Journal of Scientometric Research, 2026; 15(1):24-37.
https://www.jscires.org

Research Article

Beyond the Narrative: Structural Mapping and Thematic Evolution in Entrepreneurial Intentions Research

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ABSTRACT

Entrepreneurial Intentions (EI) research has expanded rapidly, yet its structural evolution remains underexplored. This study applies a multi-method bibliometric analysis of 2,515 Web of Science articles published between 1996 and 2023 to map the field's intellectual landscape. Using document co-citation analysis, traditional citation metrics, and structural metrics (centrality, burstness, sigma), we identify a dense core centred on the Theory of Planned Behaviour, surrounded by emerging subfields in sustainability, gender, social entrepreneurship, and education. Findings reveal that while foundational models retain high citation strength, recent structurally influential works increasingly reflect context-rich, interdisciplinary themes. This shift signals both conceptual diversification and growing fragmentation. We highlight under-integrated but high-potential areas for future research and propose strategies to reconnect these emerging domains with EI's foundational theories. The study offers a replicable roadmap for scholars seeking to enhance conceptual integration and practical relevance in entrepreneurship research.

Keywords: Entrepreneurial intentions, Bibliometrics, Bibliometric mappings, Betweenness centrality, Sigma, Burst citations.

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Received: 03-01-2026;
Revised: 23-02-2026;
Accepted: 17-03-2026.

INTRODUCTION

Entrepreneurial Intentions (EI) remain one of the most widely researched topics in entrepreneurship, with theoretical roots in behavioural psychology and expanding applications across diverse contexts. Since Ajzen's Theory of Planned Behaviour (TPB) provided a formalised lens for understanding entrepreneurial decision-making, a vast body of work has sought to model, measure, and extend EI across disciplines and research contexts (Norris F. Krueger and Carsrud 1993; N.F Krueger, Reilly, and Carsrud 2000; Lortie and Castogiovanni 2015). However, this proliferation of research has also generated a degree of thematic dispersion, raising important questions about the coherence and future direction of the field.

Over the past decade, several bibliometric and conceptual reviews have examined EI, including meta-analyses (Schlaegel and Koenig 2014; Lortie and Castogiovanni 2015), conceptual frameworks (Liñán and Fayolle 2015; Lortie and Castogiovanni 2015) and more recently, co-word or citation-based bibliometric mappings (Batista-Canino *et al.*, 2024; Donaldson, 2019; Katoch *et al.*, 2023; Ruiz-Alba *et al.*, 2020). While these studies have helped organise the field's core constructs and thematic domains, most adopt a static or linear approach - summarising dominant models, listing top-cited works, and presenting thematic or co-citation clusters with narrative interpretations around these clusters without tracing the field's structural evolution or analysing which areas of research have become more central, connected, or influential over time.

Notably, prior studies have typically relied on filtered or highly selective samples. For example, (Loi *et al.*, 2023; Mamata and Kavilal, 2025) reduced initial sets of 786 and 1,337 articles to just 61 and 122 for bibliographic analysis - representing only 7.7% and 9.1% of their original corpora, respectively. Such reductions risk skewing thematic coverage and undermining replicability. In contrast, our approach prioritises transparency, maximises thematic coverage across 2,515 articles, and enhances replicability - particularly important in a field like entrepreneurship, where emerging domains may not yet be highly cited, and articles that are more unique, controversial, or conceptually innovative are often excluded from narrower reviews. This study extends prior EI reviews in three key ways:

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DOI: 10.5530/jscires.20260019

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- *Structural Focus:* Rather than merely identifying frequently cited papers, we examine how documents reconfigure the intellectual architecture of the field using structural metrics such as betweenness centrality, citation burstness, and sigma scores.
- *Temporal Mapping:* We trace how influential ideas have shifted, identifying conceptual waves and emerging domains through betweenness centrality, sigma scores, burst analysis metrics, and timelines.
- *Strategic Integration:* While we do not overlay these metrics onto a formal strategic diagram, our integration of co-citation clusters and structural influence indicators highlights subfields with growing prominence or declining impact, offering signals of possible convergence or fragmentation.

These contributions move beyond earlier reviews by offering a dynamic and diagnostic account of the field's evolution and proposing actionable pathways for reconnecting subdomains such as social entrepreneurship, sustainability, and gender with the cognitive-behavioural core of EI research.

METHODOLOGY

This paper presents a comprehensive bibliometric analysis of 2,515 peer-reviewed articles published between 1996 and 2023. The analysis combines document co-citation mapping, citation burst detection, betweenness centrality, sigma metrics, and Web of Science journal categorisation. An initial performance analysis is also conducted at the document and journal levels.

Data Source

The dataset for this bibliometric review comprises 2,515 publications on EI published between January 1996 and November 2023. These records were extracted from the Web of Science (WoS) Core Collection using a topic search with the string "entrepr* intent*", where the wildcard symbol "*" captured variations such as "entrepreneurial" or "entrepreneurship" and "intention" or "intentions." The search was restricted to English-language journal articles, review articles, and early-access reviews to ensure wide coverage of peer-reviewed scholarly work and effective integration into the bibliometric software.

In contrast to prior reviews that analyse a narrow or selectively filtered sample of publications (Mamata and Kavilal 2025; Donaldson 2019; Loi *et al.*, 2023) and are largely narrative, our study retains the complete set of co-cited documents derived from the initial corpus, subject only to clearly defined citation and co-citation thresholds and uses automated bibliometric procedures exclusively. This approach prioritises transparency, maximises thematic coverage, and enhances replicability, which are important review principles in any research domain, including entrepreneurship and management (Borenstein *et al.*, 2009; Rosenthal 1993; C Chen 2018; C. Chen and Song 2019).

Complete records were downloaded in plain text format and imported into the bibliometric software packages CiteSpace and bibliometrix/R for analysis. Duplicate records were identified (if present) and eliminated during the data-cleaning process using CiteSpace[1]. This dataset was used for performance bibliometric analysis, including document co-citation mapping and analyses using burst detection, betweenness centrality, and sigma metrics.

Descriptive Statistics and Performance Metrics

Summary statistics were derived from the 2,515-record dataset to provide an overview of the dataset's composition and coverage. These statistics include the distribution of WoS research field categories associated with the citing journals and the growth trajectory of publication volumes from 1996 to 2023. A comprehensive summary of the highest-performing documents and journals based on citation impact is provided in the Supplementary Materials mentioned in this paper. The complete list of WoS research categories in the dataset is also included in the Supplementary Material to illustrate the interdisciplinary range of entrepreneurial intentions research captured in this bibliometric review.

Bibliometric Maps and Analyses

Document Co-citation Analysis (DCA) was employed to examine the co-citation relationships between pairs of documents cited together within the dataset (Cobo *et al.*, 2011; Vogel and Güttel 2012; Zupic and Čater 2014). DCA identifies knowledge bases or communities of related co-cited documents, representing research fronts and the emergence of new research themes (Small 1973; Chaomei Chen 2006). Nodes represent individual documents, and linkages denote co-citation relationships. Document-level co-citation was chosen over author or journal co-citation to capture greater citation detail (Chaomei *et al.*, 2010).

