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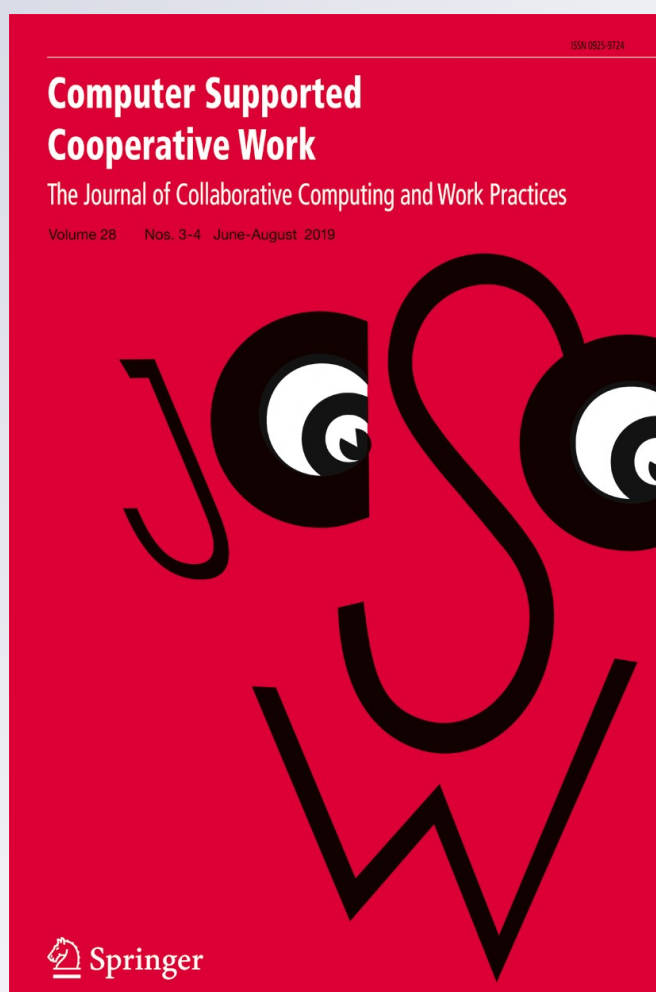Volume 28   Nos. 3-4   June-August 2019

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Exploring Indie Game Development: Team Practices and Social Experiences in A Creativity-Centric Technology Community

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Abstract.   The emergence of various interest-based online communities has led to the popularity of new forms of distributed creative teamwork such as citizen science, crowdsourcing, and open source software development. These new phenomena further complicate the context and content of distributed creative teamwork: what are the characteristics of these new forms of creative teams? And how do they shape people's perceptions and social experiences of distributed creative teams? In this paper, we report our empirical research of the team characteristics and practices in a creativity-centric technology community (i.e., independent [indie] game development) in hopes of exploring these questions. Our findings show that 1) indie game development teams are formed upon shared aspirations and use various strategies to collaborate with friends or online strangers; and their team practices are achieved through a balance between individual creativity and collective vision as well as a collaborative learning for problem solving and self-improvement; and 2) these teams mediate new forms of social interaction and collaborative experiences, featuring a mix of online comradery and weak social ties, and a mix of self-confidence and self-confliction. Using this new dataset and research context, we confirm and extend existing theories of distributed creative teams in CSCW. We also argue that studying these small-scale, self-selected, and interest-based teams can inform the design of collaborative systems to support various creative teams' social needs.

Key Words: Distributed creative teams, Computer-mediated collaboration, Indie game development

1. Introduction

A team is often defined as a social entity composed of members with high task interdependency and shared goals (Dyer 1984). In the last decade, team activities that were traditionally offline have been increasingly mediated and supported by the thriving collaborative technologies such as video conferencing, file sharing, and co-design digital space. Despite the challenges of deception, persuasion, and willingness to cooperate, now people expect to communicate easily with each other and accomplish difficult teamwork even though they are remotely located or rarely overlap in time (Bradner and Mark 2002; Olson and Olson 2000).

In particular, a body of CSCW literature has explored the sociotechnical values of distributed creative teams in workplace (e.g., design, software development, and R&D

teams). These works not only describe the challenges to support these teams in terms of leadership, awareness, trust, and communication but also point out that the strategies to form and sustain these teams as well as the social consequences they afford also vary (e.g., Al-Ani et al. 2011; Fischer 2005; Farooq et al. 2007; Luther and Bruckman 2008; Nemiro 2002; Wang and Redmiles 2016). These heterogeneous accounts of distributed creative teams highlight the importance to explore new contexts of collaborative creative practices and emerging social experiences fostered by such practices. Especially, the increasingly popular interest-based online communities have shifted the online social space "from a comprehensive information repository to a set of collective projects, a worldwide community of communities" (Carroll 2010, p. 642), leading to new forms of distributed creative teamwork such as citizen science, crowdsourcing, and open source software development (Aragon and Williams 2011). These new phenomena further complicate the context and content of distributed creative teamwork: what are the characteristics of these new forms of creative teams? And how do they shape people's perceptions and social experiences of distributed creative teams?

In this paper, we report our empirical research of the collaborative practices and team characteristics in a creativity-centric technology community (i.e., independent [indie] game development) in hopes of exploring these questions. Indie games do not refer to games created by amateurs but are broadly defined as games that are consciously created within alternative production and distribution structures outside of the mainstream game companies (Lipkin 2012). We chose indie game development teams as our research context for two reasons. First, they represent a unique type of distributed teams that has not been widely studied in CSCW: small scale, self-selected, technology-oriented, and creativity centric. While game development is a niche technological practice, indie developers do not affiliate with any massive game company or publisher. Their teams, which often consist of freelancer developers, artists, or non-professional technology users, tend to be small but are strongly interest-driven (e.g., online strangers with a shared interest in gaming and making games) and highly task-oriented (e.g., developing a sophisticated software product). Second, game development is a creative and technologically challenging practice, which relies on both individual creativity and team efforts to overcome various technical and design issues. Tensions between individualism in creative practices and the need for a holistic collective vision in game development teams raise interesting questions on the new challenges for distributed creative teams where complex interpersonal and professional social dynamics intertwine.

In sum, the specific requirements for team members' technical and creative skills, loose interpersonal connections as interest-based Internet teams, and the shared aspirations for independence and innovation collectively make studying indie game development teams a valuable addition to the existing body of CSCW literature on distributed creative teams and computer-mediated creativity. By exploring indie game development teams, we hope to expand current CSCW studies on forming, maintaining, and experiencing distributed creative teams using this new dataset and research context.

