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The Determinants of Online Payment Method Choice: Insight from an Eye-Tracking Study

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Abstract: From the perspective of product uncertainty, the effect of product type, product price and sales on buyer's online payment method choice was explored with a 2 price levels (high vs. low) \times 2 sales levels (high vs. low) \times 2 product types (experience vs. search) within-subjects eye-tracking experiment. Thirty voluntary participants from Zhejiang University participated in the experiment. The determinants of payment method choice were examined in three levels data including observable behavior data, attention eye-tracking data, and psychometric cognitive data. Repeated measures ANOVA and logistics regression indicated that product uncertainty and price were the two main determinants of online payment method choice. Pay-after-delivery was more likely to be chosen when price or product uncertainty was high. However, sales had no significant effect on the choice. The analysis of eye-tracking data, including dwell time and duration before on AOI-price and AOI-sales, found that buyers first paid attention to and had more cognitive effort on the price than sales. This study extended the theory of product uncertainty, and provided cognitive processing of information behind online payment method choice. The results of this study can help the online sellers optimize the service of payment, finally improving the development of e-business.

Keywords: product uncertainty, price, sales, product type, payment method, eye-tracking, decision-making

1. INTRODUCTION

Lemon market is the result of information asymmetric in traditional market [1]. Information asymmetric was more serious in the online market. Because of separation both in time and in space, buyers could neither judge these products through observations face to face, nor sense the quality of the products through personal experiences. Besides, it's difficult for sellers to fully convey their credibility and products' excellent quality information in webpages. Therefore, buyers have to face much more online uncertainty, such as sellers uncertainty [2], products uncertainty [3], and the uncertainty of information safety [4]. All these hindered the development of online market.

In recent years, many scholars study buyers' online shopping behaviors from uncertainty perspective, mainly about buyers' purchase decisions, such as purchase intention. The final step of online purchase was choosing a reliable payment method to fulfill transaction. Therefore, decision on payment method is an essential process of online shopping. In our accessible resource, however, only few scholars studied payment method choice in e-business. And there is doubts that whether or not the factors of online purchase decision also affect the payment method choice.

Decision-making actually depends on the cognitive process of information in the brain. Psychometric scales are difficult to collect the data reflecting cognitive and decision-making process. Dimoka (2010) argued that the data gathered by the tools of cognitive neuroscience are more objective, accurately and can be used to predict people's behaviors [5]. Among the tools of cognitive neuroscience, eye tracking has been widely used in

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different disciplines like psychology, marketing, human-computer interaction, and IS.

The goal of this study is to find the factors influencing payment method choice in online shopping and reveal the information processing during this decision-making with eye tracker. The rest of this paper is organized as follows. Section 2 provides a summary of related literature. Section 3 introduces the parameters of eye-tracking. Section 4 proposes research framework and hypotheses. Section 5 describes methodology and measurement. Section 6 describes empirical results of three levels. Finally, section 7 concludes, discusses the study's limitations, and outlines directions for future research.

2. THEORETICAL FOUNDATION

2.1 Consequences and antecedents of product uncertainty

Product uncertainty means the difficulty of buyers in evaluating the characteristics and future performance of products [3]. Recent studies revealed that product uncertainty have an important influence on online buyers' behaviors such as price premium and repurchase intention and gained increasing attention of scholars [6]. This study also explores the determinants of online payment method choice from the perspective of product uncertainty.

According to signaling theory, conveying product quality information to the buyers can reduce the uncertainty. Dimoka (2012) and Hong (2010) have found that product uncertainty was influenced by the formats of product description, third-party product certifications and communication methods [3][6].

Price, as a typically extrinsic cue of product quality, was examined to play an important role in the process of evaluating product quality [7]. Recent studies indicated that history sales also worked as an effective cue [8]. But whether these two quality information can affect product uncertainty is still unexplored.

According to Nelson (1970), products can be categorized into experience products and search products. Experience products are the products that buyers cannot know the quality before they use them while search products are the products that buyers can know the quality before using them [9]. Prior studies revealed that the buyers' perceived uncertainty on product performance and information gathering and processing were different between experience product and search product [10][11]. So we proposed that various products may also result in different perceived product uncertainty.

