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Research Status and Development Trend of the Theory of Planned Behavior: A Visual Analysis Based between 2012-2022

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Abstract

The theory of planned behavior has been widely used in several behavioral fields of research and has been proven to have good behavioral explanatory power. In order to investigate the current status and development of the theory of planned behavior, this paper sort to find out its trends in the past 10 years. This study is based on 7437 theoretical literatures on the theory of planned behavior from 2012 to 2022 collected in the core collection of the Web of Science (WOS) database and uses CiteSpace's bibliometric visualization software to study the number of articles, countries /regions, and authors of the collected data whereby to summarize the research based on the theory of planned behavior. Keyword co-occurrence, burst analysis, literature co-citation, and timeline map were used to analyze the research hotspots and frontier trends in the field of theory of planned behavior. The results show that the research literature on the theory of planned behavior increases year by year from 2012 to 2022. The country with the highest number of publications is the United States, followed by China, but a core group of authors has not yet been formed. The main research hotspots are in the areas of health promotion and environmental behavior, business and consumer behavior, and analytical studies of the theory. Future research trends are in the area of business and consumer behavior, with a focus on green consumption and pro-environmental behavior. In summary, this study provides a bibliometric review of the research literature on the theory of planned behavior over the past 10 years. The areas of business and green consumption and pro-environmental behavior serve as research trends, and interested researchers can pay further attention to relevant research in this area. Overall, the analysis demonstrates that the theory of planned behavior is essential for understanding and predicting human behavior, which enables a vast array of applications.

Keywords: Theory of Planned Behavior, Visual Analysis, Hotspot, Frontier Trend, Citespace

Introduction

The theory of planned behavior is a social cognitive model developed from the theory of rational behavior (Ajzen, 1985; 1991), explaining the general decision-making process of individual behavior from the perspective of information processing and the theory of expected value. The theory of planned behavior has been the focus of research since it was proposed and has accumulated fruitful research results. In the past 10 years, the theory of planned behavior has been deepening in dynamic development, and many research hotspots and trends have emerged. However, at present, there is little literature to systematically summarize the theory's research status, research hotspots, and research trends. Tracking and combing the latest research results of planned behavior theory in the past 10 years can not only grasp the hotspots of the theory but also further look forward to the future research trend in this field. As for that, mapping knowledge domains analysis which is a bibliometric research method widely used in recent years that can analyze the output time series, spatial distribution, and cooperative network of documents in all aspects was applied (Shiffrin & Borner, 2004). Based on CiteSpace visualization software, this paper makes a mapping knowledge domains analysis of planned behavior theories literatures collected in the core collection of Web of Science (WoS) data from 2012 to 2022 in order to understand the research status and development trend of the theory. Therefore, this paper aims to answer the following questions

1. What is the publication status and development trend of the related research literature on planned behavior theory from 2012 to 2022?
2. Which countries/regions and authors have a greater influence on the research on planned behavior theory from 2012 to 2022?
3. What are the hotspots and development trends in the field of planned behavior theory?

Data Acquisition and Methods

The data of this paper is collected from the WoS database. The period span of literature retrieval is set from 2012 to 2022 with search words include: TS (topic search) = "Theory of Planned Behavior" or "Theory of Planned Behaviour", the selected language is "English", and the file types are "articles" and "review articles". A total of 7491 articles were searched. The file format is "plain text", and the record content is "full-text records and citations". The download date is July 17, 2022. After the implementation of the "delete repetition" function in CiteSpace, a total of 7437 papers on planned behavior theory were obtained.

In this study, CiteSpace 6.1.R2 was used as the main tool for literature analysis. CiteSpace is a bibliometrics and visualization analysis tool used in scientific literature to identify and show new trends and developments in scientific development (Synnestevedt et al., 2005). CiteSpace supports various types of bibliometric research, including collaborative network analysis, keyword co-occurrence analysis, author co-citation analysis, literature co-citation analysis, and text and geospatial visualization analysis (Chen, 2017). In CiteSpace, Time Slicing is set to 2012-2022, Years Per Slice is set to 1 year, Node Types selects country, author, keyword, reference, and Selection Criteria uses the default parameters. Pathfinder and pruning the merged network were selected to prune the network structure, highlight the characteristics of the map, and show the final map in two visualizations: Cluster View-static and Show Merged Network.

Basic Situation Analysis

Trends in the Number of Published Papers

The number of literatures reflects the research level and development speed of related fields to a certain extent. Figure 1 shows the distribution of literature on the planned behavior theory in the WoS core collection database from 2012 to 2022. As shown in the figure, the research on the planned behavior theory from 2012 to 2022 is growing, reflecting the gradual increase of scholars' attention to the research field. The data shows that after 2016, the annual literature publication increased rapidly, from 460 in 2016 to 1458 in 2021, indicating that since 2016, the relevant research on the theory has entered a hotspot period of research. Until July 17th in 2022, there are already 720 articles related to the theory, indicating that studies related to planned behavior theory may still be the focus of scholars in the future.

