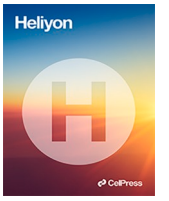
Heliyon 10 (2024) e35979



Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article



Behavioral finance in a hundred keywords

Teresa Corzo [a,*], Ramón Hernán [b], Guillermo Pedrosa [c]

[a] Icade School of Economics and Business Administration, Universidad Pontificia Comillas, c/Alberto Aguilera 23, 28015, Madrid, Spain
[b] Mutua Madrileña Automovilista, Madrid, Spain
[c] Barclays Bank Ireland, Dublin, Ireland

ARTICLE INFO

Keywords:
Behavioral finance
Keywords analysis
Co-word
Top journal
Data mapping
Data visualization

ABSTRACT

We analyze leading journals in behavioral finance to identify the most-used keywords in the area and how they have evolved. Using keyword analysis of data between 2000 and 2020 as well as data mapping and visualization tools, a dynamic map of the discipline was constructed. This study assesses the state-of-the-art of the field, main topics of discussion, relationships that arise between the concepts discussed, and emerging issues of interest. The sample comprises 3876 pieces, including 15859 keywords from journals responsible for the growth of the discipline, namely the Journal of Behavioral and Experimental Economics, Journal of Behavioral and Experimental Finance, Journal of Economic Psychology, Journal of Behavioral Finance, and Review of Behavioral Finance. During the period analyzed, our results depict a lively area and highlight the prominent role that experiments play in the field. Two related but different streams of behavioral finance research are revealed.

1. Introduction

Behavioral economics and finance have emerged as research areas that have revolutionized economic and finance theories. Since the first studies of the discipline [1,2] these areas have experienced a steady increase in research interest.

During the XXI century, the Academy has validated the importance of this behavioral approach by awarding several Nobel prizes in economic science to pioneering researchers in this area, [3–5]. Additionally, we note the work on experimental economics [4] since this area is growing rapidly.

As several studies have observed, behavioral economics and finance are closely related; there is much overlap between the two areas, which has grown over time. Recent studies [6] noted that the field of behavioral economics is wider than that of behavioral finance. The former covers issues that connect human behavior with demand, consumption, prices, investments, managerial decisions, and the role that heuristics and cognitive biases play in decision-making processes, whereas the latter focuses on the study of errors in judgment and decision-making characteristics in financial investments [6]. In 2007 [7] it was pointed out that the diffusion of behavioral finance, which is a branch of behavioral economics, was influenced by the work of some of the discipline's leading authors [8].

This study conducts a bibliometric analysis and focuses on the evolution of the field of behavioral finance during the XXI century. As we do not share a unique and universal behavioral finance definition, we follow previously proposed definitions [5] and understand behavioral finance as "finance from a broader social science perspective including psychology and sociology". Moreover, it is noted

* Corresponding author.
E-mail addresses: mcorzo@comillas.edu (T. Corzo), rhernan@mutua.es (R. Hernán), guillepedrosa@gmail.com (G. Pedrosa).

https://doi.org/10.1016/j.heliyon.2024.e35979
Received 21 September 2022; Received in revised form 4 August 2024; Accepted 7 August 2024
Available online 10 August 2024
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that the "behavioral approach offers the opportunity to develop better models of economic behavior by incorporating insights from other social sciences discipline[s]" [1], moving toward descriptive theories derived from data.

This new approach arises, at least in part, in response to the difficulties of the traditional paradigm in explaining stock market issues. Behavioral finance emerges in the context of limited rationality [9], in which investors do not always have rational and predictable reactions. However, their decision-making processes include cognitive biases and emotional aspects that can lead to various market anomalies and inefficiencies.

Although it is claimed that "it is time to stop thinking of Behavioral Economics as a revolution" and considered it a "part of the growing importance of empirical work in economics" [1], the truth is that it is still not recognized as mainstream economics or finance.

If this area is evolving, what topics are now considered in journals positioned in behavioral finance trends? How have these topics evolved in recent years? Some studies have approached these questions from different angles by performing bibliometric analyses using various datasets, timeframes, and purposes (discussed in the following section). This study departs from previous research by examining behavioral finance-related journals that publish articles that have not been previously featured in behavioral finance. We use a keyword analysis of five leading journals identified through the Web of Science (WoS), Scopus, and Google Scholar: the Journal of Behavioral Finance, Review of Behavioral Finance, Journal of Behavioral and Experimental Economics, Journal of Behavioral and Experimental Finance, and Review of Behavioral Finance. We obtained a sample of 3876 published articles with 15,859 keywords. The five journals were responsible for the growth of the discipline during the XXI century. Using data mapping and visualization tools, we obtain a dynamic map by examining keywords and classifying the research topics according to their development and importance.

This study contributes to the discipline in several ways. First, we identify the most used keywords and their evolution over 21 years (2000–2020). Second, we reveal the most frequent co-word relationships: pairs, trios, quartets, and quintets of keywords that appeared most frequently in publications. Third, we demonstrate that frequently used words in the discipline are interrelated among journals with different approaches, how these words are used over time, and how they are frequently connected throughout other publications.

This field has produced the highest number of articles in economics and business [6], followed by psychology, demonstrating that the areas of behavioral economics and finance are associated with psychology, which fosters mutual influence.

Our findings identify "experiment" as a top keyword, which is in line with the previous literature [10] that recognizes the contribution of the Nobel laureate Vernon Smith [11]. Moreover, we validate the evolution of the discipline into an empirical one following a deductive approach [1].

Within the journals analyzed, we find evidence of two distinct streams: a general one with the higher impact on research production that is related to experimental economics and the common good problem and a specific one associated with psychological traits that are explored under behavioral finance research.

Our results show that articles with the most frequent keywords within the behavioral discipline are not the ones that (within our sample) have the highest number of citations. This interesting finding highlights an avenue for research to explore the impact of behavioral finance beyond its traditional boundaries, and to explore its interactions with the broader domains of finance and economics.

2. Literature review

Few studies have conducted bibliometric or keyword analyses of behavioral finance. Existing a noteworthy exception [12], who focused explicitly on the behavioral finance field, using a different sample, methodology, and timeframe from our study. The authors analyzed scientific papers, extracted from WoS, that were published between 1987 and 2017 and contained the words "behavioral finance," "behavioral portfolio," or "investor sentiment" in the title, summary, or keywords. Like our study, they introduced a co-word analysis and used data visualization tools.

Their results showed the area's growing attractiveness and development, especially since 2009. They also found that "until 2017, this area had been disseminated mostly in journals that publish[ed] papers in the financial field with a certain generality", as the most cited papers were found in journals such as the Journal of Financial Economics, Journal of Finance, and Journal of Economic Perspectives. They observed that investor sentiment stands out in terms of both productivity and impact. The disposition effect, overconfidence, and expected stock returns were among the most prominent themes.

Another notable exception [6], which used a bibliometric analysis and uncovered the most influential authors, articles, and journals that have contributed to the state of the art of behavioral economics and behavioral finance. Pieces were also extracted from WoS by searching for the "behavioral economics, and/or behavioral finance, and/or behavioral accounting" chain in the title, abstract, and keywords. The period covered was between 1967 and 2015. The authors also observed a constant increase in the number of published articles. Ten keywords were identified: behavioral economics, choice, behavioral finance, risk, behavior, decision-making, information, psychology, demand, and prospect theory. They also found that Kahneman and Tversky (1979) stood out as a point of reference.

The authors [6] identified a broad selection of economics and finance journals with a theoretical focus that publish related research; however, none of these journals were exclusively dedicated to the field of behavioral finance. Similar findings were reported by other researchers [12].

