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Intellectual structure of Korean theology 2000–2008: Presbyterian theological journals

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Abstract
A bibliometric analysis of author keywords in articles from nine Korean theological journals published from 2000 to 2008 found 10 clusters that represent the intellectual structure of Korean theology. Three main streams of Korean theology studies were identified: Reformed theology, general theology, and evangelicalism. The intellectual structures of the representative journal for each stream were examined in depth. To visualize these intellectual structures, we used co-word analysis and a Pathfinder network (PFnet) algorithm. The Pathfinder network was constructed by two approaches: first-order cosine coefficients and second-order correlation coefficients. Semantic review of the results suggests that second-order correlation coefficients more effectively present the intellectual structure of a domain by PFnet.

Keywords
bibliometric analysis; intellectual structure; intellectual map; Korean theology; Presbyterian theological journals

1. Introduction

Christianity was first introduced into Korea in 1887. The subsequent rapid development of Korean Christianity offers an opportunity to chart its growth fully, and with modern methods, that is rare in the world of Christian history. Similarly to the work done by America's missionaries, Korean Christian churches have dispatched missionaries all over the globe. Korean Christianity's contribution to Korea's economic and social development has been enormous; as Kim Seung-Wook [1] observed, the Korean economy can attribute its miracle growth to the human resources fostered by the modern education provided by mission schools in the early missionary period. Although the role of such schools is less central now within the Korean education system, it remains important.

Although Korea has benefited from the positive contributions of Christianity, according to the National Statistics Office, its Korean Christian population shrank between 1995 and 2005 [2]. Another statistic shows that the Korean Christian population of university and high school students is sharply declining. However, the ranks of other Christian denominations, including Catholicism, are growing. Clearly, Korean Christianity is facing a changing environment, yet no study has investigated the structural features or research trends of the distinctly Korean theology that provides Korean

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Christianity with its fundamental tenets. In fact, many areas of humanities have not attracted the attention of the bibliometric community that has actively explored the domains of science and technology.

The purpose of this study was to explore a variety of co-word analyses with a Pathfinder Network algorithm in order to present a visualized intellectual structure of a humanities domain, Korean theology. In order to accomplish this purpose, we collected the index terms of the articles published in journals of Korean theology and analysed co-word relations. The co-word matrices were constructed in two ways: first-order associations and second-order associations. In addition, by using Pathfinder networks we aimed to identify the structural features of Korean theology as well as the structural features of Korean Christian churches in which Korean theology is practised.

2. Previous research

2.1. Mapping intellectual structure of research areas

In the 2008 *Annual Review of Information Science Technology*, Morris and Van der Veer Martens [3] defined research specialties as the work of a small group of scholars who study the same subject and publish the results in certain journals that explicitly refer to each other's contents. They also explained the process of tracking research specialties as it relates to the process of analysing the intellectual structure of specific research areas. The analytical approach to research specialties consists of four categories: sociological, bibliographical, communicative and cognitive. Of these, the research area that has seen the most activity is the bibliographical approach, generally called bibliometrics. The bibliometric approach has been used to analyse the intellectual structures and research trends of numerous research areas. The technique of citation analysis is most frequently used to describe particular intellectual structures and to perceive front-line research trends. In citation analysis, two major methods have proven to be most effective for the analysis of domains and have been adapted in many bibliometric studies: bibliographic coupling [4–7] and co-citation [8–11].

Domain analysis, at one time the most common approach, routinely focused on citations until Callon [12, 13] suggested the use of co-word analysis to organize text information. When applied to the analysis of intellectual structures based on index terms, this technique was found to yield more objective subject examinations than citation analysis or subject classification. According to the attributes of the targeted terms, co-word analysis can be adjusted to the requirements of diverse methods such as co-heading analysis [14], co-descriptor analysis [15] and co-title and abstract terms analysis [16]. As text processing technologies continue to develop, this technique will yield updated text mining techniques including document clustering [17–19], network analysis [20] and word profiling [21–23]. Citation analysis techniques have attracted Korean researchers. Park and Leydesdorff [24] explored the research trends of science and technology areas within Korean journals in the Science Citation Index. Seol and Park [25] discovered major sources of innovation studies using citation analysis techniques. Chung et al. [26] compared the intellectual structures of a Korean communication journal and an international journal.

Co-word analysis has been relatively less preferred by Korean informetrics researchers. Unlike this study, most of the co-word analysis studies thus far have concerned science and technology fields. Jeong et al. [27] adapted co-word analysis to identify the intellectual structure of the Korean medical informatics area and represented network-connecting words with cosine similarity values > 0.15. Lee and Jeong [28] developed co-word analysis with strategic diagrams when they analysed the Korean R&D domain within the robot technology area. Kim et al. [29] used a similar method to present the co-word network of entrepreneurship-related studies in Korea.

