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RESEARCH ARTICLE

Bibliometric knowledge mapping of consumers' inferring shopping experience in live E-commerce platform on data mining

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ABSTRACT

This study utilizes bibliometric knowledge mapping to guide the development of consumer behavior within a theoretical framework in live E-commerce environments. This analysis is based on data collected by existing customers on platforms such as Taobao, JD.com, Mogujie, Xiaohongshu, and Jumei Youpin. The literature survey chart is based on 2000 articles. The resulting theoretical concept shares the same structure as the stimulus-organism-response (S-O-R) model of consumer behaviors. The stimulus has social, technical, stream and viewer factors. The social stimulus includes social influence, and interaction among the live anchor and the consumers. The stream factor is represented by vicarious learning. The technical stimulus consists of performance and effort expectancies, the synchronicity of live session and system, and system and service quality. The viewer stimulus consists of impulsive buying tendency and innovativeness of consumers. Multilayer perceptron neural network (MLP-NN), which integrates many variables in bibliometrics, has become an effective means to guide Structural Equation Modeling (SEM) analysis and configuration, thus generating a knowledge base. The study offers many practical and theoretical implications, for instance, numerous theories are found fit to explain the roles of social stimuli such as cognitive development theory. Trust and enjoyment are found to significantly influence consumers' flow state, which implies the working of cognitive appraisal theory, as an expanded insight into the flow theory of consumer behaviors. In addition, addiction to live is another factor that is significantly critical to influencing the impulsive buying of consumers.

Keywords: live E-commerce; bibliometric study; S-O-R theory; socio-technical; customer value; flow theory; addiction; impulsive buying

1. Introduction

Traditional web-based E-commerce has evolved into today's social commerce (S-Commerce) and mobile commerce (M-Commerce), leading customers to make online purchases a new habit[1,2]. As more and more people hope to establish more meaningful social connections and humanity in their relationships, the social mechanism embedded in E-commerce is preferably a social mechanism that can offer consumers leisure needs, rather than merely transaction services[3]. Whether it is electronic commerce (E-commerce) or mobile commerce, their technology is constantly evolving. With the rise of artificial intelligence (AI) globally, new versions of E-commerce such as dialogue commerce have always been on the horizon. In the process of rapid

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customer decision-making, the session business will turn more to the intelligent use of big data, relying on algorithmic voice assistance, natural language processing (NLP) technology, and artificial intelligence systems.

Despite some recent studies on consumers' intentions to utilize live E-commerce shopping[4], there are still many aspects of consumer behaviors that lack clear understanding. For example, Lu et al.[5] use affordance theory to explain how cognitive and affective affordance impacts the relationship building between streamers and customers. Similarly, scholars exploit affordance theory to illuminate how atmospheric cues influence the perception process in shaping the dynamic brand experience of consumers in live E-commerce. This study constructs and validates a theoretical model utilizing bibliometric analyses of big data. Because there are few publications on live E-commerce, the bibliometric map is based on the keyword "E-commerce shopping behavior" to cover a broader field. Specifically, a practical, penetrating point in understanding the live E-commerce shopping experience that this study undertakes, is to examine how the relevant social and technological domains stimulate the psychological and perceptual reactions of the consumers, and in turn, shape consumer responses. Due to the emerging role of live E-commerce and limited publications, this research's purpose is to adopt the bibliometric mapping method to suggest a theoretical framework for illuminating consumer behaviors relating to influence responses represented by loyalty, addiction, and impulsive buying of consumers. As most research considers only one response in live E-commerce, with the majority focusing on loyalty[6], the combined responses provide a significant contribution. In addition, artificial neural network (ANN) provides a base to structure the broad scopes of variables, which simplifies the deductive hypotheses development process.

Having proposed the immediate psychological drivers of impulsive buying in live shopping, this study proceeds to examine the factors that contribute to the flow experience of the viewers. Flow experience, as stated earlier, involves total involvement and concentration[7] in the live shopping. Researchers, accordingly, have examined drivers of flow that align with the characteristics of flow, such as feedback, concentration, time distortion, and enjoyment[7], or directly at the stimulating level, by considering, for instance, perceived expertise, similarity and familiarity with the shopping context[8], online store atmosphere[9], and technological feature such as augmented reality[10]. In the same respect, this study considers the second objective, which is to propose a flow-characteristics and live shopping's stimulating factors to induce the flow experience of the viewers. A socio-cognitive theory, which anchors on the interrelationship of personal and contextual factors to influence the behaviors of consumers is used to explain the logic underpinning flow arising. Specifically, the stimulating factors can be termed as factors of the stream (social and technical factors, and customer values), streamer (vicarious learning), and the viewers (personal innovativeness and impulsive buying tendency). The combination is unique to those presented in the extant literature on the streamer-stream-viewer perspective. In addition, value is a cognitive reasoning aspect of live shopping, and together with personal innovativeness and impulsive buying tendency, they form the personal factors of the social cognitive theory. The social context is the socio-technical factors and the vicarious learning, as live E-commerce and especially, the shopping experiences of the viewers and consumers, are the result of socio-technical advancement that features simultaneous video, audio, interaction, and instant feedback. Vicarious learning is a significant interactive bridge between the viewers and the streamers that enable the viewers to observe how the streamers introduce, use, and engage with the products, including taking cues from the demonstration[11].

