The Role of Endowment Effect in Transaction: Case Study of Apple Store

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ABSTRACT
This article examines the how Apple Store employs the endowment effect to enhance their profits. While touching is proved to be able to enhance people's psychological ownership and further contributes to higher evaluations, We hypothesized that endowment effect could be either activated or enhanced after touching. We simulated our hypotheses based on the WTP-WTA model, and compared the simulated results with real Apple retail store data. The activation theory was more prominent compared to the enhancement theory. Further research into the applications is warranted through improve model assumptions in order to guide better retail store design changes.

Keywords: *Endowment effect, Apple Store, Design changes.*

1. INTRODUCTION

In the analysis of consumers' behaviors and preferences over products, the impacts of psychological factors on consumers' decisions have been widely observed in various markets, among which the valuation of products is one of the keys for trading. Considering the dynamic exchanges between buyers and sellers in the markets, the valuation of the same product given by buyers and sellers would have been the same according to the basic economic assumptions. Extensive empirical evidence, however, has demonstrated the significant disparity between people's willingness to acquire compensation (WTA) and the willingness to pay (WTP) for the same good[1], in which the WTA/ WTP ratio is much higher than expectations[2]. This phenomenon was further interpreted as the demonstration of the endowment effect, which was first defined by Richard Thaler as the tendency of people to underweight the opportunity costs of foregone gains and to overweight the "out-of-pocket costs" [3]. Understanding from the trading perspective, it also refers to "the tendency for people who own a good to value it more than people who do not" [4].

Many theoretical explanations for the endowment effect have been discussed. Kahneman had presented the idea that people have a loss-averse nature, and as framed the goods with the status quo, the action of selling would elicit the feeling of loss, which triggers greater psychological impact than the gains with the same value [5]. Consequently, people give a higher valuation on the goods they lose than what they potentially gain. This loss aversion diagram is supported by biological evidence, as greater activation of the mesial prefrontal cortex (MPFC), which has an association with the predicted monetary gain[6], is observed in buying rather than selling in response to low price[7]. Another explanation is through the mere ownership effect, which proves that people with ownership of the good tend to give a higher valuation than those who do not own it[8]. Such effect is illustrated by two possibilities[9]. The first possibility proposed is that an association has been established between the owners and the products they own. And since the connection is built between the self and the product through ownership, people's tendency to have positive self-evaluation will contribute to the tendency of having a positive evaluation of the good they own[10]. The second possibility is realized through the self-referential memory effect (SRE), which means the information of goods they own is easier to acquire. In that most goods have more positive traits than negative ones, people will place a higher positive value on possessed goods[11].

With the development of theories, companies and retailers started using those psychological factors in their marketing strategies to boost sales and enhance revenue. With the highest sales per square foot in the US retail

Y. Jiang et al. (Eds.): ICEDBC 2022, AEBMR 225, pp. 995–1002, 2022.
https://doi.org/10.2991/978-94-6463-036-7_146

market[12], Apple Store's special design is one of the key factors for Apple's success and has become the template for many retailers[13]. Several features are prominent in Apple Store to employ the endowment effect. First, based on Apple's own marketing report, the company designs its retail stores to offer interactive experiences for customers with all products displayed openly and touchable, and then invites all potential customers to experience their products offline[14]. Moreover, their employees are trained to strengthen the endowment effect: the employees who opened the store would tilt all the screens to the exact same angle in order to attract more potential experiences[15]; the sellers are trained not to expel or press their customers thus offering an unlimited time of staying for customers. Thus, potential customers are provided with enough time to fully use iPads, iPhones, and earphones exhibited.

