정보이론의 엔트로피 관점에서의 바라본 온라인 소비자 리뷰의 소비자 의사결정에 있어 불확실성 감소 효과

How eWOM Reduces Uncertainties in Decision-making Process : Using the Concept of Entropy in Information Theory

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초 록

본 연구는 온라인 소비자 리뷰가 제품정보 제공자로서 소비자 구매결정에 미치는 영향에 대해 살펴보았다. 정보이론에서 제시된 엔트로피의 개념을 이용하여, 온라인 소비자 리뷰 안에 존재하는 여러 가지 종류의 제품 정보에 대해 소비자들이 각각 다르게 반응하는 이유를 설명하고자 하였다. 정보 엔트로피는 한 개의 단위 정보가 감소시킬 수 있는 불확실성의 정도를 의미한다. 온라인 소비자 리뷰에는 각각 다른 정도의 엔트로피를 감소시킬 수 있는 여러 가지 정보가 있고 따라서 소비자는 감소되는 엔트로피의 정도에 따라 각각의 정보에 대해 다르게 반응한다. 본 연구에서는 여러 가지 종류의 정보에 따라 감소하는 엔트로피의 양이, 제품 정보 제공의 전후에 따라 제품 속성에 대한 인식된 중요도의 차이로 나타남을 검증하고자 하였다. 이러한 연구 가설들은 총 268명의 온라인 쇼핑몰 이용자에게 실험을 하여 정보제공의 전후에 따른 제품 속성 별 중요도에 분명한 차이가 있음을 보여줌으로써 확인되었다.

ABSTRACT

The present study examines the impact of eWOM on consumer decision making process by viewing eWOM as the product information supplier. We employ the concept of information entropy which was proposed in the information theory to explain different consumer responses to various types of product information in eWOM. Information entropy is the degree of uncertainty associated with the information in the message. In eWOM, a variety of information with different levels of entropy is available, and these different entropy levels result in different impacts on consumer behavior. The preliminary hypotheses are formulated to examine the impact of eWOM on consumer behavior, at the product attribute level and the purchase action level separately. An experiment was conducted to online shopping mall users and the analysis gives valuable insights into our future research.

키워드 : 정보이론, 엔트로피, 온라인 소비자 리뷰, 온라인 구전효과, 전자상거래, 제품 정보
Electronic Word of Mouth, Information Theory, Entropy, Uncertainty, Electronic Commerce

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1. Introduction

In the last decade, electronic word-of-mouth (eWOM) has become a particularly important part of online business. More than 90% of online shoppers have answered that they carefully refer to online reviews before making a purchase, and 80% are willing to change their decisions based on online consumer reviews [3, 30, 32]. Consumers often consider online reviews more reliable than information from sellers because these reviews contain more objective, abundant, and recent product information [10, 14].

Such reliance of customers on eWOM is basically due to the high quality of information in eWOM [1, 2]. Nowadays, online malls advertise everything from clothes to shoes. Products in shopping malls have various features, functions, and attributes. To understand a product well, more and more information is needed because the selection is made based on various criteria, including subjective preference, context, and individual situation, among many other factors. For example, to describe the softness of a diaper, simple words such as “soft” or “hard” are insufficient for customers to fully understand the true features of the product. Descriptions such as “soft like a silk skirt” and “even after three times of my baby’s urination, it is still dry and soft” would be more appropriate and helpful to customers. However, because the product information provided by the seller is often limited and biased, customers look for product information from other customers through eWOM.

In spite of the importance of product information in eWOM, the process by which information influences customer decision making is not yet fully understood. Studies with numerous perspectives have been conducted on eWOM, investigating, for example, the impact of specific ratings on sales using econometric analysis [8] and the impact of eWOM on knowledge sharing from the behavioral perspective [16]. Recently, several attempts have been made to analyze eWOM contents from the information quality perspective [15, 27]. However, even though there is a demand for such research, few studies have focused on the role of eWOM in providing information on various product attributes in detail, as well as on the impact of such information on consumer behavior.

Understanding the impact of product information on customer behavior is important because the acquisition of product information is the earliest influential stage in customer decision making [29]. All customers start shopping from the moment they acquire product information. Based on this, their consequent behavior can be explained [4]. Once the impact of attribute information is identified, explaining the subsequent impacts, causality, and final outcome is facilitated.

