The Influence of Personal Traits on Innovative Processes in Virtual Teams

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Abstract

The implementation of virtual teams becomes increasingly common practice in organizations around the world. The progress in the development of new communication technologies in the last two decades have changed the paradigm of how firms—both established and entrepreneurial—approach innovation and new product development (NPD). This study is interested in personal traits of virtual team members measured by the five-factor-model that promote innovative behavior and therefore enhances individual performance. This study’s context is an online strategic game called Travian with servers from 22 countries. We assumed that people high in extraversion and low on conscientiousness, who can be described as open minded, outgoing, assertive, active, and sociable, and also having the tendency to be organized, responsible, and careful, profit from innovative behavior, that resulted in a higher individual performance. Results were counter-intuitive, as extraversion had the opposite effect. People low in extraversion did profit more from innovative behavior. Conscientiousness did not have a moderating effect.

1. Introduction

Over the past two decades the development of new communication technologies has enabled organizations to assemble globalized virtual teams [1]. These global teams have changed the paradigm of how firms—both established and entrepreneurial—approach innovation and new product development (NPD). According to Eppinger and Chitkara [2] “A new paradigm has emerged whereby companies are utilizing skilled engineering teams dispersed around the world to develop products in a collaborative manner. Best practices in NPD are now rapidly migrating from local cross-functional collaboration to a mode of global collaboration.”

In this study, we define virtual teams as “groups of geographically and/or organizationally dispersed coworkers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task” [3: 18]. Virtual NPD teams are a boon to companies; effective ones shorten product-development cycles, reduce errors, reuse existing design, improve cross-functional and cross-organizational cooperation, reduce travel costs, and so on [5]. This affects new ventures as well as large firms seeking to be more efficient innovators [6].

In addition to wrestling with geographic issues, virtual team leaders increasingly have to manage teams whose members hail from different cultural backgrounds and have different value systems. However, given the importance of individual personality traits and diversity in virtual teams, there remains a dearth of literature on the efficacy of individual characteristics on the innovation process within these dispersed teams [7]. Several questions arise: Do innovative virtual team behaviors positively influence the individual performance of team members? If so, to what extent should leaders consider team members’ personality when pondering this relationship? Specifically, are extraverted team members more likely to perform better?

To answer these questions, we have conducted a study of dispersed virtual team members who work together in a massively multi-player online game (MMOG). This unique context offers a natural laboratory for the study of virtual teams [8, 9]. The chosen setting allowed us to investigate a large number of virtual teams made up of between three and 60 team members across 22 different countries. This sample size allows for objective measures of innovative behavior and individual performance. Online gaming allows us to obtain objective data on innovative behavior and individual outputs as well as perceptual data in a setting wherein participants are highly engaged over an extended period (in this case, about one year). Like their real-world workplace analogues, the virtual teams we studied were geographically dispersed and interacted through the
use of information and communication technologies (ICT).

This paper makes some key contributions to the literature. First, it contributes to virtual team research and cross-cultural studies in the field of innovative behavior. Second, it offers insight into innovative behavior of virtual team members, which is important for assessing individual performance. Third, the findings draw attention to the team members’ individual roles in innovation.

The remainder of this paper is organized as follows. First, we present an overview of the relationships between the variables presented in the research model. Then, we present the results of the correlation study. We conclude by discussing the model, the results and their implications for practice, future research opportunities, and limitations of our research.

2. Theoretical Foundations and Hypotheses

At its most basic level, innovation is “a process that begins with an idea, proceeds with the development of an invention, and results in the introduction of a new product, process or service to the marketplace” [10]. Schumpeter [11], one of the original contributors to innovation research, outlined two types of innovation drivers: entrepreneurial innovation and managed innovation. At the root of both types of innovation lie individuals and their innate characteristics. Be they co-located or virtual, Schumpeter’s second driver of innovation—managed innovation—is made up of individual contributors, whose behavior can influence the level of effort put forth to innovate. As such, our research focuses not on entrepreneur-innovators but, rather, on the characteristics that individual team members put forth in order to improve to their performance and innovation in the context of their team. These characteristics include intelligence, background, experience, education, and personality. In this study, we focus on personality traits that can influence innovation and its outcomes.

