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Structural Dynamics of Academic Research Ecology: The Case of the Social Sciences Korea (SSK) Program

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Abstract The focus of this research is to identify social science disciplines that are more vigorously involved in collaborative research in an era that emphasizes collaborative research. Drawing on the example of Social Sciences Korea (SSK) program, this paper identifies the patterns of changing structure of academic research ecology and reveals the ways and the extent to which each discipline's competitiveness, survival rate, position, and its accompanied role has changed. Basic statistical analysis and social network analysis are conducted on 33 agendas and 229 research teams that have participating in the SSK program for 8 years from 2010 to 2018. The first notable finding is that there are certain disciplines that perform the role of facilitator to nurture collaboration of various disciplines. Second, a group of disciplines are identified as leaders by having relatively higher competitiveness and viability. Third, the inner structure of the leading group takes an amorphous shape at the beginning and gradually transforms into a dual structure through structural differentiation. Moreover, we note that the mode of research performance is differentiated according to the characteristics of the major as well as its position within the overall research ecology: the "fox type" and the "hedgehog type."

Keywords research ecology · knowledge networks · research agenda · Social Sciences Korea · Matthew effect · the fox type · the hedgehog type

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Introduction

As the industrial society transforms into a knowledge-based information society, along with the rapid progress of information and communication technology (ICT) and the expansion of globalization, the political, economic, social, and cultural environments are precipitously changing as well (Rainie and Wellman 2012; Webster 2014). While diverse characteristics defining the existing industrial society are dismantled, convergence among differentiated social domains is proceeding in a new way. Nowadays, science is not simply staying in the realm of science itself. Rather, its influence has been expanded into other arenas such as art and literature. It seems that this trend will only get stronger as time goes on. However, the rapid progress of science and technology has created an unprecedented, and even unpredictable, social environment. People are often faced with risks that are considered predictable while they simultaneously live with the uncertainty that is difficult to calculate and even predict.

Korean society is no exception. Complex issues that cannot be simply dismissed by black-and-white logic have been erupting from various sectors of the society. On the whole, there were expectations that professional researchers should be able to quickly diagnose these social problems and present appropriate solutions. As the social sciences of Korea did not resonate with the rapidly changing social demands of the times, the critical issue of the role and identity of the Korean social science has been constantly raised from within and outside the academic community.[1]

As part of efforts to actively embrace these social expectations and encourage the revitalization of social science research, the Korean government began implementing a long-term academic support program for the social sciences in 2010. This academic support program is called the Social Sciences Korea (hereafter, the SSK) (Kim & Kim 2016; Chong & Kim 2018). The SSK was programed not to help individual researchers but to support a group of researchers sharing interests in specific research agendas. Therefore, researchers had to form a research team in advance before applying for the SSK program. Teams which were selected through the screening process could receive financial support for up to 10 years insofar as they passed the interim evaluations. One of the distinguishing features of the SSK program is its emphasis on research collaboration since the SSK is a research support program designed to help researchers achieve more creative research results through research collaboration in a freer atmosphere as long as researchers share common research interests that were beyond differences in majors and departments (SSK-Networking Support Group 2012-2018).

Essentially, collaborative research has been spreading not only in the field of natural sciences but also in the field of social sciences. Collaborative research among researchers in different disciplines has also shown an increasing trend (Han & Kim 2017; Whchty, et al.

[1] The issue of the crisis of Korean social science has been discussed in various aspects from different disciplines. For example, political scientist Im (2009) suggested the direction of Korean social science after diagnosing why Korean social science is in crisis. In recent years, Kim (2015) has proposed a direction that should go along with critical reflection on Korean social science, using the theoretical framework of sociologist Pierre Bourdieu. Based on the public sociology proposed by Michael Burawoy (2005), it is necessary to pay attention to the conflicting views of Kim (2011) and Chun & Kim (2010) on what sociology should be oriented toward. These discussions have a common point for critical reflection on what identity the social sciences should aim for.

2007). Considering these recent research trends, finding which disciplines are more vigorously involved in collaborative research than others while narrowing down the research focus into the field of social science is examined. In particular, by identifying the patterns of changing structure of a certain academic research ecology of the SSK program over time, this study intends to reveal in what ways and to what extent each discipline's competitiveness, survival rate, position, and its accompanied role within this research ecosystem has been changed.

Above all, the focus of this study is on the connection between the research director's majors on each research team and 33 research agendas of the SSK program because it is believed that the research team director's major is closely related to the selection of the research agenda. This study examines the characteristics of research directors on the basis of their attributes on the one hand and their relations with research agendas on the other. It examines the extent to which majors in the social sciences are more actively engaged to create, develop, and change the SSK research community than others and what characteristics the former share more with one another than the latter do. Based on the results of the analysis, which majors are actively involved in collaborative research are revealed in an era where research collaboration is emphasized. Lastly, if there is a difference in the collaborative aspects of such majors, the characteristics are uncovered.

Theoretical Consideration: Ecology versus Field

It is necessary to briefly comment on what theoretical framework is desirable to use in comprehensively analyzing this study's research site—the SSK program. In this paper, it is research "ecology" called the collective body of research groups that is participating in the SSK program. In an effort to understand the nature of social space and to capture its way of working, sociologists have used the concept of "ecology" and "field" (Liu & Emirbayer 2016). While systematically comparing the commonalities and differences between field and ecology, Liu and Emirbayer (216:63) define social space as "actors and positions and the relations that associate them." The reason the concept of ecology instead of the field in this study is used is not because the former is absolutely always right than the latter. Rather, the concept of ecology is more revealing than the concept of field in terms of defining the general characteristics of the SSK research groups which this study is trying to analyze.

