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The network science approach in determining the intellectual structure, emerging trends and future research opportunities – An application to senior tourism research

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ABSTRACT

This study applies bibliometric analysis to senior tourism research from 1998 to 2017, identifies its intellectual structure, emerging trends, and future research opportunities. Data collected from the Web-of-Science and Scopus is used to build an expanded network encompassing 700 core articles and 7221 citations. The results reveal a slowly increasing growth of research, with the last period including 41% of outputs. The most cited papers are mainly older, represent 1.99% of the sample and account for 8.52% of citations. The network of journals and institutions show the highest ranking to be in *Tourism Management* and in the *University of Queensland*. The identification of structural holes, critical articles and the keyword analysis highlights priorities in senior tourism, pointing to new opportunities for research. The dynamic analysis of the last two decades using CiteSpace for co-citation and co-occurrence network analysis aims to equip researchers and the hospitality industry with new exploration tools.

1. Introduction

It is imperative that scholars monitor developing literature in order to glean new insights in varied topic areas, thereby adding to the body of existing knowledge (Chen, 2006). Bibliometrics is critical for conducting periodic reviews of existing research fields, identifying contributions to knowledge, and constructing substantiated arguments about the development of a field (Denyer & Tranfield, 2006). The bibliometric study involves the statistical analysis of scientific publications, which adopts quantitative performance indicators to surmount the disadvantage of subjectivity in peer review and expert judgments (Van Raan, 2004).

Bibliometrics has become a critical tool for tourism studies by assessing research or scientific production in a specific area over time. The increasing number and complexity of research papers has created a need for visualization tools that can produce maps, graphs, and diagrams to illuminate patterns, trends, and processes. Knowledge domain visualization is defined as processes, methods and tools for analyzing knowledge areas to discover features or meanings and to visualize them in a comprehensive and transparent format (Speel, Shadbolt, De Vries, Van Dam, & O'hara, 1999). It is one of the most important steps in management and can present concepts, knowledge and links in visual format. Despite its usefulness, the number of bibliometric studies using network visualization is small and only covers short time periods (Evren & Kozak, 2014). This method is under-utilised in tourism research and has the potential, if developed, to explore the structure of tourism networks in many different contexts (Scott, Baggio, & Cooper, 2008); thus, its application in our research.

The most popular bibliometric visualization tool CiteSpace (Chen, Ibekwe-SanJuan, & Hou, 2010), used in the current study, allows the researcher to take time series snapshots of the knowledge domain and merge these into a visual map. Individual nodes can be aggregated into different thematic concentrations or clusters, based on their interconnectivity and displayed using a network map to gain insights into the central ones in a field and the connections between them. Moreover, different types of bibliometric networks can be constructed with CiteSpace, and therefore were used in the current study: (i) co-citation networks of authors, documents and journals; (ii) co-occurring author

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keywords and keywords plus; (iii) co-authorship networks of authors; (iv) co-authors' institutions, and (v) co-authors' country.

Although several studies have been conducted through CiteSpace in the areas of medicine (e.g. Pestana & Sobral, 2019), and hospitality (e.g. Li, Ma, & Qu, 2017), to the best of our knowledge this tool has only recently been used in tourism in the areas of sustainable tourism (Fang, Yin, & Wu, 2018), and tourism crisis (Jiang, Brent, Ritchie, & Benckendorff, 2017). Therefore, the authors see an opportunity to apply bibliometric analysis through CiteSpace in senior tourism research.

As elderly populations grow, this changing demographic is increasingly afflicted by adverse economic and social conditions. Travelling in particular is one of many methods countering these effects and may have a positive impact on quality of life for elderly populations (Alén, Losada, & de Carlos, 2017). As their numbers grow, seniors will be an important segment for the tourism industry in the coming decades (Alén et al., 2017). Although the disciplines of healthcare, gerontology, social welfare, and economics have long shown a scholarly interest in senior research, leisure and tourism academics have lagged behind in identifying the importance of the senior travel niche (Otoo & Kim, 2018). In fact, there has been little interest from the scientific community in the study of senior tourism, demonstrated by a small increasing trend in publications (Fig. 1). Also, senior travel reviews in the past have been dominated by cross-sectional designs which result in temporal gaps (Huber, Milne, & Hyde, 2017). Therefore, the aim of our study is to show the value of a bibliometric visualization by using CiteSpace in the field of senior tourism research from 1998 until 2017. We employ the co-citation network analysis and co-occurrence network analysis to visualize and detect the intellectual structure as well as the emerging trends in senior tourism research in the period, and future research opportunities.

The study claims originality on several grounds: (1) by focusing on the last twenty years, our dataset identifies several generations of seniors; (2) use of citation index-based expansion allows a robust construction of our dataset (Chen et al., 2010); (3) the two most comprehensive literature databases, Web-of-Science (WoS) and Scopus (Guz & Rushchitsky, 2009), are used to create our dataset, providing more representative results relating to the senior tourism field; and (4) using metrics computed by CiteSpace to visualize the merged network and to identify the dynamics of its development, we provide a better pattern and understanding of this field for subsequent scholars to repeat our efforts using other data. The rest of the paper is organized as follows: Section 2 presents the methodology. Section 3 shows the analytical results and discussion. Finally, Section 4 concludes with a summary of the work, its usefulness and limitations. The methodology and findings have implications for understanding the production of knowledge of senior tourism and will be of interest to tourism researchers.

2. Methodology

2.1. Data collection

WoS and Scopus databases generated global scientific outputs and were then analyzed by CiteSpace (http://cluster.cis.drexel.edu/~cchen/citespace/). The analysis reviews published work from 1998 to 2017 in keeping with the timeframe of other studies where a similar time horizon has been adopted (e.g. Ye, Li, & Law, 2013). It was also necessary to divide the study period into intervals to better analyze changes in the development network. Four-time periods were identified: first slice 1998–2002; second slice 2003–2007; third slice 2008–2012; fourth slice 2013–2017.

Aside from interest in the senior travel segment within tourism scholarship begun in the 1980s (Sie, Patterson, & Pegg, 2016), until the 1990s, documents collected from Web-of-Science (WoS) and Scopus are discontinued and almost non-existent.

The empirical study was carried out at the beginning of May 2018. The following keywords and Boolean operators were searched in WoS and Scopus, considered the most widespread databases in different scientific fields used for searching literature (Guz & Rushchitsky, 2009): *"senior tourists" OR "senior travel"* OR *"mature tourists" OR "elderly tourist"* OR *"older tourists" OR "elderly travel" OR "elderly tourists" OR "grey tourists" OR "silver tourists"*.

