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Does the Weather Still Affect Me When I Shop at Home? The Impact of Weather on Online Shopping Behavior

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Abstract: Previous studies have acknowledged the impact of weather changes on retail uncertainty. They primarily focus on understanding how weather conditions affect offline consumer behavior and aim to develop effective marketing strategies. However, there is little research on the complex impact of weather on online shopping behavior. To bridge this gap, we conduct a study with a sample of 261 consumers from China with shopping experience in community retail shops (CRSs). We utilize the S-O-R model and theories, including meteorological emotional effect theory, emotional coherence, and meteorological psychology, to model and elucidate the relationship between weather and consumers' online shopping behavior in CRS. Our findings reveal that weather conditions affect consumers' spending patterns and purchase diversity, mediated by consumers' emotions and risk aversion when they comfortably shop online at home. Furthermore, employing the fsQCA model, we identify the critical path through which weather conditions and consumer types influence risk-aversion awareness. The results provide management implications for retailers to develop online marketing strategies for different consumer types.

Keywords: community retail shops; weather conditions; S-O-R; online purchasing behavior; risk-aversion awareness

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1. Introduction

With the rapid development of e-commerce and the acceleration of online transformation in the retail industry [1,2], community group purchasing as an innovative operation mode is gradually showing its immeasurable market potential and value [3,4]. The community retail shop (abbr. CRS) has become a key focus for convenience stores to expand their business under the new retail format guided by the China Convenience Store Development Report 2021. Through the convenient service of "online order–home delivery", CRS greatly reduces consumers' shopping costs and time consumption, which has gained wide popularity in the market and injected strong economic vitality into the e-commerce retail sector [5,6]. Thus, an in-depth study of the online shopping behavior of CRS consumers is of vital importance in taking the pulse of the development of the e-commerce economy.

Although previous studies have explored the multiple factors influencing consumer online shopping behavior in the retail industry [7–11], the role of weather, a natural environmental element, has rarely been systematically investigated [12,13]. Especially under the complex and changing weather conditions of recent years, few studies have focused on the impact of weather on offline retail performance, which can be divided into three main areas. First, weather can influence consumers' decisions to go out and make purchases [14]. Second, weather conditions can affect the purchase pattern as factors such as purchase motivation (essential or leisure), travel costs, and weather conditions could influence the decision process of consumers [13]. Finally, consumers' purchase behavior

when entering a shop is influenced by factors such as in-store promotions, and customers' sensitivity to promotional discounts varies with weather conditions [15].

Considering the offline order-delivery-to-home model of CRS, the influence of weather factors on consumers' online shopping behavior seems to be less relevant when they are shopping online. However, we infer that consumers' decision-making process may be indirectly and subtly influenced by weather factors despite the online shopping environment. First, uncomfortable weather conditions can influence human financial decisions through psychological mechanisms [16,17], and the psychological effect of weather may change shopping habits [18]. In other words, weather can affect people's psychological state, which in turn affects their shopping behavior. For instance, positive moods may lead consumers to spend more money on purchases [19–21]. Second, CRS mainly sells fresh produce, which is vulnerable to weather when stored and distributed [22]. For example, heat weather increases product waste and leads to a profit loss if consumers are less likely to shop. Therefore, studying the mechanisms by which weather affects online consumer shopping behavior has practical implications for CRS retailers.

Therefore, an in-depth analysis of the mechanism of weather influence on the online shopping behavior of CRS consumers is not only an enrichment and extension of the existing theoretical retail system but also a direct guide to the practical operation of CRS retailers.

Based on the previous analysis, there are three gaps in current research:

- There is a lack of dedicated research on the relationship between weather and online shopping behavior under the CRS context;
- Previous research mostly relied on secondary data, ignoring the role of consumer psychological mechanisms in the relationship between weather and shopping behavior [14,23–29];
- Few studies have explored how to formulate differentiated marketing strategies for different types of consumers under the background of weather changes.

To address the research gaps, this study initially investigates the mechanism of weather influence on online shopping behavior of CRS consumers. We construct and validate a theoretical framework by integrating the S-O-R model and theories, including meteorological emotional effect theory, emotional coherence, and meteorological psychology. The framework explains how weather affects CRS consumers' responses to online shopping behavior from affective and cognitive perspectives. Furthermore, we adopt the fsQCA model to reveal the critical path of weather and consumer-type combinations on risk-aversion awareness. Our study fills the current gap in retail research of factors that would influence consumers' online shopping behavior and provides managerial insights on how to tailor marketing campaigns to different consumer types.

This paper is structured as follows. Section 2 provides a review of relevant literature. Section 3 proposes the research hypotheses about the relevant theoretical base. Section 4 describes the design of the scenario experiment and the construction of the model. Section 5 presents the empirical analysis. Finally, Section 6 concludes and sets out the managerial suggestions.

2. Background Literature

2.1. Review of Weather Factors' Impact on Human Psychology

The psychological impact of weather on humans is manifested in cognitive terms. Medical research has shown that air pollution can adversely affect human cognitive function [30,31] and impair human cognitive abilities [32–34]. In addition to existing studies that focus on common weather metrics such as temperature and air quality, Izadi et al. [35] found that different directions of air currents affect human cognition. Risk-aversion perception is a common type of cognitive ability that refers to a human attitude toward coping with risky situations. In the field of finance, empirical studies on weather and financial purchase behavior have shown that risk-aversion awareness plays a mediating role between the two [16,17,36].

The quantification of risk-aversion awareness is varied, but the core dimensions are consistent and widely used, including financial, functional, and psychophysical dimensions. Murray and Schlacter [37] quantify it in terms of financial, social, and psychophysical dimensions. Similarly, Derbaix [38] refers to financial and psychophysical dimensions. Sweeney et al. [39] emphasize the importance of financial and functional dimensions. The financial dimension mainly emphasizes the aversion of consumption to financial losses, and the empirical results of Konuk [40] show that product quality may influence consumer behavior such as reducing the risk as consumers may face financial losses when they purchase low-quality products, as functionality is primarily the risk-driven additional importance that consumers place on the functionality of goods, such as material storage, to cope with adverse circumstances. Zielke et al. [41] found that when faced with objective constraints that hinder the traditional brick-and-mortar shopping experience, consumers are more likely to turn to online shopping platforms and make material storage decisions based on the prevailing circumstances. Psychophysical factor related to these behaviors focuses on the consumer's avoidance of harm to their own safety. Zhao et al. [42] also found that outdoor activities in inclement weather were associated with heightened safety concerns.

The effect of weather on human psychology is also reflected in emotions. Persinger and Levesque [43] found that different combinations of weather events could explain 40% of human moods. Unlike the effects on cognition, the emotional aspects are more concrete and direct [44]. For example, rainy weather produces negative moods in humans [45]. Sunlight produces positive moods in humans [46–48], and artificial sunlight can reduce symptoms of seasonal affective disorder (SAD) [49–51]. In addition, warm temperatures make people feel more comfortable and produce positive moods [46,47], and lower humidity is more pleasant [44]. Recent research has begun to focus on the impact of temperature on consumer behavior. Yang et al. [52] innovatively discussed how the impact of temperature on consumers' emotions may change their attitudes towards nostalgic advertising. This study contributes to the literature on temperature in marketing.

