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Negative online reviews of popular products: understanding the effects of review proportion and quality on consumers' attitude and intention to buy

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Abstract This study investigated the effects of negative online reviews on consumers' attitude and purchase intention, more specifically in relation to popular products. The investigation took into account the proportion of negative online reviews (low and high) and their quality (low and high), as well as comparing their impact in relation to popular and unpopular products. As a control variable, a website was purposely developed to suit eight different experimental treatments and their manipulations. This study involved 382 participants, who were exposed to the specially created website and asked to perform a specific task. Their responses were captured via questionnaires. The results showed that consumers' positive attitude to popular products decreased as the proportion of negative online reviews increased. The quality of reviews was found to have a less significant influence on consumer responses. Furthermore, this research revealed that unpopular products were more affected by negative online reviews than popular ones.

Keywords Negative online review · Popular product · Attitude · Purchase intention

1 Introduction

The ever-increasing use of the internet for online purchases has brought about behavioral changes in users, more specifically in the context of online reviews, also known as eWOM (electronic word of mouth) [1]. Online reviews have gained importance in line with the increasing number of consumers who use the internet not only to communicate with other consumers but also to inspect and purchase

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products online [2]. This is because most online shoppers depend heavily on online reviews in making their purchase decision [3–5].

An online review is a positive or negative statement, made by a future, actual, or former consumer about a product or a company, made available to the public through the internet [6]. Online reviews are attracting attention as research topics for marketing, as well as those related to technology [7, 8]. Previous studies have found online reviews to be more persuasive than other kinds of reviews [9–11].

Much previous research has been conducted in an effort to understand the effects of positive online reviews on marketing [12]. However, consumers place greater emphasis on negative information in making a decision to purchase [13]. Negative impulses attract more attention and act as stronger stimuli than positive ones.

Numerous studies have reported the effects of negative online reviews on a variety of consumer responses. Bailey [14] and Xia and Bechwati [15] showed that negative online reviews decrease the intention to purchase. When a potential consumer is exposed to a large number of negative online reviews, a negative expectation of the product is formed [16]. Furthermore, Lee et al. [1] showed that negative online reviews decrease consumers' attitude to the product. However, these studies focused on general products with no specific classification.

There are copious product classifications associated with online reviews. A frequently used classification is that of experience and search products, which researchers such as [17–21] used to evaluate consumer attitude and purchase intention. Another type of classification suitable for the context of online reviews and rather under-researched is product popularity [22].

Product classification based on popularity is interesting in itself, since popular products tend not to be affected by negative online reviews. Consumers use online reviews to obtain product quality information in order to reduce risk [23, 24]. Prospect Theory, in which consumers encounter reviews related to popular products, proposes that they tend to anticipate high quality in such products [22]. In addition to high product quality [25], popular products carry several pre-assumed traits, high consumer demand representation [26], and high product sales [27]. As a result, consumers tend to take less notice of the online review itself. The works of [22, 27] suggest that online reviews are deemed irrelevant to consumers when it comes to popular products.

Consumers' attitudes to popular products are an interesting topic for investigation, particularly when considered in association with the way negative online reviews affect such attitudes. The present study therefore contributes new knowledge in this area by investigating the effects of negative online reviews of popular products on consumer responses, specifically examining the impact of the proportion and quality of negative online reviews. Further, this study treats both the quality and the number of negative online reviews as variables. Finally, the study offers insights from Indonesia, a country with an emerging economy, which many argue will become a key player in Asia's electronic commerce market.

2 Literature review

2.1 Negative electronic word of mouth about popular products

Electronic word of mouth (eWOM) is defined as any positive or negative statement made by potential, actual, or former customers about a product or company, which is made available to innumerable people and institutions via the internet [6]. Negative information has been shown to be more valuable than positive information; consumers place great store by it, both in coming to a judgment and in decision making [5, 13, 28]. Negative cues tend to attract attention and are heavily attributed to the stimulus, more so than positive ones [28].

Prospect Theory explains that anticipation of quality is higher in relation to popular products, and plays a part in consumers' forming a personal judgment [29]. That is, consumers will have higher expectations of popular products than of unpopular ones [22]. In addition, Expected Utility Theory confirms that negative information received by consumers does not affect their judgment of popular products. Popular products signal high quality [25] and represent consumer demands [26] and high sales [27].

