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Effects of Network Size, Diversity, and Interaction Frequency on Individual Creativity: A Study from South Korea

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Abstract: Creativity is becoming a necessary core competence in nearly all businesses today, and firms are striving to find ways to promote the creativity of employees. This study aimed to analyze the relationships between an individual actor's network characteristics and the actor's creativity. More specifically, this study assumed that actors qualitatively differentiate between their global and local networks depending on whether they perceive the other actors in the network as mere acquaintances or trusted persons to discuss life's important issues with. This study used large-scale survey data collected from South Korea to empirically analyze the hypothesized relationships between network characteristics and creativity. The empirical analysis of the survey data showed that the size and diversity of the global network were positively related to creativity. However, the positive effect of global network diversity decreased with an increase in the size of the network. In the local network, frequent interactions had a positive effect on creativity, while the diversity of the local network had a moderate negative effect on creativity. Implications for the creativity literature are discussed.

Keywords: creativity; global network; local network; network size; network diversity; interaction frequency



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1. Introduction

The ability to innovate is increasingly becoming a central element in organizational survival and performance (McDowell et al. 2018; Rousseau et al. 2016), and most organizations are striving to promote and maintain creativity among their members (Mumford et al. 2006). While there are many internal and external factors that may affect the innovation capability of organizations, the most important microfoundation is the creativity of individuals belonging to the organizations (Amabile et al. 1996; Mumford 2000; Shalley et al. 2000). Individuals are the source of new knowledge, and thus new knowledge resides within individuals (Nonaka 1994). Therefore, understanding creativity at the individual level and analyzing factors that affect creativity are crucial in promoting innovations in organizations.

Earlier work on creativity centered on personal characteristics correlated with creativity, but recent discussions place stronger emphasis on the idea that creativity may be a social outcome (Burt 2004, 2021; Fleming et al. 2007; Lingo and O'Mahony 2010; McFadyen and Cannella 2004; Rodan and Galunic 2004). While creative ideas may reside within each individual, such ideas may be a product of social interactions with other individuals. Given that a creative idea is often a novel recombination of existing ideas (Schumpeter 1934), sharing ideas, information, knowledge, and perspectives with others enhances the likelihood of conceiving new and useful ideas. Discussions linking creativity with social interactions emphasize the importance of the diversity of the social network (Baer 2010; Chua 2018; Perry-Smith and Shalley 2003). The focus on diversity stems from the idea that the more diversified a network, the more varied and non-redundant the ideas that one can access through the network. However, this study examined whether the effect of diversity is this unidirectional. Does network diversity always promote creativity? Are there instances where diversity may have more complicated implications for creativity?

Existing studies on social networks and creativity highlighting the importance of diversity argued that actors in brokerage positions are in the best place to produce ‘good ideas’ (Burt 2004), because one can access diverse and non-redundant ideas in that position and then control or curb the transfer of ideas to others. However, Reagans and Zuckerman (2001) found that the reality may not be so simple—brokerage is useful at the global network level, but closure is also useful at the local network level. Reagans and Zuckerman analyzed corporate R&D teams to show that teams that are internally densely connected but also in brokerage positions vis à vis other teams had the highest productivity.

This study follows the basic idea of Reagans and Zuckerman (2001) but examines how it may apply to individual-level, egocentric networks instead of team-level networks. This study found that, just as teams may be densely linked within the local network (i.e., within the team) and heterogeneously linked within the global network, individuals can have high homogeneity at the local level and heterogeneity at the global level. What delineates local versus global networks is the individual’s subjective and qualitative evaluation of the strength of the ties. Instead of the quantitative measure of interaction frequencies, this study found that each individual’s qualitative evaluation of whether an acquaintance is a trustable discussion partner when faced with big issues in life may indeed be a good indicator of a strong tie. Through empirical analysis of 1000 survey participants, this study found that diversity has a positive effect on creativity in the global network, but a negative effect when it comes to local strong ties.

This study is also different from existing studies in the way it conceptualizes and measures diversity. Conventional discussions of diversity measure the diversity of demographic variables observed in workplace settings, such as in terms of gender, race, and functional backgrounds in the boardroom or in top management teams (Miller and del Carmen Triana 2009; Smith et al. 1994), or in terms of organizational tenure in teams (Reagans and Zuckerman 2001; Reagans et al. 2004). This study examined the diversity of relationship types in each individual’s network, not limited to workplace. In other words, a person may have a set of people he/she meets with regularly who are linked through various types of relationships such as family, friends, and colleagues; here, diversity is measured in terms of the types of relationships in the given network. Measuring diversity in such a way is meaningful in that individual creativity may be affected by one’s whole network, not just one’s network within the workplace. Indeed, previous studies presented evidence showing that personal relationships outside the workplace influence work attitude or performance. For instance, BarNir and Smith (2002) and Street and Cameron (2007) argued that small business entrepreneurs often utilize personal networks to support business activities. Another interesting study performed by Glynn and Sen (2015) found that judges with daughters view gender-related cases differently than judges who only have sons. Such studies indicate that personal relationships outside the workplace have important impacts on the work itself and imply that such relationships may also affect individual creativity in the workplace.