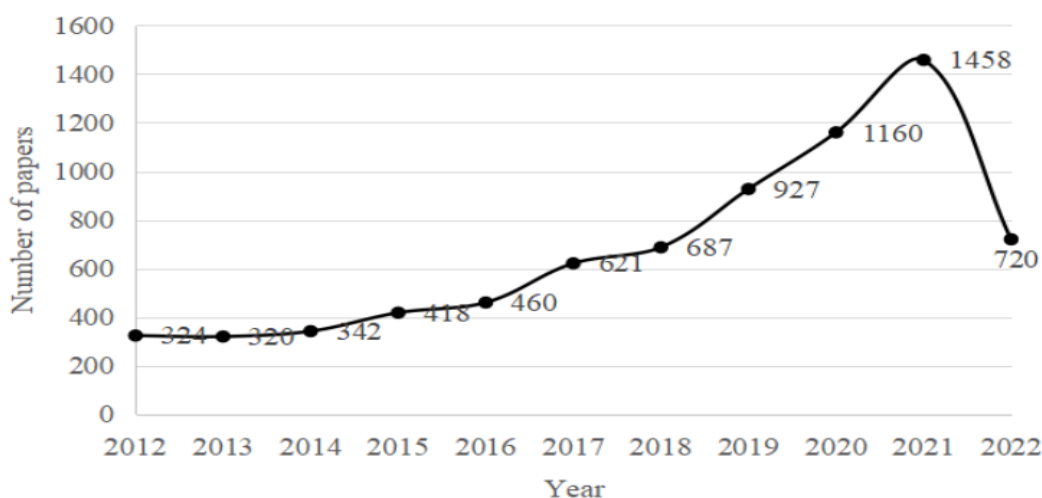


Figure 1 Annual distribution trend of literature from 2012 to 2022

Cooperation Networks

Country/Region Cooperation Networks

Based on the analysis of the collaboration network, it can detect any cooperative relationship between the countries/regions with large volume of planned behavior theory studies. The visualization map of cooperative countries/regions that studied planned behavior theory is shown in Figure 2. Between 2012 and 2022, the collaborative countries/regions network map consists of 138 nodes and 207 links with a density of 0.0219. The circle in the picture represents the frequency, and the size of the circle is proportional to the frequency count. Meanwhile, the thickness of the connection represents the intensity of collaboration between nodes (Chen et al., 2012). In addition, the greater the centrality, the greater the influence of literature in these countries/regions. Overall, the data indicates that studies related to planned behavior theory comes from 138 countries/regions in the world with the 10 most prolific countries/regions researching on the theory are presented in Table 1.

The country/region that has published the most research literature is the United States, with 1706 papers published, which indicates that the United States takes the lead and has the greatest influence in the theoretical research. This is followed by 1133 papers published in China. Although China has published a large number of research papers related to the theory, the overall influence is very small (centrality = 0.00). Meanwhile, the third largest number of

posts is in Australia, with 720 articles published. In terms of cooperation, the cooperation between countries/regions is not very close.

CiteSpace, v. 5.1.R2 (64-bit) Advanced
August 8, 2022 at 12:22:39 PM CST
Working Dir: C:\Users\y\Desktop\IPB2012\9\data
Timespan: 2012-2022 (Slice Length=1)
Selection Criteria: q=0.95, L=0.1, ZIN=10, LBY=5, e=1.0
Network: N=138, E=207 (Density=0.0219)
Largest CC: 135 (97%)
Nodes Labeled: 1.0%
Pruning: Pathfinder

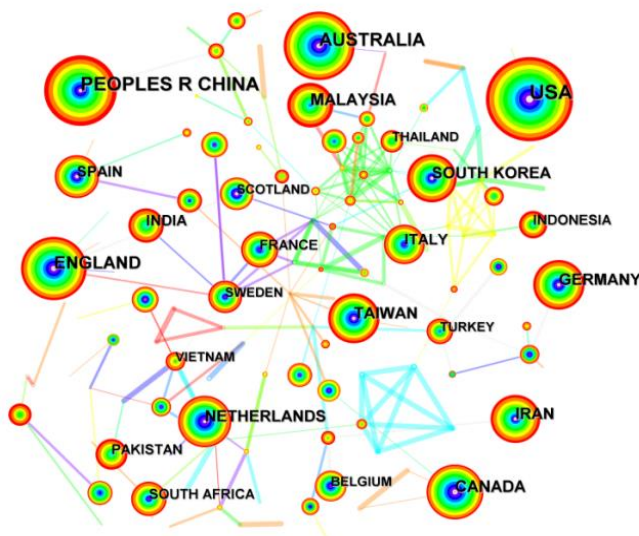


Figure 2 Collaboration network map of countries/regions.

Table 1

The top 10 countries/regions between 2012 and 2022.

Rank	Countries/Regions	Counts	Centrality	Year
1	USA	1706	0.06	2012
2	China	1133	0	2012
3	Australia	720	0	2012
4	England	627	0.09	2012
5	Malaysia	452	0	2012
6	Canada	408	0.08	2012
7	Germany	313	0	2012
8	Taiwan	308	0.03	2012
9	Iran	304	0.03	2012
10	Netherlands	282	0.06	2012

Author Cooperation Networks

Author cooperation analysis can identify core authors in a field and the strength of collaboration between authors. The greater the number of posts, the larger the node. Meanwhile, the closer the cooperation between the authors, the thicker the connection between the nodes. The visualization map of the core author of the planned behavior theory is shown in Figure 3. The collaboration network consists of 591 nodes and 566 links with a density of 0.0032. A total of 591 authors have contributed to the research. According to Price's Law, 50% of papers on the same subject are equal to about the square root of the total number of authors ($M = 0.749\sqrt{Nmax}$) (Hu et al., 2020). Therefore, it is concluded that $M = 5.85$ where this shows that the authors with 6 or more articles are the core authors in the

research field of planned behavior theory. Based on the statistical analysis of the authors of 7437 articles, it is found that the core authors of more than 6 articles are 123. A total of 1870 articles were published by the core authors, accounting for 25.14% of the total literature. According to Price's law, the number of papers written by core authors should be about 50% of the total number of papers in this field, while the proportion of 123 core authors is lower than 50% of Price's law, indicating that the research field of planned behavior theory has not yet formed a real core author group.