2. Literature review

The bibliometric map, derived using the VOSviewer visualization methodology, and as shown in **Figure 1**, utilizes the abstract of 2000 articles as the base for generating structured patterns of knowledge, which aims to identify research possibilities for conceptual modeling and empirical validation in this study. The data for

the bibliometric study includes articles from the ScienceDirect.com database, based on the keywords "E-commerce shopping behavior." As shown in **Figure 1**, the bibliometric map displays the knowledge network of variables and factors that are considered critical in the study of live consumer behaviors. The size of the nodes represents the relative strength in the role of the variable, and the proximity of the nodes reveals how closely connected between the variables[12].

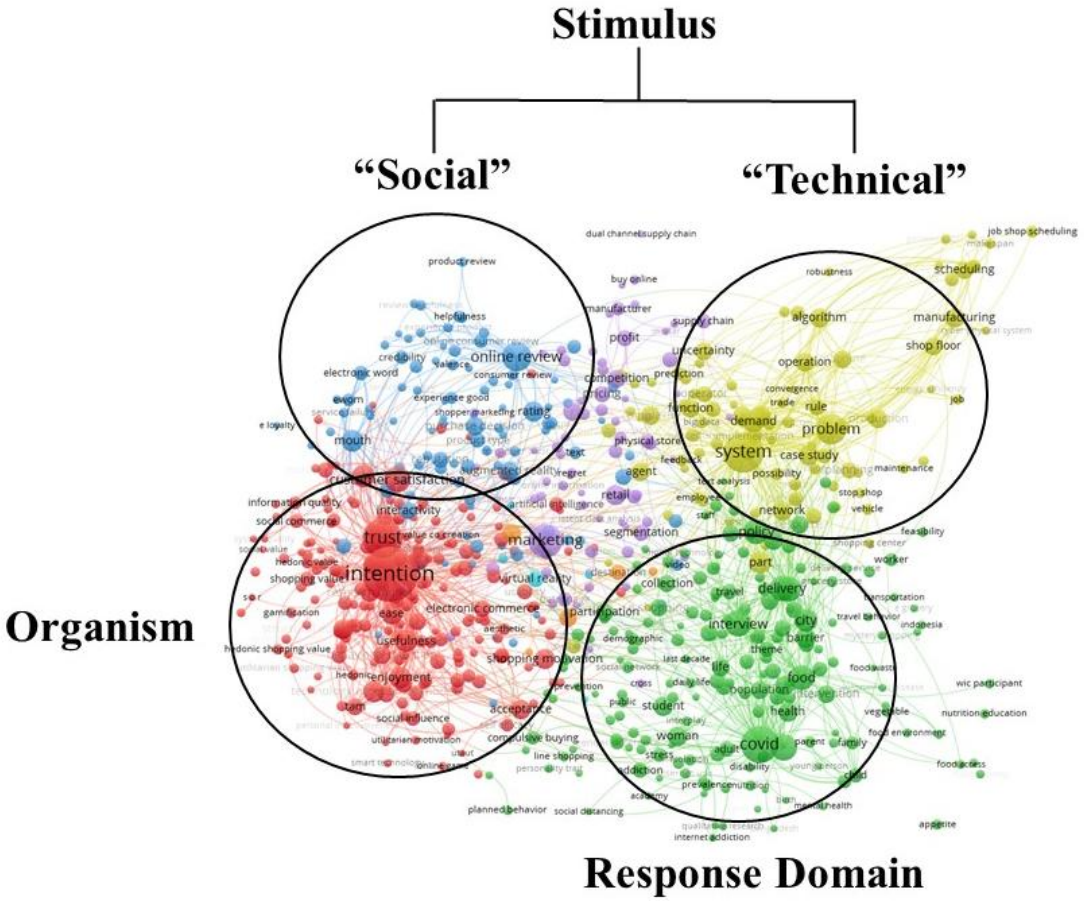

Figure 1. Bibliometric knowledge mapping of the research field of E-commerce.

Given the color distinctions, there are five major clusters of the E-commerce research emphasis in the extant literature: (1) the online review and information the consumers can obtain externally ("blue color"), which consider the social aspect, (2) the technical system ("yellow color"), (3) the socio-psychological states (e.g., trust, usefulness, intention, "orange color"), (4) the context of emphasis, such as COVID, the target market, including compulsive buying and addiction aspects of responses ("green"), and (5) the business model, which has the support of artificial intelligence, including marketing strategies ("purple color"). The number of possibilities of the interlinkage structure of the five clusters depends on the imagination of the practitioners and research scholars, the theoretical emphasis, and the strategic emphasis of E-commerce. During the COVID period, Internet connectivity continued maturity, and inventiveness in E-commerce presented limitless business prospects[13]. Taking a more systematic example directly from the bibliometric map and focusing on the factors linking customer intention, one can derive several research propositions. Thanks to technology, online evaluation is possible, which may demand data quality to get user confidence and intention. Good quality information includes adequacy, depth, reliability, understanding, conciseness, completeness, accuracy, authenticity, and diagnostic ability[14]. Online reviews are information-gathering technology that motivates E-commerce success[15].