Innovative behavior can be defined as “intentionally and directly changing things through the creation of new circumstances, or the active alteration of current ones” [12: 3]. This definition implies two important issues: First, innovative people realize organizational change. In this context Rank et al. [13: 519] adopted three psychological processes of organizational change, namely creativity, innovation and initiative. These three determinants have been identified as the three steps of the innovation process.

Second, this definition contains one more important aspect, as it says that innovative behavior is the creation of new circumstances. Therefore, it refers to the creation of “something novel, unique, and value adding” [14: 83]. This predicates that innovative behavior can only be generated by people, more precisely the innovators themselves. Innovators have been identified by Scott and Bruce [15] as people, who develop, carry, react to and modify ideas. Therefore, every operation, which is regarded in this context, can be described as innovative behavior. Usually, an individuals’ behavior is determined by his character, meaning his skills and traits [16].

In order to describe innovative behavior, Fay and Frese [17] focus on personal initiative, which can be defined as “a behavior syndrome that results in an individual taking an active and self-starting approach to work goals and tasks and persisting in overcoming barriers” [17: 97]. This model includes self-started, proactive, and persistent behaviors. These three factors “describe a class of behaviors that have been positively linked with innovation” [18: 13]. Self-started behavior can be described by “setting oneself context-specific goals” [18: 13] and “going substantially beyond one’s job” [13: 523], which can be formulated as qualitative initiative, and “spending additional energy at work” [13: 523], which is also known as quantitative initiative. Among this, there is persistent behavior, which includes the overcoming of barriers. In this context Rank et al. [13: 523] assumed that “initiative may predict innovation” and that it might be a moderator of creativity and innovation.

Personality and personal values can be defined as “enduring dispositions that cause characteristic patterns of interaction with one’s environment” [19: 675]. Researchers have used the “Big Five” to analyze the role of followers’ personality [i.e. 20, 21, 22]. These personality factors were discovered and defined by several independent sets of researchers [23-25]. The Big Five are a robust set of factors, including extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience [26]. This study analyzes two of the five above-mentioned dimensions, namely extraversion and conscientiousness, as they are most suitable to the research context of distributed teams. Balthazard et al. [27: 44] argued that extraversion is “the most appropriate initial factor to examine […] in virtual teams”. Individuals who score high on extraversion tend to be outgoing, assertive, ambitious, active, and sociable. Conscientiousness represents the tendency to be organized, efficient, responsible, and careful [19, 26, 28].
2.1. The Effect of Innovative Behavior on Individual Performance

Highly innovative, effective teams, be it co-located or virtual, are directly linked to the individual members performance. At the world-leading design firm IDEO, project teams are comprised of highly motivated individual contributors that act in concert to produce effective results for their clients. At IDEO, teams may be comprised of various personality and background types, which IDEO general manager Tom Kelly has given general roles to these individuals such as the Director, or Cross-Pollinator [29]. It is their view that the performance of the project is directly influenced by the innovation of these various roles in the team. Serial innovators, those individuals are consistent in their development of breakthrough innovations, have behaviors that a fundamental curiosity, ability to understand their environment, and go back to first principles [30]. These traits point to the importance of individual performance during the innovation development effort. Therefore, this study hypothesizes the following:

H1: Virtual team members’ innovative behavior in a virtual team is positively related to their individual performance.