2.2 Determinants of payment method choice

Unlike traditional markets, there is a separation between payment and delivery in online markets. Accordingly, online payment methods can be divided into pay-before-delivery (e.g., debit card and credit card) and pay-after-delivery (e.g., pay on delivery) [12]. The former means that buyers should pay before the product is delivered, therefore they may face both loss of money and low product quality. The pay-after-delivery means buyers can pay after they have received the product and checked the quality. This way is less risky but inconvenient because they have to prepare cash. Previous study indicated that perceived security, trust and risk in e-payment were important determinants of payment method choice [13]. Besides, Zhang and Li (2006) found that uncertainty about the quality of product have a strong influence on the payment method choice [14]. In a high uncertain context, buyers are more likely to choose a less risky payment method. Additional, payment method choice was proved to be sensitive to the price [15][16].

3. Eye-tracking

Eye tracker can record three basic parameters. Firstly, fixation is defined as looking at a target for more than 100ms. It's the main method of gaining and processing information. Secondly, saccade means the jumping eye movement between the fixation points, reflecting the trajectory of human attention. Finally, smooth pursuit

refers to the eyes movement following the target.

The eye is our major sense for acquiring information from the external environment (accounting for 80%-90%). According to eye-mind hypothesis, what an individual is looking at indicates what this individual is thinking about and/or attending to [17]. Through analyzing the trajectory of the eyes and the positions of the fixation points, we can infer the way people search information and what people are concerned about.

Area of interest (AOI) is a useful tool concentrating the eye-tracking data on what you are interested in. Two main parameters of AOI analysis are dwell time and duration before. The definition of dwell time is the summary duration including all fixations and saccades hitting the AOI. Duration before is defined as the time until AOI is found. The former can reflect individual's degree of interest and cognitive processing on the AOI [18][19]. The latter reflects the order in which the AOI get attention from the individual. It indicates that the information in the AOI may be important if the AOI is attended to quickly [18]. Therefore, the process of decision-making may be revealed by the eye-tracking parameters in different AOIs.

4. Theoretical framework

Based on the previous theoretical analysis, we propose a theoretical framework (see Figure 1). In the observational level, we can collect behavior data of payment method choice under different treatments constructed by stimuli. Information processing always begins with attention capture of information cues. To explain the causality between choice and treatment, attention level data were collected to find how individual allocate attention to extrinsic cues. Payment method choice would finally be made based on the buyer's cognitive state which may be influenced by the perceived uncertainty. So we collected perceived product uncertainty measured with psychometric scales in cognitive level. The combination of these three levels could provide a deeper understanding of the determinants of online payment method.

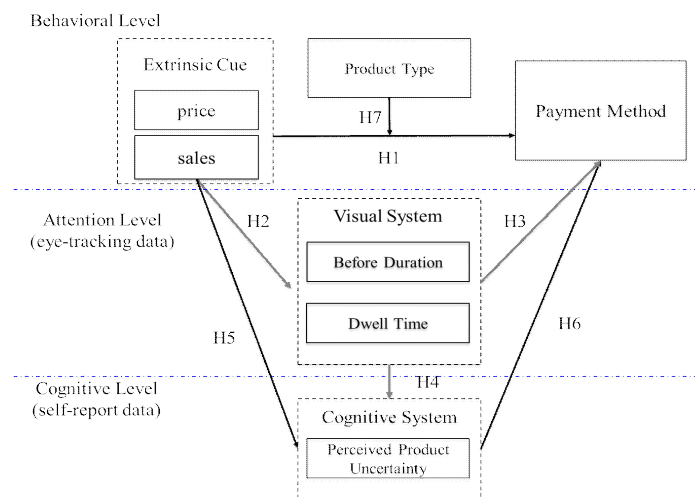


Figure 1. Theoretical framework

4.1 Behavior Level

According to theory foundation above, buyers' payment method choice is sensitive to the price and perceived risk [15]. High price makes the buyer more worried about the risk of money loss and tend to choose a suitable payment method to reduce the risk. So the first hypothesis was proposed:

H1a: Buyers are more likely to choose pay-after-delivery when price is high.

History sales are the accumulation of previous buyers' purchasing behavior. According to the observational learning theory, individual can get to learn the true quality of product by others' purchasing actions. Qiang Ye

et.al (2012) found that high history sales records improved buyer's perception of the product quality, and finally influence the intention to purchase [8]. Therefore, we proposed the second hypothesis:

H1b: Buyers are more likely to choose pay-before-delivery when sales is high.

4.2 Attention Level

Attention was perceived as a coordination mechanism for cognitive and behavioral processes [20]. Previous studies have found that different attention distributions were paid to different elements according to their attractiveness, design, size, and relationship with the task [21][22]. Individual may assign different value to the information cues of price and sales in decision-making. Therefore, we proposed:

H2: There is significant difference between price and sales in attention distribution and cognitive effort.