Table 2 lists the top 10 authors by publication volume. In terms of the number of counts and centrality, the most prolific author is White (61), followed by Hamilton (46). Both authors are from Australia; Katherine White from the Queensland University of Technology, where her main research interest is in attitude-behavior relations. Meanwhile, Kyra Hamilton from Griffith University where her research interests are in health behavioral motivation, self-regulation, and change. The two authors have collaborated in the field of parent-child health behavior (Hamilton et al., 2012; 2016).

CiteSpace v. 5.1.R2 (64-bit) Advanced
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(g=0.91, E=0.66) (Density/0.632)
Largest CC: 311 (30%)
Nodes Labeled: 12%
Pruning: Pathfinder

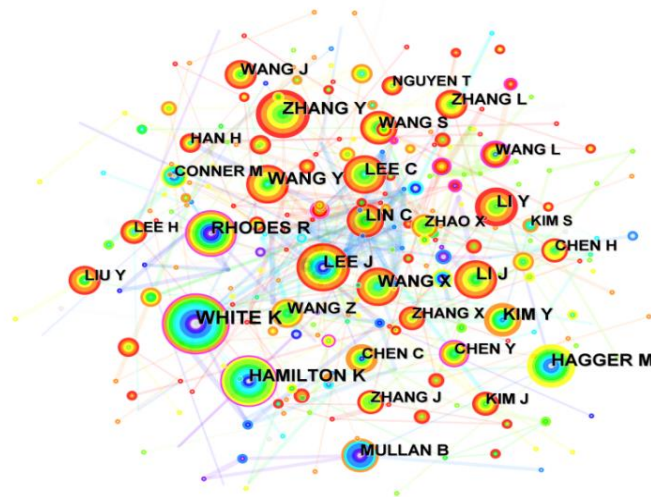


Figure 3 Collaboration-network map of authors.

Table 2

The top 10 authors between 2012 and 2022.

Rank	Author	Count	Centrality	Year
1	White K	61	0.12	2012
2	Hamilton K	46	0.16	2012
3	Hagger M	46	0.04	2012
4	Wang Y	45	0.02	2016
5	Zhang Y	45	0.03	2018
6	Li J	43	0.02	2017
7	Rhodes R	42	0.1	2012
8	Lee C	39	0.05	2012
9	Kim Y	39	0.06	2013
10	Wang X	34	0.05	2016

Knowledge-Base Analysis

Keyword Analysis: Keyword Co-Occurrences

For a paper, keywords not only describe the core content but also provide the shortest summary of the content. In general, keyword analysis is used to gain insight into the main features of a field and to provide a reasonable description of the research frontier and future research direction (Chen & Liu, 2020). The keyword co-occurrence network map of the planned behavior theory literature is shown in Figure 4, which contains 870 nodes and 1191 links with a density of 0.0032. Table 3 lists the top 15 keywords by frequency and centrality from 2012 to 2022.

In general, the keywords of the planned behavior theory can be divided into basic terminology (planned behavior, theory of planned behavior, attitude, intention, behavior, reasoned action), method (Model), and research applications (determinant, self-efficacy, impact, perception, physical activity, knowledge, consumption). High-frequency keywords do not necessarily have high centrality. In CiteSpace, the keywords with high centrality (Centrality ≥ 0.1) are easily regarded as the inflection point of the keyword frequency knowledge map, which represents the research hotspot in this field to some extent (Li et al., 2017). From the perspective of centrality, in terms of applied research, keywords such as built environment, experience, communication, quality of life, intrinsic motivation, and business are the main research hotspots.

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 Largest CC: 870 (100%)
 Nodes Labeled: 1.0%
 Pruning: Pathfinder