In 2017 a citation analysis was conducted and used article metadata to examine the top ten finance journals according to the A or A* classification in the Excellence in Research Australia list (2010) [10]. The Journal of Behavioral Finance ranked fifth. He used keywords to identify the most published authors, most cited articles, top publishing countries and universities, top publication years, and most discussed topics. He covered the journal's entire publication history until July 2015. Moreover, in this analysis, he found that in the Journal of Behavioral Finance, the top keywords were behavioral finance, decision-making, disposition effect, experiment,

framing, investor sentiment, pension plan, prospect theory, stock price, and trading volume. In this study, we identified the emergence of the keyword "experiment." Notable common keywords in the two previous studies were investor sentiment, decision-making, disposition effect, and prospect theory.

Additionally, in Ref. [13] we find an investigation of the history of the Journal of Behavioral Finance from 2004 to 2017 using metadata from Scopus and WoS. The study found that the Journal of Behavioral Finance rapidly established itself as a well-respected journal in the field. The top keywords were behavioral, investment, finance, behavior, financial, investor, risk, stock, decision, and theory, whereas the top phrases or terms were behavioral finance, investment policy, behavior, decision-making, disposition effect, and investor sentiment, which parallels our findings (presented in Subsection 4.2). Furthermore, the paper examined the Review of Behavioral Finance (78 articles in Scopus) and Journal of Behavioral and Experimental Finance (141 papers in Scopus.)

Finally, other studies approached behavioral finance differently. The authors discussed research and trends in behavioral finance over the past 20 years (1995–2013) [14]. By searching for "behavioral finance" in WoS, they retrieved "must-read" articles for a new researcher in the field and identified the number of publications and citations. Remarkably, none of the "must-read" publications were published in the journals that we analyzed.

The literature review indicates that behavioral finance is gaining momentum. Furthermore, blockbuster and seminal papers were published several years ago and not in journals explicitly devoted to the field. Journals dedicated to this area are new and have emerged as the field has developed. However, these journals are sufficiently mature to assess their impact on and contribution to behavioral finance.

3. Methodology and data

3.1. The bibliometric approach

The use of bibliometric approaches has gained prominence in literature across various disciplines. We employed a bibliometric analysis to review studies published in five prominent behavioral finance journals. The growing popularity of bibliometric reviews can be attributed to several factors, including the introduction of software tools, interdisciplinary methodologies, and enhanced capabilities to handle large volumes of data [15].

Bibliometric research employs statistical methods to analyze various forms of publications with a particular focus on scientific content. This field has experienced substantial growth in recent years and draws on research methods from disciplines, such as library science and computing. However, its applicability extends beyond these domains [15], whose extensive bibliometric research spanned business, management, accounting, economics, econometrics, finance, and social sciences.

As a variant of systematic literature reviews [12,16], bibliometric analysis involves the application of quantitative and statistical techniques, including cluster analysis and scientific mapping, to bibliographic data [15,17,18]. By employing quantitative and statistical methods, measures, and technology, bibliometric studies enhance objectivity and comprehensiveness compared with other types of reviews.

Bibliometric methodology encompasses the utilization of quantitative techniques, including bibliometric and citation analyses, applied to bibliometric data. Despite its origins in the 1950s [19], indicating its longstanding presence, this methodology extends beyond the domain of library science and has applications in various fields of study [20]. It has also garnered attention within management research [21] and has been widely employed in studies similar to the present one. Additionally, this methodology is particularly well-suited for our study due to its ability to process large volumes of data effectively and mitigate potential biases arising from the authors' influence.

Bibliometric methodology encapsulates the application of quantitative techniques (i.e., bibliometric analysis and citation analysis) to bibliometric data. The first discussions on bibliometrics began in the 1950s [19], which suggests that bibliometric methodology is not new. As a methodology, bibliometrics belongs to library science but has been applied in various fields of study [20]. It has also received attention from various areas of management [21] and has been widely used in studies like the current study. Furthermore, the methodology was well suited for this study due to its ability to process a large amount of data and eliminate author bias.

Specifically, we conducted keyword analysis. Keyword analysis involves analyzing the occurrence and frequency of specific keywords in the literature. It helps to identify key themes, trends, and research topics within a field, thereby transcending subjective interpretations.

We analyzed author keywords, which are terms or short phrases selected by the authors themselves, to classify and direct entries into indexing and information retrieval systems within subject-specific databases. Keywords serve as crucial tools for writing and searching for information in manuscripts and related areas of research.

This study utilized the concepts of "keywords" as identified in each article. This includes key phrases, which are lexemes consisting of multiple words, and simple keywords representing single terms. This differentiation is based on a literature review on keyword-extraction techniques. The International Encyclopedia of Library and Information Science describes these keywords succinctly and accurately, representing the topic or aspect of the topic discussed in a document.

The journals selected for our study required the authors to provide a list of keywords for their articles. These keywords serve various purposes [22], such as summarizing the content of the article, helping authors quickly determine if the article aligns with the readers' interests, facilitating indexing to enable quick retrieval of relevant articles, and aiding search engines in conducting more precise searches. In our study, we employed keywords as major representatives of the research area, assigning equal relevance to each identified keyword rather than considering their frequency within the article texts.

Consequently, selecting appropriate keywords is crucial because they are used for indexing purposes and greatly influence the

discoverability and citation potential of articles. They effectively defined the domains, sub-domains, topics, and research objectives covered within a paper.

Finally, we employed data visualization techniques to represent and communicate complex relationships and patterns within the papers. Scientific mapping tools, such as keyword co-occurrence mapping, help visualize the intellectual structure of a field.

3.2. Sample under analysis

The articles analyzed in this study were sourced from prominent behavioral finance journals. To identify these journals, we utilized reputable academic search engines such as Google Scholar, WoS (Web of Science), and Scopus [23]. We conducted a search using the term "behavioral finance" and compiled the results in Table 1. The journals listed in Table 1 are arranged in descending order based on their indices within each search engine.

The search yielded five journals related to this discipline. These journals show the different approaches adopted in behavioral finance and cover a broad spectrum. The selected journals were (i) the Journal of Behavioral Finance (JBF), (ii) Journal of Economic Psychology (JEP), (iii) Review of Behavioral Finance (RBF), (iv) Journal of Behavioral and Experimental Finance (JBEF), and (v) Journal of Behavioral and Experimental Economics (JBEE).

Between 2000 and 2020, the sample covered 3876 articles cited more than 65,000 times, and 15,859 keywords were used to develop these studies. Details of the samples are listed in Table 2.

The use of keywords evolved throughout the selected sample, with a significant increase from 2008 (Fig. 1) mainly due to an increase in the number of papers published in the Journal of Behavioral and Experimental Economics and the appearance of new journals in the selection whose lifespan did not match that of the chosen sample [12].

We observe an uneven number of published papers, with JEP and JBEE journals in the leading role, substantially affecting our results; ultimately, we detect two streams in behavioral finance research.

4. Results and discussion

4.1. Top 100 keywords in behavioral finance

After identifying the keywords, we calculated the number of times each keyword was used. A level is produced for each number of records, which relates to the number of repetitions. There may be different keywords at the same level because they are repeated the same number of times. Fig. 2 shows a map of 100 most repeated words, up to a level of 18 repetitions. A complete list of the top 100 keywords and their repetitions can be found in the Appendix.

Fig. 2 shows the total number of records for each keyword. The size of each bubble depends on the number of records; as we can see, “experiment” is the most repeated keyword. To help with data visualization, the color of each bubble also corresponds to the number of records. However, in this case, instead of using a numerical scale, we used a logarithmic scale to offset the effect of the high recurrence of the word “experiment” on the rest of the keywords.

In Fig. 3 we observe, in order of relevance, the top 10 keywords used by the authors were as follows: experiment, behavioral finance, behavioral economics, experimental economics, cooperation, happiness, gender, trust, social capital, and decision-making.

Table 3 presents the findings regarding the keywords found in the literature review. Most of these words have not been identified in previous studies.

4.2. Time evolution of top keywords

We assessed the time evolution of the relevance of the top keywords using data visualization tools (Fig. 4).