One route by which Apple increases revenue through the endowment effect is realized by touching to trigger the mere ownership effect. As the previous experiment has shown that touching will contribute to more feeling of ownership, even with merely imaginary touching when real touching is unavailable. More than just the difference in psychological feeling, compared with those who did not touch the objects, buyers who touched the objects also offered higher monetary valuations to the same products[16]. Journal of Consumer Research also shows that compared to those who were required to not touch products, those who actually touched products demonstrated more willingness to pay. In Apple Store, the design of the field for using products freely and openly increases consumers' user experience and touching with Apple products. Supported by Kogut's experiments, even different from physical possession of objects, just the enhanced psychological feeling of ownership achieved by touching will lead to a higher likeliness of buying[17]. Also, the principle of keeping customers experiencing as long as they want further increases customers' willingness to buy. One study shows that longer ownership would contribute to a higher valuation for a product, even this product has already been physically lost[18]. Thus, by keeping customers staying longer, Apple could enhance customers' evaluation of their products, and thus increase the possibility of successful trades.

Therefore, with Apple's openly displaying style of products, we believe that Apple's special retail store desgins are consistent with the trigger mechanism of consumers' evaluation of goods in our study. Here, we take Apple's offline retail situation as our important research object.

2. METHOD

Now we turn to explain the method that we used to value the WTP and WTA for the transaction between the visitors, customers, and Apple Store. In consideration of the explanation relying on the experiments about the transaction of pens and mugs raised by Pedro Bordalo, Nicola Gennaioli, and Andrei Shleifer[19], we consider a similar case for the Apple Store case. They defined "salience" as the criteria of the endowment effect valuation and hypothesized that rationality and sanity would probably descend when salience happens. For example, when $\delta = 1$ (refer to formula (1)), the decision-maker is a standard rational decision-maker. Attribute to the amplifier phenomenon that exists when people are making the decision, people might boost the perception of the advantages and disadvantages of the merchandise if they own them or not[19]. The formula came out based on the market price and the average quality of goods since their double attributes shown on the different ownerships. The decision makers' selling price is shown like this:

$$\mathrm{WTA} = \alpha P_M + (1-\alpha)q \cdot \frac{1}{\delta} \quad (1)$$

where the α is the probability of consuming and δ represents the level of the influence of the endowment effect. Both terms belong to (0,1]. P_M is the market price and q is the quality of mugs, which for us is the quality of merchandise.

On the other hand, for consumers, the representation of their willingness to pay is as follows:

$$\mathrm{WTP} = (\alpha P_M + (1-\alpha)q) \cdot \frac{1}{\alpha + \frac{1-\alpha}{\delta}} \quad (2)$$

These two formulas both contain two separate parts which based on accepting the market price to purchase and rejecting to buy the merchandises. When the transaction is established, merchants are willing to trade at the market price, which is P_M; when the transaction is not established, the second part of the formula represents merchants' subjective evaluation of their product quality. For formula 1, when the transaction is unacceptable, we used $\frac{1}{\delta}$ to represent the unlimited price so it simulates that the transaction could not happen. In Formula 2, when consumers cannot accept the transaction, which suggests that they think the quality of the goods does not meet their expectations, α is set to 0 and the subjective tendency acting on consumers is δ. At the same time, the value of WTP is influenced by consumers' perception of the opportunity to benefit from reselling the product, such as consumers' tendency to search prices on other trading platforms after purchasing the product to determine whether they are getting a bargain. Therefore, for WTP, the weight of subjective effect is an uncertain value with transaction possibility.

In the Apple Store case, the subject that applies to willing to accept is the Apple Store. And considering the market share and the large market size of Apple, we assume the seller to be a rational trader based on its institutional property. Thus, the endowment effect does

not impact it and its willingness to accept is equal to the market price.

$$WTA = P_M \tag{3}$$

As for the consumers, we come up with two assumptions based on the design change in the Apple retail store. We have analyzed that Apple employs a variety of ways to provide the customers with the feeling of psychological ownership so that they have an illusion that they own those products and tend to overvalue the products. The question is whether the design change is a thread to activate the endowment effect or just strengthen the endowment effect. We have two hypotheses:

Hypothesis 1: transaction behavior or dating has a trigger effect on consumers, which changes them from being rational to the irrational who has a more subjective evaluation of commodities, which is influenced by the endowment effect.

