Proposal of Modeling to Address the Purchase Behavior of a Group

Takaaki KAWANAKA*, Shuichi ROKUGAWA

*Department of Technology Management for Innovation, Graduate School of Engineering, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-8656 Japan

Abstract

In a retail store, some persons shop alone, while others shop in groups of two or three. Prior marketing research focused on the purchase behavior of one person, suggesting that only a part of the purchase behavior in a store has been studied. In this study, we focus on the purchase behavior of a group. The purchase behavior of a group of two or more persons is different from the purchase behavior of one person as the interpersonal relationship affects the purchase. Heider, a social psychologist, constructed a theory regarding a mechanism of interrelationship from a socio-psychological perspective. Heider simply described how an attitude of a person towards others becomes balanced in a three-party interpersonal relationship, and expanded the theory to include correlations among persons, objects, and concepts. With regards to using attitude to determine a consumer’s purchase in this study, if his/her attitude towards a product is divided within the group, persuasion is used to influence purchase behavior. This proposed model plays a role in expanding the breadth of the marketing study. An application of multi-agent simulation to virtual collaboration of various fashion leaders can be considered.

Key words: retail store, purchase behavior, purchase behavior of a group, balance theory, interpersonal relationship

1. Introduction

It is important to understand the decision-making processes of consumers when they make a purchase, in order to increase sales. Retailers devise various measures including points of purchase advertising, flyers (online or inserts), product arrangements, and shop layouts to attract customers. In addition, in order to assess whether these measures are effective, several methods, such as flow analysis [1,2], active marketing [3], and multi-agent simulation [4,5] are proposed. However, these studies often focused on the purchase behavior of one person as the consumer behavior model and almost never considered a purchase behavior model of groups of people. People do visit a store alone as well as groups of two or three. A lone shopper decides whether or not to purchase a product based only on the attitude towards the product held by that one consumer; hence, it is possible to determine the structure of the relationship at that time as a two-party relationship between the product and one consumer. A purchase by members of a group of two or three people, however, is decided based on either a three-party or four-party relationship, respectively, including the product. A purchase by a group involving multiple people is the result of a purchase decision by many such concerned persons; hence, the decision-making process is clearly different from that in a one-person purchase.

Pervious research that focused on human relationships includes Heider’s balance theory. This study applies the theory to model group purchase behavior. Heider’s balance theory uses a simple model to determine if interpersonal relationships are in a stable balanced condition or are in an imbalanced condition [6,7]. Modeling purchase behavior allows a sales strategy study to focus on essential points, permitting more precise prediction of the effectiveness of a new sales measure by simulations performed using a model. The second half of this paper also mentions the possibility of applying the proposed model.

2. Purchase Behaviors in Stores

Purchase behaviors in stores are divided into planned purchases and unplanned purchases. A planned purchase refers to a consumer visiting a store once and making a decision on the product that he/she wishes to purchase in advance. An unplanned purchase, on the other hand, refers to a customer making a decision to purchase a product after he/she visits the store. According to prior studies, especially those conducted overseas, about 60% of supermarket shopping and 30%-40% of department store shopping is unplanned.
The definitions of planned and unplanned purchase differ in prior studies. The presence or absence of a previous purchase plan is common among all studies, but the definition is ambiguous with regards to whether planned or unplanned purchases should be examined at the product category level or detailed brand level [11, 12].

This study is targeted towards unplanned purchases and creating a model that focuses on two or three consumers visiting a store to determine how they choose products while consulting with each other. Moreover, the discussion involves individual product selection, and therefore, the focus is mainly on selective behavior at the detailed brand level, rather than at a product category level. As for the type of store, a model for purchase behavior has been created, assuming consumers are shopping at an apparel store.

A jacket is one example of a category of products sold in apparel stores. Jackets come in a variety of brands. This study focuses on product selection behavior at the brand level (deciding which brand of jacket to purchase). The hierarchical structure of this decision is apparel store, jacket (product category), and brand. There are differences in the way that other people affect product selection behavior, based on whether the product will be used in private or in public. This study focuses on apparel type product selection behavior because it conforms to the goals of this study, assuming that apparel products are used publicly so that other people have a large impact on apparel product selection behavior.