As shown in Fig. 4, terms such as behavioral finance, experiments, experimental economics, and gender are evidently gaining importance, whereas others, such as social capital or happiness, faded away. We also observe that there are concepts within the discipline that acquired greater relevance in the past and have recently lost importance, such as decision-making, trust, and investor sentiment.

Table 1
Journals related to behavioral finance obtained by search engines.

	Journal	Best Quartile (Scopus)	Best Quartile (JCR)
Google Scholar	Journal of Behavioral and Experimental Finance	Q1	–
	Journal of Behavioral Finance	Q3	Q3
Web of Science	Journal of Behavioral and Experimental Economics	Q1	Q3
	Journal of Behavioral Finance	Q3	Q3
	Journal of Behavioral and Experimental Finance	Q1	–
	Review of Behavioral Finance	Q3	–
Scopus	Journal of Economic Psychology	Q1	Q2
	Journal of Behavioral and Experimental Economics	Q1	Q3
	Journal of Behavioral Finance	Q3	Q3
	Review of Behavioral Finance	Q3	–

Table 2
Number of papers, citations, and keywords in each journal during the sample period 2000–2020.

Journal	Papers	Citations	Keywords	Years under study
JEP	1348	38,844	5787	21
JBEE	1654	22,193	6736	21
JBF	484	1880	1655	21
JBEF	268	1753	1165	7 (since 2014)
RBF	122	539	516	12 (since 2009)
Total	3876	65,209	15,859	

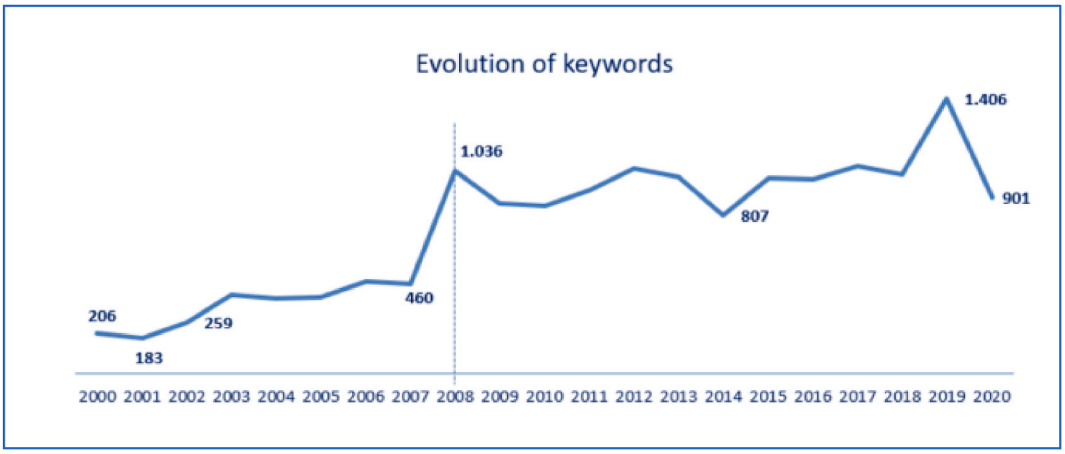


Fig. 1. Time evolution of keywords.

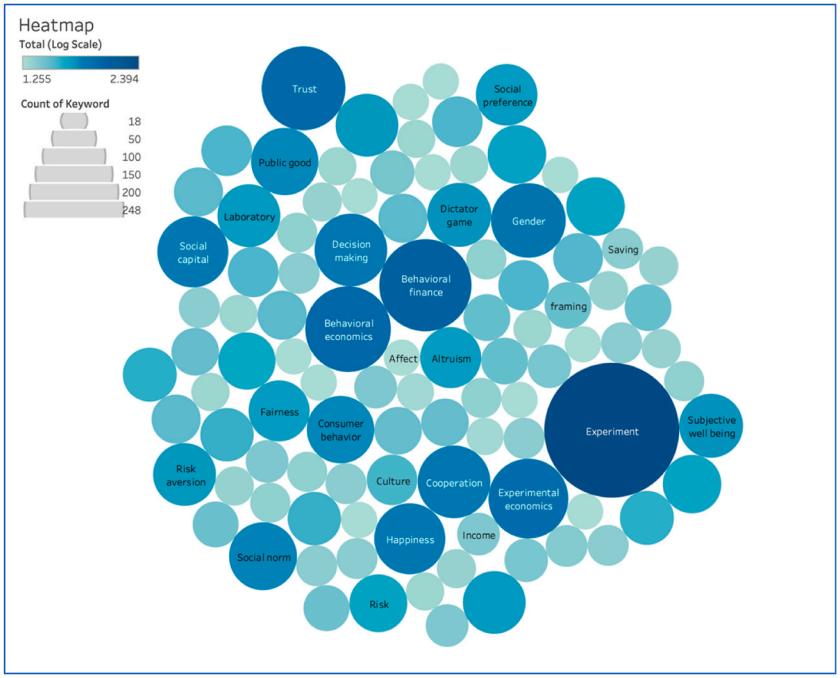


Fig. 2. Heatmap of the 100 most frequent keywords.

Interestingly, terms such as decision-making and behavioral economics appeared to be stable, pointing to an intertemporal common ground in the discipline, as shown in Table 3.

The steady increase we observed in the keyword "experiment" suggested that this discipline became experimental. However, when

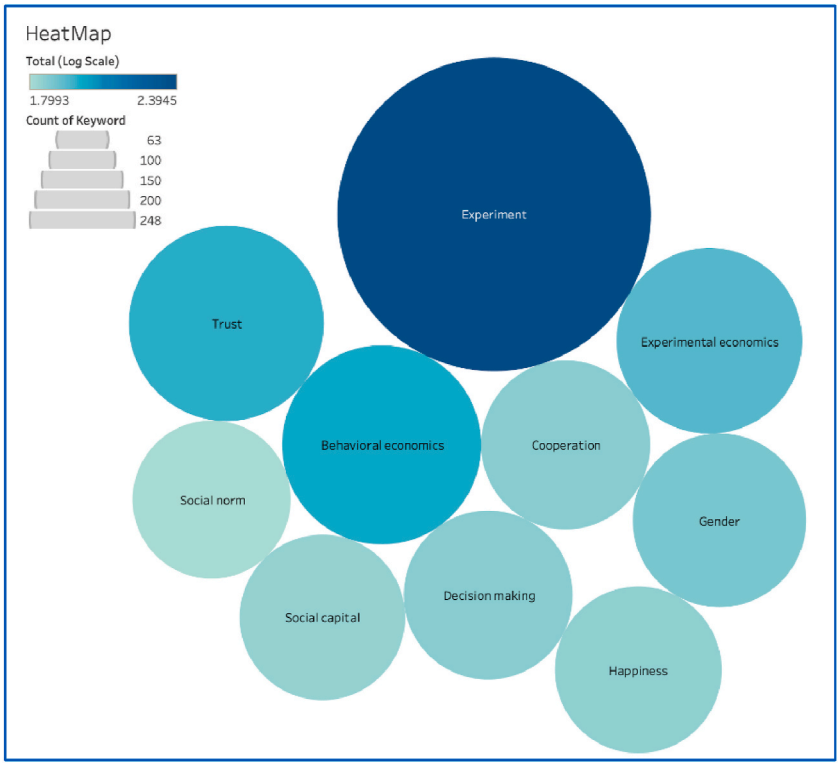


Fig. 3. Heatmap of the 10 most frequent keywords.

Table 3
Lists of the top ten keywords obtained in the papers that are reviewed in the literature review section and are related to the buildup of behavioral finance. Repeated keywords are highlighted.