2.2 Quality of online reviews

The quality of information represents the most important antecedent of information diagnosticity in eWOM [30]. Quality of information is here defined as the quality of the contents of a consumer's review, from information characteristics perspective [31]. Previous research shows that word-of-mouth recommendations that provide details about the product's specifications or contain details about the recommender's experience with the product are much more persuasive than broad, general reviews [9–11].

The quality of a review has been discussed differently in previous studies. For example, in information systems literature, quality has been evaluated based on accuracy, timeliness, precision, reliability, currency, completeness, relevancy, access, and interpretation [32–35]. As also observed [31], credibility, objectivity, clarity, and logic should be considered when evaluating the quality of an online review.

In general, online reviews fall into two categories, high-quality reviews, and low-quality reviews. High-quality online consumer reviews are persuasive, because the information is relevant to evaluation of the product and contains understandable, reliable, and sufficient reasoning. Low-quality online consumer reviews are irrelevant, unreliable, and difficult to understand, and contain insufficient reasoning [36].

2.3 Proportions of online reviews

Quality is not the sole variable consumers consider when evaluating online reviews. Consumers tend to observe the proportion of positive and negative online reviews as

well [4, 37–39]. Online shoppers look at eight or more reviews before making a purchase decision and spend half an hour to an hour reading those reviews [18]. The works of [40] suggest that when consumers are exposed to more reviews, they tend to realize enhanced information diagnostic power.

Proportion in online reviews is divided by valence, which is understood as the number of negative compared with the number of online reviews. The work of [1] shows that consumers' attitude declines when the proportion of negative online reviews about a given product rises.

2.4 Popular, search, and experience products

Popular products can be defined as those that provide a high-quality signal [25], represent consumer demand [41], and enjoy sales higher than the average. Thus, popular products score more highly than unpopular ones on these three indicators.

The number of reviews found of popular products can steer consumers in many ways, one of which is their confidence in the product. This is because online reviews of popular products reflect the quality of the product; thus, the higher the number of reviews received by consumers, the more their confidence in the product increases [26, 27]. Hence, according to Prospect Theory, when consumers are exposed to popular product reviews, they tend to have a preconceived anticipation of quality, and construct their own product assessment on the basis of high expectations [22].

A search product is one where information on product attributes is easily obtained by consumers without having to make a purchase in advance [17, 42]. Therefore, the information obtained on a search product is usually objective and easily compared with other similar products, cameras, cell phones, and computers being common examples [20].

On the other hand, an experience product is one in which information concerning its attributes is difficult to obtain. Consumers frequently want to feel and experience the product prior to any assessment. Thus, information pertaining to these products is mostly subjective, and evaluations conducted are based on previous experience [17]. Typical examples of experience products are hotels, airlines, restaurants, and other services [21].

Consumers behave quite differently when looking for information on these two types of products: they tend to seek more information on sites and articles concerning a search product than on an experience product [42].

2.5 Consumer responses

A widely studied consumer response associated with consumer online reviews is attitude. In general, attitude can be defined as an individual's feelings towards objects, people, issues, or events. More specifically, according to [43], consumers' attitude is the tendency to respond to certain stimuli related to products. In addition, consumer attitudes can also be interpreted as the tendency of consumers to respond in a consistent way to a product [44]. In order to determine consumers' attitude to a product, it is necessary to measure their selection of like or dislike, pleasant or unpleasant, as well as good or bad.

Purchase intention is a critical consumer response because it reflects actual and objective consumer purchase behavior [45]. Intention leads to a conscious inclination to obtain a desired product [46, 47]. Purchase intention is often tied to the proportions of online reviews. The higher the proportion of positive reviews, the more consumers build positive expectations and increase their willingness to purchase [48–50]. In contrast, negative reviews increase negative expectations, which in turn depress purchase intention [14, 15].

3 Hypothesis development

Consumers typically evaluate online reviews by taking into consideration the overall number of positive and negative reviews of a desired product [4, 37–39]. An increase in the number of negative reviews escalates the perception of product risk and in turn decreases the desire to purchase [1].