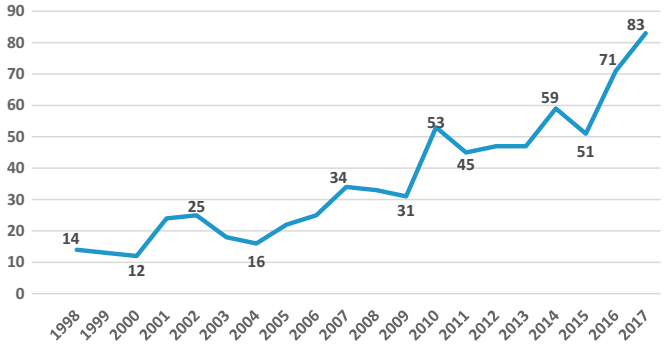

Fig. 1. Year-wise publication from Web-of-Science and Scopus.

The gross sample includes 1524 articles from WoS and 1944 articles from Scopus. The articles analyzed represent 68.93% of the documents in WoS, and 76.99% of those in Scopus All articles were analyzed to verify their relationship with the "senior tourism" research stream. This analysis led to the identification of outliers among the articles (72.24% from WoS and 67.13% from Scopus). These outliers were not relevant in the senior tourism literature, either because they analyzed old people not in tourism, or tourism per se (i.e. not specifically for seniors). Additionally, papers not cited by other studies and thus disconnected with others were eliminated on the assumption that they were not relevant to the topic. This elimination corresponded to 9.91% of papers from WoS and 4.68% from Scopus. After removing the outliers and disconnected articles, the dataset was reduced to 272 articles from WoS and 548 articles from Scopus. For further analysis with CiteSpace, a total of 512 articles from Scopus were converted to the WoS format (Chen, 2006). The conversion rate of references in the source articles from Scopus was very good at 89% after removing data irregularities, and this percentage is close to 95% which is described by Chen and Shoemaker (2014) as excellent. Duplicated articles were eliminated resulting in the net sample of 700 connected articles (Table 1).

The number of published articles on senior tourism for each of the years 1998 to 2017 are shown in the curve presented as Fig. 1, from which we observe an increasing trend in the progress of scientific literature in this field of research. Nevertheless, the relative growth rate is just 0.21 per year, and the number of research publications only doubles after 4.40 years, thus indicating slow growth in the amount of research work being undertaken on senior tourism.

2.2. Data analysis

CiteSpace includes structural, temporal and semantic metrics. Structural metrics include *betweenness centrality, modularity, and silhouette*: *betweenness centrality* indicates the important position of a node in bridging different stages of the development of a scientific field (Chen, Dubin, & Kim, 2014); m*odularity* is the extent to which a network can be divided into independent clusters with clear boundaries; *silhouette* gives the quality of a clustering configuration.

Temporal metrics include *citation burst* and *sigma*: *citation burst* is a specific duration in which the frequency of an entity increases abruptly with reference to its peers. It represents a statistically significant change in the number of citations about a specific phenomenon over a short time span within the overall time interval (Chen, 2006), irrespective of the frequency of the host entity; *sigma* is a combination of betweenness centrality and citation burst. It highlights those articles that herald new ideas (Chen, 2006).

Semantic metrics define cluster labels from phrases extracted from

Table 1
Sample size.

			Gross sample							
Subnetwork	Documents		Articles		Outliers		Disconnected	Connected		
Years	N	%	N	%	N	%	N	%	N	%
Web-of-Science										
1998–2002	111	5.0	84	75.68	54	64.29	8	9.52	22	26.19
2003–2007	187	8.5	118	63.10	79	66.95	10	8.47	29	24.58
2008–2012	580	26.2	384	66.21	240	62.50	50	13.02	94	24.48
2013–2017	1333	60.3	938	70.37	728	77.61	83	8.85	127	13.54
Total	2211	100	1524	68.93	1101	72.24	151	9.91	272	17.85
Scopus										
1998–2002	236	9.35	156	66.10	79	50.64	4	2.56	73	46.79
2003–2007	404	16.00	377	93.32	274	72.68	7	1.86	96	25.46
2008–2012	763	30.22	563	73.79	388	68.92	19	3.37	156	27.71
2013–2017	1122	44.44	848	75.58	564	66.51	61	7.19	223	26.30
Total	2525	100	1944	76.99	1305	67.13	91	4.68	548	28.19
	Scopus Converted to WoS	Scopus and WoS Connected	Web-of-Science and Scopus Duplications		Net sample of connected articles					
	N	%	N	%	N	N	% per articles	% per year		
1998–2002	73	46.79	95	39.58	7	88	36.67	12.57		
2003–2007	96	25.46	125	25.25	7	118	23.84	16.86		
2008–2012	145	25.75	239	25.24	32	207	21.86	29.57		
2013–2017	198	23.35	325	18.20	38	287	16.07	41.00		
Total	512	26.34	784	22.61	84	700	20.18	100		

Source: The authors from WoS and Scopus databases.

titles, abstracts, and keywords or from index terms of citing articles, through several algorithms, like the log-likelihood ratio (LLR) this one usually giving the best result in terms of uniqueness and coverage (Chen, 2006).

Monitoring research trends has always been a major concern of policy makers of science and technology, since it helps research resource allocation and technological forecasting. In such a situation, an attractive direction is to investigate the evolution footprints of an emerging research domain and detect hot topics (research fronts) in some important technological domains (e.g., Tseng, Lin, Lee, Hung, & Lee, 2009). Research fronts represent the most dynamic areas that attract the most scientific interest. Various types of techniques have been advocated for the purpose of delineating research areas including document co-citation (Evren & Kozak, 2014), author co-citation and co-word analysis (Jiang et al., 2017). In the current study, the following analysis was used: co-citation analysis of cited references, cited journals and cited authors; co-authorship analysis of countries, institutions and authors; and co-occurrence analysis of keywords. Co-citation is one of the most frequently-used bibliometric techniques (Evren & Kozak, 2014) for dealing with a diverse and growing academic literature (Denyer & Tranfield, 2006). Co-citation describes the intellectual development of the overall domain and detects existing scientific schools and academic networks (de Solla Price, 1965).

In the current study, the authors analyze citing articles without self-citation, an option included in the WoS citation report. Prior research suggests that each additional self-citation increases the number of citations from others by about one, after one year, and by about three after five years (Fowler & Aksnes, 2007). The question of whether self-citation is manipulative and gives undue credit to the cited has yet to be fully understood (Zhou, Amadi, & Zhang, 2018).

Co-authorship analysis identifies the underlying patterns of collaboration between researchers working in the filed (Jiang et al., 2017). Authors and countries are connected to each other when they share authorship of an article included in the sample of source articles. Co-occurrence analysis is based on the theory that research fields can be analyzed based on patterns of keyword usage in publications, which has been largely and successfully used for dynamic evolution of science. It is a content analysis technique that is effective in mapping the strength of association between keywords in textual data (Jiang et al., 2017). CiteSpace includes co-occurring *author keywords* and *keywords plus* to evaluate the trend of senior tourism research. *Keyword plus* are generated independently of the title and author keywords, describing the article contents with greater depth and variety (Wang, Wang, Zhang, Cai, & Sun, 2013). In recent years, the distribution change of keywords in different periods was applied to evaluate research trends (e.g. Wang et al., 2013). Hence, we follow this practice in our study.