Therefore, the present study examines the impact of eWOM on consumer behavior by

viewing eWOM as the product information supplier. We employ the concept of information entropy which was proposed in the information theory to explain different consumer responses to various types of product information in eWOM. Information entropy, in a word, is the degree of uncertainty associated with the information in the message. In eWOM, a variety of information with different levels of entropy is available, and these different entropy levels result in different impacts on consumer behavior.

This study is organized as follows. First, various literature on the role of product information in customer decision-making process are reviewed, followed by an introduction on the information theory. Then the hypotheses are formulated to examine the impact of eWOM on consumer behavior. The hypotheses will discuss the impact at the attribute level and purchase action level separately. Finally, the result of an experiment, which was conducted to show the potential implication and contribution of this study, is presented.

2. Theoretical Background

2.1 Product Attribute Information and Customer Decision Making

Customer evaluation of a product is significantly affected by a variety of product information. A consumer's product judgments often vary with verbal labels describing specific product attributes, such as the percentage of fat in meat [22] and knowledge of the country in which a product is manufactured. These influence a customer's product evaluation [19]. Customers not only care about factual information of the product, but are often concerned about ethical information, such as the source of labor [13]. With all available attribute information, customers develop their idea on the product and consequently, evaluate the product. Hence, the attribute information of the product has a direct or indirect impact on customer decision making. This can even affect the interpretation of other available product attribute information [19].

When customers acquire attribute information, the set of information is not simply processed or integrated but more systematically framed [17]. Customers try to acquire information in a more efficient way or subjective way, or even in an opportunistic way [26]. For example, personal experience may differentiate an individual's information acquisition process [26]. This kind of manipulation of customers during the process of gathering information explains the difference in attribute information impacts. Moreover, customers occasionally seek attribute information only when it is easy to obtain [13]. Unfavorable information may have less impact than favorable information because customers willfully ignore unfavorable information

[13]. Since customers often face inconsistent information or doubtable information, a kind of systematical processing of information [31], which is different from simple information integration, is indispensable in customer decision making. For these reasons, identifying the impact of attribute information on customer information processing has remained an important issue in consumer research.

2.2 Information Theory and Entropy

The information theory, proposed by Shannon in 1948, is a mathematical theory of communication. The theory quantifies the amount of information needed for a certain kind of communication. It also identifies how much the information is worth, based on the degree of surpriseness under a specific condition [11]. This theory is most widely used in the area of electronic engineering and data networking. However, areas in business and sociology utilize this theory whenever any kind of communication is considered important [21].

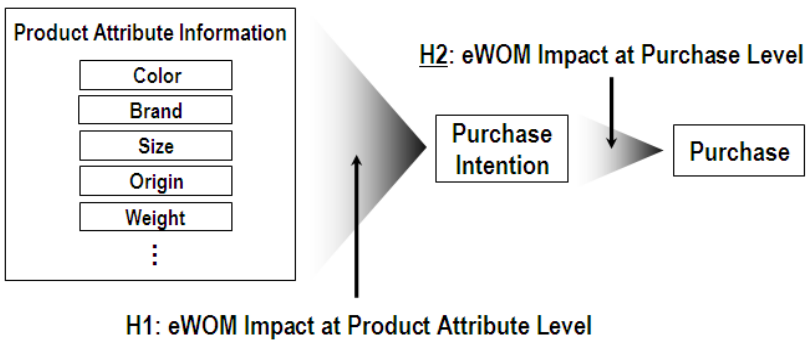
One of the most important concepts in the information theory is information entropy. This measures the amount of unknownness in describing a specific situation [7]. High information entropy implies more amount of unknownness or uncertainty to customers. Thus, if numerous possible outcomes exist, and each outcome has a variety of chances of occurrence, high entropy will exist. In contrast, if a few possible outcomes exist in describing a certain event and the chance of the occurrence of each outcome is not equal, low entropy exists in the system. In other words, if an outcome of a certain event is easily expected and figured out, low entropy is assumed. Entropy is, therefore, the function of possible outcomes and their probabilities of occurrence. The mathematical presentation of the entropy is as follows :

$$H(X) = -\sum_{i=1}^{n} p(x_i)\log_b p(X_i) \qquad (1)$$

where $p(x_i)$ is the probability mass function of x_i.

