


Review

Research Progress of Peer Effects in Consumption Based on CiteSpace Analysis

Mingdi Wang^{1,2} and Biao Luo^{1,*} 

¹ School of Management, Hefei University of Technology, No. 193, Tunxi Roan, Hefei 230009, China; 2022010138@mail.hfut.edu.cn

² College of Information Engineering, Fuyang Normal University, No. 741, Qinghe Road, Fuyang 236041, China

* Correspondence: luobiaohfut@163.com; Tel.: +86-551-62904966

Abstract: In recent years, scholars have incorporated peer effects into the research framework of consumption, providing a new perspective for studying residents' consumer behavior. However, the common themes of these two terms are relatively under-researched, and a more detailed synthesis is needed. This study presents a visual bibliometric analysis of the knowledge structure and evolution of the peer effect in the field of consumption using CiteSpace (v.6.3. R1). The results show that the peer effect in the consumer domain has received increasing attention from the academic community and has broad research prospects. This study also provides a theoretical summary based on analysis of the literature. The mechanism of generating consumer behavioral peer effects, identification methods, and reference group categories are comprehensively discussed. Finally, this study proposes future research priorities based on the shortcomings of current research.

Keywords: consumption; peer effect; CiteSpace; research outlook



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1. Introduction

Traditional research on consumer behavior is mostly carried out by examining the economic, social, and cultural factors of individual consumers [1–3]. In consumer psychology, the individual behavior of consumers has been extensively studied from the perspectives of attitude, feeling, personality, and motivation [4–7]. However, in terms of consumption behavior, an individual's behavior is affected by other individuals in the consent group [8]. This poses new challenges to obtaining a more comprehensive understanding of the complexity and diversity of consumer behavior. In 2020, China proposed building a development pattern in which both domestic and international cycles reinforce each other [9]. In this context, accurately identifying the characteristics and structural forms of consumer behavior is crucial for understanding why products and services rapidly gain popularity among specific groups and regions, which has significant implications for policymaking.

The peer effect focuses on the effects of individual interactions in social activities and can be used as a reference for research in various disciplines [10]. Manski defined the peer effect as decisions made by individuals based on their own utility-maximization goal, and it is primarily used to examine the endogenous effects generated among individuals during social interactions [11]. Over the past two decades, scholars have gradually introduced the concept of the peer effect into the theoretical framework of consumer behavior research and obtained several results [12–15]. The peer effect is an important trend in consumer behavior research.

To develop effective marketing strategies, it is essential to determine how to effectively harness the peer effect, understand consumer needs and preferences, and promote the formation of consumption trends. Thus, it has become an important issue for researchers and marketers.

In recent years, the study of the peer effect in consumption has shown an obviously growing trend. Previous studies have explored various factors that drive peer effects in consumption, such as income [16], social norms [17], and social networks [18]. In addition, different methods for identifying peer effects in consumption have also been discussed. For example, Lin et al. attempted to examine peer effects using a dataset derived from a large-scale survey conducted on students from Xiamen University, China, as well as the classical linear-in-mean model [19]. Gutiérrez et al. established a discrete mathematical model using the effects of group size, incitement to use, and recalcitrance as parameters to verify the role of peers in individual alcoholism [20]. Graham proposed a method for identifying the impact of interaction terms under the constraints of conditional variance that was based on the Tennessee Educational Experiment (STAR) in the United States [21]. Scholars have also chosen different types of reference groups when demonstrating individual consumption behavior. For example, based on the social industry reference group, Moretti confirmed the influence of the peer effect on movie consumption by establishing a model in which movie lovers infer the quality of movies by observing the box office [22]. Based on the social domain reference group, Ling et al. demonstrated that in rural China wealthier families are more likely to be influenced by their peers when making consumption decisions [23]. Based on the social network reference group, Shemesh et al.'s research showed that the location externalities of conspicuous consumption are amplified in closely connected social networks [24]. These studies validate the role of the peer effect in residents' consumption behavior.

A more thorough and comprehensive investigation of the peer effect in consumer behavior is required. For instance, in order to more thoroughly investigate the impact of peer effects on consumption behavior and gain a deeper understanding of the overall research landscape and its chronological development, it is essential to understand the evolution of the research focus in studying peer effects in consumer behavior, as well as the current trends and emerging directions.

Current publications seem to inadequately address these specific concerns or fail to effectively visualize their results. Previous scholars have explored the peer effect in consumer behavior from various angles, such as income level [23], the market [25], online reviews [26], social networks [27], and management strategies [28]. However, these studies typically focus on isolated aspects and do not provide a comprehensive overview of the field's overall status or developmental trends. Therefore, it is essential to visually summarize existing research outcomes and identify prominent trends in peer effect research within consumption. This approach will help clarify the current frontiers and hotspots in the domain, offering new insights and perspectives. Such a synthesis is not only valuable for scholars aiming to enhance the effectiveness and efficiency of their research but also functions as a crucial reference for entrepreneurs planning future management and marketing strategies.

To address these questions and overcome the limitations of previous research, this study will conduct bibliometric analysis to summarize the status of research on the peer effect in consumption over the past two decades. In addition, it will provide a more comprehensive exploration of the peer effect in consumption from various perspectives.

This study utilizes CiteSpace bibliometric software to visualize the distribution or evolution of networks involving authors, institutions, regions, journals, hot topics, and trends in research themes with visual results. The study also summarizes the theoretical mechanisms and outlooks that provide important theoretical and practical references for both academics and management professionals.

In summary, this study has the following six objectives: (1) to review the main features of the consumer behavior peer effect literature through CiteSpace, (2) to construct the generating mechanism of the consumer behavior peer effect, (3) to discuss the models used to identify the consumer behavior peer effect, (4) to classify the reference groups of the consumer behavior peer effect into categories, (5) to introduce solutions to the endogenous problem of the peer effect in consumption, and (6) to present future research outlooks and

managerial insights. The main features of the literature are introduced in Section 2, the generation mechanism and reference group classification are introduced in Sections 3 and 4, and the methods of identifying peer effects in consumption and the endogeneity problem are introduced in Sections 5 and 6.

2. Systematic Review with the Support of CiteSpace Software

2.1. Methods

Web of Science is the world's largest comprehensive academic information resource. It covers a wide range of recognized peer-reviewed articles, including a variety of core academic journals in various research fields, such as natural science, engineering technology, and biomedicine. The Web of Science database is easily accessible to most scholars around the world, and the research results are representative [29]. Therefore, this study used the Science Citation Index Expanded and the Social Sciences Citation Index to select article data.

During the data collection process (data collection date: 16 June 2024), this study searched for relevant papers using the term "topic" as follows: topic = {[peer effect*] or [cohort effect*]} and {[consumption] or [consumption behaviour*] or [consumption behavior*]}. By filtering the titles of publications and removing irrelevant papers, 1631 articles were eventually selected for inclusion in the database.

2.2. Results of Statistical Analysis

2.2.1. Publication Statistical Analysis

In order to more intuitively understand the research status of peer effects in consumption, we first conducted a statistical analysis of the publications in this field. This study has three parts, which are detailed below.

Publication Count over the Years

Figure 1 illustrates the trend in the number of peer effect publications in the field of consumption. We found that in the past two decades publications on this topic have continuously increased, indicating that the study of peer effects in consumption has received increasing attention from scholars. The data show that 1257 papers were published in the last ten years (2015–2024), accounting for 77.06% of the dataset, and 1052 papers were published in the last five years (2019–2024), accounting for 46.78% of the dataset, which proves the novelty of research on peer effects in consumption. These findings indicate that peer effect research in the field of consumption is a new hot topic and that more research is required in this field.