2.2. The Effect of Extraversion on the Relationship of Innovative Behavior and Performance

The characteristics of extraverts, outgoing, assertive, ambitious, and active are most likely to be relevant to successful innovative behavior. Heniks [31] collected several characteristics of innovative and successful entrepreneurs from different sources [32: 10-14, 33: 564]. In his study he differs between a creative nature of an innovator and his dynamic personality and refers to Schumpeter, cited by Scherer [34: 13]: The entrepreneur-innovator is characterized by “initiative,” “authority,” and “foresight”; he is “the captain of industry” type. Extraverts tend to be social, active and outgoing people [20]. Furthermore they have been described as “being sociable, gregarious and ambitious” [20]. Those individuals, who are high in extraversion, have “a high value on close and warm interpersonal relationships” [20: 96]. Extraversion has been “associated with effectiveness in a team setting” [20: 96]. This might be due to the fact that people high in extraversion tend to “act based upon their perceptions to the options of significant others” [20: 97]. If team members act in cooperation, monitoring of one common goal is ensured, which has already been identified as being supportive for collaborative teamwork. Moreover, if individuals of a team tend to be outgoing people, they might coordinate things among each other. It is highly probable that this is equal for virtual teams, as virtual teams also need to be well coordinated [35]. To a greater degree extraversion is essential in virtual teams, because virtual collaboration is only possible if innovators not merely act in isolation and maintain on their opinion, but rather ask virtual coworkers for help. Asking for support requires extraverts, who are not too shy to communicate with unfamiliar people. Thus, extraversion is an expedient trait concerning virtual teamwork. Nevertheless, Chen and Chen [16: 199] claimed that “if there are too many extrovert personnel in one team, it will have an adverse effect”. They assume that this will lead to individuals working all on their own, and not taking care of others’ opinion. This might be due to the fact that too many ambitious personalities and individuals gaining social status might bring a lot of competition [20]. When competition appears in a vast number, this again might lead to lower efficiency. Therefore, this study hypothesizes the following:

H2: In virtual teams, individuals’ extraversion moderates innovative behavior’s positive impact on individual performance in such way that the performance will be stronger for highly extraverted individuals.

2.3. The Effect of Conscientiousness on the Relationship of Innovative Behavior and Performance

Conscientiousness is defined as the “degree of organization, persistence and motivation in goal directed behavior” [20: 94]. This sort of organization requires a certain kind of “self-control”, which is “reflected in a need for achievement, order and persistence” [20: 96]. Innovative people have been identified, as being persistent individuals, who don’t give up easily. Furthermore conscientiousness has been defined as dependable, industrious, efficient, and achievement oriented [20, 21]. As innovative people should provide a “mastery of discipline”, where they have to face one projecting goal, it can be assumed that innovators reveal conscientiousness. Conscientiousness in virtual teams might differ from conscientiousness of innovative people, not working in a virtual team. Virtual teams require a high level of organization, which expects every single team member to be severe of self-control. As the members need to work virtually they don’t hold face-to-face-meetings periodically. Thus, they have to organize
their workflows regularly and into more detail. Furthermore, due to the fact that innovators should be working while facing a projecting goal, it is essential to the members of virtual collaboration to pursue the same goal. Given these facts, conscientiousness can be assumed to be more important in virtual collaboration than in face-to-face innovation. Therefore, this study hypothesizes the following:

\[ H_3: \text{In virtual teams, individuals' conscientiousness moderates innovative behavior's positive impact on individual performance in such way that the performance will be stronger for highly conscientiousness individuals.} \]

Figure 1 shows the research model of the study.

![Figure 1. The research model](image)

3. Method

3.1. The Online Game Context

As described in an article in *Science* [8], scholars in the social sciences are beginning to discover the research potential of virtual worlds. Despite the fact that most research involving virtual gaming has been focused on anthropological ethnography and sociological participation observation [36], this virtual setting holds great potential for quantitative empirical research: the availability of a vast amount of behavioral data from users collected in an unobtrusive way. The context of an online game in this study has the advantage of being highly engaging and psychologically meaningful to participants compared to laboratory simulations [37, 38]. Often the relationship between players is compared to the relationship between co-workers in their real job [38]. Research shows that most players are older than was previously thought and likely to be more social than the common stereotype suggests [37, 39]. Yet, systematic and representative research has remained elusive and rare [40]. And even though researchers admit that online games are not a perfect analogue to all aspects of organizations in the offline world (due to eventual disguise of offline identities and sometimes lower stakes), online games do open a window into the future of real-world business leadership and offer a “sneak preview of tomorrow's business world” [41].

