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Disruptive Diversity and Recurring Cohesion:

Assembling Creative Teams in the Video Game Industry, 1979-2009

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DISRUPTIVE DIVERSITY AND RECURRING COHESION: ASSEMBLING CREATIVE TEAMS IN THE VIDEO GAME INDUSTRY, 1979-2009

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To test the proposition that a high level of recurring cohesion and a high level of stylistic diversity can combine for successful team performance, this study constructs a dataset of the careers of 139,727 individuals who participated in project teams producing 16,507 video games between 1979 and 2009. Findings indicate that teams with more dissimilar stylistic experiences outperform teams with more homogenous backgrounds, but only for higher levels of recurring cohesion. Teams with high diversity and high social cohesion are better able to harmonize the noisy cacophony of an (otherwise) excessive plurality of voices, thereby exploiting the potential beneficial effects of cognitive diversity.

INTRODUCTION

Collaboration in teams is increasingly important in many creative fields such as academic research, business projects, and civic activism, as well as in various forms of cultural production, including music, film, and new media. Recent research on the social sources of innovation suggests that teams are more successful than individuals. Highly-prized artistic productions, award-winning research, and novel technology and business ventures are increasingly the outcome of collaborative teamwork, not singular endeavors (Wuchty, Jones & Uzzi 2007; Hargadon & Bechky 2006).

One approach to the study of team performance investigates the behavioral processes of group dynamics within a team (Lingo & O'Mahony 2010; Faulkner & Becker 2009; Hargadon & Bechky 2006; Murninghan & Conlon 1991). We adopt a different perspective by examining how particular teams are discrete expressions or instantiations of larger, informal, communities. We thus also study *group dynamics* – not, however, the micro behaviors of interactions among the players in a team but the meso-level historical structures and processes whereby teams assemble,

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disassemble, and reassemble. As such, our project draws upon, extends, and develops a body of research on team formation and team performance (e.g., Ruef, Aldrich & Carter 2003; Reagans, Zuckerman & McEvily 2004; Uzzi & Spiro 2005; Ibarra, Kilduff & Tsai 2005; Balkundi & Harrison 2006; Ruef 2010).

Two concepts – diversity and cohesion – occupy a central place in the literature on team formation, especially among teams in creative fields. Teams that lack diverse ideas, some argue, will be unable to engage in the kinds of innovative recombinations that are required for successful performance (Burt 2005b; Fleming, Mingo & Chen, 2007; Uzzi & Spiro 2005; Vedres & Stark 2010). But "good ideas" (Burt 2005a) alone are not enough; ideas that are not effectively implemented will not be successful (Obstfeld 2005). Implementation, some argue, requires cohesion. The dense, reciprocal ties of cohesive structures promote trust and mutual understanding, thereby facilitating coordination within a team (Burt 2005a; Reagans, Zuckerman, & McEvily 2004; Uzzi & Spiro, 2005; Vedres & Stark 2010; Berman, Downs & Hill 2002).

As our citations indicate, this is not a debate across scholarly camps; nor is it a debate about diversity *versus* cohesion. Within this research community there seems to be an emerging consensus about the importance of diversity *and* cohesion (see Obstfeld 2005 and Vedres & Stark 2010 for discussion). However, when critical assumptions in this research are confronted, several key questions remain unanswered. One approach – exemplified by recent research on brokerage and closure (Burt 2005a; Obstfeld 2005) – finds positive effects when long-distance ties of brokerage reaching outside the team occur together with dense cohesive ties within it. A limitation of the brokerage plus closure perspective is that diversity of cognitive frames is assumed to accompany diversity of ties. In place of an explicit measure of diverse cognitive frames, boundary-spanning ties are a proxy for them. The argument is plausible, but it would be on even stronger grounds if (without making inferences about ties and diversity) research tested propositions about diversity based on a variable that explicitly measured cognitive (stylistic) diversity.

Another approach – exemplified in Uzzi and Spiro's (2005) study of Broadway musicals as well as in Berman et al.'s (2002) study of teams in the National Basketball Association – finds a curvilinear relationship between cohesion and high performance. Too much cohesion suppresses diversity and leads to a group-level, cognitive lock-in. But because these studies do not have a separate measure of cognitive diversity, they must necessarily assume that social cohesion suppresses cognitive diversity. Therefore, they cannot test the proposition that a high level of cohesion and a high level of stylistic diversity could combine for beneficial effects.

This paper directly poses such a test by offering an explicit measure of stylistic diversity and by making a clear analytical and methodological distinction between diversity and cohesion. To do so, we exploit the fact that teams have histories. We are not, however, interested in a *team's* history, as, for example, in the total win-loss record of the New York Yankees, the profitability of IBM under its management team during the past five years, or the continued prominence of the Department of Sociology at the University of Chicago during the past century (Abbott 1999). Unlike these institutionalized structures in which the identity of the team persists even as its members are replaced, the problem of a "team history" is more challenging for teams that

assemble members for a particular project and disperse them upon project completion (think, for example, of film production). In such projects, where the identity of the team lasts only as long as the project, the history of the team itself could only be for a relatively short duration (perhaps as little as a month and seldom longer than a year or two). Yet even such episodic project teams do have a prior history. Comprised of the careers of its members, it is a history of their participation in prior teams.

Throughout their careers, individuals working in project-based industries (Grabher 2002; 2004) move from one project to another. What they know and who they know is, in large part, a function of the patterns of their movement through this project space. Viewed through the lens of a given project, these sequences of affiliations to different teams and their reassembly in that distinct project result in the accumulation of social relations and the enduring (or changing) exposure to particular methods of production. Thus, for a given project team, its relative homogeneity or diversity of cognitive styles can be seen as a function of its members' histories of prior exposure in previous teams. Similarly, its level of social cohesion can be seen as a function of its members' histories of prior collaboration in previous teams.

Our task is to assess whether and how the diversity of prior cognitive experiences and the accumulated cohesion of prior social relations of team members contribute to the success of the product produced by the team. By diversity, we refer to cognitive or *stylistic diversity*. The knowledge base of a given team in a cultural field, we will argue, is a function of its members' experience with various styles during prior episodes of production. A team will be more diverse to the extent that its players have more varied exposure to stylistic practices in the field.

Our notion of cohesion is similarly based on members' past experiences but here we refer to their *shared* experiences of working together. This is also a form of knowledge; but rather than technical or artistic knowledge, this is a tacit knowledge of how others work together in teams. Here we exploit the double meaning of cohesion, first, as referring to a structural property comprising the density of ties, and second, as referring to a structure that persists or is repeated in time. For us, cohesion is about density and durability. A given team will be more cohesive to the extent that its players have repeatedly worked together in the past. Our concept of *recurring cohesion* thus, takes into account the standard network analytic preoccupation with structural density. But, in addressing the possibility that cohesive structures can be built up through repeated layers, it goes beyond that traditional view. Recurring cohesion expresses a notion of topography with depth.

To test the separate and interacting effects of diversity and cohesion on performance, we study the historical mechanisms of team reassembly in a setting where creativity is highly salient: the video game industry. To do so, we collected data on 16,507 video games that were produced from the inception of the industry in 1979 to 2009. For each of these video games we compiled a complete list of all team members (as in film credits, listed according to their specialized tasks such as programming, imaging, scripting, design, music, etc). Assigning unique ID's to each of the resulting 139,727 individuals allows us to reconstruct, for each team, the complete careers of all of its team members in the video game industry. The dependent variable used in this study is a measure of game success and is constructed as an index of multiple critics' ratings.