To summarize, this study examined the two sides of diversity—how diversity in a network may increase or decrease individual creativity depending on the context of the network. The empirical analysis showed that network size and diversity in the global network generally improve individual creativity, but the positive effect of diversity decreases when the size of the global network increases. In contrast to the global network, low diversity and frequent interactions with people in the local network increase individual creativity.

2. Theory and Hypotheses

2.1. Social Networks and Creativity

Creativity refers to the ability to come up with a new and useful idea (Amabile 1996). These new and useful ideas do not suddenly emerge disconnected from existing ideas but often are novel recombinations of existing ideas (Schumpeter 1934; Nelson and Winter 1982). Some researchers argued that creative problem solving is not limited to coming up with new ideas but also includes the ability to evaluate the new ideas and select the

most adequate idea to implement (Basadur et al. 1982; Runco and Basadur 1993). In other words, creativity is in fact a process where, in the beginning, various new ideas diverge, and then after enough ideas have been generated, they converge into a useful and feasible idea. Existing research on creativity had the tendency of focusing more on the divergence of ideas than the convergence.

Early studies on the sources of creativity focused mostly on personal traits. For instance, researchers explored the effects of broad interest, preference for complexity, high energy, independent decision making, autonomy, intuition, confidence, ability to absorb seemingly contradicting ideas, persistence, curiosity, intelligence, and internal locus of control as a few examples of personal traits (Amabile 1996; Barron and Harrington 1981; Woodman and Schoenfeldt 1989). In contrast to these studies on personal traits, more recent studies have discovered the importance of social and contextual factors to individual creativity (Perry-Smith and Shalley 2003). These studies offer a view that creative people are not necessarily very special people with special traits; rather, positive social interactions and other contextual factors can help ordinary people to become creative. In other words, creativity does not reside solely within individuals but can emerge through social interactions and communications (Perry-Smith and Shalley 2003).

Many sociology and management researchers have been discussing the relationship between creativity and social networks. In the discussion of social networks, two contrasting perspectives have been suggested in regard to the effect of diversity on creativity. The first perspective emphasizes the effect of brokerage positions and network diversity on creativity. This perspective is rooted in Granovetter's (1973) discussion of the strength of weak ties, which explains that weak ties are better conduits of diverse and non-redundant information than strong ties. Assuming that creative thinking needs new information and ideas, weak ties can have a positive effect on creativity (Fleming et al. 2007). Burt (1992) developed the weak-tie argument further to argue that actors whose networks span the structural holes enjoy various benefits by becoming the sole connection between diverse clusters of people, one of the benefits being the greater possibility of conceiving good ideas (Burt 2004). The positive effect of brokerage positions on creativity has been confirmed in many empirical studies (Burt 2004; Lingo and O'Mahony 2010; Nerkar and Paruchuri 2005; Rodan and Galunic 2004; Tushman 1977).

In contrast to the brokerage perspective, some studies emphasized the importance of cohesiveness in networks, following Coleman's (1988) discussion of social capital. Cohesiveness exists when multiple actors are densely connected to each other. When cohesiveness in a group is high, trust forms in the group because the dense network enables group members to detect and sanction undesirable behaviors. Cohesiveness has a negative effect on diversity, but it can still positively affect creativity, because people share information and knowledge with trustable others, especially when it comes to tacit, complex, proprietary, and fine-grained information (Guler and Nerkar 2012; Reagans and McEvily 2003; Uzzi 1997), and exchange feedback on each other's ideas (Milliken et al. 2003). Furthermore, trust positively affects psychological factors such as positive affect and risk-taking tendency, which in turn positively affect creative activities (Amabile et al. 2005; Milliken et al. 2003).

The findings that brokerage positions and cohesiveness can both have positive effects on creativity may seem contradictory. A brokerage position is a position in a network weakly linked to otherwise unconnected clusters, and cohesiveness emerges when many nodes are densely tied to each other. Therefore, it may seem unlikely that creativity would be positively linked to two contradictory concepts. The existing literature provides two different perspectives in understanding this seeming contradiction. The first perspective distinguishes the difference between local and global networks and attempts to explain the effect of brokerage positions and network cohesiveness on creativity (Guler and Nerkar 2012; Reagans and Zuckerman 2001; Reagans et al. 2004). According to this view, individuals belonging to a team, or a local network, may maintain a very densely tied cohesiveness within the team but, at the same time, occupy brokerage positions in the global network consisting of many different individuals outside the team. In this situation, the team can

have high cohesiveness and a brokerage position at the same time. In other words, cohesiveness and brokerage positions are two independent variables, and teams with both cohesiveness and a brokerage position were found to show higher performance (Reagans and Zuckerman 2001).