2.2. Review of Psychological Impact on Consumer Purchasing Behavior

In the context of existing research, the outcomes of consumers' singular purchase behavior are routinely evaluated along with two fundamental dimensions: consumption expenditure and purchase abundance [23,26,53]. Specifically, consumption expenditure serves as a pivotal metric for assessing the economic nuances of shopping behavior, encapsulating the aggregate monetary value of all items acquired by consumers within their shopping basket during a single transaction [26,53]. Purchase abundance is employed to quantify the diversity and complexity of shopping behavior, manifested as the cumulative count of distinct product categories present in the shopping basket [23,53]. Analyzing purchase abundance offers valuable insights into the multifaceted nature of consumer needs, revealing both the breadth of categories sought and the depth of their preferences.

There is limited research on the impact of consumer risk aversion on purchase behavior. Huang et al. [54] compared the differences in consumer risk appetite among sales channels and showed that consumers who preferred shopping offline were more risk-averse than those who preferred shopping online [55]. Lundberg et al. [56] innovatively showed that indoor ambient temperature influences consumers' risk-taking and, thus, their consumption expenditure.

Existing research suggests that weather affects human moods, which in turn affects consumption expenditure and purchase abundance [57]. Positive moods have a strong positive effect on consumers' purchase intentions [19–21,58]. This is supported by the fact that people not only show positive self-rewards and thus buy more [20,58,59] but also give higher ratings to goods [60–62].

2.3. Consumer Behavior Research Based on the S-O-R Model

The S-O-R model has three components [63]. Stimulus is the 'trigger' that causes a change in the individual's internal and external states. Organism refers to the individual's emotional and cognitive state due to the stimulus [64]. In response to external stimuli, the organism produces intrinsic and extrinsic behavioral 'responses' (Response). Stimulus (S) is a factor consisting of the external environment that affects the individual, such as the weather in this study; organism (O) is a change in mental state in response to a stimulus, such as the individual's moods and risk aversion; and response (R) represents the individual's response behavior in response to the stimulus, such as the consumer's online purchasing behavior [65].

The S-O-R model has been widely used in studies related to consumer purchasing intentions [66–69]. Ma, Zhang, Ding, and Wang [67] employed the Stimulus-Organism-Response (S-O-R) model to examine the influence of online shopping experience on customer engagement and online purchase intention in the presence of weak and strong social ties. The results revealed a favorable impact of online shopping experience on customer engagement, subsequently leading to an increased online purchase intention within both the strong and weak ties cohorts. Eroglu, Machleit, and Davis [69] applied the S-O-R model to the study of online shopping, regarding environmental features and the atmosphere of the shopping website as external stimuli and the user's internal emotional state as the organism to study the user's response behavior. Thus, the S-O-R model provides a structured research perspective and a solid theoretical foundation for exploring the influence of consumers' purchase intentions [70].

In sum, from the perspective of individual consumer behavior, there is limited research on the impact of weather on consumers' psychological performance and, thus, on online purchasing behavior, and the complete theoretical framework is also lacking. However, the S-O-R model presents an ideal framework to address this gap. It not only provides a comprehensive theoretical basis but also aligns well with the research objectives of examining the mechanisms underlying the weather-purchase intention link.

3. Hypotheses and Conceptual Model

Within the framework of S-O-R, we develop hypotheses and construct a conceptual model based on meteorological emotional effect theory, emotional coherence, and meteorological psychology.

3.1. Influence of Weather Factors on Human Moods

Meteorological emotional effect theory states that changes in meteorology can affect a person's emotional state [26,43]. Human perception of weather could be divided into "favorable" and "unfavorable weather". Favorable meteorological conditions can lead to positive moods [44].

Emotions are of vital importance in human's daily life. Emotions constitute a fundamental aspect of human cognitive and psychological states. Emotions can be classified into two distinct categories: positive and negative. Positive emotions encompass a spectrum of pleasurable feelings that serve as reflections of a consumer's overall sense of well-being [71]. The strongest influences on consumer mood are temperature, weather type including sunny, cloudy, rainy, or snowy, and air quality. Therefore, our study also considers these factors.

A human prefers warm temperatures to cold temperatures. Warm temperatures make people feel more comfortable and produce positive moods [46,47]. In contrast, people feel more comfortable when the temperature is around 25 degrees Celsius [72].

There are different weather types, including sunny, cloudy, rainy, snowy, and more. Sunny days are considered better than other weather types. Previous research has shown that sunny days elicit positive moods and increase consumer expenditure [73]. Cloudy, overcast, and other similar weather types have more cloud cover and less sunlight exposure, which can elicit negative moods. Severe weather, such as rain and snow, can exacerbate

negative human moods [14,23,72,74,75] and impede human travel while increasing travel costs [76].

Air quality has been widely known to affect human health [77]. As people have become more aware of air quality, the Air Quality Index (AQI) has become a key weather variable, and lower AQI has a positive effect on human health [78]. People exposed to chronic air pollution have been shown to experience negative moods such as stress and anxiety [79]. Therefore, we propose Hypothesis H1a–H1c based on meteorological emotional effect theory:

H1a. *Warm temperature positively influences the customer's mood.*

H1b. *Favorable weather type positively impacts the customer's mood.*

H1c. *Improved air quality positively impacts the customer's mood.*

3.2. Influence of Weather Factors on Risk-Aversion Awareness

Meteorological psychology suggests that meteorological factors such as temperature and sunlight affect individual cognitive abilities [23,32,80]. Risk perception is an important part of consumer cognitive psychology, which can make consumers feel anxious [81]. Meteorological factors can affect consumers' risk perception and lead to a sense of risk aversion. In some cases, risk aversion is a consumer strategy for managing risk. For instance, consumers attempt to mitigate risk by changing their original plans, therefore minimizing potential losses [82,83].

Risk-aversion awareness is the realization that certain actions or efforts are required to avoid potential losses associated with inherent risks. It denotes a conscious understanding of the negative outcomes or detrimental effects that may result from engaging in risky behavior. By acknowledging the possible losses linked to specific risks, individuals and organizations can make decisions and implement suitable measures to mitigate or minimize exposure to such risks [40].

Consumers' risk tolerance diminishes during unfavorable weather periods [17], therefore resulting in increased risk-aversion awareness [84–86] and subsequently causing deviations in consumption plans [74]. Shafi and Mohammadi [85] regarded cloud cover as a proxy for weather conditions and found that weather-induced risk aversion leads to a reduction in consumer contributions to crowdfunding activities. And in rainy weather, consumers become risk-averse, which encourages them to buy more products at once. Unfavorable weather conditions create more uncertainty and increase consumers' risk-aversion awareness. Therefore, we propose Hypothesis H2a–H2c based on meteorological psychology:

H2a. *Cold temperature results in an increase in the customer's risk-aversion awareness.*

H2b. *Unfavorable weather type results in an increase in the customer's risk-aversion awareness.*

H2c. *Terrible air quality results in an increase in the customer's risk-aversion awareness.*

3.3. Influence of Moods on Online Shopping Behavior for CRSs

Emotional coherence is one of the two emotional mechanisms proposed by Kivetz [87]. Emotional congruence refers to people reacting in accordance with their moods, while emotional regulation refers to people trying to control their moods through various means. In line with previous research, we focus on consumers' emotional congruence.