2. Background

2.1. Distributed teamwork and creative teams

In the last decade, distributed teamwork (teamwork that occurs in different variations of time and space) has grown at a significant pace as collaborative technologies are continually being developed to support distribution (Bjørn et al. 2014; Gilson et al. 2015). These technologies certainly help to connect teams in different times and space, but they also create challenges related to communication (Cooke et al. 2013), coordination (Cooke et al. 2013), awareness (Gutwin and Greenberg 2004; Dourish and Bellotti 1992), leadership (Tjosvold and Tjosvold, 2015), and shared understanding (Mathieu et al., 2000).

The CSCW community has long been interested in distributed/virtual teams. In particular, a growing body of literature has focused on creativity-centric teams in distributed settings since such teams are of particular interest to work environments where creativity is considered a hallmark of successful work (e.g., design, software development, and R&D) (Kratzer et al. 2005; Bergström and Törlind 2007). In these teams, creativity is not an individual trait but a group activity (Paulus and Nijstad 2003), which happens in the interpersonal interaction within a specific sociocultural context (Engeström 2001; Nemiro 2002).

Similar to traditional co-located creative teams, distributed creative teams exhibit an evolving creative process that consists of idea generation, development, finalization/closure, and evaluation (Nemiro 2002). However, it can be challenging to conduct the actual actions associated with each step in a distributed setting. Specifically, multiple issues in pertaining to leadership, awareness, trust, and communication in creative virtual teams have been identified.

Leadership. Similar to leadership in traditional teams, there is a need for leaders in virtual teams to structure group tasks and provide socio-emotional processes (Al-Ani et al. 2011). In particular, Luther and Bruckman (2008) have highlighted the importance of leadership specific to distributed creative teams – for example, online collaborative leaders face challenges related to design actual projects and manage team members who are artists.

Awareness. Existing research highlights significant challenges concerning awareness in distributed creative teams. While awareness is generally considered necessary to overcome time and distance challenges in CSCW teams, researchers identified four awareness breakdowns during the virtual creative collaborative process: 1) minority ideas are under-considered, 2) novel ideas are easily lost, 3) a lack of critical evaluation of perspectives, and 4) reflexivity was weak during convergence (Farooq et al. 2007).

Trust. Closely tied to awareness is the desire for trust in distributed creative teams. Al-Ani et al. (2013) found that trust emerges among globally distributed system

developers through maintaining socially correct behavior, exhibiting technical competency, and demonstrating concern for others. In addition, trust in distributed creative teams is identified as a dynamic process that changes throughout the work life cycle. Similar to maintaining socially correct behavior, Wang and Redmiles (2016) found that when virtual team members in global software engineering teams demonstrated informal, non-work related communication (known as cheap talk), it was positively associated with trust. Recently, Trainer and Redmiles (2018) have also sought to outline the relationship among trust and awareness in distributed software teams. Their findings show that using software visualizations for awareness allowed for the development of trust amongst team members.

Communication. Communication is considered another major challenge for distributed creativity teams due to the complexity to share and express creative ideas via computer-mediated communication. For example, Bergström and Törlind (2007) examined creative collaboration of design teams in both co-located and distributed work settings and found that the creative process was often disrupted during distributed work due to a lack of shared collaborative capabilities (e.g., drawing surfaces). Aragon et al. (2009) noted that the design of systems that support collaborative creativity must facilitate sharing and play as well as consider the effects of repurposing, augmentation, and behavior adaptation.

In sum, existing CSCW research has not only described how technology can facilitate the process of collaborative creativity but also highlighted various challenges to support distributed creative teams (Fischer 2005; Olson and Olson 2000). Yet the emergence and prevalence of collaborative technologies and participatory culture is extending and complicating CSCW's research agenda on distributed creative teams even more. Increasingly, such teams emerge in interest-based online communities beyond the traditional work environments such as design and R&D (e.g., Aragon et al. 2009; Nov et al. 2011). How, if at all, do these next contexts shape the practices and experiences of distributed creative teams? We therefore introduce indie game development, a case study for a new type of data regarding distributed creative teams and computer-mediated creativity.

2.2. Indie game development

Digital game production is traditionally considered a professional technological practice for profit and everyday users have little role beyond purchasing and accepting produced games as commodities. In particular, the North American game industry produces more than 30% of the games on the global market, making game development a highly intense and professional practice in this region – "long hours, looming deadlines, hardcore workers, big money payouts and tremendous losses" (O'Donnell 2012, p. 99).

Yet, the increasing growth of indie game development seems to offer alternative ways to design and produce games and signify a cultural shift in how people perceive

games and the gaming industry. Recent industry reports have highlighted the role of indie games in economic growth and technological innovation, as well as its broader sociocultural values. Barish (2015) described that indie gaming as one of the fastest growing and most influential segments of the video game industry, which produces $80 billion dollars in annual revenue. Farago (2012) reported that indie games have dominated the mobile gaming market, accounting for 68% of all mobile game sessions. One of the most famous indie games, Minecraft (a sandbox open-ended game released in 2011 and later sold to Microsoft for over $2 billion dollars), has been widely discussed in terms of its aesthetic sensibility, breakthrough creativity, and potential application in computer-aided design (CAD) and teaching scientific concepts (Duncan 2011; Short 2012).

However, it is still challenging to define what "indie" means and why a game is "indie." Indie games, broadly construed, are games made within production and distribution structures that are different from (sometimes oppose to) those of mainstream gaming industry. Indie games are often relatively small projects in contrast to the so-called "AAA" games[1]; they are also developed by small teams of developers. "Being indie" seems to represent a new business model of game entrepreneurship, which has the potential to reconfigure and revitalize the mainstream gaming industry (McCrea 2013). O'Donnell 2012) pointed out that indie games focus on a small number of clear design and aesthetic goals and can be developed at a much smaller scale in terms of workload and manpower. Therefore, indie games are often praised as "moral, artistic high-ground" for their new forms of gameplay, innovative design, engaging experiences, and nostalgic properties (Lipkin 2012). In addition, Westecott (2013) described "indie" as an emerging subculture and an alternative ideology that transforms games from commercial products to forms of free expression. It is less of reusing existing digital materials and more of encouraging creating original products. It is also more of promoting alternative personal values, perspectives, and autonomy and less of a game-as-played (as a consumer product) and more of a game-as-made (as personalized artwork).