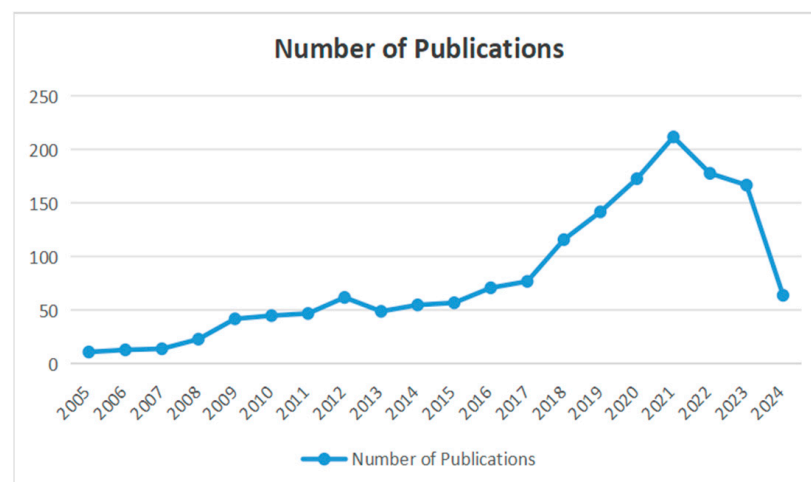


Figure 1. Number of publications in all journals.

The Quantity of Publications per Journal

As can be seen in Table 1, in the last two decades 151 journals have published articles related to peer effects in consumption. The top-producing journals in this field are *Appetite*, *BMC Public Health*, *Addictive Behaviors*, *Alcoholism: Clinical and Experimental Research*, *PLOS One*, *Substance Use & Misuse*, *International Journal of Environment Research and Public Health*, *British Food Journal*, and *Sustainability* (at 17.88%, 17.22%, 15.89%, 13.25%, 13.25%, 10.60%, 10.60%, 8.6%, 8.6%, and 8.6%, respectively). These findings provide a valuable reference for researchers when they want to be more precise in their search for journals to target in the field.

Table 1. Number of publications by journals.

Ranking	Journal Title	IF	Count	Percentage
1	<i>Appetite</i>	4.6	27	17.88%
2	<i>BMC Public Health</i>	3.5	26	17.22%
3	<i>Addictive Behaviors</i>	3.7	24	15.89%
4	<i>Drug and Alcohol Dependence</i>	3.9	20	13.25%
5	<i>Alcoholism: Clinical and Experimental Research</i>	3.0	20	13.25%
6	<i>PLOS One</i>	2.9	16	10.60%
7	<i>Substance Use & Misuse</i>	1.8	16	10.60%
8	<i>International Journal of Environment Research and Public Health</i>	4.614	13	8.60%
9	<i>British Food Journal</i>	3.4	13	8.60%
10	<i>Sustainability</i>	3.3	13	8.60%

2.2.2. Collaboration Analysis

A collaborative analysis can examine the cooperation among countries, institutions, and authors, elucidating the modes of collaboration and enhancing understanding of current research trends and situations. This study is divided into three parts, and the specific contents are described below.

Current Situation of the Institutional Collaboration Network

The visualization in Figure 2 illustrates the agencies' collaboration network. This study revealed that the global inter-institutional collaboration network is notably intricate, with a pattern of more collaboration within institutional clusters and less between different clusters. For instance, there is a prominent collaborative cluster focused on residential water-saving behavior, led by the University of Aix-Marseille, indicating close cooperation within the cluster but limited interaction with other agencies in different clusters. This limitation stems from insufficient cooperation among research institutions due to varying research emphases. In the future, researchers could endeavor to broaden inter-institutional collaboration.

Table 2 shows the status of global inter-agency cooperation in studying the peer effect in consumption. Most of the institutions in the top 10 are in Australia, the Americas, China, and Europe, meaning that the topic of peer effects in consumption is of high concern for institutions in these regions. In addition, Brown University in the United States demonstrated its quantitative and qualitative contribution to peer effects in consumption through the number of publications (16), the year of their first publication (2016), and centrality (0.05). With centrality scores of 0.12 and 0.07 respectively, with higher centrality indicating greater collaboration or connection between observation nodes and other nodes [30]. Deakin University and Emory University demonstrate significant collaborative connectivity. These scores suggest their potential as valuable resources for further research.

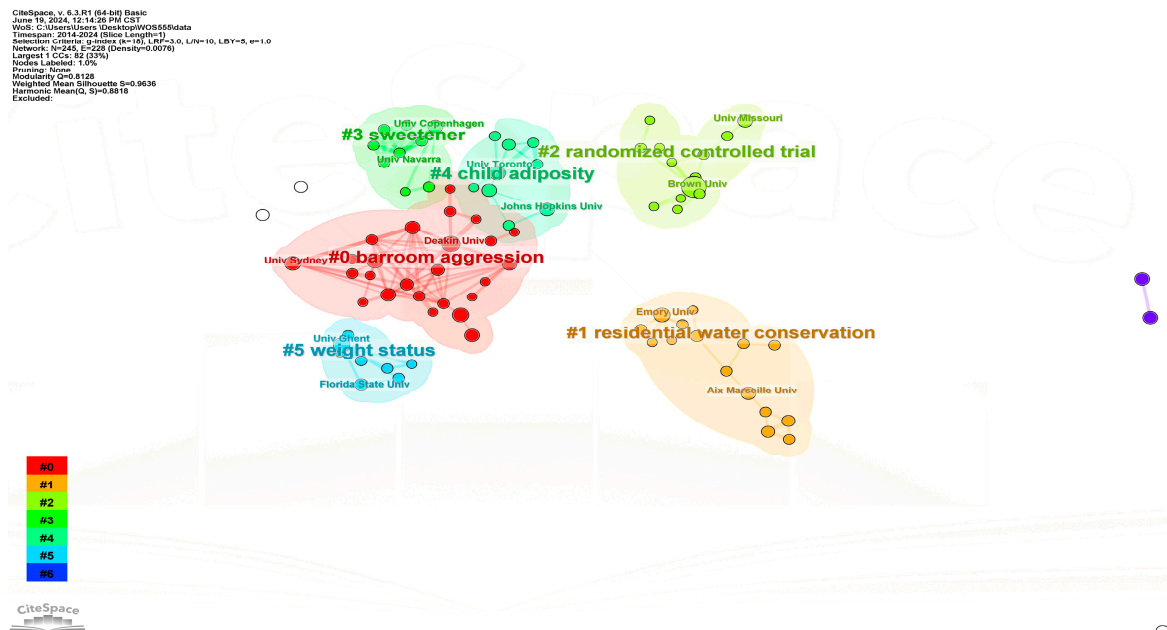


Figure 2. Visualization of institution collaboration network.

Table 2. Institution collaboration network.

