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The Effect of Last-Mile Logistics Services Quality on Customer Loyalty in Fresh Food E-Commerce: Evidence from China*

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Abstract

Purpose: In the context of fresh food e-commerce, this study investigates the intermediary mechanisms between last-mile logistics service quality (LMLSQ) and customer loyalty. Utilizing the Quality-Value-Loyalty chain as a framework, it focuses on how perceived functional and emotional value mediate this relationship. **Research design, data and methodology:** Data was gathered through questionnaires from Chinese customers who purchased fresh products from fresh food e-commerce platforms which provide self-delivery services. Partial least squares structural equation modeling (PLS-SEM) was used to examine the proposed hypotheses after confirmatory factor analysis (CFA) revealed the validity and reliability of the data. **Results:** The findings reveal that condition quality and personnel contact quality positively influence both functional and emotional value, which, in turn, significantly impact customer loyalty. Timeliness quality, however, does not significantly affect functional or emotional value, indicating its limited impact on customer loyalty. **Conclusions:** The study confirms that improving condition quality and personnel contact quality significantly boosts customer loyalty by enhancing perceived functional and emotional value. The findings highlight the importance for fresh food e-commerce platforms to offer high-quality, reliable, and emotionally satisfying LMLSQ. The results offer practical insights for e-commerce platforms to focus on specific service quality dimensions to foster customer loyalty and contribute to the theoretical understanding of the quality-value-loyalty framework.

Keywords: Last-mile logistics services quality, Functional value, Emotional value, Customer loyalty, Fresh food e-commerce, Quality-value-loyalty chain

JEL Classification Code: M16, M31.

1. Introduction

E-commerce transactions are on a steady rise, with fresh food emerging as a rapidly developing sector in China's e-commerce landscape. In 2023, the fresh food e-commerce market in China achieved a gross merchandise volume of over \$89 billion, a 14.7 percent increase from approximately \$78 billion the previous year, with fresh food e-commerce

platform users exceeding half a billion (Ou, 2024). The COVID-19 pandemic has accelerated this growth, reshaping user behavior and prompting a surge in the fresh food e-commerce market (Su et al., 2023). With nearly 4,000 dedicated platforms for fresh food transactions in China (Yang et al., 2024), renowned e-commerce giants like Meituan and Pinduoduo have entered the fray, competing with market leaders such as Tmall Fresh, JD Home,

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Dingdong, and Freshippo. E-commerce for fresh food has many benefits for companies and customers, but there are still obstacles to overcome. As a result, researchers have been studying supply chain management, models, systems, and development status and strategies in logistics (Prajapati et al., 2023), along with the decision making behaviors of customers (Maruyama et al., 2016). Despite numerous studies, there remains a gap in the literature with few exploring intermediary mechanisms between last-mile logistics services quality (LMLSQ) and customer loyalty.

Last-mile logistics services refer to the final step of the delivery process, where goods are transported from a distribution center to the recipient's chosen destination, utilizing various delivery modes provided by the logistics service provider, such as home delivery, authorized pickup points, and smart lockers (Sampath et al., 2024; Xiao et al., 2017). Last-mile logistics, often considered the front-end of the delivery process, is where the logistics service intersects with the consumer, ensuring that products reach the customer's doorstep or designated pickup point (Olsson et al., 2019). Therefore, LMLSQ is measured by how effectively a logistics provider meets customer expectations during this phase. Consumer perceptions of the value of last-mile logistics services significantly influence their satisfaction with e-commerce logistics (Sampath et al., 2024). Jiang et al. (2021) highlight that in fresh food e-commerce, LMLSQ is crucial for effective product marketing and maintaining market competitiveness due to its strong connection with customer satisfaction. Their research confirms that high-quality last-mile logistics services positively impact customer satisfaction in the Chinese market. Therefore, online fresh food retailers should enhance their last-mile delivery services to boost sales and capture a greater market share from competitors (Prajapati et al., 2023). Given that fresh food is a daily necessity with frequent purchases and low profit margins per transaction, retaining customers becomes crucial for sustaining profitability in fresh food e-commerce. However, retaining customers poses challenges due to the ease and minimal cost associated with switching between online platforms (Jain et al., 2017). Previous studies show that consumer perceived value (CPV) is crucial for fostering customer loyalty in e-commerce (Del Mar Alonso-Almeida et al., 2013; Jiang et al., 2016; Parasuraman et al., 2005). The Quality-Value-Loyalty chain, which was introduced by