Mapping Metrics

Modularity Q Index and Silhouette Scores

The quality of DCA cluster maps was assessed using the Modularity *Q* index and silhouette scores. The Modularity *Q* index measures how effectively a network divides into clusters, with values greater than 0.3 indicating a meaningful structure (Chaomei Chen 2020; Sabe *et al.*, 2023). The silhouette score estimates the cohesiveness of these clusters, with values above 0.7 suggesting highly credible partitions (Sabe *et al.*, 2023).

Detecting Research Fronts

Changes in the document co-citation linkage map indicate shifts in a field's intellectual structure - especially in its intellectual

[1]No duplicates records were present in this extracted corpus.

bases, representing the foundational citation trails from which new research builds (Chen, 2006; Persson, 1994). A research front refers to an emergent and often transient constellation of citing documents that reflect active and evolving lines of inquiry within a scientific domain (Chen, 2006). By tracing these co-citation clusters over time, one can identify the emergence, convergence, or dissolution of thematic groupings that signal intellectual movement. In this study, we interpret research fronts as indicators of conceptual innovation and field dynamism. Changes in the connectivity or composition of these clusters suggest paradigm shifts, integration of previously isolated topics, or the rise of new theoretical frameworks and concepts (Chaomei Chen 2006, 2012; Chaomei Chen *et al.*, 2009).

Identifying Transformative Papers Using Structural Metrics

In addition to traditional citation counts, this study draws on three structural metrics to identify publications that have reshaped the intellectual structure of EI research: *citation burstness (or burst citations), betweenness* centrality, and the combined sigma score:

Citation Burstness highlights articles that experience a sudden surge in citations over a short period. These "bursts" signal growing interest and often indicate emerging topics or breakthrough contributions, even if the total citation count remains modest (Chaomei Chen 2006; C Chen, Dubin, and Kim 2014; Chaomei Chen 2020). Kleinberg's burst detection algorithm is implemented in CiteSpace to determine this metric, with more positive values indicating greater burstness (Gaggero *et al.*, 2020; Chaomei Chen, Ibekwe-SanJuan, and Hou 2010).

- *Betweenness Centrality* captures how well a paper connects otherwise separate research areas. A highly central paper acts as a bridge, linking distinct subfields or schools of thought. These papers are often conceptually integrative or theoretically innovative (Chaomei Chen, Ibekwe-SanJuan, and Hou 2010; Freeman 1977). Betweenness centrality scores generated by CiteSpace are normalised and can take values between 0 and 1; larger values indicate higher betweenness centrality.
- *Sigma Score* combines these two dimensions to capture both novelty and influence. It flags papers that are both novel and gain rapid attention. This study uses sigma to identify those works most likely to shape future research trajectories - transformative publications (Chaomei Chen, Ibekwe-SanJuan, and Hou 2010). Together, these metrics help surface the most cited works and those most structurally influential - papers that have actively reconfigured the field's development over time (Sabe *et al.*, 2022; Chaomei Chen, Ibekwe-SanJuan, and Hou 2010). Sigma values range between 1, an ignorable base value and any positive value greater than 1.

Web of Science Subject Categories

WoS subject categories are assigned at the journal level, with all articles or publications in a journal assigned to one or more WoS subject categories aligned to each publishing journal (Clarivate 2023). There are 258 WoS subject categories; a journal may be assigned to up to 6 WoS categories. This study examined and tabled the *WoS categories* aligned to the 2515 articles. The purpose of using these categories is to examine what research areas have researched or are researching the topic of EI. Is this concept the sole focus of entrepreneurial and management researchers, or is this theme studied across many research areas, and what research areas have a presence in this space?

Cluster Visualisation and Labelling

Bibliometric Cluster Significance

A major outcome of Document Co-Citation Analysis (DCA) is creating a time-based cluster map, which links together research fronts and their underlying intellectual bases. A research front represents the state-of-the-art thinking within a research field-an emergent and transient grouping of current concepts and underlying research issues (Chaomei Chen 2006; Price 1965), with an intellectual base being the citation trials of the research front in the literature (Chaomei Chen 2006).

As research areas evolve, new research fronts emerge, and new intellectual bases are formed from the references cited by newer publications. In a co-citation map, the citing articles form the research fronts, while the cited articles form the intellectual bases, which appear as clusters in the network (Chen, 2006). Each cluster in the map is made up of nodes and links. A node represents a cited document, and a link shows that two documents were cited together (co-cited) in later publications. Connections between clusters and intercluster linkages reveal how research topics shift and evolve (Chen, 2011).

In the co-citation map, earlier intellectual bases appear on one side of the visualisation (e.g., left), and more recent research fronts appear on the other side (e.g., right). Each cluster is colour-coded to distinguish between research themes. The size of each node reflects its citation count (or betweenness centrality, sigma or burst citation strength). Stronger connections between nodes indicate that the two documents were frequently cited together in the literature.

CiteSpace Configuration and Metrics

In the document co-citation map, the cosine count values were calculated for yearly time slices, and the default value of 0.15 was used as the minimum cosine threshold (Chaomei Chen 2011; Chaomei Chen 2004). The *g*-index was used to select an appropriate sample of co-citation nodes for the co-citation map and for the word co-occurrences with the *g*-index scaling factor (*k*) set to 25. For optimal network quality and consistency, the Look-Back Year (LBY) parameter was set to 5, and the Link

Retaining Factor (LRF) and maximum links per node (Max Links) values were set to 3 and 10, respectively. No network pruning algorithms (e.g., Pathfinder and Minimum Spanning Trees) were used on these network maps since tests using these two pruning algorithms showed a limited reduction in the number of nodal linkages or overall network clutter (Chaomei Chen 2004; Chaomei Chen 2011).

Automated Cluster Detection and Labelling

In a co-citation network, a cluster contains strongly connected articles based on their similarity (cosine association) with weak and limited connections between clusters. Spectral clustering generates the mapping clusters, and the Kamada-Kawai mapping algorithm is used to prepare and optimise the network visualisations. Automatic cluster labels were generated from the highest title noun extracted from the citing articles to each cluster, with the log-likelihood ratio (LLR) algorithm used to rank the cluster title nouns (Chaomei Chen 2006; Chaomei Chen, Ibekwe-SanJuan, and Hou 2010). Two to four additional title nouns are also extracted and tabulated for enhanced cluster understanding. Automated cluster labelling supports methodological transparency and repeatability, addressing scientometrics concerns where cluster interpretation - and at times, even cluster formation - may rely heavily on the researcher's subjective judgement, where these overly narrative-driven interpretations risk overreach and limit analytical robustness.

Software

The software packages Bibliometrix and CiteSpace were used in this study. Bibliometrix generated the document and journal performance analyses (Aria and Cuccurullo 2017), and CiteSpace generated the DCA maps, burst, betweenness centrality, and sigma metrics.