Stronger consumer diagnostic information is achieved through a higher exposure to reviews [40]. However, some may argue that not all reviews affect popular products, because consumers may collect discrete information by different means [22]. This notion is partly explained through the Excess Information Theory, which states that consumers make their decisions based on the levels of diagnosis and access to information that are consistent with their previous beliefs and preferences [26].

Research has found that consumer attitude was less favorable when the proportion of negative online reviews increased [1]. Purchase intention also decreased as a result of negative online reviews [14, 15]. The present research, however, was based on popular products, specifically to see how the Excess Information Theory affects consumers' responses. We therefore set out the first hypotheses:

H1 (a): A higher proportion of negative online reviews of popular products does not decrease consumer attitudes significantly compared to a low proportion.

H1 (b): A higher proportion of negative online reviews of popular products does not decrease consumer purchase intention significantly compared to a low proportion.

Aside from proportion, the quality of the reviews may also influence consumers' decision. High-quality reviews provide highly relevant product evaluations [36], which may affect consumers' attitude and purchase intention.

Previous research has shown that high-quality negative reviews affect consumers' attitude more than low-quality ones [1]. However, according to Prospect Theory, when it comes to popular products, consumers have an expectation of high quality in the products [22]. Such an expectation renders a high-quality negative review incompatible with popular products, which leads us to the next hypotheses.

H2 (a): Higher quality of negative online reviews of popular products does not decrease consumer attitudes significantly compared to low quality.

H2 (b): Higher quality of negative online reviews of popular products does not decrease consumer purchase intention significantly compared to low quality.

Previous research explored the influence of both the quality and the proportion of negative online reviews on consumer attitudes and how the two are correlated. The effect of the number of high-quality negative reviews was found to be indistinguishable from the number of low-quality ones [1].

However, these findings are not necessarily applicable to popular products. This research assumes that simultaneous exposure to both proportion and quality (high and low) of negative online reviews will not lower attitude and purchase intention any further. Thus, the following hypotheses were proposed:

H3 (a): High proportion–low quality of negative online reviews have the same effect as low proportion–high quality negative online reviews on lowering customers' attitude.

H3 (b): High proportion–low quality of negative online reviews have the same effect as low proportion–high quality negative online reviews on lowering customers' purchase intention.

The effects of online reviews on sales of experience products have been explored previously [22, 27]. That work provided insights into the effects on one consumer response, namely, sales of experience products, without specifically considering product popularity. The present research assumes that the same will be true for different consumer responses, namely attitude and purchase intention for popular search products. The next set of hypotheses were designed to distinguish product popularity in a variety of scenarios.

H4 (a): Negative online reviews of popular products affect consumers' attitude in the same way as negative reviews of unpopular ones.

H4 (b): Negative online reviews of popular products affect consumers' purchase intention in the same way as negative reviews of unpopular ones.

H4 (c): The proportion of negative online reviews of popular products affects consumers' attitude in the same way as the proportion of negative reviews of unpopular ones.

H4 (d): The proportion of negative online reviews of popular products affects consumers' purchase intention in the same way as the proportion of negative reviews of unpopular ones.

H4 (e): The quality of negative online reviews of popular products affects consumers' attitude in the same way as reviews of unpopular ones.

H4 (f): The quality of negative online reviews of popular products affects consumers' purchase intention in the same way as reviews of unpopular ones.

4 Methodology and research design

4.1 Product and review selection

This study uses a 2 (negative online review quality: high and low) × 2 (negative online review proportion: high and low) × 2 (product characteristic: popular and unpopular) factorial design to test the hypotheses. The details of the experiment design are shown in Table 1.

The researchers first decided on a number of product candidates that corresponded to the characteristics of a popular product described in the previous section, by selecting those that several well-known Indonesian electronic commerce websites suggested as popular. The shortlist was then tested by means of a focus group discussion with a group of undergraduate students, in order to come up with just one product to represent a popular product and another one to represent an unpopular product. The focus group participants agreed that a product is deemed popular if consumers have adequate product information and knowledge, without making any additional effort to research it. They identified the iPhone 6 as the popular product and the ZTE Nubia as the unpopular product.