3. Previous Research

The difference between the purchase behaviors of two or more persons and those of one person is that the interpersonal relationship will influence the purchase of the shopper. Heider, a social psychologist, constructed a theory regarding a mechanism of interrelationship from a socio-psychological point of view [6, 7]. Heider simply described how the attitude of a person towards others becomes balanced in a three-party interpersonal relationship, and expanded the theory of correlations among a person, an object, and a concept. Heider’s balance theory will be explained in detail in the next chapter. This theory is expanded by Cartwright and Harary from a three-party relationship to the relationship of person “N,” [13, 14] and applied to the fields of human relations, international relations, marketing, and so forth [15, 16].

Concerning the studies of purchase behaviors in stores, there are studies analyzing the ratio of planned purchases and unplanned purchases [10, 11, 17, 18] as well as those measuring the effects of advertising and store stimulation at the time of decision-making. Other studies include those in which the purchase behaviors are analyzed based on the flow line of a consumer [1, 2], and those where the purchase behaviors are modeled according to multi-agents, and simulations are conducted based on that model [4, 5]. These studies are expected to develop further with the advancement of the Internet of things (IoT) and AI.

Purchase behavior involving multiple people has been studied by analyzing the characteristics of purchase behavior experimentally and through questionnaire surveys about products that groups of people can consume at the same time, such as restaurant purchases, travel, and movies [19]. To clarify the impact of a companion on a person’s purchase behavior, one study focused on shopping by women and their daughters by including a questionnaire survey conducted to compare the shopping behavior of a woman alone to that of a woman accompanied by a daughter [20]. However, these studies were nothing more than analytic research that included no efforts to represent purchase behavior with a general purpose model. A characteristic of this study is that, unlike these past studies, it represents the purchase behavior of groups of people using a model.

4. Heider’s Balance Theory

4.1 Attitude in Socio-psychology

The keyword of the balance theory, “attitude” is explained here. The concept of attitude used in socio-psychology is one of the important basic concepts in the consumer behavior theory. This is because the rules and mechanisms of consumer behavior can be clarified by using this concept. Attitude is considered a necessary concept when the purchase behavior is projected and explained. Attitude refers to a consistent emotional response and judgmental value, favorable or unfavorable, towards an object, and is positioned as a concept of the theoretical supplement in understanding the purchase behavior from a psychological aspect.

Attitude drew attention in consumer behavior studies because of the following: human behaviors result from reflecting intentional and free personal preferences, the symbols of consumer’s preferences, and the presumption that analysis of attitudes is effective in predicing behavior [21, 22].
4.2 Balance Theory

Heider’s balance theory is illustrated here. When the correlation of human relationships is taken on by three parties, it causes several imbalances. Heider described a three-party relation in a simple model by assuming that a person feels insecure and stressed out when positioned in imbalanced circumstances and becomes inclined to act in order to be psychologically balanced. Suppose in a three-party relationship of Person P, Person O, and Object X, the attitude towards an object is determined by the correlation of the above three parties. For example, the attitude of \( P - O \) is determined by the relationship between \( P - X \) and \( O - X \). Here, an affirmative (friendly) relationship is shown by “+” and a negative (unfriendly) relationship is shown by “−.” The three-party relationship of \( P - O - X \) can be illustrated via the eight patterns shown in Fig. 1.

In Fig. 1, the top row shows a balanced condition and the bottom row shows an imbalanced condition. One imbalanced example is shown as follows. Person P and Person O have a friendly relationship, but have opposing preferences for Object X. Assume Person P does not like Object X, but Person O likes Object X. If Person P is influenced by Person O to buy Object X, and Person P does not want to buy Object X because he/she does not like it, he/she creates an imbalanced condition in which he wants to maintain a friendly relationship with Person O. This condition is illustrated in Imbalanced 1 in Fig. 1. In order for Person P to be released from this imbalanced condition, he has to like Object X or he will become unfriendly towards Person O. When the condition becomes either of these, the three-person relationship becomes a stable balanced condition. Owing to human instinct, balanced conditions are accepted without stress, but imbalanced conditions create insecurity and stress. In order to avoid such conditions, people are inclined to move towards a stable balanced condition by choosing to distort their opinions and feelings [6].

