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# WEATHER EFFECTS ON CONSUMER VARIETY-SEEKING

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# WEATHER EFFECTS ON CONSUMER VARIETY-SEEKING

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## Abstract

*Variety-seeking, as a kind of pervasive consumer behaviour, has been studied extensively. While much of the prior research has examined the effects of individual factors on consumer variety-seeking, how external conditions, in particular weather, may influence this behaviour has not been considered. Weather profoundly affects people's daily life. Emerging studies have verified the effects of weather on the sales of department stores. This paper investigates how weather affects consumers' variety-seeking using over seven hundred thousand records of supermarket panel data. Our analyses show that bad weather (i.e., less sunlight) and higher temperature conditions both could increase variety-seeking behaviour. In addition, in these weather conditions, females and younger consumers show higher variety-seeking tendency than males, older consumers. Implications for research and practice are discussed.*

*Keywords: weather, variety-seeking, consumer heterogeneity, Mehrabian-Russell model*

# 1 INTRODUCTION

Variety-seeking, due to its prevalence in consumers' daily life, has attracted much attention from both the researchers and marketers. Consumers tend to seek variety in their daily life (Kahn 1995; McAlister & Pessemier 1982; Ratner et al. 1999), and this could be utilized strategically by retailers for commercial ends. For retailers, the variety-seeking tendency of consumers can be tapped on to increase sales by incorporating new brands or products into their offerings. For brands, they need to introduce new variety into their product or service mix from time to time to prevent their consumers from switching to other brands; they may try to poach their competitors' customers who seek variety in their purchase making.

The motivating mechanisms of consumer variety-seeking are complex, and extensive studies have been conducted to explain its drivers. Consumers' intrapersonal motives and external situations are identified as two main factors. Motives, such as novelty seeking and boredom avoiding, could cause variety-seeking directly (McGuire 1976). External situations, such as retailer store environment, price, and online reviews, could also influence variety-seeking tendency to some degrees (Menon & Kahn 1995; Chuang et al. 2008; Lin & Lin 2009; Lin & Lin 2012; Wang & Goh 2012). However, it is not always easy to exploit these factors to attain the desired commercial outcomes. For instance, it is difficult for companies to observe and control consumers' intrapersonal motives. As for the external situational factors such as store environment, although this could be manipulated, the cost of doing so could be high and may decrease the retailer's profits.

Weather conditions constitute an important external situational factor, but its potential effects on variety-seeking have not been considered. Weather conditions, such as amount of sunshine, precipitation, wind velocity, and temperature are believed to affect department store sales (Li, C et al. 2015; Murray, K et al. 2010). The rationale is that weather may affect people's moods, which in turn influences their purchase decision, word-of-mouth, and firm equity value judgement (Roll 1992; Hirshleifer & Shumway 2003; Molitor et al. 2013). Following this, it is reasonable to deduce that weather may affect consumer variety-seeking as well. Notably, weather effects on variety-seeking can be easily exploited in marketing practices. Daily weather could be observed and predicted, hence, utilizing weather conditions to increase profit bears little or no cost. Moreover, weather conditions change every day, which provides marketers with numerous opportunities to exploit it.

As previous studies suggested, external situations' influence on behaviour varies by individual differences. For example, young and old investors show different tendency of equity buying under cloudy weather (Levy & Galili 2008). Females engage in more variety-seeking behaviours in snacks purchase compared to males (Lin et al. 2011). Accordingly, our study also takes into account consumer heterogeneity, in particular gender and age, in investigating the weather effects on variety-seeking.

In this study, we employ supermarket panel data and weather data for our investigation. We obtained the supermarket panel data through collaborating with a large chain store in China, whereas the weather data was collected from an online source (refer to Section 4 for details). Based on the analysis of over seven hundred thousand data records, we show that consumers are more likely to seek variety under bad weather (when there is less sunlight) and higher temperature conditions. In addition, female

and younger consumer groups are found to engage in more variety-seeking in the above two weather conditions compared to their male and older counterparts.

Our research may contribute to the extent literature in several ways. To the best of our knowledge, this is the first study that empirically examines the weather effects on consumer variety-seeking. This is afforded by the “big data” electronically recorded in the information systems of the supermarket chain, as well as weather data available in the public domain. Our study thus serves as a demonstration of how the application of big data can afford interesting and valuable insights, which is of interest to information systems researchers. In addition, we show that different demographics of consumers vary in their variety-seeking tendency when exposed to certain weather conditions, which allows for more accurate segmentation and targeting.