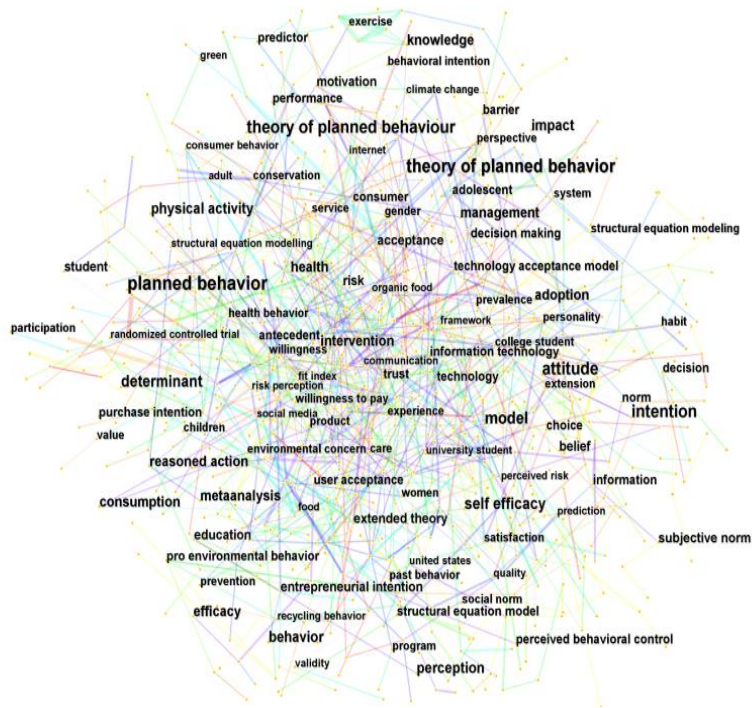


Figure 4 Co-occurrence network map of Keyword

Table 3

Top15 keywords in frequency and centrality between 2012 and 2022

Rank	Keywords	Frequency	Centrality	Year	Keywords	Frequency	Centrality	Year
1	planned behavior theory of	2746	0.01	2012	framework	101	0.18	2012
2	planned behavior	2447	0	2012	design	32	0.17	2012
3	attitude	1616	0.02	2012	duration	28	0.15	2012
4	intention	1446	0	2012	behavioral intention	47	0.14	2013
5	planned behavior	1319	0	2012	built environment	22	0.14	2012
6	model	1108	0	2012	experience	145	0.13	2012
7	determinant	849	0	2012	communication	104	0.13	2012
8	Self-efficacy	679	0	2012	quality of life	56	0.13	2012
9	behavior	634	0	2012	intrinsic motivation	23	0.13	2012
10	impact	628	0	2012	business	94	0.12	2013
11	perception	565	0	2012	policy	81	0.12	2012
12	physical activity	482	0	2012	trust	190	0.11	2012
13	knowledge	453	0.01	2012	personal norm	93	0.11	2013

14	consumption	422	0.01	2012	pattern	40	0.11	2013
15	reasoned action	398	0.02	2012	African American	40	0.11	2013

Keyword clustering analysis is helpful to further summarize the relationship between high-frequency keywords. In this paper, the logarithmic likelihood ratio (LLR) is used to cluster the keyword network. The clustering modularity $Q = 0.8037 > 0.3$, the clustering structure is significant, and the mean silhouette $S = 0.8615 > 0.5$, which indicates that clustering is reasonable. The 25 main clusters are shown in Figure 5, and the clustering information of 25 keywords is shown in Table 4. The 25 clusters were divided into three categories to understand the major research hotspot of planned behavior theory research and to better understand the cluster analysis results.

The first category is in the field of health promotion and environmental protection behavior, which includes #1(breastfeeding), #2(social norms), #5(condom use), #11(medication adherence), #12(health promotion), #15(breast cancer), #16(exercise), #21(health behaviors), #24(sustainable agriculture). As for example, Botetzagias (2015) examines how individual moral norms and demographic characteristics interact with the standard "theory of planned behavior" predictors to explain recycling intentions. Meanwhile, Cooke (2016) study the correlation between variables of the planned behavior theory and drinking intention and behavior.

The second category is the field of business and consumer behavior, which includes #0(decision making), #4(willingness to pay), #7(environmental knowledge), #8(entrepreneurial intention), #9(revisit intention), #10(social media), #13(knowledge sharing), #14(service quality), #18(purchase intention), #19(knowledge translation). Jalilvand (2012) uses the theory of planned behavior to study the influence of electronic word-of-mouth (EWM) on tourism destination choice. Meanwhile, Nuttavuthisit (2017) studied green consumption behavior.

The third category is the analysis and research related to theory, which includes #3(self-determination theory), #6(theory of reasoned action), #17(technology acceptance model), #20(theory of planned behavior), #22(structural equation modeling), #23(technology acceptance model (tam)). Steinmetz (2016) through three levels of Meta-analysis has confirmed that the theory of planned behavior is effective in behavioral change intervention. Meanwhile, Ajzen (2020) answered some questions related to the theory of planned behavior and distinguished the technology acceptance model from the theory itself.

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 Network: N=870, E=1191 (Density=0.0032)
 Largest CC: 1023 (117%)
 Nodes Labeled: 1.0%
 Pruning: Pathfinder
 Modularity Q=0.8037
 Weighted Mean Silhouette S=0.9283
 Harmonic Mean(Q, S)=0.8615



CiteSpace

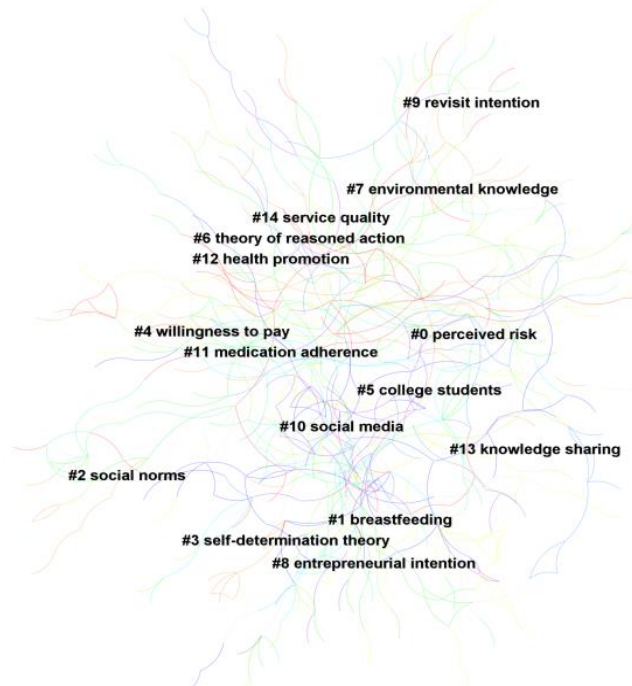


Figure 5 Cluster map of keywords.