We analyze the cognitive network of each focal team by charting the encounters of team members with stylistic elements in prior video game projects. We code all game-specific stylistic elements, including 8 genres, e.g., action, role-playing, simulation, etc. (with distinctive subcategories within each) as well as 6 perspectives, e.g., 1st person perspective, 3rd person perspective, topdown, sidescroll, etc. We then construct a variable that measures the diversity of a team by computing the (dis)similarity between each pair of team members based on their exposure to stylistic elements in these prior video game projects.

Because we expect that diversity will be a necessary but not sufficient condition for successful team performance, we also measure the interpersonal familiarity of all team member pairs by recording their co-participation in prior projects. Familiarity eases communication. But we expect that cohesion will have stronger effects when combined with diversity. Unlike familiarity, cohesion exceeds the level of the dyad by taking into account the stability of larger group structures. We thus measure the level of cohesion within a team by identifying repeated cliques of members extending back in time.

Because we also expect that a high level of cohesion, in itself, can result in routinization inimical to innovation, we further test the effects of cohesion and diversity in their interaction. Our findings indicate that teams with more diverse cognitive experiences outperform teams with more homogenous cognitive backgrounds, but only for higher levels of cohesion within a team. More cohesive teams are better able to harmonize the noisy cacophony of an (otherwise) excessive plurality of voices, thereby exploiting the potential beneficial effects of cognitive diversity. Stated conversely, stylistically more diverse teams are better able to counteract the conservatizing rigidities of an (otherwise) excessive social cohesion.

TEAMS AND THEIR HISTORIES OF REASSEMBLY

Stylistic Diversity

As several surveys of the literature suggest, there was and there remains (Williams & O'Reilly 1998; Horwitz & Horwitz 2007; Joshi & Roh 2009) no clear consensus on the relationship between diversity and successful team performance. Although some researchers report positive findings (e.g., Cox & Blake 1991; Hambrick, Cho & Chen 1996), others conclude that diversity can adversely affect performance (e.g., Milliken & Martins 1996; Ruef 2010). Much hinges, of course, on how diversity is conceptualized and measured, whether, for example, as demographic diversity along lines of gender and race (e.g., Pelled 1996; Richard, McMillan, Chadwick & Dwyer 2003) or along lines of age, tenure, and status (e.g., Reagans & Zuckerman 2001; Gibson & Vermeulen 2003). Even when there is agreement about the major line of diversity to be investigated (as, for example, in the study of "functional diversity"), there is considerable disagreement about the types of diversity and their measures (Bunderson & Sutcliff 2002).

There are good reasons to expect that diversity will matter in fields of cultural production. Cultural fields award novelty, especially when it is creatively packaged in terms that are recognizably familiar (Lampel, Lant, & Shamsie 2000; Hutter 2011). And, whether one relies on

biologists,[1] mathematicians,[2] musicians, (Gould 1994), or economists (Schumpeter 1942; Weitzman 1998), there is strong support for the notion that a novel, innovative idea is the result of recombination (Hargadon & Bechky 2006; Stark 2009). Creative teams that lack diversity will confront an impoverished repertoire of cultural elements that could be recombined in a novel product. A team comprised of members with more diverse backgrounds, on the other hand, will be better situated to develop a "hit" that will capture audiences and win critical praise (Uzzi & Spiro 2005; Fleming, Mingo, & Chen 2007).

The video game industry lacks demographic diversity along lines of age, gender, and race. This is a field in which the modal participant is a young white male. Nonetheless, like the neighboring fields of music and film, it is one that is rich in stylistic diversity. In this industry it is, indeed, possible for a programmer, graphics designer, or sound engineer to specialize in games within a very limited genre. But it is also possible, indeed likely, that an individual will be exposed to a broader range of stylistic elements as he moves through the project space of successive games. Our concept of *stylistic diversity* builds on this possibility.

For a given game, our model assumes that the repertoire of practices comprising the basic building blocks available for recombination in that focal game is a function of the stylistic elements to which its members have been exposed during their participation in the production of previous games. Our concept of diversity, however, is not a simple summation of these elements. Instead, we measure diversity as the dissimilarity of the portfolios of prior stylistic experiences of the members of the team (see the data and methods section below for elaboration). By that definition, a more diverse team will be one composed of members whose backgrounds are more different from each other.

By itself, however, team diversity cannot insure that the project will result in a successful venture. Having a wealth of ideas does not guarantee that they will be recombined in a fruitful way. In this sense, diversity is necessary but not sufficient for high performance. Indeed, to the extent that the team is diverse -- not simply because it has a rich array of stylistic experiences but because its members have distinctively different portfolios of experience -- coordination challenges are amplified as diversity increases. It is to this problem of integration across diversity that we turn.

Recurring Cohesion

In their study of new product development in cellular telephones, blue jeans, and medical devices, Lester and Piore (2004) demonstrate that each of their cases of radical innovation involves combinations across disparate fields: fashion jeans are the marriage of traditional workmen's clothing and laundry technology borrowed from hospitals and hotels; medical devices draw on both basic life sciences and clinical practice; and cellular phones recombine in

[1] "Novelties come from previously unseen association of old material. To create is to recombine" wrote the great French biologist Francois Jacob (1977: 1163). Or, in the words of Santa Fe Institute researcher John Holland (1992:20), "Recombination plays a key role in the discovery process, generating plausible new rules from parts of tested rules."

[2] Henri Poincaré: "To create consists precisely in not making useless combinations and in making those which are useful and which are only a small minority. Invention is discernment, choice. Among chosen combinations the most fertile will often be those formed of elements drawn from domains which are far apart" (Poincaré 1985 [1908]).

novel form radio and telephone technologies. They conclude that "without integration across the borders separating these different fields, there would have been no new products at all" (Lester & Piore 2004: 14 - 15).

For us, the telling phrase in this passage is "integration across the borders…" How is such integration achieved? That challenge is not one that confronts a team with low diversity. Where nearly all the members have more or less the same prior exposure to stylistic features, members share a common language. They are familiar with the terms that their fellow team members are using. Where stylistic diversity is high, on the other hand, members might confront a babel of dissonant languages, where even the same term might not have the same meaning across different communities of practice. Such dissonance can be productive (Stark 2009), but there is no guarantee that it will be. A team comprised of members with highly diverse stylistic backgrounds might have potential to develop innovative products; but if it lacks the ability to communicate good ideas among its members, it will be unlikely to fully exploit the benefits of diversity. How can diversity be organized and mobilized for productive ends?

Where terms are unfamiliar, one possibility is that integration might be achieved when the members of a team are "on familiar terms" – literally, that they are *familiar with each other*. They are on personal terms because they have jointly participated in at least one team in the past. Two players who are familiar with each other (who mutually recognize each other) have an already-open communication channel ("Hey, good to see you again.") across which they could bridge the diversity divide. Interpersonal familiarity is a kind of social lubricant, facilitating ease of interaction that can form a basis for cooperation and collaboration in complex team tasks. Familiarity is personal. As a distinctly person-to-person relationship, we conceptualize it in dyadic terms and operationalize it as such (see the data and methods section for details).