Parasuraman and Grewal (2000), suggests that providing high-quality services increases perceived value, which in turn increases loyalty. However, many studies treat consumer perceived value broadly, neglecting its multidimensional nature and its role in shaping the quality-loyalty relationship. CPV comprises various facets influencing attitudes and behaviors (Sheth et al., 1991; Sweeney & Soutar, 2001). Furthermore, there is limited research on how logistics service quality influences consumer value perception (Kilibarda et al., 2020), which makes the mediating role of CPV in the relationship between LMLSQ and customer loyalty uncertain. Examining the mediating effects of various dimensions of value can provide more detailed managerial insights in the fresh e-commerce.

To bridge these gaps, this study delves into the intermediary mechanism through which LMLSQ impacts consumer loyalty. Expanding upon the Quality-Value-Loyalty model, this study examines how LMLSQ aspects, CPV, and customer loyalty interact within the fresh food e-commerce domain. It analyzes the following research questions:

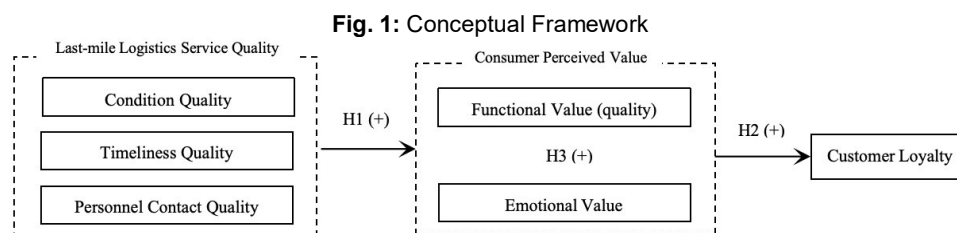
RQ1: What factors of LMLSQ can enhance consumer perceived functional value and emotional value in fresh food e-commerce?

RQ2: Can functional and emotional value positively mediate the relationship between LMLSQ and customer loyalty?

By addressing these questions, we make a significant contribution to logistics and marketing research. Theoretically, we employ the Quality-Value-Loyalty model (Parasuraman & Grewal, 2000) and offer a novel explanation for how LMLSQ generates functional and psychological values, fostering loyal customer relationships within the fresh food e-commerce realm. In practical terms, while China possesses its unique characteristics, online platforms for fresh food may draw lessons from this emerging market.

2. Theoretical Background

Drawing from the literature review, we develop a research model that outlines the chain linking LMLSQ, CPV, and customer loyalty (see Fig. 1).



2.1. Fresh Food E-commerce Platforms in China

Since 2012, the fresh food e-commerce market in China has grown rapidly, becoming a significant segment of the overall food market (Ou, 2014; Yang et al., 2024). The development was further accelerated by the pandemic and the rise of the 'house economy' in 2020 (Jiang et al., 2023). Fresh food e-commerce platforms have now become crucial in the realm of online consumer shopping (Jiang et al., 2021). These platforms are typically classified into four types: integrated platform e-commerce, vertical e-commerce, expanding e-commerce, and Online-to-Offline (O2O) models (Zhou & Wang, 2021).

Integrated platform e-commerce provides a holistic trading platform aimed at attracting fresh food retailers. While certain channels within these platforms manage their own logistics operations, the predominant distribution method is third-party logistics. Prominent examples of such platforms include Jingdong, Taobao, and Tmall. Vertical e-commerce involves retailers offering fresh produce exclusively through their own e-commerce platforms, such as Miss Fresh and Dingdong, which typically manage their own logistics networks and front warehouses for inventory and quick delivery. Expanding e-commerce leverages strong supply chain resources for reverse integration, exemplified by platforms like SF Express, which use self-operated cold chain logistics. The O2O model can be divided into two categories: the "in-store and in-home" model used by supermarkets like Yonghui Supermarkets, Walmart, and Freshippo, where customers can shop in physical stores or online and enjoy home delivery services; and the O2O comprehensive platform, which integrates offline supermarket stores into the online platform, with delivery personnel picking up and delivering goods to customers, as seen with Meituan, Ele.me, and JD Home. This study focuses on the platforms of the last three modes, which represent new retailing pattern for fresh food in China and all adopt self-delivery (Zhou & Wang, 2021). With their self-operated delivery teams, these platforms can more easily manage and improve LMLSQ, directly engage customers, and enhance the overall customer experience (Jiang et al., 2023).