The balance theory is based on the ideas that “a friend’s friend is my friend,” “a friend’s enemy is my enemy,” “an enemy’s friend is my enemy, and “an enemy’s enemy is my friend” [23]. It also describes a mechanism of interpersonal relationships in which the relationship between persons and objects is generalized and is divided into a positive relationship (friendly, similar, agreement, etc.) and a negative relationship (unfriendly, non-similar, opposition, etc.) In addition, using a “+” symbol for a positive relationship and a “−” symbol for a negative relationship, when the three-person relationship is represented in the multiplication of relationship symbols on a cycle, and if the multiplication becomes “+,” the relationship turns into a balanced condition (for example, \((+)(-)(-)=(-)\)). “−” represents an imbalanced condition (for example, \((+)(-)(+)=(-)\)). Being able to describe the balanced and imbalanced condition using symbols is one of the characteristics of this theory.

5. Proposal of a Purchase Behavior Model Based on the Balance Theory

This report proposes a purchase behavior model in a group based on the balanced theory. For example, a scenario where multiple consumers are making a decision of purchasing clothes in an apparel store is presumed. The symbols used in this study are as follows.

<Symbols Used>

\( a \) : Purchase attraction value \((0 \leq a \leq 1)\)

This value refers to the degree of attracting a purchase unique to certain products, and is attached per product brand.

\( b \) : Purchase restraint value \((0 \leq b \leq 1)\)

The purchase attraction value of a product refers to the degree of restraining the purchase of the product. If the purchase attraction value exceeds this value, the product purchase becomes positive for a consumer. If not, it becomes negative. Consumers have a unique purchase control value per product category.

(Ex.) Person P’s purchase restraint value : \( b_p \) \((0 \leq b_p \leq 1)\)
w : Weight of purchase decision right (0 ≤ w ≤ 1)

For example, when two individuals are buying a product by consulting with each other, this value refers to the weight a person has regarding purchase decision right. When Person P has \( w_p \), the other person has \( w_o \). The relationship between them is \( w_p + w_o = 1 \) (in the case of three persons, the relationship is \( w_p + w_o + w_q = 1 \)).

### 5.1 Purchase Behavior of One Person

One person’s purchase behavior is determined only by the attitude of that person alone. Here, assume the decision of whether to buy a product is determined by purchase attraction value \( a \) and purchase control value \( b \) that the consumer himself possesses. In other words, when purchase attraction value \( a \) for a product is larger than the consumer’s purchase restraint value \( b \), the consumer becomes positive about buying the product. If not, he becomes negative. The relationship of the formula using \( a \) and \( b \) and the purchase behavior becomes as follows:

\[
\begin{align*}
& a - b > 0 \quad \text{(Positive about purchase)} \\
& a - b \leq 0 \quad \text{(Negative about purchase)}
\end{align*}
\]

### 5.2 Purchase Behavior of Two Persons

In the case of two persons, purchase behavior is determined by the relationship between them and their attitude and persuasion towards the product. Assume that Person P and Person O in a good relationship with each other go shopping together for clothes in an apparel store. They consult with each other and consider buying a suit of clothes. The decision right \( w_p \) is possessed by P and the decision right \( w_o \) is possessed by O. As mentioned before, one person’s purchase behavior is determined by the size of purchase attraction value \( a \) and his/her purchase restraint value \( b \). Here, purchase restraint value \( b \) is the value unique to the consumer; it is possible that the attitude towards product \( X \) is different between Persons P and O. In this case, suppose the relationship between the two persons is positive, this study views that the persuasion provided through the discussions between P—O determines the purchase behavior of the two persons. **Fig. 2** shows the three-party relationship regarding the product purchase when P’s purchase restraint value with regard to the product category that \( X \) belongs to becomes \( b_p \) and O’s purchase restraint value becomes \( b_o \).