The focus group discussion then continued to define the quality parameters of an online review to be used in this study. Six parameters were adopted to define the quality (high and low) of a review from previous literature, which included credibility [1, 18], objectivity [1], actuality [35], relevance [32–34], ease of understanding [36], and details [30]. The focus group agreed that these parameters were adequate to differentiate between high and low quality in a review. The reviews were taken directly from various Indonesian electronic commerce websites that sell the two products selected. The reviews were examined by the focus group participants to ensure they fulfilled the six parameters for positive reviews or failed to fulfil them for negative ones. Finally, a total of 20 (10 negative and 10 positive) online reviews were selected and scored (high and low) in terms of their quality.

The works of [1, 51] considered eight online reviews in their study. A group of reviews consisting of four negative and four positives was classed as a high proportion of negative online reviews. A low proportion of negative online reviews

Table 1 Experiment design

Treatment	Quality	Proportion	Product	Objective
A	High	High	Popular	Attitude, purchase intention
B	High	Low	Popular	Attitude, purchase intention
C	Low	High	Popular	Attitude, purchase intention
D	Low	Low	Popular	Attitude, purchase intention
E	High	High	Unpopular	Attitude, purchase intention
F	High	Low	Unpopular	Attitude, purchase intention
G	Low	High	Unpopular	Attitude, purchase intention
H	Low	Low	Unpopular	Attitude, purchase intention

consisted of two negative online reviews and six positive ones. However, in the present research, the focus group agreed that a high proportion of negative online reviews required more negative reviews than positive ones to clearly differentiate from a low proportion of negative online reviews. Thus, a high proportion of negative online reviews was identified as consisting of five negative online reviews for every three positive ones.

4.2 Research instruments

The research instruments in this study consisted of manipulations of an electronic commerce webpage and a questionnaire. Eight different instruments were devised, each representing a unique manipulation (see Table 1). The questionnaire used a 7-point Likert scale, with options from "highly disagree" to "highly agree."

The manipulated electronic commerce site was specifically engineered as a control variable, and mimicked the usual state one may encounter during online shopping. The site replicated that of Lazada.com, a respected market leader and the most popular Indonesian electronic commerce site in 2014. The engineered site displayed information concerning iPhone6 for treatments A, B, C, and D, as well as ZTE Nubia Z5 s for treatments E, F, G, and H. In addition to product images, each page on the site displayed eight reviews that had previously been scored as high quality and low quality by the focus group participants. The reviews were written in Bahasa Indonesia language to fit the local context.

The questionnaire was designed for respondents to fill in after viewing a specific treatment on the manipulated website. The digitally devised questionnaire encompassed respondents' demography, a covariance test, consumer responses, and a manipulation test. The significance threshold for all tests in this research was set at $\alpha = 0.05$.

The covariance effect test consisted of three categories, which included respondents' prior product knowledge [1], attitude to online reviews [1], and brand awareness [19]. Questions regarding consumer responses on attitude and purchase intention were adapted from [19, 52], respectively. Finally, manipulation test questions were devised on product popularity [19], review quality [30, 32–34, 36], and review proportions. A summary of the questions employed in this research is presented in Table 2. The correlation table for all constructs in this research is presented in Appendix 1 in Table 4.

4.3 Research sample and demography

The study included 382 participants, who were undergraduate and graduate students of the Faculty of Computer Science, Universitas Indonesia. The process of selecting the participants was similar to that of [53], who argued that students readily access eWOM when they search for information before making a decision to purchase.

At the end of the data collection process, 317 valid and completed questionnaires representing instruments A-H had been received. The study used ANCOVA and ANOVA as the analysis method. Since this requires a uniform quantity of data samples for every treatment, the sample used was reduced to the smallest quantity of