2.2. Last-Mile Logistics Services Quality (LMLSQ)

Scholars and business experts are paying more and more attention to last-mile logistics, which is the final segment of the supply chain that connects the recipient's destination to the last distribution hub (Maruyama et al., 2016). The last mile presents difficulties, particularly in cold chain logistics, since it is sometimes considered the most costly, inefficient, and polluting segment of the supply chain (Jiang et al., 2021). Hence, evaluating and enhancing LMLSQ from the

consumer perspective is crucial for delivering value and fostering loyalty. Scholars have extensively explored logistics service quality evaluation models. A 15-item measure addressing timeliness, availability, and condition was created by Bienstock et al. in 1997. This was extended by Mentzer et al. (2001), who added function/process attributes. Five dimensions were employed by Huang et al. (2009): order condition, ordering methods, timeliness, information quality, and order discrepancy management. Lin et al. (2016) separated service quality into two categories: e-service quality and logistics. They included quality factors such as personnel contact, timeliness, condition, ordering procedures, and discrepancy handling.

In the context of fresh food e-commerce, Su et al. (2023) put forward the cold chain logistics services and confirmed that availability, condition, personal contact quality, return, timeliness positively impact consumer satisfaction and lead to customer loyalty during the COVID-19 pandemic.

The present study synthesizes existing literature and distinctive attributes of last-mile logistics in e-commerce of fresh food in China, resulting in a tailored LMLSQ evaluation model. Delivery speed, product condition and intimate service are important reasons for customers to use fresh e-commerce platforms in China (Jiang et al., 2023). In fresh food e-commerce, last-mile logistics are critical for their speed and effectiveness in delivering packages to the final destinations (Prajapati et al., 2023). Additionally, the logistics service's condition features guarantee that customers receive food that is in perfect condition, which can enhance consumers' value perception and ultimately result in customer loyalty (Su et al., 2023). Furthermore, empirical research by Jiang et al. (2021) and Su et al. (2023) highlights the importance of personnel contact quality in the context of fresh food e-commerce logistics services, as it significantly affects customer satisfaction and loyalty. In particular, the delivery personnel's attitude, professional response, and understanding of customer needs are critical in the last-mile delivery process, as their direct interaction with consumers significantly influences the overall assessment of logistics services (Jiang et al., 2021).

Therefore, the LMLSQ model integrates three dimensions, with definitions adapted from Su et al. (2023): condition quality, evaluating order accuracy and quality; timeliness quality, measuring the time taken between order placement and receipt; and personnel contact quality, reflecting consumers' perceptions of the logistics supplier's service quality regarding staff interactions.

2.3. Consumer Perceived Value (CPV)

CPV constitutes a psychological assessment and judgment made by customers, rooted in their subjective evaluation of products and services (Zeithaml, 1988). The

process of consumer choice inherently involves comparing and seeking various sets of values (Sheth et al., 1991). On one hand, individual differences in customer psychology lead to variations in the perceived value of the same service or product (McDougall & Levesque, 2000). On the other hand, the distinct attributes of different services or products result in varying perceived values among customers (Addis & Holbrook, 2001). Sheth et al. (1991) introduced a five-dimensional CPV model, encompassing functional, emotional, social, epistemic, and conditional values. Subsequently, Sweeney and Soutar (2001) condensed CPV into four dimensions, including perceived emotional, social, and functional (quality/price) values.