Due to the complex and diverse structure of consumer groups and the variety of their needs, individuals' consumption behavior can be influenced by their moods at different stages with different results [88–90]. This influence is reflected in various ways [91], including the timing of purchases, consumption expenditure, and the frequency of one-off purchases.

Donovan and Rossiter [59] found that positive moods motivate consumers to purchase a greater number of goods, leading to increased consumer expenditure. Additionally,

positive moods tend to cause consumers to spend more time selecting products [20,59]. Consumers influenced by positive moods may change their original purchase plans and increase the variety and quantity of goods purchased. Therefore, we propose Hypotheses H3 and H4 based on consumer emotional coherence:

H3. *Positive mood leads to an increase in consumer expenditure.*

H4. *Positive mood leads to an increase in purchase abundance.*

3.4. Influence of Risk-Aversion Awareness of CRSs' Online Purchasing Behavior

Bauer [92] states that risk-aversion awareness is concerned with subjective risk rather than objective risk. Thus, risk-aversion awareness emphasizes the likelihood of unfavorable consequences of a purchase that the consumer is aware of before making the purchase [38]. Unfavorable weather is associated with increased risk-aversion awareness and negative anticipatory attitudes, which in turn lead to pessimism and a preference for conservative choices [93,94]. In adverse weather conditions, consumers' sense of conservative choice leads individuals to avoid the psychological discomfort and physical safety risks associated with going outside [42]. And there is a tendency to buy necessities online to stock up on essentials [41]. Thus, weather-related risk-aversion awareness increases consumer expenditure [74,95,96] and generates high operating profits for retailers [86]. At the same time, consumers typically purchase a wide variety of goods to hedge against the risks associated with uncertainty about future weather. Therefore, we propose Hypotheses H5 and H6:

H5. *High risk-aversion awareness leads to an increase in consumer expenditure.*

H6. *High risk-aversion awareness leads to an increase in purchase abundance.*

3.5. Differences in Shopping by Consumer Types

Based on a thorough analysis, we have formulated a conceptual model that elucidates the intricate mechanism underlying the influence of weather factors on consumers' online shopping behavior, as depicted in Figure 1. Notably, the exploration of consumer gender disparities and the diversity in shopping habits has garnered substantial attention and empirical validation across disciplines, particularly in marketing and psychology [97,98]. Prior investigations have unequivocally established that gender disparities significantly shape consumer shopping behaviors [97,99]. This phenomenon can be partially attributed to the enduring influence of traditional family role assignments despite the progressive blurring of gender boundaries in contemporary society. Notably, shopping behaviors continue to exhibit gendered traits, particularly within the context of family life [100,101]. Moreover, consumers of varying genders exhibit distinct reactions to fluctuations in weather conditions and shifts in psychological states [97,102]. Specifically, weather conditions exert distinct influences on the shopping behaviors of men and women [102,103].

Concurrently, consumers' shopping habits play a pivotal role in modulating their responsiveness to alterations in weather and psychological states. Empirical evidence underscores the substantial heterogeneity in shopping behaviors among consumers with diverse shopping habits [98,104]. Illustratively, individuals who favor offline shopping channels tend to be more concerned about the impediments posed by weather conditions on their mobility [13,14]. Conversely, seasoned or frequent shoppers exhibit greater resilience against disruptions caused by weather fluctuations, whereas those with infrequent shopping patterns are more susceptible to the detrimental effects of adverse weather conditions. Based on this comprehensive analysis, it is logical to posit that consumer types characterized by gender differences and varying shopping habits will manifest divergent behavioral patterns within the conceptual framework, elucidating the mechanisms through which

weather influences consumers' online shopping behavior. Consequently, we formulate the following hypotheses:

H7a. *Differences in gender lead to eliciting incongruent behavioral manifestations among consumers within our proposed conceptual model.*

H7b. *Differences in shopping habits result in consumers displaying inconsistent behavioral manifestations within our proposed conceptual model.*

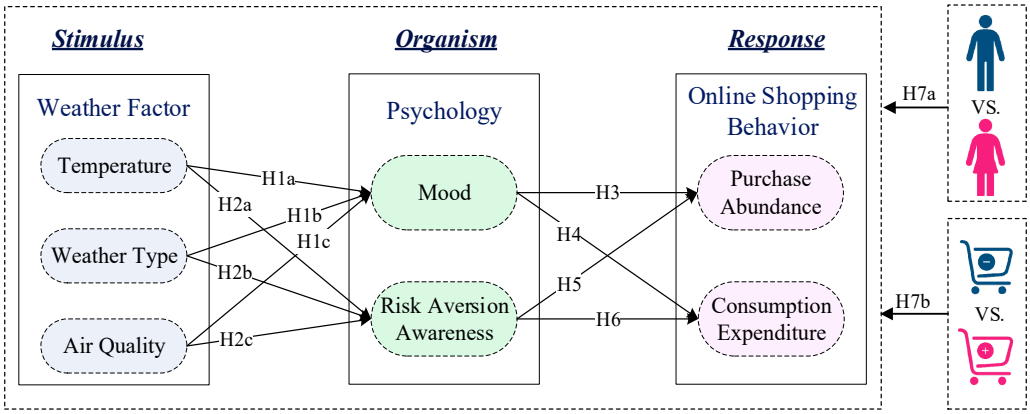

Figure 1. Conceptual Model.

4. Research Design and Method

4.1. Data Sources

4.1.1. Scenario Experimental Design

Drawing on existing research on weather and consumer behavior, we design scenario experiments to explore consumers' cognitive states in response to different weather factors and whether they decided to shop online, what items they purchased, and what amount they spent (Figure 2).

To mitigate participant fatigue and ensure high-quality data, we carefully consider the number of questions and duration of the scenario study. Moreover, we utilize one week of actual weather data from both the winter and summer seasons of 2021 in the Haidian district of Beijing to inform the weather factors in the scenario study, namely the Winter Consumer Purchase Scenario (WCPC) and the Summer Consumer Purchase Scenario (UCPC). The reason for choosing these two seasons is that these two seasons possess distinct weather characteristics, which facilitate the observation of objective phenomena. Also, the reason for choosing seven days as a period is that it encompasses both weekdays and weekends, which aligns with typical consumer purchasing behavior.

Our scenario experiment design process can be proposed as follows:

First, The scenario description is as follows: "Suppose you reside in District A of Beijing's Haidian district and have access to a CRS, which offers online ordering with home delivery. We present 18 main products, complete with images to aid in your understanding, based on the actual inventory of the shop. The prices are determined by historical sales data and will satisfy your basic material needs. You need to make daily purchasing decisions for two weeks based on the weekly weather information provided, and we will provide you with a cumulative expense list after each purchase".