Our data was derived from a popular browser based MMOG called Travian. The advantages of this game are manifold: On the one hand, it is free of charge. There are no subscription fees or initial costs, which opens the game to more casual players and not just “hard-core” gamers with a higher willingness to pay. On the other hand, being browser-based, it also lowers the entry barrier for new players, because no special client software needs to be installed on the computer. These factors provide for a broad user base and make it particularly interesting for scientific research. The game itself is a real-time strategy game (RTS). Players start out as chieftains of their own villages and seek to gain natural resources, build armies and expand their realms. The game is timed to last approximately one year, at which one entity being deemed the winner based on the fastest completion of a certain building called “wonder of the world”. The game is played with up to 25,000 users on one server, using scarce resources, and only one actor or team can win. Actors soon find themselves in a social dilemma [42] which is typical for the social dilemmas present in any organization that coordinates labor parts. The actors have to cooperate with other actors to protect their territory and resources and to successfully expand their realm. In the race to dominate, actors form teams of up to 60 members under a leading chieftain. Teamwork, diplomacy and negotiation skills play a crucial role in this context leading to complex team structures and interactions between and among teams. In the later stages of the game it becomes quite important for alliances to collaborate effectively, negotiate, and team up with other alliances. Alliance members become colleagues, and losing a village or contingents of soldiers causes real emotions, suggesting psychological involvement. Due to the characteristics of Travian, teams within Travian can be regarded as virtual teams following our definition.

3.2. Sample and Procedure

Our approach was to obtain data directly from the computer servers (log files), and to enhance the data with a questionnaire distributed to subscribed Travian players. The study employed several two criteria. First, we drew data from game servers that had been running for at least 200 days, thus ensuring that
teams were well established and their membership stable. Second, the study focused on players who were at least 18 years old. Using these criteria, the study identified 5,252 teams with 18,087 members from 22 countries: Australia, Brazil, Chile, Denmark, the United States, Germany, Spain, Iran, Finland, France, Israel, Hungary, Indonesia, Italy, Japan, Netherlands, Poland, Portugal, Russia, Slovenia, Turkey, and the United Arab Emirates. To ensure that only highly engaged players were surveyed, a link to the survey was posted on the game’s login page for only four days. Highly engaged Travian players log on several times a day; others, less often. Therefore, less engaged players were much less likely to be part of the sample. The questionnaire was available to players only once. Once they closed the questionnaire, they could not access it again, ensuring that no player could answer it twice.

The servers showed a total of 165,956 players, 57,161 of whom filled out the survey, for a response rate of 34%. Data sets with missing values were excluded. This reduced the sample size to 5,252 teams with 18,087 members from 22 countries. The average age of the surveyed players was 30 (range: 18 to 69), and 18% of the sample were female.

3.3. Measures

Players operate in teams. Thus, players’ perception may be affected by grouping effects, at both the team and the country level, and therefore may not be independent of each other. The hypotheses involve predictors measured at the individual level (Big Five, Innovative Behavior, Performance). These nested data structures call for hierarchical linear modeling (HLM), rather than ordinary least squares (OLS) analysis (Hox, 1995; Raudenbush and Bryk, 2002). All predictors were standardized prior to hypotheses testing (Hofmann and Gavin, 1998). In order to show the nested data structure, an intra-class correlation coefficient, namely ICC(1), was calculated (ICC(1)= .11 for the country level ICC(1)= .52 for the team level). Note: due to the large sample size mean scores are generally more stable.

Dependent Variable. The data on individual performance were obtained directly from the log files of the game server. The game provides an in-game scoring system that objectively lists the inhabitants of each player’s village. These inhabitants of the player’s villages grow with the player’s successful actions. This offers the advantage of ranking and measuring each player’s performance unobtrusively and objectively. Individual performance was measured one month after the survey.

Independent Variables. For measuring the individual personality values, the study adopted the Big Five approach, according to which personality is assessed using a ten-item scale [43]. All items were rated on a five-point scale with anchors of “strongly disagree” and “strongly agree”. The items didn’t have to be adjusted to the virtual context. Five of the ten items measured the dimension of extraversion (e.g. “I see myself as someone who is outgoing, sociable”) while the other five items were measured on the dimension of conscientiousness (e.g. “I see myself as someone who makes plans, follows through with them”). Both measures showed good reliability with Cronbach’s α = .81 for extraversion and Cronbach’s α = .87 for conscientiousness.