Table 2 includes CiteSpace metrics for a dynamic analysis of the network of senior tourism research, which is discussed in the corresponding sections.

In order to generate all the seven individual networks included in Table 2, which explain the selection of Journals, Institutions, Countries, Keyword, among others, identified in the column *Node Type,* different CiteSpace threshold settings were selected: (1) For text processing: *Term Source; Title, Abstract; Author Keywords (DE)* and *Keywords PLus (ID);* (2) for links: *Cosine* for strength and *within slices* for scope; (3) For selection criteria: *g-index*, $k = 5$, the *thresholds (c, cc, ccv = 2, 1, 8),* where c = minimum number for citations, cc = minimum number of co-citations, ccv = minimum number of co-citations coefficients; (3) For visualization: *cluster view-static*, to obtain the merged network by year, while *cluster view-animated* and *Show Network by Time Slices*, to obtain each four fifth-time periods networks; (4) For period selection: *time slicing from* 1998 *to* 2017, *# slices per year*: 1, to obtain the network by year, and *# slices per year* = 5, to obtain the four fifth-slices period; (5) For criteria selection: *Node Type = Journal*, to obtain *Journal Co-Citation Network*; *Node Type = Cited Author*, to obtain the *Author Co-Citation Network*; *Node Type = Keywords*, to obtain *Co-Occurring Author Keywords* and *Keywords Plus*, among other *Nodes Type*, defined in Table 2. All documents that were outside the threshold selection criteria were excluded from analysis. The selection criteria explain the documents included in our gross sample discussed above. Moreover, the CiteSpace results of the net sample were further subjected to a manual 'clean up' process that allows the identification of duplicate names for tourism journals and for authors. For example, some duplicate labels for the same journal are: "Cornell Hospitality Quartely is the same as Cornell Hosp Q; Ann Tourism Res is the same as Annals of Tourism Research; J.Travel Tour Mark = Journal of Travel & Tourism Marketing; J Vacat

Table 2
CiteSpace metrics by node type.

Network	Node Type by year	Modularity	Nodes	Links	Density	# Clusters	Mean Silhouette
Journal co-citation network	**Journals**						
	1998–2002	0.4929	51	153	0.1200	7	0.7143
	2003–2007	0.6272	64	192	0.0952	7	0.8571
	2008–2012	0.6922	120	360	0.0504	12	0.6667
	2013–2017	0.7015	210	630	0.0287	21	0.4286
Network of co-authors' Institutions	**Institutions**						
	1998–2002	0.7500	13	2	0.00256	11	0.1818
	2003–2007	0.6667	14	3	0.03300	11	0.1818
	2008–2012	0.8400	23	5	0.01980	13	0.3077
	2013–2017	0.7491	35	17	0.00286	16	0.3750
Network of co-authors' country	**Countries**						
	1998–2002	0.5283	29	30	0.0739	13	0.3077
	2003–2007	0.4300	36	94	0.1492	7	0.4286
	2008–2012	0.4692	56	127	0.0825	9	0.5556
	2013–2017	0.4151	86	237	0.0648	14	0.6429
Document co-citation network	**Documents**						
	1998–2002	0.3445	18	36	0.235	7	0.4273
	2003–2007	0.5799	19	26	0.152	7	0.5703
	2008–2012	0.5002	27	46	0.131	8	0.4994
	2013–2017	0.4313	42	126	0.146	7	0.7131
Author co-citation network	**Cited author**						
	1998–2002	0.4392	186	814	0.0473	30	0.2286
	2003–2007	0.4012	41	123	0.1500	8	0.6250
	2008–2012	0.4886	80	240	0.0759	15	0.4000
	2013–2017	0.4913	139	417	0.0435	38	0.3421
Co-authorship Network	**Author**						
	1998–2002	0.875	13	4	0.0513	8	0.500
	2003–2007	0.720	11	5	0.0909	5	0.600
	2008–2012	0.500	13	1	0.0128	7	0.143
	2013–2017	0.833	22	3	0.0130	4	0.750
Co-occurring author keywords and keywords Plus	**Keyword**						
	1998–2002	0.6397	26	40	0.1231	7	0.571
	2003–2007	0.5266	41	123	0.1500	4	1.000
	2008–2012	0.4714	68	68	0.0896	15	0.467
	2013–2017	0.5106	115	115	0.0526	7	1.000

Source: The authors.

Mark = Journal of Vacation Marketing; International Journal of Tourism Research = Int J Tour Res. Some journals are wrongly labelled, like a spelling error occurred in Jurnal of Hospitaly Management, which should be Journal of Hospitality Management. With author's name, it can occur that the same name corresponds to different researchers from different fields of analysis, or that the same author has two or more different names. In order to minimize the error of incorrect classifications, all the co-authors have helped in this cleaning process.

3. Results and discussion

3.1. Network of journals

The network of journals, shown in Table 2, has good modularity over time, which indicates that the journals tend to have more connections inside the group within which they are located, exhibiting a good degree of collaboration. This network is centralized around the top journals, as can be seen by the great variation among the number of links each node possesses. Nevertheless, the density is decreasing with time while the number of clusters is increasing (from 7 to 21), suggesting the connection among the top journals has become more decentralized with the passage of time as more new journals become involved in senior tourism research.

The top 10 journals account for 48.71% of total publications (TP) and 47.47% of total citations (TC). *Tourism Management* accounts for most of the senior tourism research with 91 articles; while *Journal of Travel and Tourism Marketing* and *Tourism Review* stand out among the other sources with the highest ratio of citations per publication (Table 3).

A citation burst can be used to detect the most active journals of research. A citation burst provides evidence that a particular type of node is associated with a surge in citations, which means the node has attracted an extraordinary degree of attention from the scientific community (Chen et al., 2014). Table 4 shows the top 10 journals with the strongest citation bursts in the data set. The first two that were detected are the *International Journal of Tourism Review*, with the highest citation burst from 2011 until 2017, followed by *Tourism Management*, with a citation burst from 2008 until 2012. *Current Issues in Tourism* is the journal with the highest length of citation bursts (2010–2017).

3.2. Collaboration among institutions

The network of Institutions, shown in Table 2, has good modularity, including between 11 and 16 clusters with clear boundaries. The great number of organizations over time has led to a decentralized structure with a loose network (Barabasi, 2002). In fact, the low density suggests the network does not have central Institutions around which all the others are arranged (Freeman, 1979). There are many isolated Institutions, as can be seen by the little variation among the number of links each node possesses, increasing from two links in the first slice to 17 links in the last slice. The connections among Institutions become unclear and decentralized with the passage of time as more organizations become involved.

Some of the most productive institutions in senior tourism research include the University of Queensland in Australia with the highest publications and citations in this field of research, followed by Hong

Table 3
Top journals in senior tourism research.