Yet it should be noted that the indie game development community as a whole is a complex, heterogeneous technology community, which may not fit the overall utopian picture of creative emancipation and entrepreneurial collectivism (Parker et al. 2018). Though indie game developers often pursue alternative ideologies, channels, and infrastructures to innovate game development, they are still subject to the power and economic structure of the mainstream gaming industry in various ways. For example, in the game world where discoverability (e.g., to be noticed and to be desired) is the key, many indie developers with little marketing budget struggle to make an impact (Parker et al. 2018). Instead, they have to rely on the various forms of "cultural intermediary" (organizations that mediate between various stakeholders with different needs and goals) to achieve the production, distribution, reception, and

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[1] AAA, or Triple-A, games refer to games with the highest development budgets and levels of promotion.

consumption of their games and realize their "indie-ness" and independence (Parker et al. 2018).

In this study, we understand people engage in indie game development for various purposes and not everyone is on the same agenda. We especially focus on the subset of indie game developers who are interested in forming distributed small teams to develop games as collaborative endeavors, and how their teamwork are intertwined with their complicated social and emotional needs and aspirations to advocate the indie culture.

3. Methodology

Three types of data were collected for this study, including threads on online forums, interviews, and offline observations of indie game development teams. We did so to obtain a holistic picture of team practices in indie game development.

First, due to indie game developers' high level of online participation, we collected developers' self-reports of their personal experiences of engaging in the indie game community that were posted to active public English language forums for indie game development. These online forums include Unity forum, indie gamer forum, Reddit (game dev), and Reddit (Indie Dev). In total, 1653 posts and comments with a time span from 2010 to 2017 were collected.

Second, after consulting an informant who was the organizer of a local International Game Developers Association (IGDA) chapter in USA, we requested to join Facebook Groups for indie game developers using keywords "indie game development" and "indie game developer." We then posted a recruitment message on those groups who accepted our requests to join and post ($N = 6$) in order to recruit game developers who had engaged in activist/non-profit oriented indie game development and were willing to be interviewed as voluntary participants. We also directly contacted indie game developers in USA who we already knew to ask their willingness to participate using a snowball sampling. All developers who responded to our requests and agreed to participate were interviewed. As a result, 12 semi-structured in-depth interviews were conducted in order to investigate indie game developers' attitudes and experiences that were not included in the self-reported forum data – for example, the implicit psychological and social reasons why they engaged in indie game development. Interviews were conducted via text/audio Skype chat based on participants' preferences from December 2017 to February 2018. In each interview, 15 predefined open-ended questions were asked and the average length of interviews was 80 min. All 12 participants were located in the USA. Six self-identified as female and six as male. Nine self-identified as Caucasian, two as African American and one as Asian. The average age of the participants was 31 years old (min. = 25, max. = 51) and average years of experience in indie game development was 8.5 years (min. = 2 years, max. = 17 years). Five of them (42%) developed indie games full time as freelancers or working in small studios (two to three people) while seven (58%) as part time or a hobby.

Lastly, one of the authors is an active member of two local indie game development meetup groups. She attended several events and workshops in 2017 hosted by

the meetup groups and conducted participant observations (Spradley 2016) of group members' interactions, discussions, and activities. She also attended the 2018 Global Game Jam in a mid-sized city in the United States to observe how a collection of individuals gathered together to plan, design, and create one or more indie games within 48 h. In this study, these observations were not part of the data analysis but mainly used to understand the context of indie game development, so as to better interpret developers' self-reports and interviews.

We used an empirical, in-depth qualitative analysis of the collected data (Strauss 1987) in the hope of shedding light on indie game developers' collaborative practices and social experiences. Our coding and analytical procedures were: 1) we closely read through the collected data to acquire a sense of the whole picture as regards developers' perceptions and interpretations of their teams and collectively identified thematic topics and common features in the data (e.g., team formation; individual creativity; team practices; social experiences; collaborative tools and strategies) for further analysis; 2) we carefully examined and reviewed the thematic topics and developed sub-themes; 3) we collaborated in an iterative coding process to discuss, combine, and refine themes and features to generate a rich description synthesizing how indie game developers engage in and experience their teamwork.

4. Findings

In this section, we present the unique characteristics of indie game development teams as they are manifested in how such teams are formed, coordinated, and experienced. We divide our findings into three parts: the *formation* of indie teams; the *core team practices* in indie teams; and *team experiences* in indie game development.

4.1. The formation of indie teams

4.1.1. *Aspirations for independence and creativity*

Many indie developers were well aware of how challenging indie game development could be. They especially pointed out that the high demand for a full spectrum of technical and social skills and self-motivated activities made it a high risk but not necessarily high reward field. For example, P6 (female, Asian, 29) described that passion, aspiration, and persistence were crucial in this area since the financial pressure and the risk of "much pain but no gain" were common: "You have to be very internally motivated when a paycheck isn't necessarily pushing you to the finish line. It's a very competitive space as well, so when you spend a year or years on a game and then don't get much of a response, it can be demoralizing."

However, many also explained why they were willing to dedicate tremendous time and efforts to indie game development despite the high costs and risks. P11 (male, white, 32) noted, "I've found the indie field to be filled with extremely friendly, creative, and passionate people, more so than any other industry. It's very small and tight knit. Indies tend not to see each other as competitors, and always do

whatever they can to help each other get that big break." For them, making indie games was beyond a personal hobby. It represented aspirations shared by many who were passionate about creativity, innovation, and arts: to engage in a creative and passionate technological community, to support and learn from one another, to create products of which one can be proud, and eventually, to use gaming as an artform to advance human culture.