Ranking	Institutions	Country	Count	Centrality	Year
1	Brown Univ	USA	16	0.05	2016
2	Deakin Univ	Australia	7	0.12	2016
3	Univ of Melbourne	Australia	7	0.02	2019
4	Univ of Sydney	Australia	7	0.01	2021
5	Univ of Toronto	Canada	7	0.02	2020
6	Emory Univ	USA	6	0.07	2017
7	Erasmus Univ	The Netherlands	6	0.00	2020
8	Peking Univ	China	6	0.00	2022
9	Aix Marseille Univ	France	5	0.02	2020
10	Hong Kong Polytech Univ	China	5	0.00	2020

Current Situation of Regional Cooperation Network

The findings presented in Table 3 demonstrate the current state of interregional collaboration. Firstly, the United States emerges as a global leader in peer effect research on consumption, with the highest number of published papers (245), the highest centrality score (0.53), and the earliest year of study initiation among the top 10 regions (2015). This underscores the United States' prominent position in this area of research. Secondly, it is notable that regions with higher levels of cooperation are predominantly wealthy or developed. Specifically, among the top ten countries engaged in this study, eight are from developed regions, with China as the only developing country represented. This distribution likely reflects the advantages of developed regions, such as larger research budgets, exceptional researchers, and better infrastructure, which provide staff with greater opportunities for international participation and collaborative research projects [31]. Furthermore, China's ranking can be largely attributed to its sizable population and rapidly growing economy, enabling it to leverage scale effects from demographic dividends and allocate increasing resources to collaborative research endeavors [32].

Table 3. Region collaboration network.

Ranking	Regions	Count	Centrality	Year
1	USA	245	0.53	2015
2	Peoples R China	135	0.13	2016
3	England	77	0.39	2019
4	Australia	61	0.13	2021
5	Canada	50	0.11	2020
6	Germany	48	0.15	2017
7	Spain	38	0.19	2020
8	France	37	0.11	2022
9	The Netherlands	37	0.04	2020
10	Italy	31	0.02	2020

Figure 3 depicts a cluster view of the regional collaboration network, revealing extensive cross-regional cooperation. By further examining the top four regions in regional cooperation, we found evidence of collaborative interactions, indicating significant progress in research on peer effects in consumption. Furthermore, it was evident that the initiation time of cooperation between regions varied. Among the top four regions in regional cooperation, the United States and the United Kingdom initiated regional collaboration at the earliest, while China and Australia began their cooperation at a later stage, highlighting the potential synergy between these two countries in this area of research. Moreover, regional collaborations are categorized into five clusters: researchers in the USA, UK, and Canada focus on health behaviors; those in Germany, Spain, and Italy on weight-related studies; those in Brazil and the Netherlands on food-related research; those in Brazil and Italy on orphan crops and green marketing; and those in China and Australia on peer effects among college students.

CiteSpace v. 5.3.R1 (64-bit) Basic
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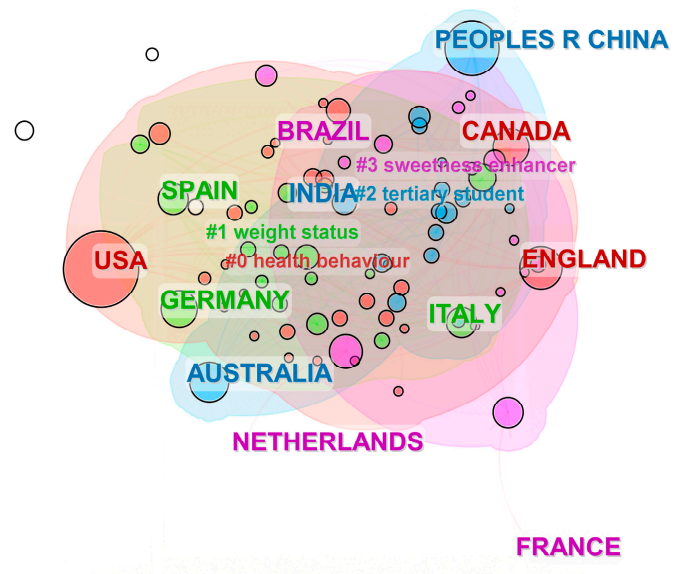


Figure 3. Visualization of Region collaboration network.

Status of the Author Collaboration Network

The cooperative network among authors in the field of peer effects in consumption is illustrated in Table 4. Overall, collaboration between authors is less common than collaboration between institutions or regions, and the majority of centrality scores (0.00) indicate a lower ability for these authors to collaborate with others. Out of the 344 authors included in this study, only 2 had collaborated more than three times. Furthermore, Carey, Kate B and Barnett, Nancy P were identified as the most frequent collaborators in this area of research, highlighting their relatively stronger collaborative relationships with other researchers.

Table 4. Author collaboration network.

Ranking	Authors	Count	Centrality	Year
1	Carey, Kate B	4	0.00	2018
2	Barnett, Nancy P	3	0.00	2014
3	De bourdeaudhuij, Ilse	2	0.00	2014
4	Slade, Tim	2	0.00	2019
5	Graupensperger, Scott	2	0.00	2022
6	Smit, Crstal R	2	0.00	2017
7	Neale, Zoe	2	0.00	2020
8	Tian, Lin	2	0.00	2022
9	Cho, Seung B	2	0.00	2020
10	Jaupitre, Olivier	2	0.00	2020

2.2.3. Co-Citation Analysis

Co-Citation Network of Journals

The journals in which studies on peer effect in consumption are cited the most are listed in Table 5. It can be seen that four of the top ten journals have an IF value higher than six in the WOS database, indicating that these journals are the core journals in the research field of the peer effect in consumption. The first ranked journal, *Addict Behav*, has a centrality of (0.08), indicating that it plays an important role in connecting other journals in the co-citation network. We also found two journals with very high centrality, namely, *Psychol Bull* with a centrality of 0.12, and *J Consum Res* with a centrality of 0.14, indicating that these journals have potential influence on the research in this field and can provide valuable references for future studies on peer effect in consumption. Researchers could choose to submit their papers to journals with high centrality in order to enhance the citation of their papers.

Table 5. Journal co-citation network.

Ranking	Journals	5-Year IF	Count	Centrality
1	<i>Addict. Behav.</i>	3.8	144	0.08
2	<i>Addiction</i>	5.9	120	0.05
3	<i>J. Pers. Soc. Psychol.</i>	7.3	109	0.29
4	<i>Alcohol Clin. Exp. Res.</i>	3.6	98	0.11
5	<i>Psychol. Bull.</i>	24.1	98	0.12
6	<i>J. Stud. Alcohol</i>	-	96	0.05
7	<i>J Adolescent Health</i>	6.1	92	0.07
8	<i>J. Consum. Res</i>	8.6	90	0.14
9	<i>PLOS One</i>	3.3	89	0.02
10	<i>J. Stud. Alcohol Drugs</i>	2.7	81	0.03

Figure 4 depicts a visual cluster of the journal co-citation network. This study discovered that the top 10 categories within the journal co-citation cluster pertain to consumer behavior, education, economics, sociology, business, energy, and fuels, as well as nutrition and dietetics. This indicates that the research and cited journals regarding the topic of peer effects in consumption are multidisciplinary. This offers a valuable reference for researchers aiming to broaden their research content from a specific discipline to a broader range of disciplines.