## **2 CONCEPTUAL BACKGROUND**

We first review the previous literature on consumer variety-seeking to obtain a better understanding of this behavior. We then discuss the M-R model, which serves as an overarching framework to understand how weather conditions may affect consumer variety-seeking behavior.

### **2.1 Variety-seeking Behaviour**

Variety-seeking has been studied extensively in the marketing, psychology, consumer behavior and microeconomics literature (Givon 1984; Kahn 1995; McAlister & Pessemier 1982; Sajeesh & Raju 2010; Seetharaman & Che 2009; Wang & Goh 2012). Generally, variety-seeking refers to an individual’s tendency of trying out a different or wide variety of products, such as brand switching or multi-brand buying (McAlister & Pessemier 1982). In our study, we accordingly define variety-seeking as brand switching that occurs in a purchase transaction. Prior research categorizes variety-seeking as hedonic purchase behavior associated with feelings and psychosocial motivations rather than cognitive processes and functional benefits, and as examples of low-effort decision-making (Baumgartner 2002; Hoyer & Macinnis 2001).

Satiation/stimulation, external situations, and future preference uncertainty have been identified as three major factors that influence consumer variety-seeking behavior (Givon 1984; Harlam & Lodish 1995; Kahn 1995; McAlister and Pessemier 1982; Simonson 1990; Sajeesh & Raju 2010). Satiation and stimulation are related to intrapersonal motives and may cause direct variety-seeking behavior (Kahn 1995; McAlister & Pessemier 1982). For instance, individuals may seek variety to avoid boredom or to seek novelty (McGuire 1976). Further, it is suggested that there exists a relationship between variety-seeking and level of stimulation, whereby people in low stimulation level tend to engage in more exploratory and variety-seeking behavior. External situations have to do with stimuli in the environment, such as other consumers (McAlister & Pessemier 1982), price promotion (Kahn & Raju 1991; Lin & Lin 2009), and the retail environment (Menon & Kahn 1995; Chuang et al. 2008; Lin & Lin 2009; Lin & Lin 2012). Lastly, variety-seeking due to consumers’ preference uncertainty typically implies that consumers seek variety so that they will have a portfolio of options as a hedge against future uncertainty or to protect interests in their favorite options (Harlam & Lodish 1995). In this study, we focus on external situational factors in particular weather, given that it has received little

attention in the literature on consumer variety-seeking, and also due to its potential value and ease of exploitation by the retailers and marketers.

## 2.2 Mehrabian-Russell (M-R) Model

The Mehrabian-Russell (M-R) model is based on Stimulus-Organism-Response (S-O-R) paradigm, relating features of the environment (S) to approach/avoidance behaviors (R) within the environment, which are mediated by the individual's emotional states (O) aroused by the environment (Mehrabian & Russell 1974). Stimuli in the environment are such as visual cues (e.g. design of landscapes, buildings, furniture, color, lighting, other people), sounds (e.g. music, noise, etc.), smells/scents (e.g. fragrance, cooking odors), or other stimuli that appeal to a person's sense of touch or taste; Organism's (person's) emotional states of pleasure, arousal and dominance ("PAD" dimensions). Responses refers to how an individual approaches (e.g. moves towards, explores) or avoids (e.g. move away from) an environment. The model explains how environment stimuli influence individuals' emotional states, and in turn cause corresponding behaviors.

A number of studies have applied the M-R model in various consumer environments. Donovan and Rossiter (1982) conducted the first study and suggested that consumer arousal would stimulate additional time, effort and money spent, only if the store is considered to be a pleasant environment. Since then, the M-R model and its modifications have been applied widely in retail, service, leisure and tourism contexts. The contexts that have been examined include shopping (Ong and Khong, 2011; Tai and Fung, 1997, Vaccaro et al. 2011), tourist shopping behavior (Yuksel, 2007), retail marketing (Baker et al. 1992; Kaltcheva & Weitz, 2006; Vaccaro et al. 2009; Vaccaro et al. 2009), online shopping (Koo and Ju, 2010), service provision (Chebat et al. 1993; Harris & Ezeh 2008;) and restaurant management (Jang and Namkung, 2009, Chen et al 2015; Tsaur et al. 2015). The findings of these studies generally support the notion that environment stimuli affect consumers' emotions, which in turn, influence their responses.