Another perspective explains the contradiction by distinguishing different stages in the process of creativity. As mentioned before, creativity can be thought of as a process where, in the beginning, there is a divergence of various new ideas, following which the ideas are evaluated and the most useful idea is selected for implementation. Existing research on creativity had the tendency of focusing more on the divergent thinking in comparison to the latter part of the process. According to Fleming et al. (2007), a brokerage position in a network of various actors can have a positive effect on the divergence of ideas, but the actual implementation of ideas requires cohesiveness between actors.

This research focused on the ambivalent characteristics of network diversity. One unique argument of this study is that an individual actor's network can be distinguished between local networks and global networks based on the actor's subjective judgement. This is different from Reagans and Zuckerman's (2001) study, where the distinction between local and global networks was made by differentiating between team members and non-team members. This study argues that the people an actor identifies as a close group of people can be referred to as the local network, whereas other acquaintances can form the global network. Through empirical analyses, this study found that having many divergent ties in the global network has a positive effect on creativity, while engaging in frequent interaction with less divergent actors in the local network also has a positive effect on creativity.

2.2. Divergence of Ideas: The Effect of the Global Network

Apart from the strength and the diversity of social ties, social ties in general are known to have a positive effect on creativity (McFadyen and Cannella 2004; Paulus and Nijstad 2003). As the number of social ties increases, the amount of available social capital increases, leading to a greater amount of embedded resources that can be accessed and utilized (Burt 1992). One type of embedded resource important for new knowledge creation is tacit knowledge (Nelson and Winter 1982). Explicit knowledge can be codified and communicated indirectly and thus may not require interpersonal interactions for knowledge transfer. However, tacit knowledge cannot be easily codified and therefore requires direct interactions between actors to be transferred from one person to another (Nelson and Winter 1982).

Sharing tacit knowledge is more likely to facilitate the process of new knowledge creation in comparison to the transfer of explicit knowledge because new knowledge tends to emerge not from finding solutions to existing problems but from the collaborative process of finding solutions when even the problem itself is unclear (McFadyen and Cannella 2004). In other words, when the nature of new knowledge to be created is not yet known, creating new knowledge is more likely to be achieved through the process of sharing tacit knowledge between actors rather than by applying existing explicit knowledge. Therefore, direct interpersonal interactions between actors are likely to promote new knowledge creation.

An increase in the number of direct social ties leads to an increase in accessible information and other resources, expanding the possibility of new knowledge creation through the sharing of tacit knowledge between actors. Specifically, an increase in social ties is advantageous for the divergence of ideas, or what Fleming et al. (2007) call generative creativity. Therefore, individual creativity can be expected to be higher for individuals with a greater number of direct social ties in the global network.

Hypothesis 1 (H1). *The more global network ties an actor has, the higher the actor's creativity.*

Not only the number of social ties in the global network but also the diversity of the social ties affects one's creativity. Since the accumulation of knowledge occurs path-

dependently, people who experience different paths in life gather different types of information, ideas, and perspectives. Therefore, interacting with different types of nodes in the network enables the accumulation of diverse information (Burt 1992; Granovetter 1973). On the grounds that creativity is a recombination of existing knowledge and ideas, being able to access diverse knowledge and ideas establishes an advantageous position in developing creativity. Therefore, when the global network of an actor consists of other individuals whose social networks do not overlap with each other, the actor has a higher probability of achieving higher creativity.

Many existing studies found evidence for the benefits of diversity in developing creativity. Some studies analyzed the effect of diversity in gender and ethnic backgrounds (Blau 1977; Hillman et al. 2002; Miller and del Carmen Triana 2009), age and tenure (O'Reilly et al. 1989; Zenger and Lawrence 1989), and work experience and functional backgrounds (Glick et al. 1993; Smith et al. 1994). Most diversity studies in the field of organizational behavior focused on individual demographic characteristics as listed above. These previous studies confirmed that heterogeneity among members in organizations generally offers new information and perspectives, leading to higher innovative capabilities for organizations. However, some studies also showed that homogeneity brings the benefits of better communication and cohesiveness (Uzzi 1997; Fleming et al. 2007).

While studies on diversity have accumulated for a long time with significant findings, it is not easy to find studies that focused on diversity in terms of the types of social ties. Most individual actors are related to other actors through different types of relationships such as familial ties, friendship ties, and coworking ties. There are few, if any, studies in the literature that analyzed how the diversity of the types of relationships affects the creativity of individuals. For instance, would a person who mostly engages in relationships with just family members possess more creativity than a person who engages in interactions with family members, friends, and also coworkers? This study examined the diversity of relationship types an actor regularly engages in. If an actor meets with many people regularly and they are all friends, diversity would be low, and if he/she meets with only a small number of people regularly but they consist of family members, friends, and colleagues, diversity would be higher.

Depending on the relationship type, the topic, style, and depth of communication and the consequences of social interactions may differ. For example, Procidano and Heller (1983) found that perceived social support from family and perceived social support from friends are two separate constructs, with different antecedents and consequences. Therefore, actors with diverse relationship types in the global network are more likely to access more diverse topics of knowledge at differing levels of depth compared to actors with concentrated relationship profiles and thus have a higher likelihood of producing creative ideas.