To pursue such aspirations, indie game developers especially valued their "independence" from the massive gaming industry, as P4 (female, African American, 33) pointed out: "Independence really boils down to a game creator that owns their creation and intellectual property. They aren't making someone else's vision or owned by a publisher. Indies can work with publishers and the typical investment thing happens where a publisher will take some of the profits, but in large part, the indie owns what they make." They were motivated to team up in hopes of uniting with other similar minds to advocate the indie culture of independence and creativity, and to make this niche and non-mainstream technology community more visible to the public, for example:

> The social aspect of making games is important to indies. Having team members or even just interested bystanders helps a lot with motivation and training and growth, as it is with diversity in any setting. (P8, male, white, 30)

> At a studio it's easier to get help and support from inside the studio, but as an indie you need to reach out more to get support from other developers. You need resources, you need information, you need advice, and you need team members who can help and lift you up when you get stuck. This is especially important if you're an indie working and living far away from a local games scene. (P1, female, white, 33)

According to these quotes, the indie culture is largely driven by team building, collaboration, and coordination. Indie developers are often geographically distant from one other and indie game development is usually perceived as a niche technological area with limited public visibility and recognition. Therefore, many developers feel encouraged to form a team for both social/emotional and instrumental purposes. On one hand, knowing and communicating with other people who share the same passion and ambition for indie games enhance their confidence and sustain their dedication to this field ("it [indie game development] can be tough emotionally and physically. You need friends" [P12, female, white, 35]). On the other hand, collaborating as teams is crucial to maintain the independence of the indie game community (e.g., in terms of intellectual property and freedom to express and create) and to resist negative influences from the main gaming industry (e.g., largely revenue driven and opposition to openness and sharing). As isolated individuals, it is challenging for indie game developers to gather sufficient knowledge, information,

and resources to turn creative ideas into sophisticated technological products. Yet collaborating as teams pools scattered resources and link remote individuals, making alternative production and distribution structures for game development possible.

In this sense, shared aspirations for independence and creativity both encourage the formation of distributed teams in indie game development and reinforce indie developers' emotional attachment to this community:

> What you'll more likely find is that the longer you work in the indie field, the more people will become your "work friends"—freelancers, most of the time, in indie work. You'll have a natural understanding of each other since you're both pursuing your passions, and if your skills complement each other and you have good work ethics, you'll probably want to work together again (Anonymous online post)

> That's great for meeting with similar interests and passions. Just having a group of people that you can talk to is huge! This makes a huge difference in keeping inspired and motivated. You know you're not alone. (P9, male, white, 51)

As a result, many indie developers perceived collaboration as teams not only as a strategic practice to overcome various challenges in indie game development but also a core value of the indie culture: teamwork represents unity, openness, sharing, and mutual support; it also defines the collaborative and creative nature of indie game development.

4.1.2. *Teaming up with friends or online strangers?*

Yet indie developers' strategies and attitudes toward how to seek teammates varied. Some tended to team up with people whom they already knew or met in the real life. For example:

> I actually happened to know my boss from high school. We went our separate ways after graduating and kept loose contact. After I graduated from college he happened to be looking for a 3rd artist so the stars just sort of aligned well with that. (P5, male, white, 29)

> I was already good friends with the people I work for so that was very helpful in getting me a job at their studio :P I have also met other indie game dev teams at conventions where our studio has shown demos at booths such as PAX west and Indie Popcon. They were all very supportive and interested in each others' projects and we still keep threads of communication open on twitter and whatnot. (P11, male, white, 32)

Both developers were members of distributed indie game development teams or studios. However, their participation in these teams was still built upon offline social

networks: they either already had strong and long-term personal relationship with their potential team members (e.g., "know my boss from high school" and "already good friends") or at least had face to face interactions before. These existing social relations appeared to reinforce mutual trust and the tendency to coordinate, making them more willing to join the team and to collaborate with team members.

However, others strongly recommended not to team up with existing friends for better team performance and lower risk of damaging social capital. An anonymous online post described,

> Unfortunately I'd have to say this [developing games with friends] has a high likelihood of also ending friendships. People burn out, gain other interests, life gets in the way, etc. On a completely voluntary project, even one with friends, it is a lot easier to just bow out. Maybe everybody is interested enough that all goes well. Maybe the game stops development because of mutual agreement. There are all sorts of possibilities. Over the years I've just grown wary of the idea of being coworkers/teammates with friends, especially when you have no guarantee they are as invested as you are.

This post objected to the idea of intertwining personal relationship (e.g., friendship) with professional relationship (e.g., task-oriented game development teams) when forming teams. For this poster, developing indie games as a team required knowledge, experience, dedication, and a shared goal. While teaming up with offline friends may assure the initial trust among team members, there is no guarantee on teammates' technical skills, creativity, shared interests, and commitment – all of these are crucial to overcome the financial and social challenges in making indie games. In particular, under some situations collaborating with friends can be counterproductive. Developers may be reluctant to criticize their friends or urge them to complete the assigned tasks due to the concern about hurting their friendship, leading to low team performance. Any unsuccessful collaboration or unsatisfying social experience of the teamwork may end the friendship as well.

Some of the interviewees also advocated the idea of identifying qualified strangers online as teammates. For them, working with an Internet-based team both expanded the possibility of finding people with required skills and shared interests and avoided the risk of damaging their existing social networks. They shared a few successful examples:

> The two commercial projects I'm working on right now are in cooperation with other developers whom I met online. For both of these projects, I have been the artist, and they're programming. There's an interesting element of social engineering in gaining project partners. I wouldn't want to collaborate with my friends for this. Being a friend does not automatically qualify a person to be a good teammate. When there isn't a budget involved, you have to build on work trades, social capital, and patience in finding good collaborators. (P8, male, white, 30)

> A guy and I met in IRC (internet relay chat) in #quake. He worked for an ISP in Seattle at the time and we played Quake online together and talked on IRC a lot. We made a few games together and he helped me get my first job. It comes down to finding your group. That group that has the same passions and enjoyments as you. (P9, male, white, 51)

These quotes highlight how teaming up with online strangers optimizes their game development practices: they conducted fruitful teamwork despite geographical limitations and even without face-to-face interaction ("It's the best way to stay sane and make progress"); they enjoyed working with other similar minds who shared the same passion for games; and they even received valuable help to advance their professional career (e.g., "helped me get my first job").

It should also be noted that teaming up with online stranger was not depicted as an overly rosy picture. For example, an anonymous online post pointed out, "A non-trivial game is a pretty big commitment, so I wouldn't look to start that with a random I'd never met before. You have to rely on them, they have to rely on you, and neither of you have any idea if you can do that. I have heard of at least one successful commercial game that came from an online collaboration between people who, to my knowledge, hadn't met before. So it can happen. It's just how we can make it happen."