Live E-commerce is a recent form of social commerce, which supports the role of social technology clusters. Marketers believe that live E-commerce is an effective channel for customers to make quick purchase decisions[16], stimulated by the social technology features and novelty of live E-commerce, such as interactive, simultaneous, and social features and real-time technology advantages[17]. Han and Li[18] concept of leveraging E-commerce to help rural communities alleviate poverty has its origins in the social and technical systems that make up an E-commerce platform. That is to say, farmers in rural areas and any new consumers or individuals who come into contact with E-commerce rely on favorable social and technological variables. Therefore, in the research of E-commerce, the social and technological fields have become a universal theoretical concept, which this study adopts in combined technology adoption model (TAM) and the stimulus-organism-response (S-O-R) model[1,2]. A successful information system model considers the systematic aspects of information and service quality as important driving factors. The IS success model studies consumers' social purchasing behavior.

The above bibliometric study reveals a conceptual model in the S-O-R structure suitable for studying live E-commerce shopping. The S-O-R structure is at the appropriately abstract level to integrate many factors in the extant literature. For instance, the S-O-R theory can explain how consumers react emotionally or cognitively, such as relating to the level of risk[19] and the nature of value received[20], when exposed to the socio-technical stimulation of live E-commerce, e.g., website quality and firm reputation. The S-O-R theory is adopted while considering the socio-technical aspects of the stimulation, as guided by the bibliometric map in **Figure 1**.

Consumer's flow is completely immersed in an activity[21]. Although flow experience is a recently studied variable in live E-commerce[1,2], as shown in **Figure 2** when zooming into **Figure 1**, the theoretical basis of flow still needs to be broadened. In addition, the conceptual model also includes impulse buying as an additional response variable that is not shown in the literature measurement chart. It will enhance positive feelings, and this positive feeling will only enhance the hedonic shopping experience that impulse buyers desire. Tarka[22] pointed out "the rising of awakening and emotion, including the need for fantasy. Impulsive online shopping is particularly prominent among female consumers[23]. Those who purchase on a whim also have a high level of brand-added value[24].

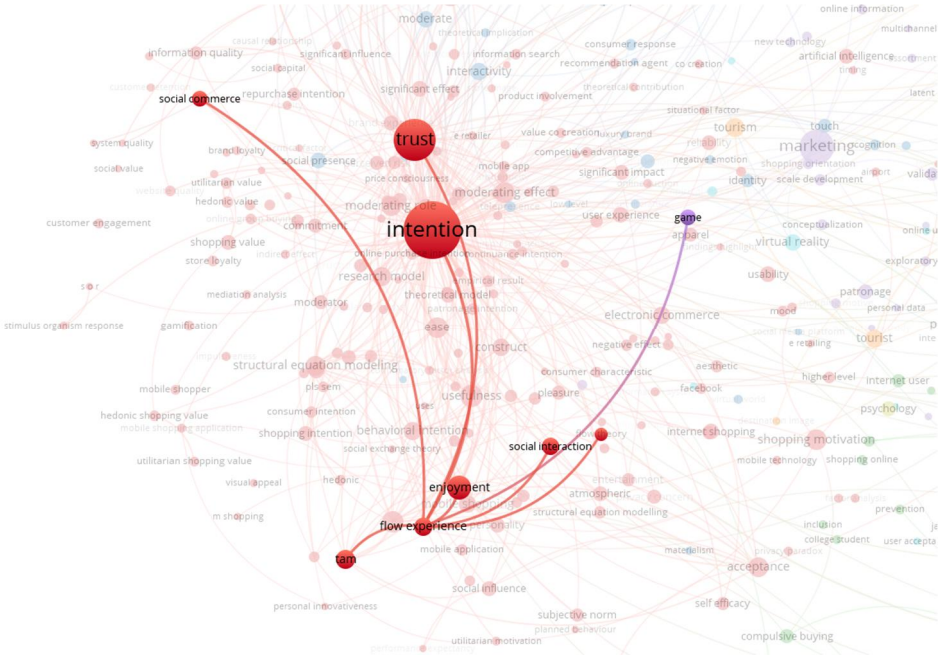

Figure 2. Bibliometric knowledge mapping of live E-commerce shopping literature from ScienceDirect.

S-O-R theory:

The nature of socio-technical stimulation takes the S-O-R to its environment and psychological discipline. The S-O-R theory is now a popular consumer behavior theory[25]. Later, with the expansion of social media and live E-commerce technology, research scholars accordingly apply the S-O-R theory by considering the social atmosphere and environment (e.g., social presence[26]; host reputation[27]). The hypothetical general format of the S-O-R theory is S → O and O → R.

Besides customer loyalty, the model captures two additional responses, namely, impulsive buying and addiction to live E-commerce. Impulsive purchasing behavior is a frequently overlooked variable in the context of interactive E-commerce and mobile commerce[28]. The following explains each of the S-O-R elements and the two dominant theories: flow theory and socio-technical system theory. The hypothetical details are excluded for this study adopts Artificial Neural Network (ANN) to serve as the knowledge base for the Structural Equation Modeling (SEM) analysis.