RESULTS AND DISCUSSION

The key results from this EI bibliometric analysis of 2,515 articles from WoS between 1996 and 2023 are described in this section. The initial data cleaning process confirmed a high-quality dataset with:

- No bibliometric duplicate records.
- Missing data was experienced for DOI (4.9%), author keywords (5.0%), and Keywords Plus (7.5%) fields.
- Two records were incomplete and removed by CiteSpace pre-analysis (n=2513 for all mapping functions). Bibliometrix/R used all 2,515 records for the remaining analyses. These levels of missingness and record removal pre-analysis were considered negligible.

Descriptive Statistics and Performance Analyses

Overview of Dataset Characteristics

Table 1 provides an overview of the bibliometric dataset's key descriptive statistics. Across the 2,515 records:

- Publication Types: 2,300 articles (91.5%), 155 early-access articles (6.2%), 57 review articles (2.3%), and three early-access reviews.
- Citations: 75,067 references were cited across the documents, averaging 26.64 citations per document.
- Keywords: 2,044 Keywords Plus terms and 4,396 Author Keywords were extracted.
- Authorship Patterns: 5,719 authors contributed, averaging 3.17 co-authors per document.
- International Collaboration: 34.3% of publications involved international co-authorship.

Publication Growth Over Time

The growth of EI-related publications between 1996 and 2023 is shown in Figure 1.

- Early Stage (1996-2005): Publication counts were very low, ranging between 0 and 3 articles per year.
- Expansion Phase (2007–2015): Steady growth occurred, reaching around 7–100 publications annually.
- Acceleration Phase (2016–2023): Research output surged to 477 articles in 2022, with 430 articles in 2023.

The slight drop between 2022 and 2023 likely reflects an indexing lag rather than a decline in research interest. Emerging topics such as social entrepreneurship, sustainable innovation, and 'green' entrepreneurship initiatives are expected to drive continued growth in the research domain.

Document Performance Analysis and Metrics

To identify the most influential articles in the field, both raw citation counts and normalised citation scores were examined:

- *The Top Locally and Globally Cited Documents:* The three most highly cited documents within the dataset with the highest local and global citations were:

1. Krueger, Reilly, and Carsrud (2000), "Competing models of entrepreneurial intentions" in *Journal of Business Venturing*, Local Citations: 1,254, Global Citations: 2,513.
2. Liñán and Chen (2009), "Development and Cross-Cultural Application of a Specific Instrument to Measure Entrepreneurial Intentions" in *Entrepreneurship*

Table 1: Corpus descriptive summary.

Description	Results
Timespan	1996:2023
Sources (Journals, Books etc.)	579
Documents	2,515
Average citations per doc	26.64
Document average age	4.71yrs
References	75,067
DOCUMENT CONTENTS	
Keywords Plus (ID)	2,044
Author's Keywords (DE)	4,396
AUTHORS	
Authors	5,719
Authors of single-authored docs	226
AUTHORS COLLABORATION	
Single-authored docs	272
Co-authors per Doc	3.17
International co-authorship %	34.27
DOCUMENT TYPES	
Article	2300 (91.5%)
Article: early access	155 (6.2%)
Review	57 (2.3%)
Review: early access	3 (0.12%)
Total	2,515

Theory and Practice, Local Citations: 1,074, Global Citations: 1,567.

3. Souitaris, Zerbinati, and Al-Laham (2007), "Do entrepreneurship programmes raise entrepreneurial intentions of science and engineering students? The effect of learning, inspiration and resources" in *Journal of Business Venturing*, Local Citations: 535, Global Citations: 1,103.

Complete local and global citation counts for the top 25 most influential documents, along with DOIs for direct access, are provided in Supplementary Table 1S.

- *Top Normalised Citation Scores:* Normalised citation metrics adjust for document age, offering a fairer comparison across older and newer publications. The highest normalised local citation scores were:

1. Schlaegel and Koenig (2014), "Determinants of Entrepreneurial Intent: A Meta-analytic Test and Integration of Competing Models" in *Entrepreneurship Theory and Practice* - 11.82.
2. Kautonen, van Gelderen, and Fink (2015), "Robustness of the Theory of Planned Behavior in Predicting Entrepreneurial Intentions and Actions" in *Entrepreneurship Theory and Practice* (2015) - 12.44.
3. Liñán and Fayolle (2015), "A systematic literature review on entrepreneurial intentions: citation, thematic analyses, and research agenda" in *International Entrepreneurship and Management Journal* - 11.88.

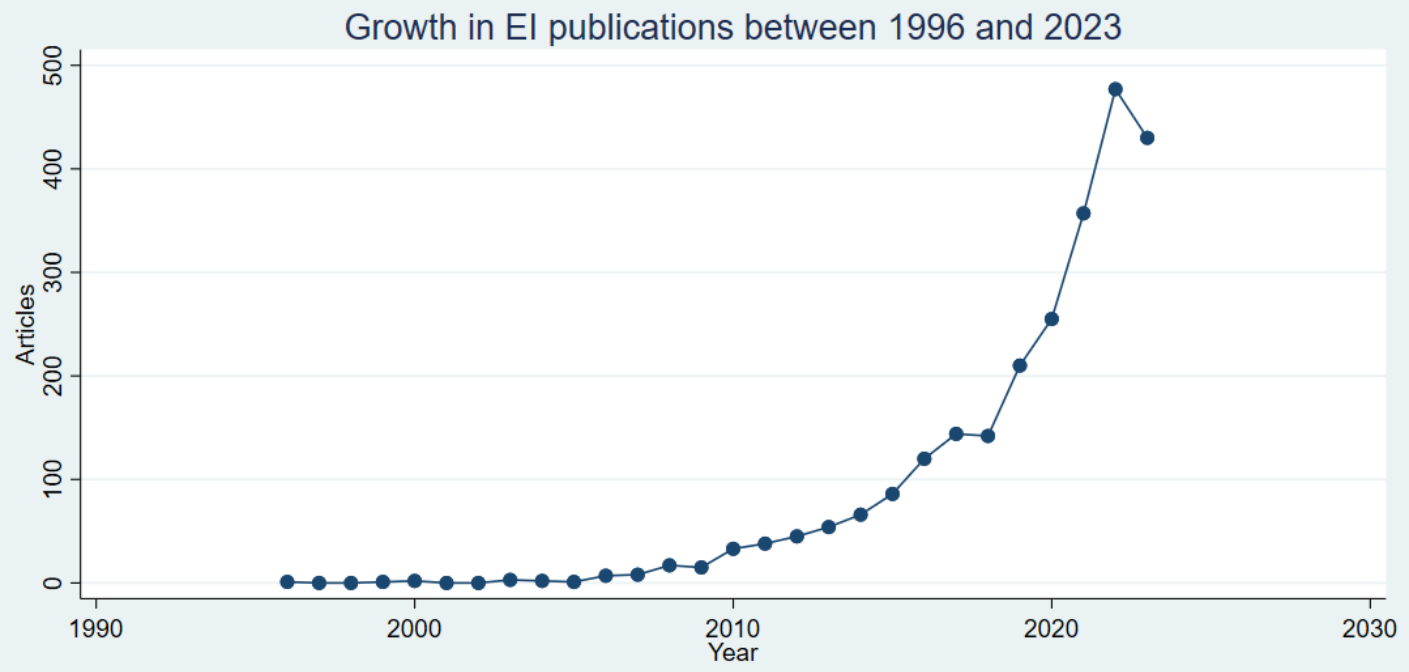

Figure 1: Growth in EI Publications 1996–2023.