In summary, there seems to be no consensus among indie developers on the best practices to find potential qualified team members. Existing offline social networks may not provide the required skillsets and shared interests/passions for developing indie games; online strangers may offer a larger pool of qualified candidates but indicate possibly higher cost to build and maintain trustworthy and reliable collaborative relationships. A thread in an online forum discussed "What make Internet teams successful?" It received more than 50 comments that offered various suggestions, such as:

> This isn't an issue with being "online" or "offline" but rather the personalities involved in the team. Way too often people only care about their part and see the rest of the team as tools to get something completed instead of being a real team. A good lead will care about the teams well-being, a bad lead won't. (anonymous online post)

> Having a cohesive vision as a team and the right mindset are key. I've been working with an Internet team for about 8 months now, and the first thing we did was create a solid vision of what we wanted the game to be. Regular communication is also super important, my team has discord calls several times a week. That level of communication isn't required, but it's a lot harder to stay motivated as a team if you aren't communicating a good amount. Now my team has been working together for most of a year, have grown to 20ish members, and getting ready to go to Kickstarter. (anonymous online post)

These quotes point to two important aspects for identifying qualified team members online and maintaining effective teamwork: 1) a cohesive and solid vision of the game, which all team members agree on and are enthusiastic to pursue collectively; 2) the willingness to master various communication and collaborative technologies, which makes distributed team coordination, group decision making, code/asset sharing, and project management possible. Some participants also provided strategies to combine advantages of Internet based teams and teams of friends and/or acquaintances:

> I've kept things on a casual professional level, they don't get added to my Facebook friend's list for instance, but they can still message me there and in particular send me photos of their pets doing adorable things. I think this type of distance is good to both let us know more about one another and keep things professional so we get the job done. (P3, female, white, 28).

> My suggestion is to make good use of game jams and local dev meetups. Even if there's not a jam on, if there's someone you're interested in working with, I'd start with a jam between you, because that's lower stress / commitment / overhead than a proper project and lets you test the waters of "getting stuff done" with each other before increasing the commitment. (An anonymous online post)

For them, the key was to seek a balance between casual personal relationships and professional, work-related connections. We refer this balance to relationship "at a casual professional level": casual enough to learn about potential team members' personality, behavioral patterns, and work ethics but with sufficient distance to maintain the standard for high quality teamwork. In this process, participating in short term, low stress, and low commitment local game development events is considered an effective tryout to build trust, test skills, and determine compatibility.

4.2. Core team practices in indie game development

Indie developers noted that teamwork took many forms in indie game development. For example, P2 (female, white, 27) mentioned, "Collaboration can be anything in indie games. You can have people playtesting for you or doing the art, or helping you program. You can still have a personal project and collaborate with others. But you can also have a collaborative game just as easily." Once a small team is established, two core themes often emerge in many indie developers' team practices: balancing the tension between individual creativity and collective vision, and engaging in collaborative learning both for problem solving and for self-improvement.

4.2.1. *Balancing individual creativity and collective vision*

One initial problem that many indie game teams often encountered, regardless of online stranger or offline friends based teams, is the tension between their individual creativity and game development as a team task. Making indie games is a unique technological practice – it is creativity centric but depends on polling different team members' expertise and resources. Therefore, balancing the individual passion to innovate and the group effort to envision the future game becomes a key team practice for many indie developers. P8 (male, white, 30) described how such tension and balance could occur as early as in the brainstorming stage of game development:

> When we are brainstorming on new ideas for the game, I normally have a rule of following the passion. We are on a team together because we want to be, so we have to trust each other. If someone is very passionate about something, you need to trust that they will follow that idea through to the end. When I don't like an idea, I try to ask questions of why and how this would be in the game, and let others explain it to me instead of just saying no. That process is very beneficial in looking at ideas from all angles. We often say "There are no good ideas in brainstorming" meaning the first ideas we come up with will never be the best. However, the can be a seed of something great so it is always worth looking just a little more at stuff, even if your gut reaction is not to like it.

For P8, trusting team members' individual passion and creativity was essential – such a trust brought the team together, made team members work towards a common goal, and lay seeds for successful products. Yet, he pointed out that the team as a whole was responsible of reconciling different ideas and opinions to achieve a consensus, which would become the vision directing the team's development practices. In this process, disagreements, arguments, and comprises often happened. For example,

> I did some rough docs, layouts and concepts - then presented it to my team of friends. It was the first time I pitched anything! It was more formal than I expected as well (considering this was a group of friends). But we all took it seriously. So I presented the idea, they liked it and we tweaked and refined it as development went on! It's interesting - you want to provide a clear vision to the team, one that they can invest in and attach themselves to. But the idea must also be malleable enough that it can change on feedback, and change based on the strengths of the team. (P10, male, African American, 27)

This quote highlights the significance of team efforts to incorporate individual differences into a creative vision that everyone can agree on. According to these

developers, achieving such a consensus depends on: 1) a professional and formal attitude, which perceives game development as a team task rather than a one-person show; 2) a balance between specificity and flexibility, which wins team members' support and allows everyone to contribute based on their expertise. For them, how to create a holistic collective vision out of hetero-geneous individual creativity directly affected their team performance, as P7 (male, white, 25) summarized,

> As in any relationship, there can be conflicts. Creative differences and the maturity of the parties involved can make or break a collaboration. When you're talking about innovating, you're treading into unproven waters. Design decisions are harder to make and agree on. Compromise and ego suppression are indispensable, especially when it comes to making things that you have dreamed about. It can be hard to let go of your vision. (P7)

In this sense, team practices in indie game development are unique due to the strong individualism in creative activities and the need for collaboration and coordination to optimize a small team's capabilities and resources.

4.2.2. *Collaborative learning for problem solving and self-improvement*

Another core theme of indie developers' team activities focuses on collabo-rative learning. Many of them are non-professional game developers and acknowledged how challenging this area could be. To overcome such chal-lenges, learning various new skills (e.g., programming, modeling, game engines, and project management) is a continuous process; and indie devel-opers prefer to do so with team members, as P4 (female, African American, 33) described, "Making games is still for the most part hard. It was a lot hard back in the day. Though it can feel pretty negative a lot of the way, but anyone who's done it can tell you, the feeling of working with your team to solve all the problems, to complete a thing, or to get something working for the first time – nothing beats it. And it makes up for almost everything that felt so hard before it. The next best thing is seeing someone else enjoy it. That's kinda the best feeling in the world." For them, collaborative learning was not only for solving various problems in the development process but also significant for self-improvement. Such learning practices can happen in both formal and informal ways, including group workshops, online questions and answers, or just as part of their daily communication and practices. For example:

> I have actually gained the most varied experience working for my current team since I am responsible for nearly all of the project's art assets from concept art to modeling texturing and rigging. It has forced me to learn many new skills such as writing custom shaders and effects, which I collaborate with our