Hypothesis 2 (H2). *The more diverse an actor's global network, the higher the actor's creativity.*

H1 and H2 suggest that the number and the diversity of ties in one's global network are positively related to one's creativity. However, social interaction is costly. Forming and maintaining relationships cost time and effort (Harris and O'Malley 2000; Roberts 2011), especially if the relationship ties are scattered across different groups of people. While it may seem that increasing social ties in quantity and diversity at the same time can maximize the creativity benefits from the global network, such an attempt may actually weaken the positive effects hypothesized in H1 and H2 because of the difficulty of maintaining relationships with numerous and diverse people. Therefore, the positive effect of diversity may weaken when the number of ties in the network increases.

Hypothesis 3 (H3). *The positive effect of global network diversity on creativity will be weaker when the number of ties in the network increases.*

2.3. Convergence of Ideas: The Effect of the Local Network

Just as generating new and diverse ideas is an important part of the creative process, converging thus generated ideas into an implementable idea is crucial. The definition of creativity itself states that creativity is the ability to produce new and useful ideas (Amabile 1996), not just new ideas. While most existing studies on creativity focused on the generation or divergence of ideas as the central activity of the creative process, some scholars pointed out the significance of idea evaluation and implementation. Fleming et al. (2007) called this part of the creative process the development of creative ideas, and Lingo and O'Mahony (2010) called it nexus work.

At the idea generation stage, exposure to numerous and diverse ideas raises the likelihood of successful creative output. Therefore, the diversity of the global network is likely to affect creativity positively, as hypothesized in H2. However, once the idea generation stage is over, actors are most likely to evaluate the ideas, select the best or the most feasible one, and develop the selected idea into an implementable plan with close in-group members. While accumulating new ideas from the global network is a relatively passive task, the convergence and the development of ideas involve active and committed participation in an ongoing social interaction.

Such in-depth communication and exchange of fine-grained information are better performed in a highly embedded, cohesive network structure (Uzzi 1997; Fleming et al. 2007). Therefore, while idea generation may begin with the exposure to new and diverse information in the global network, the development of the idea is more likely to be pursued in a local network of strong ties. Trust in such a group encourages knowledge sharing among the group members, since they know that ex-post sanctioning is possible should anyone take advantage of the shared knowledge in an objectionable way.

Trust in the local network is reinforced when the members of the network frequently interact with each other (McAllister 1995). The frequency of interaction also increases the breadth and depth of communication between the local network members, enabling the successful execution of the creative process.

Hypothesis 4 (H4). *The more frequent an actor's interaction in the local network, the higher the actor's creativity.*

In addition to the frequency of interaction, redundant ties between members of a local network affect trust building within the group (Coleman 1988). When many redundant ties are formed between members of a local network so that any two actors in the network are highly likely to know each other or at least can be indirectly connected through another actor, group norms can be strongly enforced. In such a network, actors hesitate to behave against the group norm for the fear of acquiring a bad reputation.

Existing network studies on cohesion generally assumed that redundant ties are likely to exist in a network of homogeneous actors (Lawrence 1997), because social ties are characterized by homophily. Social interactions are more likely to occur between people who share demographic similarity—in other words, 'birds of same feather flock together' (McPherson et al. 2001, p. 417). While conventional diversity studies generally examined similarity and diversity in terms of demographic dimensions such as race, gender, age, and organizational tenure (Blau 1977; Glick et al. 1993; Hillman et al. 2002; Miller and del Carmen Triana 2009; O'Reilly et al. 1989; Smith et al. 1994; Zenger and Lawrence 1989), this study focused on the diversity of relationship types between the actors.

If one's local network is characterized by low diversity in terms of relationship types, it is likely that the other actors the focal actor is connected to know each other as well. For example, if the people an actor identifies as confidants are all colleagues at work, there is a good chance that the colleagues know each other. In contrast, if the actor identifies a family member, a friend, and a colleague as their closest confidants, the possibility of the three knowing each other would not be as high. When the local network consists of homogeneous relationship types, the members of the local network are likely to form a

cohesive group with community-like characteristics that facilitate mutual coordination (O'Reilly et al. 1989). Such cohesive local networks will promote the development of new ideas into feasible plans through free sharing of knowledge, frequent communication, and open opinion exchange.

The reason that the effect of diversity is reversed from what is hypothesized in H2 is because of the difference between the global and the local network. The global network in this study is the whole set of people each actor regularly meets with, while the local network is the set of people connected by strong ties as qualitatively evaluated by the focal actor. The global and local networks serve different functions (Reagans and Zuckerman 2001). The global network is where new and diverse information and knowledge are shared, which can be rearranged and recombined to form various new ideas. Diversity in the global network aids the creative process by enabling the actors to access diverse and different information and perspectives. Actors then share and discuss the new ideas with the members of the local network to develop the ideas into a feasible plan. At this stage, homogeneity and cohesion aid the creative process by facilitating communication and mutual coordination.