In order to visualize intellectual structure, White and Griffith [30] chose multidimensional scaling with a second-order correlation matrix derived from a co-citation matrix. White [31] suggested that the first-order similarity would be appropriate for a Pathfinder network when he used a Pathfinder network instead of multidimensional scaling to remap information scientists. His suggestion was in reference to the chaining effect caused by a correlation-based Pathfinder network that hindered main authors from becoming hubs of the network. In attempt to produce a correlation matrix, diagonal value seemed to be treated as a missing value in the first-order similarity matrix. White [31] mentioned that the way he and his colleagues evaluated the diagonal in the raw data matrix before correlation was based on McCain's treatment [32] of the diagonal as missing data. He also used the same data in research conducted in 2003, which means that his argument concerning diagonal value was consistently adapted to generate a correlation matrix.

On the contrary, Lee [33] retained diagonal value and was still able to generate correlation coefficients in his research. He argued that diagonal value did not cause serious problems in calculating correlation coefficients. Two other studies [34, 35] have also shown that second-order correlation coefficients perform better than first-order similarity in clustering terms; both have documented when each factor has been independently adapted.

2.2. Previous analysis on research domains

As performed through a bibliometric analysis, domain analysis is used mostly in the science and technical fields. The preferred objects for bibliometric analysis are academic journal articles or patents, because these are structuralized and developed according to the information resources within the limited locations where the subject-related terms appear.

The quantitative technique has a particularly wide range of applications for the analysis of the intellectual structures within the life science and medical science areas [7, 36–39], and the patent area [17, 19, 40]. Scientific areas including earth science [41, 42] and software engineering [43] aim to provide objective explanations of intellectual structures. In the social sciences, informatics and file maintenance [9, 21, 22, 44, 45], are the primary targets of quantitative analyses of intellectual structures. Quantitative technique is also actively utilized in economy and management [46–48]. However, in academic areas such as philosophy, theology and literature (e.g. some of the humanities), informative research publications and nonspecific technical terms preclude the objective analysis of intellectual structures on the basis of quantitative techniques. Therefore, if it is to be a general tool for the domain analysis of research subjects, quantitative technique should be applied to a wide range of academic areas and, moreover, should be used to clarify the identities of individual areas and the efficiencies of each technique.

3. Research method

3.1. Collection of index terms/keywords

Index terms used by authors were gathered from nine theological journals representing Korean theology from 2000 to 2008. Table 1 shows the number of terms and their percentages.

The profiles of the journals are as follows. *RTC, JRT, PTQ* and *JPCTS* are published by the Presbyterian theological schools that serve the largest four Presbyterian denominations in Korea, whereas *KJCS* and *TT* are published by liberal denominations. *TBT* is the journal of the evangelical theology connected with Presbyterian churches. *CHK* examines Korean Christianity from historical perspectives. *FS* reports on the research journals in which religious belief and academy coincide; its contributors and readers consist mainly of Presbyterians.

3.2. Statistical treatment

Two methods were used for statistical treatment. One deals with the analysis of whole journals and individual journals, whereas the other evaluates similarities between journals. Two methodologies were used to derive practical statistics: first-order cosine coefficient (normalized co-occurrence frequency) and second-order Pearson's correlation coefficient. The former, which uses the first-order cosine similarity among keywords, measures the correlation coefficient between keywords by normalizing their co-occurrence frequency. This treatment method is significantly influenced by the co-occurrence frequency of any two keywords. In the latter, the matrix of the first co-occurrence frequency of the keywords is entered into an SPSS program before calculating the second-order Pearson's coefficient correlation. Therefore, this method not only yields information about the co-occurrence of any two keywords but also indicates if they have similarity to other keywords. Simply put, the second-order Pearson's correlation coefficient indicates that the correlation between two keywords is proportional to the similarity between these two particular keywords and other keywords. Even though White [31] asserted that a second-order correlation based on a Pathfinder Network is not effective, Lee [33]

Table 1. Journal titles, numbers of terms, their percentages, and years

Titles	Index terms	Percentages	Years
Reformed Theology and Church (*RTC*)	117	5.2	2000–2008
Christianity and History in Korea (*CHK*)	130	5.8	2000–2008
The Bible and Theology (*TBT*)	274	12.3	2000–2008
Faith and Scholarship (*FS*)	128	5.7	2001–2008
Korean Journal of Christian Studies (*KJCS*)	521	23.4	2000–2008
Theological Thought (*TT*)	309	13.9	2000–2008
Journal of Reformed Theology (*JRT*)	117	5.2	2000–2008
Presbyterian Theological Quarterly (*PTQ*)	361	16.2	2000–2008
Journal of Presbyterian College and Theological Seminary (*JPCTS*)	274	12.3	2000–2008
Sum	2231	100	—