Table 2 Question items

Category	Question Item	Mean	SD	C.A.	C.R.
Confounding effects					
Prior product knowledge [1]	I have previous knowledge about smartphones	–	–	–	–
Attitude to online reviews [1]	When I purchase from online shops, I always read the reviews displayed on the site	5.934	1.114	.624	0.766
	When I purchase from online shops, the reviews affect my decision-making process	5.346	1.122		
Brand awareness [19]	I recognize the brand of the product	4.651	2.056	.893	0.949
	When I think of smartphones, this brand comes to mind	4.092	2.124		
Consumer responses					
Attitude [52]	In my opinion, iPhone6/ZTE Nubia is an excellent product	4.684	1.318	.915	0.946
	I consider iPhone6/ZTE Nubia to be an entertaining product	4.610	1.312		
	I consider iPhone6/ZTE Nubia to be a prestigious product	4.529	1.202		
Purchase intention [19]	I am considering purchasing this product	4.044	1.728	.943	0.964
	I will purchase this product when I need a smartphone	3.632	1.644		
	I will purchase this product soon	3.754	1.701		
Manipulation test					
Product popularity [19]	I consider the product to be a popular product	4.529	2.152	.912	0.958
	I recognize and am familiar with the product	3.996	2.110		
Review quality [30, 32–34, 36]	The review provided detailed information.	3.827	1.736	.811	0.912
	The review contained information about the negative aspects of the product	4.213	1.793		
	The negative online review was easy to understand (meaningful)	3.827	1.736		
Review proportions	There were more than two negative online reviews	4.375	2.379	.932	0.966
	The number of negative online reviews was greater than the number of positive ones	4.051	2.461		

valid data per single treatment, which was 34. Hence, for all eight treatments, the study ended up with a total of 272 samples. The participants were asked to respond to two treatments, A and D, B and E, C and F, or D and H. The participants were evenly divided in terms of gender, 68 males and 68 females, and most were between 19 and 23 years old (59 individuals). Almost all participants had previously experienced online shopping (131 individuals), and they also avidly read online reviews on the electronic commerce sites they visited.

4.4 Manipulation test

This study performed a manipulation test to ascertain whether the sample correctly realized the research instrument as well as to validate the attributes selected by the focus group participants. This was done to ensure respondents could differentiate popular and unpopular products, high quality and low quality online reviews, and a high proportion and a low proportion of online reviews.

The whole dataset was first tested for product popularity (Cronbach's alpha: 0.912), proportion of negative online reviews (Cronbach's alpha: 0.932), and quality of negative online reviews (Cronbach's alpha: 0.811). An independent t test was then performed to measure the valence differences in the research instruments, with the following results: product popularity ($t(270) = 28.216$, $p < 0.001$), proportion of negative online reviews ($t(270) = 27.542$, $p < 0.001$), and quality of negative online reviews ($t(270) = 11.264$, $p < 0.001$). Additionally, the dataset with only popular products was tested with regard to the proportion of negative online reviews (Cronbach's alpha: 0.937) and quality of negative online reviews (Cronbach's alpha: 0.816). Finally, an independent t test for the proportion of negative online reviews ($t(134) = 20.378$, $p < 0.001$) and the quality of negative online reviews ($t(134) = 6.611$, $p < 0.001$) was also conducted.

4.5 Reliability and validity test

This research also tested for instrument reliability in its covariates, which included variables of prior product knowledge (only one question, therefore no reliability test), attitude to online reviews (Cronbach's alpha: 0.624), and brand awareness (Cronbach's alpha: 0.893). The dependent variables were also tested using Cronbach's alpha for measuring reliability. Reliability was tested for the dependent variables consumer attitude (Cronbach's alpha: 0.915) and purchase intention (Cronbach's alpha: 0.943). More specifically, the dataset with only the popular product was tested for dependent variable reliability, yielding consumer attitude (Cronbach's alpha: 0.895) and purchase intention (Cronbach's alpha: 0.928).

All question item in the instrument exhibit strong reliability surpassing the general requirements of Cronbach's Alpha of greater than 0.7 [54]. One particular confounding effect of 'attitude to online review' was particularly lower, however this research argue that it is still acceptable having values still greater than the undesirable C.A. of at least 0.6, as suggested by [54, 55]. Perhaps, the low C.A. means that the instrument measures different things (conceptual heterogeneity), and not necessarily mean low reliability. Additionally, C.A values highly depend on the number of items in the scale, in which more items tend to yield higher C.A values [56]. Nonetheless, to strengthen our case, an alternative measure of reliability using Composite Reliability (C.R.) is also provided in Table 2.

Discriminant validity measures the degree in which a construct differs from one another. In this research, discriminant validity was first measured by evaluating the cross loading values of each indicator in a construct, and ensuring that the item loading on the assigned construct were "an order of magnitude larger than any other loading" [57]. Additionally, all loading factors must have values of greater than

0.70. [58]. The loading factors of all indicators in this research are presented in Appendix 2 in Table 5.