2.1. Flow theory

The "flow" concept's originator is Mihaly Csikszentmihalyi[29]. The flow experience of consumers is a state completely immersed in the events they are involved in, such as live E-commerce. Csikszentmihalyi[30] believes that as a driving force for human progress, humans need a fluid state to function and reach higher levels. To generate flow, flow activities should be pleasing to the eye and have sufficient motivation for consumers to focus their attention on the consumption process[29]. In a centralized flow, consumers may feel that time passes quickly, and to some extent may even feel the fusion of fully absorbed actions and consciousness. Therefore, flow activities can guide people's psychological energy commitment to consumption activities, thereby generating loyalty (O → R). For example, when a student's abilities match the learning challenges and the topic is engaging, a state of fluidity arises[31], in which the student becomes engaged or loyal to the course of study.

According to Csikszentmihalyi[30], due to the creation of appropriate conditions that can be washed away like water, the emergence of a flow experience is essential for a pleasant moment. The difference between streaming experience and general consciousness is that it combines action with consciousness, that is, "Thinking enters activity as if the actor and action are integrated"[30]. Social states with similar meanings to anxiety and boredom-anomie and alienation, making it difficult to move around the world. In a disorderly environment, people feel awkward, just like in live E-commerce. As an antidote to anxiety, this research adopts the perspective of Faqih[32], which states that "trust is a key prerequisite for successfully eliminating uncertain, unsafe, and ambiguous noise related to internet purchasing technology". So, the host or anchor's live E-commerce service should focus on influencing consumer trust. As Csikszentmihalyi[29] emphasized, flow will not occur without the possibility of achieving the goal. So, trust is the reduction of ambiguity. Gaining consumer trust can reduce anxiety and create an environment conducive to experiencing flow. The fundamental principles proposed by Csikszentmihalyi[30] and the above considerations make this research assume trust based on the premise of flow, instead of assuming that the flow experience will change trust.

2.2. Socio-technical system theory

Within the live E-commerce technology platform, showcasing products to customers through real-time video live E-commerce is a core principle for establishing live E-commerce. In this regard, the social technology systems theory can affect consumers' perception and flow status. Output optimization requires different social and technological system components, depending on the consumer environment and technological platform. For example, in an E-commerce platform for creating business value, organizations can use social systems represented by organizational structure and human factors to analyze through

descriptive and normative technical systems[33].

2.3. Social stimuli

Social impact refers to the mutual benefit and win-win situation for the audience, making it possible in live E-commerce. It presents social evidence[34], demonstrating the popularity or credibility of products and services. Interactive is a key technical feature of social commerce, which refers to the extent to allows the creation of environments that promote interaction and knowledge sharing[35]. In addition to the important role of live E-commerce in promoting interaction and social impact, as it is a relatively new E-commerce product, personal traits such as innovation are also important factors. Innovation is a characteristic of individuals who tend to willingly adopt new practices, products, or services[36]. Live E-commerce, especially those stimulated by internet celebrity promotion, often creates an impulse to buy. Originally, impulsive purchasing tendencies were often associated with unplanned purchases. Sideline learning refers to observing how live E-commerce hosts perform and demonstrate products to achieve the purpose of learning. It can positively affect the adoption of new products[37], such as consumers' emotions and perceptions of products[38]. Therefore, in terms of influencing the consumer decision-making process, alternative learning is similar to word-of-mouth learning, as implied by social cognitive theory.

2.4. Technical system stimuli

The variables typically considered in ATM technology are performance and expected workload. Performance expectations refer to the degree to which consumers perceive the benefits of using real-time E-commerce shopping, while effort expectations refer to the use of E-commerce online shopping[39]. Synchronicity is a key technical attribute aimed at providing consumers with a seamless positive experience, reflecting the shorter psychological distance and care of the owner[40]. The crucial technological systems and service quality that affect shopping participation, such as in mobile form[6] or corresponding real-time E-commerce.

2.5. Organism variables

Organism variables consider customer value, such as utilitarianism, hedonism, sociality, etc. Organizational variables consider customer value, while organizational variables consider the perception and psychological effects of customers viewing organisms as consumer cognitive and emotional devices explained that consumers' cognitive devices are a complex knowledge structure that includes complexly intertwined belief subsystems, known as memory schemata. Customer perceived value has been widely believed to affect consumer decision-making[41]. When customers obtain practical value, that is, to meet Functional requirements and price requirements[41], they will show a continuous intention[42]. Different customer values are also a source of motivation for consumers. As pointed out by Tarka, Kukar-Kinney and Harnish[22], the improvement of arousal and emotional state will eventually enhance positive feelings, enhance consumers' hedonic shopping experience, and thus trigger impulse buying.

2.6. Response variables

Positive responses such as loyalty are essential but they still lack the revenue-growing power of firms intending to push the performance to a new height[1,2]. Impulsive online shopping is particularly prominent among female consumers[23] and internet celebrities. People who make impulsive purchases also have a high degree of brand addiction[43]. Addiction is reflected in long-term live E-commerce broadcasts and is characterized by internet addiction[44].