Paule Vianez et al. (2020) [12]	Costa et al. (2019) [6]	Calma (2017) [10]	Calma (2019) [13]	This paper
Investor Sentiment	**Behavioral Economics**	**Behavioral Finance**	**Behavioral Finance**	**Experiment**
Disposition Effect	Choice	**Decision Making**	**Disposition Effect**	**Behavioral Finance**
IPO	**Behavioral Finance**	**Disposition Effect**	**Investor Sentiment**	**Behavioral Economics**
Overconfidence	Risk	**Experiment**	**Prospect Theory**	Experimental Economics
Portfolio Selection	Behavior	Framing	Investors	Cooperation
Expected Stock Return	**Decision Making**	**Investor Sentiment**	Herding	Happiness
Arbitrage	Information	Pension Plan	Investor Behavior	Gender
Model	Psychology	**Prospect Theory**	**Overconfidence**	Trust
Bias	Demand	Stock Price	Volatility	Social Capital
Attention	**Prospect Theory**	Trading Volume		**Decision Making**

we examined each journal separately, we found that two distinct research streams appeared.

- Journal of Behavioral and Experimental Economics (JBEE)

Previously named *Journal of Socio-Economics*, the JBEE deals with economic issues related to other social sciences, especially psychology, using experimental research methods. Therefore, this journal addresses contributions to behavioral economics, experimental economics, economic psychology, judgment, and decision-making.

Fig. 5 shows that the journal has increased its experimental activity by presenting numerous experiments in recent years. The incidence shown by the keywords "social capital" and "trust" between 2009 and 2013 was related to different authors [24], with more than 70 citations, who analyzed the discourse and behavior of economic actors who are involved in credit activities. These studies demonstrated that behind the alleged generous nature of the trust relationship, there was an economic rationality whose social and temporal optimization horizons differed from those of the commercial exchange model seen in conventional economic theory, influenced by the financial crisis of that period.

- Journal of Economic Psychology (JEP)

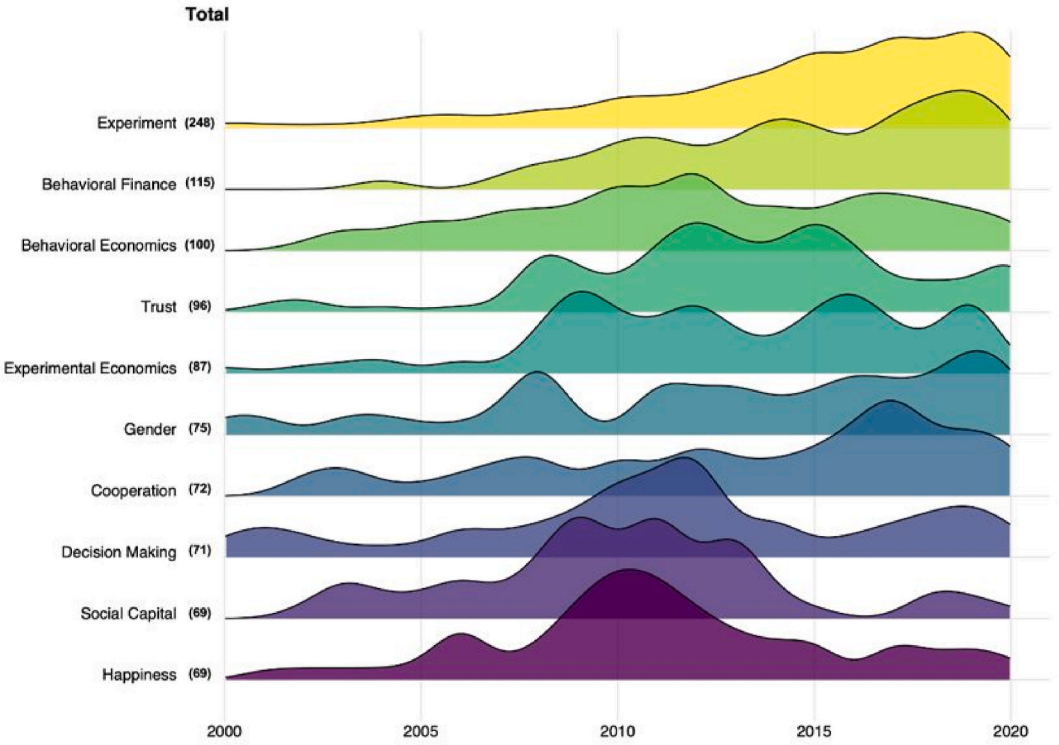


Fig. 4. Evolution of the top 10 keywords in the sample of study (2000–2020). Each of the ridgelines depicts how each of the keywords has evolved. The area under each curved line equals 1; all colored shapes have the same area.

This academic journal aims to publish research that improves the understanding of behavioral aspects, mainly psychological, of economic phenomena and processes, and of economic psychology as a discipline that studies the psychological mechanisms underlying economic behavior.

One of the concepts among the top ten keywords was tax compliance (Fig. 6), the name of which suggests a vital psychological component. This is due to experiments on tax compliance and tax evasion [25] with more than 375 citations. These authors estimated the determinants of an individual's intrinsic willingness to pay taxes (fiscal morals) using information from the World Values Survey of a wide range of countries over several years of data.

The keywords "experiments and experimental economics," "decision making," and "behavioral economics" were consistently used along this time frame. As with the JBEE, we observed an emergence of the keywords "trust," "happiness," and "gender."

- Journal of Behavioral and Experimental Finance (JBEF)

This journal began publishing articles in 2014. The number of repetitions of the main keywords within this journal was lower than that in other journals. The primary purpose of this journal is to publish high-quality research in all fields of finance, where such analyses are conducted from a behavioral perspective and using experimental methods. The journal covers diverse topics such as, but not limited to, the investigation of biases, the role of various neurological markers in financial decision-making, national and organizational culture and its effects on financial decision-making, the design and implementation of experiments to investigate financial decision-making, as well as trade, methodological experiments, and natural experiments.

The financial nature of this journal is clear from the beginning, as it began with an essential dedication to the analysis of market efficiency [26]. As shown in Fig. 7, the keywords "behavioral finance" and "experimental finance" were present throughout the sample period, as are behavioral biases, especially "overconfidence" and "disposition effect." We noted the recent emergence of "experimental economics" and "experiments" as the top keywords.

- Journal of Behavioral Finance (JBF)

Formerly known as *The Journal of Psychology and Financial Markets* (until 2002), JBF is aimed at personality and directed at a broad audience: social and organizational psychologists, clinical and counseling psychologists, psychiatrists and other mental health professionals, marketing and consumer behavior specialists, specialists in the multidisciplinary study of judgment and decision-making, professionals and researchers in finance and accounting, specialists in behavioral economics, economic sociologists, and anthropologists.

