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The effects of role variety and ability disparity on virtual group performance[☆]Sijing Zheng^a, Xiaohua Zeng^{a,*}, Cheng Zhang^b^a City University of Hong Kong, Hong Kong, China^b Fudan University, PR China

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ABSTRACT

Virtual groups mobilize talent across geographical boundaries and, as a result, the composition of virtual groups is often diverse. For example, they often consist of people from different functional areas (role variety) and at various levels (ability disparity). This study examines how role variety and ability disparity influence virtual group performance. Its analyses are based on field data from a popular video game that contains one million virtual groups performing collaborative tasks. Group members' characteristics and group performance were objectively recorded by the game system. Regression and fuzzy set qualitative comparative analysis (fsQCA) are used to analyze the data. The results from the regression show that group members' role variety is positively associated with group performance, but this relationship was weakened by their ability disparity. The fsQCA approach further demonstrates how role variety and ability disparity interact with other factors such as members' game experience to influence group performance.

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1. Introduction

Virtual groups are becoming increasingly common in organizations. People who are physically located at different locations can now work together using information and telecommunication technologies. In the U.S. in 2014, approximately 23% of employed persons or 24 million people worked remotely full-time or part-time in an average day (Bureau of Labor Statistics, 2015), and 37% of organizations have experienced an increase in the number of requests for “flexible work arrangements” during the past three years (Society for Human Resource Management, 2012). The number of people engaged in telecommuting or in virtual work continues to rise each year. It is predicted that more than half of the workforce worldwide will work remotely or virtually as early as 2020 (Fast Company, 2014).

While the emergence of virtual groups has enabled organizations to leverage scarce resources across geographic and other boundaries (Munkvold & Zigurs, 2007), it has led to higher diversity in group composition. In addition to their location differences, virtual group members are more likely to have different knowledge backgrounds. For example, a senior staff member in a research company may work remotely with a junior worker in a marketing company. Such group diversity is particularly prominent when making new operational decisions such as new product development and marketing (Curşeu, Schrujjer, & Boroş, 2007; Troy, Hirunyawipada, & Paswan, 2008) and

in interorganizational alliances and joint ventures (Amaldoss & Staelin, 2010; Van Knippenberg & Schippers, 2007).

One intriguing question is how group diversity influences virtual group performance. We are particularly interested in group diversity in knowledge. Specifically, group members may have varied knowledge in two distinct dimensions: they may exhibit role variety, i.e., they may work in different functional areas (e.g., R&D, marketing); and they may exhibit ability disparity, i.e., they may have different ability levels (e.g., junior, senior). In their conceptual study, Harrison and Klein (2007) proposed that variety and disparity are among the most important dimensions in classifying group diversity and can influence group processes and performance. Many of the empirical studies that followed have tested the effects of variety and disparity (e.g., Curşeu, Schrujjer & Boroş, 2007; Franck & Nüesch, 2010; Staats & Gino, 2012; Curşeu & Sari, 2013), but most of these studies address the context of face-to-face groups—virtual groups are rarely considered. Our research seeks to bridge this gap.

We examine the effects of role variety and ability disparity – both independently and jointly – on virtual group performance. Two complementary analytical techniques are used: regression and fuzzy set qualitative comparative analysis (fsQCA). The results from the regression analysis shed light on the net effect of each dimension of group diversity, whereas the results from the fsQCA indicate how these factors combine to influence performance. For example, high-quality performance may occur with certain levels of role variety and ability when other factors (e.g., group members' experience, friendship relationship) are also present. Our analyses are based on field data from a popular video game that contain nearly one million virtual groups performing various collaborative tasks online. Video game contexts have been used to investigate virtual group process in previous studies

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* Corresponding author. Tel./fax: +852 3442 5749/0346.

E-mail addresses: mksijing@cityu.edu.hk (S. Zheng), xiaohua.zeng@cityu.edu.hk (X. Zeng), zhangche@fudan.edu.cn (C. Zhang).

(e.g. Edwards, Day, Arthur, & Bell, 2006; Lin & Ni, 2014) because of their objective system-recorded – as opposed to self-reported – measures. Our data include information regarding each group's task performance and each member's role, ability level and other characteristics, thus allowing us to measure how role variety and ability disparity influence group performance.

The contributions of this research are twofold. First, as discussed, we examine the effects of knowledge diversity in virtual group settings. Virtual groups are now being utilized by more companies and are attracting increasing attention from scholars (e.g. Gibson & Gibbs, 2006; Gilson, Maynard, Young, Vartiainen, & Hakonen, 2015; Martins, Gilson, & Maynard, 2004; Maznevski & Chudoba, 2000; Tidwell & Walther, 2002; Wong & Burton, 2000). The virtual working environment is different from the traditional working environment, and it brings new uncertainties regarding the effects of group diversity. For example, while role variety is often believed to improve group performance because of a larger pool of resources, its effects in virtual groups can be more complicated. Virtual settings may increase the cost of information integration, yet they provide sheltering effects and encourage more information sharing (Tidwell & Walther, 2002). The overall effects on virtual group performance must be examined. Second, this research examines the interrelationships of different dimensions of group diversity, which remain largely untested (even in face-to-face groups). Some theorists conjecture that certain types of diversity may interact with one another to influence group processes (e.g., Harrison & Klein, 2007). Auh and Menguc (2006) show that top management teams' functional diversity and experience diversity represent complementary tacit knowledge, and they jointly strengthen the effect of customer orientation on organizational performance. Because groups in organizations are usually diverse in more than one dimension, examining the interactions between various dimensions of diversity will deepen our understanding of how group diversity influences performance. There has been increasing interest in a joint analysis of different types of diversity and situational factors (e.g. Lu, Chen, Huang, & Chien, 2015; Van Knippenberg & Schippers, 2007). This study's fsQCA approach is strong enough to explore the interaction effects.