3. Method

3.1. Sample and data collection

This study collected the data using a questionnaire survey method. The survey description includes ethical guidelines for survey objectives, autonomy, and anonymity, as well as guidelines for responding to general information and theoretical components. Frequent live E-commerce customers who have received invitations include Taobao, JD.com, Mogujie, Xiaohongshu, Jumei Youpin, etc. However, due to the convenience of data collection, specific situations on each live E-commerce website cannot be controlled.

Following the guidelines given by Forza[45] on questionnaire design and testing, this study first conducts a careful examination of the questionnaire items, followed by pilot testing and the final data collection phase. The questionnaire examination involves three academic colleagues specializing in E-commerce, a live E-commerce platform designer and trainer for rural revitalization, and a consumer who is an active loyalist to Taobao live E-commerce. To prevent cross-influence, which may yield biased results, each participated separately. The questionnaire examination started with a briefing of the research objective so that the evaluating comment would be directed to accomplish the objective. The second phase involved pre-testing with a small group of consumers (n = 50). The aim was to see if the research tool and data collection strategy were appropriate for the study and if the measurements accurately reflected the tool's intended meaning and purpose. The primary study exploited the social media popularized with ongoing live E-commerce activities. The researchers contacted the anchors for assistance with survey circulation, ensuring that the study report would be shared with them when ready. Following the advice of Navani et al.[46], when more than six factors with less than 3 measurement items for some factors, and when there are multiple low commonalities, a sample size greater than 500 may be required. However, in this study, each construct had at least 3 measurement items, and the total variance of interpretation (TVE) was high because the item loading was greater than the 0.7 threshold, so a sample size of 500[46] was sufficient.

3.2. Measurement tools

The five-point Likert scale provides for the response, using one = strongly disagreed to 5 = strongly agreed. To ensure the construct and reliability of the questionnaire, a literature review, which provides the appropriate definition of the construct, guides the design of the questionnaire, followed by pilot testing with 50 sets of regular customers on live E-commerce platforms. As a result, the survey yields robust reliability results of Cronbach Alpha more than 0.90 for each construct and secures both convergent and discriminant validities.

3.3. Data analysis

The S-O-R theoretical model encompasses 19 variables including technical and social factors and stream and viewer factors in stimuli, the organism, and response variables. The data analysis is two-staged in sequence, by, first, exploiting neural network simulation to serve as a knowledge base for further structural equation modeling[47]. While the neural network (NN) simulation identifies the importance of the variables in explaining a dependent variable, the Structural Equation Modeling (SEM) validates the overall S-O-R model by Root Mean Square Error of Approximation (RMSEA), Normed Fit Index (NFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Relative Fit Index (RFI)[48].

4. Results

This section presents the validation outcomes using ANN and SME methods. The concept was derived using the derived bibliometric map, which concludes a conceptual model of nineteen variables. Each variable

is measured using three measurement items that have been tested to have high reliability, ranging between 0.92 and 0.96. Though a sample size ranging from 285 to 570 is considered sufficient[49] from the empirical recommendation on SEM, this study was able to receive 517 valid returns. Moreover, models based on larger samples[49] tend to aggregate successfully, with higher factor loading.

Table 1 shows the population statistics, with participation rates of 42.7% and 57.3% for men and women, respectively. 82.8% of the research participants have more than 3 years of experience in E-commerce, and the proportion of using live E-commerce less than 2 times per week is as high as 59.2%. The majority of people participating in the survey preferred Taobao platform (47.2%), followed closely by JD.com (14.5%). 45.8% of respondents reported having negative experiences with live E-commerce.

Table 1. Demographics and live E-commerce profiles.

Gender:	**Age:**	**Education:**	**Career:**	**Live E-commerce:**
Men: 42.7%	<18: 0.2%	High school: 4.6%	School students: 25.3%	1 year or less: 8.5%
Women: 57.3%	18–25: 46.6%	Vacation: 51.5%	Staff: 36.2%	1–2 years: 8.7%
	26–35: 21.1%	Bachelor: 22.8%	Government staff: 18.2%	3–5 years: 29.2%
	36–45: 20.1%	Above or master: 21.1%	Freelancer: 11.6%	5 years or more: 53.6%
	46 or above: 12%		Other: 8.7%	
Weekly live E-commerce:	Most preferred platform:	Monthly salary:	Never negative experience with live E-commerce:	-
<2 times: 59.2%	Taobao: 47.2%	<2000 RMB: 41.2%	Yes: 45.8%	
2–4 times: 16.6%	JD: 14.5%	2–4000: 19.3%	No: 54.2%	
5–7 times: 9.1%	Mogujie Street: 2.7%	4–6000: 14.5%		
>7 times: 15.1%	Xiaohongshu: 6.4%	>6000: 25%		
	Jumei Youpin: 1.2%			
	Other: 28%			

Table 2 shows the convergence and discrimination validity of the nineteen constructs. Convergence and discriminant validities both provide non-overlapping structural validation, which requires educational and reflective measurement interpretations of structural meaning[50], and is evidenced by the cross-correlations in values greater than the square root of the total variance explained (TVE) shown in the diagonal for discriminant validity, and with TVE for each construct greater than 0.5, and factor loadings over 0.7 for each measurement item as evidence for convergence validity.

Table 2. Validity and reliability assessments.