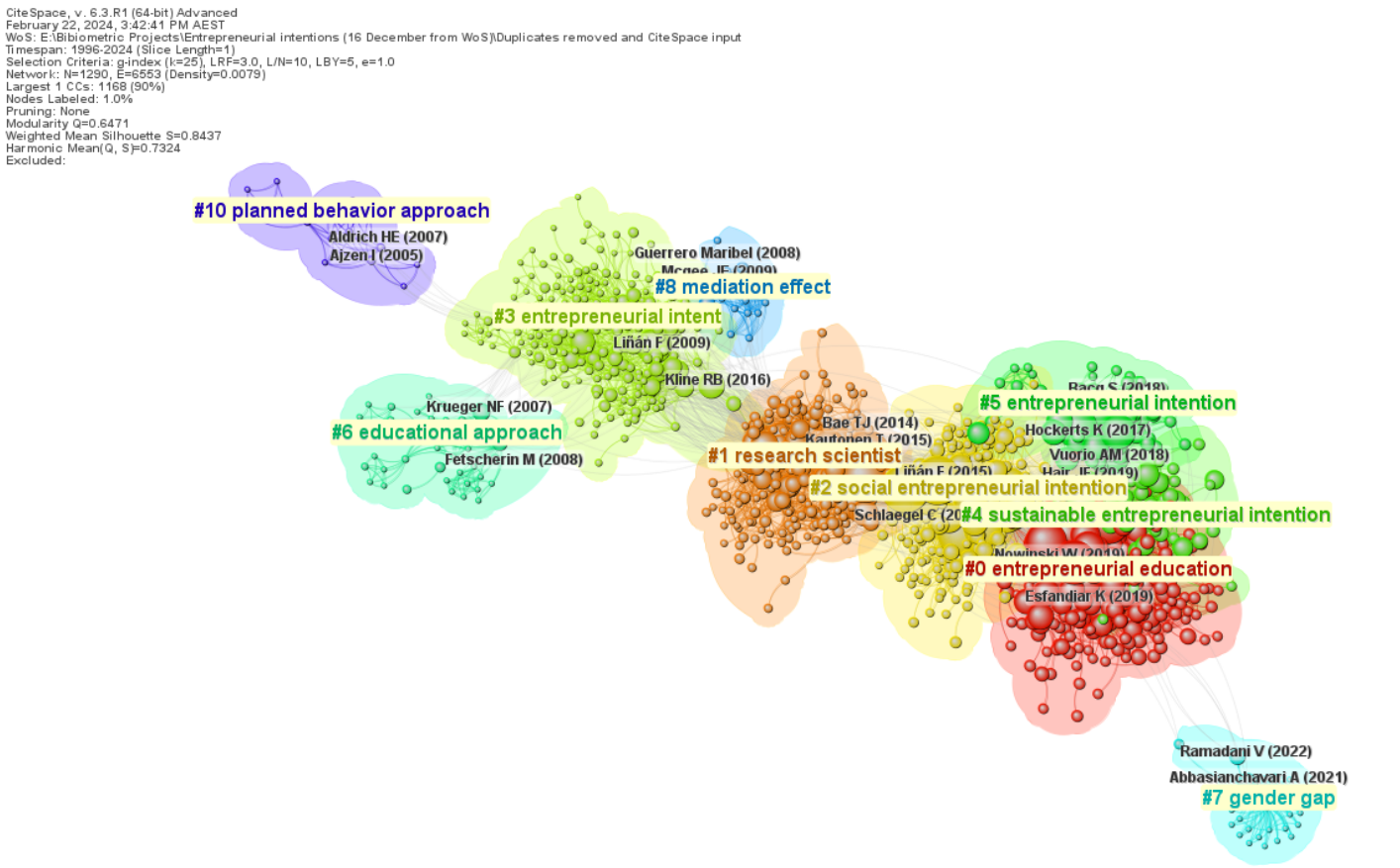

Figure 2: *Document Co-citation Map with Node Labelling using the Highest Cluster Citations. Note.* Cluster labels are generated from the highest title noun from the citing articles to each cluster.

Complete normalised local and global citation counts for the top 25 most influential documents and DOIs for direct access are provided in Supplementary Table 1S.

- *Historical Perspective on Citations* The most cited works are historical "classics":

1. The mean publication year across the top 25 cited documents (Table 1S) is 2010 (median year is 2011).
2. The latest publication among top-cited references was published in 2015 (see Table 1S).

Thus, while traditional citation metrics identify foundational studies, they under-represent emerging trends - a gap addressed by burst detection analyses.

Journal Performance Analysis and Metrics

Publication patterns across journals were also assessed, using both output counts and impact metrics (total citations, *h*-index, *g*-index).

- Top Journals by Citation Count.
- Top Journals by Publication Volume.

1. Entrepreneurship Theory and Practice (ETP) - 7,102 total citations.
2. Journal of Business Venturing (JBV) - 6,199 total citations.
3. International Entrepreneurship and Management Journal (IEMJ) - 4,636 total citations.

1. Frontiers in Psychology - 155 articles.
2. Sustainability - 128 articles.
3. Education and Training - 87 articles.

Interestingly, the top two output journals - *Frontiers in Psychology* and *Sustainability,* are more recent players in this research domain (2015 and 2016, respectively), reflecting the broadening interdisciplinarity of EI research.

- Top Journal *h* and *g*-index Metrics

1. Education and Training 34 and 57
2. IEMJ 33 and 68
3. International Journal of Entrepreneurial Behavior and Research 27 and 50

Detailed journal impact metrics and rankings for the top 25 journals are provided in Supplementary Table 2S.

Bibliometric Document Co-citation Analysis

The document co-citation network generated using CiteSpace is presented in Figure 2, with cluster labels selected from popular nouns extracted from the document's titles and ranked using the LLR ranking algorithm. The map comprises 1,290 nodes and 6,553 links, forming a ten-cluster solution with strong structural properties: a modularity *Q* score of 0.6471 and a mean silhouette score of 0.8437. All individual cluster silhouette scores exceed 0.7, indicating high internal consistency, with the lowest silhouette value observed in Cluster #0 (0.744). Cluster sizes range from 14 to 265 cited references, with a median cluster size of 126. Clusters #3 and #5 notably carry similar labels – "entrepreneurial intent" and "entrepreneurial intention" but their distinct thematic boundaries are clarified in Table 2 with alternative LLR-derived descriptors.

Table 2 also summarises key attributes for all ten clusters. The largest cluster, #0 (entrepreneurial education), contains 265 references, has a silhouette score of 0.744, and a mean publication year of 2019. The smallest, Cluster #10 (planned behavior approach), includes 14 references with a silhouette score of 0.994 and a mean year of 2003. The most recent clusters - Cluster #0 (entrepreneurial education), Cluster #4 (sustainable entrepreneurial intention), Cluster #5 (entrepreneurial intentions), and Cluster #7 (gender gap) - include references extending to 2023, suggesting their continued relevance in the field.