High CPV leads to positive customer outcomes such as purchase intention, increased satisfaction, and loyalty. According to Parasuraman et al. (2005), CPV plays a crucial role in loyalty by mediating between perceived service quality and customer loyalty. In this context, CPV serves as a bridge between the initial evaluation of service quality and the enduring loyalty of customers. The Quality-Value-Loyalty framework proposed by Parasuraman and Grewal (2000) offers a structured model that connects these concepts. In their model, perceived quality serves as the starting point, influencing CPV, which in turn impacts customer loyalty. This chain is supported by empirical studies in the e-commerce realm such as those by Del Mar Alonso-Almeida et al. (2013), and Jiang et al. (2016), which demonstrate that high CPV, driven by superior service quality, significantly enhances customer loyalty. In last-mile logistics services context, integrating tangible elements (e.g., timeliness and condition quality) and intangible elements (e.g., personnel contact quality) aligns with CPV's multidimensional nature. This study dissects CPV into perceived functional value (quality) and emotional value to evaluate their intermediary roles from both functional and psychological perspectives. According to Sweeney and Soutar (2001), functional value is the benefit that comes from perceived quality and expected performance, whereas emotional value is the enjoyment that one obtains from the service.

3. Hypotheses Development

3.1. LMLSQ and CPV

Consumers' overall perception of service quality plays a crucial role in enhancing their perception of value (Rasheed & Abadi, 2014). The degree of service quality discrepancy can be measured by comparing a customer's expectations for each quality dimension, each with varying impacts on CPV (Rasheed & Abadi, 2014). In e-commerce, service quality dimensions notably influence CPV positively (Del Mar

Alonso-Almeida et al., 2013; Jiang et al., 2016). The delivery of value through logistics services to customers depends on the quality of those logistics services (Kilibarda et al., 2020). Superior service quality in online retail cold chains generates economic, functional, emotional, and social value for consumers (Su et al., 2023).

In fresh food e-commerce, LMLSQ significantly influences CPV. Timely and punctual delivery enhances customers' perceived functional value, showcasing the service's efficiency and reliability. Additionally, such timeliness can evoke positive emotions like relief and convenience, adding to the emotional value of the service. High condition quality, ensuring products arrive undamaged, further enhances functional value, fostering perceptions of reliability and trustworthiness. Moreover, receiving products in pristine condition can evoke positive emotions such as satisfaction and happiness. Positive interactions with delivery personnel, characterized by professionalism and personalized service, instill trust and confidence, enhancing functional value. These interactions can also evoke emotions like gratitude and appreciation, contributing to the emotional value of the service. Hence, the hypotheses are as followed.

H1a-c: (a) Conditional quality, (b) timeliness quality and (c) personnel contact quality positively impact perceived functional value.

H1d-f: (d) Conditional quality, (e) timeliness quality and (f) personnel contact quality positively impact perceived emotional value.

3.2. CPV and Customer Loyalty

One of the main factors influencing customer loyalty and satisfaction is the value provided to them (Kilibarda et al., 2020). Consumers typically gauge the value of services by comparing them with alternatives offered by competitors (Sheth et al., 1991). Consequently, customers are more likely to remain loyal to a company if they perceive it to offer superior value compared to other options available in the market. A product or service that demonstrates exceptional value can effectively encourage customers to maintain their loyalty and usage (Yuen et al., 2020). In e-commerce, online retailers who provide consumers with high perceived value of cold chain logistics service quality are more likely to secure loyalty (Su et al., 2023). Empirical studies consistently affirm that consumer perceived value positively influences loyalty (Del Mar Alonso-Almeida et al., 2013; Jiang et al., 2016).

When examining LMLSQ, the importance of functional and emotional value in fostering customer loyalty becomes evident. A seamless, efficient, and high-quality last-mile

delivery experience enhances perceived functional value. Timely and accurate delivery, intact products, and courteous interactions with delivery personnel contribute to this positive perception. Such experiences reinforce customers' belief in the company's superior value, fostering loyalty. Additionally, emotional value derived from LMLSQ significantly influences loyalty. A personalized and positive last-mile delivery experience evokes feelings of pleasure and enjoyment, strengthening the emotional bond between the customer and the company. Consequently, customers are more likely to remain loyal to a company that consistently delivers exceptional LMLSQ, further solidifying the connection between perceived value and loyalty. The hypotheses are as followed.

H2: Perceived (a) functional value and (b) emotional value lead to loyalty.