Pierre Bourdieu not only developed the term field but he is also a representative scholar who carried out a series of sociological studies on various social domains through the framework of the field (Bourdieu 1975, 1985; Bourdieu & Wacquant 1992). According to Bourdieu, field is a "*relational configuration endowed with a specific gravity*" that is formed by actors who share the same understanding or stake but are in different social positions. What is important here is that the actors who share a common stake but occupy different positions in a field are in a state of constant struggle to turn the governing principle they seek into one that runs through the entire field. In other words, field is not a simple social space, but a "*space of conflict and competition*", the analogy here being a battlefield, in which participants vie to establish monopoly over the species of capital effective in it" (Wacquant 1992: 17, Italics original).

By contrast, although ecological theory, like field theory, acknowledges that human relations are competitive in a social space, it does not mean that competition among actors necessarily

leads to struggle for domination and hierarchical relations. To borrow Liu and Emirbayer's comments (2016: 69), it can be said that whereas field theory generally emphasizes coercion, ecological theory emphasizes "competitive cooperation."

Another difference between the field theory and the ecological theory, which is particularly noteworthy for our research, is the differentiated approach to the degree of homogeneity of the members constituting the social space (Liu & Emirbayer 2016: 70). It has been reported that ecological models assume more homogeneous composition of social space than field models do. With regard to this issue, it is worthwhile to mention DiMaggio and Powell's description:

> By organizational field, we mean those organizations that, in the aggregate, constitute a recognized area of institutional life: *key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services and products*. The virtue of this unit of analysis is that it directs our attention not simply to competing firms, as does the population approach of Hannan and Freeman (1977), or to a network of organizations that actually interact, as does the inter-organizational network approach of Laumann et al. (1978), but to *the totality of relevant actors* (DiMaggio & Powell 1983: 148, Italics added).

That is, whereas field models try to encompass "the totality of relevant actors," ecological models regard social space as a general composition of homogeneous "one type of actors" (Liu & Emirbayer 2016: 70).

The reason why this study aims to analyze the SSK program in terms of the ecological model is due to the fact that the research teams' directors in the SSK program share many homogeneous features. The vast majority of the research teams' directors are professional researchers with doctoral degrees in the social sciences and with positions above associate professors in universities. Of course, their specialized field of study or major is diverse. In addition, there is a clear heterogeneity that the final degree awarding bodies are spreading not only in Korea but also in the United States and around the world. There are also a variety of research agendas in which research directors conduct research predominantly. Nevertheless, these heterogeneities are heterogeneous under the umbrella of the homogeneity they share, and the ecological model that focuses on homogeneity could be a more valid analytical framework. Most importantly, research directors are those who perform their own research under the provisions of the SSK program and receive compensation and evaluation from external agencies. They are not those who have a stake in their preferred governance principle and are not competing with each other to push the principle into the governing principle of academic social space.[2]

[2] As one reviewer pointed out, we cannot say that there is no competition between researchers involved in the SSK program. This is because researchers who work on the same agenda, although belonging to different research teams, are in a competitive relationship with the purpose of their research team as the final beneficiary of sustained research support. Therefore, there is local competition in the micro boundary, which is the same agenda. Nevertheless, in the overall SSK program dimension, we suggest the ecological perspective is a more valid theoretical framework in that the competitive cooperation can be regarded as a basic attitude and orientation towards the entire research support program that the researchers take.

Methods and Research Background

This study tracks the development of a total of 229 research groups that were selected as new research teams each year for the first four years of the SSK project, which began in 2010. These 229 research teams are composed of researchers having about 1,000 doctoral degrees in total, and who selected one of 33 research agendas to conduct intensive research on the subject. First of all, this study focused on the attributes of research directors, the distribution of research agendas, and the continuity of research. The selected research groups start with a small research team, conduct research through a medium-sized research group, and eventually grow into a large research center. As of September 2018, 70 of the 229 research groups selected during the first four years of the SSK project were actively conducting studies, while 159 were disqualified after an interim or phase assessment. Therefore, the overall survival rate of research teams that joined the SSK is 30.6% (70 out of 229).

As an initial step for the SSK program, the National Research Foundation of Korea (NRF), which can be compared with the National Science Foundation (NSF) in the USA, conducted exploratory research to choose relevant research subjects that would be worthy of financial support. These relevant research subjects were called "research agendas." Each year, new research teams were selected to study topics related to these research agendas. Of course, the topic of research was not chosen only in the top-down way. Although relatively small, the bottom-up method also co-existed by teams that wanted to apply for the SSK program to voluntarily set up research topics (Kim & Kim 2016; Chong & Kim 2018). Looking over eight years from 2010 to 2018, individual research teams conducted intensive research on one of the research agendas classified into 33 areas. As a result of classifying the academic specialties of research teams' directors, it was found that they span a total of 19 disciplines of humanities and social sciences.

Using both statistical analysis and social network analysis, this study tracked the development of a total of 229 research teams. They were newly selected each year for the first four years of the SSK program, which began in 2010. This study primarily focused on the attributes of the research director in each research team, the distribution of research agendas, and the continuation of research by individual research team.

First, based on descriptive statistical techniques, the proportion of specific disciplines in the whole research ecology of the SSK program was examined, with focus on the early stage of the program and the year 2018. This proportion was called "the competitiveness of each discipline" within academic ecology. At the same time, "the survival rate of each discipline" was measured; that is, the degree to which each discipline passed an interim assessment and continued to receive research support.