Document Co-citation Knowledge Bases

The transient intellectual foundations of the EI literature are mapped in Figure 2, with cluster evolution patterns discussed below. On average, the cited documents within each cluster span 10.4 years (median = 9.5; *SD* = 5.1), though this varies considerably: for example, Cluster #6 (education approach) spans nearly two decades (1996–2015) while Cluster #8 (mediation effects) is more narrowly focused (2008–2011). Full details, including each cluster's top-citing and cited documents, are summarised in Table 3S in the Supplementary Materials.

The earliest co-citation relationships emerged between Cluster #6 (education approach) and Cluster #3 (entrepreneurial intent) around 2006, with Cluster #3 evolving from Cluster #6. In subsequent years, new clusters emerged from these foundational bases:

2008–2011: Cluster #10 (planned behavior approach) branched from Cluster #3, followed by Clusters #1 (research scientist) and #8 (mediation effects), both of which maintained strong links with Cluster #3.

2012–2015: Cluster #5 (entrepreneurial intention) evolved from Clusters #1 and #3, while Cluster #2 (social entrepreneurial intention) emerged from Clusters #1 and #3 in 2015.

2016–2018: These years saw sustained interlinkages among Clusters #1, #2, #3 and #5. Cluster #4 (sustainable entrepreneurial intention) emerged from Cluster #5 in 2017, and Cluster #0 (entrepreneurial education) developed from Clusters #1 and #2 in 2018.

2019–2021: Cluster #4 formed stronger co-citation ties with Clusters #0 and #2, while Clusters #0, #1, #2, #4, and #5 became densely interconnected.

2022–2023: Cluster #7 (gender gap) appeared, emerging from Clusters #0 and #4, with Cluster #0 becoming a central hub strongly linked to Clusters #2, #4, #5, and #7 by 2023.

This evolving network reflects the intellectual drift of the EI literature toward social and sustainable entrepreneurship themes, with increasing attention to education, gender, and inclusive entrepreneurial behaviour. Following (Chen *et al.*, 2009), such co-citation clusters correspond to thematic structures in the field, helping to clarify the knowledge bases and conceptual turning points that have shaped current EI research. The evolution of these knowledge bases and their co-citation relationships between clusters and nodes within these clusters is visualised in the attached movie file (contained in the Supplementary Material file).

Burstness, Centrality and Sigma Outcomes (Important, emergent and conceptually important papers)

Citation counts alone do not always reflect which studies will drive change or introduce fresh thinking. We use three complementary metrics to identify influential works: burst strength, betweenness centrality, and sigma, highlighting *the immediate impact and structural importance of recent articles in a corpus* (Chaomei Chen 2011; Sebastian and Chen 2021).

Table 3 lists the top 10 papers with the highest burst citation strengths (Schlaegel *et al.*, 2014) lead with a burst score of 68.15, followed by multiple high-impact publications by Liñán (2009, 2011, 2015) and Kautonen (2013, 2015). Most of these highly cited documents are in Clusters #1 (research scientist) and #2 (social entrepreneurial intention). Table 4 highlights the top 10 papers with *ongoing* burst activity as of 2024, with Cluster #0 (entrepreneurial education) dominating these recent bursts. Table 4Sa in the Supplementary Materials lists *all* three hundred ninety-seven publications that showed notable burst activity. Across these 397 articles, the average publication year was 2015 (SD=4.2). Table 4Sb in the supplementary materials lists *all* burst articles extending to 2024.

Unlike traditional citation performance metrics, burst citations offer researchers a thorough procedure to detect the most important publications within a bibliometric study, with high burst citations indicating pivotal research containing important emergent themes and concepts.

Betweenness centrality measures how well a publication bridges different areas of the research network. High centrality indicates a publication's potential to shape or redirect scholarly discourse. Table 5 lists the top 10 betweenness centrality papers within this corpus; the mean year of these publications is 2012(*SD*=4.38). Kline's (2016) SEM textbook had the highest centrality score. Articles by Kautonen (2013) and Fayolle (2015) were also in this top 10 list, with these articles also featuring in the top 10 burst citations.

Articles with high betweenness centrality are often more intellectually significant than those with high citation counts or *h* or *g*-index values. While traditional metrics highlight widely cited work, they usually overlook papers introducing new concepts or bridging distinct research areas, with high-betweenness centrality papers offering fresh, actionable insights and can open up new directions for research (Chaomei Chen 2011; Sebastian and Chen 2021).

The papers with the top 10 *sigma scores* are noted in Table 6, with a high sigma metric highlighting a potentially transformative publication. Kautonen (2013) and Fayolle (2015) again appear as standout publications, underlining their importance across all three bibliometric temporal and structural (burst strength, centrality and sigma metrics). These three metrics, burst strength, centrality, and sigma, consistently highlight key contributions within Clusters #0 (entrepreneurial education), #1 (research scientist|social entrepreneurial intention), and #2 (social entrepreneurial intention|social entrepreneurship). These clusters represent highly active and thematically dynamic research areas, reinforcing their significance for future research inquiries into entrepreneurial intentions.

WoS Research Categories

The Web of Science (WoS) subject categories offer insight into the disciplinary landscape of EI research. The 2,515 articles in the dataset are distributed across 93 WoS categories, ranging from *Agricultural Economics and Policy* to *Zoology*, illustrating the field's interdisciplinary reach. Unsurprisingly, the categories of *Business* (*n*=1,057), *Business | Finance* (*n*=20), and *Management* (*n*=685) contain the largest number of EI-related publications. However, these three categories collectively account for only 49.6% of this corpus, meaning that over half of all EI research articles in our bibliometric dataset are published in journals outside of traditional business or management domains. This finding underscores the broad diffusion of EI research across diverse disciplines. In total, 90 non-business, non-management WoS categories are represented. A full breakdown of these 93 research areas is provided in Table 5S in the Supplementary Materials.

Figure 3 is an annotated cumulative category chart highlighting the growth of EI-relevant subject categories over the last 25 years. The red vertical lines mark inflection points, years where the number of WoS categories meaningfully jumped - years when disciplinary expansion accelerated more than usual**.** These inflection points are data-driven graphic additives, with these lines marking sudden diversification in 2014 with the addition of 9 new categories, in 2020 with 13 new categories and in 2022 with 10 additional categories. A heatmap displaying the 93 WoS categories and the first year of their inclusion in the corpus is described in Figure 1S of the Supplementary Materials.

These findings suggest that entrepreneurial intentions research has, for a number of years, been in a phase of thematic diffusion and localised contextual enrichment where most of the published works in EI are appearing in non-management journals. While the field retains a strong cognitive core, its conceptual edges are expanding into domains with practical and varied resonance-including sustainability, social inclusion, and education policy. Management researchers and journal editors may benefit from linking these new strands of possible foundational EI theory more explicitly, ensuring relevance without sacrificing coherence.