> programmer for a lot. I also collaborate with our team's animator to make sure my character rigs have all the features she needs to provide convincing animations. I think the best part of this is to learn from each other. (P6, female, Asian, 29)

> Our team has also organized tutorials and workshops. We're currently doing the adobe game dev 6 week course that's all online and free, and anybody who completes the course gets a very official certification. (P3, female, white, 28)

According to these quotes, learning with teammates seems to be a natural process and part of daily routine for many indie developers. They were motivated to participate in formal, organized workshops to improve the team's technical skills as a whole; they also gradually learned new skillset just by engaging in teamwork and working with other members. As part of a small team, they were responsible of multiple tasks due to the lack of resources and manpower. This drove them to practice and master a wide range of different skills and knowledge. In order to make successful games that required programming, artwork, animation, story-telling, experience/interface design, and audio engineering, they also had to coordinate with team members whose various expertise, priorities, and backgrounds contributed to their mutual understanding and mutual learning. In addition, very often learning just occurred in an implicit way – for example, by answering others' questions online, by sharing and discussing ideas with team members, by chatting about the work in progress, and by providing feedback and opinions for someone's work.

Many developers also highlighted that modern collaborative technologies significantly facilitated how they learned from/with their teammates:

> We keep up an active trello board to keep track of tasks that need to be done and anything that would overlap between team members. We also chat on Google hangouts nearly every day sending drawings and screenshots back a forth as well. When we really need to hash out details we have team meetings on skype. (P6, female, Asian, 29)

For them, these tools not only made computer-mediated collaboration possible but also offered multimodal communication channels for them to maintain frequent interaction with teammates. In doing so, they managed to know more about each other, discuss and solve problems together, and gained skills, knowledge, and experience.

4.3. Mixed social experiences emerging in indie teams

The unique ways how indie game development teams are formed and coordinated often lead to developers' complex feelings, perceptions, and experiences of involving in this creativity-centric technology community. Many expressed their social

experiences as "mixed" – a mix of online comradery and weak social ties, and a mix of self-confidence and self-confliction.

4.3.1. *A mix of online comradery and weak social ties*

Developers described engaging in indie teams as a socially supportive experience – they exchanged various types of social support with their team members, including informational, emotional, and instrumental support (Freeman and Wohn 2017). For example, they noted,

> We definitely help each other, things like retweeting each other for big announcements, trading contacts for things like publishers or bigger companies we are trying to get a hold of, etc. We also tend to look within our teams first if we know people are hiring for contracts and such. (P8, male, white, 30)

> Everybody in our team kinda has their own specialty so if you can't figure it out you just go ask them. Also trading advice on things like publishers, the hows of running a kickstarter or putting together a webpage, whether we should go to this convention or that convention is all stuff we talk about. (P12, female, white, 35)

For them, their team members were not only collaborators to complete tasks (e.g., develop a game) but also people who provided them with useful advice and information, helped them improve their technical skills, and supported them to overcome various challenges in indie game development. Their interaction may start as task-oriented but gradually evolve into a socially meaningful relationship by developing shared understandings and going through ups and downs together. In particular, many developers disclosed that such a relationship could be extended to the non-gaming context:

> The best thing I got from my team members is not to learn about game development but to know more about international culture in general! Since we all come from different cultures. (P7, male, white, 25)

> I have utterly relied on cooperation from people online in making games. Some of my team members are my oldest friends, people I still talk to regularly. I haven't even met them in person! (An anonymous online post)

These quotes point to how collaboration, support, and trust emerging in indie teams are not limited in the gaming context: long term friendships are forged even without face to face interaction; highly personal interactions often occur; and appreciations of other cultures and tolerances for differences happen.

Many indie developers summarized their engagement in indie teams as a type of "online comradery" – support and care about one another both online and offline, which made their team experience socially satisfactory and emotionally valuable. One developer described, "our team is in a Discord group — we give each other the (virtual) high fives when something good happens to a member (whatever that is, marriage, promotion, graduation, etc.), and honestly that's the best thing in my life" (an anonymous online post).

However, not everyone is willing to develop such a socially bonded relationship with teammates. Some revealed that they only maintained weak social ties with their teammates for team performance and privacy concerns. An anonymous online post explained:

> I have been laid up recently due to an accident so unable to get out and spend time with friends. I must admit that I do enjoy my online team friends and they have kept me busy. However, a balanced life with friends outside of your workspace is a good idea. Lol I have actually made many new online friends since starting our game. I like to work with them but we don't have to be buddies in our daily life. It's like you don't friend your co-workers. One reason is to keep everyone professional; another reason is that I do trust them but I do not want to expose my personal life to people I met online.

This understanding is closely related to the balance between casual personal relationships and professional, work-related connections in forming teams that we discussed in section 4.1.2. While this developer appreciated the online friendship afforded by his/her teamwork and considered it socially meaningful, he or she suggested that it should not be extended to offline or outside of the "workspace." This poster enjoyed the collaborative and friendly working atmosphere but had no pressure to maintain such loosely connected interpersonal relationships or heighten them to close friendships. P7's (male, white, 25) comment also echoed this opinion: "Most of my social interaction with my teammates is on Twitter. People will show images of projects they're working on, or share opinions or industry news, and I'll favorite or reply to tweets now and then. We don't exchange phone number, add Facebook friends, or meet offline. We just interact on Twitter." For him, Twitter represented the most appropriate social distance for him and his team members. Twitter allowed for quick and short communication, easy following and replying, and socially connected but not emotionally attached communication.

4.3.2. *A mix of self-confidence and self-confliction*

Some indie developers also described the continuous struggles between self-confidence and self-confliction. Engaging in a creativity-centric technology community, they were proud of what they could achieve. This reinforced their self-confidence both as technology users and as innovators. Yet, the high demand for creativity and technical skills, instability, and tremendous financial pressure also led

to their self-confliction – feelings of escapism, isolation, self-doubt, and uncertainty sometimes emerged. An anonymous online post explained how this mix of self-confidence and self-confliction affected his/her team:

> Let's just say everyone in the team has their "phases" in their lives. Sometimes you enjoy meeting new people and taking new challenges so you are super happy and productive. Sometimes you grow tired of it and rather do something less social and less stressful. So we may have a member who disappeared and reappeared. Maybe you just overdid it and burned out. So we may have a member who run away from us forever. That is pretty normal for most people when intensely working on something to the point of obsession. We all have this issue. Maybe you need a time out for some years, to come back to making games with a fresh perspective, and a renewed interest in it. Maybe making games just isn't for you, who knows. Also, the Indie / Self-employment route is a pretty difficult path for most to walk. You need to learn how to cope with all the pressure and uncertainty that route brings with it. This will make you strong.