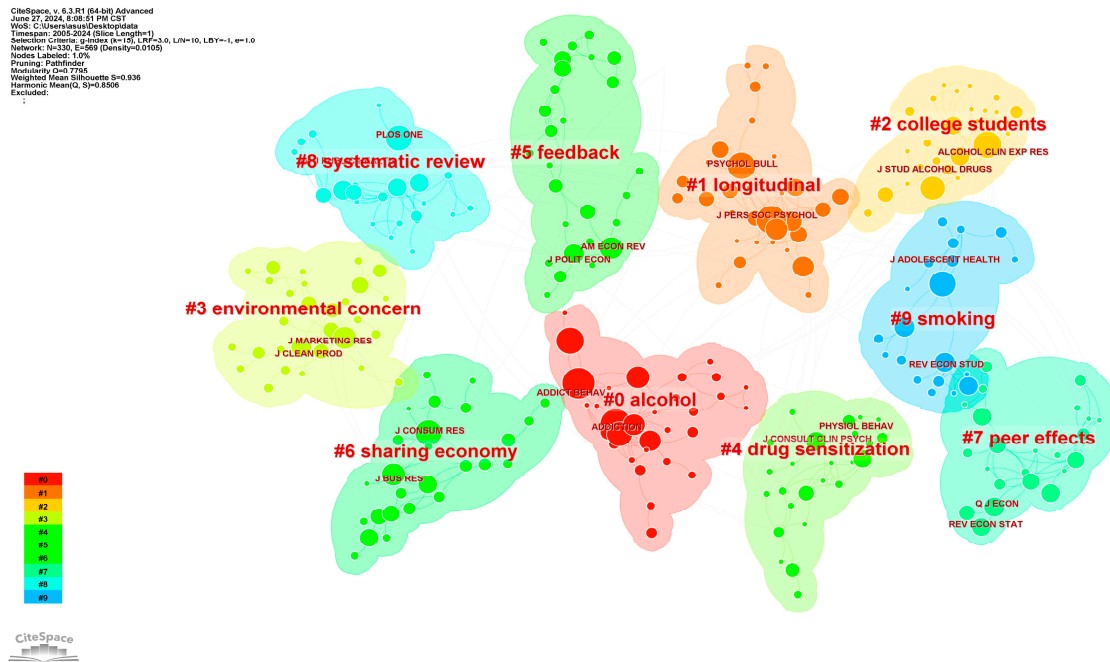


Figure 4. Visualization of journal co-citation network.

Co-Citation Network of References

Table 6 shows the 10 most cited studies on peer effects in consumption. Specifically, four articles discuss the interrelationship between the sharing economy, peer effects, and consumption [33–36]. Three articles discuss the problem of peer effects in students’ consumption behavior [37–39]. Two papers discuss the identification of peer effects [11,40]. Another article discusses the influence of groups on individual food intake under socially derived norms [41]. The most cited articles show that, in the study of peer effects in consumption, scholars are highly concerned with the sharing economy.

Table 6. Reference co-citation network.

Ranking	Journals	Count	Centrality	Year
1	Manski C.F., <i>Rev. Econ. Stud.</i> , V60, P531 [11]	38	0.18	2018
2	Borsari B., <i>J. Subst. Abuse.</i> , V13, P391 [37]	27	0.18	2010
3	Fornell C., <i>J. Marketing. Res.</i> , V18, P39 [40]	24	0.03	2020
4	Bardhi F., <i>J. Consum. Res.</i> , V39, P881 [33]	24	0.01	2018
5	Borsari B., <i>J. Stud. Alcohol.</i> , V64, P331 [39]	23	0.13	2010
6	Hamari J., <i>J. Assoc. Inf. Sci. Tech.</i> , V67, P2047 [34]	20	0	2018
7	Belk R., <i>J. Bus. Res.</i> , V67, P1595 [35]	15	0.02	2018
8	Ajzen I., <i>Organ. Behav. Hum. Dec.</i> , V50, P179	15	0.08	2020
9	Hayes A.F., <i>Introduction. To. Mediation.</i> , V0, P0	15	0.07	2018
10	Gaviria A., <i>Rev. Econ. Stat.</i> , V83, P257 [38]	15	0.03	2022

Figure 5 shows the main categories of the cited literature. The top nine categories of the co-cited literature were screened, and were divided into four categories: education, sharing economy, social interaction, and marketing strategy. Education includes the categories of youth alcohol consumption, food choices, social influences, and gender differences. The sharing economy includes brand extension, social capital, and collaborative consumption. Social interactions include drinking, high school, and social interactions. Marketing strategy includes peer comparison and economic benefits. In the above research, scholars may find new ideas about peer effects in consumption.

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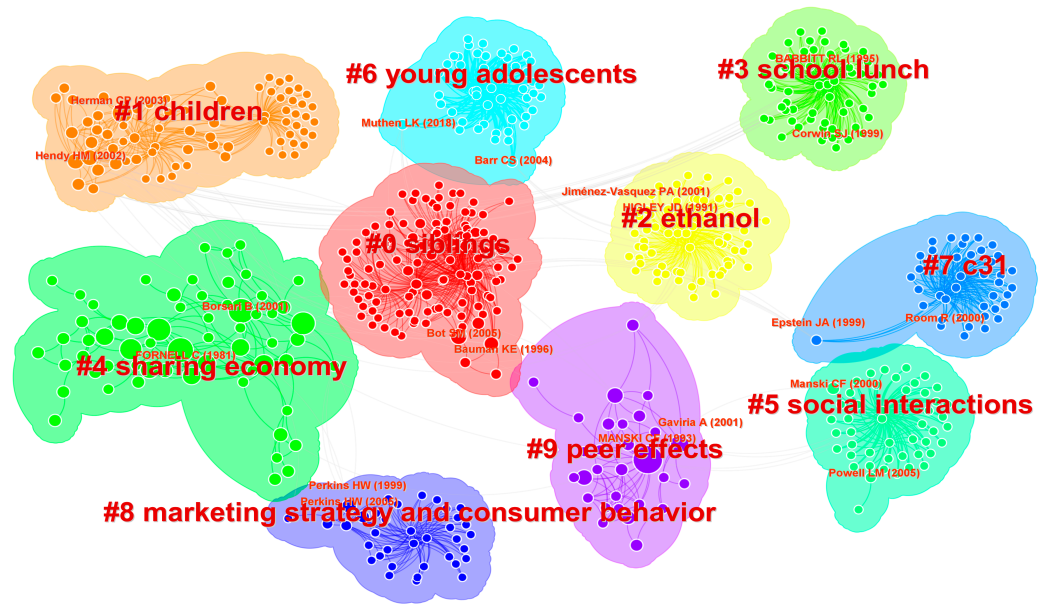


Figure 5. Visualization of reference co-citation network.

2.2.4. Co-Occurrence Analysis Category Co-Occurrence

Table 7 shows the main co-occurrence categories in the study of peer effects in consumption. These disciplines include medicine, economics, environmental sciences, resources, environment and safety, business, nutrition and dietetics, computer science and information systems, and psychology. The number of medical and economic categories are the highest, indicating their important position in the study of consumer peer effects. In addition, environmental science, business, and nutrition and dietetics are hot areas and frontiers in this research field.

Figure 6 shows a cluster view of the co-occurrence of major categories in studies on peer effects in consumption, helping us to explore the topic distribution in this research field. The image shows clusters of five main categories: economics, computer science and information systems, pharmacy, environmental science, and psychology. The economics cluster is mainly composed of the public, environmental, and occupational health, health policy and services, nutrition and dietetics, and healthcare sciences and services categories. The computer science and information system cluster mainly refers to the peer effects of e-commerce behavior in consumption. The pharmacy cluster mainly discusses the psychological behavior of the peer effects of drug abuse in consumption. The environmental science cluster focuses on peer effects and energy-related issues in consumption, such as green and sustainable technology, environmental science, and engineering, and related research. The psychology research cluster focuses on issues related to rehabilitation, oncol-

ogy, pediatrics, and social work. These findings provide valuable insights indicating that the categories of research on peer effects in consumption are multidisciplinary and that research focus and interest should be expanded to different categories.

Table 7. Category co-occurrence.