Additionally, discriminant validity was also examined using the Fornell–Larcker criteria. Such method compares the square root of Average Variance Extracted (AVE) (exhibited in the diagonals) with the correlation values of each construct in its respective rows and columns. The square root of AVE should be greater than its correlation to other variables. As exhibited in Appendix 3 in Table 6, the overall discriminant validity in this research is supported.

Finally, a more modern method to measure discriminant validity was conducted, using the Heterotrait–Monotrait (HTMT) criterion, as suggested by Henseler [59]. The HTMT results, in Appendix 4 in Table 7, exhibited one multicollinearity problem among two constructs, namely, 'product popularity' and 'brand awareness'. A logical explanation is that the two constructs were measuring the same thing and created an overlap as they were perceived similarly by the respondents. In this research, 'brand awareness' was treated as a construct that measured potential confounding effects, therefore, its similarity with 'product popularity', a construct used exclusively to ensure the questionnaire was correctly manipulated by the respondents, can be ignored.

4.6 Potential confounding effect

The study introduced a potential confounding effect as covariates, owing to the existence of other variables that might affect the dependent variable. These covariates were only considered in the dataset of the popular product.

The two-way ANCOVA test showed that not all covariates affected consumer attitude. The effects of prior product knowledge ($F(1,129) = 0.344$, $p = 0.558$) and attitude to online reviews ($F(1,129) = 0.032$, $p = 0.859$) were insignificant. However, brand awareness ($F(1,129) = 14.450$, $p < 0.001$) had a confounding effect on consumers' attitude.

A similar confounding effect was found with regard to purchase intention. Prior product knowledge ($F(1,129) = 1.595$, $p = 0.209$) and attitude to reviews ($F(1,129) = 0.031$, $p = 0.860$) were insignificant, whereas brand awareness ($F(1,129) = 9.782$, $p = 0.002$) had a confounding effect on purchase intention.

5 Research results

5.1 Hypothesis test results

5.1.1 The effects of the proportions and quality of online reviews in relation to popular products

The first test was conducted with two-way ANCOVA, in order to analyze the effects that the proportion and quality of negative online reviews have on consumers' attitudes and purchase intentions for popular products, bearing in mind the three aforementioned covariates.

The proportion of negative online reviews had a significant influence on consumers' attitude for a popular product ($F(1,129) = 4.808$, $p = 0.030$), with a high proportion of negative online reviews ($M = 4.922$, $SD = 1.2815$) having a greater effect than a low proportion of negative online reviews ($M = 5.387$, $SD = 0.9716$). Therefore, the hypothesis related to the effect of the proportion of negative online reviews on consumers' attitude for a popular product (H1a) was rejected.

However, the results showed that the effect of the proportion of negative online reviews was not the same on purchase intention in relation to popular products, being insignificant ($F(1,129) = 1.210$, $p = 0.273$). A high proportion of negative online reviews ($M = 4.206$, $SD = 1.4785$) did not have a greater effect than a low proportion of negative online reviews ($M = 4.534$, $SD = 1.6270$). Therefore, the hypothesis related to the effect of the proportion of negative online reviews on purchase intention for a popular product (H1b) was accepted.

The quality of negative online reviews had no significant effect on consumers' attitude to popular products ($F(1,129) = 1.029$, $p = 0.312$). A high quality of negative online reviews ($M = 5.020$, $SD = 1.2093$) did not affect consumer attitude differently than a low quality of negative online reviews ($M = 5.289$, $SD = 1.0941$). Therefore, the hypothesis related to the effect of the quality of negative online reviews on consumers' attitude for a popular product (H2a) was accepted.

The study yielded the same results for the effects of the quality of negative online reviews on purchase intention for popular products. The quality of negative online reviews had no significant effect on purchase intention for popular products ($F(1,129) = 0.232$, $p = 0.631$). A high quality of negative online reviews ($M = 4.270$, $SD = 1.6149$) did not affect purchase intention differently than a low quality of negative online reviews ($M = 4.471$, $SD = 1.5032$). Therefore, the hypothesis related to the effect of the quality of negative online reviews on purchase intention for popular products (H2b) was accepted. A visualization of the relationships between review proportion, review quality and consumer responses of attitude and intention to purchase is displayed in Figs. 1 and 2.