The data on innovative behavior were obtained directly from the log files of the game server. The game provides the possibility for individual team members to generate creative ideas (Scott and Bruce, 1994), and to search out new technologies, process, techniques, and/or product ideas (Yuan and Woodman, 2010) to explore the different characters of their troops. Furthermore, players need to investigate and secure funds needed to implement new ideas (Scott and Bruce, 1994). Players can invest a maximum of 20 units per character. We calculated a ratio on the same day of the survey and linked it.

Control Variables. Data on gender, age, and tenure were obtained from the team-member survey.

4. Results

Given the data’s multilevel nature, we tested hypotheses 1 to 3 using HLM. We standardized all predictors prior to hypotheses testing. Table 1 shows means, standard deviations, and correlations of study variables.

Table 1 shows means, standard deviations, and correlations of study variables. Table 2 shows the results of the analysis. The test of the main effect hypothesis (hypothesis 1) is reported in the columns labeled Model 2; tests of the interaction hypotheses (hypotheses 2 and 3) are reported in the columns labeled Model 3. Note for all tables: Parameter estimates are reported in the body of the table, with standard errors reported in parentheses; * p < .10; ** p < .05; *** p < .01; **** p < .001; To provide an effect size comparable with moderator research [44], R’s are estimated from ordinary least squares (OLS) regression that include a manager fixed effect. Hypothesis 1 predicted that innovative behavior of a virtual team member is positively related to their
### Table 1. Means, standard deviations and correlations for study variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Age</td>
<td>18,087</td>
<td>30.26</td>
<td>9.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Gender</td>
<td>18,087</td>
<td>0.82</td>
<td>0.38</td>
<td>-.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Tenure</td>
<td>18,087</td>
<td>14.76</td>
<td>12.95</td>
<td>.09</td>
<td>.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Extraversion</td>
<td>18,087</td>
<td>3.60</td>
<td>0.86</td>
<td>-.00</td>
<td>-.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Conscientiousness</td>
<td>18,087</td>
<td>3.98</td>
<td>0.80</td>
<td>.05</td>
<td>-.01</td>
<td>.05</td>
<td></td>
<td>.59</td>
<td></td>
</tr>
<tr>
<td>6 Innovative Behavior</td>
<td>18,087</td>
<td>4.66</td>
<td>10.35</td>
<td>.07</td>
<td>.02</td>
<td>.15</td>
<td></td>
<td>.02</td>
<td>.02</td>
</tr>
<tr>
<td>7 Performance</td>
<td>18,087</td>
<td>1,935</td>
<td>2,184</td>
<td>.10</td>
<td>.03</td>
<td>.33</td>
<td>.01</td>
<td>.01</td>
<td>.43</td>
</tr>
</tbody>
</table>

*p < .10; **p < .05; ***p < .01; ****p < .001;

Table 2. Results of HLM analyses on individual performance

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1418.15 (115.64)</td>
<td>1491.83 (110.22)</td>
<td>1492.59 (110.22)</td>
</tr>
<tr>
<td>Age</td>
<td>72.98 (11.55)</td>
<td>45.46 (11.12)</td>
<td>45.65 (11.12)</td>
</tr>
<tr>
<td>Gender</td>
<td>55.73 (11.14)</td>
<td>45.92 (10.70)</td>
<td>45.92 (10.70)</td>
</tr>
<tr>
<td>Tenure</td>
<td>271.67 (12.24)</td>
<td>258.10 (11.77)</td>
<td>258.57 (11.78)</td>
</tr>
<tr>
<td>Extraversion</td>
<td>-10.26 (13.31)</td>
<td>-9.77 (13.32)</td>
<td></td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>59.32 (13.35)</td>
<td>58.31 (13.36)</td>
<td></td>
</tr>
<tr>
<td>Innovative Behavior</td>
<td>457.73 (10.85)</td>
<td>458.72 (10.87)</td>
<td></td>
</tr>
<tr>
<td>IB*Extraversion</td>
<td>-23.29 (12.43)</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>IB*Conscientiousness</td>
<td>7.28 (12.41)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>.12</td>
<td>.26</td>
<td>.26</td>
</tr>
<tr>
<td>F-Value</td>
<td>795.76</td>
<td>1074.24</td>
<td>807.69</td>
</tr>
</tbody>
</table>