3.3. The Mediating Effect of CPV

Building upon the Quality-Value-Loyalty framework introduced by Parasuraman and Grewal (2000), customer loyalty is fostered through the delivery of enhanced value via superior service quality. Expanding on this model, Parasuraman et al. (2005) validated the e-service quality scale, emphasizing CPV as a critical determinant of customer loyalty. Previous research underscores service quality's positive influence on loyalty via its impact on CPV (Del Mar Alonso-Almeida et al., 2013; Jiang et al., 2016; Rasheed & Abadi, 2014). In e-commerce, enhanced cold chain logistics service quality heightens consumer value perceptions, thus bolstering satisfaction and loyalty (Su et al., 2023).

Combining previous studies with the hypotheses outlined earlier, functional and emotional value emerge as key intermediary mechanisms in understanding how LMLSQ impacts customer loyalty in fresh food e-commerce. Functional value acts as a mediator, reflecting customers' perceptions of the practical benefits derived from LMLSQ. Timely delivery, intact products, and positive interactions enhance their perception of service quality, reinforcing loyalty through an enhanced overall value proposition. Emotional value also mediates this relationship by capturing positive emotional responses to LMLSQ. Timely delivery and product quality evoke feelings of relief, satisfaction, and happiness, while positive interactions with personnel elicit gratitude and appreciation. These emotional connections deepen customer attachment to the company, nurturing loyalty.

H3a-c: Perceived functional value mediates the relationship between (a) condition quality and loyalty, (b) timeliness quality and loyalty, as well as (c) personnel contact quality

and loyalty.

H3d-f: Perceived emotional value mediates the relationship between (d) condition quality and loyalty, (e) timeliness quality and loyalty, as well as (f) personnel contact quality and loyalty.

4. Methods

4.1. Data Collection and Sample

Data were collected through an online survey distributed to customers via the Chinese social app WeChat, targeting those who have previously purchased fresh food from e-commerce platforms offering self-delivery services. Given that the target audience was Chinese customers, the questionnaire was translated into Chinese using the back-translation method to ensure accuracy. The survey began with a screening question asking respondents if they had bought fresh food from any of the following online platforms: Miss Fresh, Dingdong, Freshippo, Meituan, Ele.me, or JD Home. Only respondents who confirmed their purchases continued to the main survey questions. Table 1 presents the demographics of the 121 respondents, showing that 60.33% are female and 39.67% are male. Notably, 86 respondents (71.07%) are between the ages of 25 and 40. A survey of online fresh food buyers in 2024 indicated that over three-quarters of respondents were in this age range (Ou, 2024), suggesting that our sample is representative of the mainstream consumer base in the online fresh food market. Additionally, all respondents have at least a high school education, indicating good comprehension of the questionnaire.

Table 1: Sample Description

Demographic Items		Frequency (%)
Gender	Male	48 (39.67)
	Female	73 (60.33)
Age	18-24	21 (17.36)
	25-40	86 (71.07)
	41-45	14 (11.57)
Education	High school	47 (38.84)
	Bachelor's Degree	45 (37.19)
	Post-graduate Degree	29 (23.97)
Monthly Income (CNY)	Below than 6000	30 (24.79)
	6001-10000	54 (44.63)
	10001-15000	19 (15.70)
	Over 15001	18 (14.88)

4.2. Measures

We initiated the scale development process by reviewing existing literature for validated scales relevant to our study. All scale items were sourced from established literature but were slightly modified to fit the fresh food e-commerce context. Specifically, items measuring condition quality and timeliness quality were adapted from Su et al. (2023) and Thai (2013), while items assessing personnel contact quality were also taken from Thai (2013). To measure perceived functional and emotional values, we used items adapted from Petrick (2002), and customer loyalty items were drawn from Su et al. (2023). The final questionnaire was structured into three parts: a motivation letter, background information, and items measuring the constructs of the research model. Responses were recorded on a five-point Likert scale, ranging from 1 ("strongly disagree") to 5 ("strongly agree").

4.3. Analysis Methods

After collecting the data, CFA and PLS-SEM were performed. The sample size of 121 participants was sufficient to meet the criteria for PLS-SEM, as it exceeded the minimum requirement of being more than 10 times the largest number of indicators used for any single latent

construct and the largest number of structural paths directed at any specific construct. This ensures adequate statistical power and reliable results. The primary rationale for opting for PLS-SEM over Covariance-Based Structural Equation Modeling (CB-SEM) lies in its suitability for smaller sample sizes (Hair et al., 2012).