Ranking	Category	Count	Centrality	Year
1	Substance abuse	95	0.22	2005
2	Economics	59	0.54	2007
3	Public, environmental, and occupational health	46	0.5	2009
4	Business	44	0.23	2018
5	Psychiatry	43	0.13	2005
6	Nutrition and dietetics	39	0.1	2005
7	Environmental sciences	32	0.14	2008
8	Psychology	27	0.04	2006
9	Computer science and information systems	26	0.16	2009
10	Psychology and clinical	25	0.07	2009

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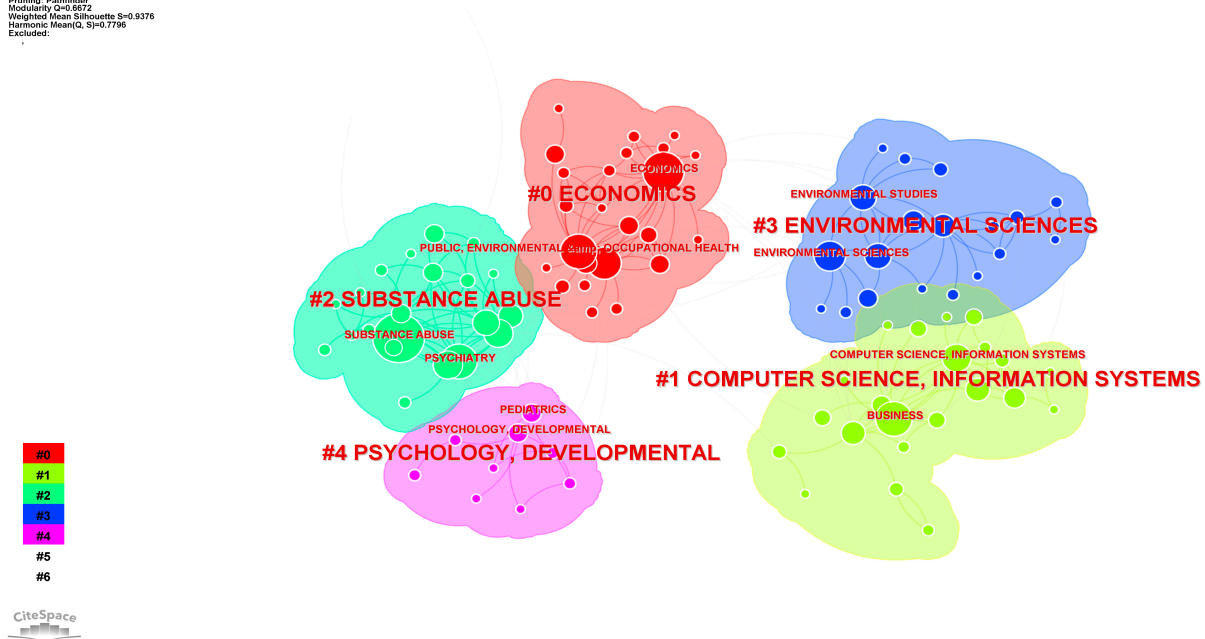


Figure 6. Cluster visualization of category co-occurrence.

The Co-Occurrence of Keywords

Table 8 describes the co-occurrence of keywords in the field of peer effects in consumption; frequently occurring keywords indicate the most popular content and the latest development hotspots in the field. These keywords are highly relevant to peer effects and consumption. Specifically, of the top 10 co-occurring keywords, “consumption”, “peer effect”, “behavior”, and “influence” are the exact words of the peer effect domains in consumption (at 181, 89, 85, and 52, respectively). In addition, “substance use”, “risk”, “health”, “alcohol consumption”, “sharing economy”, and “teens” are high-frequency keywords in the top 10, which means that these keywords are more popular and valued by scholars in this field and that they dominate recent research.

Table 8. Keyword co-occurrence.

Ranking	Keywords	Counts	Year	Centrality
1	Consumption	181	2014	0.27
2	Peer effects	89	2014	0.09
3	Behavior	85	2014	0.11
4	Substance use	75	2014	0.08
5	Risk	61	2014	0.07
6	Health	59	2014	0.11
7	Alcohol consumption	57	2014	0.09
8	Impact	52	2014	0.09
9	Sharing economy	51	2018	0.05
10	Adolescents	39	2014	0.05

Bursts of Keywords

Keyword bursts serve as indicators of the hotspots and emerging trends within the research domain, indicating a predominant focus in academia. Figure 7 presents the top 20 keywords exhibiting the strongest citation bursts from 2015 to 2024. The findings reveal that the top five keywords with the strongest bursts are “quality” (with a strength of 3.91), “pain management” (3.85), “smoking” (3.27), “sustainable consumption” (3.17), and “social network” (3.03), signifying their significance in shaping the research landscape of peer effects in consumption. The top five keywords with prolonged bursts include “satisfaction” (4 years), “social influence” (3 years), “preferences” (2 years), “identification” (2 years), and “environment” (2 years), suggesting sustained scholarly attention towards these topics. The latest five keywords among the top 20 are “quality”, “pain management”, “identification”, “satisfaction”, and “physical activity”, meaning that they represent recent frontiers in this research domain. The keywords with the earliest bursts are “smoking”, “social network”, “physical activity”, “social influence”, and “preferences”. It is evident that there is comprehensive and extensive coverage of various aspects within this research domain, as indicated by differences in the strength, duration, recency, and timing of the keyword bursts. These results offer valuable insights for scholars aiming to explore diverse facets of peer effects in consumption, thereby contributing to multifaceted academic advancements within this field.

The Top 20 Keywords with the Strongest Citation Bursts

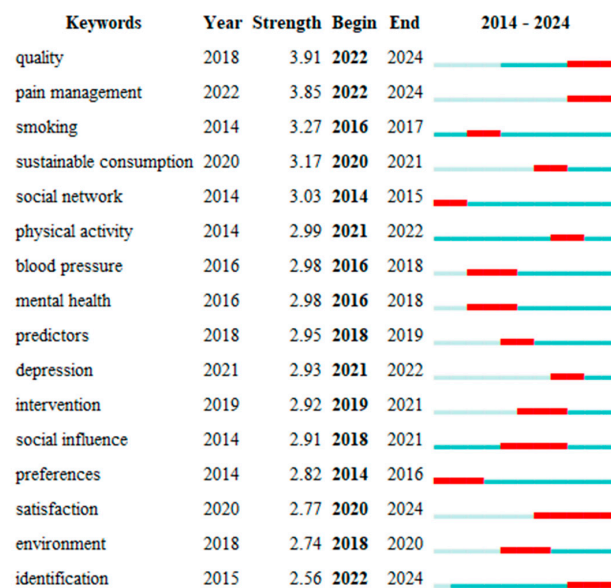


Figure 7. Top 20 keywords with the strongest citation bursts.

2.3. Results of Statistical Analysis

In summary, we mainly analyzed the knowledge base, correlation, current situation, and evolution of peer effects in consumption, thus providing a valuable reference for a comprehensive understanding of the research status in this field. However, it is also very important to gain an in-depth understanding of how peer effects in consumption operate and interact, revealing the nature and principles behind the phenomenon. This study continues to explore the generation mechanism of peer effects in consumption, identification methods, and solutions to endogenous effects, and it aims to identify the reference group of peer effects in consumption. These discussions are crucial for guiding practical applications and scholarly work in the field.

3. The Mechanism of Consumer Behavior Peer Effects

According to the theoretical mechanism, the peer effect is considered to be a specific manifestation of the social interaction effect. The behavior of individual consumers is affected by the output of other individuals in the process of social interaction. The social interaction effect was first proposed and distinguished by the Western scholar Manski, and on this basis the first linear model was established to quantify and identify the objective existence of the effect. Manski explained the theoretical mechanism of the peer effect in terms of the preference, expectation, and constraint interactions proposed in the field of economics [42].