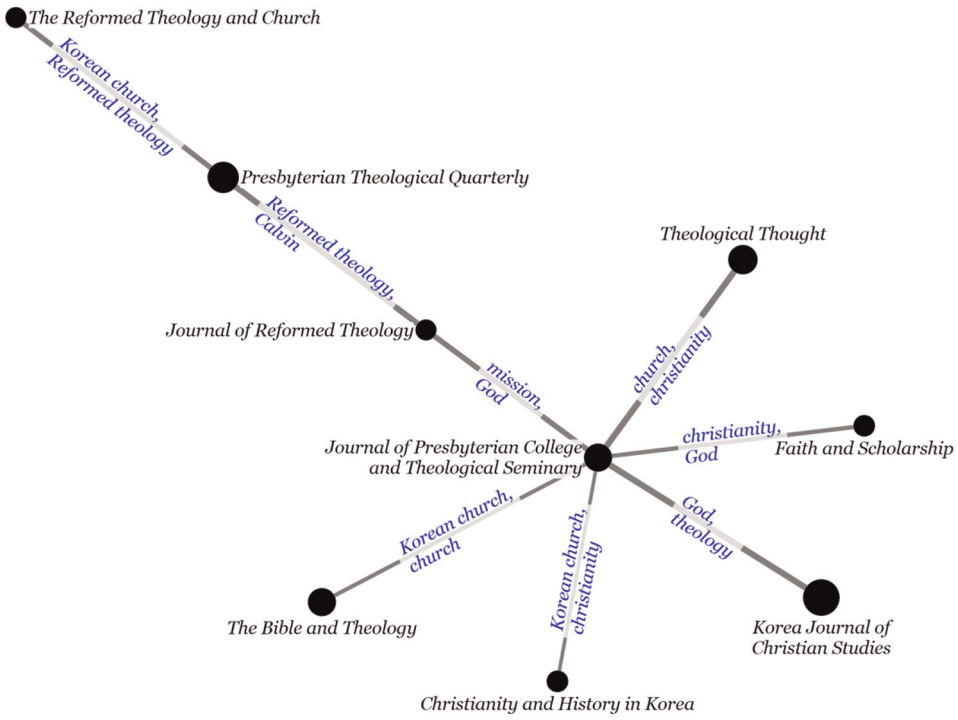

Figure 1. PFNet of nine journals.

proved that using the diagonal value as it is should not pose a problem. Based on Lee's assumption, this study created a Pathfinder Network by second-order correlation coefficients derived from a cosine matrix with diagonal values. After the details of the Pathfinder Networks generated by the two methodologies were compared, the authors chose the method that produced the more detailed Pathfinder Network structures.

In addition to the statistical treatment of journal structures based on index terms, a map of whole journals was organized. For this we used two statistical techniques: Pathfinder Network (PFNet) and multidimensional scaling. The former is the mapping of whole journals organized by similarity (here, among the nine journals). We also used a PNNC (parallel nearest neighbour clustering) algorithm [22, 49] to discover the main research themes. The mapped journals are expressed as vectors of co-occurrence frequency of keywords in order to measure the cosine similarity between vectors. Accordingly, the map was finalized using multidimensional scaling formed from the cosine similarity matrix of whole journals. For this study, we selected PROXSCAL from SPSS's multidimensional scaling programs.

4. Analysis

4.1. Journal relationships

The Pathfinder Network in Figure 1 represents the relationships among the nine journals based on their similarities. We expressed the journals as the vector of co-occurrence frequency of keywords in order to measure the cosine similarity of the vectors. The more similar the keywords shared among the journals are, the more highly correlated the journals are.

All of the journals are divided into two groups: one focused on *JPCTS* and the other based on *PTQ*. The *JPCTS* group contains common subjects such as God, Korean Church, church and Christianity. The journals in this group cover general topics in Korean theology. We also clarified that *FS* and *CHK* do not have sufficient relationships with other journals. The *PTQ* group, however, which is connected with Reformed theology, shows strong relationships among the journals.

In order to obtain more descriptive results we used multidimensional scaling (MDS). Figure 2 shows an MDS map of journals that has been formed using the cosine similarity matrix among the journals, produced with PROXSCAL from SPSS's MDS programs. In the MDS map, the axis of coordinates, which originally had no meaning, can include some meanings depending on the researcher's preference.