Second, The seasonal orientation and task description are as follows: "Suppose it is winter; you are tasked with making daily purchases of consumer goods based on the weather information provided for one week. Each day, you need to make the following decisions: (a) whether to make a purchase; (b) which shopping method to use; (c) the number of items to purchase; or enter 0 if you do not intend to buy the item".

Figure 2. Experimental design of the scenario.

Third, The weather information includes temperature ranges, weather type, and air quality for today and tomorrow. To enhance visual clarity, a static weather image is introduced in the corresponding background of the picture.

Fourth, In filling out the questionnaire, consumers are required to provide three types of information: stimulus information, organism information, and response information. Specifically, stimulus information aims to acquire data related to temperature, weather type, and air quality. Organism information is gathered to understand the emotions and risk-aversion awareness of the respondents. Response information focuses on the consumers' shopping decisions, primarily encompassing purchase abundance and consumption expenditure.

(a) Stimulus Information:

Consumers could use a 1–10 Likert scale to rate daily weather conditions based on temperature, weather type, and air quality. This approach is necessary as each participant resides in a unique environment and geographical location, and thus, different weather factors will produce varying levels of stimulation for them [105].

(b) Organism Information:

This section comprises two main components: mood and risk-aversion awareness.

A comprehensive four-dimensional approach (E1–E4) is used to measure mood [106]. This approach aims to assess consumers' positive emotions, which include feelings of happiness, relaxation, excitement, and liveliness [106,107]. Each dimension is rated on a 1–10 Likert scale, ranging from strongly disagree to strongly agree. The robust measurement framework makes it easy to determine whether consumers' emotional states tend to be positive or negative. The final score, indicating mood, derives from the mean scores of E1, E2, E3, and E4.

Based on existing research, we have quantified the financial, functional, and psychophysical dimensions when combining consumer shopping characteristics in retail stores [37–42]. Given the focus of the study on online shopping behavior, specific scales are developed, including financial loss due to product quality (RAA1), material supply function (RAA2), and outdoor activity risk (RAA3). Referring to the calculation of Li and Choudhury [108], the final risk-aversion awareness score is derived from the average of the RAA1, RAA2, and RAA3 scores (1–10 Likert scale).

(c) Response Information:

In filling out the response information, consumers could indicate the purchase action based on personal preference and weather, with the options of online shopping for CRS, offline shopping in a more distant shopping mall, or no purchase action. We focus on two indicators of consumer purchasing decisions in the CRS: purchase abundance and consumption expenditure. Purchase abundance refers to the number of types of items a consumer purchases in a single shopping trip. Consumption expenditure refers to the total amount of money a consumer spends on items purchased on a single shopping trip. Purchase abundance refers to the number of types of items a consumer purchases in a single shopping trip. Consumption expenditure is the total amount of money spent by consumers on items purchased in a single shopping trip.

Finally, Additional measures: we offer a representative range of retail items categorized based on the goods sold for CRSs and set reasonable sales prices based on actual sales experience. Moreover, to provide individuals with a more visual experience of the weather and shopping, we have included images of corresponding scenarios for weather conditions and shopping items in the questionnaire. This approach aims to enhance the questionnaire experience and provide more realistic decision-making. The specific options for the questionnaire are shown in Table 1.

Table 1. Measurement of questionnaire variables.

Type	Title	References
S	T. According to the weather information we have provided, what do you think of the degree of today's temperatures? W. According to the weather information we have provided, what do you think the weather type will be like today? (Judge by sunny, cloudy, rainy, or snowy.) A. Based on the weather information we have provided, what do you think the air quality will be like today?	Measurement based on real conditions
O	E1. Mood: happy (strongly agree to strongly disagree). E2. Mood: relaxed (strongly agree to strongly disagree). E3. Mood: excitedly (strongly agree to strongly disagree). E4. Mood: lively (strongly agree to strongly disagree). RAA1. I think that future purchases will be of poor quality and thus cause me financial loss (strongly agree to strongly disagree). RAA2. In the long term, I think it's important to stock up on functional items (strongly agree to strongly disagree). RAA3. The psychological and physical risks of going out are higher (strongly agree to strongly disagree).	Babin and Darden [106] Shi, Wang, Qiao and Shang [107] Dang-Van et al. [109] Murray and Schlacter [37], Derbaix [38]; Konuk [40] Sweeney, Soutar and Johnson [39] Zielke, Komor and Schlößer [41] Murray and Schlacter [37], Derbaix [38]; Zhao, Wang, Liu, and Jackson [42]
R	PD. Online purchasing decisions for CRSs.	Calculate

4.1.2. Scenario Experiment Development

To begin the scenario experiment, we first conducted a pre-experiment with a total of 57 participants. Based on their suggestions, we adjusted the drink prices accordingly. The official start date of the scenario experiment was 31 December 2021. To improve the coverage and representativeness of the sample, the experiment was conducted with a wide range of participants without geographical restrictions. A total of 261 participants

were invited, with 222 valid responses obtained after excluding results with abnormal participation length, the validity rate of which was 89.2%.

The participants covered all the provinces of the Chinese mainland. We statistically described the participants as shown in Table 2. The gender ratio of participants in the scenario experiment is 1.22:1, the average time taken to complete the questionnaire is 1134.5 s, and the average cumulative purchase amount is CNY 1458.43. Most of the participants in this scenario experiment come from the 26–30 age group, followed by the 31–40 age group. The largest proportion of participants' occupations are in management, followed by technical/R&D staff and sales staff. The sample of participants includes a diverse range of occupations, with 15 types of workers represented.

Table 2. Descriptive statistics of participants.

Category	Classification	Percentage	Category	Classification	Percentage
Gender	Man	122 (54.95%)	Age	Under 18	1 (0.45%)
	Woman	100 (45.05%)		18~25	31 (13.96%)
Occupation	Students	13 (5.86%)		26~30	86 (38.74%)
	Production staff	23 (10.36%)		31~40	80 (36.04%)
	Sales staff	20 (9.01%)		41~50	15 (6.76%)
	Management staff	46 (20.72%)		51~60	8 (3.6%)
	Administrative staff	16 (7.21%)		60 or more	1 (0.45%)
	Finance/Audit staff	14 (6.31%)	Number of outgoing purchases (per week)	0	1 (0.45%)
	Clerical staff	17 (7.66%)		1–3	149 (67.12%)
	Technical/R&D staff	30 (13.52%)		4–6	64 (28.83%)
	Others	43 (19.37%)		7 or more	8 (3.6%)

4.2. Descriptive Analysis

We plot the correlation analysis between organisms and purchase behavior (Figure 3). We find some positive correlations between emotion and purchase amount or purchase abundance, as well as risk-aversion awareness. In contrast, the correlation between emotion and risk-aversion awareness is extremely low.