Cohesion, by contrast, is not dyadic. It is a property of a group with a minimum size of three. For contemporary network analysts, cohesion refers to a relational structure where members are densely linked to each other – as when actors A and B, who are linked to actor C, are also linked to each other. Even when, in larger groups, all ties are not closed (Moody & White 2003; Vedres & Stark 2010), the density of ties among the members of the group promotes effective monitoring, mutual understanding, shared expectations, identity, solidarity, and trust (Coleman 1988; 1990). If familiarity can be expressed in dyadic terms, cohesion can be expressed as a network topography.

Among other studies on the role of cohesion in predicting team performance (Webber & Donnahue 2001; Reagans, Zuckerman & McEvily 2004), we highlight the work of Reagans & Zuckerman (2001) because their research design specifically focuses on the twinned effects of diversity and cohesion. Based on data covering 224 R&D teams in 29 corporations from seven industries (automotive, chemicals, electronics, aerospace, pharmaceuticals, biotechnology, and oil), Reagans & Zuckerman (2001) measure demographic diversity as a function of the organizational tenure of the teams' members; and they define cohesion as higher levels of density within a team's communication network. They find a positive effect on team performance for both demographic diversity and communication density.

The findings of Reagans & Zuckerman (2001) suggest that it would be useful to test the separate and combined effects of diversity and cohesion among creative teams. In our research design, we needed first to develop a conception of diversity more appropriate for cultural fields: our measure of stylistic diversity addresses this question. But the historical nature of our dataset does not allow us access to communication networks inside teams. To devise an appropriate measure of cohesion, we build on Berman, Down, and Hill's (2002) study of 23 teams that competed in the National Basketball Association from the 1980-81 season through the 1993-94 season.
Professional basketball is a skilled performance, requiring players with deep knowledge of the game and acute skills in execution. But, like other creative endeavors, it takes more than assembling a cast of brilliant performers. To win consistently, they must play together as a team – in basketball, even more so than in many other sports. Berman et al. (2002) argue for the importance of tacit knowledge of a particular kind. Less a knowledge of the game, this is knowledge of the nuances and subtleties of how one's teammates play the game. To achieve an unconscious synchronicity of action, a successful team requires a group-level pattern-recognition capability. It is only through the experience of working with each other that players can construct the interpretive schemata required for split-second, on-the-spot, mutual adjustment (Berman, Down & Hill 2002: 16).

Berman et al.'s (2002) measure of team-based tacit knowledge is based on the cumulative experience that members of a team have playing with each other. That is, they measure shared team experience by assessing how many years of experience each player had *on a specific team* (and they weight these years of player-team experience by the minutes played in that season by that player). But note that our videogame case offers distinctive challenges. Teams in the NBA are institutionalized. Players can change but the identity of the team remains, to play in season after season. In the videogame industry, however, where the team develops a game and then disperses, it would be as if the team played one game and one game only. Building a measure of cohesion based on how often team members had played together on that specific team would yield the same answer for every team: once.

Like Berman et al. (2002) we investigate the extent to which members of the focal team have "played together." But because the dynamics of team formation are different in the videogame industry, we must chart their joint participation on *prior* teams.[3] Like Berman et al. (2002), we also expect that the tacit knowledge of one's teammates' work habits matters for successful performance (see also Uzzi & Spiro 2005). Cohesion, reassembled on the focal team out of smaller cliques that had played together on prior teams, leads to improved patterns of dense network communication. Because such pattern recognition is a group-level property, to move beyond familiarity to cohesion, we will count cohesive structures only when at least three members of the focal team have worked together on another team in the past. Finally, our measure of cohesion specifically addresses the issue of repetition of such cohesive structures (see the data and methods section for elaboration).

[3] For this reason, the more apt sports analogy might be to international soccer. Adopting our methods here would suggest research that investigates the proportion of members who had *played together on team clubs prior* to their selection to the national team.

Note that we are developing a more dynamic conception of cohesion than is typical in the contemporary network literature where cohesion is typically a static construct.[4] The relative lack of attention to the problem of the persistence, or stability, of cohesive group structures is curious because network analysts often argue that cohesion fosters predictability and, most importantly, trust. The development of trust is a process that involves mechanisms of reciprocation. Unlike spot market transactions which can take place at a moment in time, reciprocity can only occur across time. Trust and predictability require repeated interactions. Cohesive structures promote trust only if they are repeated. In arguing that cohesive structures foster trust, network analysts thus *use a conception of cohesion that implies duration* – not simply a structure of cohesively dense ties at one moment in time but some degree of stability across time. Yet the implication is seldom explicitly addressed and tested: studies of cohesion are typically based on cross-sectional snapshots of networks assuming that cohesive structures are robust and stable. If the study of cohesion is to match the actual phenomenon, we need analytic tools in which conceptualization and method address the topological *and the temporal properties* of cohesive groups (Vedres & Stark 2010). Our conception of cohesion, thus, embraces factors of density and durability, of structure and of repetition.

EMPIRICAL CONTEXT: THE VIDEO GAME INDUSTRY

The production of video games is closely related to advances in the computer and semiconductor industries. In 1958 William A. Higginbotham developed *Tennis for Two,* the first video game, in the Brookhaven National Laboratory; but because personal computers were non-existent at the time, video games could not be introduced to a wider audience. That changed in the 1970s with the introduction of the first personal computers and the first home video game consoles. Launched in 1972, the Magnavox Odyssey successfully brought video gaming into American homes. But it was with the release of the Atari 2600 gaming platform in 1979 that a true nation-wide rage took off. Video games such as *Pong*, *Pac-Man* and *Pitfall!* became instant blockbusters generating large profits for the firms involved in their production. Whereas video games had once carried colorful associations with mafia and gambling (the first video game companies, such as Atari and Gottlieb and Williams, having been founded by entrepreneurs who had previously produced arcade equipment such as pinball machines, see Kent 2001), the maturation of the industry as a safely legitimate form of home entertainment was signaled when toy manufacturers such as Nintendo, Bandai, and Mattel diversified into video gaming with action heroes or doll-type favorites previously featured in comic books or board games.

Playing a video game requires a computer platform. Traditionally, these platforms can be divided into three main categories: PC's, consoles, and handhelds. PC's are multipurpose computers that can be used as gaming devices, consoles are computer platforms solely dedicated to playing video games and handhelds are portable computer platforms that are solely dedicated to playing

[4] Cohesion has not always been defined, however, in such purely structural terms. The predecessors of network analysis gave prominence to temporality over topology in a clear emphasis on duration (Friedkin 2004). In one of the founding studies of the field, Moreno and Jennings (193:164), for example, defined cohesion as "the forces holding the individual within the groupings in which they are." In this emphasis they echoed Simmel, whose publication in an early issue of the *American Journal of Sociology* was titled: "The Persistence of Social Groups" (Simmel 1898). See also Festinger, Schachter, and Bak (1950). By the century's turn, structural properties had trumped durational features in social network analysts' conception of cohesion.

games. Throughout the history of the industry these computer platforms have gone through cycles of rapid technological development. Game consoles, for example, have been introduced in cycles, each cycle representing a new generation, with the technological specifications for each new generation differing widely from the previous. Their successive introduction is one of the factors driving changes in the "game mechanics" and design rules for video games (De Vaan 2011; Baldwin & Clark 2000).