SOURCE TITLE	Total Publications			Total Citations			Scopus	WoS	Total
	Scopus	WoS	TP	Scopus	WoS	TC	TC/TP	TC/TP	TC/TP
Tourism Management	40	**51**	91	388	**531**	919	9.70	10.41	10.10
Annals of Tourism Research	23	**30**	53	203	**243**	446	8.83	8.10	8.42
Journal of Travel Research	**22**	13	35	164	**189**	353	7.45	14.54	10.09
Asia Pacific Journal of Tourism Research	**21**	10	31	144	**146**	290	6.86	14.60	9.35
Current Issues in Tourism	**21**	10	31	142	**184**	326	6.76	18.40	10.52
International Journal of Contemporary Hospitality Management	**16**	5	21	92	**111**	203	5.75	22.20	9.67
Journal of Travel and Tourism Marketing	**14**	10	24	**180**	173	353	12.86	17.30	**14.71**
Tourism Analysis	**13**	4	17	**104**	36	140	8.00	9.00	8.24
International Journal of Tourism Review	**12**	11	23	123	**154**	277	10.25	14.00	**12.04**
Journal of Vacation Marketing	**12**	3	15	**80**	41	121	6.67	13.67	8.07
Total	194	147	341	1620	1808	3428	8.31	14.22	10.12
Percentage	27.71	21.00	48.71	22.43	25.04	47.47	–	–	–

The highest frequency of publications is marked in bold.
Source: The authors.

Table 4
Citation burst of the top journals.

Cited Journals	Strength	Begin	End	1998 - 2017
International Journal of Tourism Review	10.6632	**2011**	2017	
Tourism Management	9.535	**2008**	2012	
Annals pf Tourism Research	8.6588	**2008**	2012	
International Journal of Contemporary Hospitality Management	7.7612	**2015**	2017	
Asia Pacific Journal of Tourism Research	6.2816	**2014**	2017	
Current Issues in Tourism	6.0601	**2010**	2017	
Journal of Travel & Tourism Marketing	5.4793	**2009**	2012	
Journal of Vacation Marketing	4.6176	**2008**	2012	
Journal of Travel Research	4.561	**2008**	2011	
Tourism Analysis	3.971	**2015**	2017	

The highest frequency of publications is marked in bold.
Source: the authors.

Kong Polytechnic University in China, shown in Table 5. The United States boasts the highest number of institutions, with Hebrew University Jerusalem displaying highest total link strength with a higher frequency and length of inter-institutional research collaboration. The production of documents made by researchers within the institution itself occurs in the National University Singapore, University Guelph in Canada, and University Munich in Germany, all with a zero-total link strength.

Table 5
Top Institutions in senior tourism research.

Rank	Institutions	TP	TC	TC/TP	Total link Strength	Countries
1	Univ Queensland	25	525	21	23	Australia
2	Hong Kong Polytech Univ	19	342	18	27	Hong Kong
3	Griffith Univ	14	288	20.6	12	Australia
4	Texas A&M Univ	11	225	20.5	12	USA
5	Purdue Univ	9	329	36.6	23	USA
6	Univ Zurich	9	187	20.8	2	Switzerland
7	Natl Univ Singapore	9	169	18.8	0	Singapore
8	Michigan State Univ	8	327	40.9	19	USA
9	Univ Surrey	8	243	30.4	12	UK
10	Univ Stavanger	8	130	16.3	9	Norway
11	Washington State Univ	8	140	17.5	3	USA
12	Hebrew Univ Jerusalem	7	386	55.1	29	Israel
13	Univ Palermo	7	100	14.3	9	Italy
14	Temple Univ	6	105	17.5	9	USA
15	Edith Cowan Univ	6	196	32.7	7	Canada
16	UCL	6	274	45.7	6	UK
17	Univ Calgary	6	208	34.7	3	Canada
18	Monash Univ	6	152	25.3	3	Australia
19	Univ Wisconsin	6	140	23.3	1	USA
20	Australian Natl Univ	6	137	22.8	1	Australia
21	Univ Nevada	5	208	41.6	27	USA
22	Univ Bergen	5	190	38	2	Norway
23	Univ Minnesota	5	160	32	1	USA
24	Univ Guelph	5	127	25.4	0	Canada
25	Univ Munich	5	126	25.2	0	Germany

Source: The authors.

3.3. Scholarly communities and ccollaboration by country

The co-authorship network has the objective to demonstrate the collaborative relationship between authors in the research area (Jiang et al., 2017). The co-authorship network for tourism senior has a good modularity, with a small number of isolated clusters (between 4 and 8). It is a fragmented network, with low density in all periods of time, with a number of isolated authors. Four clusters are displayed in Fig. 2. The colour of links between authors demonstrates the first year of co-authorship, with warmer colors indicating more recent collaboration. The size of rings means the number of citations that papers receive each year while the colour of the rings demonstrates the year of citation, with warmer colors indicating more recent citations. The authors who published the most papers are typically located in the centre of each cluster and identified by bigger letters.

Jang S. and Kim M. published the most senior tourism papers in our data set, both with five articles, followed by Prideaux B, Ruys H and Wei S, all with four articles. The cluster with Eusébio C is one recent cluster.

Collaboration is strongly determined by geographical and spatial constraints. In fact, when we analyze the network of co-authors' country, the objective is to demonstrate the collaborative relationship between authors' countries and territories. All years have an acceptable modularity (Table 2). The partitions in the network on the basis of connectivity characteristics show some variation in the number of clusters (from 7 to 14), an indicator of its dynamics. The development of senior tourism research collaboration in different countries is presented along a time axis in Fig. 3. The USA, Australia and United Kingdom have acted as the foundation for collaboration with other countries in later years. The density of the network has its highest value in the second slice, where the structure of the network is more concentrated in some countries. Nevertheless, the decreasing values of density, and the increased number of nodes and links, highlights that the foundation researchers are active collaborators with researchers across many countries.

3.4. Research themes

The network of keywords (Table 2) presents a clear representative interconnected keyword, as can be seen by the large variation in the number of linkages of each node. The density is highest in the first two time periods, where a small group of keywords is dominating. In the last 2 periods the number of keywords is increasing and the density f the network is decreasing. The analysis of keywords and their co-occurrences allows us to map the intellectual structure of a discipline and the changes in that structure over time (Ding, Chowdhury, & Foo, 2001). The evolution of key research-front terms between 1998 and 2017 is shown in Table 6. From the *betweenness centrality*, the keywords that are strongly interconnected with other keywords are identified. This provides information on the possible convergence fields of research in senior tourism. It can be seen that the growth of research topics occurred mainly in 2013, where the following main central keywords occurred: *tourism management, tourist perception, tourism behavior, motivation, tourist satisfaction, tourism attraction, ecotourism*, and *tourist attitude*, which indicated a growing focus on the management and development of tourism, specially tourist perception, motivation and attitude. This illustrates that detailed issues related to senior tourism were being examined through a broader range of disciplinary backgrounds as the field matured. The relative high values of betweenness centrality suggest the research topics converge and research collaboration is active in this research area.

