces Column 4 in Table 2. In Columns 2 and 3, we find that the coefficients of both *General Coordination Experience* and *Firm-Specific Coordination Experience* maintain their statistical significance and magnitude, while the coefficients on the interactions between *General Coordination Experience* and *Team Familiarity*, and respectively between *Firm-Specific Coordination Experience* and *Team Familiarity* are statistically insignificant, indicating that both general coordination experience and firm-specific coordination experience are equally important across all levels of team familiarity. These results carry through in Column 4, where we also introduce the interaction between *General Coordination Experience* and *Firm-Specific Coordination Experience*. We find that the coefficient on this interaction is positive and statistically significant. An interpretation of this finding is that general and firm-specific coordination experience foster different types of skills that reinforce each other. If the same skills were developed, we would expect a substitutive effect.

6 Discussion and Conclusions

What determines team performance? While this question has received extensive attention in management and psychology, we make a number of significant theoretical and empirical contributions.

From a theoretical perspective, our study extends existing work (Lewis 2004, Reagans et al. 2005, Espinosa et al. 2007, Huckman and Pisano 2006, Groysberg et al. 2008, Huckman et al. 2009) by studying the performance consequences of a novel form of experience and its general and firm-specific dimensions that may help team managers develop coordination skills. This helps them coordinate their expertise and activities more effectively, specifically coordinating with distinct managers from different functions. We find that teams with more coordination experience, overall as well as in its general and firm-specific dimensions, perform better. Further, we find that general and firm-specific coordination experience matter for all levels of team familiarity. Finally, general and firm-specific coordination experience appear to be distinct, complementary forms of experience.

Our empirical setting is distinctive in several ways. Our data covers a large segment of the products created by the electronic games industry over an extended period of time, including game-specific sales figures and development teams. This lets us extend prior literature by focusing on the commercial and critical reception rather than operational aspects of team performance, and observing team composition and its effects not only within firms, but across firms and over time. Further, detailed data on team managers' team and firm affiliations over time let us study various measures of coordination experience and their impact on team performance.

Several important questions remain for future work. First, it is unclear through what mechanisms coordination skills develop. They can result from learning by doing, which is the mechanism we assume in this paper, or from observation and discussion, which has been found to matter for task-specific skills (Boh et al. 2007). Understanding which mechanism is more important and under what circumstances would provide significant insights for practitioners. If learning by doing is key for developing coordination skills, matching team managers based on their coordination experience matters less because they learn over time. Conversely, if coordination skills develop through observation and discussion, the

quality of interaction partners and their willingness to share are crucial. For coordination skills to be transmitted, inexperienced team managers should be given the opportunity to increase the range of their social network by working with demographically diverse team managers (Reagans et al. 2004) or should be matched with experienced ones, particularly with ones willing to mentor. Studies using the diversity of team managers' social networks and performance evaluations that measure both the coordination skills and the mentoring behavior of team managers would represent significant steps in this direction.

Effective coordination involves skills such as communication, handling relationships, and agenda setting. It would be useful to assess the extent to which these skills are general, and thus developed through general coordination experience, and the extent to which they are firm-specific, and thus developed through familiarity with firm-specific routines and the styles of the firm's managers. If they are firm-specific, what routines and which managers are most conducive to improved coordination? How can firms familiarize newly-hired team managers with such routines and managerial styles? Firm-level studies in the spirit of Faraj and Sproull (2000) or Huckman et al. (2009) could address these questions.

Coordination skills may be innate or the result of training or on-the-job experience. An alternative approach to ours would be to use information on the educational background of team managers as a proxy for innate talent or training. Alternatively one could use demographic variables as proxies for talent or training. Dezső and Ross (2011) provide evidence that female participation in top management results in significantly better performance, particularly in innovation-intensive firms. One explanation for this is that women have a different management style that is particularly effective in innovation-intensive environments, where creativity and the sharing of information are crucial. Proxying for innate coordination skills by team members' gender may help address this issue.

Finally, we consider the performance consequences of general and firm-specific coordination skills acquired through experience. But are there other forms of experience, such as the breadth of functions a manager worked in, that enhance coordination skills? We hope that this study will inspire work on these and other related issues, and will help practitioners in the important task of composing effective teams.