3. Hypotheses Development

In general, customers make purchase decisions as follows. First, they acquire product attribute information from various sources to evaluate a product and its attributes [25, 28]. Subsequently, they form purchase intention based on the evaluations on the attributes. If all important attributes of a product (e.g., CPU power of the computer) show satisfactory evaluation, a high purchase intention will emerge; if the evaluation on such attribute is doubtable, a low purchase intention will be derived. Finally, customers with higher purchase intention will be more likely to purchase the product. To distinguish the impact of eWOM on these aspects of the consumer decision-making process, the present study will dis-



〈Figure 1〉 Research Model Framework

cuss (1) the impact of eWOM at the product attribute level and (2) the impact of eWOM at the purchase intention level separately (<Figure 1>).

3.1 eWOM Impact at the Product Attribute Level

When customers acquire product attribute information, they face various attribute information with different entropy levels. High information entropy exists when the information is provided to describe the situation associated with high uncertainty and unknownness. In other words, information with high entropy can reduce a larger amount of uncertainty than information with low entropy. With this rationale, we can categorize product attributes based on their entropy levels (i.e., according to the amount of uncertainty that the information can reduce).

For example, when a customer buys a diaper, he/she will look for information on "length" and "softness." In this situation, length information has lower entropy than softness because having different opinions or descriptions on length is uncommon, whereas having different opinions and descriptions on softness is more possible. If the length is 30 cm, unless there is a mistake, then there will be no other information but 30 cm. Moreover, customers will not have uncertainties about the length information. Only a few words are used to deliver the size information as well. However, in describing the softness of the diaper, not only does it require using more words, such as "as soft as the skin of a newborn baby and silk-touch paper, among others," but it also has a higher probability of having different opinions on the degree of softness. For customers, avoiding a certain degree of uncertainty in understanding the softness of a diaper can be difficult. Therefore, length information and softness information bring different levels of uncertainties, that is, entropies.

Note that information entropy interprets information value only from the perspective of uncertainty. Low information entropy in

〈Table 1〉 Examples of Product Attributes with Different Entropy Levels

	Product Attribute with LOW information entropy	Product Attribute with HIGH information entropy
Attribute Description	◦ Attributes with less possible descriptions (i.e., outcomes) ◦ Attributes with less controversies in opinions ◦ Attribute that is objectively describable	◦ Attributes with more possible descriptions (i.e., outcomes) ◦ Attributes with more controversies in opinions ◦ Attribute that is not objectively describable
Attribute Examples	Brand, size, weight, class, etc.	Softness, scent, texture, taste, etc.
Information Examples	"The brand of this camera is Samsung." "This pencil is 5 inches long."	"This wool sweater is as soft as silk but a little bit heavy, especially if worn in spring."

length information does not imply any insignificance in the length information in decision making. Apparently, the length of a diaper is usually considered important in product evaluation. However, from the information theory perspective, acquisition of length information from eWOM does not add much value compared with the acquisition of softness information because of the different levels of uncertainty reduction.

This entropy level is important for customers because it determines the value of each information in the product attribute acquisition process. The higher the information entropy, the more valuable is the information to customers. High information entropy implies that it provides the necessary information when high uncertainty exists and can reduce more uncertainty. Therefore, for customers, information with higher entropy is more valuable and influential than information with lower entropy.

When customers perceive information with various entropy levels because of the different degrees of uncertainty reduction, they respond differently to the information. They react more sensitively to the information with higher entropy than to information with lower entropy because it reduces more uncertainty. In other words, customers are more likely to change their purchase decisions based on information with higher entropy than on information with lower entropy. Thus, information with higher entropy is expected to have a stronger effect on customer behavior and make customers respond more sensitively to it.

For example, when a customer buys a diaper online, he/she will not respond sensitively to size information in eWOM because it is usually not new or surprising information. Once customers acquire size information, whether in centimeters or inches, it will be fully understood without uncertainty. However, customers will sensitively respond to high entropy information, such as softness and absorbency,

because eWOM usually provides new and unanticipated information about these kinds of attributes [15]. To understand the diaper's absorbency level, customers carefully read eWOM and qualitatively analyze the words the reviewers used. Hence, customers are expected to value the absorbency information in eWOM more than the size information and to react more sensitively to it. Based on this finding, we have the following hypothesis:

H1 : eWOM will have a stronger effect on product attribute with high information entropy than on an attribute with low information entropy.