This post shows that many indie teams experienced "phases" or fluctuations as developers dealt with the internal struggle between being creative, risk-taking, and adventurous and the natural demands for security, certainty, and steadiness. Indie teams are forged on shared aspirations and interests, and team members are generally motivated to collaborate towards a common goal (e.g., creating a game which everyone is proud of). Yet, the collaborative experience is not stable but dynamic – it often subjects to how different team members cope with their internal struggle – "super happy and productive," "grow tired of it," or "overdid it and burned out."

Nevertheless, this struggle appears to result from the fact that indie game development as a highly intensive and creative practice ("pretty normal for most people when intensely working on something to the point of obsession"). Another anonymous online post described how indie game development still could be a "lonely" experience even though teamwork was involved:

> Even when I was working with my team, I knew from experience when I was going too far with my own imagination. I was with my team but I was lonely because I only concentrated on the game itself. I think what many creative people don't confront is the fact that, at least the way I see it, artistic things like games are not meant to be just self-centric or an escape from real life, but rather they are meant to be something that colors the way that you experience reality and social life. And that's supposed to enhance the way you approach life rather than destroy your ability to deal with the world or to interact with people. I think a good way for all indie developers who want to enjoy innovation and optimize it by working with their team members is live out the

> richness of their imagination, rather than using it as a replacement for escaping from the world or from other people.

How does this happen? According to this post, one reason can be the misunderstanding of making games as a self-concentrated escape from the real world. It proposes that game development should inspire how both developers and players can experience the world and interact with others. It not only provides players with valuable and meaningful insights about the world, society, and people by playing the game but also makes game development a truly collaborative experience.

5. Discussion

Using indie game development as a case, we have presented our findings of the characteristics of small-scale, self-selected, and interest-based distributed creative teams. To answer the two questions that we proposed at the beginning of this paper, we have shown that 1) indie game development teams are formed upon shared aspirations and use various strategies to collaborate with friends or online strangers; and their creative practices are achieved through a balance between individual creativity and collective vision as well as a collaborative learning for problem solving and self-improvement; 2) these teams mediate new forms of social interaction and collaborative experiences, featuring a mix of online comradery and weak social ties, and a mix of self-confidence and self-confliction.

In this section, we discuss how our findings confirm and/or extend current understandings of distributed creative teams in CSCW.

5.1. The dilemmas of trust and awareness in distributed creative teams

Our findings show that the characteristics of indie game teams confirm some results from previous studies on workplace-based distributed creative teams, including the desire for socio-emotional connections (e.g., online comradery) (Al-Ani et al. 2011) and the need for stable sharing and communication (e.g., collaborative learning) (Aragon et al. 2009). Yet, our findings also point to some aspects of distributed creative teamwork that may have been overlooked in other studies, especially with regard to the dilemmas of trust and awareness (Al-Ani et al. 2013; Wang and Redmiles 2016) in small scale, self-selected, and interested-based creative teams.

The idea of being socially engaged with someone (e.g., developing interpersonal trust) is usually viewed as a facilitator for all types of teamwork (Hossain and Wigand, 2004; Yang 2013). Distributed creative teams are no exception. Yet in our study, those self-selected and interested based small teams considered social engagement a double-edged sword for their team performance. On one hand, they acknowledged that a certain degree of social interaction was essential to "glue" the team together and make indie game development a socially supportive experience. On the other hand, many of

them rejected the idea of collaborating with existing friends or socially bonded with their teammates, warning that such efforts might damage their social network or risk their privacy. There appears to be a dilemma in how indie developers perceive interpersonal trust in their teams: their teamwork reinforces and benefits from mutual trust (e.g., collaborating with a reliable friend who also loves game development) but also destroys trust (e.g., realizing that a friend was unreliable after an unsuccessful team project). In this sense, a high level of trust may discourage rather than promote team creativity. With the concern that they may end friendships that they valued, many indie developers chose not to collaborate with people they already trust but form teams with qualified online strangers.

Therefore, these small teams represent a new form of distributed creative teams and highlight their unique social interaction consequences. They are self-selected and interest based, which potentially both improve team members' social capital (e.g., making new friends or reinforcing existing friendships) and diminish it (e.g., ending friendships). They are also creativity centric and technology oriented, which makes forming and engaging in a team a highly strategic and risky decision due to the possibility of higher social engagement but lower team performance. For example, collaborating with one's best friend naturally makes the teamwork more fun and social; yet it may also cause distractions and slow progress.

This complex dynamic between the expectations for social engagement with team-mates and the enthusiasm for effective team performance sheds light on the subtly intertwined personal relationship and professional collegueship in distributed creative teams. Taking indie game development as a case, such teams are task-driven and built on an instrumental goal (e.g., making a functional digital game), which require professional attitudes, special skillsets, dedication, and excellent work ethics to make it happen. Often consisting of online strangers with a shared aspiration, these teams also open to opportunities of casual interaction, mutual learning, and social support, which are necessary for retaining team members in this challenging and stressful field.

In addition, the dilemma of trust calls for the attention to the complexity of awareness in distributed creative teams. While the awareness of team members' presence and activities are essential to build trust and facilitate distributed teamwork (Farooq et al. 2007), our findings highlight the partic-ular importance of self-awareness (e.g., how individuals experience and cope in teamwork) for creativity-centric teams. Very often, once a team is formed, attention is only paid to experiences and practices at the team level. It is a legitimate expectation since teamwork is more than merely combining team members' individual work together. However, creativity-centric teams are different – in these teams, self-awareness of individual experiences does not simply dissolve in teamwork but contributes to the overall creative process. As our findings show, in indie game development, team members' internal struggles, their often-changing personal experiences and feelings throughout the whole teamwork process, and how they cope with such fluctuations (e.g., a mix

of self-confidence and self-confliction) – all of these are integral to the overall team experience and team performance. Instead of just being a component of a team, members of indie development teams are well aware of their independent identities, strong agency, and personalized perceptions and experiences, which significantly affect how their teams collaborate and create. Yet, such independence does not necessarily harm the cohesion of the team. Rather, it makes collaborative creative practices in indie game development both socially meaningful for the team members and overall effective at the team level. For many indie developers, developing games depends on collaborative creativity, which requires sharing, coordination, and comprises; it is also a fundamentally personalized experience, which reinforces self-awareness – it is driven by individual passion, built on personal skills, affected by subjective emotions and feels, and can contribute to one's social satisfaction and self-identification.