Hypothesis 2: Consumers are inherently irrational, and they will use their existing cognition to make subjective judgments on goods. When an offer is made, their increased knowledge of the target product leads to an increase in irrational subjective judgment

To figure out the design change act in which way, we structure two different methods to assess the willingness to pay. For the activation assumption, we define a new variable ε as the probability of the activation of the endowment effect, which belongs to (0,1] (a larger number indicates a higher level of activation). If the design change activates on someone, we hypothesize that the one would obey the law of WTP we mentioned before; if not, this individual would be considered as a rational person, and only market price when he or she purchases the merchandise multiplies α can be added into the WTP. For the strength situation, we use △ to express the increment of the endowment effect, and this term is added on the δ. Two expressions show below:

$$WTP = \varepsilon \cdot [(\alpha P_M + (1-\alpha)q) \cdot \frac{1}{\alpha + \frac{1-\alpha}{\delta}}] + (1 - \varepsilon)\, \alpha P_M \tag{4}$$

$$WTP = \varepsilon \cdot [(\alpha P_M + (1-\alpha)q) \cdot \frac{1}{\alpha + \frac{1-\alpha}{\delta + \Delta}}] + (1 - \varepsilon)(\alpha P_M + (1-\alpha)q) \cdot \frac{1}{\alpha + \frac{1-\alpha}{\delta}} \tag{5}$$

We use different WTP formulas to simulate the transactions in reality. After the simulation, we compare our simulated results with the real revenue data from Apple's annual report. If the assumption makes sense, we will manipulate the value △ to try to find out the design change makes difference to what extent.

3. DATA

To find out the connection between the different types of designs in Apple retail stores and several elements that we assumed to be correlated, we used the Wayback machine searching method to get the Web information of apple during the period from 1996 to 2022. In accordance with the 'master list' we found on the website called ifoApplestore which collected the information of every retail apple store. The master list included the stores' names, types, locations, opening dates, and other details of those retail stores.

As we discovered, in Columbia and Providence Place, two indoor retail stores were first constructed with version 2.0 design with one narrow table. After a few weeks, Apple decided to have a little modification to the decorations thus they chose another two stores, in Topanga and Twenty-Ninth Street respectively, to set three bars. Similarly, a different style of version 2.0 was the combination of a single table row and only GB without POS. We, therefor, can generalize that the main style of version 2.0 design for the Apple store was through the usage of a long single table as the show stand. In consideration of these reasons, we marked 2009 as one remarkable design-changing time. Five years later, in Tokyo, Japan, an existing building was demolished, while the first brand new Japan store was built in 7 years with the BJC version 3.0 design, for which added a touchable space to the table and extended for a larger available space. Therefore, we mark 2014 as another design-changing time.

We collected the information on annual retail financial results from Apple inc., including the revenue and profits-loss ratio in both all segments and retail segment, store visitors, store opened during year, CPU units sold in retailing, and capital expenditure in retailing. Among those seven elements, we did a correlation analysis to find out their correlations with our marked design changing times. The results is shown in Table 1.

Based on the results of the correlation analysis, especially the Pearson value, we considered that three elements could be the most relevant and prominent: revenue retail, store visitors, and CPU units sold in retail, with 0.684**,0.718**, and 0.804** of Pearson value respectively.

Table 1. Results of Correlation Analysis.

		Design Change	Total Revenue	Profit Loss	Revenue_retail	Profit Loss_retail	Store visitor	Open_days_year	CPU_units_sold	Capital_expenditure	Retail_manufacture
Design changes	Pearson	1	.574*	.584*	.684**	.635*	.718**	.491	.804**	.695*	.870
	P-value	0	.040	.028	.007	.020	.009	.075	.002	.012	.328
	N	14	13	14	14	13	12	14	12	12	3

4. EXPERIMENT

Before we introduced our simulation method, some assumptions were needed to be informed in advance. First of all, we assumed that every visitor would only have one transaction and every transaction had the same turnover. Based on this assumption, the random variables were only used to simulate whether trade happens or not. Second, we used separate information for each year to simulate the revenue of Apple store, of which the maximum would be limited by the number of visitors each year. We first estimated potential revenue per person through the average revenue retail per CPU. The total revenue of Apple store per year was then calculated by multiplying the potential revenue per person by number of visitors who finally make the deal per year, which was simulated through the random varibles. After that, we repeated the above simulation for 50 times. The summary and 95% confidence interval of repeated simulation would be utilized to calculate the final similarity of simulations. Third, we assumed that every consumer had no bias over products so that the random variables of buying motive are normally distributed around 50%.