![Fig. 2](three-party-relationship.png)

**Fig. 2** Three-party Relationship between P—O—X Regarding Product Purchase Supposing P—O’s Relationship is Positive

In **Fig. 2**’s Balanced 1 condition, persons P and O are both positive about purchasing product \( X \) and in Balanced 2 condition, both are negative about purchasing product \( X \). In these two cases, decision-making to purchase as a group is easy. On the other hand, in **Fig. 2**’s Imbalanced 1 condition, P is negative about purchasing product \( X \), and O is positive about purchasing product \( X \); their ideas are divided. When this occurs, in the actual store, P and O start a discussion, and P tries to persuade O to agree with him, and O tries to persuade P, and vice versa. As a result, if P agrees with O, both become positive about purchasing product \( X \), and if O agrees with P, both become negative about purchasing it. In both cases, the three-party relationships become balanced conditions. In this situation, pay attention to the difference between \( a \) and \( b \) to model the process of persuasion. The bigger \( a - b \) becomes the more intense the degree driving them to make impulse purchases will become. The smaller it becomes, the less intense the degree driving them to...
make impulse purchases will become. Therefore, it is considered that each person will have stronger persuasion in the positive purchase position if the difference becomes larger in the plus direction and stronger in the negative purchase position if the difference becomes smaller in the minus direction. For example, in Fig 2’s Imbalanced 1 condition, if P is originally negative about purchasing X, as $a - b_p$ becomes smaller, P’s persuasion, which could change the attitude of O (whose attitude is positive towards a purchase), becomes large. On the contrary, if O persuades, the bigger $a - b_o$ becomes, and O’s persuasion, which could change the attitude of P (whose attitude is negative towards a purchase), becomes large.

In creating a model, the next important point is the purchase decision right. The purchase behavior involving multiple consumers influences who has how much purchase decision right in purchase decision-making as a group. In this case, who pays the purchase fees for the product significantly influences the decision right, as well as skilled persuasion based on the product knowledge becoming one of the factors to navigate the decision right. Moreover, compared with a parent and a child, it is presumed that a grandparent and a grandchild could alter the purchase decision right. This is because it is expected that the person with whom a child goes shopping, in the case of a mother who is strict with her children and a grandmother who is lenient with her grandchildren, will influence the purchase decision right.

The proposed model of this study determines who can persuade the other person, the person who is positive about a purchase or the person who is negative about a purchase by using the plus and minus of the value, $w_p(a - b_p) + w_o(a - b_o)$, which takes into account the weight of purchase decision right $w_p, w_o, w_q$, respectively, and the purchase restraint value of persons P, O, Q towards product category that product X belong to is $b_p, b_o, b_q$. The purchases of the three persons is determined by the four-party relationship of $P - O - Q - X$. In this situation, there are a total of 64 patterns of balanced and imbalanced conditions; the breakdown is 8 patterns of the balanced condition and 56 patterns of the imbalanced condition. Fig. 3 shows the balanced conditions (8 patterns). Fig. 4 shows the imbalance conditions (6 patterns) where at least the three-party relationship of $P - O - Q$ is in positive relationship. In the case of three persons, a model construction is continued on the condition that the three-party relationship always stays positive.

### 5.3 Purchase Behavior of Three Persons

The two persons’ model is expanded to the three persons model for purchase behavior. Suppose a group of three, Persons P, O, and Q in a good relationship with each other go shopping together to buy a suit of clothes. Assume the weight of purchase decision right is $w_p, w_o, w_q$, respectively, and the purchase restraint value of persons P, O, Q towards product category that product X belong to is $b_p, b_o, b_q$. The purchases of the three persons is determined by the four-party relationship of $P - O - Q - X$. In this situation, there are a total of 64 patterns of balanced and imbalanced conditions; the breakdown is 8 patterns of the balanced condition and 56 patterns of the imbalanced condition. Fig. 3 shows the balanced conditions (8 patterns). Fig. 4 shows the imbalance conditions (6 patterns) where at least the three-party relationship of $P - O - Q$ is in positive relationship. In the case of three persons, a model construction is continued on the condition that the three-party relationship always stays positive.