As mentioned above, attention can leading to the final action like choice or decision. More attention on price indicates that buyer regard the price as more important, meaning more worried about the risk of money loss. Therefore, we proposed the hypothesis:

H3: Pay-after-delivery is more likely to be chosen when dwell time on price is long.

Based on the literatures above, we believe that in the case of high uncertainty, buyers' cognitive load will increase and the time of cognitive processing will become longer. So we proposed that:

H4: Dwell time on price and sales is positively associated with product uncertainty.

4.3 Cognitive Level

As a typical extrinsic cue, price is the major factor that buyers concern in shopping. A number of studies found that buyers usually perceived product quality based on price. The product with a higher price should be more likely to have a higher quality [23]. It's rational to link low price with low product quality, and poor performance in the future. Accordingly, we proposed:

H5a: Price is negatively associated with perceived product uncertainty.

As discussed above, high sales can improve buyer's perception of product quality and a high sales means that the product attracted more buyers. In turn, it improves later buyers' confidence in product quality. Such confidence can mitigate perceived product uncertainty. Therefore, we proposed:

H5b: Sales is negative associated with perceived product uncertainty.

Payment method choice was found to be influenced by product attribute and transaction context [14]. Sometimes, it's impossible to accurately evaluate the quality of the products or predict whether or not the products will perform as well as expected. In such a high product uncertainty case, buyers intend to choose pay-after-delivery to avoid the risk of low quality and money loss. Therefore:

H6: Pay-after-delivery is more like to be chosen when perceived product uncertainty is high.

4.4 Moderation effect

It may differ in assessing the internal attributes of experience product and search product [9]. Klein (1998) believed that it's more difficult and costly to collect enough information to evaluate experience products than search products [24]. Moreover, it's impossible to describe the characteristics of experience product perfectly over the Internet interface [3]. The lack of information can lead to a higher perceived product uncertainty. Therefore:

H7a: Experience products have a higher product uncertainty than search product.

Product type can reflect the nature of products and create different perceived uncertainty on buyers. So the effect of price and sales on payment method choice can be different to some extent among various products. Therefore, we propose the following hypothesis:

H7b: Product type can moderate the role of price and sales in payment method choice.

Similarly, attention to price and sales can also be different between experience product and search product. In high uncertainty environment, more attention will be paid. So we proposed:

H7c: Dwell time on price and sales is longer for experience product than that for search product.

5. RESEARCH METHODOLOGY

We conducted a 2 price levels (high vs. low) \times 2 sales levels (high vs. low) \times 2 product types (experience vs. search) within-subjects laboratory experiment using eye tracker (SMI Hi-Speed 500i) to test the hypotheses. Participants were instructed to browse the shopping websites and evaluate the product quality. The task was to decide which online payment method used to pay for the product.

5.1 Measurement

Online payment method choice was a binary variable. Pay-before-delivery was coded as 0, and pay-after-delivery as 1. Debit card, credit card and pay on delivery were initially set in the experiment. However, only few participants choose credit card (9.7%) during experiment. Therefore, we regroup the payment methods into pay-before-delivery (credit card and debit card) and pay-after-delivery (pay on delivery) according to the time of payment.

Adapted from Dimoka (2012), perceived product uncertainty was measured by three items on standard 7-point Likert-type scales, anchored at “1=strongly disagree”, “4=neutral”, “7=strongly agree”.

Price, sales and product types were operationalized as binary variables. Low price and low sale were both coded as 0. Search products were coded as 0, and experience products 1.

The parameters of dwell time and duration before were recorded in the experiment. The measurement unit is millisecond.

The control variables included trustworthiness of online retailer and online shopping experience. Trustworthiness may affect the adjustment of product quality. It was measured by items adapted from prior studies [25], anchored at “1=strongly disagree”, “4=neutral”, “7=strongly agree”. Online shopping experience may influence perceived product uncertainty. It was measured in number of online shopping in the past one year.

5.2 Experimental material

The stimulus material was a simplified Amazon web page. The information cues included product image, product name without brand, price, sales within one month, text description about the product and three payment methods. As a high reputation B2C platform, Amazon.cn was selected as experiment context to control seller uncertainty. According to pretest, necklace and mobile Hare Driver Device (HDD) were chosen as experience product and search product respectively. With balance consider of affordable price range of potential college participants, the amount of high price (RMB 800) and low price (RMB 200) were adjusted based on the real product prices on the Amazon. To control the effect of numbers on the participants, prices of these two products were the same. According to Kim (2006), “claim + data + backing” argument was the most effective form of trust-assuring argument [26]. This type of argument was extracted for each product from a great deal of arguments posted in Amazon.cn and text length of each product description was similar. Three payment methods mentioned above were listed on the webpage.