Second, using social network analysis along with two-mode data, the overall relational topology between disciplines and research agendas was retrieved over time. The early SSK research ecology was compared with the recent ecology in 2018, centering on the majors of each research team's director and the research agendas. How the various majors and agendas in the SSK research ecology are connected and interacted with each other are examined. For more systematic analysis of overall network structure, core-periphery structure of two-mode data (disciplines and agendas) is generated by using core-periphery categorization analysis.[3] The centrality of each discipline to identify each discipline's local- and global- position and its

accompanied role.[4]

Results

The Relative Constancy of Major Attributes of Research Directors over Time

Several notable analyses have been conducted regarding the characteristics of the research teams and research directors. First, although a total of 229 research teams participated in the SSK program during the first four years (2010-2013), 70 research groups have been participating in large research centers (59 research teams, selected in 2010-12) or medium-sized research groups (11 research teams, selected in 2013). In other words, with the exception of 70 research teams that continue to conduct the study, 159 other teams have stopped working as a result of the interim assessment. In terms of survival rate, the average survival rate of the research teams is 30.57%. If one looks at this survival rate further, the survival rate of the current large research centers (corresponding to the research teams selected from 2010 to 2012) is 28.64% (59 out of 206) while that of the current research groups (corresponding to the research teams selected in 2013) is 47.82% (11 out of 23).

Table 1 General Characteristics of Research Directors of the SSK Project

Attributes of Research Directors		Early Stage	2018.12.
Sex	Man	194 (85%)	59 (84.3%)
	Women	35 (15%)	11 (15.7%)
Status	Professor	168 (73%)	54 (77.1%)
	Associate Professor	41 (18%)	13 (18.6%)
	Assistant Professor	17 (7%)	2 (2.9%)
	Others	3 (1%)	1 (1.4%)
Location of Institutions	Metropolitan Area	164 (72%)	58 (82.9%)
	Non-metropolitan Area	65 (28%)	12 (17.1%)
Total		229	70

[3] The center-periphery structure is a kind of block structure composed of a population with a high density and a population with a low density. A block with a high density among diagonal blocks forms a central block while the other block on a diagonal line forms peripheral block with a low density. Throughout this analysis, it is expected that, in the central block, the major disciplines frequently engage in the central agendas to form one cohesive subgroup.

[4] The concept of centrality is a fundamental and important method of analyzing the features of a node in relation to social network analysis. In this study we will focus on the degree centrality and betweenness centrality. In general, degree centrality measures the degree to which a node is directly connected to other nodes. As a result of degree centrality, the higher the degree of direct connection of a node to the other nodes around it, the greater the power or influence at the local level of the node. On the other hand, in the case of betweenness centrality, we measure the degree to which a node is located on the geodesic distance between different nodes in the network. Betweenness centrality measures the extent to which it acts as a broker between different nodes. Compared to degree centrality, it can be said that betweenness centrality reveals the global centrality in that a node takes a strategically important place in the connection structure of the whole network.

The basic characteristics of each research group were examined by focusing on the attributes of the research teams' directors. For the following reasons, this study focused its analysis on the characteristics of the research manager. The research director's attributes apparently tend to represent the research topics and research interests of each research team. It is assumed that the professional researcher's academic specialty and research interest are closely related to the selection of research topics and research agenda. Another reason for paying attention to the nature of the research director is that it is very difficult to keep track of the records of the researchers in other research teams except for the research director because those researchers change their affiliation very frequently. It is expected for the analyses centered on the attributes of the research director to provide a basis for maintaining consistency in the study and bring about more reliable results.

Focusing on the research directors' characterization of research teams, some interesting phenomena emerged when comparing the characteristics of the 229 new teams to those of the research teams that have been conducting research until now (See Table 1). First of all, it was revealed that the sex ratio of the research directors and the directors' status in universities showed almost the same level without any major change. At the time of selection, the percentage of male and female directors was 85% (194) and 15% (35), respectively. As of 2018, among the 70 surviving research groups, the percentage of male and female directors was 84.3% (59) and 15.7% (11), respectively. It is understood that the constancy shown in the sex ratio of research directors reflects the proportion of male and female professors in the Korean social science community. The research directors' status has not changed much, either. More than 90% of the research directors were full-time professors or associate professors. It has been revealed that the SSK project is mainly led by full-time professors who have tenure.

Derivation of the Matthew Effect

When the universities to which the research director is affiliated are assessed, one can confirm that the research supervisors are concentrated in several major universities from the beginning to the present. It has been confirmed that the concentration of research teams into certain top universities is increasing over time. Initially, 136 out of 229 research teams were identified as belonging to 10 universities, and the research teams of these top 10 universities accounted for 59.4% of the total research team. In recent years, 53 out of the 70 research groups carrying out further research have been located in the top 10 universities, and their share has increased to 75.7%. Most of these top 10 universities were universities in Seoul or the metropolitan area. Initially, research teams were selected from 65 universities across the country. However, research groups belonging to universities located in Seoul, which have relatively good research infrastructure and are favorable in securing and maintaining excellent researchers, showed higher survival rate in the long-term competition process. It can be inferred that the concentration of research groups in universities located in Seoul further intensifies.