Benefitting from these technology improvement cycles, video games in the past decades have evolved from simple two-dimensional table tennis games to fully equipped three-dimensional virtual worlds. The move from single-screen to side-scrolling game production opened up an entire new world, and recent advancements in 3D graphics have given video game producers yet another dimension to explore. These technological innovations allowed video game producers to create video games that heavily draw from everyday life, containing elements of culture, politics, and social interaction. Recent games such as Sid Meier's *Civilization* series or *God of War* have sold millions of copies and are considered to be prime examples of cultural products characterized by sophisticated design.

Doubtless, some video games are little more than simple imitations of already existing games. But the forefront of the industry finds continuous experimentation with the singular challenge of video gaming: how to create a convincing form of narrative story-telling that is nonetheless animated (perhaps uniquely so) by the actions of the users (Bissell 2010). In this perpetual search for an ever more creative (yet always unresolved) tension between the framed (fixed) narrative and the fluid "ludonarrative," a new video game project seeks to differentiate itself from others by introducing radically new game mechanics, new perspectives, and enhanced graphics as well as by crafting new genre combinations and new narrative strategies of character development made possible by (and, in turn, further stimulating) new technological capabilities (Delmestri, Montanari & Usai 2005; Tschang 2007; Bissell 2010)

Deus Ex is an example of a game resulting from creative and novel combinations. In its "Top 100 Video Games of All Time" the website Imagine Games Network (IGN) describes the game as follows:

> "In an industry chock-full of hype, *Deus Ex* offers a complex yet plausible web of X-Files-style conspiracy while guiding the player entertainingly through open-ended environments, problems with multiple solutions, and a skillful blend of action, role-playing and good ol' fashioned adventure. It presents larger-than-life set pieces without the sometimes excessive style of the similarly-themed Metal Gear Solid games. It gives us a ton of great voice acting, interesting characters, and a sense of drama and dystopian inevitability that still had a ray of light at the end of the tunnel. Not to mention pronunciation flame wars (www.ign.com 22/10/2011)."

IGN's description displays the breathless theatricality characteristic of much of the industry. At the same time, it is representative of the industry standard that an innovative game can result from adding twists and fresh ideas to existing conventions (Uzzi & Spiro 2005). By creatively

combining various stylistic elements, video games can capture the passionate attention of gamers and yield the artistic excitement prized by industry critics.

Developing a game for a console in the early 1990s cost $50,000 to $400,000. Creating one today costs in the neighborhood of $20 million (New York Times 2010). Total global video game industry earnings were $22 billion in 2002, and nearly doubled to $42 billion in 2007 when its earnings surpassed those of the film industry. By 2011 global spending on video games surpassed that on music (PriceWaterhouseCoopers 2009). Consumers around the world are estimated to spend this year nearly $18 billion on hardware and $44.7 billion on the software for these games (Gartner 2011). By the opening decade of this century, the typical video game project was a highly complex activity involving an average of some 80 team members. These costly ventures are not taking place in someone's garage.

DATA

To test the separate and interaction effects of stylistic diversity, interpersonal familiarity, and recurring cohesion (together with a set of control variables) we constructed a dataset including information on 139,727 unique members of 17,431 unique production teams in the global video game industry from 1979-2007. The work of each of these production teams resulted in a published video game. The individual team members in the dataset are assigned a unique ID which can be used to track an individual's career history and more importantly the history of these individuals in social structures. Additionally, for each video game, we know the release date, the computer platform for which the game is released, its developer and publisher, the stylistic elements used in the game, and its artistic success.

We capture these experiences of a team member by coding its level of exposure to the stylistic elements in prior video game projects. We code all game-specific stylistic elements, including 8 genres, e.g., action, role-playing, simulation, etc. (with distinctive subcategories within each) as well as 6 perspectives, e.g., 1st person perspective, 3rd person perspective, topdown, sidescroll, etc. The permutations of these yield 105 unique elements.

Our goal was to collect comprehensive data on every commercially-released video game in this global industry. To do so, we have drawn data from various sources. The starting point was the Game Documentation and Review Project *MobyGames*[5]. The MobyGames website is an exhaustive repository of software titles, covering the individuals involved in the production process, the release date of each title, the platform(s) on which the game can be played, and game specific characteristics such as genre and perspective, as well as critics' reviews. The database goes back to the inception of the industry in the 1970s.

[5] The Game Documentation and Review Project MobyGames can freely be consulted at http://www.MobyGames.com. The MobyGames database is a catalog of 'all relevant information about electronic games (computer, console, and arcade) on a game-by-game basis' (http://www.MobyGames.com/info/faq1#a). The information contained in MobyGames database is the result of contribution by the website's creators as well as voluntarily contribution by MobyGames community members. All information submitted to MobyGames is checked by the website's creators and errors can be corrected by visitors of the website.

To ensure the quality of the data, we checked the MobyGames database against the German *Online Games Datenbank* (OGDB).[6] This online database is complementary to the MobyGames database in that it provides more detailed information on the release dates of video games. Also, whereas MobyGames is of American origin, the OGDB is maintained by German moderators. Combining two sources from different cultural and institutional traditions lowers the likelihood that our findings are affected by cultural biases in the data. Both the MobyGames and the OGDB databases are crowd-sourced; and all entries to them are checked for accuracy by moderators of the websites and their users. By integrating both sources, we constructed a highly accurate database, free of errors and omissions. In the rare case that neither of the two databases provided high quality information on a video game or in the rare case that the information in the two databases was contradicting, we consulted other online or hardcopy resources.

From this working database we excluded games that were released as compilation disks, shovelware, or re-releases. We also excluded games that were produced for mobile phones because the data are not reliable. As a gaming device, mobile phones do not attract the attention of the avid gamers who are the main contributors to the online data sources. The final database therefore includes the video games produced for 81 unique computer platforms involving PC's, game consoles, and handhelds.

METHODS

Analytic Framework

We test our expectations with a set of regression analyses that assess the effect of the stylistic diversity, interpersonal familiarity, and recurring cohesion of a production team on the critical success of a video game. The variables used in these linear regressions are all measured at the team level. In 63% of all cases, the team members are brought into the project by a publisher and an independent development studio, while in the rest of the cases both the publishing and development skills are supplied by a single firm. Some of these firms are involved in only one video game, but most of the firms produce multiple video games. Therefore our data are nested. To account for patterns in the error structure resulting from this nestedness of the data, we estimate a fixed-effects model. We do so by including a dummy variable for each publisher. Their role as financiers of the production projects provides them with a hierarchically higher position than developers, and practices that are inherent to the publisher are therefore more likely to persist across sequences of projects.