Table 4

Information on the 25 co-occurrence clusters of keywords.

Cluster	Size	Silhouette	Mean (Year)	Label (LLR)
0	49	0.874	2016	decision making
1	44	0.917	2014	breastfeeding
2	43	0.931	2016	social norms
3	42	0.944	2014	self-determination theory
4	42	0.898	2017	willingness to pay
5	41	0.939	2014	condom use
6	41	0.956	2017	theory of reasoned action
7	39	0.949	2017	environmental knowledge
8	38	0.906	2016	entrepreneurial intention
9	36	0.907	2017	revisit intention
10	36	0.887	2016	social media
11	34	0.96	2015	medication adherence
12	34	0.92	2014	health promotion
13	33	0.982	2016	knowledge sharing
14	32	0.903	2017	service quality
15	32	0.918	2015	breast cancer
16	32	0.946	2014	exercise
17	31	0.959	2017	technology acceptance model
18	31	0.939	2016	purchase intention

19	31	0.958	2014	knowledge translation
20	31	0.888	2013	theory of planned behavior
21	29	0.978	2015	health behaviors
22	28	0.956	2014	structural equation modeling
23	22	0.893	2015	technology acceptance model (tam)
24	19	0.931	2019	sustainable agriculture

Keyword-Trend Analysis

Burst keywords can detect keywords with a high-frequency change rate and can be used to identify research directions that have received a lot of attention over time in order to determine the cutting-edge content in the research field (Zhou et al., 2018). Through the keyword burst analysis, the top 43 keywords in the research field were identified, which clearly shows the evolution of the research frontier from 2012 to 2022. Figure 6 shows the top 43 keywords with the highest citation bursts. It can be divided into three stages.

The first stage is from 2012 to 2017, extracting words related to the application of planned behavior theory. Burst keywords include physical activity, exercise, primary care, condom use, group norm, vegetable consumption, fruit, obesity, women, knowledge translation, smoking, intrinsic motivation, adolescent, information technology usage, sexual behavior, risk behavior, e-commerce, social networking site. It shows that the research direction of this stage is mainly related to the field of physical health behavior and user behavior which focusing on health behavior.

The second stage is from 2018 to 2019. The burst keywords include deterrence, need, public health, stigma, religiosity, consumers intention, and help seeking. Analysis of the keywords at this stage shows that the research mainly focuses on the application in the field of commercial consumption behavior. Meanwhile the third stage is from 2020 to 2022, whereby the burst keywords include consumer behavior, young consumer, and health consciousness. It shows that this stage continues the research of the second stage, focusing on green consumption, organic food consumption, and pro-environmental behavior.

Top 43 Keywords with the Strongest Citation Bursts

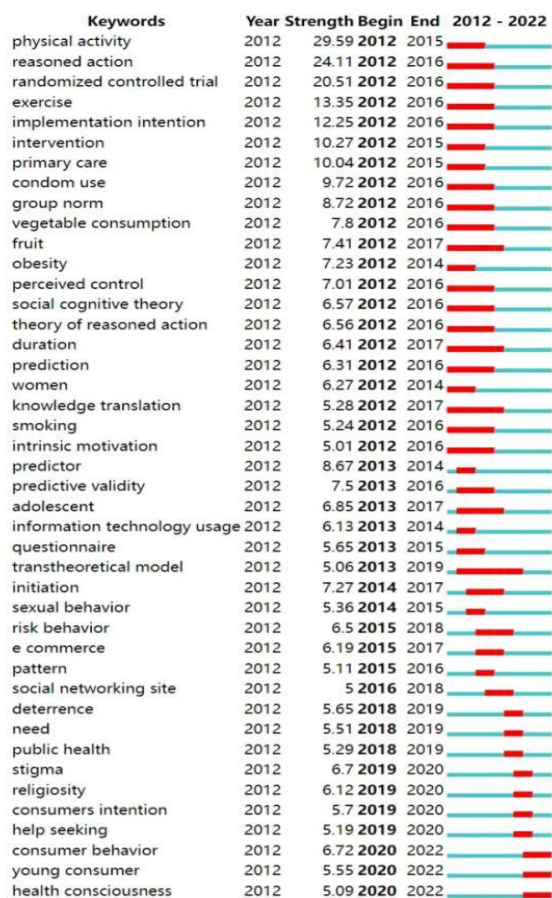


Figure 6 Top 43 Keywords with the strongest citation burst

Co-Cited-Reference Analysis

The cited literature is the knowledge base. In the co-citation analysis of the literature, the logarithmic likelihood ratio (LLR) is used to cluster the co-cited references network, and 30 clusters of co-cited references are obtained, which has 1121 nodes and 1341 links in the network, and a density of 0.0021. The clustering modularity $Q = 0.8984 > 0.3$, and the mean silhouette $S = 0.9613 > 0.5$, which indicates that the clustering structure is significant and reasonable. The 30 main clusters are shown in Figure 7.

The largest cluster is named (#0 household food waste), suggesting that there are a large number of studies on "household food waste" citing the literature in this cluster. The clustering sequence number is marked according to the form that increases sequentially from #0. The smaller the sequence number is, the more the number of documents contained in the corresponding cluster is, which reflects that it is more important in the study of planned behavior theory. The analysis focuses on the first five largest clusters.