	V1	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V9**	**V10**	**V11**	**V12**	**V13**	**V14**	**V15**	**V16**	**V17**	**V18**	**V19**
V1	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V2	0.51	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3	0.67	0.64	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V4	0.47	0.65	0.57	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V5	0.53	0.69	0.66	0.67	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V6	0.46	0.70	0.61	0.65	0.72	0.95	-	-	-	-	-	-	-	-	-	-	-	-	-
V7	0.55	0.68	0.67	0.62	0.76	0.76	0.95	-	-	-	-	-	-	-	-	-	-	-	-
V8	0.53	0.65	0.68	0.66	0.74	0.71	0.72	0.95	-	-	-	-	-	-	-	-	-	-	-
V9	0.48	0.64	0.64	0.64	0.65	0.64	0.68	0.76	0.96	-	-	-	-	-	-	-	-	-	-
V10	0.55	0.61	0.64	0.56	0.65	0.60	0.66	0.76	0.72	0.95	-	-	-	-	-	-	-	-	-
V11	0.58	0.63	0.71	0.61	0.65	0.65	0.70	0.75	0.69	0.71	0.95	-	-	-	-	-	-	-	-
V12	0.62	0.59	0.73	0.49	0.61	0.58	0.68	0.66	0.62	0.66	0.72	0.94	-	-	-	-	-	-	-
V13	0.62	0.67	0.73	0.59	0.65	0.64	0.67	0.69	0.66	0.73	0.69	0.68	0.95	-	-	-	-	-	-
V14	0.58	0.66	0.7	0.60	0.62	0.64	0.66	0.73	0.65	0.71	0.79	0.73	0.72	0.96	-	-	-	-	-
V15	0.68	0.7	0.78	0.59	0.69	0.64	0.70	0.72	0.71	0.73	0.74	0.79	0.76	0.77	0.94	-	-	-	-
V16	0.68	0.55	0.71	0.51	0.59	0.57	0.62	0.66	0.58	0.69	0.68	0.73	0.72	0.68	0.77	0.93	-	-	-
V17	0.77	0.56	0.71	0.47	0.55	0.48	0.57	0.56	0.52	0.62	0.61	0.70	0.70	0.63	0.74	0.77	0.96	-	-
V18	0.66	0.63	0.75	0.56	0.61	0.58	0.63	0.68	0.65	0.70	0.75	0.73	0.73	0.74	0.77	0.76	0.74	0.95	-
V19	0.77	0.58	0.70	0.50	0.58	0.55	0.59	0.58	0.56	0.61	0.65	0.64	0.66	0.63	0.66	0.67	0.76	0.70	0.96

Note 1: V1 = impulsive buying tendency. V2 = performance expectancy. V3 = innovativeness. V4 = effort expectancy. V5 = synchronicity. V6 = social influence. V7 = interaction. V8 = system and service quality. V9 = vicarious learning. V10 = utilitarian value. V11 = economic value. V12 = social value. V13 = enjoyment. V14 = perceived value. V15 = trust. V16 = flow. V17 = addiction. V18 = loyalty. V19 = impulsive buying. Note 2: Reliability measure, Cronbach Alphas are between 0.92 and 0.96, and the total variance explained is between 0.861 and 0.925.

The factors predicting flow state (V16), addiction (V17), loyalty (V18), and impulse buying (V19) were identified by a multi-layer perceptual neural network (MLPNN) simulation. The MLPNN structure[51] includes a set of input neurons coupled to the intermediate layer and nodes, and an output layer through synaptic connections, as shown in **Table 3**.

Table 3. Neural network analysis—The normalized importance.

		V16 (Flow)	V17 (Addiction)	V18 (Loyalty)	V19 (Impulsive buying)
	Sample training	352 (68.1%)	352 (68.1%)	363 (70.2%)	363 (70.2%)
	Sample testing	165 (31.9%)	143 (27.5%)	154 (29.8%)	154 (29.8%)
	Total (N)	517	517	517	517
	No. of inputs	15	16	17	18
Hidden layers	No. of hidden layers	1	1	1	1
	No. of units in a hidden layer	9	3	6	7
	Activation function	Hyperbolic tangent	Hyperbolic tangent	Hyperbolic tangent	Hyperbolic tangent
Output layer	Dependent variable	Flow	Addiction	Loyalty	Impulsive buying
	Activation function	Identity	Identity	Identity	Identity
	Relative error	0.239	0.204	0.261	0.25
Normalized importance (%)	V1	91.3	100	9.8	100
	V2	36	29.1	47	18.2
	V3	32.5	31.4	72.3	48.2
	V4	15.1	12.1	33.8	36.8
	V5	27.8	15.9	44.9	32.5
	V6	30.9	36.2	47.9	40.5
	V7	26.5	17.2	47.3	25.9
	V8	27.6	28.3	31.5	14.4
	V9	28.7	51	59.9	28
	V10	49	33.2	35.3	37.3
	V11	24.1	27.8	100	49.5
	V12	57.7	45.6	33.8	17
	V13	76.8	77.9	66.8	24.2
	V14	18.2	29.6	82.6	23.4
	V15	100	63.9	23.3	44.6
	V16	-	84.2	95.5	11.9
	V17	-	-	72.2	58.8
	V18	-	-	-	53.7

Note: V1 = impulsive buying tendency. V2 = performance expectancy. V3 = innovativeness. V4 = effort expectancy. V5 = synchronicity. V6 = social influence. V7 = interaction. V8 = system and service quality. V9 = vicarious learning. V10 = utilitarian value. V11 = economic value. V12 = social value. V13 = enjoyment. V14 = perceived value. V15 = trust. V16 = flow. V17 = addiction. V18 = loyalty. V19 = impulsive buying.