*p < .10; **p < .05; ***p < .01; ****p < .001;

Note: Parameter estimates are reported in the body of the table, with standard errors reported parentheses;

*a To provide an effect size comparable with moderator research [46], R²’s are estimated from ordinary least squares (OLS) regression that include a manager fixed effect.
individual performance. As indicated in table 2, this hypothesis was supported \((\gamma = 458.72, t = .18, p < .001)\). Hypothesis 2, regarding the moderating influence of extraversion on the positive relationship of innovative behavior and individual performance was not supported by the data \((\gamma = -23.29, p < .10)\), the effect was significant but negative, not positive as assumed. Hypothesis 3, regarding the moderating influence of conscientiousness on the positive relationship of innovative behavior and individual performance could be supported by the data \((\gamma = 7.28, n.s.)\). To interpret the results of the moderation hypotheses, simple slopes were estimated for the relationships of hypothesis 2. Based on the work of Aiken, West, and Reno [45], these slopes were computed from \(\beta\) coefficients, derived from regression equations that adjust the interaction term to reflect different moderator values.

Since there are no theoretically meaningful breakpoints in the continuous moderating variable of extraversion, high and low scores were defined as values that respectively lay one standard deviation above and below the sample means. The values for high and low extraversion are thus derived from the study’s sample and do not represent artificial extremes. The slopes plotted in Figure 2 illustrate the hypothesized relationship.

![Figure 2. Simple slopes for the interaction between innovative behavior and extraversion on individual performance](image)

**5. Discussion**

Innovation is a “key factor of success” for an individual as well as the organization in which she/he is a part [18: 3]. Nonetheless “organizations often fail to manage innovation and innovative people” [18] and they “fail to provide sufficient space for people with creative personalities outside mainstream activities” [47: 2]. The challenge of understanding creative individuals is may be higher in the context of virtual teams as communication and collaboration are primarily based on electronic communication media and technology, such as email, telephone and video conferencing [7, 48]. Therefore, the study’s goal was to advance research on innovative behavior of individual team members by providing insight into the influence of innovative behavior on individual performance in a virtual context.

Furthermore, the aim was to shed light on the role of personality values in the innovative process. The data shows that innovative behavior positively influences the individual performance of a virtual team member. These results show how important innovative behavior is in the virtual context. The results show that innovative behavior can be established, and that it has a significant influence on individual performance within an environment where communication, collaboration, and task completion are defined by a distributed virtual network.

The study furthermore examined personal traits’, namely, extraversion and conscientiousness, moderating influence on the relationship between innovative behavior and individual performance. The results were counter-intuitive and highlighted a different personality type that reacts positively to innovative behavior than assumed: people low in extraversion profit benefit more from innovative behavior in terms of higher individual performance. The effect is not very strong but significant.