Dependent Variable

Critical Success measures the average score awarded to a video game by professional industry critics. We used an indicator from the MobyGames database which is a weighted average of normalized ratings and reviews by professional critics in prominent online, television, and print media outlets. The higher the score, the higher the collective critical opinion is of the game (MobyGames Website, 03/02/2011). The typical review source is a magazine or a gaming website. Examples of such sources include *Game Informer* (in the United States), *PC PowerPlay* (in Australia), *Jeuxvideo.com* (in France) as well as the German website *eurogamer.de*. MobyGames adamantly maintains quality standards for the review sources

[6] The Online Games Datenbank can freely be consulted at http://www.ogdb.de

indexed in the score.[7] To be included, a review source must, for example, have published a minimum of 100 reviews, meet professional writing standards, and be published within a month of the game's release date. Blogs are excluded as are media outlets that aggregate scores of individual users or critics.[8]

Independent Variables

Stylistic Diversity. Our *stylistic diversity* variable measures the dissimiliarities in the stylistic portfolios of a team's members. To construct this variable, we first record the stylistic portfolios of the members of the focal team. Team members build up portfolios of experiences throughout their careers by being exposed to different stylistic elements in prior projects. We count the number of games in which a given team member was exposed to a stylistic element. That is, rather than recording the exposure in binary terms, we record it as a value. The stylistic portfolio of a team member describes the distribution of his or her level of exposure to the possible set of 105 unique elements described above in the data section. The distribution of a team member's coverage of stylistic elements locates the team member in a multidimensional space, captured by a K-dimensional vector.

We then calculate the differences between each team member's stylistic portfolio and the portfolios of all other team members, using Jaffe's (1986) widely used similarity index (Rodan & Galunic 2004; Phelps 2010). The dissimilarity between team member *i* and team member *j* is given by:

$$d_{ij} = 1 - \left[\sum_{k=1}^{K} f_{ik}\, f_{jk} \Big/ \left(\sum_{k=1}^{K} {f_{ik}}^2 \right)^{1/2} \left(\sum_{k=1}^{K} {f_{jk}}^2 \right)^{1/2} \right]$$

where f_{ik} is the fraction of stylistic element *k* in all stylistic elements *K* covered by team member *i*. The dissimilarity measure satisfies the following conditions:

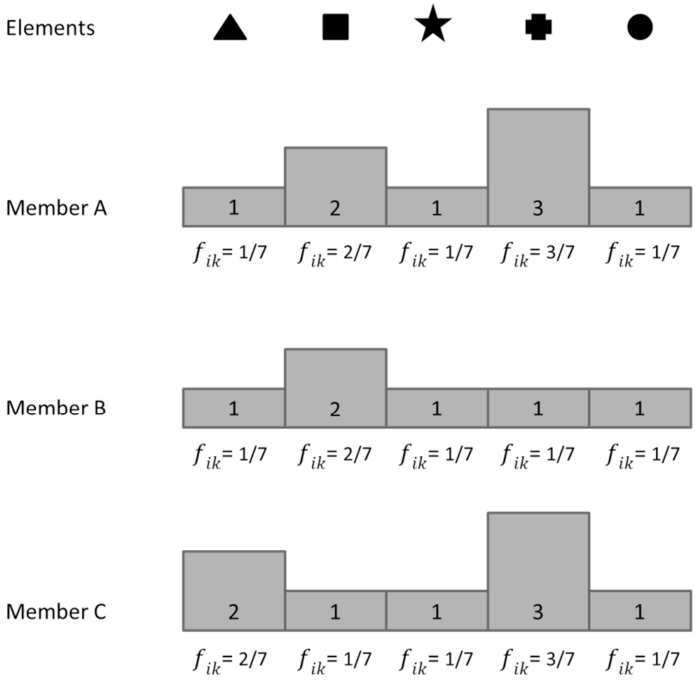
$$0 \leq d_{ij} \leq 1$$
$$d_{ii} = 0$$
$$d_{ij} = d_{ji}$$

These steps in our procedure are represented in Figure 1. The three team members in Figure 1 have all been exposed to five stylistic elements. However, the distribution of their exposure over the stylistic elements is different. Following this example, member A and member B have a dissimilarity score of 0.12, member A and member C have a dissimilarity score of 0.06 and member B and C have a dissimilarity score of 0.20.

[7] See http://www.mobygames.com/info/mobyrank for more information.

[8] Websites such as MetaCritic, GameRankings, Rotten Tomatos, and GameStats are considered aggregate sources and are thus not included in the score.

Figure 1.
Dissimilarities of stylistic portfolios of team members



We used every value of d_{ij} to construct a matrix D_g for every game g which allowed us to calculate the *stylistic diversity* variable for game g as follows:

$$Stylistic\ Diversity_g = \sum_{i=1}^{N} d_{ij} * p_i * p_j * 1/2$$

where d_{ij} is the dissimilarity between team member i and team member j, p_i and p_j represent the presence in the team of member i and member j respectively[9]. The values are multiplied by ½ in order to take only the lower triangle of the matrix into account.

Interpersonal Familiarity is calculated by measuring the intensity of prior collaborations between each dyad within the focal team. In constructing the variable we follow Newman (2001) and calculate familiarity at the dyad level as a function of the pair's co-participation in a prior project and the team size of these projects. Two team members of a large video game production project are assumed to be less familiar on average than two members of a smaller project. Suppose a team member collaborates in a project that has N other team members in total, then we assume that he or she is $1/N$ times familiar with each team member $1/N$ times. To account for this difference, we weigh co-participation ties by taking into account the size of the team. Our familiarity variable, moreover, also takes into account frequency of co-participation. Taking

[9] Both the value of p_i and the value of p_j are equal to 1/N where N is the number of team members in the focal team.

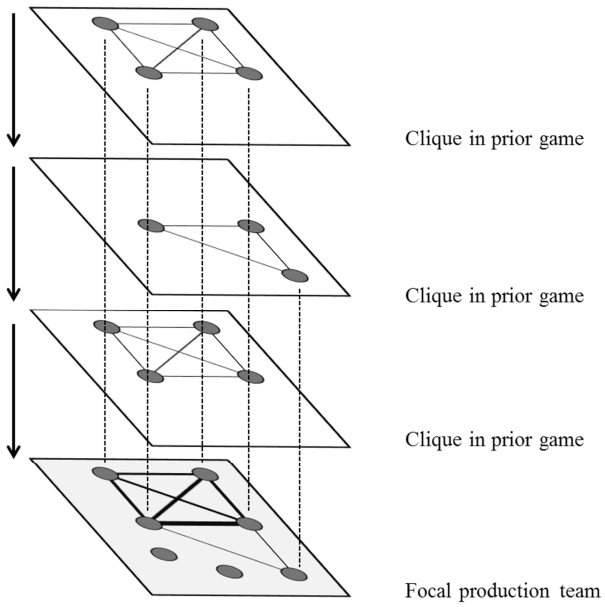
team size into account, members who have often worked on teams together are on more familiar terms than those who have only been together once. We therefore calculate the strengths of the ties derived from each of the projects participated in by a particular dyad. As a result, the level of *familiarity* of the members of game *g* is given by:

$$Familiarity_g = \frac{\sum_{i(\neq j)} \sum_v \frac{\delta_i^v \delta_j^v}{n_v - 1}}{n_g}$$

in which δ_i^v equals 1 if team member *i* had been involved in game *v* and 0 otherwise, n_v equals the number of team members of game *v* and n_g is the number of team members involved in the current game *g*.