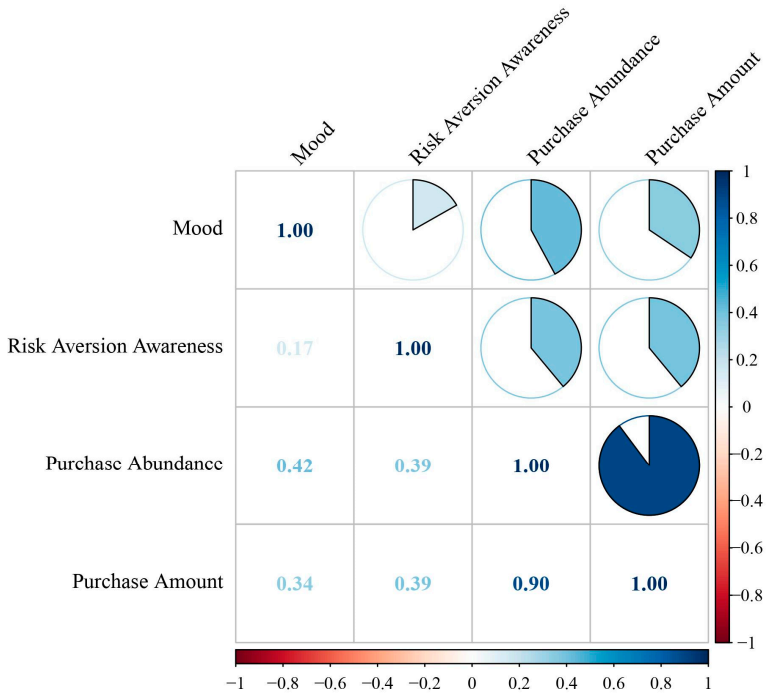

Figure 3. The correlation analysis between organisms and purchase behavior.

4.3. Model

To test the hypothesis, we use a regression model to compare the mean of the respective 7-day data under UCPC and WCPC. The specific models used are as follows:

$$\Delta Y_i = \beta_i + \gamma_i \Delta X_i + \delta_i Control_i + \varepsilon_i \quad (1)$$

$$\Delta Y_i = (\sum_{t=1}^{n} y_{UCPC_{it}} - \sum_{t=1}^{n} y_{WCPC_{it}})/n \quad (2)$$

$$\Delta X_i = (\sum_{t=1}^{n} x_{UCPC_{it}} - \sum_{t=1}^{n} x_{WCPC_{it}})/n \quad (3)$$

where $x_{UCPC_{it}}$ denotes customer i's evaluation score (or other independent variables of the weather conditions on day t in the summer consumption scenario. $y_{UCPC_{it}}$ denotes customer i's sentiment score (or other dependent variable) on day t in the summer consumption scenario. n represents the cumulative number of purchase days ($n = 7$ in this study), $Control_i$ denotes the control variables, specifically the type of consumer (gender, age, income) and shopping habits, and ε_i denotes the residual term.

Fuzzy set qualitative comparative analysis (fsQCA) is a qualitative comparative analysis technique rooted in set theory, which assists in analyzing the relationship between elements, known as "set membership" [110,111]. Unlike traditional linear regression and structural equation modeling (SEM), fsQCA operates on the principles of Boolean algebra and is an asymmetric analysis [111]. fsQCA incorporates a consistency metric, which measures the extent to which causal combinations produce consistent outcomes, and a coverage metric, which represents the goodness of fit, similar to R2 in traditional regression analysis [112,113].

5. Empirical Analysis

5.1. Analysis of the Online Purchasing Behavior for CRSs

5.1.1. Path Coefficient Test

We first measure the reliability and validity of the two-dimensional scales of emotion and risk-aversion awareness. The results show that Cronbach's coefficient is greater than 0.8, and the data have a certain degree of reliability. The KMO value is greater than 0.6, and Bartlett's test of sphericity significance's sig value is less than 0.01. We perform factor extraction and find that only one factor could be extracted from each of the two scales, so the validity meets the requirement.

Then, we begin by examining the analysis of consumer purchasing behavior through the S-O-R theoretical framework. The calculated results and their respective impact effects are indicated in Figure 4.

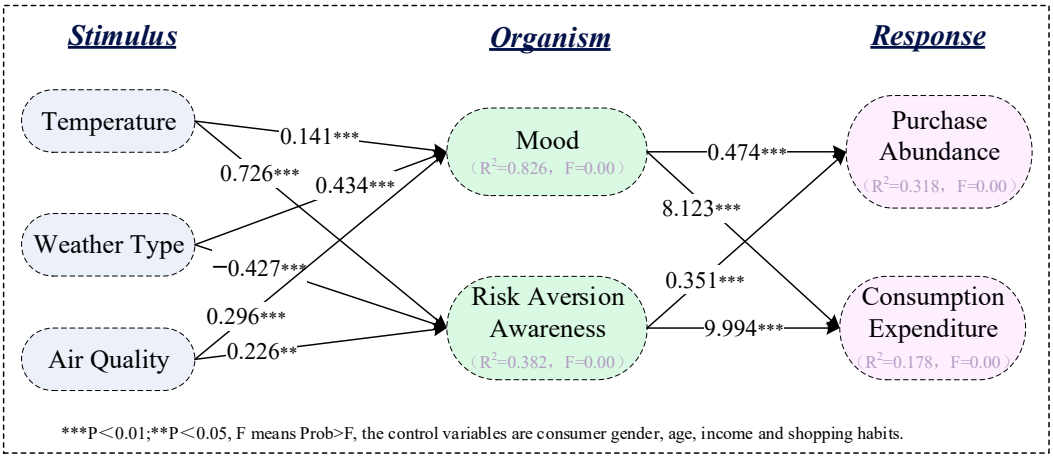

Figure 4. Results of the consumer purchasing behavior model.

The results confirm Hypothesis H1a. Temperature has a positive and significant effect on customer mood ($\gamma = 0.141$, $p < 0.01$). Consumers prefer warm temperatures to cold temperatures. Hypothesis H1b is valid. Favorable weather type has a positive and significant effect on customer mood ($\gamma = 0.434$, $p < 0.01$). Sunny will be more pleasant for consumers than other weather types. Hypothesis H1c is valid. Air quality has a positive and significant effect on customer mood ($\gamma = 0.296$, $p < 0.01$). Severe pollution can lead to extreme emotional discomfort for consumers. In the empirical results above, we also find that weather type has the strongest effect on mood.

Our results do not support Hypothesis H2a, as we find no evidence that uncomfortable temperatures increase risk-aversion awareness. On the contrary, the higher the temperature, the higher the customers' risk-aversion awareness ($\gamma = 0.726$, $p < 0.01$). Hypothesis H2b is confirmed. Since weather type has a negative coefficient of influence on risk-aversion awareness, and the higher the weather type score in our scenario experiment, the better the weather conditions are perceived by consumers (comfort: sunny > cloudy > rainy > snowy). Therefore, it can be judged that individuals' risk-aversion awareness is higher in unfavorable weather types ($\gamma = -0.427$, $p < 0.01$). We inferred the following reasons: on one hand, consumers are concerned about the adequacy of their food stocks to meet future living needs in adverse weather conditions. On the other hand, consumers who live far from their homes are concerned about the possibility of not being able to travel due to adverse weather conditions. These concerns lead them to be more risk-averse in their online shopping decisions. Our results do not support hypothesis H2c. The better the air quality, the more risk aversion consumers are aware of ($\gamma = 0.226$, $p < 0.05$), but this is only significant at the 5% level. To further explain the empirical results of hypotheses H2a and H2c, we conduct more detailed analyses in Sections 5.2 and 5.3.