3.1. Interpretation Based on Preference Interactions

Preference interaction theory posits that the choices made by peers within a group have a direct impact on an individual's behavioral preferences when selecting from a set of options [43]. In the process of social interaction, individual consumers interact with other consumers in the group, make preference responses according to changes in the environment, and finally decide which consumption behavior to choose. For example, herding and snobbery are typical behaviors by which other actors influence individual preferences [44,45].

Drawing from the classical Hegselmann-Krause (H.K.) model of continuous opinion dynamics [46], we assume that each individual consumer has defined trust boundaries and only communicates with peers whose opinions fall within this range of confidence. Moreover, it is assumed that every consumer in the group exerts an equal influence.

When updating their opinion, individual consumers adopt the average opinion of their peers as their new stance. Consider a social group comprising multiple individual consumers. The consumers in the group all hold their initial opinions. The viewpoint of consumer i at moment k is denoted by the real number $(k) \in [0, 1]$. The confidence range of a consumer is denoted as ε_i . Then, the view neighbors of consumer i are denoted as follow:

$$N_i(k) = \{j \in \{1, 2, \dots, N\} : |x_i(k) - x_j(k)| \leq \varepsilon\} \quad (1)$$

When the views of individual consumers i and j merge, the view of individual consumer i at the moment $k + 1$ is described as follows:

$$x_i(k + 1) = \sum_{j=1}^n w_{ij}(k) x_j(k) \quad (2)$$

The update weight (k) of the viewpoint of consumers j and i is defined as follows:

$$w_{ij}(k) = \begin{cases} 1/N_i(k), & j \in N_i(k) \\ 0, & j \notin N_i(k) \end{cases} \quad (3)$$

According to the model proposed by Hegselmann, individual consumers interact with all social groups within the range of confidence so as to decide whether to adopt consumption behavior. We can infer that the decisions that drive the individual consumer in the next moment are the average of the decisions made by all members of the social group in the previous moment.

3.2. Interpretation Based on Expected Interaction

Expected interaction refers to the process where an individual observes their peers' behaviors before acting and anticipates making adjustments based on others' choices to mitigate the disadvantages of information asymmetry [47].

Drawing inspiration from Solomon Asch's classic Asch experiment, we can understand how expected social conformity affects individual judgment and sense of self. Under varying degrees of peer pressure from their group members, each participant was asked in turn to answer a series of questions, such as determining the longest line or matching it to a reference line.

According to the Asch experiment, all participants provided accurate responses in a control group without peer pressure. However, when surrounded by peers who gave the wrong answer, more than one-third of the subjects conformed to the incorrect opinion. The results of the Asch experiment demonstrate that peer pressure exerts a measurable influence on response accuracy. Taylor and Fiske also demonstrated that an observer tends to focus more on and be more influenced by the remarks of the person they are directly facing when observing a group conversation [48].

The Asch experiment is very instructive for the study of peer effects. An important reason why consumer conformity behavior is affected by peer effects is group identity. Group identity is closely related to individual effectiveness. If consumers make individual decisions contrary to the group, their sense of identity within the group may decline, thus compromising their utility [49]. For example, using the Bureau of Labor Statistics' (BLS) Consumer Expenditure Survey (CEX), Yuan found that every USD 1 increase in average spending by peers resulted in an increase of USD 0.60 in average spending by individuals on coats and footwear. This means that under the influence of group identity psychology, the peer effect dominates individual consumption decisions [50].

The expected interaction mechanism of the peer effect in changing individual behavioral cognition can also correspond to learned behavior. The motivation or incentive for an individual's action depends on an estimate of the expected likelihood of achieving the outcome of the action. Bandura's social learning theory [51] holds that individuals modify their existing knowledge by observing, extracting, and absorbing behavioral information from peers so as to make optimal decisions. By comparing the costs of independent decision-making with those of imitating and learning from others' choices, socially oriented individuals strive to choose their own optimal options in order to maximize their benefits. Focusing on dairy consumers in India, Chandra et al. provided evidence of peer effects on consumers' attitudes towards various food safety attributes and practices. One way for Indian residents to ensure food safety depends on the information available to consumers through their social networks [52].

3.3. Interpretation Based on Constraint Interaction

The interaction of behavioral constraints can also be interpreted as the constraint interaction. This concept involves grouping individuals with specific behaviors into defined groups whose behaviors are mutually exclusive, resulting in a peer effect [28]. There is a lack of empirical evidence on the constraint interaction mechanism of behavior in consumption. The market mechanism in economics is a typical example of a constraint interaction mechanism [42].

Since resources are fixed, the more resources other consumers acquire, the fewer are left for themselves, leading to a peer effect of resource competition in a constrained environment.

For instance, during the COVID-19 pandemic, consumer demand for masks was significantly influenced by expectations about social interactions under similar market conditions. In social settings, such as classrooms, positive interactions related to constraints occur. For example, when a few students invest in helpful textbooks, it often leads to wider dissemination of information and expanded consumption options among their peers, creating peer effects.

4. Category of Reference Group

In recent years, research on the peer effect in consumer behavior has steadily increased. To systematically categorize the existing research results, we can apply the concept of a reference group as a standard framework.

Hyman initially introduced the concept of a reference group, which refers to individuals' subjective evaluation of their social status in comparison to that of others, with the social status of others serving as their point of reference [53]. Cooley proposed the theory of the looking-glass self, which posits that individuals' self-concept is formed through their evaluations and attitudes towards themselves as reflected in a mirror [54]. Merton argued that reference groups, also referred to as significant others, play a pivotal role in shaping individual self-assessment and social behavior.

Merton classified frames of reference into three categories: those with whom one has direct and stable social interactions, those who belong to a similar social category or position, and those who occupy a different social category or position [55]. Following Merton, reference group theory was swiftly utilized in diverse fields such as economics and education. Park and Lessig's research revealed that reference groups exert a substantial impact on consumers' propensity to make purchases [56]. Seaton et al. found that attending a good secondary school has a significant negative effect on students' self-evaluation of academic performance [57]. According to the views of scholars [42,54,58], this study divides the reference groups of consumer behavior into three categories: reference groups based on industry fields, reference groups based on social regions, and reference groups based on social networks.

4.1. Industry-Based Reference Groups

Research has shown that individual consumers can acquire information through observational learning, particularly within social groups such as student organizations and sports and leisure clubs. Prolonged exposure to these environments can significantly influence consumption behavior due to the peer effect.

For instance, Young-Ha et al. conducted a study on the factors influencing adolescent consumers' conspicuous consumption, including mass media influence, peer effects, and conformity. Empirical studies demonstrated that conspicuous consumption among high school students is a significant determinant that encourages individuals to engage conspicuously in under-age-consumption. The use of a hierarchical multiple regression analysis led to these findings [59]. Deconinck and Swinnen utilized survey data from the Russian Longitudinal Surveillance Survey (RLMS) to examine individual factors influencing beer consumption, employing hysteresis and synchronization measurements to establish the lower and upper limits for peer effects. The results indicated that the choice to consume beer is significantly impacted by the collective behavior of one's peer group [25]. Moretti confirmed the influence of peer effects on film consumption by establishing a model whereby film lovers can infer the quality of films by observing the box office [22].

4.2. Reference Groups Based on Social Fields

Social regions are another common and significant reference group. Empirical evidence suggests that the interaction effect of individual consumption decisions is more pronounced within the same region. Ling et al. observed that in rural China there is a 0.24% increase in a household's consumption for every 1% increase in the consumption expenditure of peer households. Furthermore, it has been noted that wealthier households exhibit greater susceptibility to peer influence when making consumption decisions. Lastly, it has been found that households are more responsive to changes in the consumption patterns of their less affluent peers than to their more affluent counterparts [23]. Using a large representative sample of credit and debit card transactions in Singapore, Agarwal et al. conducted a study on the spending behaviors of individuals in their local communities who had undergone personal bankruptcy. Their findings revealed that in the year following bankruptcy monthly credit card expenditures by peers decreased by 3.4%. However, no noticeable reduction in

consumption was observed among individuals living near the bankrupt person, or among consumers whose social connections with the bankrupt individual had weakened [60].