5. Results

5.1. Reliability and Validity

Before proceeding to the inner model, it is crucial in PLS-SEM to initially evaluate the reliability and validity of the outer model (Hair et al., 2012). The results presented in Table 2 demonstrate the outcomes of the CFA for the outer model. Standardized factor loadings for each item exceed 0.7, indicating strong relationships between the observed variables and their respective constructs. Additionally, both Composite Reliability (CR) and Cronbach's alpha coefficients are above 0.7 for all constructs, indicating high internal consistency reliability. All of the average variance extracted (AVE) values are more than 0.5, indicating that a significant portion of the variation in the indicators can be accounted for by the corresponding constructs. This confirms the convergent validity of the data.

Table 2: Reliability and Convergent Validity

Construct	Item	Factor loading	Cronbach's alpha	CR	AVE
Condition Quality	CQ1 Accurate delivery	0.893	0.821	0.843	0.735
	CQ2 Quality guarantee	0.830			
	CQ3 Intact package	0.849			
Timeliness Quality	TQ1 Quick delivery	0.760	0.775	0.816	0.688
	TQ2 Short order time	0.836			
	CQ3 Quick re-delivery	0.887			
Personnel Contact Quality	PCQ1 Good service attitude	0.859	0.794	0.795	0.708
	PCQ2 Patient, kind responses	0.853			
	PCQ3 Responsible, customer-focused	0.812			
Functional Value	FV1 Outstanding quality	0.890	0.843	0.850	0.760
	FV2 Very dependable	0.860			
	FV3 Consistent performance	0.865			
Emotional Value	EV1 Feel good	0.877	0.847	0.848	0.766
	EV2 Gives pleasure	0.880			
	EV3 Sense of joy	0.868			
Customer Loyalty	CL1 Commitment	0.858	0.773	0.784	0.686
	CL2 Continue use	0.785			
	CL3 Best choice	0.840			

Furthermore, discriminant validity analysis, presented in Table 3, verifies that each variable is distinct from the others within the model. Specifically, all AVE values surpass the squared correlations between constructs, providing

evidence that each construct measures a unique aspect of the latent variables and is sufficiently different from the others in the model.

Table 3: Measurement Statistics and Correlations

	Mean	S.D.	CL	CQ	EV	PCQ	FV	TQ
CL	3.882	0.877	0.828					
CQ	3.705	0.968	0.427	0.857				
EV	3.642	1.007	0.463	0.405	0.875			
PCQ	3.824	0.911	0.373	0.291	0.486	0.842		
FV	3.617	1.040	0.411	0.426	0.407	0.429	0.872	
TQ	3.705	0.947	0.443	0.584	0.357	0.404	0.397	0.829

Notes: Bold numbers are the square root of the AVE values; values below them are the correlations between constructs.

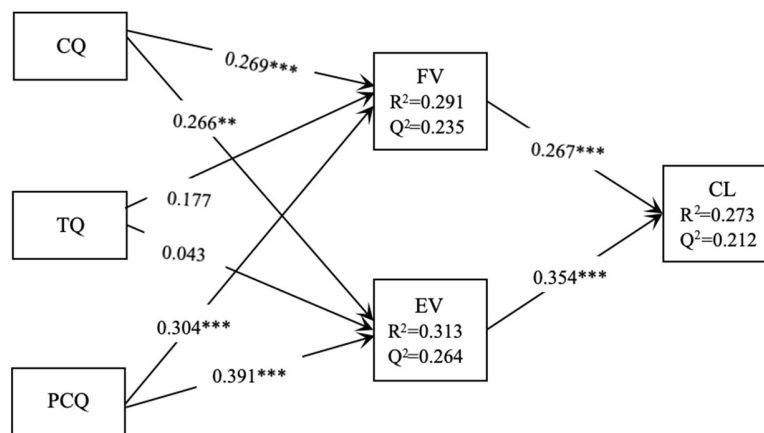
The effectiveness of a model is determined by its capacity to predict the endogenous constructs. Metrics such as coefficient of determination (R^2), cross-validated redundancy (Q^2), and standardized root mean square residual (SRMR) are utilized to assess the model's performance. The R^2 values presented in Fig.2, all exceeding 0.26, suggest substantial predictive accuracy of the model, as per Cohen's criteria (1988). The Q^2 values, measuring the model's predictive relevance, are all above zero, ensuring acceptable predictive relevance for the respective endogenous constructs as depicted in Fig. 2. In addition, with a SMRM value of 0.074, falling below the acceptable threshold of 0.090, the model confirms a satisfactory level of goodness-of-fit.