Our study confirms Hypotheses H3 and H4. Based on empirical evidence on the effect of moods on customer purchase behavior, we find that moods have a significant and positive impact on both purchase abundance and consumer expenditure for CRSs ($\gamma = 0.474$, $p < 0.01$; $\gamma = 8.123$, $p < 0.01$), which is consistent with previous research. Positive customer sentiment leads to a greater willingness to shop and, as a result, more money is spent on more expensive goods.

Our study confirms Hypotheses H5 and H6. Based on empirical evidence on the effect of risk-aversion awareness on customers' purchasing behavior, we find that risk-aversion awareness has a significant and positive impact on both purchase abundance and spending for CRSs ($\gamma = 0.351$, $p < 0.01$; $\gamma = 9.994$, $p < 0.01$). A high level of risk-aversion awareness leads consumers to make large one-off purchases to avoid the risk of future uncertainty about the impact of weather on the quality of life.

5.1.2. Mediation Effect Test

We use the bootstrap sampling test (with a sample size of 5000) to assess the mediation effect of the consumer purchasing behavior model [114]. We use weather conditions as the independent variable, mood, and risk-aversion awareness as the mediating variables, purchase abundance and consumption expenditure as the dependent variables, and consumer characteristics such as gender as the control variables. The direct effect test is carried out first (Table 3). Only after verifying the direct effects can the introduction of indirect effects prove the mediating role of the model. If the 95% interval (BootCI) of the effect value does not include the number 0, then there is a mediation effect. Otherwise, there is no mediation. The specific results are shown in Table 3. We find that all of them are valid, except that there is no significant mediating effect of mood in the effect of temperature and air quality on consumer expenditure.

Table 3. Results of the mediation effect test.

Pathway	Direct/Indirect Effect	LLCI	ULCI	Mediating
Temperature → Mood → PA	0.302 ***/0.225 ***	0.104/0.084	0.500/0.331	YES
Temperature → Mood → CE	8.862 ***/2.797 ***	2.282/−0.054	15.443/0.230	No
Weather Type → Mood → PA	0.484 ***/0.384 ***	0.179/0.140	0.790/0.496	YES
Weather Type → Mood → CE	11.730 **/9.309 ***	1.601/0.061	21.860/0.454	YES
Air Quality → Mood → PA	0.294 **/0.253 ***	0.061/0.059	0.527/0.399	YES
Air Quality → Mood → CE	5.809/5.124 ***	−1.952/−0.018	13.570/0.322	No
Temperature → Risk-Aversion Awareness → PA	0.357 ***/0.171 ***	0.206/0.066	0.508/0.258	YES
Temperature → Risk-Aversion Awareness → CE	6.573 **/5.122 ***	1.571/0.050	11.503/0.263	YES
Weather Type → Risk-Aversion Awareness → PA	0.405 ***/0.141 ***	0.264/0.051	0.546/0.188	YES
Weather Type → Risk-Aversion Awareness → CE	6.434 ***/3.947 ***	1.695/0.043	11.173/0.177	YES
Air Quality → Risk-Aversion Awareness → PA	0.391 ***/0.156 ***	0.251/0.065	0.532/0.216	YES
Air Quality → Risk-Aversion Awareness → CE	6.317 ***/4.616 ***	1.616/0.049	111.019/0.219	YES

*** $p < 0.01$; ** $p < 0.05$; LLCI refers to the lower limit of the 95% interval of Bootstrap sampling, ULCI refers to the upper limit of the 95% interval of Bootstrap sampling, and bootstrap counts are 5000.

5.2. Empirical Analysis Based on fsQCA

5.2.1. Selection and Calibration of Variables

To further analyze why parts H2a–H2c hold, we explore how the combination of three antecedent variables, temperature, weather type, and air quality affects consumers' risk-aversion awareness. The qualitative fuzzy set comparative analysis method differs from traditional regression models in that it identifies the relationship between specific combinations of consumer types and risk-aversion awareness. For example, we are interested in whether differences in consumer age, gender, and shopping habits co-exist with differences in risk-aversion awareness.

Three variables as antecedents were selected, including temperature, weather type, and air quality. We also include consumer characteristics (age, gender, and shopping habits) as antecedent variables. We use the logistic function provided by the econometric software and apply the direct method to calibrate the data concerning previous studies. At the same time, following the mainstream QCA method, the objective quartile is used as the calibration base point, and the thresholds of Fully Affiliated, Crossover Point, and Completely Unaffiliated of the antecedent conditions with the outcome data are classified according to the 95%, 50%, and 5% quartile values, as indicated in Table 4.

Table 4. Calibration points and descriptive statistics.

Results and Conditions		Calibration Points			Descriptive Statistics			
		Fully Affiliated	Crossover Point	Completely Unaffiliated	Mean	Standard Deviation	Minimum	Maximum
Results	Risk-Aversion Awareness	−8.63	−1.56	1.83	−2.50	3.55	−9.50	8.00
Conditions	Temperature	−5.64	2.33	5.97	1.40	3.55	−9.00	9.00
	Weather Type	−5.50	1.00	5.14	0.49	3.18	−7.50	8.33
	Air Quality	−7.00	0.54	4.90	−0.12	3.39	−9.00	8.00
	Gender	1.00	1.00	2.00	1.45	0.50	1.00	2.00
	Age	2.00	3.00	5.00	3.47	0.98	1.00	7.00
	Habits	2.00	2.00	3.00	2.36	0.56	1.00	4.00

5.2.2. Analysis of Necessary Conditions

The combined path of conditioned variables can only be further analyzed if the single conditioned variable is not a necessary condition. In this study, the necessity of each antecedent variable is analyzed to derive the necessary conditions for each factor, as indicated in Table 5. Consistency refers to the degree of consistency between the outcome variable and the antecedent variable, and its standard is 0.9. According to Table 4, the

consistency of each antecedent variable is less than 0.9, which indicates that consumers' risk-aversion awareness is jointly influenced by several variables.

Table 5. Results of the necessity test for individual conditions.

Conditions	Consistency	Coverage
Temperature	0.76	0.75
Weather Type	0.69	0.68
Air Quality	0.73	0.72
Gender	0.86	0.61
Age	0.75	0.62
Habits	0.81	0.62

5.2.3. Conditional Portfolio Analysis Based on fsQCA

We use fuzzy set qualitative comparative analysis (fsQCA) for the case set comparative analysis, as indicated in Table 6. We set the consistency threshold to 0.8 and marked combinations with consistency greater than the threshold as 1 in the outcome variable column and combinations less than the threshold as 0 in the outcome variable column. After performing the path normalization analysis, we obtain the complex solution, the compact solution, and the intermediate solution. For the antecedent variable configuration, the consistency is 0.816, which is greater than 0.8, and the coverage is 0.663, which is greater than 0.5, and the combination path explanation is high.