Accordingly, we adopt the M-R model, focusing on weather as the stimuli, to investigate how daily weather may affect consumer variety-seeking behavior. The M-R model adapted to this study is shown as follows.

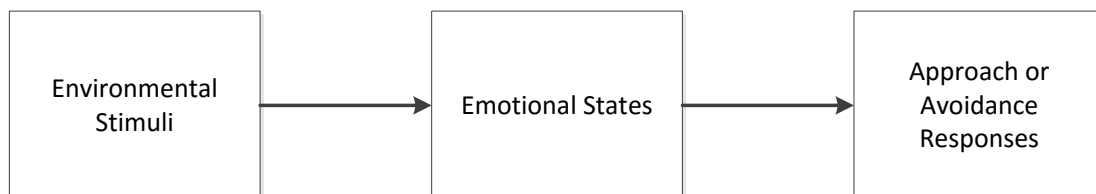


Figure 1. Adapted M-R model

## 3 HYPOTHESES DEVELOPMENT

### 3.1 Weather Effects on Variety-seeking

#### 3.1.1 *Effects of Weather on Emotion*

Weather is widely believed to influence people's mood. For example, the majority of people think they feel happier in days with a lot of sunshine as compared to dark and rainy days (Watson, 2000). Sunlight and temperature are identified as two major variables affecting emotion states (Cunningham 1979; Howarth & Hoffman 1984; Eagles 1994; Tietjen & Kripke 1994; Denissen & Butalid 2008; Simonsohn 2010; Murray & Muro 2010; Klimstra et al. 2011; Lucas & Lawless 2013).

Specifically, a low level of sunlight has been shown to be associated with negative moods (Denissen & Butalid 2008; Howarth & Hoffman 1984; Denissen & Butalid 2008; Simonsohn 2010; Murray & Muro 2010). High temperature could also lead to negative moods, such as lower anxiety and depression (Howarth & Hoffman 1984; Denissen & Butalid 2008).

Based on the previous studies, our study identified sunlight and temperature as the two important weather parameters, i.e. the Stimuli (S) in the environment of the M-R model. In line with this model and the previous studies, we may also infer that both uncomfortable weather (weather with less sunlight) and high temperature could arouse negative emotions, which constitutes the Organism (O) component.

#### 3.1.2 *Effects of Emotion on Variety-seeking*

Optimal stimulation level (OSL) is a central theory postulated to account for why people seek varieties and how emotion states influence it (Zuckerman 1979; Steenkamp & Baumgartner 1992; Chuang et al. 2008; Lin & Lin 2009; Lin & Lin 2012). OSL refers to the optimal level of stimulation an individual would like to experience in response to external stimuli (McReynolds 1971). Previous research suggests that a person may engage in exploration of the environment (e.g., variety-seeking or novelty seeking behavior) to achieve a satisfactory level when the amount of stimulation is below optimal (Menon & Kahn 1995; Steenkamp & Baumgartner 1992).

People experiencing negative emotional states (e.g., sadness, depression, tiredness) could be seen as in a low stimulation level. Relatedly, Van et al. (1996) pointed that variety-seeking can be viewed as a mild arousing activity that increases stimulation level, which is consistent with McAlister & Pessemier (1982). Thus, it is reasonable to deduce that negative emotions may promote variety-seeking behavior. Empirical studies have provided evidence indicating that people experiencing negative emotions, such as sadness, boredom, and depression, tend to engage in more variety-seeking behavior (Chuang et al. 2008; Lin & Lin 2009; Lin & Lin 2012).

The theoretical links as discussed above are consistent with the the M-R model (Figure 2), which led us to hypothesize:

**H1:** The tendency of variety-seeking is higher under weather with less sunlight.

**H2:** The tendency of variety-seeking is higher under weather with high temperature.

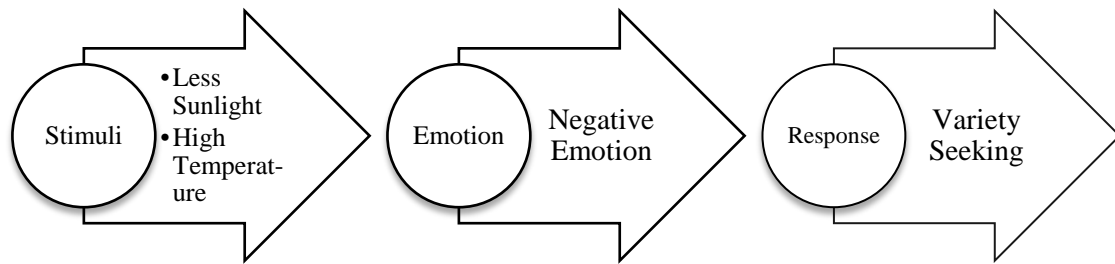


Figure 2. *M-R model of weather, emotion and variety-seeking behaviour*

### 3.2 Individual Heterogeneity

#### 3.2.1 Gender

The variety-seeking tendency of males and females could be affected differently by weather condition. On one hand, females have been shown to be more sensitive to mood effects of weather conditions (Aleksandar et al. 2006). As for mood stability, females have reported higher rates of depression than age-matched males (Piccinelli & Wilkinson 2000; Borrow & Cameron 2014). On the other hand, females enjoy shopping more than males and tend more to perform hedonic purchase behaviour; e.g., impulsive buying and variety-seeking (Rook & Hoch 1985; Xu 2007). Lin et al. (2011) suggest that females tend to buy more variety of snacks than males when exposed to health warning. Building on the findings above, we hypothesize that females are more sensitive to weather conditions in their variety-seeking behavior:

**H3:** Under bad weather condition (weather with less sunlight), the tendency of variety-seeking of female consumers is higher than that of male consumers.

**H4:** Under bad weather condition (higher temperature), the tendency of variety-seeking of female consumers is higher than that of male consumers.

#### 3.2.2 Age

As people age and their time left in life decreases, they become more focused on emotion regulation when exposed to particular environment (Carstensen 1992; Mather & Carstensen, 2005). Older adults appear to be less sensitive to negative environment and are more likely to ignore or forget negative information than younger adults (Charles et al. 2003; Isaacowitz et al. 2006; Kensinger et al. 2007; Mather et al. 2004; Mather & Carstensen 2003; Gruhn et al. 2005; Kensinger et al. 2002). In addition, older people have been shown to be more goal-directed and rational (Mather & Knight 2005). This may lead older people to have a lower variety-seeking tendency since variety-seeking is identified as feeling-based behaviour. Levy & Galili's (2008) empirical study demonstrates this point, showing that young investors are more susceptible to cloudy weather. Accordingly, we hypothesize:

**H5:** Under bad weather condition (weather with less sunlight), the tendency of variety-seeking of young consumers is higher than that of older consumers.

**H6:** Under bad weather condition (higher temperature), the tendency of variety-seeking of young consumers is higher than that of older consumers.

## 4 RESEARCH METHODOLOGY

### 4.1 Data Collection

Our data sets consist of 1) supermarket panel data provided by a national-wide chain store, and 2) weather data in a large city in China.<sup>1</sup> The supermarket panel data includes transaction records information of over 30,000 kinds of merchandise spanning from 2013.1.1-2014.12.31, and members' information including basic consumer attributes such as gender and age.

We selected transactions involving beer as the context to test our hypotheses for three reasons. First, as a mature and repeatedly purchased product, the transaction records of beer, and also related variety-seeking behaviours, are abundant. Second, consumers seek more variety in hedonic products (Van et al. 1996), and beer is a widely-accepted representative type of hedonic products (e.g. Drolet et al. 2007). Third, anecdotal evidences have suggested that weather changes can affect beer sales<sup>2</sup>, making it an ideal product type for our research.

The beer transaction records extracted from the supermarket panel data contains 2,778,917 observations of 923,964 consumers from 2013 to 2014. To obtain the consumers' attributes, we only kept the records of consumers whose members' information are accessible. In order to investigate robust consumer variety-seeking behaviour, we removed those consumers who made less than 5 beer transactions. Combining the data set with the weather variables at the daily level, we finally have 762,150 beer transaction records during 760 days of 80,619 consumers.