The largest cluster (#0 household food waste) has 60 members and a silhouette value of 0.954, with 2018 as the average year. These labels also include household food, food waste, influencing factor, and application accuracy. According to the topic distribution and cited frequency, the core literature of topic clustering can be obtained. Morren (2021) found that in addition to subjective norms, the addition of personal norms (a typical dimension of normative structure) to the planned behavior theory model appropriately improves the

understanding of cross-cultural differences in environmental behavior. Wan (2017) extended the theory of planned behavior and found that subjective norms play a vital role in the incentive of recycling behavior. Meanwhile, Russell (2017) used a comprehensive model that combines the theory of planned behavior, interpersonal behavior theory, and environmental behavior comprehensive model to test consumers' food waste behavior. Other than that, Lin (2021) found that the perception of policy effectiveness has a significant positive impact on willingness, while the perception of government control has a negative impact on the willingness to reduce food waste.

The second largest cluster (#1 entrepreneurial intention) has 55 members and a silhouette value of 0.992, with 2019 as the average year. These labels also include entrepreneurship education, entrepreneurial self-efficacy, entrepreneurship education program, and engineering student. In the core literature, Munir (2019) expanded the existing research on the entrepreneurial intention by using the personality trait integration model and the theory of planned behavior and concluded that the personality traits of students in emerging economies have a great influence on the attitude dimension. Meanwhile, Karimi (2016) assessed the impact of elective and compulsory entrepreneurship education programs (EEPS) on students' entrepreneurial intention and opportunity discovery using pre-and post-investigation.

In addition, the third largest cluster (#2 sorting behavior) has 47 members and a silhouette value of 0.983, with 2020 as the average year. These labels also include electric vehicle, urban household intention, solid waste separation, and influencing residents' waste. Taufique (2018) integrated environmental attitude, subjective norms, perceived consumer effectiveness, and behavioral intention into the model to investigate their impact on ecologically conscious consumer behavior (ECCB). Meanwhile, Yuriev (2020) commented on the scope of pro-environmental behavior from the perspective of planned behavior theory.

The 4th largest cluster (#3 non-Hispanic black preschooler) has 45 members and a silhouette value of 0.936, with 2013 as the average year. These labels also include young male, vegetable consumption, fresh fact, and traffic offence. Elliott (2012) conducted a comparative study of one-component and two-component of planned behavior theory in the context of college students' alcoholism. Meanwhile Conner (2013) assessed the simultaneous effects of cognitive attitude, emotional attitude, expected negative emotional response, and expected positive emotional response on blood donation intention and behavior.

The 5th largest cluster (#4 understanding guests' intention) has 44 members and a silhouette value of 0.997, with 2018 as the average year. These labels also include guests' behavior, green p2p accommodation, emerging bicycle tourism, and sharing economy perspective. Han (2017) discussed the formation process of tourists' decision-making of bicycle tourism as a form of sustainable tourism. Kiatkawsin (2017) investigated the environmental behavior of young travelers.

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 Network: N=1121, E=1341 (Density=0.0021)
 Largest CC: 1023 (91%)
 Nodes Labeled: 1.0%
 Pruning: Pathfinder
 Modularity Q=0.8984
 Weighted Mean Silhouette S=0.9613
 Harmonic Mean(Q, S)=0.9288

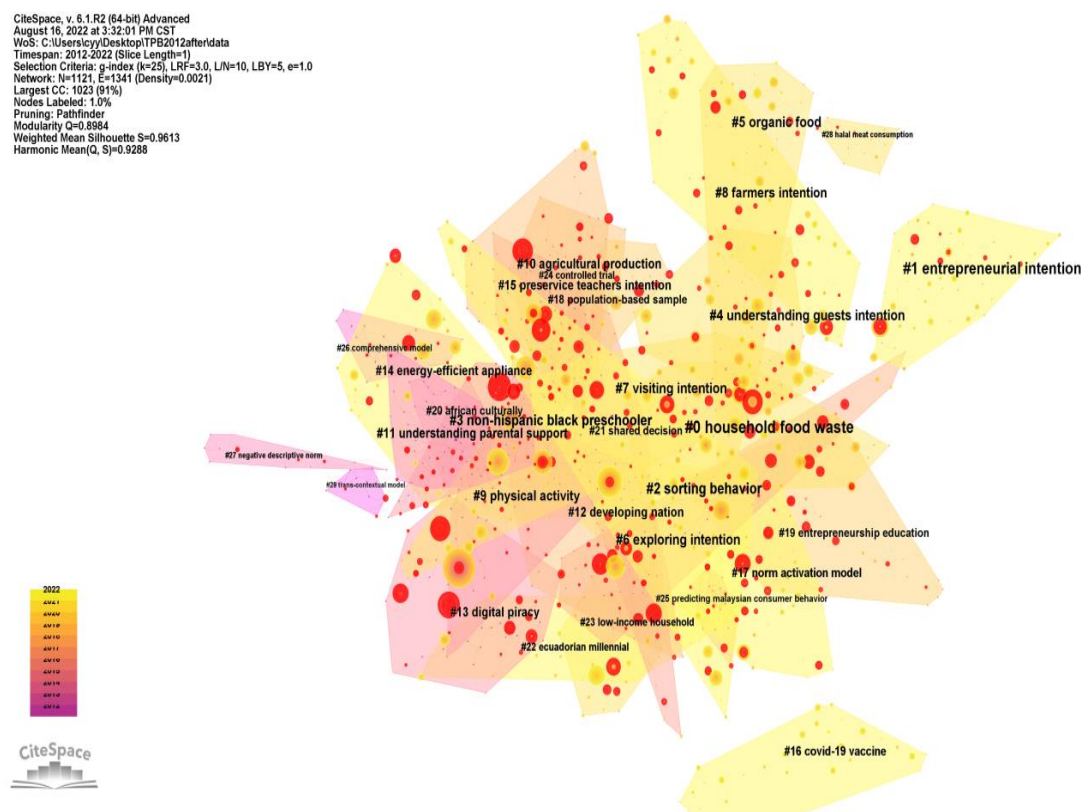


Figure 7 Co-citation-cluster map of cited references.