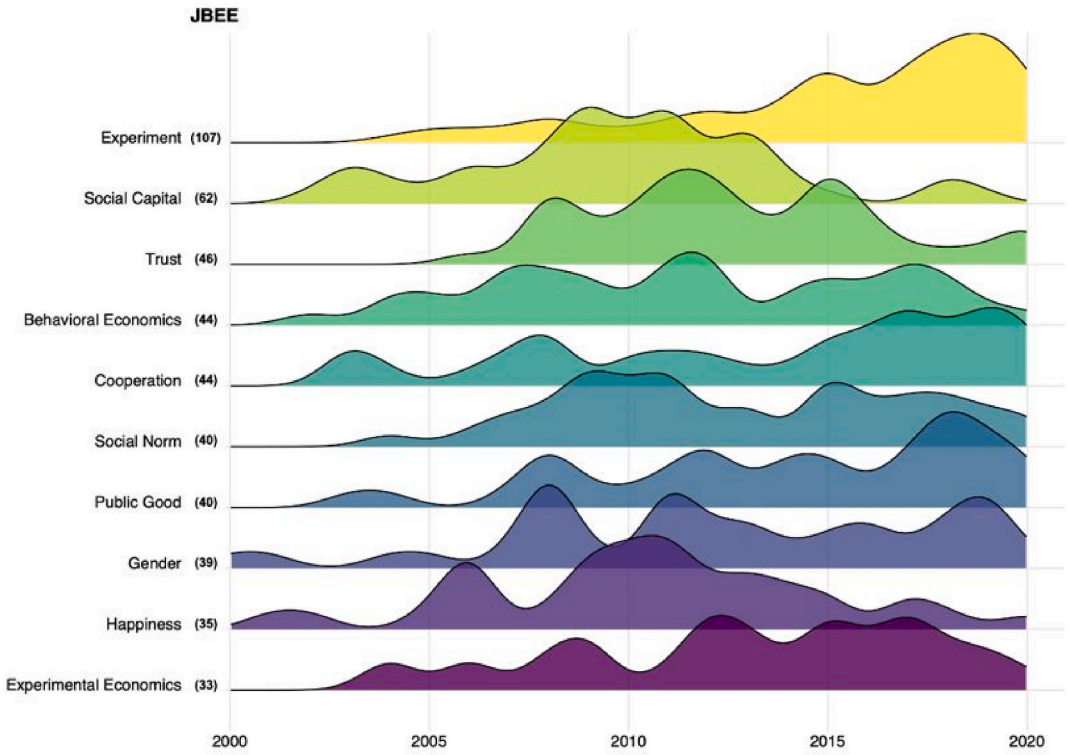


Fig. 5. Evolution of the top 10 keywords in JBEE (2000–2020). Each of the ridgelines depicts how each of the keywords has evolved. The area under each curved line equals 1; all colored shapes have the same area.

As shown in Fig. 8, the keywords that were most used in this journal were directly related to investments and financial markets, including investor biases, which are widely studied in behavioral textbooks.

The steady increase in the use of the investor sentiment concept is noteworthy, such as was stood out in a study with more than 48 citations [27]. In contrast, the keyword "investment decision," which reached its maximum level of coverage in 2015, with authors with more than 44 citations [28], faded away. Within this group, we did not find the word "experiment."

- Review of Behavioral Finance (RBF)

This academic journal covers theoretical and empirical approaches to financial decision-making and how decision-makers' behavioral attributes influence a company's economic structure, investors' portfolios, and the functioning of financial markets.

As shown in Fig. 9, the top ten keywords were significantly related to financial content and psychological biases, as in the case of JBF. Several words were repeated in both journals, such as behavioral finance, investor sentiment, risk aversion, and herding. The word "experiment" or "experimental" was not found in this top-10 keyword group, as was the case for the JBF.

After reviewing the five journals, we examined how each journal contributed to the ranking of the most recurrent keywords, noting the different topics that each journal addressed. Two research streams emerged: one is more general, psychological, and focusing on experimental research methods (JBEE, JEP), where experiments were key, whereas the other focused on finance and investor biases (JBF and RBF). The JBEF was in the middle ground in terms of keywords, sharing features of both streams. Moreover, the keywords formerly detected in the behavioral finance literature review were related to the second strand detected in our sample (JBF and RBF). Table 4 lists the top ten keywords in each journal to facilitate comparison.

The relative weights of the journals within this sample were uneven. Some journals, such as JBEE and JEP, had a consolidated structure with many citations, papers, and keywords, skewing the aggregate ten-keyword rankings.

4.3. Relationships between keywords

We analyzed the keywords with high recurrence in the selected sample and found that different words were repeated frequently. We observed that the average number of keywords used by the authors was 4.09. Among the keywords, some appeared together regularly. The repeated sets of keywords are shown in Fig. 5. Of the 218 pairs of keywords that were used together more than once, "experiment" and "public good" was the most repeated pair. In addition, we tracked 157 repeated trios of keywords, 13 repeated quartets, and three quintets (Fig. 10).

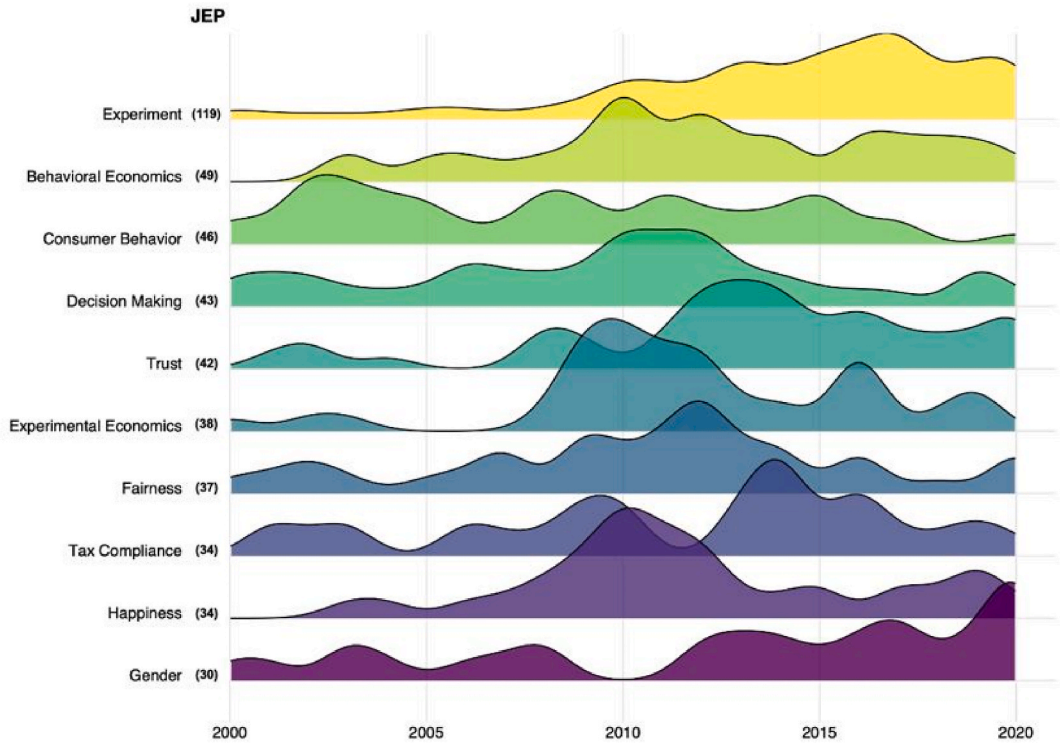


Fig. 6. Evolution of the top 10 keywords in JEP (2000–2020). Each of the ridgelines depicts how each of the keywords has evolved. The area under each curved line equals 1; all colored shapes have the same area.

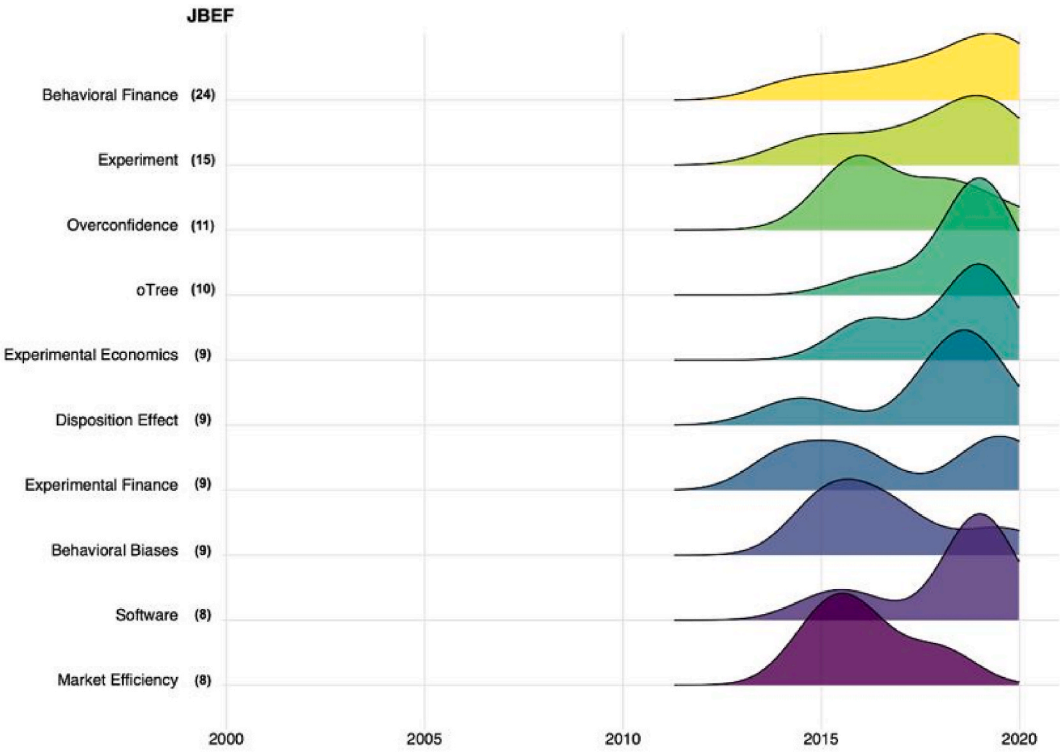


Fig. 7. Evolution of the top 10 keywords in JBEF (2000–2020). Each of the ridgelines depicts how each of the keywords has evolved. The area under each curved line equals 1; all colored shapes have the same area.