Recurring Cohesion measures, for each team, the degree to which *subgroups* of its members have collaborated in prior teams. A subgroup is recorded by identifying all instances in which *at least three* members of the focal team have co-participated in a prior game project. A given subgroup (or clique, because each is a fully connected graph) can accommodate a unique set of members or it could repeat itself, either partially or fully. In the latter cases, repeated ties can be considered as a layering of historically cohesive structures. Having identified these 3+ member cliques, we then calculate the extent to which these cliques are layered. We do so by analyzing the presence of individuals in multiple cliques, resulting in a *N* by *N* non-symmetric matrix *L*. Each cell of this matrix, L_{vw}, contains a value ranging from 0 to 1 capturing the number of individuals present in both clique *v* and clique *w* as a share of the number of individuals present in clique *v*. Our strategy for identifying recurring cohesion is represented in Figure 2.

Figure 2.
Constructing recurring cohesion.



For the focal production team (represented on the bottom panel of Figure 2), composed of seven team members, we identified the prior games in which at least three of the members of the focal team had participated. Two of these games involved four members of the focal team, and another game found three members of the focal team. These three cliques can be layered: the cliques with four members involved the *same* four individuals, while two members of the three person clique were also present in the four-member cliques. This recurring involvement in multiple cliques is represented in the figure by the thick edges between the members in the focal team. Note that two members of the focal team are isolates, caused either by their newcomer status in the industry or by the fact that they had never been in a cohesive subgroup with any of the other team members. Following this strategy the *recurring cohesion* variable is formally described by the following equation:

$$Durable\ Cohesion_g = N * \frac{\sum_{v=1}^{N}\left(\sum_{v(\neq w)}(1 + L_{vw}) * {S_v}/{S_g}\right)}{2 * (N * (N-1))}$$

in which N is the number of cliques ranging from v to N, S_v is the number of team members in g also represented in clique v, S_g is the number of members in team g, and L_{vw} is the number of members in clique v and w as a share of v[10]. This variable calculates the average similarity in terms of social composition of the cliques identified in the focal games' history adjusted for the relative size of these cliques. Note that repetition does not necessarily imply continuity.

Control Variables

Team size is a count variable that counts the number of individuals involved in the production of the video game. The main reason for including this variable in the regression model is that it controls for variation in the dependent variable that is related to a simple increase the number of human resources. One may argue, for example, that more members result in higher quality games regardless of the fact that they are more diverse or more cohesive.

Newcomers is a count variable that measures the number of team members that have no prior experience in the production of video games. In contrast to their experienced counterparts who have well established track records, and identifiable talents, these newcomers are expected to have little experience and unseasoned skills (Guimera et al. 2005). Additionally, newcomers are not yet aware of the status quo which is likely to have an effect on their role in the team.

Average industry tenure measures the average number of years that the team members of the focal game have been active in the video game industry prior to the year of production of the focal game. In particular, this variable measures the effect of the influence of experienced video game professionals. This variable is likely to proxy the average amount of experiences and skills held by team members.

[10] For $N = 1$ the durable cohesion variable equals $N * {S_v}/{S_g}$ and for $N = 0$, the durable cohesion variable equals 0.

Award-winning member. Some project teams are built up around a star designer. Creative individuals such as Eugene Jarvis and Shigeru Miyamoto have established a reputation for being able to continuously deliver high quality innovative video games. For example, Miyamoto has been responsible for heading the teams that developed *King Kong* and *Mario Bros*. To control for the impact of these and other celebrity designers we constructed a dummy variable equal to one for each team if one of its team members had won a Lifetime Achievement Award in any of the years after the production of the focal game. We used information on the Game Developers Choice Awards which are awarded annually by the Game Developers Conference to the most innovative and creative game designers.[11] These video game awards resemble the Oscars in the feature film industry.

Multi-firm production. Initially all video games were produced by the manufacturers of the computer platforms, but the dominant mode of production in recent decades tends to involve a development studio and a publishing company. *Multi-firm production* is a dummy variable equal to 1 if the publisher and the developer of the video game are different legal entities and equal to 0 if both the publishing activities and the development activities are in the hands of one firm or different divisions of the same legal entity. To construct this variable we traced the founding and merger and acquisition histories of all firms in the dataset. Firms that were set up as divisions, subsidiaries or labels of other firms were coded as being dependent on a parent firm. In the case that a firm was acquired by another firm we also coded the firm as being dependent on a parent firm from the acquisition data onwards.

We include ***genre dummies*** in our models to control for variation in the dependent variable that is caused by the average popularity of specific genres. Video games in highly competitive genres are benchmarked against much more games and possibly higher quality games[12] which are expected to influence the score that a reviewer would award a game. The genre dummies are not mutually exclusive. Games can have elements of multiple genres in the gameplay and therefore all main 8 genres are included as dummy variables in the analyses.

Year dummy variables control for temporal trends in how games are reviewed by critics. Throughout the course of the video game industry, critics' standards evolve and critics become socialized with one another. Another time-related issue picked up by the year dummies is the fact that throughout the course of the industry teams inherently become more diverse and cohesive. Both diversity and cohesion are outcomes of processes and by accounting for these time effects we argue that the composition of a production team and the associated review scores from two different years cannot be compared without bearing in mind the evolving nature of the industry.

Table 1 presents the descriptive statistics and the correlation matrix for the variables used in our regression models. Two cells in the correlation matrix show correlation coefficients that exceed 0.70.[13] First, there is a 0.79 correlation between *interpersonal familiarity* and *recurring*

[11] The Game Developers Choice Awards were introduced in 2001 and were preceded by the Spotlight Awards, which were presented from 1997 to 1999. We used information of both award shows.

[12] If fierce competition causes innovation to increase (Blundell, Griffith, & Van Reenen 1999) the average benchmark against which a game is compared is higher, regardless of any diversity or cohesion considerations.

[13] Although high levels of correlation are unlikely to bias the coefficient estimates, it may cause the standard errors to be inflated. As a result, tests of the hypotheses become more conservative (Allison 1999). In order to assess

cohesion. This is an expected outcome. Both are measures of the social histories of individual team members; but whereas *interpersonal familiarity* takes the dyad as the unit of analysis, *recurring cohesion* measures the extent to which cliques in the history of a focal team are repeated. The second correlation coefficient that exceeds 0.70 is the association between *Team Size* and *Newcomers*. Larger teams are indeed more likely to have a larger number of newcomers than smaller teams.