In the co-citation references network map, the analysis of highly cited papers is helpful in order to have a clear understanding of the knowledge base of hotspot areas. Table 5 lists the top 10 references cited from 2012 to 2022, sorted by the number of citations. These highly cited articles mainly come from cluster #1(entrepreneurial intention), #3 (non-Hispanic black preschooler), #5(organic food), #7(visiting intention), #9(physical activity), #12(developing nation), #13(digital piracy) (2 articles), #23 (low-income household) (2 articles).

The most frequently cited papers are those written by Paul (2016) (Counts = 222, Cluster = 5), which mainly studies the willingness of Indian consumers to buy green products. The second is Fishbein and Ajzen's (2011) (Counts = 174, Cluster = 13) published work "Predicting and changing behavior: The reasoned action approach". This book systematically discusses key issues related to the framework of inferential action and provides methodological and conceptual tools for predicting and interpreting social behavior and designing interventions for behavior change. It is the most representative work of the theory of planned behavior in recent years. According to Google Scholar statistics, the book has been cited 9114 times. The third is Hair's (2017) (Counts = 171, Cluster = 23) work, which is an extended version of the second edition of the introduction to partial least squares structural equation Modeling (PLS-SEM), which shows that the most common method adopted in the application of the theory of planned behavior is structural equation model.

Table 5

Top 10 most-cited references from 2012 to 2022.

Rank	Counts	Centrality	References	Cluster ID
1	222	0	Paul, J., Modi, A., & Patel, J. (2016). Predicting green product consumption using theory of planned behavior and reasoned action. <i>Journal of retailing and consumer services</i> , 29, 123-134.	5
2	174	0.01	Fishbein, M., & Ajzen, I. (2011). <i>Predicting and changing behavior: The reasoned action approach</i> . Psychology Press.	13
3	171	0	Hair Jr, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2017). <i>Advanced issues in partial least squares structural equation modeling</i> . Sage publications.	23
4	166	0.03	Yadav, R., & Pathak, G. S. (2017). Determinants of consumers' green purchase behavior in a developing nation: Applying and extending the theory of planned behavior. <i>Ecological economics</i> , 134, 114-122.	7
5	160	0	Yadav, R., & Pathak, G. S. (2016). Young consumers' intention towards buying green products in a developing nation: Extending the theory of planned behavior. <i>Journal of Cleaner Production</i> , 135, 732-739.	12
6	159	0.01	McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. <i>Health psychology review</i> , 5(2), 97-144.	9
7	151	0.05	Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. <i>Health psychology review</i> , 8(1), 1-7.	3
8	148	0.07	Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. <i>European business review</i> , 31(1), 2-24.	23
9	140	0.03	Kline, R. B. (2015). <i>Principles and practice of structural equation modeling</i> . Guilford publications.	13
10	132	0	Hair, J. F., Jr., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). A primer on partial least squares structural equation modeling (PLS-SEM). Sage Publications.	1

Co-Cited-Reference-Trend Analysis

Figure 8 depicts how the network is divided into different co-citation clusters over time. In the network, the average time of the literature in each cluster is calculated to reflect the time

characteristics of the literature cited in the corresponding clustering. The color of the clustering label represents the time of the establishment of the literature. The longer the time is, the cooler the color is. On the contrary, the closer the time is to the present, the warmer the color is. The change of the whole color reflects the evolution of the research. Therefore, combined with the previous keyword division stage analysis, according to the average years of cluster literature and the color of cluster label, this study divides the study of planned behavior theory from 2012 to 2022 into three stages.

There are 17 clusters with the average time of literature in the first stage from 2012 to 2017, which include #11 (understanding parental support), #13 (digital piracy), #20 (African culturally), #29 (trans-contextual model), #3 (non-hispanic black preschooler), #9 (physical activity), #26 (comprehensive model), #27 (negative descriptive norm), #6 (exploring intention), #10 (agricultural production), #15 (preservice teachers intention), #21 (shared decision), #12 (developing nation), #18 (population-based sample), #24 (controlled trial), #19 (entrepreneurship education), #25 (predicting Malaysian consumer behavior). It is concluded that this stage is about the application of health behavior and consumers.

In the second stage, there are 9 clusters with an average time of 2018 to 2019, including #0 (household food waste), #4 (understanding guests' intention), #1 (entrepreneurial intention), #5 (organic food), #7 (visiting intention), #8 (farmers intention), #14 (energy-efficient appliance), #23 (low-income household), #28 (halal meat consumption). This stage is mainly about the field of business entrepreneurship, consumer behavior, and tourism behavior. Meanwhile, in the third stage, there are 4 clusters with an average time of 2020 to 2022, which include #2 (sorting behavior), #17 (norm activation model), #22 (ecuadorian millennial), and #16 (covid-19 vaccine). This stage is mainly about the field of green consumption and pro-environmental behavior.