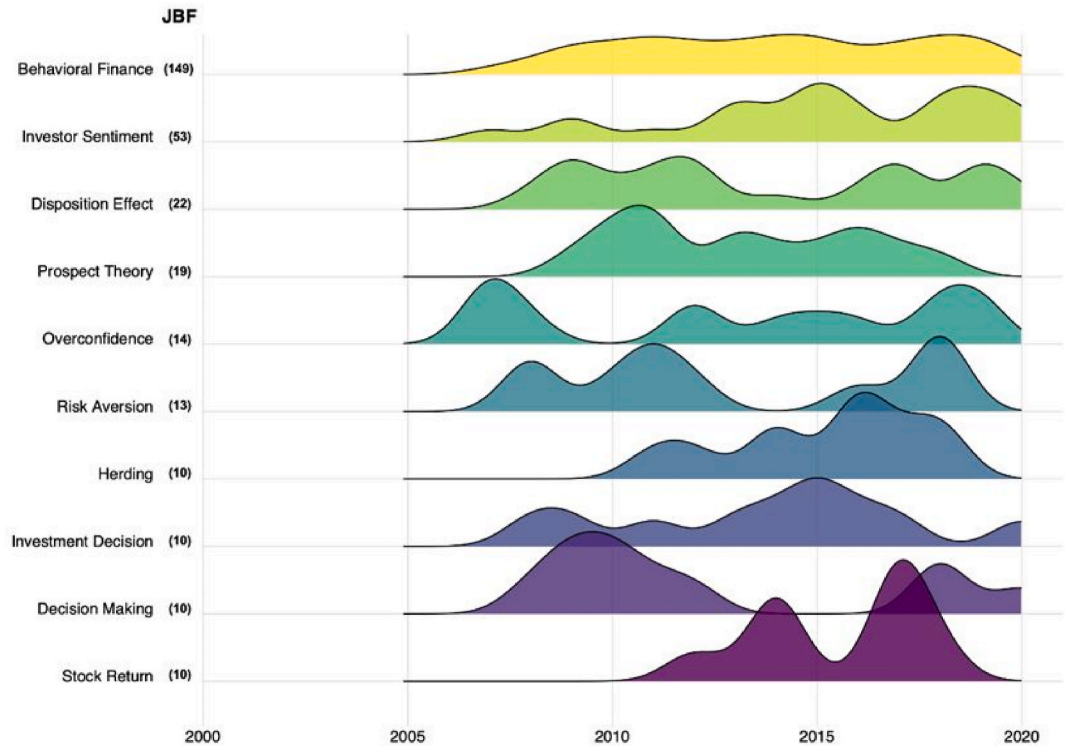


Fig. 8. Evolution of the top 10 keywords in JBF (2000–2020). Each of the ridgelines depicts how each of the keywords has evolved. The area under each curved line equals 1; all colored shapes have the same area.

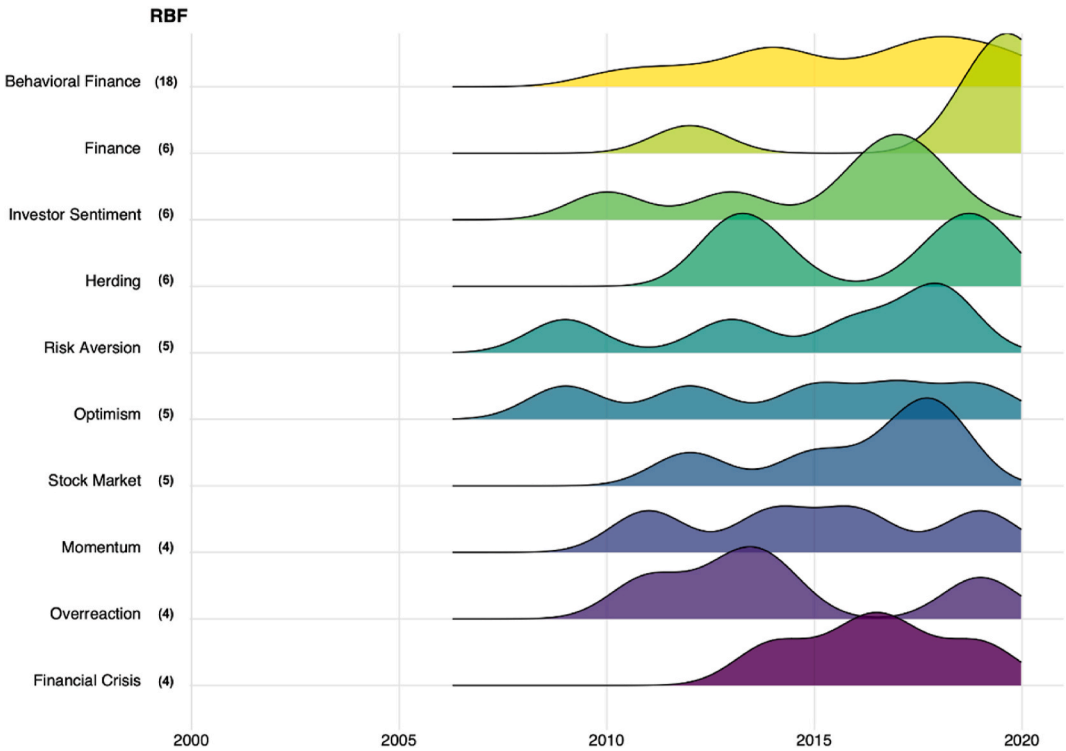


Fig. 9. Evolution of the top 10 keywords in RBF (2000–2020). Each of the ridgelines depicts how each of the keywords has evolved. The area under each curved line equals 1; all colored shapes have the same area.

Table 4
List of the top ten keywords in each journal. Repeated keywords are highlighted. The keywords that are repeated only in JBEF, JBF, and RBF are bold and italicized.

JBEE	JEP	JBEF	JBF	RBF
Experiment	**Experiment**	***Behavioral Finance***	***Behavioral Finance***	***Behavioral Finance***
Social capital	**Behavioral Economics**	**Experiment**	***Investor Sentiment***	Finance
Trust	Consumer Behavior	***Overconfidence***	***Disposition Effect***	***Investor Sentiment***
Behavioral Economics	**Decision Making**	oTree	**Prospect Theory**	Herding
Cooperation	**Trust**	**Experimental Economics**	***Overconfidence***	***Risk Aversion***
Social Norm	**Experimental Economics**	***Disposition Effect***	***Risk Aversion***	Optimism
Public Good	Fairness	Experimental Finance	Herding	Stock Market
Gender	Tax Compliance	Behavioral Biases	Investment Decision	Momentum
Happiness	**Happiness**	Software	**Decision Making**	Overreaction
Experimental Economics	**Gender**	Market Efficiency	Stock Return	Financial Crisis

4.3.1. Quintets (repeated five-keyword sets)

Three sets of five keywords were identified as having been repeated within the discipline by at least two articles throughout the investigation. The first set comprised the keywords "behavioral finance," "bounded rationality," "overconfidence bias," "self-attribution bias," and "structural equation model." This specific set occurred in two different journals with a joint author, where the two articles used the same keywords: "Are individual investors irrational or adaptive to market dynamics?" [29] published by the JBEF, and "Elucidating investors rationality and behavioral biases in Indian stock market" [30]. The authors used the other two five-keyword sets in different articles published in the same journal; for instance, the authors posed a research question in one article and provided an answer to it in another. The second quintet contained "categorical imperative," "commitment," "duty," "Kant," and "rational choice." The question posed in this quintet was whether *Homo economicus* can follow Kant's categorical imperative [31] The answer was provided in a subsequent study by the same authors [32]. Finally, the last repeated quintet incorporated "calibration," "judgment errors," "metacognition," "unaware," and "unskilled." The repetition was due to a question raised in a paper [33] and another question as to whether this situation would continue. Both papers were written by the same author [33].