5.2. Hypotheses Testing

5.2.1. Pathway Coefficients

Data analysis was conducted using PLS-SEM, with bootstrapping (5000 cases). Results are depicted in Fig. 2 and Table 4. Firstly, condition quality ($\beta = 0.269, p < 0.01$) and personnel contact quality ($\beta = 0.304, p < 0.01$) positively influence functional value, supporting H1a and H1c. Secondly, condition quality ($\beta = 0.266, p < 0.05$) and personnel contact quality ($\beta = 0.391, p < 0.01$) positively influence emotional value, supporting H1d and H1f. Thirdly, functional value ($\beta = 0.267, p < 0.01$) and emotional value ($\beta = 0.354, p < 0.01$) positively impact customer loyalty, supporting H2a and H2b. However, the effects of timeliness quality on functional and emotional value are insignificant, indicating that timeliness quality cannot influence functional and emotional value, thus leading to the rejection of H1b and H1e.

Fig. 2: Path Analysis



Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 4: Path Coefficient

Hypothesis	Path coefficient	T-stat	Result
H1a: CQ→FV	0.269	2.753***	supported
H1b: TQ→FV	0.177	1.110	rejected
H1c: PCQ→FV	0.304	3.036***	supported
H1d: CQ→EV	0.266	2.593**	supported
H1e: TQ→EV	0.043	0.377	rejected
H1f: PCQ→EV	0.391	2.822***	supported
H2a: FV→CL	0.267	3.118***	supported
H2b: EV→CL	0.354	4.217***	supported

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

5.2.2. Mediating Effect Result

This study employed PLS-SEM with bootstrapping (5000 cases) to evaluate the mediating effect. The bootstrap method utilizes estimation results to determine confidence intervals of indirect effects, with significance indicated if the intervals exclude 0 (Hayes, 2017).

The findings in Table 5 support H3a, H3c, H3d, and H3f, with mediating effects of 0.072, 0.081, 0.094, and 0.138,

respectively, with bias-corrected and percentile 95% confidence intervals that do not include 0. However, H3b and H3e are not supported, with intervals including 0. This suggests that functional value mediates between condition quality and customer loyalty, as well as personnel contact quality and loyalty, but not between timeliness quality and loyalty. Similarly, emotional value mediates between condition quality and loyalty, and personnel contact quality and loyalty, but not between timeliness quality and loyalty.

Table 5: Mediating Effect Result

Hypothesis	Path coefficient	T-stat	95% Bias-Corrected CIs	Result
H3a: CQ→FV→CL	0.072	1.860*	(0.014, 0.170)	supported
H3b: TQ→FV→CL	0.031	0.935	(-0.019, 0.111)	rejected
H3c: PCQ→FV→CL	0.081	2.054**	(0.019, 0.177)	supported
H3d: CQ→EV→CL	0.094	2.233**	(0.021, 0.187)	supported
H3e: TQ→EV→CL	0.015	0.358	(-0.061, 0.106)	rejected
H3f: PCQ→EV→CL	0.138	2.780***	(0.050, 0.243)	supported

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

6. Discussion

6.1. Results Summary and Discussion

This study identifies key quality factors in fresh food e-commerce last-mile logistics that boost consumers' perceived functional and emotional value, leading to customer loyalty. Condition quality and personnel contact quality positively impact both values, enhancing loyalty. However, timeliness quality does not significantly affect these values. Mediating effects show that functional and emotional value mediate the relationships between condition quality and loyalty, and personnel contact quality and loyalty, but not between timeliness quality and loyalty.