![Fig 3 Balanced Conditions of a Four-party Relationship (8 patterns)](image-url)
In this situation, P and Q persuade O and P. In this situation, O persuade P and Q and P
behavior of Imbalanced 1 in group is determined. For instance, the purchase
is purchased. \( w_p(a - b_p) + w_o(a - b_o) + w_q(a - b_q) = 0 \) \( \cdot (6) \)
At this time, in Imbalanced 1 in Fig. 4, the absolute values of \( w_p(a - b_p) \), \( w_q(a - b_q) \), and \( w_o(a - b_o) \) are equal; and if this remains unchanged, the imbalance is not resolved. Many groups of three shoppers in a good relationship with each other, however, are presumed to prioritize maintaining their good relationship; therefore, it is predicted that to prevent the deterioration of their relationship, they are highly likely to eliminate this product from those they consider purchasing. As a result, they will not purchase this product.

As shown above, it is clear that a purchase behavior model can be created for two persons by applying the balance theory of Heider’s three-party relationship. Furthermore, it has been illustrated that the model can be expanded to a four-party relationship (three persons) and a five-party relationship (four persons) or more.

5.4 Merits of Modeling based on Balance Theory

The extremely small number of studies about multiple person purchase behavior in past studies mainly included corroborative analyses based on questionnaire surveys and the like, and focused on macroscopically clarifying trends in the object population. This study, however, adopted the approach of focusing on modeling the actions of individual people based on a theory of human relationships to study how microscopic relationships among people affect product purchasing behavior when viewed from the perspective of the overall society. This method has important merits. For example, to perform a computer simulation of the behavior when consumers purchase products inside a retail store, it is necessary to begin by modeling the decision-making process of the consumers, representing this quantitatively, and then entering the results into the computer. The approach adopted for this study permits this. Human relationships and the psychological activity of a person are invisible; however, if the proposed model is used, it is possible to reflect this in the behavior rules of multiple consumers.

We believe that this approach is a first step in applying artificial intelligence, big data, and IoT to marketing.

6. Applicability of the Proposed Model

Among the predicted applications of this model, the first is performing a multi-agent simulation by identifying a consumer in a store as one agent on the...
computer and incorporating this model into the behavior rules of the agent. From a consumer's perspective, searching for a product in a group of two or three people provides a broader perspective on the search and increases the quantity of information used to discover the desired product, such that it is more than when one person searches alone. This is a merit in that it permits multiple people to input information and judgments. One person, on the other hand, can make a prompt decision to purchase a product; however, a disadvantage of a group of people shopping together is that it takes longer to reach a decision because of the process of persuasion through discussion. Such a situation could not be reproduced by a model premised on the purchase behavior of one person.

The parameters of this model, which are a, b, and w, are useful when quantifying the purchase behavior of a consumer agent. If, for example, point-of-purchase (POP) advertising for a product can be made attractive (expanding a), the probability of a consumer agent making a purchase is increased when the consumer agent sees this POP advertising. The strategy of the store at this time is to find a way to display an attractive POP advertisement so that it is more easily seen by consumers. If it becomes possible to infer the value of a using IoT technology, the gap between the model and reality can be narrowed.

There is another area where the model can hypothetically be applied. Currently, there are services that have a celebrity known as a fashion expert to select clothing of a certain brand; however, if it were possible to numerically represent the choices of the celebrities in some way (to analogize the value of b), it would be possible to apply this model to simulate the selection of clothing based on a collaboration with multiple celebrities. In addition, if this could be expanded to include the tastes of historical figures, it would also be possible to make selections through collaboration with people who lived in different times. This would permit the introduction of the world of virtual reality into sales promotions.

7. Conclusion

This study applied the balance theory of Heider to model the purchase behavior of groups of two or three people. It cited as an example the conformity phenomenon of apparel purchase behavior where one group psychology results in people feeling secure if they keep up with fashion, but insecure if they do not. The proposed model can explain the phenomenon of keeping up with fashion resulting from group psychology at the individual consumer's purchase behavior level. Also, because this model can simulate the process of persuasion among people, it can also represent the assertions of individual consumers, and even represent everything from the phenomenon of conformity—keeping up with fashions and booms—to purchase behavior in the age of the individualist.

The growth of the internet and the advance of artificial intelligence have been accompanied by the blending of reality and virtual space in the gaming world, among other fields. The authors hope that in the future, this study will be applied in various areas and contribute to a paradigm shift in marketing.

References

[10] Yukihiro Aoki, “Chapter 5: Review of Existing Studies with Regards to Purchase Behavior Analysis in Stores” (Written and edited by