Table 1.
Descriptive statistics and correlation matrix

Variables	Observations	Mean	SD	Min	Max
1 Review Scores	6093	71.553	12.409	12	96
2 Recurring Cohesion	6093	2.294	2.202	0	19
3 Interpersonal Familiarity	6093	0.310	0.309	0	4
4 Stylistic Diversity	6093	0.199	0.057	0	0
5 Team Size	6093	94.282	99.669	2	921
6 Newcomers	6093	21.589	26.601	0	485
7 Average Industry Tenure	6093	3.888	2.004	0	23
8 Award Winning Member	6093	0.011	0.104	0	1
9 Multi-Firm Production	6093	0.374	0.484	0	1
10 Action - Genre	6093	0.544	0.498	0	1
11 Adventure - Genre	6093	0.152	0.359	0	1
12 Simulation - Genre	6093	0.125	0.330	0	1
13 Strategy - Genre	6093	0.199	0.399	0	1
14 Sports - Genre	6093	0.109	0.311	0	1
15 Racing/Driving - Genre	6093	0.110	0.312	0	1
16 Education - Genre	6093	0.007	0.081	0	1
17 RPG - Genre	6093	0.124	0.330	0	1

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Review Scores	1.000																
2 Recurring Cohesion	-0.011	1.000															
3 Interpersonal Familiarity	0.074	0.796	1.000														
4 Stylistic Diversity	-0.004	-0.350	-0.431	1.000													
5 Team Size	0.178	0.240	0.235	0.046	1.000												
6 Newcomers	0.179	-0.053	-0.053	0.225	0.740	1.000											
7 Average Industry Tenure	-0.013	0.571	0.436	-0.164	0.175	-0.156	1.000										
8 Award Winning Member	0.042	0.078	0.043	0.011	0.185	0.084	0.086	1.000									
9 Multi-Firm Production	0.189	-0.007	0.068	-0.110	0.071	0.062	0.001	0.037	1.000								
10 Action - Genre	-0.087	0.047	-0.005	-0.088	0.071	0.020	0.085	-0.019	0.008	1.000							
11 Adventure - Genre	-0.051	-0.063	0.002	0.007	-0.110	-0.056	-0.098	-0.027	-0.001	-0.179	1.000						
12 Simulation - Genre	0.070	-0.012	0.002	0.058	-0.025	-0.003	-0.053	0.071	0.027	-0.190	-0.134	1.000					
13 Strategy - Genre	0.054	0.018	0.027	0.072	-0.056	-0.045	-0.015	0.035	-0.048	-0.290	-0.152	0.089	1.000				
14 Sports - Genre	0.059	0.016	0.003	0.020	0.045	0.033	0.016	-0.001	-0.001	-0.278	-0.142	0.025	-0.145	1.000			
15 Racing/Driving - Genre	-0.031	-0.031	-0.054	0.031	0.008	0.020	-0.005	-0.011	-0.023	-0.114	-0.128	0.047	-0.168	0.107	1.000		
16 Education - Genre	-0.033	0.006	-0.008	0.023	-0.028	-0.017	-0.004	-0.009	-0.025	-0.056	0.067	0.019	0.026	-0.015	-0.029	1.000	
17 RPG - Genre	0.077	-0.004	0.015	0.030	0.058	0.067	0.022	-0.001	0.012	-0.083	0.050	-0.097	0.030	-0.120	-0.119	-0.031	1.000

whether the high levels of correlation/multicollinearity affected our results we calculated the variation inflation factors (VIF's) for each of the variables. None of the VIFs exceeded a level of 3 which is generally interpreted as an indication that our results are unlikely to be affected by multicollinearity.

Table 2.
Publisher fixed-effects regressions for predictors of critical success

	Model 1	Model 2	Model 3	Model 4
Independent Variables				
Recurring Cohesion * Stylistic Diversity				3.234 *
				1.332
Interpersonal Familiarity * Stylistic Diversity			-0.036	
			0.033	
Recurring Cohesion		-0.526 **	-0.531 **	-1.026 **
		0.144	0.144	0.251
Interpersonal Familiarity		4.336 **	4.775 **	4.840 **
		0.930	1.014	0.953
Stylistic Diversity		-3.172	-2.599	-7.127
		3.307	3.349	3.685
Control Variables				
Team Size	0.026 **	0.021 **	0.025 **	0.019 **
	0.003	0.003	0.005	0.003
Newcomers	0.026 **	0.037 **	0.033 **	0.042 **
	0.009	0.010	0.010	0.010
Average Industry Tenure	0.348 *	0.301 *	0.291 *	0.316 *
	0.122	0.130	0.131	0.130
Award Winning Member	-1.138	-0.864	-0.789	-0.954
	1.405	1.404	1.405	1.403
Multi-Firm Production	2.609 **	2.520 **	2.525 **	2.527 **
	0.343	0.344	0.344	0.344
Genres				
Action	-1.705 **	-1.596 **	-1.594 **	-1.590 **
	0.378	0.378	0.378	0.377
Adventure	-0.695	-0.751	-0.756	-0.731
	0.499	0.500	0.500	0.499
Simulation	1.934 **	1.863 **	1.873 **	1.849 **
	0.476	0.475	0.476	0.475
Strategy	2.008 **	1.980 **	1.988 **	1.932 **
	0.444	0.444	0.444	0.444
Sports	1.796 **	1.731 **	1.749 **	1.703 **
	0.540	0.539	0.539	0.539
Racing/Driving	-0.829	-0.827	-0.822	-0.826
	0.496	0.496	0.496	0.495
Education	-1.579	-1.361	-1.366	-1.404
	2.079	2.076	2.076	2.075
RPG	1.941 **	1.819 **	1.816 **	1.803 **
	0.495	0.495	0.495	0.495
Constant	54.004 **	54.332 **	54.152 **	54.925 **
	7.667	7.671	7.672	7.671
Year Dummies Included	Yes	Yes	Yes	Yes
Publisher differences				
F-statistic	2.65	2.64	2.63	2.63
df	41, 5453	44, 5453	45, 5453	45, 5453
p-value	<.0001	<.0001	<.0001	<.0001
Model fit				
N	6044	6044	6044	6044
R-Squared	0.071	0.135	0.135	0.137

* p < .05
** p < .01

RESULTS

Table 2 presents the results of our fixed-effects regression models.[14] The first model includes all control variables. *Team size* is positive and significant, indicating that video games produced by larger teams are likely to receive positive critics' reviews. Larger teams have more human resources to deploy which may lead to an increase of quality of the video game. Teams that accommodate many newcomers – for similar levels of *team size* – are also likely to get favorable critics reviews. Newcomers may be able to bring fresh ideas to the team and they may be more likely to disregard the status quo. In a setting where creativity is highly salient, newcomers are likely to positively contribute to the performance of a team. *Average industry tenure*[15] also has a positive and significant effect on the level of the critics' review scores indicating that teams comprised of members with extensive experience in the video game industry are more likely to receive positive review scores from game critics. This result confirms the notion that an increase in learning leads to an increase in the quality of work. Our *award-winning designer* variable is not significant, indicating that the role of the celebrity designer should not be overstated and supporting Tschang's (2007: 994) argument that "the designer is not necessarily the key actor in completing the game, and that a team's efforts are also critical for a game's development." The variable *Multi-firm production* is positive and statistically significant, indicating that games published and developed by multiple firms are more likely to receive positive critics' reviews. The first model also includes variables that control for the genre of the video game and for the year of production of the video game. Games containing elements of *Action* are more likely to receive negative critics' reviews. In contrast, *Simulation*, *Strategy*, *Sports* and *Role Playing Games* are highly regarded by critics.

To this baseline of controls, our second model introduces the independent variables stylistic diversity, interpersonal familiarity, and recurring cohesion. The coefficient for *stylistic diversity* is negative but not significant, indicating that the effect of stylistic diversity in the team does not increase the level of the expected review scores, nor does it lower these scores. This finding is in line with previous research on the diversity in teams, which had found mixed results for various types of diversity measures. *Interpersonal familiarity*, however, is positively related to the review score that critics award to a video game, indicating that video game development teams that comprise members who on average have a longer collaborative history together are likely to produce video games that are highly valued by critics. The coefficient of *recurring cohesion* shows a negative relation with the dependent variable and is statistically significant at the 1% confidence level. Teams assembled out of recurring cohesive subgroups do lock in to established routines and are unable to create the kinds of exciting games that enjoy critics' favor.