This study suggests that the future of EI research lies in both refining existing EI models and broadening the field's thematic and disciplinary scope. We encourage scholars to move beyond narrowly defined bibliometric or narrative reviews that rely on limited subject classifications or restricted article sets-unless such filtering is explicitly aligned with the study's objectives. Instead, we advocate for the use of broader, more inclusive corpora that reflect the full intellectual and thematic diversity of EI scholarship. Such comprehensive datasets allow for a more holistic understanding of the field's fragmentation and support efforts to reconstruct conceptual linkages across disciplines, methodologies, and practitioner domains. When applied critically, bibliometric mapping-used not as an end in itself but as a scaffolding for synthesis-can help build a more integrated, inclusive, and actionable entrepreneurship research landscape.

What This All Means: Interpreting Conceptual Momentum and Influence

This study has traced how EI research has evolved over nearly three decades. Using bibliometric tools, we mapped how clusters of frequently co-cited papers form, expand, and sometimes fade over time. While earlier sections presented technical indicators - such as burst strength, centrality, and novelty scores, this section offers a more accessible interpretation of what these findings mean for the field's structure and direction.

Dominant and Emerging Knowledge Bases

The co-citation network reveals several well-established clusters. The largest and most structurally embedded cluster (Cluster 0) reflects core research themes in entrepreneurial education and psychological predictors such as self-efficacy. This cluster remains highly active and central, indicating its continued influence.

However, three other clusters, Clusters 2, 4, and 5, have shown strong momentum in the past five years. These clusters centre on social entrepreneurship, sustainability of entrepreneurial intentions and actions, and new models of entrepreneurial intention. Their rapid growth in recent years suggests they are becoming increasingly influential, possibly driving the next wave of conceptual development in EI research.

Interestingly, Cluster 1, while smaller, exhibits high levels of structural influence. It contains papers that potentially act as conceptual bridges, integrating themes like gender, social intention, and entrepreneurial education into potentially new hybrid identities. These bridging papers are valuable for their content and their ability to connect otherwise disconnected areas of scholarship.

Table 2: Document Co-citation Cluster Details with Alternative Cluster Labels.

Cluster	Size	Silhouette	Mean year	Years range	Top terms (log-likelihood ratio)
0	265	0.744	2019	2014-2022	Entrepreneurial education, structural equation modelling, entrep. self-efficacy.
1	249	0.887	2012	2007-2020	Research scientist, social entrepreneurial intention, gender differences.
2	221	0.79	2015	2012-2021	Social entrepreneurial intention, social entrepreneurship.
3	203	0.855	2006	2002-2017	Entrepreneurial intent, entrepreneurial perception, career intention.
4	68	0.894	2019	2015-2022	Sustainable entrepreneurial intention, entrepreneurial event model.
5	66	0.959	2018	2012-2023	Entrepreneurial intention, social entrepreneurship, social entrepreneur.
6	41	0.986	2003	1996-2015	Education approach, developing self-efficacy, women business owners.
7	26	0.994	2020	2019-2023	Gender gap, balancing employment, determining social entre. Intention.
8	15	0.995	2009	2008-2011	Mediation effect, entrepreneurial regulation, vocational guidance.
10	14	0.994	2003	2002-2007	Planned behavior approach, theory, family business exposure, entrep. Intent. self-efficacy

Note. Entrepreneurial is abbreviated as "entrep." This table describes cited publications.

Table 3: Top 10 Burst Citation Documents with Burst Strength.

Bursts	Node Name	DOI	Cluster-ID
68.15	Schlaegel C, 2014, Entrep Theory Pract	10.1111/etap.12087	2
54.89	Kautonen T, 2015, Entrep Theory Pract	10.1111/etap.12056	1
54.84	Liñán F, 2015, Int Entrep Manag	10.1007/s11365-015-0356-5	2
51.60	Bae Tj, 2014, Entrep Theory Pract	10.1111/etap.12095	1
47.97	Fayolle A, 2014, J Bus Res	10.1016/j.jbusres.2013.11.024	1
46.87	Liñán F, 2009, Entrep Theory Pract	10.1111/j.1540-6520.2009.00318.x	3
35.87	Fayolle A, 2015, J Small Bus Manage	10.1111/jsbm.12065	1
31.93	Kautonen T, 2013, Appl Econ	10.1080/00036846.2011.610750	1
27.28	Liñán F, 2011, Entrep Region Dev	10.1080/08985620903233929	1
26.09	Maresch D, 2016, Technol Forecast	10.1016/j.techfore.2015.11.006	2

Table 4: Top 10 Documents with the Highest Burst Citation Strength Current in 2024.

Bursts	Node Name	DOI	Cluster-ID
17.63	Hair JF, 2019, Eur Bus Rev	10.1108/EBR-11-2018-0203	4
14.38	Meoli A, 2020, J Bus Venturing	10.1016/j.jbusvent.2019.105982	0
14.12	Hassan A, 2020, Educ Train	10.1108/ET-02-2020-0033	0
12.8	Elnadi M, 2021, Int J Manag Educ-Oxf	10.1016/j.ijme.2021.100458	0
11.91	Liu Xy, 2019, Front Psychol	10.3389/fpsyg.2019.00869	0
9.7	Hoang G, 2021, Educ Train	10.1108/ET-05-2020-0142	0
9.4	Shah IA, 2020, Journal of Economic Structures	10.1186/s40008-020-00195-4	0
8.86	Jena RK, 2020, Comput Hum Behav	10.1016/j.chb.2020.106275	0
8.74	Gieure C, 2020, J Bus Res	10.1016/j.jbusres.2019.11.088	0
8.52	Shi YC, 2020, Front Psychol	10.3389/fpsyg.2020.01209	0

Note. Although the records were selected to November 2023, the burst citations end year extends to 2024

Table 5: Top 10 Documents with the Highest Betweenness Centrality Score.

Centrality	Node Name	DOI	Cluster-ID
0.17	Kline RB, 2016, Principles and Practice of Structural Equation Modeling,		3
0.09	Kautonen T, 2013, Appl Econ	10.1080/00036846.2011.610750	1
0.08	Souitaris V, 2007, J Bus Venturing	10.1016/j.jbusvent.2006.05.002	3
0.07	Karimi S, 2016, J Small Bus Manage	10.1111/jsbm.12137	2
0.07	Zhao H, 2005, J Appl Psychol	10.1037/0021-9010.90.6.1265	3
0.06	Nabi G, 2017, Acad Manag Learn Edu	10.5465/amle.2015.0026	2
0.06	Fitzsimmons JR, 2011, J Bus Venturing	10.1016/j.jbusvent.2010.01.001	1
0.06	Fayolle A, 2015, J Small Bus Manage	10.1111/jsbm.12065	1
0.06	Santos FJ, 2016, J Small Bus Manage	10.1111/jsbm.12129	1
0.06	Fetscherin M, 2008, J Electron Commer Re		6

Table 6: Top 10 Documents with the Sigma Score.