The results highlight the importance of condition quality and personnel contact quality in the fresh food e-commerce sector, significantly contributing to both functional and emotional values, which enhance customer loyalty. This aligns with Su et al. (2023), indicating that high-quality interactions and well-maintained product conditions are crucial for customer retention. However, timeliness does not significantly impact CPV or enhance customer loyalty through CPV. This may be due to the self-delivery operations of the platforms studied, which have strict time schedules and commitments to delivering fresh products within a short time (Zhou & Wang, 2021). These platforms might already meet or exceed consumers' expectations, so improvements in timeliness do not significantly affect perceived CPV or loyalty.

6.2. Theoretical Implication

This study's theoretical implications extend traditional frameworks into fresh food e-commerce, offering nuanced insights into consumer behavior and loyalty. Firstly, applying the Quality-Value-Loyalty model (Parasuraman & Grewal, 2000) within this context advances theoretical frameworks in consumer behavior and marketing. By validating the model, this research highlights how LMLSQ intricately influences customer loyalty in the fresh food sector. Specifically, it reveals that high-quality service, including product condition quality and positive personnel interactions, enhances perceived functional and emotional value, thereby strengthening customer loyalty.

Secondly, this research extends prior studies by exploring how perceived functional and emotional value mediate the relationship between LMLSQ and loyalty. By empirically examining these dimensions, the study illuminates the mechanisms enhancing loyalty in fresh food e-commerce. It builds upon established literature (Del Mar Alonso-Almeida et al., 2013; Jiang et al., 2016; Parasuraman et al., 2005) to demonstrate how these dimensions of CPV shape customer loyalty distinctively.

Thirdly, the study underscores the multidimensional nature of CPV and its pivotal role in shaping consumer loyalty. By validating the influence of CPV in the context of fresh food e-commerce, the research deepens our understanding of how different aspects of service quality contribute to loyalty. This nuanced understanding enriches theoretical frameworks by emphasizing the specific pathways through which LMLSQ influences customer loyalty. It highlights the importance for e-commerce platforms to strategically manage both functional and emotional dimensions of CPV to foster enduring customer relationships and loyalty.

6.3. Managerial Implication

The study's findings suggest several important managerial implications for fresh food e-commerce platforms that provide self-delivery services. Firstly, ensuring high condition and personnel contact quality is crucial. The study reveals that these factors significantly enhance both functional and emotional value perceived by customers, thereby positively influencing customer loyalty. Managers should prioritize investments in robust delivery systems to maintain product freshness and integrity. Simultaneously, training delivery personnel to provide courteous and personalized service can further enhance the overall customer experience.

Furthermore, focusing on enhancing customer loyalty during the last-mile delivery process is paramount. This can be achieved by offering flexible delivery options and

accommodating special requests from customers. By prioritizing CPV at every touchpoint of the delivery journey, platforms can strengthen their brand reputation and build lasting relationships with their customer base.

Gaining insights into how perceived functional and emotional value mediate the relationship also provides strategic advantages. Platforms can strategically emphasize the reliability and efficiency of their last-mile logistics services in marketing campaigns to highlight functional benefits. Additionally, leveraging emotional appeals—such as sharing positive customer experiences or showcasing the emotional satisfaction of receiving fresh food deliveries—can deepen customer engagement and loyalty.

6.4. Limitation and Future Research

While this study contributes valuable insights, it is not without limitations. Firstly, the sample period was short, which constrained the ability to observe long-term customer retention rates and repurchase behaviors. Future research could address this by employing longitudinal data collection methods to track customer behavior over extended periods, providing more robust insights into customer loyalty dynamics in fresh food e-commerce.

Secondly, given the sample size in this study, the research may face limitations in generalizability and statistical power. Future research should aim to include larger and more diverse samples to enhance the reliability and applicability of findings. Additionally, the study's exclusive emphasis on the Chinese market may have limited the findings' applicability in other cultural and geographic situations. Future research might broaden the scope of this constraint to encompass a wider range of geographical locations and cultural contexts.

Thirdly, this study specifically focused on empirically examining relationships within the last-mile logistics sector of fresh product delivery. Future research endeavors could broaden the investigation to encompass other aspects of the supply chain or explore different industries altogether. This expansion would provide a more comprehensive understanding of how logistics service quality influences customer loyalty across various sectors and contexts.

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