Table 2 The Top 10 Universities with Multiple Research Directors of the SSK

Total number of universities with more than one research director	**Early Stage (2010-2013)**		**2018. 12**	
	65		**28**	
Top 10 Universities	Universities	Number of participating research teams (%)	Universities	Number of participating research teams (%)
	Seoul National	31 (13.5%)	Yonsei	13 (18.6%)
	Yonsei	24 (10.5%)	Seoul National	10 (14.3%)
	Korea	23 (10.0%)	Korea	9 (12.6%)
	Sungkyunkwan	13 (5.7%)	Kyunghee	4 (5.7%)
	Pusan National	9 (3.9%)	Hanyang	4 (5.7%)
	Ewha Womans	8 (3.5%)	Sogang	3 (4.3%)
	Kyunghee	8 (3.5%)	Sungkyunkwan	2 (2.9%)
	Sogang	7 (3.1%)	Pusan National	2 (2.9%)
	Hanyang	7 (3.1%)	Ewha Womans	2 (2.9%)
	Keimyung	6 (2.6%)	Konkuk	2 (2.9%)
	-	-	Pukyong National	2 (2.9%)
The proportion of research teams from the top 10 universities with a large number of research managers to the overall research teams	**59.4% (136/229)**		**75.7% (53/70)**	

It seems that the Matthew effect is occurring in institutional dimension. The Matthew effect is one of the many classically mentioned concepts in understanding scholarly achievement and its ramifications within scholarly communities.[5] As is well-known, the Matthew effect is the terminology that Robert K. Merton (1973) has cast using the phrase in the Bible's Matthew Gospel (13:12). According to Merton, "the Matthew effect consists of the accruing of greater increments of recognition for particular scientific contribution to scientists of considerable repute and the withholding of such recognition from scientists who have not yet made their mark" (1973:446). The point of particular attention to the Matthew effect in relation to this study is the resource disparity resulting from the Matthew effect and the resulting chain effect: "One institutional version of the Matthew effect … [is that] centers on demonstrated scientific excellence are allocated far larger resources for investigation than centers which have yet to make their mark" (Merton 1973: 457). In the early stage of the SSK program, there were research groups that were able to conduct research with relative advantage in terms of research conditions and personnel composition. Over time, these research groups seem to have a kind of synergistic effect on improving their competitiveness by increasing their research achievements, along with their greater financial support.

[5] It is reported that the phenomenon that "the rich get richer while the poor get poorer", which is mentioned by Merton in the process of analyzing and setting up the scientific community as a subject, has also been observed in various fields of society such as economy, science, politics, education, and culture through the study of social scientists have (e.g., Frank 1996; Piketty & Saez 2006; Hacker & Pierson 2010; Rigney 2010). The phenomenon of concentration of wealth, power, status, and social recognition among a small number of the entire society members is becoming a very common phenomenon.

Relatively High Competitiveness and Survival Rate Concentrated on Specific Majors

Based on the major of each research director, this time, this study looked at which major areas have participated in the SSK program. In addition, the proportion of individual majors in the overall SSK program was examined. Furthermore, this study analyzed what majors have been suspended frequently over time and have shown high viability. The analysis found that a total of 19 major areas were involved in the project. The majors showing the highest percentage of participation were Sociology, Economics, Political Science, Public Administration, and Business Administration.

These five majors accounted for more than 50% of the total research teams from the early stage of the SSK program to the present. For example, of the 227 teams, the research directors of 48 teams were found to have majored in Sociology. Sociology accounted for 20% of the total research team majors. Recently, the number of research groups has been reduced to 70, among which 14 are based on Sociology. Sociology accounted for 20% of the total majors, showing almost the same status as the early days. Economics fell to 11.4 percent from 14.8 percent and Business Administration decreased to 8.6 percent from 11.3 percent as well. Political science, on the other hand, increased from 13.1 percent to 18.6 percent, and public administration from 11.3 percent to 17.1 percent.

Table 3 Competitiveness and Survival Rate of Majors

Major	Number of Selected Research Teams and Competitiveness	Number of Ongoing Research Teams and Competitiveness	Survival Rate by Major
Sociology	48 (20.9%)	14 (20.0%)	29.2%
Economics	34 (14.8%)	8 (11.4%)	23.5%
Political Science	30 (13.1%)	13 (18.6%)	43.3%
Public Administration	26 (11.3%)	12 (17.1%)	46.2%
Business Administration	26 (11.3%)	6 (8.6%)	23.1%
Education	18 (7.8%)	5 (7.1%)	27.7%
Law	12 (5.2%)	2 (2.9%)	16.6%
Psychology	10 (4.3%)	1	10.0%
Journalism	7 (3.0%)	2 (2.9%)	28.6%
Social Welfare	6 (2.6%)	3 (4.3%)	50%
Literature Information	2	1	50%
Geography	2	1	50%
History	2	0	0%
Architecture	1	1	100%
Child Welfare	1	1	100%
Consumer Information	1	0	0%
Anthropology	1	0	0%
Japanese Studies	1	0	0%
IT Management	1	0	0%
Number of Research Teams and Average Survival rate	**229**	**70**	**30.57%**

In order to measure which majors are continuing their research over a period of eight years, the survival rate for each major was measured. Survival rate was measured by setting the number of the same major research teams as the default number and comparing it to the number of the surviving research teams. The overall average survival rate of all participating research teams is 30.57%. Public administration was found to have the highest survival rate (46.2%). After Public Administration, the survival rate of political science was high (43.3%), followed by Sociology (29.2%), Economics (23.5%), and Business Administration (23.1%). On the other hand, the survival rate of Law and Psychology was 16.6% and 10%, respectively, indicating a relatively low survival rate.

Based on the research director's majors, there were initially 19 majors involved in the SSK program. However, five majors—History, Consumer Information, Anthropology, Japanese Research, and IT Management—were found to have very few teams selected from the start and are now in the area of majors that no longer carry out research. In the end, the SSK research community has found that the entire research ecology is basically formed and maintained around several social science majors. Of course, individual majors have shown that some ups and downs in survival rates were observed, but the overall composition itself has remained unchanged.