Beginning with the nearest neighbor rule put forward by T. M. Cover and P. E. Hart[20], large data samples could be classified by features in the nearest neighbor. To minimize some disadvantages such as easily fooled by irrelevant attributes and memory limitation, Ball tree was devised by Ting Liu, Andrew W. Moore, and Alexander Gray to solve the problems of efficient high-dimension statistics[21]. Base on a dataset, they structure a root node and separate four grandchildren after separating two children classifications as the internal tree structure.

After getting a series of simulated value of annual revenue from 2001 to 2012, we put them into a matrix and transpose the matrix. Thus, twelve values were seemed as eigenvalue of each simulation and evert transposed matrix was a twelve-dimensional point. Regarding the actual value as the origin point, we valued the distance between the origin point and simulated point. Based on the original algorithm, this distance is used to classify which cluster the O point is more like with, and which category the classifier is more inclined to place it in. For our experiment, we processed reversely by looking at the similarities between the simulated set of points and the O point and thus to confirm the mimetic experiment's authenticity. The similarities were quantified based on the variation of the Euclidean distance. Because each the Euclidean distance is lower than 1, we measured the similarity by 1 /(distance (x1, x2……xn) + 1), for which 1 is considered as completely similar.

5. RESULT

The simulation experiment results for hypothesis 1 show that the similarity of the 50 simulations is around 75%, and the variation is very subtle (refer to Figure 1). The average value is 0.74988, while the variance is 0.0072. The simulations were stable and close to real situations.

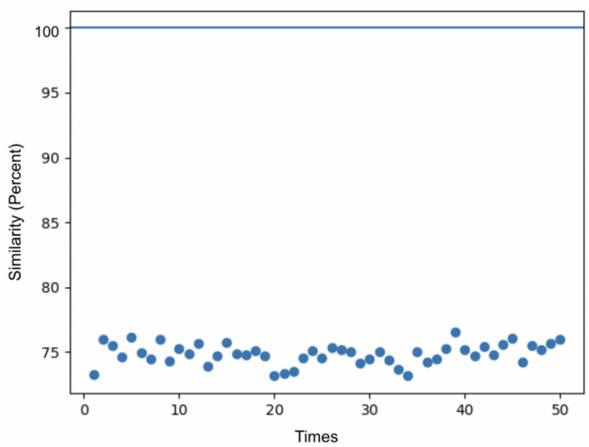

Figure 1. Similarities for trigger simulations

The simulated experiment for hypothesis 2 was divided into many cases based on various enhancement values. Here we simualted for six cases. From experiments, we can find that the best case of enhancement value is around 5%, but even then, the

simulated similarity can only reach 70%-72%. This also proves that our hypothesis number one is more realistic. Moreover, the confidence interval for the simulation results of hypothesis 2 is very unstable, and the fluctuation can even exceed 50%. This also proves from another perspective that customers are not irrational before they make a transaction. In other words, the phenomenon of consumers' irrationality caused by their different evaluations of different products occurs when they start to make a transaction or when they are preparing to make a transaction, which is exactly the time when the endowment effect appears. The results are displayed in Table 2.