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Figure 1. Team Composition

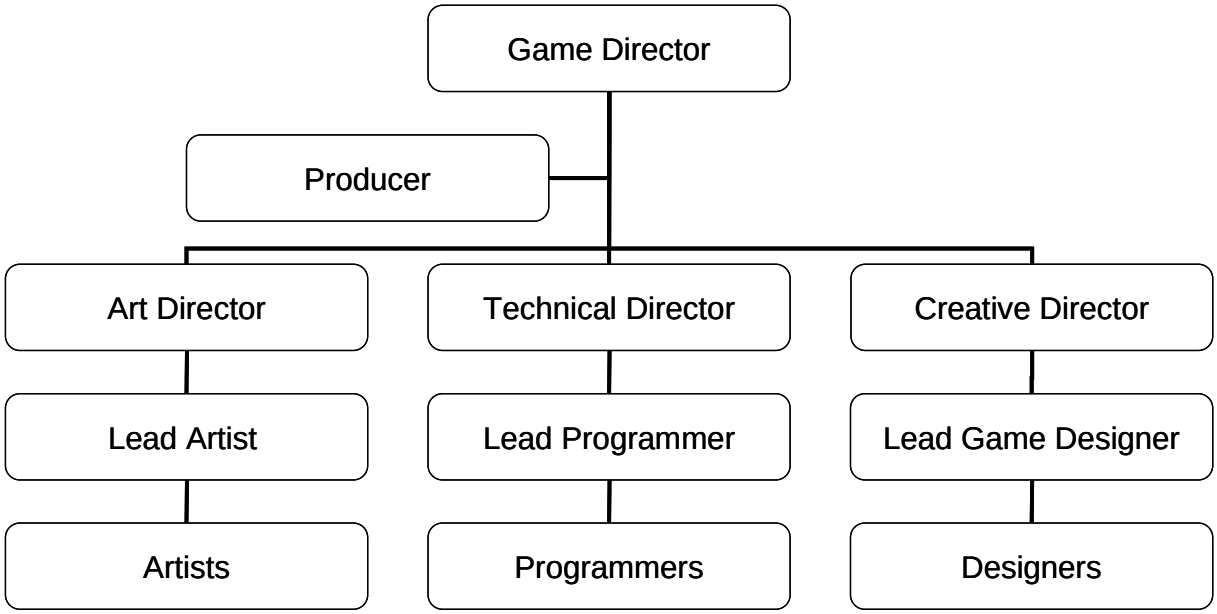

Figure 2. Sales Rank of Games in Sample

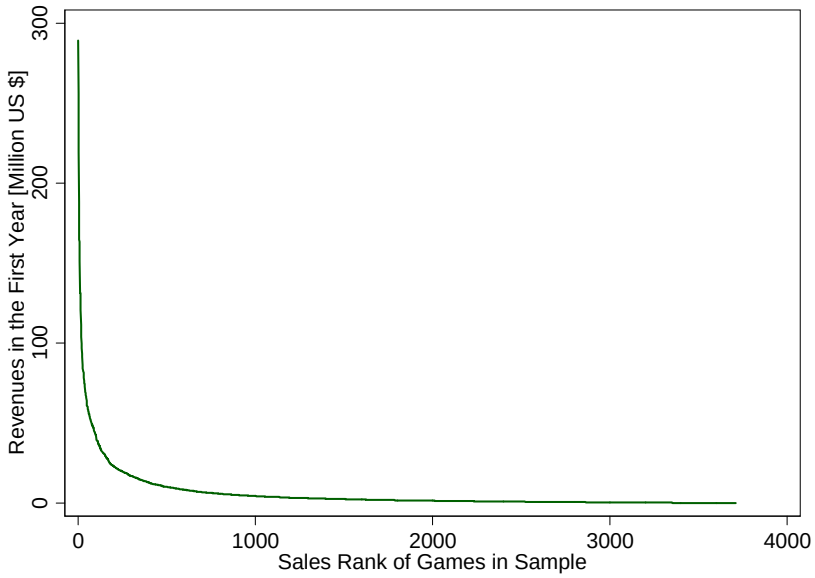

Table 1. Descriptive Statistics and Correlations (N=3,710)

	Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Game Revenue	14.22	1.82	3.58	19.48	1												
2	Coordination Experience	2.106	0.82	0	4.64	0.33*	1											
3	General Coordination Experience	1.409	0.91	0	4.58	0.28*	0.76*	1										
4	Firm Specific Coordination Experience	1.429	0.84	0	3.96	0.26*	0.70*	0.15*	1									
5	Team Familiarity	0.296	0.37	0	3.09	0.06*	0.41*	0.21*	0.45*	1								
6	Task Experience	0.839	0.54	0	3.00	0.23*	0.50*	0.41*	0.34*	0.21*	1							
7	Managerial Experience	1.984	0.78	0	4.85	0.33*	0.25*	0.13*	0.27*	-0.08*	0.27*	1						
8	Team Size	7.588	5.79	2	65	0.33*	0.24*	0.14*	0.25*	-0.08*	0.21*	0.82*	1					
9	Licensed Game	0.194	0.40	0	1	0.16*	0.16*	0.15*	0.11*	0.06*	0.09*	0.04	0.04	1				
10	Series	0.611	0.49	0	1	0.28*	0.12*	0.05*	0.13*	0.05*	0.11*	0.19*	0.16*	-0.16*	1			
11	Developer's Past Performance	15.18	2.62	0.69	20.09	0.41*	0.37*	0.20*	0.40*	0.10*	0.28*	0.27*	0.26*	0.15*	0.17*	1		
12	Publisher's Past Performance	17.23	2.50	0.69	21.14	0.45*	0.30*	0.26*	0.22*	-0.01	0.25*	0.30*	0.29*	0.17*	0.15*	0.43*	1	
13	Vertical Integration	0.35	0.48	0	1	0.12*	0.06*	0.01	0.09*	-0.04	0.06*	0.15*	0.18*	-0.01	0.11*	0.25*	0.02	1
14	Games Released on Platform	5.579	0.91	0	6.79	-0.27*	-0.21*	-0.24*	-0.08*	-0.02	-0.05*	0.10*	0.08*	-0.13*	0.04	-0.21*	-0.18*	0.01