This time, the maintenance and survival of research agendas based on agenda setting process are investigated. The research agendas in the SSK program takes three types, one type is top-down agendas, another type is bottom-up agendas, and another is mixed type.[6] In the case of a mixed type of agendas, it was bottom-up agendas when it was selected, but thereafter, these selected agendas were categorized by research theme and converted to top-down. A notable point with regard to research agendas is whether there is a drastic difference in survival rates among the agendas set out in these three different ways: 33.3% for the bottom-up, 31.5% for the mixed type, and 28.9% for the top-down. It seems that there is no critical cut-off point among these survival rates although there is a slight difference. In other words, no matter how the research agendas are given, there is no significant variation in the survival rate. That is, the way in which agendas are given to researchers is not a factor that makes a big difference in the survival rate of research groups.

Table 4 Types of Research Agendas and the Survival Rate

Types of Agenda (Selected Years)	Number of Research Teams		Survival Rate (%)
	Early Stage	December, 2018	
Top-down Agenda (2011-13)	107	31	28.9%
Mixed Agenda (2010)	92	29	31.5%
Bottom-up Agenda (2011-13)	30	10	33.3%
Total	229	70	30.6%

[6] A top-down agenda is a case in which important research topics are selected by the National Research Foundation of Korea in advance and given to researchers who support the research program (the SSK). A bottom-up agenda, on the other hand, differs from the top-down agenda in that researchers autonomously select research topics they are interested in and apply for the research program.

Weakening Clustered Networks of Overall Research Ecology

Figure 1 is an overall topological map of the SSK research ecology that shows cumulatively what kind of relationships are formed between the 19 majors of research directors and 33 research agendas at an early stage. In this figure, the nodes marked with red circles represent 33 research agendas, and the nodes marked by blue squares represent 19 majors.[7] What is noteworthy in this topology is which majors are playing a central role in the overall ecology of the SSK program. It seems that Sociology (Soc), Political Science (Pol), Public Administration (PA), Economics (Econ), and Business Administration (BA) occupy a central position due to participation in various research agendas. In the early stage of the SSK program, all the majors and research agendas are directly or indirectly connected to each other. Thus, the whole research ecology takes the form of a huge cluster without an isolate.

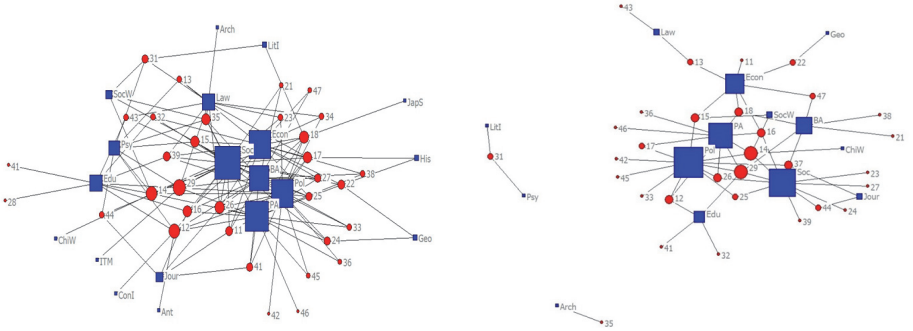


Fig. 1 The SSK Research Ecology Focusing on Majors and Agendas

Some majors' central position in the whole research ecology seems to be weakened as the SSK program proceeds. While a few majors such as Sociology, Political Science, and Public Administration seem to maintain their position as central courses, Economics and Business Administration are likely to be somewhat pushed away from the center due to their relative weakness. At the middle and bottom of the far left of December 2018 in Figure 1, there are majors like Archaeology (Arch), Psychology (Psy), and Literature Information (LitI). These majors are disconnected from the major chunk of research community. Therefore, one can confirm that these majors respectively engage in only one research agenda. Although not shown in this figure, research on two of the 33 selected agendas is not proceeding any further because research teams studying these two agendas were eliminated in the mid-term evaluation process.[8] Among 19 majors, five majors—Consumer Informatics, History, Anthropology, Japanese

[7] In the case of nodes labeled as agendas, they were coded as two digits. In this case, the first digit indicates the time when the agenda was selected. For example, node agendas with leading 1s are agendas selected in 2010, 2 for 2011, 3 for 2012 and 4 for 2013 agendas. The last digit of the two digits is the distinguished agenda.

[8] Two research agendas as follows: "Korean society and education" and "Changes in international Order of East North Asia and the Korean Peninsula," which were adopted and studied in 2011 and 2012, respectively.

Studies, Information Technology Management—were no longer involved in the SSK program.