4.3. Reference Groups Based on Social Network

Naturally occurring social networks serve as important reference groups in the study of consumer behavior. For instance, by using health data from U.S. high schools, one study demonstrated a positive, albeit small, peer effect on fast food consumption among adolescents within the same school friendship network [61]. Similarly, Gao et al. used a multivariate linear regression model to show that individual online loan spending of an individual is significantly and positively influenced by the average spending on online loans by their roommates [62]. Furthermore, Zhang et al. explored the impact of online reviews on consumer decision-making concerning competing products, as well as the influence of local and global peer information. Their empirical analysis, based on data from a restaurant review website, found that increases in the average price or volume of spatially adjacent and feature-similar alternatives decreased the likelihood of choosing the focus product, with a 92.0% (for price) and 66.6% (for volume) decrease for one product, and a 72.2% (for price) and 45.8% (for volume) decrease for the other [26].

5. Identification Method

The identification of peer effects is essential for validating the theoretical hypotheses underpinning peer effect theory in consumer behavior. As research across various social disciplines advances, the methods for identifying peer effects have become more sophisticated and diverse. This paper outlines several commonly used methods to identify and measure the peer effect in consumer behavior, providing valuable insights for scholars in the field.

5.1. Peer Effect Model Recognition Methodology

5.1.1. Linear-in-Means Model

Manski utilized the mean of the reference group's behavior as a proxy for peer behavior and proposed a linear regression model with that mean as the baseline [11]. According to Manski, we can represent the model for identifying the reference group of fixed effects of consumer behavior as follows:

$$Y_{ig} = \alpha + \beta x_i + \gamma d_g + \delta w_{ig}^e + \varepsilon_i \quad (4)$$

Here, the parameters are defined as follows: X_i represents the observable characteristics of an individual consumer, such as green consumption behavior and habits, learning ability, and economic conditions; d_g describes the observable characteristics of the individual consumer's reference group; w_{ig}^e refers to an individual consumer's beliefs about peer behavior; N_i is the given consumer's information set, i.e., the consumer's subjective probability estimate of a certain action being taken by other consumer peers in the reference group; and ε_i represents an individual consumer's unobservable characteristics.

The prerequisite for this model to hold, is that w_{ig}^e can be represented by the mean value of the actions of all consumer members within the reference. For instance, Gaertner analyzed consumer demand models in which an individual's demand increases with the average demand of the reference group at a fixed price [63].

The above equation, however, fails to disentangle the endogenous interaction effect coefficient from the situational effect coefficient. It merely isolates the combined social interaction effects associated with the mapping problem. Linear average models typically assume that the influences of other consumers in the same group are equally weighted and do not account for potential heterogeneity among individual consumers. Therefore, it is necessary to introduce dummy variables into the research and consider the heterogeneity of individual consumers in order to enhance the scientific rigor and validity of our study.

5.1.2. Spatial Econometric Model

The spatial measure is a series of regressions made on variables after adding spatial effects. When the premise of individual consumer heterogeneity exists, the use of spatial econometric models can effectively avoid the mapping problem and can also consider the notion that different consumer peers exert different degrees of influence on an individual's consumer decisions. The basis for building the spatial model is the proximity matrix describing social network A , where element (a_{ij}) takes a value of 0 or 1. A value of 0 means that there is no association between the individual consumers corresponding to row i and column j , and conversely, a value of 1 means that there is an association. The weight matrix is added to Equation (4), as shown in Equation (5):

$$Y_i = \alpha + \beta x_i + \gamma \sum_{j \neq i} a_{ij} x_j + \delta \sum_{j \neq i} a_{ij} Y_j + \varepsilon_i \quad (5)$$

Here, it is assumed that " $E(\varepsilon_i | (x_i) i \in V, A) = 0$ ". Bramoullé et al. [64] found that parameters α , β , γ , and δ in Equation (5) are identifiable if there is no linear correlation between matrices I , A , and A^2 . If matrices I , A , and A^2 are linearly correlated, the above parameters cannot be identified. They also found that the peer effect of having an undirected network is identifiable if the size of the reference group is different; for example, if the number of individual consumers in the reference group is different. In general, the social network identification problem relies on weight matrix A (A is a priori information, which is equivalent to a constraint on the coefficients). Most realistic network structures meet the above conditions, and the estimated coefficient of the peer effects δ can be identified.

5.1.3. Discrete Choice Model

The discrete choice model is an experimental design that measures consumer buying behavior by simulating the competitive market environment for the product or service to be studied.

The general principle of the discrete choice model is random utility theory, which generally treats the original (fixed-effects model) regression coefficients as random variables. The multinomial logit model and the probit model are the simplest forms of discrete choice models. In the discrete choice model, the chooser's strategy is to choose the alternative with the highest utility, at which point the utility function can be constructed using assumptions based on the underlying assumptions. The difference in utility arising from a decision can be articulated as a function that includes individual characteristics of the behavior, attributes of the reference group, and expectations regarding peer behavior. A peer effect emerges when the utility derived from adopting a certain consumer behavior exceeds the utility of not engaging in that consumer behavior.

We set up a Bayesian herd behavior model. Suppose that the probability of each consumer receiving shopping information is denoted as α and that the accuracy of this information is represented by β . It should be noted that β is a random variable, which can take on values greater than or less than 1/2 [65].

In a Bayesian network, if the information of consumers X and Y are directly connected, then the knowledge of X 's information affects Y 's decision, and the probability that the information is correct is β . Consumer Y observes and imitates X 's and Y 's behaviors, and, if their behaviors are the same, with a certain probability, there will be a follower behavior.

$$p(i^* = i^{x,y} | consumer) = \frac{p(consumer | i^* = i^{x,y}) \cdot p(i^* = i^{x,y})}{\int p(consumer | i^* = i^{x,y}) p(i)} \quad (6)$$

When consumer Y 's information is incongruent with X and Y 's information, they experience uncertainty regarding the accuracy of their information. According to the

Bayesian probit model, the likelihood of consumer Y opting for an alternative strategy based on accurate information exceeds the likelihood of adhering to their initial choice.

$$\frac{p(i^* = i^{x,y} | consumer)}{p(i^* = i^z | consumer)} = \frac{[\alpha^3 \beta^2 (1 - \beta) + \alpha^2 \beta (1 - \beta) (1 - \alpha)] / p(consumer)}{[\alpha^2 \beta (1 - \beta) (1 - \alpha) \beta] / p(consumer)} > \quad (7)$$

Here, i^* represents the true information, $i^{x,y}$ represents the consistent message received by the first two consumers, and i^z represents what consumer Z receives. The concept of follower behavior implies that peer consumers make a collective decision. Therefore, theoretically, when influenced by peer effects, consumers may find it more advantageous to follow others' choices rather than strictly adhering to their own information, even though they consider the likelihood that their personal information is correct.

5.2. Variance Identification Method

It is also possible to help identify the peer effect by utilizing an analysis of variance. Glaeser et al. proposed the multiplier effect test, which makes full use of aggregated data at the reference group level for comparison with micro-individual data for identification [66]. Graham proposed a method for identifying the impact of interaction terms under the constraints of conditional variance that was based on the Tennessee Educational Experiment (STAR) in the United States [21]. We employ Graham's conditional variance restriction approach to discern the collective impact of consumer behavior.