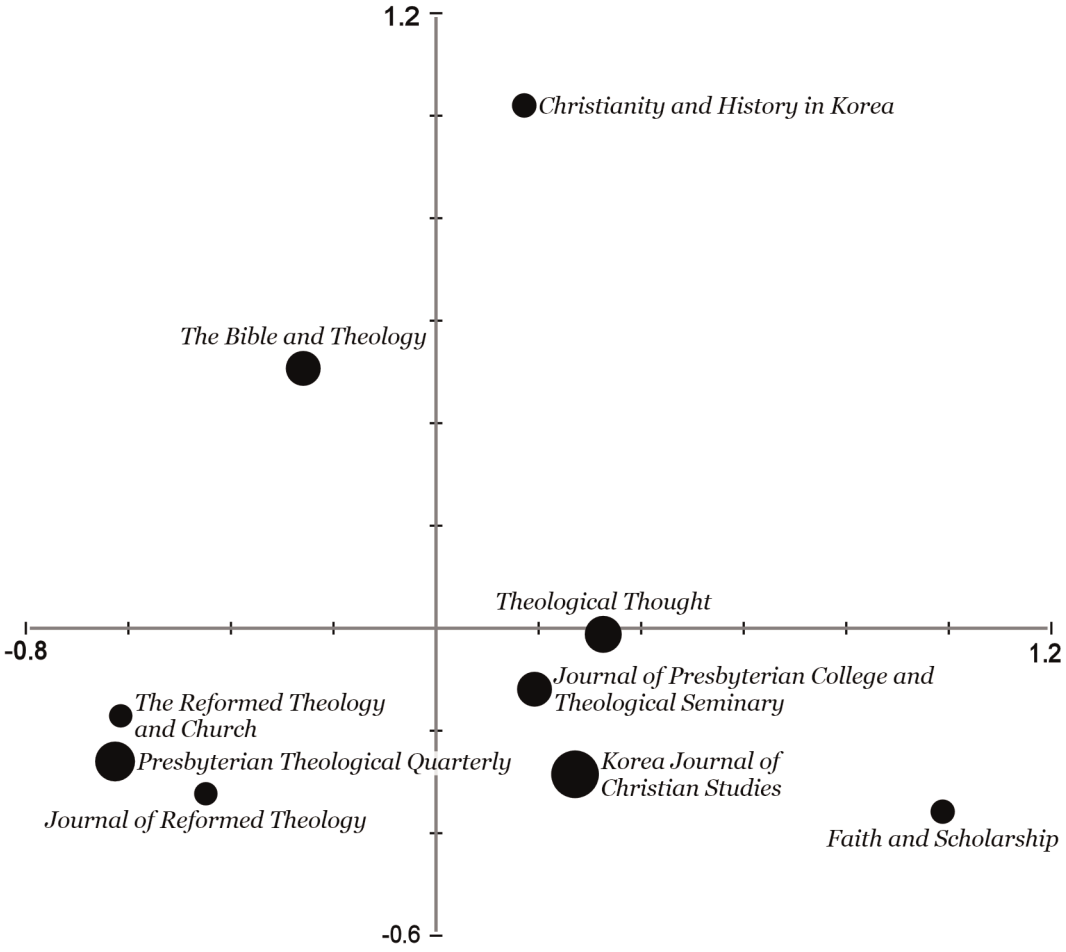

Figure 2. MDS map of the journals. The size of the spheres indicates the number of articles in the journals.

Three clusters were identified in the MDS map. One cluster, located at the lower left, presents three journals of the *PTQ* group in the PFnet of Figure 1. The three journals in this group demonstrate their strong relations in both maps. These journals were about a specific topic, Reformed theology.

While the *PTQ* group's journals in MDS are gathered together the same as in the PFNet, the journals of the *JPCTS* group are scattered on the MDS map. In particular, *TBT* and *CHK* in the upper area are separated from the general group (*JPCTS*). The main theme of the third cluster is evangelicalism.

JPCTS, the hub of the PFnet, also appears at the centre of MDS; accordingly it proved to cover general topics in Korean theology. Unlike its title, however, *JPCTS* seems to have lost its the identity as a vehicle of Presbyterian theology. Except for *TBT* and *CHK*, all of the journals in the *JPCTS* group in the PFnet are gathered at the lower right. *TBT* and *CHK* specialize in evangelicalism, missionary and historical events. Although they are connected to the hub of the *JPCTS* group in the PFnet, it did not show the relationship between these two peripheral journals. MDS seemed to discover weak relationships between peripheral nodes that the PFnet ignored.

We found three major clusters of Korean theology with the PFnet and MDS. To examine the intellectual structure of Korean theology in depth, we generated a PFnet of keywords from articles published in nine journals. In addition, we identified a core journal of each cluster; the intellectual structures of the core journals are presented in Section 4.3.

4.2. The intellectual structure of Korean theology

The research topics of nine Korean theology journals and their relations are presented in a PFNet using first-order cosine coefficients (Figure 3). The titles of the nine clusters in Figure 3 represent the essential keywords in each cluster. The titles of clusters are arranged in order of size, as follows:

Figure 3. Pathfinder Network of Korean theology using first-order cosine coefficients.

- structure with evangelicalism and Reformed theology as its centre;
- New Testament, the Pyongyang Great Revival, experience; structure with the three keywords as its centre roots;
- tree structure with God as its roots;
- the Holy Spirit and Kingdom of God;
- tree structure with Christ as its roots and the Bible and Jesus as its branches;
- tree structure with Old Testament as its roots;
- tree structure with Calvin and related terms as its roots;
- structure with pastoral counselling as its centre;
- structure with ecclesiology as its centre.