3.2 eWOM Impact at the Purchase Intention level

eWOM reduces uncertainty in the customer decision-making process. Reducing uncertainty is important, especially in online shopping malls, because customers cannot meet the seller face to face and have to make purchase decisions without seeing the actual product. They have to evaluate the product based solely on product information on the Web. In this circumstance, eWOM provides substantial product information used as the basis for customers' product evaluation. With eWOM, customers can make more precise, reliable, and unregrettable purchase decisions [12].

eWOM reduces uncertainty in product evaluation; thus, customers who read eWOM can make purchase decisions with more confidence. In other words, customer purchase action will become more decisive. Confident customers hesitate and regret less when purchasing [20]. eWOM reduces the gray area in consumer behavior and enables customers to decide with higher certainty. Based on this deduction, we have the following hypothesis :

H2 : eWOM will increase the decisiveness of customers' purchase intention.

4. Data Collection and Result

To validate the hypotheses, we design and conduct an experiment as follows. First, we present a package tour product without online customer reviews. We ask the customers to evaluate 11 types of attributes, such as price, schedule, popularity of the spot and season. These attributes were selected from various tourism literature [6, 9, 18, 23, 33]. We also ask about their purchase intention through a 9-point Likert scale and their purchase action through a Yes/No question form. We then ask the customers to rank the 11 attributes based on their perceived importance in decision making. Second, we present various customer reviews on this tour package product. These reviews have various ratings and opinions to avoid bias. Afterwards, we repeat our questions on attribute, purchase intention, purchase action, and attribute ranking.

4.1 Descriptive Statistics

We collect data from 268 respondents who have online shopping experience (<Table 2>).

(1) H1 Validation

We test H1 in two ways. First, we conduct multivariate regression analysis on the 11 product attributes using purchase intention as the dependent variable. Attributes with high entropy are expected to show increased coefficient. As shown in the <Table 3>, five attributes show insignificant effects on purchase intention. Thus, we exclude them from our discussion. Among the low-entropy attributes, price shows decreased influence as expected, whereas schedule does not. Among the four high-entropy attributes, accommodation, emergency support, and freedom show an increased effect as expected, whereas weather does not.

We then compute the average ranking of the attributes and examine their changes after

〈Table 2〉 Data Description

Gender	Freq(%)	Age	Freq(%)
Male	145(54.1)	20~29	87(32.5)
Female	123(45.9)	30~39	89(33.2)
Total	268(100)	40~49	55(20.5)
		50~59	37(13.8)
		Total	268(100)

〈Table 3〉 H1 test 1-Regression Analysis on Product Attributes

Attribute	Entropy level	Before eWOM(R2 = 0.491)			After eWOM(R2 = 0.302)			Attribute Importance	Hypotheses
		beta	T-value	Sig.	beta	T-value	Sig.		
Brand	L	.000	.003	.997	.018	.180	.858	NA	-
Price	L	**.491**	9.403	**.000**	**.198**	2.828	**.005**	Decrease	S
Popularity	L	.003	.044	.965	.000	.001	.999	NA	-
Schedule	L	**.164**	2.465	**.014**	**.252**	2.376	**.018**	Increase	NS
Accommodation	H	.009	.132	.895	.159	1.513	**.132**	Increase	S
Emergency Support	H	.054	.757	.450	**.199**	1.400	**.163**	Increase	S
Freedom	H	.011	.174	.862	**.218**	2.610	**.010**	Increase	S
Guide Service	H	.071	1.048	.296	.125	.992	.322	NA	-
Refund Policy	H	.016	.251	.802	.121	1.143	.254	NA	-
Transportation	H	.050	.712	.477	.100	1.020	.309	NA	-
Weather	H	**.168**	2.717	**.007**	**.161**	1.781	**.076**	No Change	NS

Note) S : Supported; NS : Not supported; NA : Not applicable.

〈Table 4〉 H1 test 2-Ranking Comparison on H1 Product Attributes

Attribute	Entropy level	Average Ranking before eWOM	Average Ranking after eWOM	Paired t-test (sig.)	Attribute Importance	Hypotheses
Brand	L	8.16	8.34	0.189	NA	-
Price	L	2.84	3.37	0.000	Decrease	S
Popularity	L	4.46	5.06	0.000	Decrease	S
Schedule	L	3.82	4.4	0.002	Decrease	S
Accommodation	H	4.53	4.86	0.032	Decrease	NS
Emergency Support	H	7.62	6.61	0.000	Increase	S
Freedom	H	5.28	5.19	0.400	NA	-
Guide Service	H	8.66	8.37	0.093	Increase	S
Refund Policy	H	8.36	7.37	0.000	Increase	S
Transportation	H	5.53	5.83	0.016	Decrease	NS
Weather	H	6.75	6.6	0.439	NA	-

Note) S : Supported; NS : Not supported; NA : Not applicable.