Against our assumption, people high in extraversion, who can be described as open minded, outgoing, assertive, active, and sociable do not benefit as much from innovative behavior in terms of higher individual performance. Even if a virtual team does not consist only of people who display these less open minded personalities, it is shown that they are more affected by an innovative behavior. People high in conscientiousness, who rely more on norms and are generally more careful, do not benefit from innovative behavior. These insights are of great importance for organizations, management, and groups working in a virtual context as they form real-world virtual teams. Within the context of virtual teams, arguably the most impactful personality trait of the “Five Factor Model” is extraversion. One could argue that members of a virtual team do not hold face-to-face meetings, and as a consequence they don’t have to be highly social, active and outgoing people, which are attributes that have been linked to extraversion previously. However, innovative people of a virtual team have been adopted to be higher of extraversion than other innovators, because they need to be outgoing and forceful in order to ask their
virtual coworkers for assistance or provoke them for required action. If they are not socially outgoing individuals, they might believe that they have to do everything on their own. This is inefficient for virtual collaboration, as one of the basic ideas of a virtual team is that its members concentrate on their core competencies and share their expert knowledge in order to use synergy effects. We assumed that extraverted individuals proactively manage knowledge and information flow, which can be important in instances where design information needs to disseminate to disparate centers and individuals globally. In our study we focus on innovative behavior as personal investment of an individual in innovation. Individuals high in conscientiousness and “degree of organization, persistence and motivation in goal directed behavior” [20: 94] may in general be more likely to have a personally vested interest in innovation and therefore a higher individual performance as they are especially persistent. Given the fact that innovation takes time, a disciplined individual is needed to stay calm and not to give up during challenging periods in the project. In this context, these individuals should rely on “persistent pursuit of a challenge” [14: 84]. Having a closer look at our focus on innovative behavior, as mentioned, personal investment of an individual in innovation, to be highly extraverted seems to be contra-productive. As this investment seems to direct enhance personal skills, and therefore the individual performance, virtual collaboration seems to not have a direct effect to this investment. Extraverts seem to lose a bit of the effect of this investment on the way of its implementation. The study’s findings provide three main conclusions. First, the study contributes to virtual team research and cross-cultural studies in the field of innovative behavior. The chosen MMOG setting contributes in several ways. The chosen setting allowed an investigation of a high number of virtual teams of all sizes with a member range from three to sixty team members across 22 different countries. Furthermore, the setting provides objective measures for innovative behavior and individual performance. Second, an insight into innovative behavior of virtual team members, which is important for individual performance, was obtained. This relationship is challenged in the context of virtual teams as communication and collaboration are primarily based on electronic communication media and technology [7, 48]. Furthermore, many studies focus on the influence of innovative behavior on the performance of the project or the team [29]. Third, the findings draw attention to the team members’ individual role in the innovation process. Team members’ personality influences the innovation process and its outcome. Leaders of virtual teams who want to increase individual performance through innovative behavior need to understand and establish conditions that support this behavior in a virtual environment. Certain types of team members affect the effectiveness of innovative behavior. Virtual team leaders cannot use the same style of leadership with all team members, because followers’ personalities influence their responses to certain conditions in the team. That is why leaders need to adapt their behavior to their followers’ special characteristics and preferences, necessitating the identification of team members’ personalities via established methods like Myers-Briggs. Leaders can use different scales and measures that are applied by researchers to obtain a specification of a team members’ characteristics [49]. These can be used during the team selection process, and be a formal aspect of the project planning phase. Overall, this study reveals how important different personality traits are to the performance of virtual teams, form both an individual and collective context. Unfortunately, determining and assessing these traits can be easily overlooked from a project standpoint. However, management and human resources would be well-served to integrate well-defined assessment procedures to arrange for the proper mix of personalities in these virtual teams. In the next section we review limitations and areas for further research. Even though the results of our study are very promising, there are several limitations to the research. We employed a correlational design, which limits causal conclusions. However, this limitation is offset by the use of multiple data sources and the temporal separation of survey data and performance data, which both mitigate self-report bias and reverse causality. However, a correlational study design can never assure causality. Therefore, experimental designs on the questions studied would further improve the results.

6. Limitations and Future Research

Though the results of our study are very promising, there are several limitations to the research. We employed a correlational design, which limits causal conclusions. This limitation is offset, however, because we drew data from multiple sources and because of the temporal separation of survey data and performance data, which both mitigate self-report bias and reverse causality. Nonetheless, a correlational study design can never assure causality. Therefore, experimental designs on the questions studied would further improve the results.

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1 http://www.myersbriggs.org/
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Finally, we conducted this study in the context of a game, which may limit the extent to which the findings can be generalized for work environments.

As for future research, we hope this study encourages others to explore the richly rewarding arena of online games. We believe the study’s results highlight the relevance and significance of research virtual teams, which is still in its infancy. As more and more researchers realize the potential of these games, we hope this study will help pave the way for new research designs.

We discovered new ways of collecting data that not only broaden the sample in terms of demographics and nationalities but also give access to thousands of participants, who can be studied to gain deeper insights into human and organizational processes. As for the meaning of these virtual teams in corporate practice, more research is needed on different aspects of team and organizational processes in geographically distributed teams.

7. References