Table 7 shows the top 15 keywords with strong citation burst from 1998 to 2017. *Burst* detection can identify bursts of keywords as indicators of emerging trends (Chen et al., 2014). Geographical keywords such as United States and Australia are evident in the results because the tourism industry is largely based on physical location and resources, thus keywords are likely to reflect research exploring this growing segment of seniors and case studies in specific locations. United States was the strongest burst between 1999 and 2009. The hottest topics from 2008 to 2012 were *tourism destination, tourism development, tourism management, destination attractiveness*, and *heritage tourism*. The most recent citation burst of keywords is Spain which reflects recent financial issues in this country. *Tourism management* and *motivations* are also hot topics from 2013 to 2017. This indicates that recent hot topics attracted researchers with a management and psychological background.

A clear representative keywords trends seems to be present, which can help researchers, and the hospitality industry to create senior tourism solutions for society.

3.5. Co-citation analysis by thematic clusters

The network of co-cited documents, described in Table 2, has many of its links dispersed around few nodes, suggesting being centralized on some top articles in all time periods (high density). Fig. 4 shows some highly cited articles in a timeline visualization of the network, where red rings indicate citation bursts over time periods (Chen et al., 2014). The cited articles are represented by nodes in the network, and links between nodes represent the number of times citations appeared together in the source documents included in the data set. The colour of links denotes the time a particular connection was made, based on the publication year of the source article. Blue colors indicate older connections, whereas red colors indicate more recent connections. The Figure shows some relevant articles (identified by the first author) distributed by thematic clusters.

CiteSpace divides the co-citation network into many clusters of co-cited references, so that references are tightly connected within the same cluster. The recency of a cluster is measured by percentiles and the mean year of publication. The number of elements in each major homogenous cluster is listed in Table 8, all with 10 or more documents and with good silhouettes, meaning they can be labelled by noun phrases from titles of the cited articles in the cluster (Chen et al., 2010).

CiteSpace allows the identification of a core of thematic clusters,

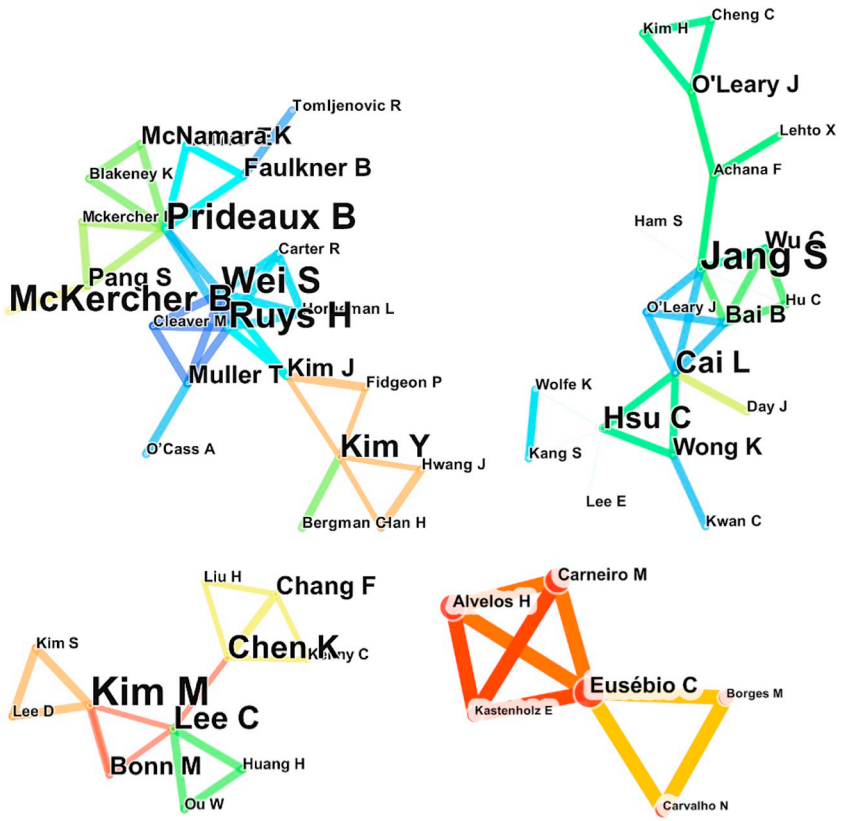

Fig. 2. Some relevant clusters in co-authorship network.

defined by clusters #0 up to cluster #6. All clusters have good silhouette (≥0.70), which is an indicator not only of its homogeneity, but also of the quality of the cluster configuration.

Cluster #0 is labelled *information source* because it includes articles focusing mainly on travel information sources, apart from their travel motivations, travel constraints, market segmentation, and well-being motivations.

Cluster #1 is labelled *nature conservation* because it includes articles focusing mainly on nature-based motivations, psychological well-being, and tourists' environmental concerns.

Cluster #2 is labelled *elderly population* because it includes articles focusing on seniors, including their heterogeneity, their motivations and differences with non-seniors.

Cluster #3 is labelled *information technology* because it includes articles focusing on use of the internet, social media platforms and mobile devices.

Cluster #4 is labelled *cultural politics* because it includes articles focusing on seniors cultural, economic and social diversity.

Cluster #5 is labelled residents' perception because it includes articles focusing on residents' perceptions. As these articles go beyond describing senior tourism, this cluster was omitted from our research.

Finally, cluster #6 is labelled *rural development* because it includes articles focusing on destination attractiveness in the rural area, and on cultural tourism and mass tourism activities as ways to promote rural development.

The most cited papers give a historical perspective on scientific

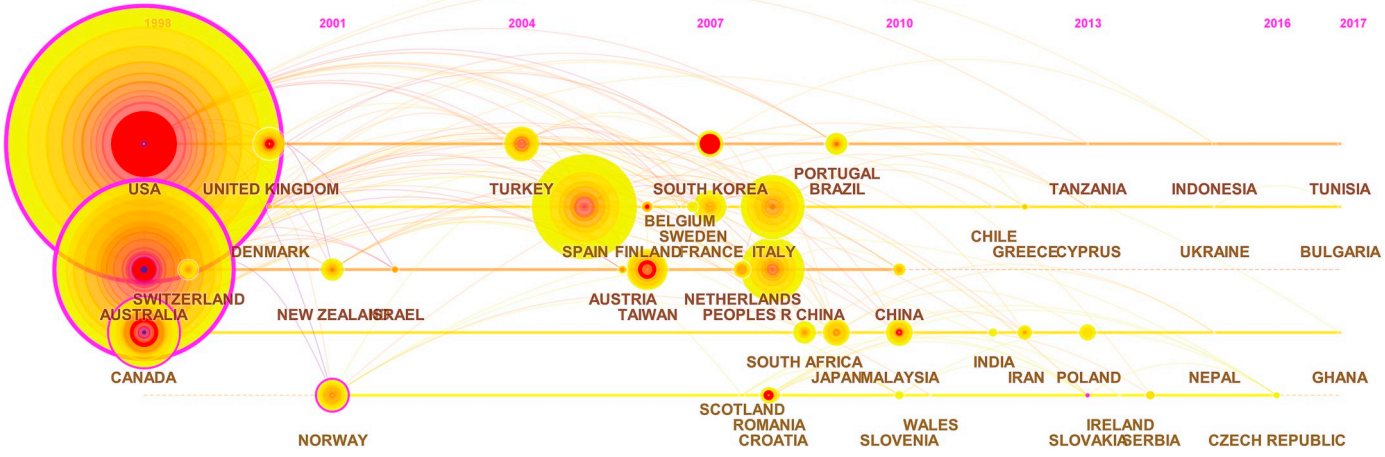

Fig. 3. Time-slice view of co-authors' countries.