5.3 Experimental procedures

Before the experiment begins, participants read an instruction firstly to make clear what the task is for them. Then they reported the demographic information and shopping experience in a pre-questionnaire. For eye tracking experiment, eye calibration was the first step to ensure a correct eye movement tracing. After that, eight web pages were presented randomly.

One trial began with a random webpage. Participants were instructed to read all the related information carefully before reporting one payment method that they would like to choose to pay for the product. The experimenter recorded the answer and pressed the button. A questionnaire page would be presented to measure perceived product uncertainty. Participants reported the score of each item, and the experimenter recorded it. Next trial was followed after the experimenter presses the button when the questionnaire was completed. In

totally, there were eight trials.

After the eye-tracking experiment, participants reported their trustworthiness of Amazon.cn in a post-questionnaire. Participants received RMB 20 for completing the whole half an hour experiment.

5.4 Participants

Thirty participants without high myopia, astigmatism, achromatopsia disease were recruited from Zhejiang University. Three participants were excluded in the following analysis because of incompleteness eye-tracking data. The data of remaining participants (14 men and 13 women, mean age, 20.96 ± 1.99 , 17.7 ± 11.37 time of online shopping experience during the past year) were used to test the hypotheses.

6. DATA ANALYSIS AND RESULTS

6.1 Effect of extrinsic cue in online payment method choice

As Table 1 indicated, the number of participants choosing pay-after-delivery increased when price was high. This relationship kept constant between product types. At the same time, experience product (4.349 ± 1.016) was perceived higher uncertainty than search product (3.759 ± 0.914).

Table 1. Descriptive statistics for product uncertainty and online payment method choice

Product types	Price	Sales	Online payment method choice				Product uncertainty
			Pay-before-delivery		Pay-after-delivery		
Search product	Low	Low	20	74%	7	26%	3.840
		High	21	78%	6	22%	3.790
	High	Low	16	59%	11	41%	3.716
		High	16	59%	11	41%	3.691
Experience product	Low	Low	13	48%	14	52%	4.395
		High	18	67%	9	33%	4.049
	High	Low	9	33%	18	67%	4.494
		High	8	30%	19	70%	4.457

Within-subject repeated measures ANOVAs for two factors (price, sales) on payment method choice were conducted for search-product trials and experience-product trial respectively. For search product, the results exhibited marginal significant main effect of price ($F=3.250$, $p=0.083$), indicating that pay-after-delivery payment method was more chosen for high-price product than low-price one. For experience product, both the main effect of price ($F=8.300$, $p=0.008$) and the interaction effect of price and sales ($F=7.429$, $p=0.011$) were significant, supporting H1a. Further simple effect analysis indicated that sales' main effect was significant only for low-price product ($F=5.91$, $p=0.022$). Pay-before-delivery was more likely to be chosen when sale was high. H1b was partially supported. Compared with search product, the effect of price on payment method choice, in the case of experience product, was more significant, supporting H7b.

6.2 Attention processing of product-related cues

Price and sales were set as the AOIs. The data of AOI dwell time and AOI duration before were extracted from the eye tracker. As Table 2 indicated, for all products, the duration before on price was shorter than that on sales. Except low-price and low-sales experience product, dwell time on price was longer than that on sales.

Table 2. Dwell time and duration before of AOI price and sales (ms)

Eye-tracking data		Duration before		Dwell time	
		Price	Sales	Price	Sales
Search product	Low price & low sales	712.933	1698.144	1421.43	962.589
	Low price & high sales	785.737	2982.985	1346.3	751.093
	High price & low sales	772.385	1048.144	1111.826	839.515
	High price & high sales	560.637	2404.778	1550.356	1323.907
	Mean	707.9231	2033.5128	1357.478	969.2758
Experience product	Low price & low sales	620.1222	1429.104	1323.907	1700.874
	Low price & high sales	555.9222	1411.048	1578.448	1405.133
	High price & low sales	765.837	1035.637	1418.174	1371.556
	High price & high sales	572.5259	1410.893	1494.196	741.2519
	Mean	628.6018	1321.6705	1453.6813	1304.7037

The duration before of price was significantly shorter than that of sales ($t=-5.504$, $p<0.0005$), indicating that buyers pay attention to the price earlier than sales. The dwell time on the AOI of Price was significantly longer than that of sales ($t=-3.296$, $p=0.003$), showing that price cue gained a deeper processing than sales cue. All above supported H2.