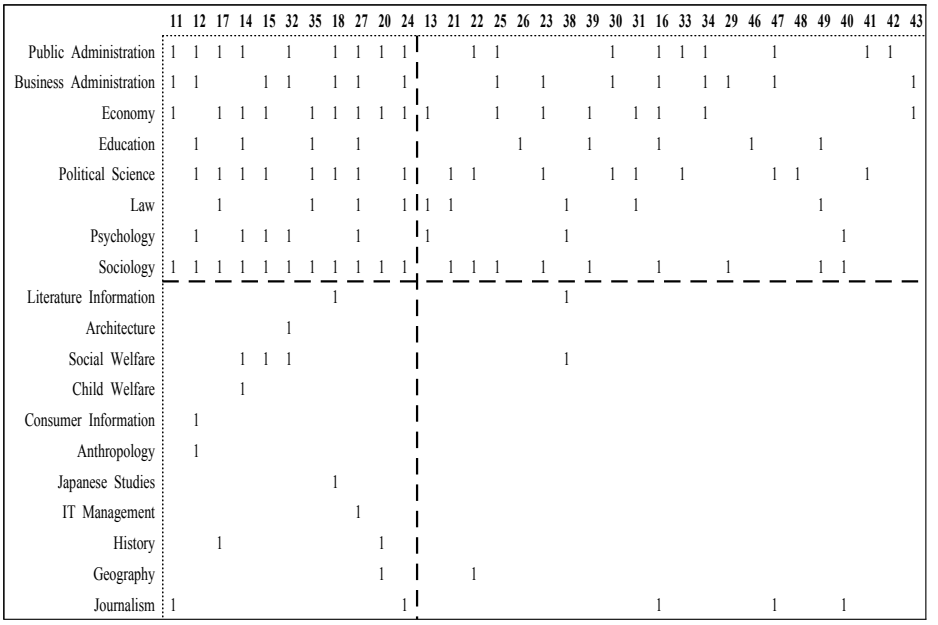
The Formation and Change of Core Groups within Research Ecology

Now, this paper seeks to identify the status of majors and agendas in the whole research ecology. For this purpose, which majors and research agendas are taking core or peripheral positions in the SSK research ecology in terms of relational perspective are systematically examined. Moreover, whether there are any changes in the status of individual nodes (majors and agendas) over time are studied. This analysis is intended to identify "network block structure" consisting of relatively denser core layer and less dense peripheral layer (Wasserman and Fast 1994). The majors and research agendas located in the core are more densely connected to each other so that the density of the core is relatively high. The density between majors and agendas located in the core at the early stage is 0.631, while the core density is 0.579 in 2018, a slight reduction from the initial density. (See Table 3) In the early stage of the SSK program, eight out of 19 majors—Public Administration (PA), Business Administration (BA), Economics (Econ), Education (Edu), Political Science (Pol), Law (Law), Psychology (Psy), and Sociology (Soc)—are located in the core. However, in 2018, three among these eight majors—Education, Law, and Psychology—have moved downward from the core to the periphery, while the five other majors remained in the core. In terms of knowledge networks, some major disciplines in core areas have proven to play a leadership role in the SSK research ecology by showing a relatively higher competitiveness and survival rate than other majors in the social sciences.

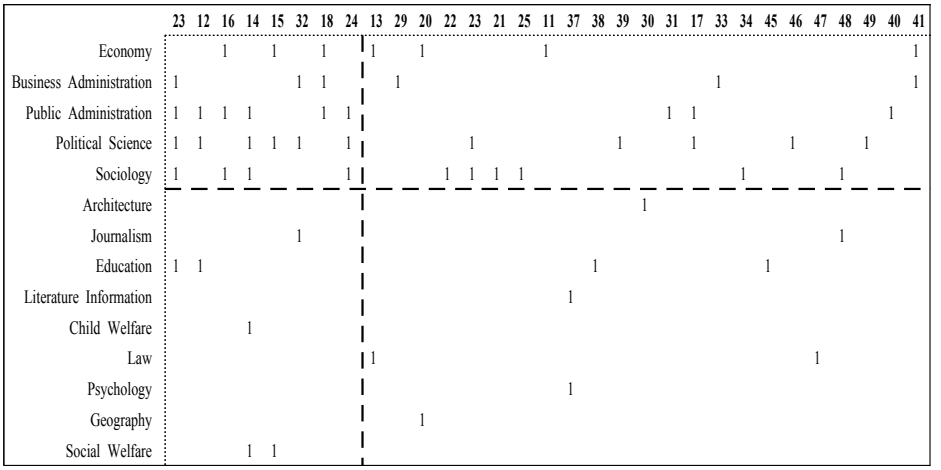
In the case of the research agenda, 11 out of 33 agendas occupy a central position in the entire study ecosystem at the beginning of the project. In other words, in the early stage of the project, 8 majors and 11 research agendas occupied a core position in the whole research ecology of the SSK program. However, in 2018, eight research agendas were found to have a core position in the entire research ecology, forming a close relationship with five majors. That is, the number of research agendas located in the core status has decreased from 11 to 8. One thing to note here is that the four themes of agenda initially occupying core status changed into peripheral status in 2018. On the other hand, the agenda “Future Society 2” was located in the periphery at the beginning of the SSK program but shifted to the core in 2018.

One of the salient features of the entire research ecology when comparing the early stage of the SSK program and the state in 2018 is the changing relationship between the core and the periphery. In the early days of SSK, the majors located in the center and the agendas located in the periphery are relatively interconnected. The density between the center major and the peripheral agenda during this period is 0.32. In recent years, however, this relationship has weakened and the density has decreased to 0.179. Simple comparisons are certainly difficult because there is a change in the number of nodes between the two points; i.e., a change in the size of the group. Nevertheless, as a whole, the major-agenda relations within the core are consistently dense and solid over time, while major-agenda relation between center and periphery are weakening. In other words, the overall SSK ecology is reconstructed around specific majors and agendas over time. These majors not only continued to exert their influence as leaders in the overall research ecology, but also played a pivotal role in maintaining the research ecology homeostasis.