*Notes. * denotes significance at the 1% level.*

Table 2. Coordination Experience and Team Performance

	Game Revenue			
	(1)	(2)	(3)	(4)
COORDINATION EXPERIENCE:				
Coordination Experience		0.189***		
		(0.039)		
General Coordination Experience			0.178***	0.189***
			(0.030)	(0.030)
Firm Specific Coordination Experience				0.114***
				(0.037)
CONTROLS:				
Team Familiarity	0.187***	0.049	0.131*	0.022
	(0.072)	(0.077)	(0.072)	(0.080)
Task Experience	0.150***	0.063	0.055	0.028
	(0.052)	(0.054)	(0.054)	(0.054)
Managerial Experience	0.266***	0.257***	0.283***	0.268***
	(0.061)	(0.061)	(0.061)	(0.061)
Team Size	0.005***	0.005***	0.005***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Licensed Game	0.429***	0.407***	0.401***	0.393***
	(0.064)	(0.064)	(0.063)	(0.063)
Series	0.706***	0.698***	0.705***	0.700***
	(0.051)	(0.051)	(0.051)	(0.051)
Developer's Past Performance	0.081***	0.073***	0.082***	0.072***
	(0.012)	(0.012)	(0.012)	(0.012)
Publisher's Past Performance	0.171***	0.165***	0.163***	0.162***
	(0.013)	(0.013)	(0.013)	(0.013)
Vertical Integration	0.088*	0.089*	0.091*	0.089*
	(0.053)	(0.053)	(0.053)	(0.053)
Games Released on Platform	-0.450***	-0.425***	-0.416***	-0.412***
	(0.035)	(0.036)	(0.036)	(0.036)
Constant	10.722***	10.522***	10.475***	10.511***
	(0.358)	(0.358)	(0.357)	(0.357)
DUMMY VARIABLES:				
Genre	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
No. of Observations	3,710	3,710	3,710	3,710
Adj. R^2	0.391	0.395	0.397	0.398
F Statistic	52.17***	53.17***	53.12***	52.81***

Notes. OLS regressions of game revenues on the coordination experience of the development team's managers. Variables are defined in the text. Regressions include dummy variables for genres, years and months. Robust standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels respectively.

Table 3. **Coordination Experience and Team Performance – Interaction Effects**

	Game Revenue			
	(1)	(2)	(3)	(4)
COORDINATION EXPERIENCE:				
General Coordination Experience	0.189***	0.179***	0.177***	0.158***
	(0.030)	(0.028)	(0.028)	(0.029)
Firm Specific Coordination Experience	0.114***	0.102***	0.102***	0.092***
	(0.037)	(0.034)	(0.034)	(0.034)
INTERACTION EFFECTS:				
General Coordination Experience × Team Familiarity		-0.019	-0.006	-0.034
		(0.018)	(0.021)	(0.024)
Firm Specific Coordination Experience × Team Familiarity			-0.034	-0.042
			(0.031)	(0.033)
General Coordination Experience × Firm Specific Coordination Experience				0.084***
				(0.031)
CONTROLS:				
Team Familiarity	0.022	0.017	0.039	0.048
	(0.080)	(0.033)	(0.040)	(0.043)
Task Experience	0.028	0.027	0.025	0.039
	(0.054)	(0.054)	(0.054)	(0.054)
Managerial Experience	0.268***	0.271***	0.273***	0.290***
	(0.061)	(0.061)	(0.061)	(0.061)
Team Size	0.004***	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Licensed Game	0.393***	0.393***	0.396***	0.391***
	(0.063)	(0.063)	(0.063)	(0.063)
Series	0.700***	0.696***	0.694***	0.696***
	(0.051)	(0.051)	(0.052)	(0.051)
Developer's Past Performance	0.072***	0.072***	0.072***	0.072***
	(0.012)	(0.012)	(0.012)	(0.012)
Publisher's Past Performance	0.162***	0.162***	0.163***	0.163***
	(0.013)	(0.013)	(0.013)	(0.013)
Vertical Integration	0.089*	0.088*	0.088*	0.081
	(0.053)	(0.053)	(0.053)	(0.053)
Games Released on Platform	-0.412***	-0.414***	-0.414***	-0.417***
	(0.036)	(0.036)	(0.036)	(0.036)
Constant	10.511***	10.899***	10.905***	10.889***
	(0.357)	(0.357)	(0.357)	(0.357)
DUMMY VARIABLES:				
Genre	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Month	Yes	Yes	Yes	Yes
No. of Observations	3,710	3,710	3,710	3,710
Adj. R^2	0.398	0.398	0.398	0.400
F Statistic	52.81***	51.64***	50.71***	49.93***

Notes. OLS regressions of game revenues on the coordination experience of the development team's managers. Variables are defined in the text. Regressions include dummy variables for genres, months and years. Robust standard errors in parentheses *, **, *** denote significance at the 10%, 5%, and 1% levels respectively.