Table 6
Keywords with high frequencies and centrality by slices.

Years	Keywords	Count	Centrality	Years	Keywords	Count	Centrality
1998–2002	Tourist perception	35	0.34	2003–2007	Tourism management	35	0.41
	USA	34	0.41		Ecotourism	34	0.43
	Tourism development	33	0.35		Motivation	33	0.42
	Tourism safety	30	0.34		Japan	29	0.23
	Australia	25	0.21		Elderly population	28	0.21
	Tourism destination	24	0.39		Intentions	25	0.37
	Heritage tourism	23	0.42		Australia	23	0.37
	Tourist attraction	20	0.31		Canada	22	0.13
	Tourist satisfaction	19	0.34		USA	19	0.36
	Elderly population	14	0.28		Tourist attraction	18	0.23
					Landscape	15	0.18
2008–2012	Tourism destination	43	0.42	2013–2017	Tourist perceptions	57	0.44
	Tourism development	42	0.44		Tourist behavior	54	0.43
	Tourism management	40	0.46		Tourism management	53	0.44
	Tourism attraction	39	0.38		Tourism attraction	50	0.41
	China	36	0.36		Ecotourism	48	0.34
	Heritage tourism	29	0.35		Motivation	43	0.41
	Motivation	25	0.36		Health tourism	36	0.27
	Tourist perception	23	0.16		Tourist satisfaction	35	0.41
	USA	20	0.41		Tourist attitude	34	0.28
	UK	18	0.21		Spain	34	0.21
	Tourism attitude	16	0.22		Tourist experience	31	0.23
	Tourism satisfaction	13	0.18		Landscape	27	0.13
	Ecotourism	11	0.23		Experience	23	0.13
					Information technology	23	0.36
					Rural tourism	20	0.22
					Authenticity	17	0.14
					Service	16	0.13

Source: The authors.

Table 7
Top 15 keywords with the strongest citation bursts.

	Citation burst			
Keywords	Strength	Begin	End	Duration (1998 - 2017)
Unites States	186.993	**1999**	2009	
Australia	72.342	**2004**	2009	
Ecotourism	11.395	**2004**	2009	
Japan	67.619	**2005**	2012	
Tourism development	62.102	**2008**	2014	
Tourism destination	60.954	**2008**	2014	
Heritage tourism	64.261	**2010**	2012	
Destination attractiveness	35.602	**2010**	2014	
Spain	39.519	**2014**	2017	
Tourism management	42.992	**2011**	2017	
Tourist satisfaction	83.727	**2014**	2017	
Motivation	40.394	**2014**	2017	
Tourist experience	43.317	**2015**	2017	
Health tourism	50.791	**2015**	2017	
Service	44.676	**2015**	2017	

Source: the authors.

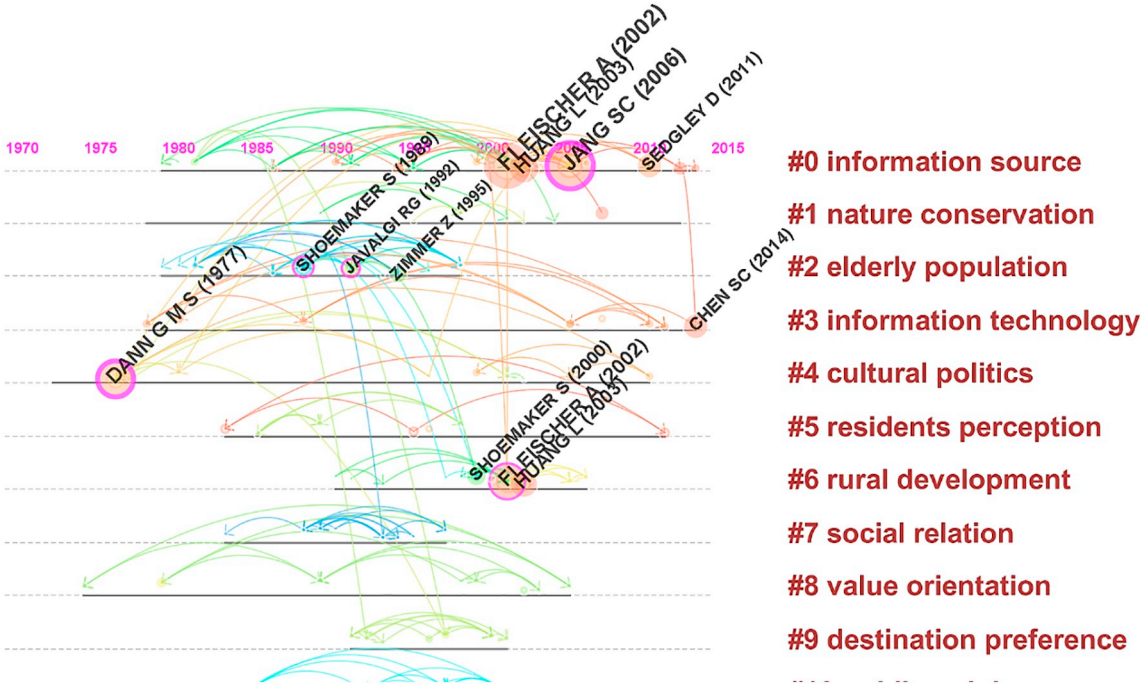

Fig. 4. Timelines of co-citation clusters.

progress and reveal recognition of scientific advancement (Chen, 2006). Our databases show the highest-cited articles belong to cluster #2, labelled *elderly population* by LLR, with a median of publications between 1980 up to 1992. As usual in the literature, older papers receive more citations than recent ones, given the time length of knowledge diffusion. This research stream is slowly increasing and, therefore, very old papers represent the pillars of senior tourism research. Shoemaker (1989) and Javalgi, Thomas, and Rao (1992) are the two most highly-cited and central articles from both clusters #2 and #3. Shoemaker (1989) was one of the first articles to question homogeneity in the senior market and to use senior travel motivations to segment the market into clusters, while Javalgi et al. (1992) conducted research comparing the behaviour of senior versus non-senior tourists. Table 9 shows the that the two more cited articles provide conceptual frameworks in the early stages of the field and are central to the network.