Hypothesis 5 (H5). *The less diversified an actor's local network, the higher the actor's creativity.*

3. Materials and Methods

3.1. Empirical Setting and Data Analysis

This research used the 'Art and Culture Consumption Behavior Survey' which was administered with the support of the National Research Foundation of Korea. The project was planned by a joint research team consisting of researchers from Yonsei University and Seoul National University. With the goal of collecting large-scale data on issues including art and culture consumption, creativity, social relations, and various demographic characteristics, the research team prepared 685 survey questions. The survey was administered by a professional survey service firm called Ipsos Korea, from 28 August to 15 September 2012. Ipsos Korea sent out invitations to about 20,000 persons to participate in the survey, and among the respondents who agreed to participate, a total of 1000 respondents were selected through stratified sampling to equally represent respondents of different income levels. The respondents were of ages between 20 and 60, living in the 7 largest metropolitan areas in Korea. Tables 1 and 2 show the regional and income-level composition of the sample.

Table 1. Demographic characteristics of the sample.

Cities	Age Group								Total
	Male in 20s	Female in 20s	Male in 30s	Female in 30s	Male in 40s	Female in 40s	Male in 50s	Female in 50s	
Seoul	37	38	46	45	43	43	37	40	329
Busan	12	11	13	13	14	14	14	15	106
Daegu	8	7	9	9	10	11	9	9	72
Incheon	10	9	12	11	13	12	10	10	87
Gwangju	5	5	6	6	6	6	5	5	44
Daejeon	5	5	6	6	7	7	5	5	46
Kyunggi	33	32	44	44	48	47	35	33	316
Total	110	107	134	134	141	140	115	117	1000

The survey was a long survey with 685 questions divided into 6 different sections. The sections were: (A) Art and culture consumption behavior, (B) Individual consumption experience, (C) Social relationships, (D) Childhood experience, (E) Perspectives and Values, and (F) Personal characteristics. Since the survey itself was initially conducted to analyze art and culture consumption behavior, the first two sections were concentrated on art and culture, but the survey also collected data on various other personal tendencies and characteristics including their social networks and creative abilities. The data were organized to

reflect the relevant variables, and multivariate regression analyses were conducted to test hypotheses on social networks and creativity.

Table 2. Income distribution of the sample.

Income (Million KRW)	%
Below 2.49	20
2.50–3.49	20
3.50–4.49	20
4.50–5.49	20
Over 5.50	20
Total	100

3.2. Variables

The dependent variable of this study was the individual actor's creativity. To measure creativity, the survey used 12 items measuring originality in the Kirton Adaptation-Innovation Inventory. The Kirton Adaptation-Innovation Inventory is a widely used measurement that has been tested and validated in many different countries and languages including Korean (Bobic et al. 1999; Chung et al. 2003). The survey also included 6 items from Hurt et al.'s (1977) short version of scales for the measurement of innovativeness. Hurt et al.'s scale is another widely used scale for measuring innovativeness or creativity (Pallister and Foxall 1998; Roehrich 2004) and has been used in the Korean language as well (Lee et al. 2012). In order to translate the items to Korean without changing the meaning, nine different researchers separately translated the items into Korean and then compared the translations. The final output was decided by the consensus of the researchers. As a pilot test, the researchers distributed the first translated draft of the survey to a small number of people with a similar demographic distribution to the stratified full sample. With feedback from the respondent who participated in the pilot survey, the researchers edited and finalized the translated items. All items were measured on a 5-point Likert scale.

Factor analysis was conducted on the 18 items from the survey, and only 12 items were loaded on the same factor, with the other 6 items loading onto two different factors. Therefore, 6 items were excluded from the analyses, and only the remaining 12 items that loaded onto the same factor were used. The responses to the 12 items were averaged to measure creativity. The 12 items used in this study are shown in Table 3. Cronbach's alpha for this measure was 0.9053.

Table 3. Items measuring creativity.

How Similar Do You Think You Are to Each of the Following Items? ¹	
1.	I find it stimulating to be original in my thinking and behavior
2.	I am challenged by ambiguities and unsolved problems
3.	I enjoy trying out new ideas
4.	I consider myself to be creative and original in my thinking and behavior
5.	I am an inventive kind of person
6.	I seek out new ways to do things
7.	I have original ideas
8.	I proliferate ideas
9.	I am stimulating to others
10.	I cope with several new ideas at the same time
11.	I will always think of something when stuck
12.	I would sooner create than improve

¹ Each item was measured by using a 5-point Likert scale.