In sum, a better understanding of how these small scale, self-selected, and interested-based creative teams approach the intertwined social interactions/expectations leads to a broader examination of the role of trust and awareness in distributed creative teams. It also informs the design of collaborative systems to support various creative teams' social needs. Overall, it seems necessary to afford the appropriate (rather than the highest) level of trust and social bond in distributed creative teams for better team performance. It is also valuable to not only facilitate the awareness of team members' social presence but also reinforce individual members' self-awareness to optimize the contributions of their individualized experiences to team creativity. In this process, tensions and conflicts between individual creativity and collective vision may emerge, which we will discuss in the next section.

5.2. Tensions between individual creativity and collective vision in distributed creative teams

Two related themes emerged throughout many of our findings in this work: 1) a collective and shared vision and aspiration are essential to form and coordinate small-scale, self-selected, and creativity-centric technology teams, and 2) team efforts to incorporate individual differences into a collective vision is a necessary but difficult concept to harness within the development of distributed creative teams. Indeed, our findings align with many previous results on the significant values of the team creative process (Nemiro 2002) and the challenges of workplace based distributed creative teams (Bergström and Törlind 2007; Farooq et al. 2007) by highlighting the importance of using creativity to develop a meaningful foundation for a team vision for problem-solving. However, we also further explicate the tensions and struggles emerging in this process, taking the heterogeneous nature of self-selected, interest-based creative teams into account.

In our study, creativity is a valued and integral part of the indie game development process and is often encouraged within the overall context. Our

participants often spoke of their creative efforts and how this medium allowed them to express themselves in a unique way through design and technology. Participants also mentioned the importance of a collective vision that is necessary for effective teamwork. Yet, while both creativity and collective vision are viewed as positive aspects to distributed creative teams, they can actually oppose each other and create conflicts. For instance, individual creativity is a uniquely individual facet of human cognition with some people being more creative than others. This also means that one person's creativity is often individually different than another person. Creative differences are often the root of many social conflicts. The emergence of interest-based online communities further magnifies such differences by connecting more people with diverse backgrounds, knowledge, and experiences together. When we align creative differences with the need to have a collective vision, it becomes obvious how creativity can hinder a collective vision. Differences in creativity may be the direct result in failures associated with developing a collective vision. The question becomes: how does a completely self-selected and interest-based distributed team overcome this and still develop a collective vision?

The answer comes from people's identification of shared aspirations and collective learning. For example, many participants in this study continually noted how most team members had a shared passion for gaming and game development. This passion directly helps team members to work to get on the same page. If team members did not have a shared goal and share commonalities in what they desire to accomplish, then they would most likely leave the team. In addition, through collaborative learning, indie game developers learned from one another's differences and optimized their limited resources to solve team related problems, whether explicitly communicating or using collaborative technologies. Such progress not only provides creative manners to overcome team obstacles but also improve their skills to communicate, compromise, and innovate.

These understandings may lead to a reconsideration of how we design collaborative technologies to support participation, leadership, and decision-making in distributed creative teams. Overall, it is challenging to manage individual creativity and a collective vision in parallel in a creative team. Yet, it is actually necessary to manage them in such way in order to develop accurate and similar shared cognition. Teamwork is not groupthink, and individual creativity guards against groupthink development. Due to the pronouncement of creativity in self-selected interest-based teams, it is more likely that a truly "shared" understanding of their team members and task would emerge. Creativity may result in disagreements, conflicts, and arguments among team members, but it also ensures that the process of sharing knowledge and information is diverse among the team. In this sense, designing collaborative systems to support distributed creative teams may still need to focus on affording individual creativity and equal participation in decision making rather than merely emphasizing team level activities (e.g., a shared whiteboard). In this way,

individual creativity has the potential to significantly contribute to a more holistic basis of teamwork by reconciling and incorporating many different perspectives.

5.3. Limitations

A few limitations of this study should be noted. We focus on a subset of activist and non-profit oriented indie game developers who develop games as small teams. This sample may not represent the ideology and practices of indie game development as a whole. All interview participants were volunteers recruited from Facebook groups and indie game developers' self-reports were collected from online forums. There is a potential bias toward indie developers who were active social media users. In addition, a significant benefit of our dataset is that it includes both self-reported online forum data and in-depth, rich interview data. Therefore, we did not specifically compare or differentiate these two types of data in the hope of offering a more comprehensive picture of small indie game development teams. However, it is possible that the interview data tend to be more positive due to the self-selected participants and the online data tend to be more critical due to the anonymity of online forums. In future research, a variety of other data sources (e.g., logs and large-scale surveys) could be used as a way to reach a broader participant population and further validate findings from the interviews and online forum data.

6. Conclusions

Using indie game development as a case, we have shown how small-scale, self-selected, and interest-based distributed teams are formed, coordinated, and experienced in a creativity-centric technology community. We have highlighted the characteristics of these teams: 1) the importance of shared aspirations and the tensions between personal relationships and professional colleagueship in forming such teams; 2) the core team practices to build a collective vision from diverse individual creativities and through mutual learning; and 3) the complex social experiences resulting from the first two aspects.

We make three interlinked contributions to CSCW. First, our contribution lies in the case study itself. Indie game development is an understudied topic in CSCW. Our case study provides new empirical evidence of how collaborative technologies and participatory culture lead to new forms of distributed creative teams and makes creativity more accessible – freelancer developers, artists, or non-professional technology users can all form virtual teams to engage in game design and development. Second, our findings confirm and extend existing theories of distributed creative teams. Though trust on team members and the awareness of their presence and activities are essential to facilitate distributed teamwork, we highlight the dilemmas of trust and awareness in indie game development teams and shed light on the subtly

intertwined personal relationship and professional colleagueship in such teams. We also further explicate the tensions and struggles between individual creativity and collective vision in these teams. Third, we argue that a better understanding of these small scale, self-selected, and interested-based creative teams would inform the design of collaborative systems to support various distributed creative teams' social needs (e.g., affording the appropriate rather than the highest level of trust and social bond and reinforcing individual members' self-awareness).

Acknowledgements

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