A. Blocked Adjacency Matrix (Early Stage)



B. Blocked Adjacency Matrix (December, 2018)



A. Density Matrix (Final Fitness: 0.701)

	Core	Periphery
Core	0.631	0.32
Periphery	0.129	0.025

Overall Density: 0.214
Number of Ties: 134

B. Density Matrix (Final Fitness: 0.563)

	Core	Periphery
Core	0.5791	0.179
Periphery	0.088	0.045

Overall Density 0.134
Number of Ties: 58

Fig. 2 The Categorization of Core and Periphery

Diachronic Dynamics: Structural Differentiation within the Core

This time, this paper delves into the centrality indicator in a two-mode network using social network analysis (Breiger 1974; Borgatti & Everett 1997). Here, a particular area of interest is which majors play a central, pivotal role in the entire SSK research ecology. Table 5 shows the centrality of each major area at the beginning of the project. As for the degree centrality (Borgatti, et al. 2018; Freeman 1978-79, Hanneman & Riddle 2011; Prell 2012; Wasserman & Faust 1994), Sociology (0.606), Public Administration (0.545), Political Science (0.515), Economics (0.515), and Business Administration (0.455) were high[9]. From the point of view of betweenness centrality, Sociology (0.205) has been found to most actively take the role of "broker" or "bridge" that mediates various agendas by being involved in diverse research agendas (Burt 1992; 2004). In the early stage of the SSK program, sociology actively engaged in diverse research agendas. Sociologists' active involvement in different agendas resulted in an unintended consequence at the whole ecological level. Sociology not only played a role as a mediator between various agendas but also contributed to the construction of a whole research cluster. Following Sociology, Public administration (0.183) and Political Science (0.161) act as mediators as well. On the other hand, betweenness centrality was not relatively high for Economics (0.127) and Business Administration (0.094).

Table 5 The Centrality of the Majors in the 2-Mode Network (Early Stage of the SSK)

		1	2	3	4	5
		Degree	2-Local	Eigenvector	Closeness	Betweenness
1	Architecture	0.030	0.001	0.023	0.413	0.000
2	Business Administration	0.455	0.207	0.367	0.622	0.094
3	Economics	0.515	0.265	0.412	0.645	0.127
4	Education	0.273	0.074	0.188	0.543	0.097
5	Literature Information	0.061	0.004	0.038	0.451	0.003
6	Law	0.273	0.074	0.187	0.535	0.041
7	Social Welfare	0.121	0.015	0.090	0.489	0.009
8	Sociology	0.606	0.367	0.482	0.726	0.205
9	Consumer Information	0.030	0.001	0.030	0.445	0.000
10	Journalism	0.152	0.023	0.120	0.476	0.006
11	Psychology	0.242	0.059	0.182	0.552	0.045
12	Child Welfare	0.030	0.001	0.032	0.445	0.000
13	History	0.061	0.004	0.049	0.434	0.000
14	Anthropology	0.030	0.001	0.030	0.445	0.000
15	Japanese Studies	0.030	0.001	0.031	0.429	0.000
16	IT Management	0.030	0.001	0.039	0.451	0.000
17	Political Science	0.515	0.265	0.386	0.670	0.161
18	Geography	0.061	0.004	0.040	0.423	0.000
19	Public Administration	0.545	0.298	0.421	0.697	0.183

[9] In the case of a two-mode network, centrality measures are not simply derived. Centrality measures are usually normalized by dividing the maximum value, that is, the size of the other node set.

Following the initial phase, this paper evaluated the current state of the SSK research ecology. Based on degree centrality, the five majors of social sciences are still highly connected, just as in the early days of the SSK program. This confirms that these majors are consistently involved in various research agendas and actively conduct their own research. What is remarkable with regard to degree centrality in 2018 is that Political Science (0.355) is the most directly connected major with various agendas. Sociology (0.323) has shown the second highest degree centrality.

On the other hand, in terms of betweenness centrality, Economics (0.248) is the most active in the entire research ecosystem and is playing the role of a mediator. In its case, its degree centrality—the degree of direct connection with other nodes at the local level—is lower than that of Political Science, Sociology, and Public Administration but it acts as a kind of bridge that mediates various research agendas. It can be said that economics is taking a strategically important position on the global level. After economics, political science (0.233) and sociology (0.230) played a role as intermediaries.

Table 6 The Centrality of the Majors in the 2-Mode Network (December, 2018)

		1	2	3	4	5
		Degree	2-Local	Eigenvector	Closeness	Betweenness
1	Architecture	0.032	0.001	0.000	57.000	0.000
2	Business Administration	0.194	0.037	0.222	0.543	0.127
3	Child Welfare	0.032	0.001	0.086	0.404	0.000
4	Economics	0.226	0.051	0.193	0.553	0.248
5	Education	0.129	0.017	0.172	0.456	0.082
6	Geography	0.032	0.001	0.010	0.322	0.000
7	Journalism	0.065	0.004	0.068	0.410	0.005
8	Law	0.065	0.004	0.010	0.329	0.041
9	Literature Information	0.032	0.001	0.000	19.000	0.000
10	Public Administration	0.290	0.084	0.522	0.588	0.170
11	Political Science	0.355	0.126	0.591	0.626	0.233
12	Psychology	0.032	0.001	0.000	19.000	0.000
13	Sociology	0.323	0.104	0.483	0.613	0.230
14	Social Welfare	0.065	0.004	0.130	0.463	0.006

Discussion

The analysis of the structure and changing patterns of the research ecology through social network analysis reveals some interesting features concerning a differentiated role-taking of some majors. First, some major disciplines with various research interests more actively take part in various research agendas than others. Sociology, and then the majors such as Political Science, Public Administration, Economics, and Business Administration are actively participating in various agendas. These majors are judged to be highly open to various agendas.