There are N groups, and there are M_c consumers in the C th group for the following equations:

$$Y_{ci} = \alpha_c + (\gamma_0 - 1)\bar{\varepsilon}_c + \varepsilon_{ci} \quad (8)$$

Here, Y_{ci} denotes the observable consumer performance. α_c indicates the external influence (unobservable). ε_{ci} indicates the individual consumer level. $\bar{\varepsilon}_c = \varepsilon'_c l m c / M_c$ indicates the average number of consumers in the group. $W_c = 1$ indicates a small group, and $W_c = 0$ indicates a large group. In estimating the social interaction term γ_0 , we can obtain the identification statistic of the social interaction term using the operation of two statistics similar to the within-group variance and between-group variance. The definitions of these two statistics are as follows:

$$G_c^w = \frac{1}{M_c(M_c - 1)} \sum_{i=1}^{M_c} (Y_{ci} - \bar{Y}_c)^2, G_b^w = (\bar{Y}_c - \mu y(W_c))^2 \quad (9)$$

Here, $\bar{Y}_c = \frac{1}{M_c} \sum_{i=1}^{M_c} Y_{ci}$, $\mu y(W_c)$ is the average performance of the consumers in the same group category, and G_c^w is viewed as the within-group sample variance caused by individual differences among consumers and external effects. G_b^w indicates the between-group variance; if the interaction is affected by the size of the group, then the between-group variance will be different between the two groups. The above calculation leads to the following:

$$E(G_c^b | W = 1) - E(G_c^b | W = 0) = \gamma_0^2 E(G_c^w | W = 1) - E(G_c^w | W = 0) + T_0(1) - T_0(0) \quad (10)$$

where left side of the formula shows the difference between the two groups. The first term on the right side is the difference between the two groups caused by consumer influence, while the second term is the difference between the two groups caused by external factors. γ_0^2 is the coefficient of the consumer factor influence term, which also indicates that the individual consumer has a small influence on both groups, while the interaction effects from the interactions contribute more to the difference between the two groups. Identification estimates were obtained when there was no difference between the two groups in terms of external influence.

6. The Endogeneity Problem of Peer Effect

Endogenous social effects have long been an important issue in sociological and social-psychological research. The endogeneity of peer effects should be studied to dis-

tinguish them from exogenous social effects. The presence of endogeneity arises from unobservable individual characteristics that simultaneously affect both the formation of links in the network and the outcome of interest [67]. For example, if all other things are equal, the decision to drop out of a high school in the United States varies by the type of school, ethnic group, or dropout rate of another reference group, and there is an endogenous effect. An exogenous effect exists if, all other things being equal, the decision to drop out varies by the socio-economic conditions of the reference group. Manski stated that the endogeneity problems of peer effects can be categorized into three main types: mapping problems, correlation effects problems, and group self-selection problems [68].

6.1. Mapping Problems for Peer Effects

The mapping problem arises from the overlap of information between individual features and the features of a reference group, represented by their mean values [43]. This issue can be likened to a scenario where both a person and their shadow in a mirror move simultaneously, making it difficult to discern whether the observed correlation stems from the shadow's movement or the person's actual motion. To address this in studying the peer effects on consumer behavior, one strategy involves using instrumental variables that account for consumer peer influences or regional fixed effects, which include institutional and environmental factors [69]. Alternatively, employing the median instead of the mean can help mitigate the mapping problem [70].

6.2. The Problem of Correlation Effects for Peer Effects

The association effect problem refers to the possibility of the unobservable characteristics of the reference group being associated with individual characteristics [43]. This occurs when focal individuals exhibit significant positive relationships with their peers, not due to direct inter-individual interactions, but due to a convergence of behaviors influenced by unseen characteristics of the reference group. This can lead to severe endogeneity issues. For instance, in the cultural industry, residents' consumption of cultural products may be driven more by these correlation effects than by individual interactions. To address this, existing literature typically employs two main strategies: one involves using external information from outside the consumer behavior reference group to construct instrumental variables [71], and the other involves removing the invisible characteristics of the reference group either through differential treatment or by controlling for fixed effects of individual consumers [72].

6.3. The Issue of Cluster Optionality

The cluster self-selectivity problem refers to the fact that the main explanatory or dependent variables are influenced to some extent by individual choices. Literature primarily addresses this issue using the instrumental variables method and the staged identification approach to mitigate self-selectivity concerns. Heckman's two-stage model is commonly applied to address sample selection bias, where a selection equation model is used in the first stage to categorize individuals into reference groups, and an outcome equation model is employed in the second stage to test the effects [73].

The structural equation approach can also be used to solve the consumer group self-selectivity problem. Goldsmith-Pinkham and Imbens hypothesized that, in groups, each behavioral individual has a set of observable and unobservable characteristics that other behavioral individuals can observe, and each individual then selects their own "peers" based on their characteristics [74]. A probit model is then used in the structural equation to reflect the presence or absence of ties between individuals, treating the entire social network as the result of individual choices.

7. Conclusions

This study contributes to the understanding of peer effects in consumer behavior. Firstly, it utilizes CiteSpace to visualize the structure, rules, and distribution of outcomes

related to consumer peer effects for the first time. This provides scholars with a clearer view of developing trends, research hotspots, and key nodes, thereby improving the efficiency and accuracy of literature reviews. Secondly, the study delineates three theoretical mechanisms of the peer effect in consumer behavior: expectation interaction, preference interaction, and constraint interaction, offering a theoretical basis for further investigation in this field. Thirdly, this research introduces various methods to identify peer effects in consumer behavior, including the reference group mean method, the measurement model, the discrete model, and variance identification methods. This diversification provides a methodological framework for future research. Fourthly, it addresses the endogenous problem of the homogenization effect in consumer behavior, contributing fresh methodological insights. Fifthly, this study provides a clear classification of reference groups for the group effect in consumer behavior and provides valuable views for scholars to select appropriate peer effect reference groups in their research.

Despite these contributions, the CiteSpace visual analysis indicates that research on consumer behavior's group effect, particularly in network environments like Web 3.0 and social media, is still limited. Future studies should deepen the conceptual understanding of peer influence, broaden the scope of peer effect reference groups in online settings, and enrich research on consumption behavior in these contexts. With the in-depth development of Web 3.0 technology and the wide application of social media, residents' social networks transcend traditional social organizations and familiar groups. Online virtual communities and other Internet-based groups expand the range of peer effect reference groups. However, research on the peer effect of consumption in the network environment is still very limited. Therefore, future research needs to further strengthen the conceptual understanding of peer influence, expand the reference group of peer effects in the network environment, and enrich the research on consumption behavior.

Moreover, the methodology for studying peer effects in consumption needs improvement. Future research could integrate advanced methods like causal reasoning [75], machine learning [76], and randomized [77] or field experiments [78] to improve the theoretical models of peer effects and validate consumer behavior more comprehensively. In addition, combining quantitative and qualitative research methods could provide a more comprehensive examination of peer effects in consumption.

This study holds important implications for social management, particularly in guiding economic development and consumption behaviors. During the transition to new economic models, leveraging group influence can encourage residents to adopt rational and healthy consumption patterns, thereby elevating consumption standards and fostering high-quality development. Given the variation in peer effects across industries and countries, policymakers are positioned to customize strategies that reflect these differences. In societies that emphasize collectivist values, harnessing peer effects can effectively shape policies that support healthy consumption practices. Moreover, administrative agencies can design tailored policies for various consumption sectors to help residents cultivate sensible consumption habits.

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