〈Table 5〉 H2 test 1-Descriptive Statistics on Purchase Intention and Action

Levels	Value	Before eWOM	After eWOM
Purchase Intention	Average	5.13	7.84
	S.D.	1.749	1.675
	Min.	1	1
	Max.	9	9
Purchase Action	Buy	71	12
	Not buy	197	256

the reviews are shown. The ranking of high-entropy attributes is expected to decrease, whereas that of low-entropy attributes is expected to increase. Eight out of the eleven attributes show significant changes (<Table 4>). Price, popularity, and schedule show decreased effects, as expected. However, accommodation and transportation do not show increased effects, as expected. Based on the two tests, the importance of price clearly lessens after customers acquire abundant product information. Emergency support shows a noticeable increase in impotomers acquire information.

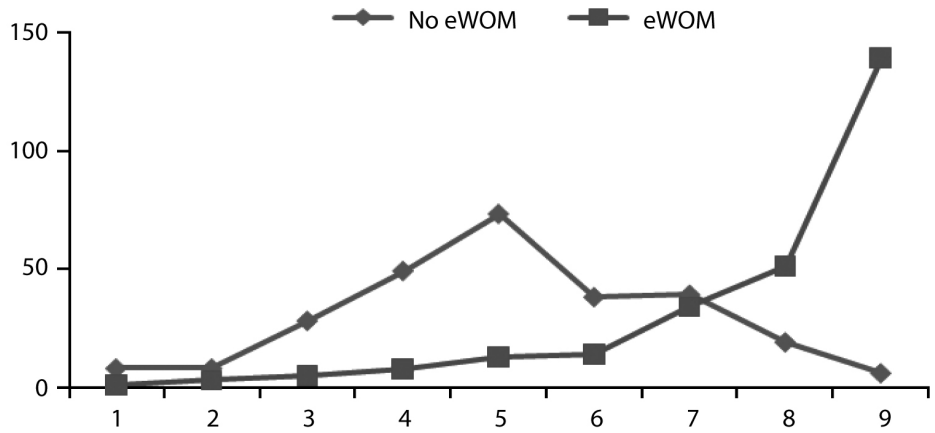
(2) H2 Validation

We test H2 in two ways. First, we examine the patterns of customer purchase intention changes. As shown in <Table 5> and <Figure 2>, purchase intention sharply increases after information acquisition. Before showing the reviews, the peak (i.e., mode) was in the mid-

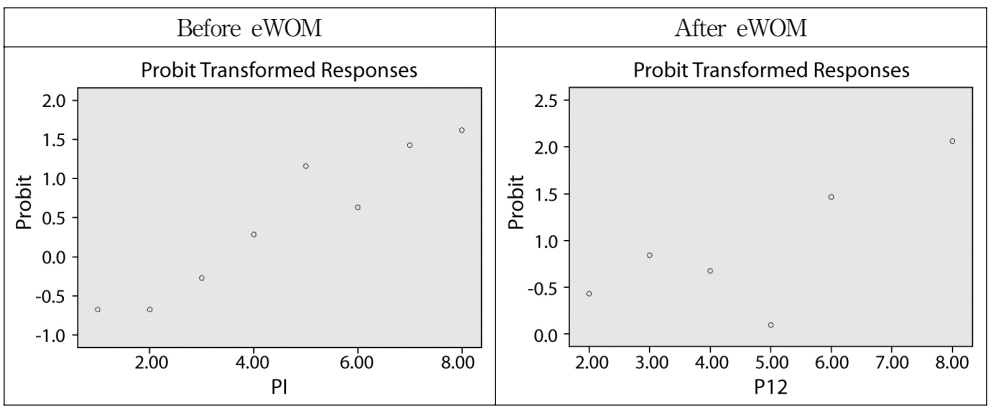
dle point of the Likert scale. However, after the showing, the peak moves to the highest point (i.e. 9) of the scale. Second, to determine the relationship between purchase intention and action, we conduct a probit analysis. As shown in <Table 6>, the goodness of fit is not satisfied. However, <Figure 3> shows an exceptionally low rate of purchase among customers with a moderate level of purchase intention after information acquisition.