4.3.2. Quartets and trios (repeated four- and three-keyword sets)

As shown in Figs. 11 and 12, 13 four-word sets and 157 three-word sets were used in more than one article.

These keywords were treated in the same section because they exhibited a familiar pattern. The common root of the two groups was taxation and public goods. Tax behavior assumes more than one dimension. Therefore, the ultimate reason why people pay taxes is interrelated with a significant set of variables that have been frequently treated in behavioral finance, in which different studies have explored economic simulations. In contrast, experimental studies have addressed the extension of common problems. As people act differently in the same situation, certain personalities may be particularly prone to tax evasion. According to research carried out in 1987 [34], some individuals may be characterized by sets of attitudes, norms, and personality variables that correlate with tax evasion. Others may strongly identify with the responsibilities of their communities.

4.3.3. Pairs

The analysis revealed that 218 pairs of keywords were repeated, of which more than 80 were formed with the word "experiment," demonstrating the experimental nature of the discipline. To graphically represent the most-used pairs, Fig. 13 shows a relational network graph of the most repeated pairs, setting the level of five repetitions as the lower limit.

The Journal of Behavioral and Experimental Economics contained many articles with experimental methods. The most used methods were experimental asset markets and experimental studies. Experimental economics applied experimental methods to examine economic questions. The central input to this behavioral finance stream came from experimental psychology. Methods developed in sociology, such as surveys, interviews, participant observations, and focus groups, did not have the same influence. Typically, these methods are more expensive in terms of resources than experimental methods. However, it is possible that the training of financial academics leads them to prefer methodologies that allow for greater control and more straightforward causal interpretation [35].

4.4. Topics of impact beyond the behavioral finance domain

Finally, we identify topics within the discipline of behavioral finance that are interesting to other authors. We use the number of citations (obtained using the Scopus search engine) of the papers in our sample as the representative variable of interest. We find that the most cited items did not deal with the most frequently used keywords in the discipline. Table 5 shows the ten most cited.

The most cited paper conducted a literature review of subjective well-being and its determinants [36] while the second most cited paper, and the only one that was not a literature review, aimed to propose and evaluate a series of modifications and improvements to the national satisfaction index models [37].

This opens an interesting research avenue. If the most cited articles do not include the keywords that are most frequently used by the authors in behavioral finance journals, we could inquire regarding the impact of behavioral finance research beyond its frontiers and advisability of addressing research efforts toward topics that arouse interest in the scientific community.

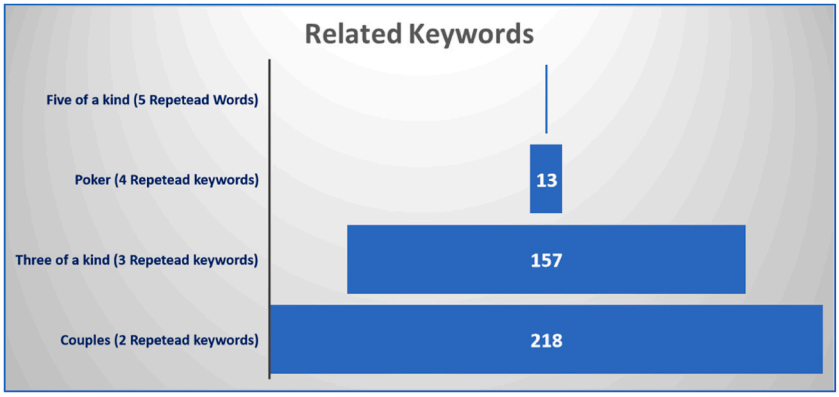


Fig. 10. Repeated subsets of words.



Fig. 11. Most frequently repeated quartets (number of repetitions).

Along these lines, the trends in the interactions, similarities and differences, between behavioral finance streams and the broader financial community emerge as an interesting area for future research. It also raises questions about the interplay between the more open field of behavioral economics and the more specific field of behavioral finance, which seems to have a dynamism of its own, but seems to be of less interest to the scientific community.

5. Conclusion

In this study we conducted a keyword analysis and examined five leading journals in behavioral finance to provide quantitative insights into the structure, impact, and evolution of this scientific field during the 21st century. The journals were selected using Scholar Google, WoS, and Scopus. We used data mapping and visualization tools to illustrate the findings, provide a dynamic map of the discipline and its most frequent interrelationships, and identify emerging issues for the future.

Two distinct literature streams related to behavioral finance emerged: a general one that is economics-related and focuses on experimental methods, led by the Journal of Economic Psychology and Journal of Behavioral and Experimental Economics, and one that focuses on finance and investor biases, including the Journal of Behavioral Finance and Review of Behavioral Finance. The Journal of Behavioral and Experimental Finance shares standard features with both.

Our findings are in line with the previous literature reviews and create common ground in the active and evolving discipline. Additionally, the most frequent relationships among these keywords were investigated.

We highlighted the evident experimental character that the discipline acquired, noted the experiment-based studies, and confirmed

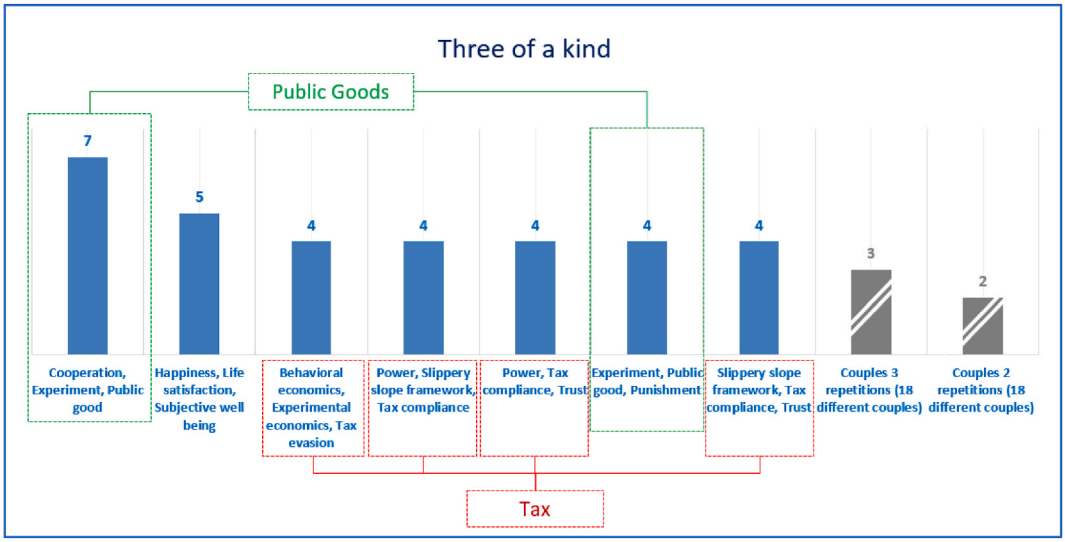


Fig. 12. Most frequently repeated trios (number of repetitions).