Table 6. Constructs of antecedent variables of risk-aversion awareness.

Combined Configurations	Path 1	Path 2	Path 3
Temperature	●	●	⊗
Weather Type	⊗		
Air Quality	●	⊗	●
Gender	•	•	•
Age	⊗	•	•
Habits	•	•	•
consistency	0.952	0.886	0.855
Raw coverage	0.361	0.454	0.423
Unique coverage	0.055	0.020	0.019
Solution consistency	0.816		
Solution coverage	0.663		

Note: ● means that the core condition exists; • means that the auxiliary condition exists; ⊗ means that the condition does not exist; and blank represents a fuzzy state, i.e., it does not affect the results.

The three paths highlight the influential factors of temperature and air quality on consumer risk-aversion awareness. Additionally, age, gender, and consumer shopping habits play significant roles in shaping risk-aversion awareness, therefore reflecting variations in risk-aversion awareness among different types of consumers in response to weather conditions. In path 1, risk-aversion awareness increases when both temperature and air quality are present while age and weather conditions are absent.

In path 2, risk-aversion awareness increases when temperature is present, but air quality is absent, which is influenced by the simultaneous presence of gender, age, and consumer shopping habits. We also find that uncomfortable temperatures lead to a lower level of risk-aversion awareness. Low temperatures tend to favor the storage of food, and consumers tend to show greater confidence in the quality of food sold in this situation and significantly lower risk aversion. In practice, it is a risk-averse mindset, i.e., "There should be plenty of fresh food that I will choose to buy" vs. "there should be plenty of non-fresh food that I will not rush to buy".

In path 3, the presence of the air quality element and the absence of the temperature element contribute to increased consumer risk-aversion awareness, along with the influence

of gender, age, and consumer shopping habits. Based on the previous findings, poorer air quality diminishes consumers' risk-aversion awareness. The impact of air quality on outdoor activities is relatively less severe compared to factors like rain or snowfall. This phenomenon primarily relates to the varying sensitivity of different consumer types toward air quality. Individuals who are highly sensitive to air quality perceive minimizing outdoor exposure during poor air quality as a successful strategy for health risk aversion, resulting in lower overall risk aversion awareness. Conversely, individuals who are less sensitive to air quality may show a weaker risk-aversion awareness.

5.3. Robustness and Heterogeneity Tests

5.3.1. Relationship between Temperature Extremes and Fresh Produce Expenditure

We have analyzed average consumer expenditure on fresh produce across different channels for both low and high temperatures. As shown in Figure 5, consumers spend much more on fresh food when the perceived temperature is low than when it is high. This shows that a risk-averse mindset exists (there should be plenty of non-fresh food that I will not rush to buy). This further confirms our analysis that Hypothesis H2a is not supported.

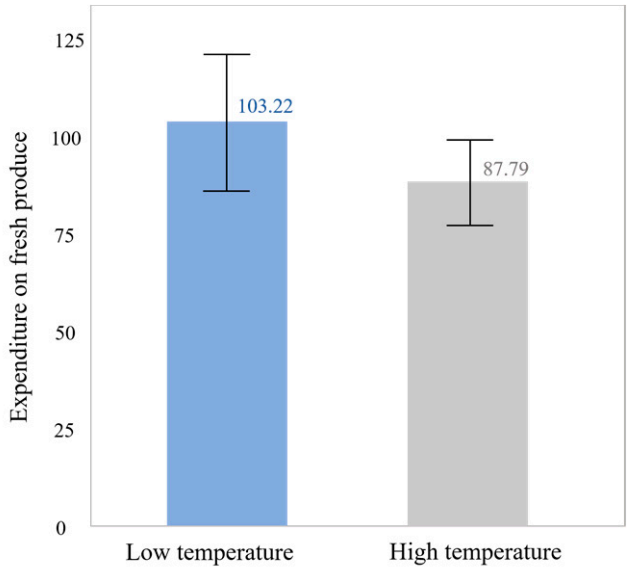

Figure 5. Bar chart of extreme temperatures and fresh produce expenditure.

5.3.2. Analysis of Heterogeneity by Gender

We compare the different purchasing behavior between men and women under different weather conditions by testing test Hypothesis H7a (Figure 6). Hypothesis H7a shows the slightly different purchase influence mechanisms under the male and female categories. Our findings indicate that risk-aversion awareness does not have a statistically significant impact on women's purchasing expenditure ($\gamma = 5.405$). Women, influenced by their role in the family, often focus on maintaining a regular supply of household goods [100]. In addition, their cautious nature enables them to make rational purchasing decisions, which minimizes the risk of waste [103]. Furthermore, the influence of air quality on the risk aversion of both consumer groups was found to be marginal ($\gamma = 0.216$, $p < 0.1$; $\gamma = 0.228$), further supporting the notion that air quality affects different populations differently. In summary, assume that H7a is valid.

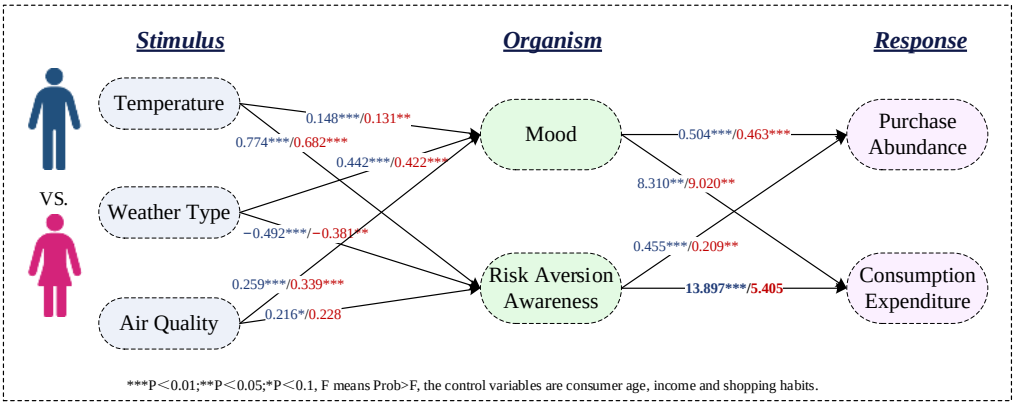

Figure 6. Analysis of heterogeneity by gender.