〈Table 6〉 H2 test 2-Probit Analysis

eWOM Impact	Beta		Pearson's goodness-of-fit test		
	Coefficient	Z-value(Sig.)	Chi-Square	df	Sig.
Before eWOM	0.373	6.436 (0.000)	11.733	7	0.110
After eWOM	0.386	5.011 (0.000)	15.860	7	0.026



〈Figure 2〉 H2 test-Purchase Intention Distribution



〈Figure 3〉 Plots of Probit Analysis

5. Discussion

5.1 Summary of Findings and Future Research

The result of the study does not strongly support our preliminary hypotheses. Nonetheless, our findings give valuable insight into our future research as follows.

First, the impact of eWOM on product attributes apparently differs with each entropy level. In H1, we differentiate eWOM impact according to the entropy level of the attribute information. We divide the attributes into two types (i.e., high and low) and examine the impact of eWOM on each type. The result shows a certain degree of difference among eWOM impact as expected. It is, however, unclear whether the degree of difference accurately corresponds to the entropy level. Admittedly, our validation is not sufficient to examine the precise impact of eWOM on various attributes because of the too simplified attribute categorization. Therefore, for future research, refining the concept of entropy applied in the eWOM context is indispensable. Attributes are to be divided into more than two entropy levels, and a new validation method will be developed to highlight the different impacts of eWOM on attributes.

Second, enhanced decisiveness in customer behavior is not clearly observed in the analysis. However, we believe this is not because of our rationalization but because of inappropriate validation methods. We examine purchase intention distributions (<Figure 2>) and conduct a Probit analysis. Nonetheless, both methods are insufficient to show the "decisiveness" of customers because they measure only the post-eWOM status, not the during-eWOM status. The concept of decisiveness is closely related with time to make a purchase decision and the confidence level associated with it. It is difficult to measure from the result of customer behavior, and should thus be measured during the decision-making process. Both increased purchase intention and purchase action do not fully reflect the confidence level of the customers. Hence, for future research, we need to refine the concept of decisiveness and develop a new validation method. It may be possible to compare the concept of hesitation with decisiveness for contrast, or develop sub-concepts of decisiveness for conceptual rigorousity. Subsequently, with the refined conceptualization, we will be able develop a new method able to validate the hypothesis of decisiveness effectively.

Third, from the result, we observe distinctive increases of purchase intention and action. Even though the reviews shown are neutral-the equal mix of positive and negative reviews-customers' purchase intention surprisingly increased after the reviews are shown. From this, it is suspected that, purchase intention can be increased not only by positive reviews but also by the existence of the reviews. While positive reviews have been be-

lieved to increase purchase intention by increasing the perceived value of the product [1], whether the existence of eWOM can increase purchase intention by reducing uncertainty has not been discussed. Therefore, for future research, eWOM impacts can be discussed separately in two types, as follows : 1) positive eWOM will increase purchase intention by increasing the perceived value of the product, and 2) the existence of eWOM will increase purchase intention by reducing uncertainty.

5.2 Potential Contribution

The present study will contribute to IS discipline in the following aspects. First, this study rationalizes different impacts of eWOM on various product attributes using a single criterion called information entropy. Using a single criterion of entropy is especially meaningful to analyze the contents of eWOM from information quality perspective. Recently, the focus of eWOM research has been shifting from quantity (i.e. rating) to quality (i.e. contents) [19]. Customers start to realize the importance of individual information in various reviews. In other words, when there are more than sufficient reviews, only few reviews with quality information can actually have an impact on customer behavior. This study, therefore, attempts to provide rationales to explain such different impacts of eWOM using the concept of entropy, and to answer questions such as why some reviews are considered more helpful and read more by customers than other reviews, etc.

Second, we apply Information theory to the eWOM context and interpret its value from the entropy perspective. This is theoretically insightful because Information theory is an effective tool which quantifies the importance of messages in communication. The theory has been used in broad disciplines such as networking and telecomputing but in IS behavioral studies. Since the eWOM activities are the complete set of communication among customers [17], it is adequate and meaningful to apply Information theory to eWOM context. We hope our study can contribute to the IS field by extending the applicability of Information theory to the eWOM context.

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