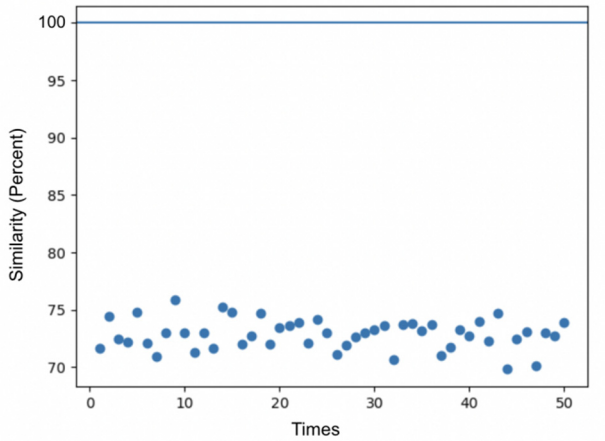

Figure 2. Similarities for strengthen = 0%

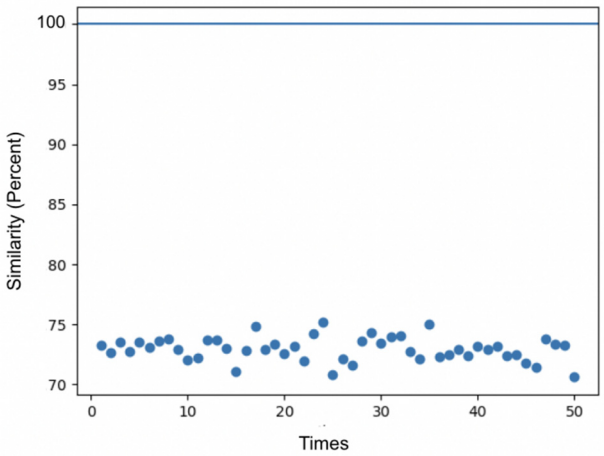

Figure 3. Similarities for strengthen = 5%

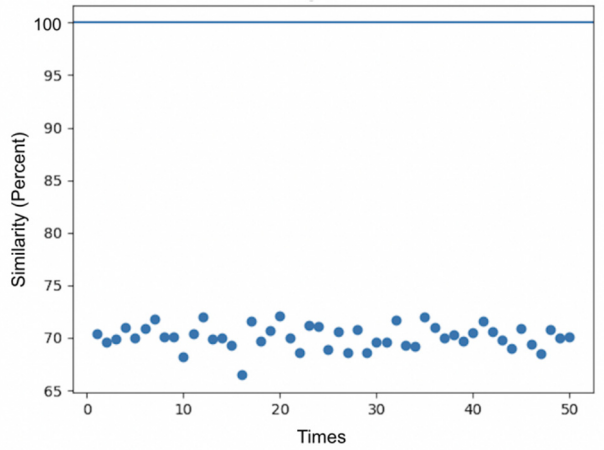

Figure 4. Similarities for strengthen = 10%

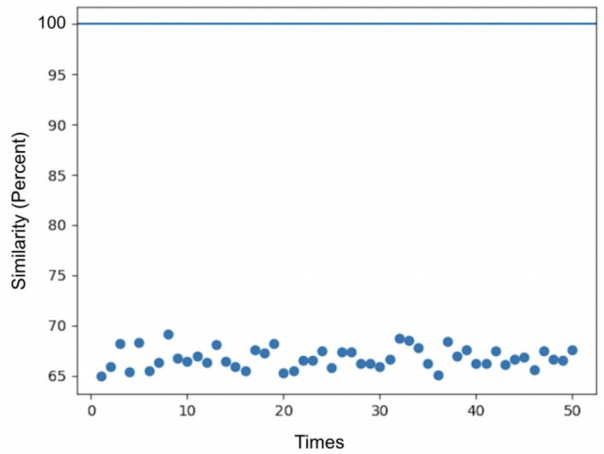

Figure 5. Similarities for strengthen = 20%

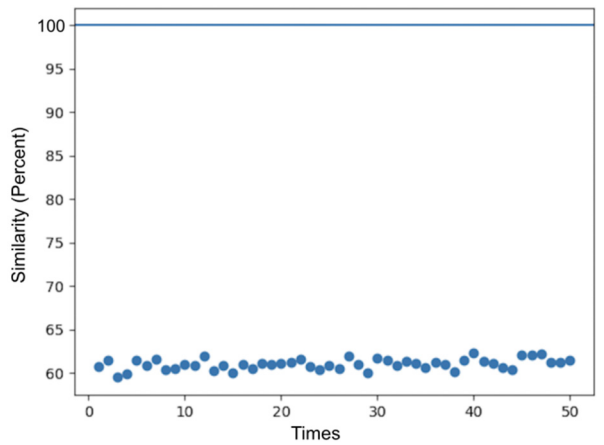

Figure 6. Similarities for strengthen = 35%

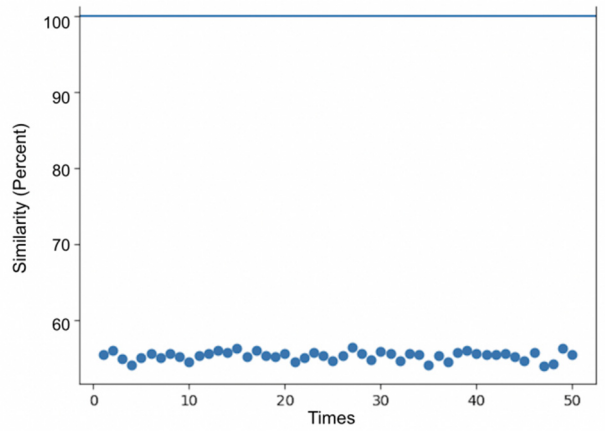

Figure 7. Similarities for strengthen = 50%

Table 2. Similarity of Two Assumptions

Variable	Mean	Std.Dev.	Min	Max	conf. interval	
trigger	0.749882	0.007237	0.73065	0.767502	-	-
0%	0.728736	0.01312	0.698142	0.758682	-0.14947	0.188494
5%	0.729712	0.009884	0.706114	0.751948	-0.3769	0.116569
10%	0.70123	0.01118	0.664625	0.720499	-0.1374	0.277262
20%	0.667594	0.010316	0.649143	0.691282	-0.19179	0.232092
35%	0.610261	0.006233	0.59487	0.622954	-0.22981	0.471216
50%	0.552968	0.005912	0.538787	0.56358	-0.6901	0.053716

6. CONCLUSION

Based on our simulation, the design changes to increase touching and interactions with consumers are relevant to the sales promotion, which is manifested in the increases in the transactions. And compared to the increment theory, the theory that those designs work as activation of the endowment effect, turning people from rationals to irrationals, has more similarity with the real-world data. This indicates that only if consumers consider those products, the endowment effect would be activated. It might be due to that fact that only when consumers consider those products for the transaction, do they start to evaluate them, which leads to subjective evaluations and irrationality. In the Apple case, only if they are going to buy those Apple products, do they start to evaluate them and the endowment effect activates their over-evaluation thereafter.