Sigma	Node Name	DOI	Cluster-ID
14.87	Kautonen T, 2013, Appl Econ	10.1080/00036846.2011.610750	1
13.16	Liñán F, 2015, Int Entrep Manag J	10.1007/s11365-015-0356-5	2
9.74	Kautonen T, 2015, Entrep Theory Pract	10.1111/etap.12056	1
9.47	Fayolle A, 2015, J Small Bus Manage	10.1111/jsbm.12065	1
5.41	Souitaris V, 2007, J Bus Venturing	10.1016/j.jbusvent.2006.05.002	3
4.52	Fitzsimmons JR, 2011, J Bus Venturing	10.1016/j.jbusvent.2010.01.001	1
3.54	Liñán F, 2011, Entrep Region Dev	10.1080/08985620903233929	1
3.47	Karimi S, 2016, J Small Bus Manage	10.1111/jsbm.12137	2
3.26	Schlaegel C, 2014, Entrep Theory Pract	10.1111/etap.12087	2
2.94	Nabi G, 2017, Acad Manag Learn Edu	10.5465/amle.2015.0026	2

Making Sense of Influence and Momentum

We used several indicators to understand how particular papers and clusters shape the intellectual structure of EI research:

Citation burst identifies papers that received a surge of attention quickly. These "hot" publications often reflect newly popular ideas or topics undergoing rapid uptake. In our dataset, articles by (Meoli *et al.*, 2020; Hassan *et al.*, 2020; Elnadi and Gheith, 2021) showed strong citation bursts in the last five years, highlighting the key themes of the nexus between EI and entrepreneurial value with moderating influences, entrepreneurial ecosystem relationships with EI, and relating self-efficacy with the TPB perception items. The DOIs in Table 4 allow direct access to each listed article.

Betweenness Centrality (BC) measures a paper's structural role in bridging research clusters. High-BC articles often introduce ideas that connect otherwise distinct areas of the literature. The most central articles included (Fayolle and Gailly, 2015; Souitaris *et al.*, 2007; Karimi *et al.*, 2016), reflecting the relationship between education and EI and the TPB model with broader conceptual debates.

Sigma is a composite metric reflecting both novelty and structural influence. It combines a paper's citation burst strength with its centrality. Articles that rank highly on sigma - such as (Kautonen *et al.*, 2013; 2015; Fayolle and Gailly, 2015; Linnan and Fayolle, 2015) - have not only attracted rapid scholarly attention but also reshaped the field's structure by connecting subdomains or introducing new conceptual angles encompassing systematic review of the EI literature (2004-2013), predicting EI using TPB and the influence of entrepreneurship education on EI.

Papers or clusters that score highly across multiple indicators represent either longstanding pillars of the field (e.g., foundational TPB work or early educational models) or emerging hotspots (e.g., gender, sustainability, social entrepreneurship). Understanding influence in this way provides more than just a count of citations; it captures how scholarship actively drives intellectual convergence, spurs conceptual shifts, or bridges disciplinary divides.

Interdisciplinary Spread and Conceptual Fragmentation

Another insight comes from the Web of Science (WoS) categorisation of articles. The 2,515 records in this study were spread across more than 90 subject categories-ranging from business and management to education, psychology, and regional studies. This signals broad interdisciplinary reach, which is a strength. However, it also contributes to conceptual fragmentation, as studies addressing similar questions may appear disconnected in the formal literature.

This dispersion may help explain why EI research can feel mature and uncoordinated. Researchers often work in silos defined by discipline or journal category, reducing the chance of theoretical integration. Future work may benefit from explicitly reconnecting these streams-for example, linking educational interventions to psychological intention models or integrating sociocultural context into entrepreneurial intention frameworks.

Anchor Publications with Enduring Structural Influence

Two publications stand out across all three influential metrics—burstness, betweenness centrality, and sigma scores, suggesting they have played an outsized role in shaping the EI literature's direction over the past decade. The first is (Kautonen *et al.*, 2013), which provides a rare longitudinal test of the TPB in predicting not just EI but actual entrepreneurial behaviour. Drawing on two-wave data from Finland, it offered empirical confirmation

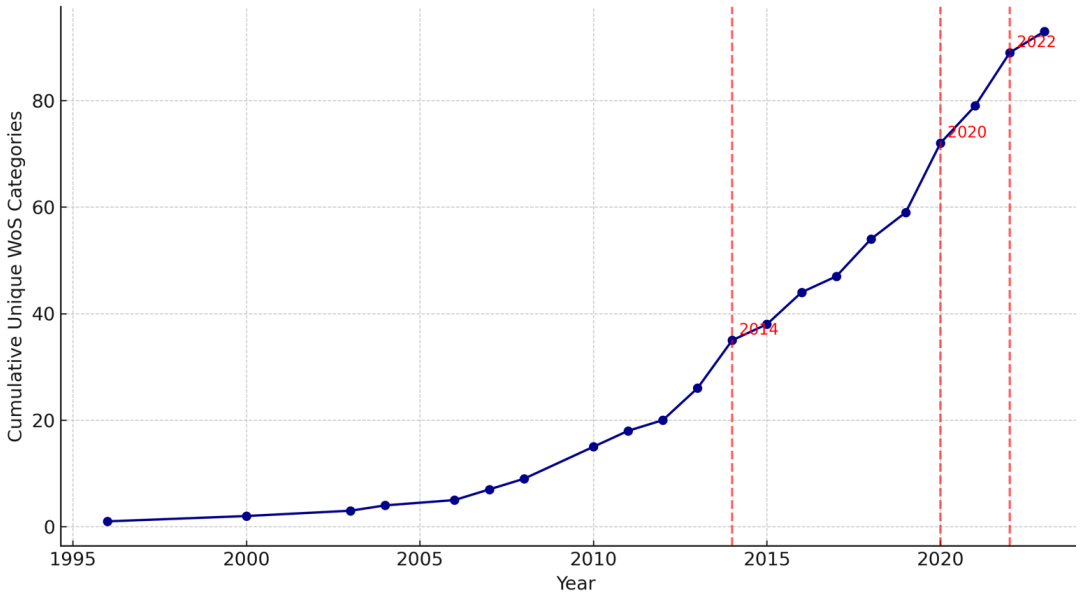

Figure 3: Cumulative Web of Science Categories over Time.

that intention and perceived behavioural control predict future entrepreneurial action, closing a critical gap in the EI literature. Its high burst and structural centrality indicate that it has served as both a consolidating force within TPB research and a bridge to newer behavioural models (Cluster 3).

The second is Fayolle and Gailly (2015), which examines how entrepreneurship education affects entrepreneurial attitudes and intentions over time. Notably, it introduces the concept of hysteresis and persistence - showing that educational interventions can have different impacts depending on prior exposure to entrepreneurship and that these effects may endure. Its influence is marked by citation volume and its role in connecting education-focused research to broader debates around intentionality, behavioural formation, and policy. These publications illustrate how the field's most influential contributions offer theoretical refinement, empirical innovation, and cross-cluster linkage - connecting core constructs like TPB and self-efficacy with adjacent domains such as education, gender, and behavioural outcomes.

CONCLUSION: LINKING STRUCTURAL AND CONCEPTUAL INSIGHTS

This study reveals that while EI research has diversified thematically, its intellectual structure remains unevenly anchored by a small set of integrative works but fragmented across a wide disciplinary spectrum. Using a multi-method bibliometric framework, we examined the intellectual structure and thematic evolution of the field through document co-citation analysis, citation burst detection, betweenness centrality, and sigma metrics. Each technique offers a distinct perspective on the field's development over time. Importantly, bibliometric techniques offer advantages over traditional narrative or systematic reviews. Their capacity to analyse large-scale publication patterns provides a more comprehensive, data-driven understanding of a field's conceptual architecture. This is particularly valuable for identifying research fronts, conceptual blind spots, and the cross-field exchange of ideas - interdisciplinary diffusion patterns that may not be visible through manual review alone.