The PFnet in Figure 3 was derived from the first-order associations. As we examined the structure of Figure 3 in detail, we found several problems. Some subject keywords are connected to unrelated clusters and mislocated. For example, the term 'Korean Church' shows up in an unrelated cluster (cluster 4, 'The Holy Spirit and Kingdom of God') that is connected to distantly related keywords such as 'theological education'. To compensate for this problem, we constructed a second PFnet using second-order Pearson's correlation coefficients.

The titles of the 10 clusters in Figure 4 represented the essential keywords in each cluster. The titles of clusters are arranged in order of size, as follows:

- structure with Korean Church, the most frequent keyword of whole journals, as its centre;
- structure with evangelicalism and Reformed theology as its centre;
- structure with Christ, and Church and Bible as the most frequent keywords, as its centre;
- tree structure Holy Spirit as its roots;
- structure with Old Testament as its centre;
- tree structure with God as its roots;
- tree structure with death as its roots and Jesus and embryonic stem cells as its key concepts;
- tree structure with Calvin as its roots;
- structure with pastoral counselling as its centre;
- structure with ecclesiology as its centre.

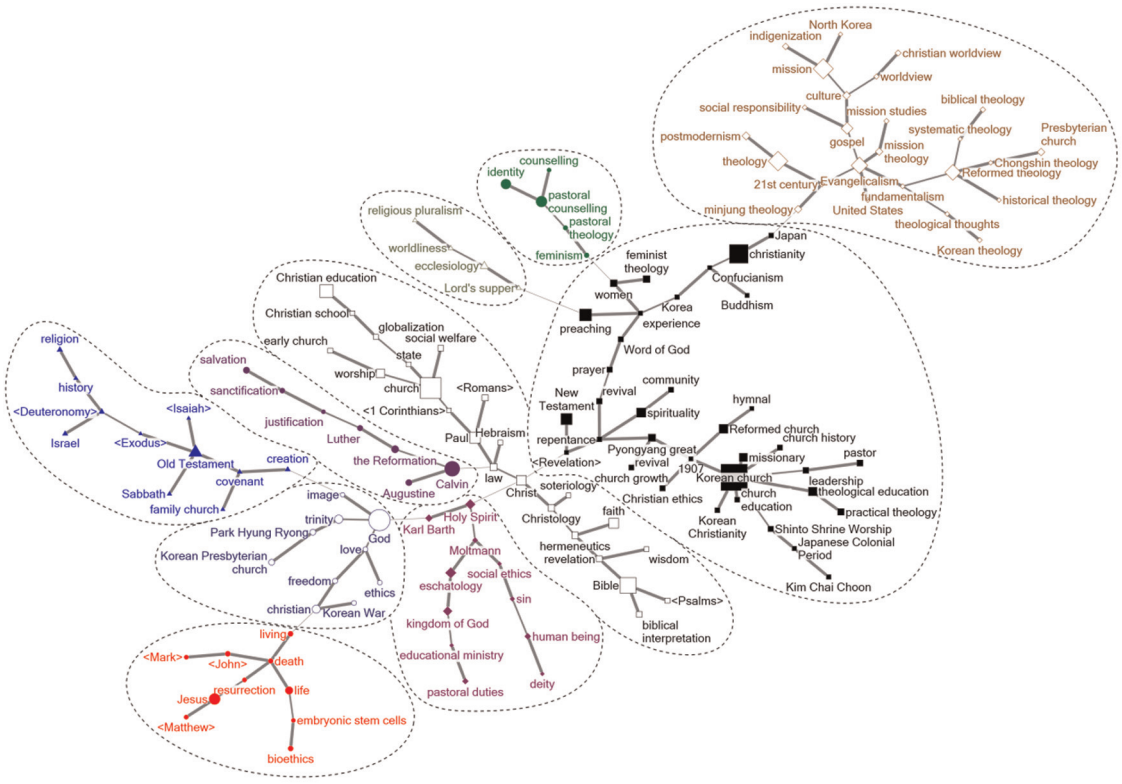

Figure 4. Pathfinder network of Korean theology using second-order Pearson's correlation coefficients with cluster separation.

In the second PFnet (Figure 4), the mislocation problem of Figure 3 has been adjusted. For example, 'Korean Church' appears as a hub of a cluster with relevant keywords such as 'Korean Christianity' and 'Pyongyang Great Revival', whereas in the first map, 'Korea Church' belongs to a relatively small, peripheral cluster (top and edge). In the comparison of overall structure between the two figures (Figures 3 and 4), cluster 7 of Figure 4 appears as a new cluster. 'Jesus', originally in cluster 5 of the first map, has moved to cluster 7 in the second map.