The first independent variable was the number of global network ties. As discussed before, this research distinguishes between the global network and the local network. The

global network is a network that encompasses the general social relationships of an actor, whereas the local network includes a small number of people the actor is very close to. The number of global network ties was measured by the number of persons an actor meets more than once in a month for socialization. Since meeting with another person more than once in a month just for socialization purposes requires a significant amount of effort and time, these people can represent a meaningful global network for the focal actor. To calculate the number of ties, the following five items from the survey were used. The main question for these five items was, 'How many acquaintances do you regularly meet more than once in a month, excluding your family members or people you meet for work purposes?', and the respondent was asked to indicate the number of people for the following five categories: work, school, residential area, hometown, and other. The sum of these five numbers was calculated to measure the number of global network ties.

The second independent variable was the diversity of the global network. Using the five items explained above, an entropy value representing the diversity of an actor's global network was calculated. If an actor's global network consists of a similar number of acquaintances from work, school, the residential area, and their hometown, the entropy value would be high. If an actor has a large number of global network ties but they consist mostly of acquaintances from school only, then the entropy value would be low.

The third independent variable was the local network interaction frequency. To identify the local network, the survey asked respondents to name up to five persons they discussed the most important issues in life with during the past year. Then, the survey asked several questions regarding these five (or less than five) important relationships. One of the questions asked how often a respondent meets face to face with the person in the local network, and the respondent had to choose from a 6-point Likert scale: more than once a week, once a month, once in 2 to 3 months, once in 6 months, once a year, and almost never. Since this scale is reverse coded with the number 1 representing the highest frequency and 6 the lowest frequency, it was again reverse coded in this study for easier interpretation, so that 1 represents the lowest frequency and 6 the highest. Then, the frequency over the five (or less than five) important relationships was averaged to measure the local network interaction frequency.

The fourth independent variable was the diversity of the local network. In the questions about the five (or less than five) most important relationships explained above, one question asked about the type of relationship with each person. The respondent could choose from 11 different options: husband/wife or partner, parent, sibling, son/daughter, relative, superior at work or teacher/professor, colleague or subordinate at work, alumni from same school, neighbor, hometown acquaintance, and other. Similar to measuring the diversity of the global network, the entropy value of the local network was calculated to measure the diversity.

To control for other factors that may affect creativity other than the social network variables this research is interested in, age, gender, education, and income were included as control variables. For age, the survey asked the year the respondent was born, and the number was subtracted from the year of the survey to calculate the age. For gender, females were coded as 0 and males as 1. For education, respondents were asked to choose from seven different levels of education: 1 for no education, 2 for elementary school graduate, 3 for middle school graduate, 4 for high school graduate, 5 for 2-year professional college graduate, 6 for 4-year college graduate, and 7 for graduate school graduate and above. Income was measured by the respondent's monthly income in million KRW.

4. Results

Table 4 shows the descriptive statistics and the correlations between the variables used in this research. The mean value for the dependent variable, creativity, was 3.198, showing that the respondents evaluated their creativity to be slightly higher than the middle of the 5-point Likert scale. On average, respondents had about 11~12 people they meet at least once a month for social purposes. In the case of people they meet with to discuss important

issues in life, the average was 3.756, indicating that the interaction frequency is somewhat low, somewhere in the range of once in 2 months to 6 months.

Table 4. Descriptive statistics and correlations.

	Variable	N	Mean	Std. Dev.	Min	Max	1	2	3	4	5	6	7	8
1	Creativity	1000	3.20	0.59	1	4.833								
2	Global Network Ties	1000	11.61	14.19	0	95	0.157							
3	Global Network Diversity	1000	0.57	0.47	0	1.386	0.229	0.369						
4	Local Network Interaction	1000	3.76	0.79	1	5	0.061	0.132	0.049					
5	Local Network Diversity	1000	0.92	0.40	0.001	1.610	−0.056	0.022	0.032	0.184				
6	Age	1000	39.59	10.17	20	59	0.064	0.116	0.107	−0.029	0.069			
7	Gender	1000	0.50	0.50	0	1	0.174	0.115	0.176	−0.061	−0.067	0.021		
8	Education	1000	5.48	0.96	2	7	0.231	0.032	0.061	−0.053	−0.044	−0.023	0.244	
9	Income	1000	2.27	1.60	0	12	0.204	0.060	0.164	−0.027	−0.023	0.268	0.465	0.271

Multivariate regressions were used to empirically test the effect of network characteristics on individual creativity. Table 5 shows the results for the regression models. Model 1 includes only the control variables, Models 2 through 8 include various combinations of different independent variables and a moderating variable, and Model 9 is the full model with all variables included.

The number of global network ties shows a positive and significant relationship with creativity in Models 2, 4, 5, and 9, supporting Hypothesis 1. The results imply that actors with many acquaintances in their network tend to have more sources to gather information and knowledge from and consequently have higher chances of having good ideas.

The diversity of the global network ties also has a positive and significant effect on creativity, as can be seen from Models 3, 4, 5, and 9, supporting Hypothesis 2. The results imply that not only the quantity but also the characteristics of the relationships with acquaintances may matter in increasing creativity. Actors who interact with others who are bonded through different types of relationships seem to be in an advantageous position to collect different types of information and knowledge and generate more ideas through the recombination of this information and knowledge.