### 4.2 Variables Measurement

#### 4.2.1 *Dependent variable*

Following previous studies on variety-seeking of panel data (Ooi, K et al. 2012; Wang & Goh 2012), we construct the dependent variable, variety-seeking through brand switching (*VS*) modelled as a dummy variable. The variety-seeking variable (*VS*) was generated based on prior experience of the consumer. 0 is assigned if the consumer has prior experience purchasing the brand of the current transaction record; 1 indicates that the consumer had no prior experience with the brand of the transaction record. For example, if a consumer had purchased 10 units of beer of brand A and has just bought a unit of beer of brand A again, his variety-seeking is coded as 0; his variety-seeking variable is coded as 1 if he bought a unit of beer of brand B. In the dataset, there are 166 possible brands for a beer transaction coded as *brand\_id*, ranging from 1 to 166.

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<sup>1</sup> From website <http://www.weather.com.cn/>

<sup>2</sup> <https://thefesweekly.wordpress.com/2013/05/12/effect-of-weather-changes-on-beer-sales/>



#### 4.2.2 Weather variables

Following prior literature (Bassi et al. 2013; Hirshleifer & Shumway 2003), we categorize the weather conditions into good weather (with relatively more sunlight, i.e. sunny and cloudy days), and bad weather (stormy, snowy, rainy, and foggy days). Table 1 presents the frequency of the distribution of weather conditions. As shown in Table 1, the days are distributed evenly between good weather and bad weather. As can be seen in Table 1, the average number of beer transactions under the good weather condition is descriptively higher than that under the bad weather condition.

Weather Conditions	Good_weather	Total days	Average beer transactions per day per consumer
Sunny, cloudy days	1	354	Mean 29.60 (std,29.36)
Stormy, snowy, rainy, and foggy days	0	376	Mean 22.93 (std, 45.75)

Table 1. The distribution of the weather conditions.

The daily temperature ranges from -1 to 40 centigrade. The distribution of the temperature was shown in Figure 3. The number of days of different temperature is bell-shaped, while the beer transactions per consumer are descriptively slightly higher under high temperature conditions. The average value of beer transactions per consumer in the different temperature situations is 9.37 times, with a standard deviation of 4.166.

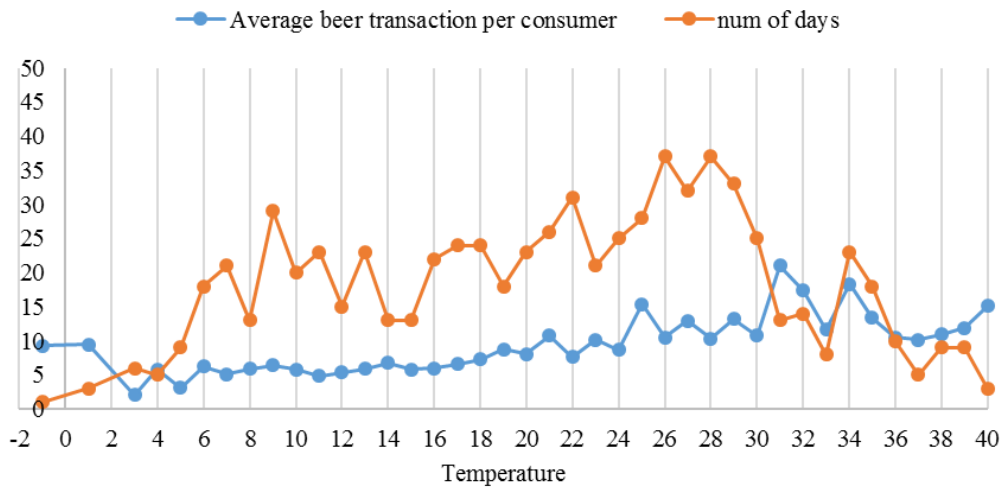


Figure 3. The distribution of the temperature and beer transactions.

#### 4.2.3 Individual attributes and interaction terms

We extracted the individual attributes, *Age* and *Gender*, from the membership information of the national-wide chain store. Among the 80,619 consumers, 48.5% are females and 51.5% are males. The

average age of the consumers is 41.68. The distribution of the average beer transactions across the two attributes are shown in Figure 4 and Table 2.