'Christ', cluster 3 in Figure 4, is worthy of note because 'Christ' is the essential subject of both the 'Bible' and 'Christian theology' clusters. Accordingly, in the second map 'Christ' appears at the centre, connecting cluster 1 ('Korean Church'), cluster 4 ('Holy Spirit') and cluster 8 ('Calvin'). Generally, the bridge terms of neighbouring clusters are not very close. The semantic relations between clusters seem to be divided into two categories: 'semantically related' and 'accidentally co-occurred'. When two terms occur in the same context, they are 'semantically related'. On the contrary, when two terms appear in the same paper without semantic relations, they have 'accidently co-occurred'.

In the first map, the 'semantically related' cases are 'resurrection' (cluster 3) and 'Jesus' (cluster 5); 'law' (cluster 5) and 'Calvin' (cluster 7); 'women' (cluster 7) and 'feminism' (cluster 8); and 'Christ' (cluster 5) and 'Holy Spirit' (cluster 4). The 'accidentally co-occured' cases are 'state' (cluster 1) and 'Lord's Supper' (cluster 9); 'Christianity' (cluster 1) and 'Confucianism' (cluster 2); and 'church education' (cluster 4) and 'image' (cluster 3). In the second map, except for 'Japan' (cluster 1) and 'Minjung theology' (cluster 2), all of the bridge keywords are closely related to each other. The second map performed better than the first map in terms of the semantic relations of bridge terms in PFnet.

4.3. The intellectual structures of individual journals

We selected a core journal from 'Reformed theology', 'general theology', and 'evangelicalism and mission'. The subjects of these journals are *PTQ* (Reformed theology), *JPCTS* (general theology), and *TBT* (evangelicalism). They were chosen based on their position and size in the PFnet (Figure 1) and the MDS map (Figure 2).

The PFnet structures of individual journals are identical to the structure of Korean Theology (Figure 4), but the node sizes have been modified according to keywords frequency in each journal. The cluster titles of individual maps are same as in Figure 4.

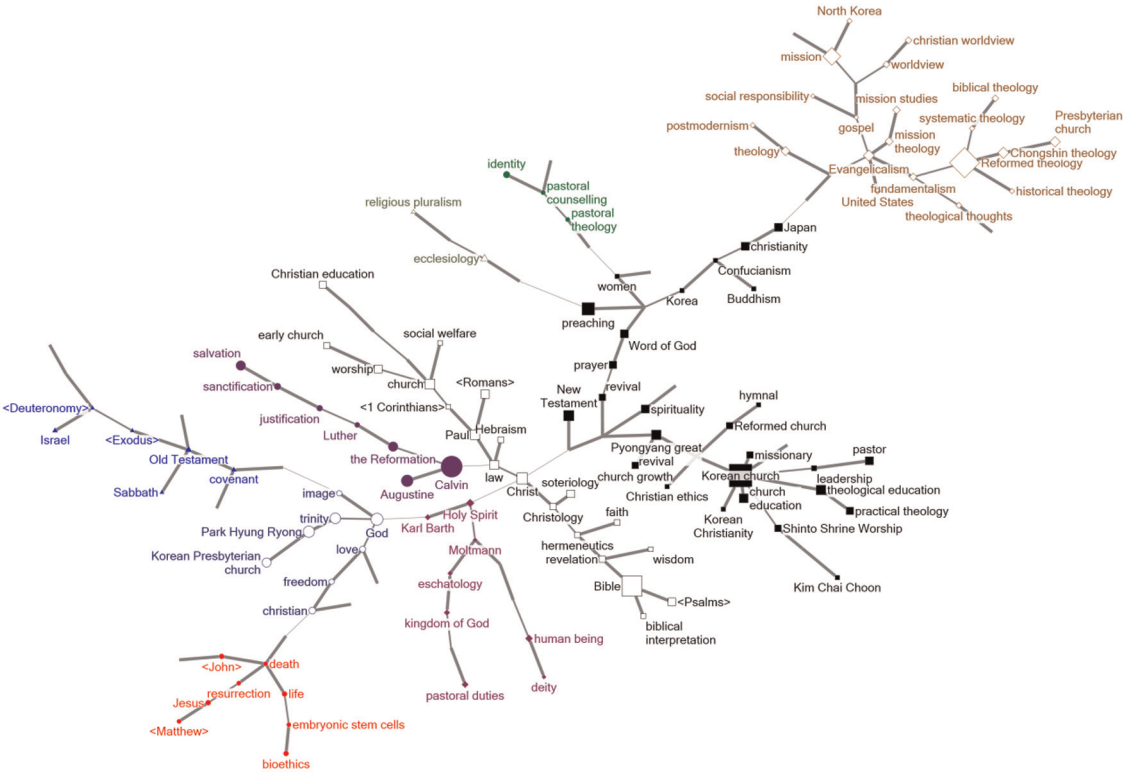

Figure 5. Presbyterian Theological Quarterly.