However, as argued in Hypothesis 3, the number of global network ties and the diversity of these ties seem to have a trade-off. As Models 3 and 9 show, the moderator is negative and significant, signifying that the positive effect of global network diversity becomes weaker as the number of global network ties increases. Thus, Hypothesis 3 is supported. This result suggests that when an actor is related to other actors through different types of relationships such as familial ties, friendship ties, and coworking ties, maintaining such a diverse global network becomes costly as the number of ties increases.

Models 6, 7, and 9 show that the local network interaction frequency has a positive and significant effect on creativity, supporting Hypothesis 4. Interacting frequently with the most trusted people could increase creativity by enabling the actors to have deeper conversations, which may lead to a deeper level of thinking about new ideas and realistic implementation plans.

Hypothesis 5 expected local network diversity to have a negative effect on creativity because the diversity in this case may harm the cohesiveness and mutual coordination in the local network. The results for Models 7, 8, and 9 only provide moderate support for this hypothesis. When entered into the regression model alone in Model 7, the local network diversity variable has a negative effect on creativity, but it is not significant. When entered with the local network interaction frequency in Model 8, the local network diversity has a negative effect significant at the $p < 0.1$ level. However, in the full model, the local network diversity is negative and significant ($p < 0.05$). Overall, Hypothesis 5 receives only a moderate level of support from the regression results.

Table 5. Multivariate regressions: individual creativity.

	Model 1		Model 2		Model 3		Model 4		Model 5	
Independent										
Global Network Ties			0.006	***			0.003	*	0.008	**
			(0.001)				(0.001)		(0.003)	
Global Network Diversity					0.240	***	0.205	***	0.264	***
					(0.038)		(0.041)		(0.050)	
Global Network Ties * Diversity									−0.006	*
									(0.003)	
Local Network Interaction										
Local Network Diversity										
Controls										
Age	0.002		0.001		0.001		0.001		0.001	
	(0.002)		(0.002)		(0.002)		(0.002)		(0.002)	
Gender	0.092	*	0.072	†	0.061		0.054		0.055	
	(0.041)		(0.041)		(0.041)		(0.041)		(0.041)	
Education	0.112	***	0.111	***	0.111	***	0.111	***	0.107	***
	(0.020)		(0.019)		(0.019)		(0.019)		(0.019)	
Income	0.040	**	0.042	**	0.035	**	0.036	**	0.038	**
	(0.013)		(0.013)		(0.013)		(0.013)		(0.013)	
Constant	2.362	***	2.347	***	2.294	***	2.295	***	2.274	***
	(0.128)		(0.127)		(0.127)		(0.126)		(0.126)	
F	21.720	***	21.600	***	25.830	***	22.610	***	20.080	***
R-Squared	0.080		0.098		0.115		0.120		0.124	
Adjusted R-Squared	0.077		0.094		0.111		0.115		0.118	
N	1000		1000		1000		1000		1000	
	Model 6		Model 7		Model 8		Model 9			
Independent										
Global Network Ties							0.008		**	
							(0.003)			
Global Network Diversity							0.265		***	
							(0.050)			
Global Network Ties * Diversity							−0.006		*	
							(0.003)			
Local Network Interaction	0.060	**			0.068	**	0.052		*	
	(0.023)				(0.023)		(0.023)			
Local Network Diversity			−0.063		−0.088	†	−0.095		*	
			(0.045)		(0.045)		(0.044)			
Controls										
Age	0.002		0.002		0.003		0.001			
	(0.002)		(0.002)		(0.002)		(0.002)			
Gender	0.097	*	0.089	*	0.094	*	0.056			
	(0.041)		(0.041)		(0.041)		(0.041)			
Education	0.114	***	0.111	***	0.114	***	0.108		***	
	(0.020)		(0.020)		(0.020)		(0.019)			
Income	0.039	**	0.040	**	0.039	**	0.037		**	
	(0.013)		(0.013)		(0.013)		(0.013)			
Constant	2.118	***	2.418	***	2.164	***	2.146		***	
	(0.158)		(0.135)		(0.159)		(0.157)			
F	18.870	***	17.790	***	16.390	***	16.650		***	
R-Squared	0.087		0.082		0.090			0.131		
Adjusted R-Squared	0.082		0.078		0.085			0.124		
N	1000		1000		1000			1000		

Values in parentheses are standard errors; † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5. Discussion

Creativity is becoming the necessary core competence in nearly all industries today, and most business leaders are trying hard to find ways to promote creativity in their organizations. This study aimed to analyze the relationships between one's network

characteristics and creativity. More specifically, this research differentiated the global network and the local network and observed how these two types of networks qualitatively determined by individual actors may affect their creativity. The empirical analysis of the survey data showed that the size and diversity of the global network are positively related to creativity. However, the positive effect of global network diversity decreased with the increase in the size of the network. In the case of the local network, frequent interactions had a positive effect on creativity, while the diversity of the local network had a moderate negative effect on creativity.