Fig. 5 shows an overview of the network of co-cited references and burst terms on senior tourism research. Major foundation articles are likely to be located towards the centre of the network because they are often cited together in the same source documents. Articles that link two clusters together indicate an opportunity for researchers to fill an information gap (Haythornthwaite, 1996). Consequently, articles produced as a result of this kind of effort provide conceptual bridges and it is probable that in linking disparate fields of understanding, they will be cited by scholars engaged in researching different areas. These articles are measured in CiteSpace by betweenness centrality and are also defined as structural holes by Burt (1992). The most central articles belong to cluster #0, the major cluster in terms of size, with 23 references. This is the second more recently-formed cluster, with a median of publications between 1980 up to 2001. The review by Fleischer and Pizam (2002) of senior travellers' motivations and constraints form an important bridge between the former cluster #0 and the secondary cluster #2 dominated by Shoemaker (1989). The more recent article by Jang and Wu (2006) of the study of push and pull motivations and emotions provides an important bridge between the former cluster #0 and cluster #6, dominated by Milman (1998). Huang and Tsai (2003), providing an analysis of the destination selection attributes focusing on direct travel suppliers and indirect travel motivator, offer an important bridge between the primary cluster and cluster #5. From an overview of the network of co-cited references and burst terms, other structural holes and disconnected clusters may indicate developing areas, such as the cluster of nodes connected to Vigolo and Bonfanti (2016) in hospitality services (cluster # 36); and connected to Vila, Cathy, and Gerard (2012) in the restaurant industry (cluster #50).

3.6. Temporal analysis

Table 10 includes the articles that have significant values in structural and temporal metrics. The article with the highest strength of

Table 8
Major clusters of co-cited references.

#	Size	Silhouette	Label (LLR)	Year Ave.	Std.	Min	P50	P75
0	23	0.705	Information source	1998	10.1	1980	2001	2006
1	15	0.863	Nature conservation	1998	9.83	1979	1999	2005
2	15	0.94	Elderly population	1991	6.49	1980	1992	1997
3	14	0.782	Information technology	1998	12.9	1979	2006	2010
4	13	0.695	Cultural politics	1991	13.6	1973	1997	2001
5	12	1	Residents' perception	1996	8.49	1997	1997	2002
6	12	0.874	Rural development	1999	4.9	2000	2000	2002

Source: The authors.

Table 9
Top articles with the most citation counts.

Citations	Author	Year	Source	Cluster #
167	Jang & Wu.	2006	*Tourism Management*	0
164	Fleischer & Pizam.	2002	*Annals of Tourism Research*	0
104	Hsu, Cai & Wong.	2007	*Tourism Management*	0
98	Horneman, Carter, Wei & Ruys.	2002	*Journal of Travel Research*	0
85	Huang & Tsai.	2003	*Tourism Management*	0
62	Kim, Wei & Ruys.	2003	*Tourism Management*	0
44	Sedgley, Pritchard & Morgan.	2011	*Annals of Tourism Research*	0
29	Chen, Liu & Chang.	2013	*International Journal of Hospitality Management*	0
7	Alén., Losada & de Carlos.	2017	*Current Issues in Tourism*	0
98	Sangpikul.	2008	*Tourism*	1
383	Shoemaker.	1989	*Journal of Travel Research*	2
232	Javalgi, Thomas & Rao.	1992	*Journal of Travel Research*	2
289	Zimmer, Brayley & Searle.	1995	*Journal of Travel Research*	2
177	Romsa & Blenman.	1989	*Annals of Tourism Research*	2
383	Shoemaker.	1989	*Journal of Travel Research*	3
232	Javalgi, Thomas & Rao.	1992	*Journal of Travel Research*	3
68	Chen & Shoemaker.	2014	*Annals of Tourism Research*	3
288	Dann.	1977	*Annals of Tourism Research*	4
172	Milman.	1998	*Journal of Travel Research*	6
167	Jang & Wu.	2006	*Tourism Management*	6
140	Shoemaker.	2000	*Journal of Travel Research*	6
98	Horneman, Carter, Wei & Ruys.	2002	*Journal of Travel Research*	6

Source: The authors.

citation bursts (62.8) of all the co-citation network is Shoemaker (1989), a reference from clusters #2 and #3. Dann (1977) is the reference with the highest citation burst (strength 47.622) from cluster #4, being a relevant mark in senior tourism research, with a current citation burst from 2012 until 2017. Dann (1977) was the first researcher to analyze the connection between tourists' home situation and their leisure patterns, including factors stemming from "anomie" and "ego-enhancement" in the tourist himself. Dann (1977), is a sleeping beauty, because there is a gap of 35 years between its publication and subsequent citation burst, in contrast with Shoemaker (2000), which waited only three years. Apart from these articles, Shoemaker, 1989, Shoemaker, 2000), Romsa and Blenman (1989), and Javalgi et al. (1992), have citation burst before 2009. Shoemaker (2000) focuses on the analysis of the senior market over ten-years; Romsa and Blenman (1989) concentrate on differences in their preferred activities from non-seniors; while Javalgi et al. (1992) focus on differences between the behaviour of seniors and that of non-senior tourists.

All the following articles have citations burst near 2017. Huang and Tsai (2003) is also a sleeping beauty, because a gap of 10 years exists between publication and citation burst; Sedgley, Pritchard, and Morgan (2011) focused on the need for more individualised, subjective research that explores the intricacies of older people's lives; and finally Kim, Wei, & Ruys, 2003) is another article of interest representing an investigation of seniors' perception of the relevant travel features. All these articles have high sigma scores, which measure the combined strength of structural and temporal properties of a node. Such papers are extremely important and are likely to be highly cited in the future (Chen, 2006).

4. Conclusion

The expansion of the ageing population globally brings the natural prediction that seniors should be acknowledged as one of the most important groups of individuals in the tourism sector, and that this situation is likely to prevail for the next thirty years (Alén et al., 2017). Indeed, this segment is already bringing huge advantages to the hospitality industry, as it is nearing one of largest potential markets for hotels, restaurants, and retail businesses (Chen, Liu, & Chang, 2013; Huang & Tsai, 2003).