5.3.3. Heterogeneity of Shopping Habits across Different Customer Types

We test hypothesis H7b that the mechanism of purchase influence is slightly different for different shopping habits. [98]. We collect the frequency of purchases each consumer makes in their daily lives, categorizing them as either small (1–3 times per week) or large (4–6 times per week) purchases. By comparing these two habits (Figure 7), we find that risk-aversion awareness has less impact on customers who make a larger number of purchases. Frequent shopping ensures a steady and continuous supply, so customers are less likely to consider risk factors [115]. In addition, air quality has a lesser effect on the risk-aversion awareness of the two consumer groups ($\gamma = 0.234$, $p < 0.1$; $\gamma = 0.168$), further demonstrating that air quality does not have a consistent effect on different groups of people. In summary, assume that H7b is valid.

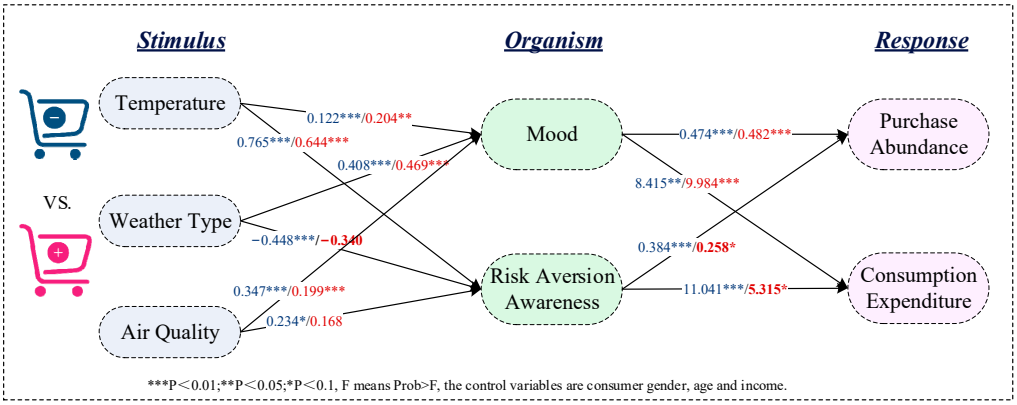

Figure 7. Analysis of the heterogeneity of shopping habits.

5.3.4. Robustness Test of fsQCA Component

Regarding the robustness test of the fsQCA component, we consulted previous studies and made a small modification to the PRI consistency threshold by increasing it by 0.05 while keeping all other conditions and parameters unchanged. We find that the adjusted parameters did not produce any significant differences in the results, which suggests that the findings presented are robust and reliable.

In summary, we have explained the empirical results through a series of robustness tests to ensure the reliability of our findings.

6. Discussion and Conclusions

Many retailers focus on weather changes to anticipate consumer shopping behavior for marketing decisions [13,75,80]. To the best of our knowledge, this study initially explores the mechanisms by which weather influences online consumer shopping behavior and states the important role of psychological organisms. We conducted scenario experiments

using actual weather data and goods sold in CRSs as the basic experimental materials. We confirmed the research framework by testing for path coefficient, direct effects, indirect effects, robustness, and heterogeneity. In addition, considering the inconsistency of the effect of weather conditions on risk aversion, we also identified three pathways affecting consumers' risk-aversion awareness using the fsQCA method in conjunction with customers' gender, age, and shopping habits.

6.1. Theoretical Implications

Our findings offer significant theoretical contributions. First, this study fills the gap that most research overlooks in exploring the factors influencing consumers' online purchase behavior. Previous studies have unequivocally established the influence of weather on consumers' offline shopping patterns [14,23,72,76]. However, our study extends this understanding by revealing that even within the confines of online shopping, where CRS consumers remain indoors, temperature, weather types, and air quality continue to exert varying degrees of influence on spending behavior. We develop a framework based on the S-O-R model and adopt specific theories to explore the mechanism of weather factors' influence on CRS consumers' online shopping behavior and to explain CRS consumers' online shopping behavior responses from an affective and cognitive perspective [116–118].

Second, our findings align with prior research emphasizing the pivotal roles of cognition and emotion in shaping consumer purchasing decisions [119], demonstrating that emotion and risk-aversion awareness serve as crucial mediators in weather-induced alterations to online shopping behavior. In previous studies, scholars have pointed out that weather affects mood and, thus, consumer behavior [44,46,59]. However, we have a new finding based on the validation of this conclusion that mood has a stronger effect on purchase abundance, while risk-aversion awareness has a stronger effect on consumer expenditure.

Third, although previous research confirms that risk affects consumer behavior [120,121], we integrate this concept into a novel framework specific to weather-related online shopping, uncovering that unfavorable weather types heighten risk-aversion awareness, ultimately stimulating increased consumer expenditure and purchase abundance. Drawing on previous scholars' ideas to quantify perceived risk, we conduct a study on three dimensions: financial, functional, and psychological safety. These dimensions include concerns about financial loss due to poor quality of goods [40], psychological safety considerations due to going out [42], and a focus on the functionality of household goods [41]. This risk-aversion awareness will lead consumers to purchase more items and increase their consumption expenditure.

Finally, our findings provide a theoretical basis for an in-depth study of the impact of weather on online shopping behavior. Echoing previous discoveries in diverse domains [97,99], we acknowledge that distinct consumer segments (gender and shopping habits) exhibit nuanced differences in their overall responsiveness. We find slight differences in the mechanisms by which weather affects shopping behavior across consumer types. For example, the positive impact of risk-aversion awareness on women's consumption expenditure is not significant compared to men's. Consumer types have a key role in the study of shopping influences [122,123], so it is necessary to further validate the moderating role of consumer types in future research.

6.2. Practical Implications

Our research findings offer significant practical implications. First, our research highlights the importance of considering weather factors, particularly temperature and weather type [124], in enhancing the online retail performance of CRSs. This study presents an opportunity for CRSs to leverage weather information to stimulate shopping activity [23]. Moreover, CRSs can effectively inform consumers about specific weather conditions through online pop-ups, displays, or audible alerts, therefore generating additional revenue.

Second, our findings highlight the importance of targeting marketing campaigns at different consumer types [125–127]. Different consumer segments exhibit varying sen-

sitivities to weather conditions, providing retailers with an opportunity to tailor their online promotions accordingly. For example, for consumers who are in the habit of making multiple purchases, retailers can promote some products online and recommend them as a priority on rainy days; otherwise, they are so insensitive to risk-aversion awareness that they will not spend more money.

Finally, our findings provide powerful support for retail managers when they face the uncertainty of online sales. Managers need to focus not only on consumers' intuitive behavioral data [124,128] but also on their psychological state [129,130]. Weather factors have a significant impact on consumers' mood and risk-aversion awareness, which in turn affects their shopping behavior. Retailers must take steps to identify consumers' emotions and risk aversion to position themselves well in the sales process.

6.3. Limitations and Future Research

We use scenario experiments to examine consumers' psych-mechanical responses under the influence of weather factors. However, future research should gather more comprehensive data by incorporating medical technology to capture a broader range of signals related to consumers' psych-mechanical changes [131–133]. Unlike previous studies, we focus on CRS and use scenario experiments to explore the impact of weather on the online shopping behavior of CRS consumers. Therefore, a more comprehensive dataset can be used in future studies to explore the impact of weather on consumers' migration behavior across different channels.

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