Specifically, MLPNN's performance is as follows: MLPNN predicts that the main factors for impulse buying include consumer's impulse buying tendency, loyalty (normalized importance 53.7), economic value (normalized importance 49.5), consumer innovativeness (normalized importance 48.2), and addiction to live (normalized importance 58.8). What comes with it is experience flow, enjoy flow, trust flow, and social value.

The most important determining factor of customer loyalty is their economic value and flow experience, followed by perceived value, innovation, etc. MLPNN has determined that the key predictive elements of flow experience are trust and impulse buying tendencies, followed by enjoyment and social value.

SEM analysis has become relatively simple, utilizing the neural network results in **Table 3**. **Table 4** presents the standardized path load predictions from V10 (practical value) to V19 (impulse buying), and the structural changes are explained by the R-squared at the bottom of the table.V2 (performance expectancy), V11 (economic value), V15 (trust), V17 (addiction to live), and V18 (loyalty) are the critical predictors to explain the variation of V19 (impulsive buying) and V11 (with standardized loading of 0.19), followed by V16 (flow state, standardized loading of 0.16) and V17 (standardized loading of 0.17) are the significant predictors to explain the variance of V18 (loyalty). The following (**Table 4**) are SEM statistical data, which provides a solid combination for the assumed model.

Table 4. SEM Path coefficients and variance percentage explained.

Constructs	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	Remark
V1	0.13	0.03	0.11	0.13	-	0.13	0.21	0.35	0.03	0.41	-
V2	0.05	0.04	0.13	0.03	0.14	0.1	-	-	0.05	-	-
V3	0.06	0.21	0.25	0.26	-	0.16	0.07	0.09	0.13	0.12	-
V4	-	0.06	0.04	0.03	-	-	-	-	-	-	-
V5	0.07	0.06	0.03	0.02	-	0.04	-	-	-	0.04	-
V6	-	0.06	0.08	-	-	-	-	0.07	-	0.08	-
V7	0.06	0.13	0.05	0.18	-	-	-	-	-	-	-
V8	0.39	0.22	-	-	0.14	-	-	0.08	-	-	-
V9	0.26	0.07	0.03	0.04	-	0.12	-	-	0.05	-	-
V10	-	0.17	0.28	0.11	0.11	0.09	0.11	0.06	0.05	-	-
V11	-	-	0.06	0.25	0.32	-	0.05	-	0.19	0.12	-
V12	-	-	-	-	0.21	0.23	0.18	0.12	0.04	-	-
V13	-	-	-	0.07	0.14	0.08	0.17	0.15	0.06	0.05	-
V14	-	-	-	-	-	0.15	0.02	-	0.10	0.02	-
V15	-	-	-	-	-	-	0.22	0.13	0.01	−0.14	Mediation
V16	-	-	-	-	-	-	-	0.26	0.16	0	Mediation
V17	-	-	-	-	-	-	-	-	0.17	0.19	-
V18	-	-	-	-	-	-	-	-	-	0.1	-
R-squared	0.66	0.69	0.7	0.67	0.73	0.8	0.7	0.75	0.75	0.71	-

Note: V1 = impulsive buying tendency. V2 = performance expectancy. V3 = innovativeness. V4 = effort expectancy. V5 = synchronicity. V6 = social influence. V7 = interaction. V8 = system and service quality. V9 = vicarious learning. V10 = utilitarian value. V11 = economic value. V12 = social value. V13 = enjoyment. V14 = perceived value. V15 = trust. V16 = flow. V17 = addiction. V18 = loyalty. V19 = impulsive buying.

5. Discussions

This research's purpose is to investigate the factors that affect customers' live streaming of E-commerce behavior, and propose a comprehensive model for verification, by using the bibliometric map as a guide. The bibliometric map yields a conceptual model that shares the structure of the stimulus-organism-response (S-O-R) theory of consumer behaviors. The stimulus consists of socio-technical dimensions, stream and viewer factors. Organism factors that are shown to have of significant impact on the positive responses of the consumers include the economic value and social value of live, enjoyment, trust and flow experience. Three

types of responses are shown to be significant outcomes, namely loyalty, addiction, and impulsive buying, which are also interrelated, especially loyalty and addiction are shown to have significant impacts on impulsive buying. This research is based on 570 valid survey responses and uses the simulation results of a multilayer perceptual neural network (MLP-NN) as the guiding basis for structured programming (SEM) configuration, confirming the effectiveness of the theoretical structure.

6. Interpretation of the findings

6.1. Theoretical implication

This research contributes from the angle of adopting a socio-technical perspective and expanding using socio-cognitive theory to incorporate the value perception of viewers and value co-creation through vicarious learning of streamers, to suggest a set of stimulating factors. Then, flow theory that anchors on the influence of trust and enjoyment is employed to induce immersive flow, which forms the organistic states of the consumption process, and will subsequently, induce addiction and loyalty as two additional factors that lead the viewers to perform Impulsive buying.