Our analysis identified ten major thematic clusters, spanning early theoretical and educational foundations to sustainability, social entrepreneurship, and gender. Several clusters-particularly those related to entrepreneurial education, social entrepreneurial intention, and gender experience-exhibited dense interlinkages, suggesting a field moving beyond isolated conceptual testing toward more embedded and impact-oriented research directions.

As discussed in earlier sections, works by Kautonen and Fayolle stand out across local and global citations and all three structural dimensions - burst strength, betweenness centrality, and sigma. These works exemplify the rare combination of structural significance and temporal resonance, helping consolidate foundational ideas and shaping future research directions. The clusters most associated with these influential works, clusters #0 (entrepreneurial education), #1 (social entrepreneurial intention), and #2 (social entrepreneurship), appear to represent the field's most vibrant and emergent knowledge bases.

Publication patterns mirror this thematic diversification. Fewer than half of all 2,515 EI-related articles appear in business or management journals, while over 90 Web of Science (WoS) categories contribute to the field. While this diffusion underscores EI's broad conceptual relevance, it raises concerns about coherence. Despite high citation bursts, many recent works have failed to integrate structurally into the broader intellectual network - an indicator of fragmentation.

The divergence between temporal popularity and structural integration presents an important caveat: citation bursts alone may signal attention, not influence. Without conceptual uptake across clusters, even popular studies risk remaining siloed within narrow subfields. The field thus faces a dual challenge, maintaining openness to new perspectives while ensuring cumulative theoretical development. In this light, bibliometric analysis offers more than technical mapping - it provides a strategic lens for confronting fragmentation, guiding integrative theory-building, and aligning scholarly inquiry with societal needs. Tracing where clusters evolve and when they dissipate, this study highlights where intellectual capital accumulates, and conceptual bridges remain underdeveloped. The future of EI research depends on thematic novelty and strategically stitching these themes into a coherent and policy-relevant research agenda.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

While this study offers a systematic overview of the EI field's intellectual evolution, its findings are bounded by certain methodological and interpretive limitations. These also highlight promising directions for future conceptual and empirical work.

The results of any bibliometric study depend heavily on the dataset's quality, breadth, and comprehensiveness. Although no subject area restrictions were applied in this study, only articles and early-access reviews were included. A broader inclusion strategy - incorporating conference proceedings, book chapters, or grey literature, has been recommended by both bibliometricians and meta-analysts. Such inclusion could enrich baseline networks, enhance bibliometric map quality, and reduce peer review and publication selection biases (Borenstein *et al.*, 2009; Rosenthal 1993; C Chen 2018; C. Chen and Song 2019). A future bibliometric EI study using a broader set of document types could yield important complementary insights.

The co-citation maps presented here were generated using spectral clustering and the Kamada–Kawai layout algorithm in CiteSpace. While alternative tools like VOSviewer offer robust visualisation

capabilities, CiteSpace uniquely supports automated cluster labelling, manages larger datasets more efficiently, and enables integration of temporal and structural metrics (e.g., sigma, burst detection, centrality). These features justify its use in this study. However, automated cluster labelling via noun phrase extraction can sometimes yield ambiguous or overly narrow descriptors. Researchers must examine citing and cited documents to build richer conceptual interpretations.

Document Co-Citation Analysis (DCA) assumes that co-cited documents share genuine conceptual linkages. This assumption can be undermined by biased citation practices, disciplinary silos, or structural inertia (Vogel and Güttel 2012; Chaomei Chen, Ibekwe-SanJuan, and Hou 2010; Boyack and Klavans 2010). Complementary techniques, such as direct citation, bibliographic coupling, or author co-citation analysis, could offer additional structural insights.

A broader concern is whether the entrepreneurial intentions field retains disciplinary coherence. With over 90 Web of Science categories represented and fewer than half of EI articles published in business or management journals, the field now spans psychology, education, environmental studies, and even domains like telecommunications or nutrition. While this diffusion enhances interdisciplinary innovation, it also raises questions about whether entrepreneurship retains conceptual ownership of the EI domain. Without strategic efforts at reintegration, the fragmentation risk may outweigh topical diversity's benefits.

This review relied on a single database (Web of Science), excluded non-English publications, and applied citation-based thresholds. While these constraints limit generalisability, the study still provides a robust structural snapshot of EI research. The absence of qualitative coding or full-text content analysis suggests that findings should be interpreted as indicative rather than exhaustive. That said, bibliometric mapping holds both retrospective and forward-looking value. Thematic clusters identified here offer a basis for reconnecting new areas of interest-such as gender, sustainability, and social entrepreneurship-with foundational theories in entrepreneurial cognition and behaviour. These linkages could transform fragmented subfields into a more integrated, policy-relevant research landscape.

The implications of this research extend beyond academia. For policy-makers, educators, and entrepreneurial support organisations, the findings reveal that much of the influential literature remains anchored in traditional cognitive frameworks. Few structurally influential publications have emerged from practice-oriented or context-rich studies. This misalignment invites closer attention to entrepreneurs' realities in underrepresented or informal economic contexts. Future studies could build on these findings by combining structural mapping with expert interviews, case studies, or qualitative synthesis. This would help trace how influential ideas move from scholarly discourse into entrepreneurial practice. For management researchers, this also offers a renewed opportunity to revisit theory building as both an academic and a practical exercise.

This study contributes a replicable framework for understanding structural evolution in research domains. Beyond EI, similar approaches could be applied to other entrepreneurship subfields - such as digital transformation, sustainability, or inclusion, to surface conceptual blind spots and neglected research areas. The trajectories of key research themes identified in this study - including their emergence, growth, and structural connections, offer valuable insights for shaping entrepreneurship curricula and policy frameworks.

Ultimately, the challenge is not merely to accumulate more studies but to strategically connect them. This review demonstrates the areas in which scholarly influence has concentrated and those where it has fragmented or dissipated. The task ahead is to integrate diverse conceptual strands - behavioural models, gender theory, education, and sustainability into a coherent, future-ready research agenda. In this sense, bibliometric mapping becomes more than an analytical tool: it is a shared language for bridging fragmentation, prompting synthesis, and aligning scholarship with theoretical clarity and societal relevance.

ACKNOWLEDGEMENT

All authors certify that they have no affiliations with or involvement in any organisation or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

FUNDING

The first author is a recipient of an Australian Government Research Training Program Stipend, which provided financial support for this research.

DECLARATION OF GENERATIVE AI APPLICATION

ChatGPT assisted with manuscript editing, structural and contextual advice.

Grammarly assisted with text edits and grammar.

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Cite this article: Duplock R, Casali GL, McLennan C. Beyond the Narrative: Structural Mapping and Thematic Evolution in Entrepreneurial Intentions Research. J Scientometric Res. 2026;15(1):24-37.