Second, the fact that these five majors have occupied the central position is not a temporary phenomenon. However, as time went on, it was confirmed that structural differentiation

occurred among the majors belonging to the core area. The agendas involved in Sociology, Political Science, and Public Administration were also characterized by the involvement of other researchers from various majors. On the other hand, economics and business administration have participated in various agendas, but those agendas are characterized by relatively less participation by researchers in other major fields. In the end, researchers who majored in Sociology, Political Science, and Public Administration, whether they intended or not, play an important role in the so-called multivocal agendas; i.e., research agendas in which diverse majors are involved. On the other hand, research agendas involving Economics and Business Administration show that relatively few majors are involved in those subjects. Economics and Business Administration not only occupy a relatively central position in the univocal agenda areas, but also show a comparative advantage in acting as a mediator.

According to Berlin (1998), authors and thinkers could be divided into two categories throughout human history: "the hedgehog" type and "the fox" type. The hedgehog type refers to people who want to look at the world through a single central theory or viewpoint rather than knowing a lot or pursuing goals for various issues. On the other hand, the fox type seeks broad knowledge while paying attention to various types of problems and empirical facts that may even be contradictory or incompatible. Therefore, while the hedgehog is a scholar or thinker who is interested in a unified world view, the fox may be a scholar or thinker who is more interested in various aspects of empirical facts. What is relevant from Berlin's idea for our study is applying his categorization to a process of clarifying the identity of academic majors. Even if we take the risk of oversimplification, we might classify various majors in social sciences as the hedgehog type or the fox type.

To recapitulate, it was confirmed that the mode of research performance was differentiated according to the characteristics of the major. Agendas involving Sociology, Political science, and Public administration tended to involve a large number of researchers from other major fields. We propose that these majors represent the characteristics of "the fox type" mentioned by Berlin in terms of carrying out research with wide interest in various subjects. Economics and Business Administration are basically conducting research on various agendas. However, in the case of the agendas involving these two majors, participation of researchers belonging to different major fields seems to be decreasing as time goes on. At the same time, Economics and Business Administration are taking on a dominant position in the agendas. Considering these trends, we propose that these two majors represent "the hedgehog type" with a tendency to look at the world from a single worldview or perspective.

Conclusion

Through this study using basic statistical and social network analysis, the synchronic structure and diachronic dynamics of the research ecology generated with the support of the NRF were investigated. To sum up, there are three major notable findings. First, in an era where collaborative research is highlighted, there are major disciplines performing the role of facilitator to connect various disciplines. Interestingly, it is true that major disciplines performing the role of facilitator are not newly established ones but major disciplines; i.e., Sociology, Political Science, Public Administration, Economics, and Business Administration, all of which

representing social sciences from the past. Therefore, from the viewpoint of research support policy, it is desirable to give special support to these majors in order to activate creative collaborative research.

Second, in terms of knowledge networks, this study has identified a group of disciplines that are leaders in the research ecology of the SSK program based on their relatively high competitiveness and viability (survival rate) compared to other majors. These are Sociology, Economics, Political Science, Public Administration, Business Administration, Education, Law, and Psychology. In fact, all of the research teams participating in the SSK program are competent research groups in that they have been selected through three-to-one to four-to-one fierce competition. Although the rankings of some majors in the leading group (the core) have dropped relatively slightly, these majors have continued to exert their influence as leaders in the entire research ecology. The fact that there is a hierarchy between these competent research teams and that there are major disciplines that serve as a leader implies that these disciplines play a pivotal role in maintaining the whole research ecology.

Third, looking at the knowledge ecology from a relational perspective, one can find that the inner structure of the leading group takes an amorphous shape at the beginning and gradually transforms into a dual structure through structural differentiation. When researchers conduct research on agendas, it is found that there is a difference in the way of conducting research depending on academic disciplines. On the one hand, there are majors heavily involving in the agendas of active collaboration with various majors. Sociology, Political Science, and Public Administration represent multivocal-oriented research pattern —the fox type. On the other hand, there are majors mainly focusing on cooperation within their own major while mainly involved in research agendas engaging only a few majors. Economics and business administration represent univocal-oriented research pattern. This is understood as a combining result of each discipline's innate attributes and its relational status in the research ecology.

Although the Social Sciences Korea (SSK) is one of the most large-scale and cooperative research support programs in the sphere of Korean social sciences, there has been relatively few studies of diverse important issues on the SSK such as what majors, research agendas, and research directors constitute the SSK program and how these factors have changed since the SSK program was launched. It is expected that the empirical research findings and interpretations on these findings in this article provide both researchers and practitioners with a valuable source for understanding the SSK program correctly in a dynamic sense and for designing future development of the SSK program. Particularly, this article provides important insights on the characteristics of the SSK program by utilizing the Matthew effect, which is not intentional over time, but that more advantage is concentrated on a small number of research groups on the opportunity structure. On the other, it reveals that the research forms of the core groups in the whole research ecology are differentiated in the fox type and the hedgehog type.

This study has some limitations in two aspects. First, it should be pointed out that this study is limited to the research that participants in the SSK program, so it cannot be regarded as a completely representative study of the whole social science. Second, the SSK program is not a terminated research support program, but is in progress. Therefore, it is too early to predict how the program will be completed in the future with the results revealed through this study. Nonetheless, the logical analysis of the structural dynamics associated with the path and trend so far has significance as a means of presenting a basis for understanding the current state. We

hope that complementary or additional comparative analyzes will contribute to understanding the current status of the Korean social sciences in particular and retrieving the changing mechanisms of academic research ecology in general.

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