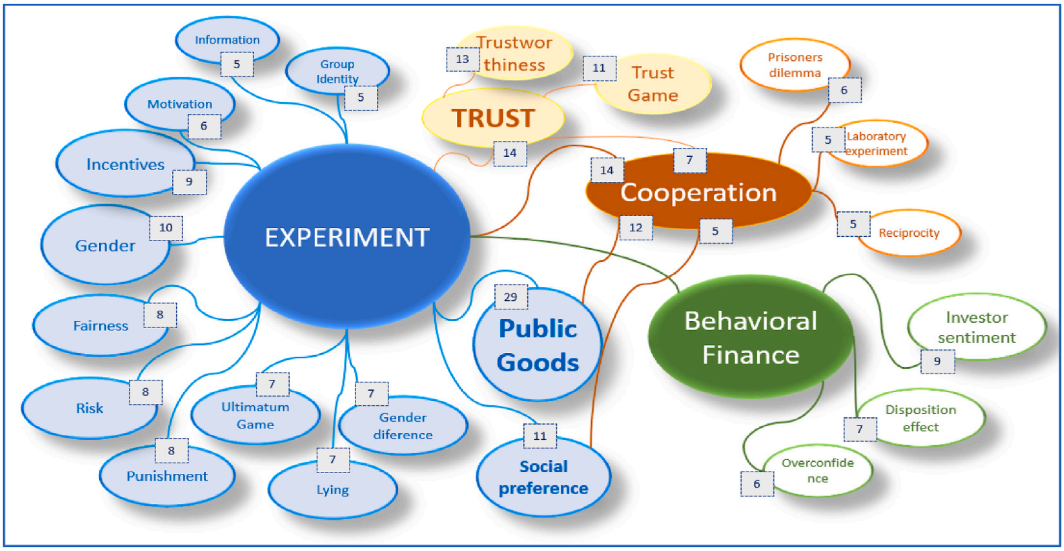


Fig. 13. Most frequently repeated pairs (5 or more repetitions).

previous findings [11]. Prospect theory [2] was another essential capstone of map construction. Other trendy topics, such as gender and happiness, became visible. These results corroborate the evolution of the field into an empirical and evidence-based discipline, demonstrating that the behavioral theory is not a finished product but a rapidly growing field [1].

Surprisingly, the papers with the highest number of citations in our sample did not correspond to the ones with the most commonly used keywords within the behavioral discipline. This intriguing finding highlights a research avenue to explore the impact of behavioral finance beyond its traditional boundaries, and to explore its interactions with the broader domains of finance and economics. Our results suggest that there may be important aspects and connections within the field that extend beyond those typically captured by commonly used keywords.

Reciprocally, it would be valuable to explore how the keywords identified in this study stand out in other finance journals as well. This analysis would provide insight into their importance and implications across the field, offering a comprehensive understanding of the main areas of research within behavioral finance in different academic contexts.

Data availability statement

The data associated with this study is available in: Hernán, Ramón; Corzo, Teresa; Pedrosa, Guillermo (2023), "Keywords data

Table 5
Most cited papers in the sample under study, as of September 2021.

Papers	Year	Citations *(as of September 07, 2021)*
Do we know what makes us happy? A review of the economic literature on the factors associated with subjective well-being *Keywords: Happiness; Life satisfaction; Public policy; Subjective well-being.*	2008	3243
The evolution and future of national customer satisfaction index models *Keywords: 3920; Customer satisfaction; E21; Loyalty; National barometers.*	2001	1678
Social innovation: Buzz word or enduring term? *Keywords: Bifocal innovation; Business innovation; Government support; Pure social innovation; Social innovation.*	2009	1416
Culture differences and tax morale in the United States and Europe *Keywords: Culture; Tax compliance; Tax evasion; Tax morale.*	2006	1379
Enforced versus voluntary tax compliance: The "slippery slope" framework *Keywords: Authority; Compliance; Power; Social behavior; Taxation; Trust.*	2008	1279
"I think I can, I think I can": Overconfidence and entrepreneurial behavior *Keywords: Overconfidence; Perceptions.*	2007	1091
Well-being at work: A cross-national analysis of the levels and determinants of job satisfaction *Keywords: Cross-national analysis; J28; Job satisfaction.*	2000	1071
Does marriage make people happy, or do happy people get married? *Keywords: Division of labor; Marriage; Selection; Subjective well-being*	2006	996
Mindless statistics *Keywords: Collective illusions; Editors; Rituals; Statistical significance; Textbooks.*	2004	994
Estimation of residential water demand: A state-of-the-art review *Keywords: Demand estimation; Water demand; Water resources management.*	2003	992

extracted from Behavioral Finance journals", Mendeley Data, V1, https://doi.org/10.17632/ms5d852szf.1.

CRediT authorship contribution statement

Teresa Corzo: Writing – review & editing, Validation, Supervision, Project administration, Investigation, Conceptualization. **Ramón Hernán:** Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Guillermo Pedrosa:** Visualization, Validation, Software, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Top hundred keywords.

Ranking	Keyword	#Reps	Ranking	Keyword	#Reps
1°	Experiment	248	51°	Incentives	27
2°	Behavioral Finance	116	52°	Expectation	26
3°	Behavioral Economics	100	53°	Rationality	26
4°	Trust	96	54°	Bargaining	25
5°	Experimental Economics	87	55°	Financial Literacy	25
6°	Gender	76	56°	Income	25
7°	Cooperation	72	57°	Unemployment	25
8°	Decision Making	72	58°	Punishment	24
9°	Happiness	70	59°	Education	23
10°	Social Capital	69	60°	Efficiency	23
11°	Social Norm	63	61°	Endowment Effect	23
12°	Consumer Behavior	62	62°	Information	23
13°	Public Good	62	63°	Personality Traits	23
14°	Dictator Game	56	64°	Poverty	23
15°	Subjective Well Being	56	65°	Preferences	23
16°	Overconfidence	54	66°	Saving	23
17°	Risk Aversion	54	67°	Taxation	23
18°	Laboratory Experiment	53	68°	Children	22
19°	Reciprocity	53	69°	Discrimination	22

(*continued on next page*)

(*continued*)

Ranking	Keyword	#Reps	Ranking	Keyword	#Reps
20°	Social Preference	52	70°	Financial Crisis	22
21°	Altruism	51	71°	Herding	22
22°	Fairness	51	72°	Job Satisfaction	22
23°	Life Satisfaction	48	73°	Stock Return	22
24°	Prospect Theory	47	74°	Human Capital	21
25°	Tax Compliance	47	75°	Inequality	21
26°	Risk	46	76°	Mental Accounting	21
27°	Field Experiment	45	77°	Risk Attitude	21
28°	Tax Evasion	40	78°	Self-Control	21
29°	Uncertainty	40	79°	Stock Market	21
30°	Investor Sentiment	39	80°	Entrepreneurship	20
31°	Loss Aversion	39	81°	Herd Behavior	20
32°	Culture	36	82°	Learning	20
33°	Disposition Effect	35	83°	Materialism	20
34°	Investment Decision	35	84°	Optimism	20
35°	Risk Preference	35	85°	Religion	20
36°	Willingness To Pay	35	86°	Risk Perception	20
37°	Gender Difference	34	87°	Anchoring	19
38°	Decision-Making	33	88°	Contingent Valuation	19
39°	Emotions	33	89°	Affect	18
40°	Time Preference	33	90°	Consumer Psychology	18
41°	Well-Being	33	91°	Economic Growth	18
42°	Communication	31	92°	Emotion	18
43°	Competition	31	93°	Game Theory	18
44°	Personality	31	94°	Health	18
45°	Bounded Rationality	30	95°	Identity	18
46°	Charitable Giving	30	96°	Institutions	18
47°	Framing	30	97°	Intertemporal Choice	18
48°	Motivation	30	98°	Prosocial Behavior	18
49°	Trust Game	29	99°	Social Network	18
50°	Ultimatum Game	29	100°	Welfare	18

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