Firstly, the research supports the S-O-R theoretical framework, but the contribution extends beyond in that S-O-R provides a robust, integrative ability to apply many other theories in conceptualizing S, O, R, and their relationships. The notable theories highlighted in the social stimuli are social impact theory and theory of planned behavior (TPB) for explaining social influence, TPB for consumer innovativeness, and cognitive development theory and social learning theory for delineating the role of vicarious learning. Specifically, from the perspective of TPB, consumer innovativeness is a significant factor influencing the organization states (e.g., economic value, social value, enjoyment, trust), and responses in terms of loyalty and impulsive buying. Vicarious learning is learning by observing[37], which fits into the notion of the cognitive-psychological process of adjustment of consumers to the environment (advocated in cognitive development theory), and which, gradually, consumers form norms and perceptions favorable to induce continuing live E-commerce participation and impulse purchase (advocated in social learning theory).

Secondly, customer loyalty is a key indicator of the sustained performance of organizations[52]. This research shows that customer loyalty can be influenced by a solid foundation of flow theory and social technology system theory, which are also supported by many embedded theories aiming to explain the interrelationships of S, O, and R variables.

Thirdly, the two key drivers of a mobile experience state are trust and enjoyment. Trust and enjoyment can be seen as a cognitive and emotional assessment[53], which is a key theme of cognitive evaluation theory. In particular, cognitive appraisal is related to consumers' perception of the live delivery of E-commerce retail (such as consumer trust). In contrast, customers' enjoyment is expressed through emotional evaluation[54]. Experiences that stimulate strong emotions are usually handled psychologically. In addition, the factor of trust overcame the anxiety barrier of mobile experience[55]. Trust is expressed in consumers' beliefs in live E-commerce, which means that it reaches a level where consumers form a positive belief in the reliability of the described function.

Fourthly, is the important role played by consumers' innovation and compulsion to purchase, which has rarely attracted people's attention. Being innovative and innovative is an individual characteristic. Consumers are moved by their innovation and often exhibit higher levels of pleasure when participating in technology or technology products, thereby attracting and continuing to adopt. Therefore, consumers' innovative and compulsive purchasing tendencies have a significant stimulating effect on flow stimulation, as well as their impact on loyalty and impulsive purchasing.

6.2. Practical implications

Our research has provided important inspiration to live E-commerce traders.

The research first pointed out that significant customer loyalty and addiction affect their impulsive behavior. Although the nature of addiction is different from that of substances, live E-commerce inevitably has significant psychological impacts[56], especially in the host's social and product display. Grew et al.[57] also found a similar finding that affects the patronage value of pharmacies.

Secondly, empirical support for the theory of social technology systems suggests that consumer behavior should be guided by concepts, which is consistent with the views of Schilke and Cook[58]. So, the social background is an essential stimulus factor in a social business environment.

Third, this study shows that consumers' innovation and compulsive purchasing tendencies have a significant stimulating effect on loyalty, and this effect is generated in the flow state of consumers. Therefore, these unique consumer cognitive styles should be utilized by E-commerce platforms and live E-commerce enterprises and engagement levels to develop appropriate marketing strategies to enhance loyalty.

Fourthly, trade operators represented by live E-commerce hosts should focus on strategies to establish a favorable atmosphere that can induce participation in customer flow status, as flow status can immerse customers in attendance. Wu and Ho[59] shared the themes expected by users' beliefs regarding their experiences with real-time chats on mobile banking. Social technology development mainly refers to alternative learning that has a significant impact on impulse buying tendencies, performance expectations, customer innovation, interaction, system and service quality, and customer value perception and enjoyment. Therefore, practitioners should actively guide customers' expectations into live E-commerce.

6.3. Limitations and further research

This survey is not without limitations. Fundamentally limited to sampling methods, sampling relies on the snowball-like convenience of obtaining participants from various social media channels. So, this study needs to be replicated nationwide, combining customer segmentation in rural communities in China and different levels of urban development. Secondly, further research can use in-depth interviews to understand the nature of experience and the relationship between theoretical variables (events), utilizing comparative insights from data analysis. Thirdly, the S-O-R model provides a framework to conceptualize the logic of business models and enable business operators to cultivate entrepreneurial abilities in live E-commerce. The theoretical framework has achieved solid results in explaining significant R-squared changes in organic and reaction structures. As research on live E-commerce has now reached beyond products, further research can consider expanding the model of this study too, for instance, hotels and tourism[60], including creative use of gamification[61].

Author contributions

Conceptualization, YM and CCT; methodology, YM and CCT; software, YM; validation, CCT; formal analysis, YM; investigation, YM; resources, YM and CCT; data curation, YM; writing—original draft preparation, YM; writing—review and editing, YM and CCT; visualization, YM and CCT; supervision, CCT; project administration, YM and CCT. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

Abbreviation

CFI	Comparative fit index
IFI	Incremental fit index
NFI	Normed fit index
RMSEA	Root mean square error of approximation
RFI	Relative fit index

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