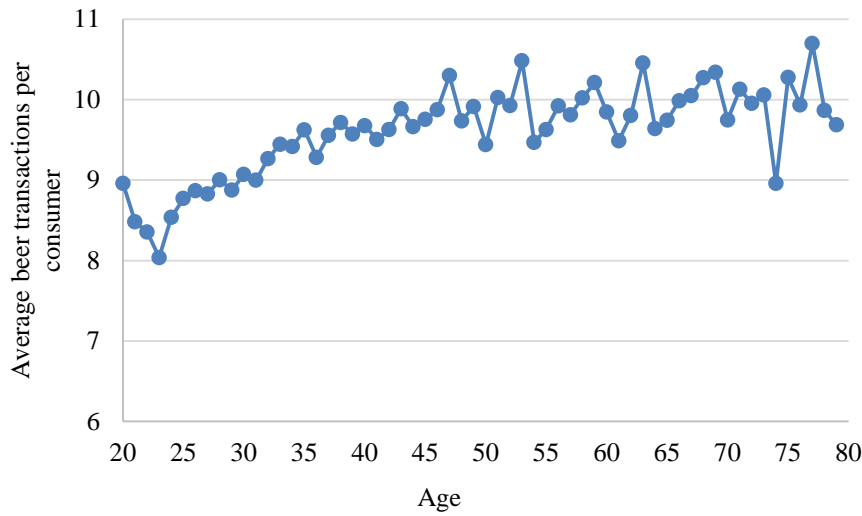


Figure 4. Distribution of beer transactions across different ages.

Gender	Variable Gender	Total consumers	Average beer transactions per day per consumer
Female	1	39123	Mean 9.09 (std, 7.10)
Male	0	41496	Mean 9.80 (std, 8.25)

Table 2. Distribution of the gender.

In addition, four interaction terms of the two attributes with *Temperature* and *Good\_weather* (*Age\*Good\_weather*, *Age\*Temperature*, *Gender\*Good\_weather*, *Gender\*Temperature*) were generated to capture the potential effects of consumer heterogeneity in response to the weather changes.

#### 4.2.4 Control variables

We control for the price effect in brand switching with the dummy *low\_price*. The variable is assigned 1 when the price of the current transaction is more than 10 percent lower than the average price of the same unit in a year.

We also control for individuals' purchasing behaviors with 3 variables. The inter-purchase time since last purchase (*Interval*) is calculated by counting the number of days between the last and the current purchase. The total brands purchased before the current transactions (*Brands\_bought*) is the proxy for the individual preference in variety-seeking. The total transactions involving beer purchase (*Beer\_trans*) is a proxy for the individual preference of beer drinking.

In addition, to control for the likely difference of weather effects between the weekday and weekend, we include the dummy *Weekend*. The descriptive statistics for all the variables are shown in Table 3.

Variable	Obs	Mean	Std. Dev.	Min	Max
VS	762150	0.33	0.47	0	1
Temperature	762150	25.08	8.33	-1	40
Good_weather	762150	0.46	0.50	0	1
Age	762150	42.29	14.15	20	79
Gender	762150	0.47	0.50	0	1
Age*Good_weather	762150	19.54	23.26	0	79
Age*Temperature	762150	513.49	681.65	0	3160
Gender*Good_weather	762150	0.21	0.41	0	1
Gender*Temperature	762150	11.64	13.70	-1	40
Low_price	762150	0.15	0.36	0	1
Interval	762150	22.83	67.94	-674	427
Beer_trans	762150	15.76	22.85	5	547
Brands_bought	762150	3.05	2.39	0	23
Weekend	762150	0.36	0.48	0	1

Table 3. Descriptive statistics of all the variables.

### 4.3 Model Development

Since the dependent variable has discrete binary values, the classical linear regression would not be suitable in analyzing the model. Instead, a panel logit model would be more appropriate (Greene 2007). The probability density of variety-seeking in terms of brand in the t-th transaction by consumer i is

$$Pr(VS_{it} = 1 | x_{it}) = \frac{e^{\alpha_i + \beta x_{it}}}{1 + e^{\alpha_i + \beta x_{it}}}$$

Where  $\alpha_i$  is a random variable to capture consumer specific effects; and  $\beta x_{it}$  is the linear function of the independent variables.

$$\beta x_{it} = \beta_1 Age_i + \beta_2 Gender_i + \beta_3 Good\_weather_i + \beta_4 Temperature_i + \beta_5 Low\_price_{it} + \beta_6 Interval_{it} \\ + \beta_7 Brands\_bought_{it} + \beta_8 Beer\_trans_i + \beta_9 Interaction\_terms_i$$

We use the random effects logit model for estimation of both models with and without interaction terms.

### 4.4 Estimation Results

The estimation results are presented in Table 4.