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[14] Critics reviews were available for 6,044 games. We therefore assessed the robustness of the results obtained from our regression analyses in multiple ways. First, we measured whether our sample of 6,044 games was representative for the population of 16,507 games. We ran Kolmogorov-Smirnov tests to examine whether the distribution of the within sample observations differed from the outside sample observations and we tested whether the median of the within sample and the median of the outside sample observations were statistically different. We did so for our three main variables. Results show that there was no statistical significant difference between both the distribution and the median for the in sample versus the out sample observations.

[15] We experimented with alternatives for measuring the experience held by team members. For example, we measured the average number of games produced by all team members prior to joining the focal team. These alternative measurement methods did not yield different directions nor did they lead to different significance levels.

In the third model we include an interaction between *stylistic diversity* and *familiarity*. There is no significant relation between the combinatory effect of familiarity and stylistic diversity on the critical success of the project. Based on this outcome one may argue that teams with highly familiar members are unable to successfully address and reconcile the dissimilarities between the members in video game production teams. This finding is in line with our expectations laid out in the previous section.

In the fourth model we include an interaction between *stylistic diversity* and *recurring cohesion*. This interaction is positive and significant. At the same time, the *recurring cohesion* variable remains negative and significant and coefficient and standard error for the *stylistic diversity* variable remains negative and not significant. The interaction effect and its main effects are jointly significant at the 1% level. In contrast to earlier research in which cognitive diversity was inferred (but not explicitly measured) from brokerage ties (Burt 2005b; Obstfeld 2005) and to work that assumed that diversity must necessarily be low at high levels of cohesion (Uzzi & Spiro 2005), we developed concepts and created measures to directly test the proposition that a high level of cohesion and a high level of stylistic diversity could combine for beneficial effects. Our findings indicate that such a combination can be productive.

Recall that high levels of diversity will find teams composed of members with highly dissimilar stylistic frameworks; and that high levels of cohesion will find teams composed of members with repeated exposure to more similar routines of work. These high levels of stylistic diversity are disruptive: they disrupt the established scripts and codes formed through repeated subgroup interactions. But they do not shatter them. The strong social bonds forged through recurring cohesion make it possible to assemble – out of dissimilar stylistic portfolios – exciting recombinations.

DISCUSSION AND CONCLUSION

In terms of the variables of greatest theoretical interest, the results of our linear regression models indicate that, net of other effects, stylistic diversity is not statistically correlated with creative success, interpersonal familiarity is positively associated, and durable cohesion has a negative effect on critical success. Teams whose members have been dissimilarly exposed to stylistic elements in the field are not more likely to produce a successful video game. Teams whose members have been more frequently *exposed to each other*, however, are significantly more likely to produce a game that is highly regarded by the field's professional critics. This finding for our dyadic variable suggests that interpersonal familiarity – knowing each other – does facilitate communication within the team. More cohesive ties accumulated by working together with at least two others on a prior team, by contrast, are an obstacle to high performance.

Interpreting the difference in the signs for these two variables – positive for interpersonal familiarity and negative for durable cohesion – must focus on the difference between the dyadic character of the former and the repeated clique structure of the latter. Dyad pairs know each other. But triads (or larger cliques) not only know each other but have learned something

together in a group context. Two actors can be on familiar terms. Three or more actors can be mutually familiar with a code of conduct. And the more repeatedly they interact, the more effectively they can carry these codes (bundles of informal routines) into the focal team. In principle, repeated cohesive structures should yield more dense communication than dyadic familiarity. In fact, we expect that they do. But it is not enough to address improved communication. The further question concerns what is being communicated.

The informal codes and routines carried by repeated cohesive structures are not simply a tacit knowledge of how to work together. They are also a mutually shared pattern recognition of *what works*. And the more they are repeated, the more they give rise to a familiar attitude: "That worked before. Let's try it again." In themselves, cohesive structures are a means to exploit patterns that are already recognized. If they result in improved communication (in the absence of high cognitive diversity) it is communication about what is already known. In short, durable cohesion, in itself, poses a danger that a team will fall into competency traps. But competence in doing what has already been done is not rewarded in cultural fields that place a high value on novelty.

The interaction terms introduced in Models 3 and 4 provide further analytic leverage on processes of team formation and successful team performance. The interaction term for stylistic diversity with interpersonal familiarity is not significant. Teams whose members are on familiar terms are not more likely to exploit the potential benefits of high stylistic diversity. That there is such potential, however, is demonstrated in the statistically significant positive finding for the interaction of stylistic diversity with recurring cohesion. The positive effect of that interaction further demonstrates that teams built up around repeated cohesive structures are not necessarily condemned to unsuccessful competency traps.

The findings of our study, we suggest, are in line with major statements in the field. They can be read, for example, through the lens of March's (1991) classic distinction between exploration and exploitation, with diversity and cohesion performing these roles respectively. They are also congruent with Nelson and Winter's (1981) equally classic depiction of the firm (transposed here to the new format of the project team) as a bundle of individual skills and a bundle of routines, again with the members' prior cognitive exposure and their prior social relationships as the counterparts. And they are not discrepant with the more recent notion of innovation as a product of exposure to diverse ideas and closure to implement them (Burt 2005b). But, despite this congruence, we offer a different interpretation of our findings, keyed to yet another classic statement, Kogut and Zander's (1992) concept of "combinative capabilities."

Like their counterparts in other creative endeavors, whether that be in other cultural fields or in other activities of technological innovation (for our setting is distinctively at this intersection), teams producing video games are engaged in a field characterized by relentless search. In a sense, this is search in which they cannot know in advance what they are looking for (Stark 2009). A "big hit," of course, is the goal; but the precise profile of what will be this year's blockbuster game is unknown – and exactly what is at stake. One way to characterize a successful search would be a dangerous reduction of the classic statements to a simple recipe: "Exploration is good, exploitation is good. But don't stir together too much of either." Or, "For a successful innovation, add just enough brokerage and just the right amount of closure." Our

findings pose a cautionary warning to such simple formulas because we find a positive outcome when high levels of diversity combine with high levels of cohesion.

Rather than an additive function, the process we see at work is more combinatory. In contrast to the recipes, moreover, it is far from smooth. We interpret the positive interaction of stylistic and durable cohesion in their contribution to the combinative capabilities of the team. Cohesion in this view is not merely about implementing new ideas. It is primarily about generating new ideas (Vedres & Stark 2010). Teams with high diversity but low cohesion lack the capability to recombine these stylistic elements into a game that strikes the right chord of recognizably familiar novelty. That is, without the friction of some already established, informally codified routines, the dissimilarity of the team's members will sound like only so much noise. Conversely, teams with high levels of cohesion but low levels of stylistic diversity might be effectively coordinated. They have capabilities, but they lack diverse elements to be recombined. That is, without the friction of dissonant yet creative misunderstandings among the diverse team members, the cohesive team efficiently cranks out yesterday's old favorite. It is the double friction – the friction of familiar routines rubbing against the dissonance of those working with unfamiliar terms – that uncomfortably yet productively combine to generate exciting ideas.

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