Dwell time on sales for experience was significantly longer than that for search product ($t=-2.409$, $p=0.017$). But there was no significant difference in dwell time on price between experience product and search product ($t=-0.777$, $p=0.438$). H7c was partially supported.

Conducting correlation analysis between product uncertainty and dwell time on price and sales, we found that both the relation were not significant (pearson=0.048, $p=0.486$; pearson=-0.011, $p=0.875$ respectively), not supporting H4.

6.3 Antecedents of product uncertainty

Repeated measures ANOVES for 3 factors (product type, price, sales) on product uncertainty were conducted. A significant main effect of product type indicated that experience product was perceived higher uncertainty than search product ($F=9.822$, $p=0.004$). H7a was supported. Neither price nor sales had significant effect on the product uncertainty, not supporting H5a and H5b. But the interaction effect between product type and price was significant ($F=4.746$, $p=0.039$). Further simple effect analysis indicated that, for experience product, the impact price on product uncertainty was positively marginal significant ($F=2.97$, $p=0.095$).

6.4 Factors of online payment method choice

Logistic regression was conducted for experience product and search product respectively. For search product, both product uncertainty ($\beta=0.979$, $p=0.002$) and price ($\beta=1.161$, $p=0.021$) had a significant positive effect on the choice, supporting H6. However, sales had no significant effect on payment method. The variable of dwell time on price was put into the model at first, but the result showed the β as 0 and not significant. H3 was not supported. So we did not list it in Table3. The two control variables, trustworthiness and online shopping experience had a significant negative effect on the choice. For experience product, both product uncertainty ($\beta=0.59$, $p=0.009$) and price ($\beta=1.086$, $p=0.013$) have a positive effect on the choice, also supporting H6. Online shopping experience had a significant negative effect on the choice. The result of logistic regression was showed in Table 3.

Table 3. Result of logistic regression(online payment method choice)

Dependent variable: online payment method choice			
	Variables	Search product	Experience product
		β	β
Independent variables	Product uncertainty	0.979**	0.59**
	Price	1.161*	1.086*
	Sales	-0.054	-0.241
Control variables	Trustworthiness	-0.752*	-0.123
	Experience	-0.102***	-0.046*
	constant	0.431	-1.274

+(p<0.1); *(p<0.05); **(p<0.01); ***(p<0.001)

7. DISCUSSION

7.1 Key findings

Some findings were found in this study. Pay-after-delivery was more likely to be chosen to avoid potential risks when price was high. Further, the moderated effect of product type on such price effect was significant. For experience product, such effect was greater. However, there's no significant difference on payment method choice between high sales and low sales.

In behavior level, the effects of price on payment method were significant for both product types. And in attention level, we found that buyers paid attention to earlier and had more cognitive effort on the price than sales. The results of less cognitive effort on sales can explain why sales was not the factor affecting choice in the behavior level.

In cognitive level, price and sales are not the antecedents of product uncertainty. Although price and sales are related to perceived product quality, but they may not reflect the real quality. Maybe that's why price and sale had no significant effect on perceived product uncertainty. Product uncertainty was demonstrated to be the determinant of payment method choice.

7.2 Contribution and implication

This study explored the determinants of online payment method with an eye-tracking experiment. An innovation research framework was developed to explain the observation in behavior level with attention data and cognitive data. The moderation effect of product type on payment method choice was revealed in attention and cognitive level. The study also extended the literature of product uncertainty by investigating its effect on online payment method choice.

For sellers, pay-before-delivery is beneficial because it can shorten the account receivable period and improve the utilization of the fund. So the implication of this study for achieving this practice is that seller should not only control uncertainty-related factors to reduce product uncertainty, but also should set a reasonable price for the product.

7.3 Limitation and suggestions for future research

Based on the theoretical framework and some related literature, the eye-tracking data in attention level should have both influenced product uncertainty in cognitive level, and payment method choice in behavior level. However, it was not supported by the result. Learning effect may be serious in this within-subjects eye-tracking experiment even the webpages were randomly presented. Another factor may be the buyers' product familiarity. So for the future research, experiment should be optimized with between-subjects design and control product familiarity as well. Besides, there're much more extrinsic cues available on webpage except price, sales, and text description. How individual pay attention to and perceive of all the available extrinsic cues?

What's the relative effect of extrinsic cues on decision-making? All deserve to be explored.

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