Large nodes or nodes with red in the network are either highly cited, have citation bursts, or are highly cited and have citation bursts (Chen, 2017). Furthermore, combined with the cluster of highly cited references, the average time of all kinds of literature, and burst nodes, it can be concluded that the main research areas of planned behavior theory are #1 (entrepreneurial intention), #5 (organic food), #7 (visiting intention), #23 (low-income household), #2 (sorting behavior). Among them, cluster #2 (sorting behavior), which has a relatively close average literature time, contains a large number of documents, and has a high citation burst of literature, which is the research trend in recent years, and the main contents are green and pro-environmental behavior.

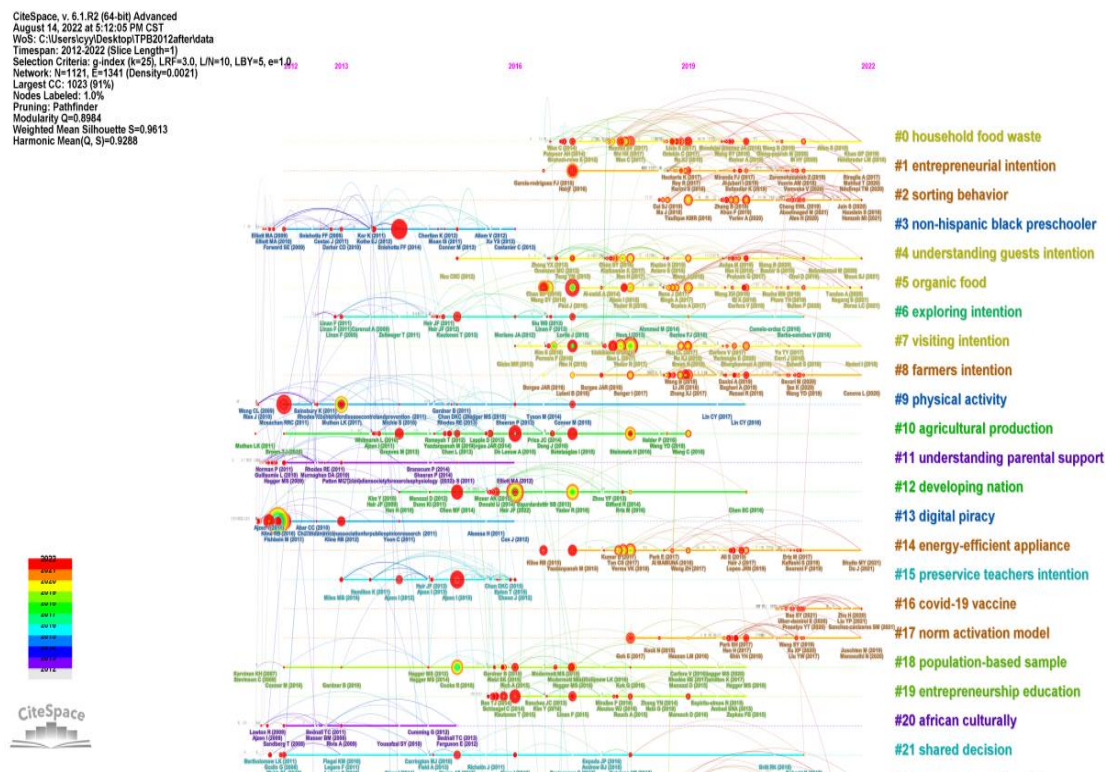


Figure 8 Co-citation-timeline map of cited reference

Conclusions

Based on the CiteSpace software, this study uses the core collection of the WoS database to visually analyze the literature in the field of planned behavior theory from 2012 to 2022, objectively determining the distribution of countries/ regions, authors, and topics that have made important contributions and describes the hotspots and emerging trends of the theory. The main conclusions are as follows:

The research on the planned behavior theory is growing on the whole from 2012 to 2022. Since 2016, the related research on theory has entered a hotspot period and will still be an important theory concerned by scholars for some time in the future. The United States has the largest number of articles on the planned behavior theory, followed by China, however the theory's literature in China has little influence. The third place in the number of posts in Australia. The core author group in the research field of the theory has not yet been formed, and the author with the largest volume of publication is White (61), and followed by Hamilton (46), both of whom are from Australia.

Keyword co-occurrence analysis shows that the research hotspots can be divided into three aspects: basic terms, methods, and applications. The keyword cluster network map forms 25 clusters. The research hotspots of the theory of planned behavior mainly focus on the field of health promotion and environmental protection behavior, business and consumer behavior, and theoretical analysis and research. Keyword burst analysis shows that the research direction from 2012 to 2017 is mainly in the field of health behavior and user behavior, focusing on health behavior. Meanwhile, the research from 2018 to 2019 mainly focuses on the application in the field of business consumption behavior. The future research trend of the theory may be in the field of business and consumer behavior, with emphasis on green consumption, organic food consumption, and pro-environmental behavior.

A total of 30 clusters were formed in the co-cited references network, and the average time of documents in each cluster reflected the trend of the cluster. It is concluded that years from 2012 to 2017 mainly researching on health behavior and consumer application, and years 2018 to 2019 is on business entrepreneurship, consumer behavior, and tourism behavior. In addition, the literature from years 2020 to 2022 mainly about the field of green and pro-environmental behavior, which is an active and frontier field of the theory of planned behavior research. Overall, from the analysis it shows that the planned behavior theory is important in understanding and predicting human behaviors, which allows for such a wide range of uses.

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