For hypothesis two, we only examined the strength with positive values while there is no test with a strength value below 0%, i.e., weakening. However, if hypothesis one is correct, the optimal value △ should be negative downward weakening until canceled with the original rational-human hypothesis. This trend of weakening is observed in our simulation results that strength between 0-5% gives the highest similarity. Further examination is needed to prove our hypothesis.

Moreover, even though our simulations are close to real revenue, they are not highly similar to real data. One possible explanation is that every customer actually has a purchasing tendency of whether to buy one thing or not. Especially for electronic devices in Apple stores, which are generally high price products, people usually purchase them with some plans in advance. Thus the possibility of impulsive spending is low. So our assumption that purchasing possibilities for customers are random variables around 50% might need improvement.

Finally, while drawing a conclusion, we also found several doubts that need to be solved or improved. Based on our theoretical hypothesis and experimental verification, we believe that the triggering node of endowment effect is whether consumers begin to make subjective evaluations of commodities, and this triggering will determine the dominant position of

rationality and irrationality in consumers' consciousness. But computer simulations are always subject to our experimenter's guesswork and can be at odds with reality, and apple's historical data is too heavily influenced by the external economic environment to be able to separate out the factors we care about. Therefore, we believe that it is necessary to conduct experiments and investigations on the actual situation, and to exclude consumers' targeted preferences for certain commodities before they are exposed to them. That is, before they are influenced by the irrational factors.

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