4.3.1. Presbyterian Theological Quarterly. The keyword that most frequently appears in *PTQ* is 'Reformed theology', because the journal focuses upon research about Reformed theology. Other notable keywords in *PTQ* (Figure 5) include 'mission', 'Korean Church', 'Calvin', 'Augustine', 'Bible', 'God', 'trinity', 'Park Hyung Ryong', and 'Pyongyang Great Revival'. *PTQ* is the only journal that has extensively dealt with Calvin and Augstine, the most important figures in the history of Reformed theology.

Although the Pyongyang Great Revival appears primarily in graphic representations of the subject clusters of whole journals, when connected with the ideas of church revival movement or church growth, this subject is likely to lose its identity within Reformed theology. In addition, research on the Old Testament is insufficient compared with the other Reformed theology journals (*RTC* and *JRT*).

4.3.2. Journal of Presbyterian College and Theological Seminary. Although this is a journal of the Presbyterian Church, it is based explicitly on neither Reformed theology nor evangelicalism. Consequently, we regarded it as the representative journal for general topics of Korean theology. The main theme of this journal is 'Korean Church', which appears most frequently (Figure 6). 'Church', 'Moltmann', 'Kingdom of God' and 'Christianity' are popular keywords in this journal. These terms are strongly distinguished from the keywords presented in the map of *PTQ* (Figure 5). Based largely on two subjects, mission and spirituality, this journal explores research on mission similarly to *PTQ* and research on spirituality more actively than the other three Presbyterian journals. These two subjects are most frequently mentioned but no particular correlation appears between them.

The striking index term in this journal is 'Moltmann', the German Reformed theologian who originated liberation theology (which is not a tenet within Korean Presbyterian theology). More studies in this journal have included the index term 'church' than in the other Presbyterian journals in cluster 1 (Reformed Theology).

4.3.3. The Bible and Theology. The representative cluster in this journal is the second ('evangelicalism') because evangelicalism appears as the largest node in this map. The neighbouring nodes of evangelicalism are also larger than the nodes of other clusters. The 'eschatology' cluster and 'embryonic stem cells' cluster are also notable. *TBT* includes

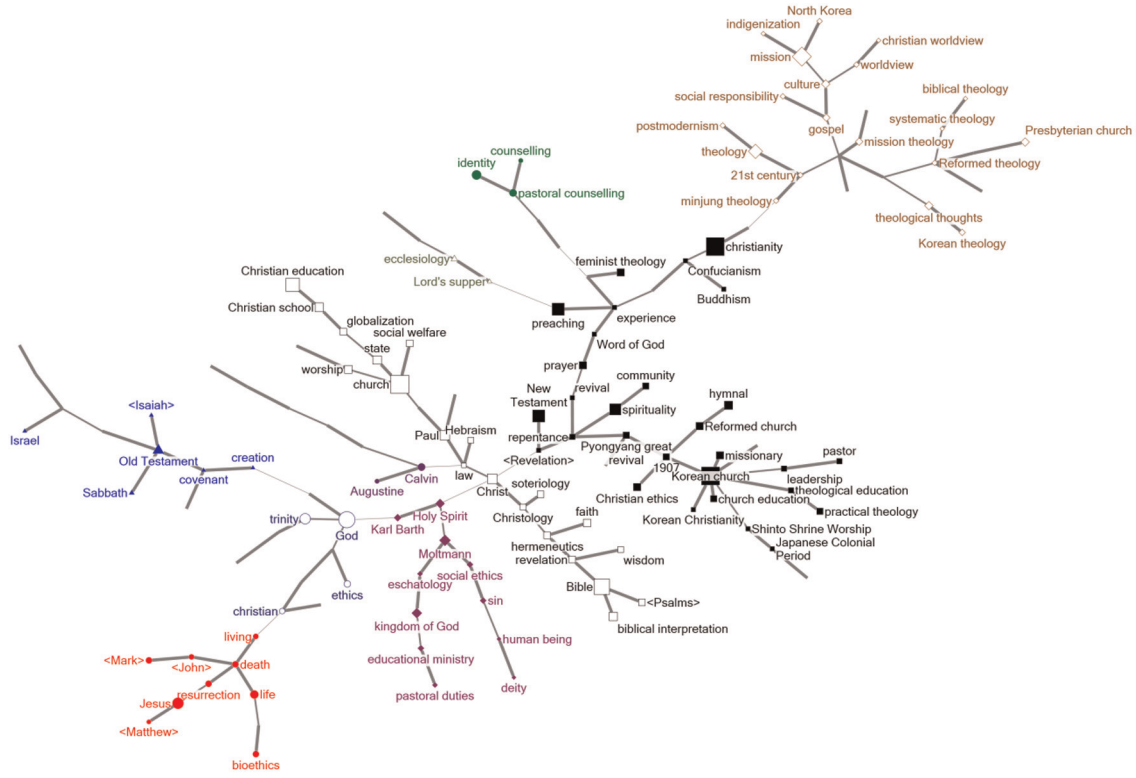

Figure 6. Journal of Presbyterian College and Theological Seminary.

evangelicalism as the primary index term, but also contains a wide range of keywords including gospel, eschatology, pastoral duties, pastoral counselling, theological education, Christian education, church, embryonic stem cells and bioethics (Figure 7). Even though many of these terms are theological terms, some of them do not belong to theological studies (e.g. embryonic stem cells and bioethics). Because this journal investigates life sciences from an evangelical viewpoint, these two subjects emerge as its most distinct fields. The topic areas of *TBT* seem to be diverse, which explains why it departed from the general theology cluster in the MDS map (Figure 2).