The remainder of this article is organized as follows. Section 2 describes the conceptual background and develops hypotheses involving the effects of role variety and ability disparity. Section 3 describes our data and analyses. Section 4 presents empirical results. Section 5 concludes the study with a discussion of the study's managerial implications and its limitations.

2. Theoretical background and hypotheses

2.1. Role variety and ability disparity as two dimensions of knowledge diversity

Knowledge can be characterized by both breadth and depth (Alavi & Leidner, 2001). At the individual level, knowledge breadth refers to the number of knowledge domains with which a person is familiar or the number of functional roles in which a person can perform (Bierly & Chakrabarti, 1996; Prabhu, Chandy, & Ellis, 2005). Knowledge depth refers to the amount of within-field knowledge a person possesses or the level of sophistication and complexity of a person's knowledge. For example, the development of a software product requires knowledge in several areas, including knowledge regarding interfaces, databases, and network communications. A person with a wide breadth of knowledge will have perspective or experience in all of these areas, whereas a person with a greater depth of knowledge within an area (e.g., database) will have a great deal of experience in that area. Thus, breadth captures the horizontal dimension of knowledge, whereas depth captures its vertical dimension.

At the group level, drawing on Harrison and Klein's (2007) conceptualization of variety and disparity, this study defines role variety and ability disparity based on knowledge breadth and depth across all

members of a group. Specifically, *role variety* refers to the composition of a group's knowledge breadth, or differences in kind or category of knowledge among group members. A group is said to have high role variety when its members together play a larger number of roles or have access to a greater number of knowledge domains. *Ability disparity* refers to the composition of a group's knowledge depth, or differences in the concentration of knowledge held among group members. A group is said to have high ability disparity when its members are more unequal in both their capability levels and the sophistication of their knowledge. For example, consider a three-person group that develops software products. If the group members are all from different domains (e.g., interface, database, and network communication), the group has a high level of role variety; if one member is a database expert and the other two are novices, the group also has a high level of ability disparity.

There are two advantages to the above conceptualization of role variety and ability disparity. First, as with knowledge breadth and depth, role variety and ability disparity focus on the horizontal and vertical dimensions of knowledge diversity, respectively. Thus, they are relatively independent of each other, which avoids potential collinearity problems when both are included in the analysis. Second, although in principle all forms of diversity elicit both social categorization and information processes (Van Knippenberg & Schippers, 2007), role variety and ability disparity differ with regard to their relevance to key theoretical perspectives (Harrison & Klein, 2007). Because role variety describes differences among members with different knowledge domains, the most relevant theory involves information processing. By contrast, ability disparity describes the proportion of resources held by members, highlighting inequality within groups, which makes the social categorization process more salient. We discuss these theories in more detail below.

2.2. Role variety, ability disparity, and virtual group performance

The effects of role variety can be interpreted primarily from the information processing perspective. This perspective is concerned with group-level exchange, processing, and integration of diverse information, knowledge and perspectives. In a group with high role variety, members represent different sets of knowledge and expertise (Harrison & Klein, 2007). Collectively, the group possesses a large pool of resources. Based on information processing theory (Ashby, 1956), greater information richness fosters better choices, plans and products, provides the potential for more comprehensive decision-making and may be helpful in managing non-routine problems (Simons, Pelled, & Smith, 1999). Furthermore, greater variety in knowledge categories potentially leads to a greater depth of information available to the group that can then be leveraged not only to improve planning and decision-making but also to stimulate creative thinking (see a review by West, 2002). In addition, members with different areas of functional expertise can produce valuable external knowledge sharing with people outside the group (Cummings, 2004). Therefore, role variety is expected to have a positive impact on group performance. By contrast, when all group members belong to a single category, those members are viewed as redundant to one another because no information is gained by adding more persons to the group who are from the same category (Shannon, 2001).

The other perspective on group diversity is that of social categorization processes, that is, similarities and differences among group members form the basis for categorizing the self and others into subgroups (Williams & O'Reilly, 1998). According to the similarity/attraction paradigm, people prefer to work with others who are similar to them, which implies that groups with high role variety may give rise to conflicts or disagreement (e.g., Lovelace, Shapiro, & Weingart, 2001). However, in virtual groups, we propose that this negative effect may be dominated by other benefits for communication that arise in virtual settings. We first note that virtual settings contain far

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