	Model 1	Model 2	Hypothesis
VARIABLES	VS	VS	
Temperature	0.0140***	0.0157***	H1 (supported)
Good_weather	-0.0376***	-0.0433**	H2 (supported)
Age	0.000139	-0.000109	
Gender	-0.0512***	-0.0596***	
Age*Goodweather		0.00320***	H3 (supported)
Age*Temperature		-9.82e-05***	H4 (supported)
Gender*Goodweather		-0.0483***	H5 (supported)
Gender*Temperature		0.00118*	H6 (supported)
Low_price	0.263***	0.263***	
Interval	0.000557***	0.000558***	
Brands_bought	0.0234***	0.0225***	
Beer_trans	-0.0288***	-0.0287***	
Weekend	-0.00127	-0.00286	
Constant	-0.731***	-0.770***	
Observations	762,150	762,150	
Number of consumers	80,619	80,619	
Log likelihood	-474328.32	-474287.40	

Significant at 0.01 \*\*\*, 0.05 \*\*, and 0.10 \*.

Table 4. Estimation Results

All the core variables (with respect to Hypotheses 1 to 6) have significant effects on variety-seeking. For weather effects, increase in temperature will lead to higher variety-seeking probability in beer. Compared to good weather conditions, variety-seeking in beer occurred more under bad weather conditions including stormy, snowy, rainy, and foggy days.

Regarding individual attributes, females show higher variety-seeking tendency than male in beer purchasing. The variety-seeking behaviors did not significantly differ by age. Furthermore, under bad weather conditions (less sunlight), females show higher variety-seeking tendency than males, while young consumers also show higher variety-seeking tendency than their older counterparts. Under higher temperature conditions, females and young consumers are respectively more likely to engage in variety-seeking behavior than the other groups, too. The results indicate that female consumer group and young consumer group are more sensitive to weather changes with respect to the variety-seeking behavior.

It is also notable that some control variables were significant in our results. Obviously, a cut in price is a temptation for brand switching, since the variable *Low\_price* is significantly positive. The inter-purchase time since last transaction (*Interval*) has a positive and significant effect on variety-seeking behaviors as well. In addition, the more brands a consumer has tried before

(*Brands\_bought*), the higher the variety-seeking probability is for a consumer in a new transaction, while more transactions a consumer had is counteractive.

## **5 DISCUSSION AND IMPLICATION**

While the motivation mechanisms behind consumer variety-seeking may be complex, our study suggests that it could be affected by sunlight and temperature, and varied by individual heterogeneity. The findings, afforded by the big data electronically generated, provides retailers and marketers a simple yet cost-effective measure to exploit the consumer variety-seeking behavior for profit maximization. Furthermore, they may increase the effectiveness through targeting the right consumer segments, i.e., the female and younger groups, who are more sensitive to weather changes with respect to this behavior.

Specifically, to attract customers to try out a new brand or product, our finding suggests that it may be more fruitful for retailers to focus their marketing efforts on bad weather days (when there is less sunlight and the temperature is higher). In addition, to further economize on their marketing efforts, they may target the female and younger consumer groups since these consumers are more sensitive to weather effects. Strategies targeting these particular consumer groups may save expenditure and acquire higher marketing precisions.

Our results related to control variable, though not our main focus, also point to some findings. Specifically, consumers who have tried out more brands, with less transaction records, or longer inter-purchase time may be more likely to engage in variety-seeking. These findings may be applied in both new brand promotion and customer retention. First, for promoting a new brand, retailers may segment customers based on their transaction records and target certain groups to save marketing cost and obtain more effective results. Second, to promote customer retention, a brand may identify their customers with a larger probability of switching to other brands with the help of the retailer. To prevent attrition, the brand can introduce new products to these customers.

## **6. LIMITATIONS**

A limitation of our study is that we only investigated beer purchasing. Future work may include more products to improve the generalizability of the weather effects on consumer variety-seeking. Another limitation is that we do not verify the mechanisms via which weather affects consumer mood and subsequently their variety-seeking behavior. This can be augmented with a supplementary survey in the future. Moreover, other product parameters (such as whether the brand is a national or foreign one) and weather parameters (such as wind power and smog) will be included in our further study to enhance the granularity of our understanding about the weather effects on variety-seeking. Notwithstanding these limitations, our research may serve as an important first step towards the use of big data to uncover interesting and valuable insights of values to both research and practice.

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