5. Conclusion

In examining the intellectual structure of Korean theology, we generated a Pathfinder Network with co-word analysis, using first-order cosine similarity and second-order correlation coefficients. This study suggests that the Pathfinder Network composed of second-order associations effectively presents the structure of this research domain. Compared with the PFnet that comprises first-order cosine similarities, the PFnet comprising second-order correlation coefficients has several advantages. First, the structure of key terms such as 'Christ' is clearly represented. Second, it clearly visualizes relationships between bridge terms that connect clusters logically and in general places terms in a semantically proper position. Therefore, in terms of both the generated global structure of a Pathfinder Network and local details, it is more reasonable to apply second-order correlation coefficients.

The outcomes of this study demonstrate that the major streams of Korean theology are classified as three clusters: Reformed theology, general theology and evangelicalism. The key areas of research include Korean Church, Old Testament, New Testament, the Bible, God, the Holy Spirit, Christ, Jesus, church, mission, John Calvin and preaching. Reformed theology is the theological base of the three Presbyterian journals (*Reformed Theology and Church, Journal of Reformed Theology* and *Presbyterian Theological Quarterly*). General theology has more common topics that are neither explicitly Reformed theology nor evangelicalism. *Journal of Presbyterian College and Theological Seminary* is the representative journal of this group, even though it is published by the Presbyterian Church. The journals of the third cluster are related to evangelicalism; however, these journals cover a wide variety of topics including nontheological

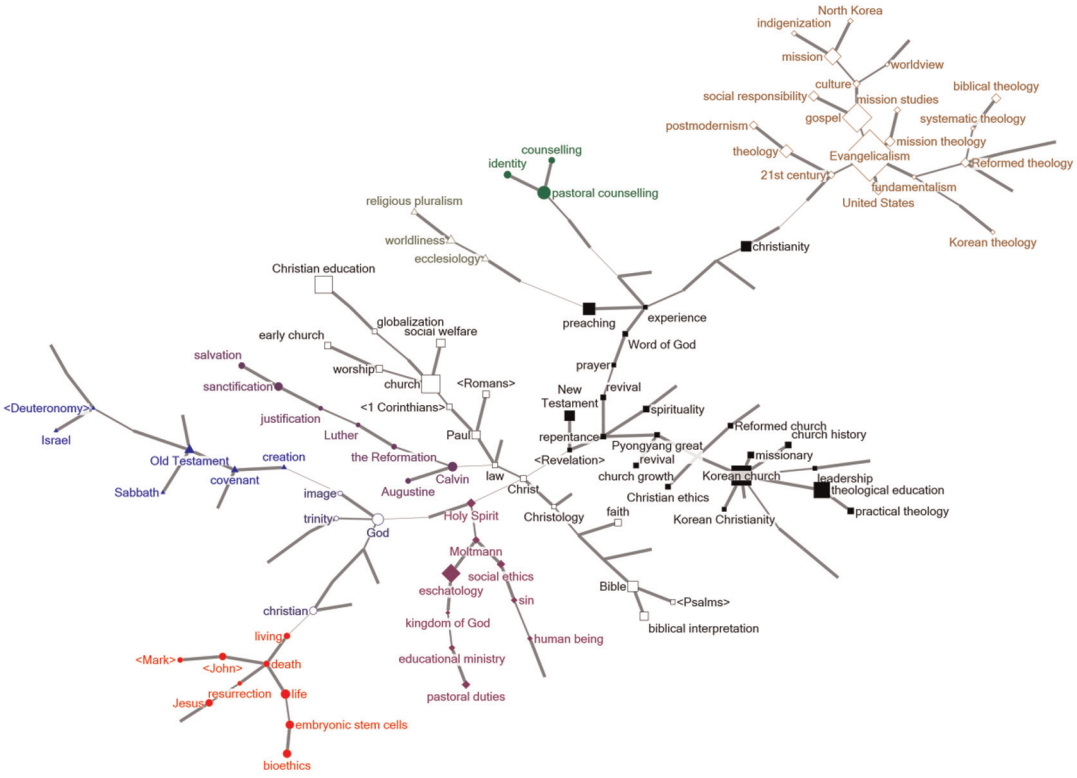

Figure 7. The Bible and Theology.

ones such as embryonic stem cells and bioethics. The map of MDS successfully presents this characteristic of the third cluster.

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