This study contributes to the research stream on creativity in two aspects. First, this study emphasizes the influence of social interactions on individual creativity while distinguishing the differentiated effects of the global network and local network. Existing research on creativity found some evidence that creativity does not necessarily belong to certain geniuses but may be an outcome of social interactions (Burt 2004, 2021; Fleming et al. 2007; Lingo and O'Mahony 2010; McFadyen and Cannella 2004; Rodan and Galunic 2004). Reagans and Zuckerman (2001) also explored the idea that the position in the social interaction networks may help or hinder teams in achieving a high level of productivity, and two different types of networks may affect such a relationship—the global network and the local network. This research builds on Reagans and Zuckerman's idea but applies the idea to individual-level egocentric networks instead of team-level networks and analyzes the effects of networks on creativity. This study assumed that individuals evaluate the strengths of their ties to others and differentiate their most trusted group of people (local network) from their overall acquaintances (global network), and analyzed how the global and local networks may have different effects on individual creativity. This paper may contribute to the future development of the creativity literature by suggesting a new way of understanding individual-level egocentric networks and their effects on creativity.

Second, this study proposes that network diversity may have different implications for creativity depending on whether the network is global or local. This may be counter-intuitive since diversity is usually seen as an important antecedent for creativity in most studies linking diversity to creativity (Glick et al. 1993; Hillman et al. 2002; Miller and del Carmen Triana 2009; O'Reilly et al. 1989; Smith et al. 1994; Zenger and Lawrence 1989). The empirical analysis results of this research suggest that while affiliation type diversity in the global network is definitely conducive to creativity, it may have a moderate negative relationship with creativity in the local network. In other words, while it is beneficial to engage with acquaintances connected through different types of affiliations to come up with new ideas, it is also beneficial to 'flock together with birds of a feather' when it comes to the most trusted group of people. These findings may offer a more complicated view of the relationship between diversity and creativity.

The findings from this study may also have managerial implications. The results on the global network suggest that employees who maintain a large number of social relationships with different types of acquaintances such as coworkers, friends, and neighbors are more likely to be creative. Therefore, employees' active socialization outside the workplace can be beneficial for firms. Ensuring a work-life balance and supporting social interactions outside the workplace can actually have positive consequences for employee creativity. In addition, creating an atmosphere where coworkers can trust each other and become closely related to each other so that they can share their own personal stories and life's important issues may also be beneficial in increasing employee creativity. Since coworkers are bound to interact frequently with each other, if coworkers become the local network of employees by building trust between them, firms may be able to expect positive effects of the local network on creativity.

Despite the above-mentioned potential contributions, this study has the following limitations. First, since the data for this study were not collected in a firm setting, generalizing the findings directly to firms would be difficult. Even though the findings may apply to the creativity of employees working in firms, this study cannot strongly argue that employees with certain global and local network relationships will generate more new

ideas useful for firms. Applying the findings to the firm setting will be more complicated as employee creativity at the workplace would also be affected by various factors such as task characteristics, reward system, and leader–member exchange. These contextual factors in the firm environment were not considered in this research.

Second, the survey for this research was a self-report survey, and creativity was measured by items included in this survey. In other words, the creativity variable was measured through self-evaluation. Given this measurement, there is a possibility that there may be a discrepancy between the self-reported creativity and the actual creativity of the respondents. Since the survey was a large-scale survey distributed to respondents selected through stratified random sampling, measuring self-reported creativity was the only available option. Yet, many existing studies confirmed a positive relationship between creative self-efficacy and the actual creative performance (Gong et al. 2009; Tierney and Farmer 2002, 2004), so we may postulate that respondents who evaluated themselves as being creative would actually be better at creative performance.

Future research could address the limitations mentioned above in the following ways. First, in order to test the hypotheses in ways more relevant to a business organization context, future research could test whether the global and local network characteristics of individual employees in firms indeed affect their creativity at work. By collecting data from one firm or multiple firms, future researchers could test the relationships hypothesized in this study together with other important factors such as task characteristics, reward systems, and leader–member exchange. More interesting relationships between variables may be revealed, such as firm context variables moderating the relationship between social network characteristics and employee creativity. Future researchers could also solve the potential problems of self-reported creativity measures by asking coworkers or supervisors to evaluate the creativity of each employee.

Another way of addressing the limitations of this research could be through experiments. Creativity can be more objectively measured by administering divergent thinking tasks in an experimental setting. By combining a more accurate measure of creativity in an experimental setting with a survey on the social network characteristics, future researchers may be able to conduct more rigorous analyses of the hypotheses tested in this study.

Despite the limitations, this research investigates an interesting issue of local and global network characteristics affecting creativity in diverse ways. Since creativity is increasingly becoming a core source of firm competitiveness (McDowell et al. 2018; Rousseau et al. 2016), continuous inquiry into the area of creativity will develop more implications and helpful suggestions for the business world.

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