Using bibliometric analysis through CiteSpace, this paper seeks to reveal its potential to analyze senior tourism's evolution over the past twenty years, its particular dynamics, and which areas are being pursued by scholars. The results extend beyond bibliometric studies of senior tourism research combining co-citation analysis and co-occurrence of keywords to understand the development of this field from

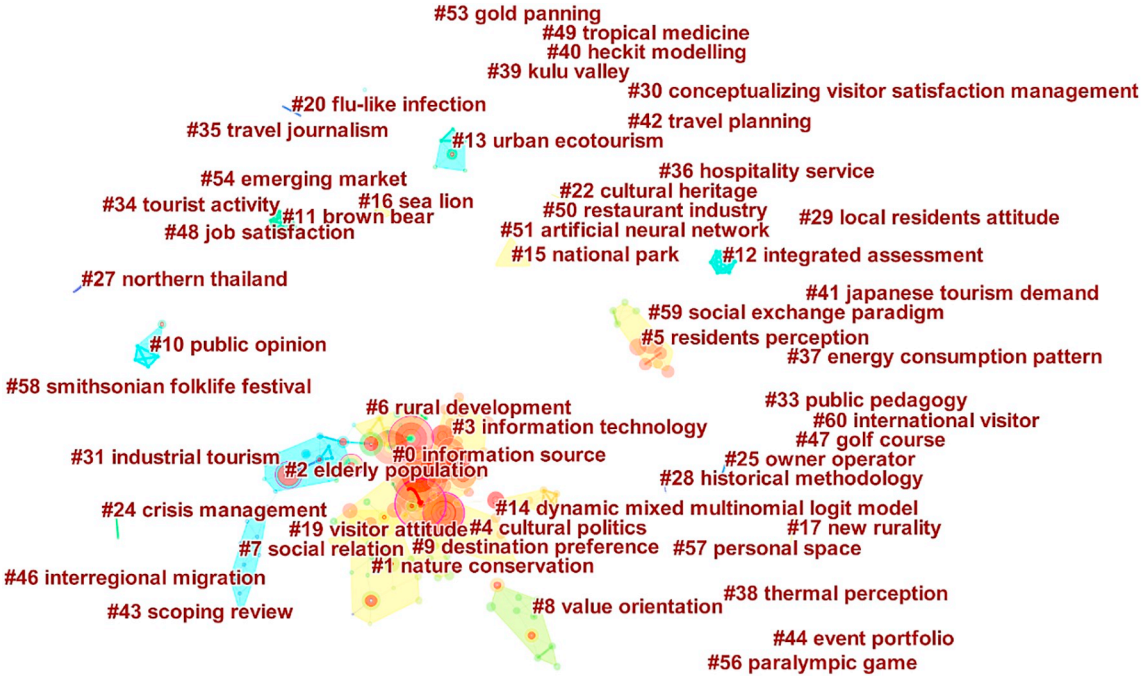

Fig. 5. Overview of the network of co-cited references and burst terms.

Table 10
Top articles in centrality, citation burst and sigma.

Authors	Year	Centrality	Sigma	Citation burst				To be cited (years)	#
				Strength	Begin	End	Duration (1998 - 2017)		
Shoemaker.	1989	0.33	2.12	62.8	1999	2004		10	2; 3
Shoemaker	2000	0.26	1.36	51.4	2003	2009		3	6
Sedgley, Pritchard & Morgan.	2011	0.20	1.02	50.8	2015	2017		4	0
Dann.	1977	0.41	2.68	46.7	2012	2017		35	4
Huang & Tsai.	2003	0.25	1.08	37.4	2013	2017		10	0
Romsa & Blenman.	1989	0.22	1.06	31.9	2002	2003		13	2
Javalgi, Thomas & Rao.	1992	0.28	1.41	21.4	2002	2009		10	2
Fleischer & Pizam.	2002	0.37	1.47	20.5	2015	2017		13	0
Kim, Wei & Ruys.	2003	0.25	1.10	18.8	2014	2017		11	0
Jang & Wu.	2006	0.44	1.40	17.4	2013	2017		7	0

Source: The authors.

different perspectives. These techniques offer several advantages compared with the traditional approaches to analyze the literature. Firstly, by measuring and visualizing along the period the relational analysis of different nodes (authors, articles, journals and countries), this dynamic study provides insights into the knowledge domain (Chen, 2006). Secondly, the clustering techniques used in this research not only identify articles that serve as an important bridge between two clusters, like Shoemaker (1989, 2000), Jang and Wu (2006), Huang and Tsai (2003) and Kim et al. (2003), but also suggest developing areas, like Vila et al. (2012) in the restaurant industry (#50); Vigolo and Bonfanti (2016) in the hospitality services (#36); and Eusébio, Carneiro, Kastenholz, and Alvelos (2017) in social tourism (#59). Thirdly, the bibliometric visualization used in this paper adds a new dimension to the analysis and provides insights into the flow of major trends and collaborations. Finally, the temporal analysis of document citation burst as well as the co-occurrence analysis of most frequently keywords, help to identify emergent recent topics and trends. The maturity of research on senior tourism is perceivable by the fact that it has moved from being focused mainly on the clusters of *elderly population* and *rural development*, to more specific ones with a broader disciplinary base: *motivations, information source, wellness tourism*, and *cultural politics*. Therefore, this field of study is turning more multidisciplinary, being progressively analyzed from the new angles provided by diverse scientific approaches, which complement and enrich its content. When keywords are analyzed from a geographical point of view, and considering the whole period, it is apparent that research efforts on senior tourism have been concentrated in two countries mainly: USA and Australia. Nevertheless, in the last years countries such as Spain and Japan have emerged, which makes sense if the severe problem of ageing populations in these societies is taken into consideration, which has an evident impact in the growth of this market segment and the corresponding interest on it. Keywords are also helpful for understanding research priorities and their evolution over time. Thereby, during the time span 2008–2012 the analysis of some dimensions of senior tourism segment, related to *tourism destination* and *development, tourism management, tourism attraction* and *heritage tourism,* has seen a period of consolidation. However, between 2013 and 2017 new topics have strongly burst onto the research scene: *tourist satisfaction, tourist experience, health tourism, service* and *motivations*, attracting researchers with a management and psychological background. The results show that research on senior tourism moved from broader topics, like tourism management, to more specific topics, like satisfaction, motivation, experience, as the field has matured.

The study has some limitations. Firstly, we have focused exclusively

on tourism journals, excluding works published elsewhere, like in books and in conference papers. Secondly, this work was restricted to the English language journals. Giving the relevance of Spain, Japan, Portugal, and France, among others, in senior tourism research, it seems likely that some of the literature may be published in the languages of these countries. Also, despite the relevance of Web-of Science and Scopus databases to tourism research, other important studies could have been included into other databases. Nevertheless, it is evident that bibliometric analysis has helped to characterize both qualitatively and quantitatively, the dynamics of the senior tourism research field including its development, hotspots and trends of investigation, and collaboration. As a result, researchers and the hospitality sector have been equipped with new tools of exploration. Moreover, senior tourists will soon constitute one of the largest prospective market segments for the hotel, restaurant, and shopping industries (Chen et al., 2013).

This paper could be useful to anyone interested in engaging in senior tourism research. Through an innovative and scientifically rigorous method, it could also provide a sound analysis of the state of the art of senior tourism research if it incorporates insights into the major identified articles. As a final point, the methodological analysis used in the current study through CiteSpace, can be a powerful way to help tourism research transition towards a less undisciplined array of theories and models (Tribe, 1997).

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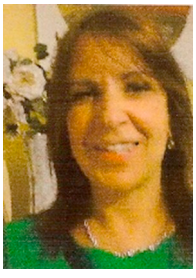

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