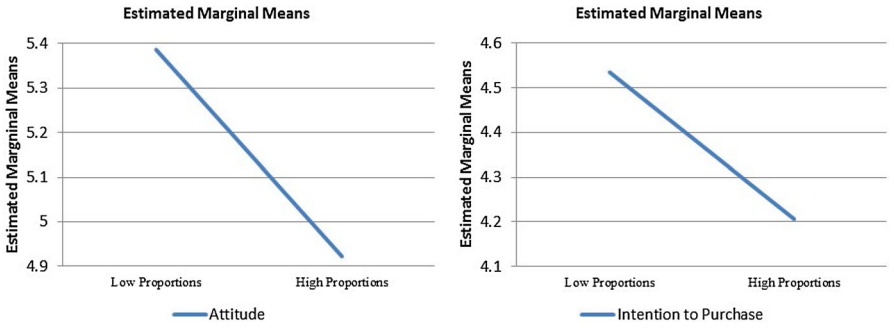

Fig. 1 Estimated marginal means of review proportions

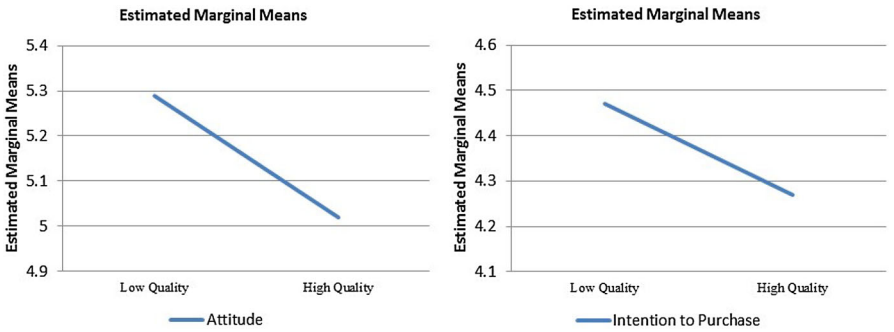

Fig. 2 Estimated marginal means of review quality

5.1.2 The valence of proportions and quality

Two way ANCOVA yielded no significant difference between high proportion-low quality negative online review with low proportion-high quality negative online review for both customer responses, namely attitude ($F(1,129) = 0.511$, $p = 0.476$) and purchase intention ($F(1,129) = 0.179$, $p = 0.673$). Estimated marginal means yielded from this test is reported in Fig. 3.

To ascertain the results, this research conducted a second test with one-way ANOVA. This method was used to compare research instrument B, which had high proportion–low quality negative online reviews, with research instrument C, which had low proportion–high quality negative online reviews. The result showed no significant difference between research instrument B and C for attitude ($F(1,66) = 0.517$, $p = 0.475$) as well as for purchase intention ($F(1,66) = 0.115$, $p = 0.736$).

Therefore, H3a and H3b were both accepted; empirically proving high proportion–low quality negative online reviews had the same effect as low proportion–high quality negative online reviews towards both consumer responses of attitude and purchase intention.

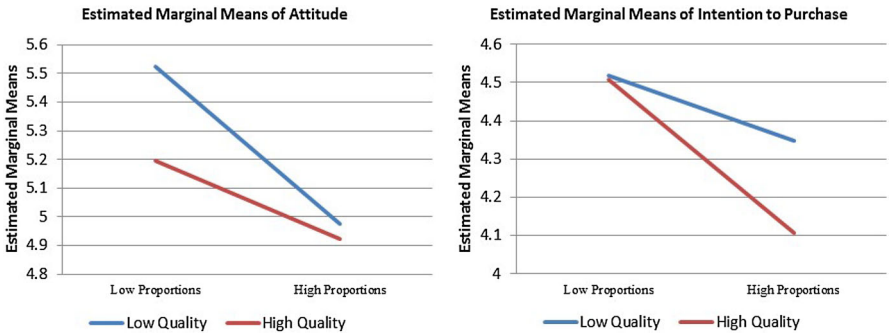

Fig. 3 Estimated marginal means of the relationship of quality and proportions

5.1.3 Understanding the effects of negative online reviews on product popularity

In this section, we aimed to to measure consumer attitude and purchase intention, using three-way ANOVA. This method was chosen because the attribute of product popularity was included in the fourth hypothesis.

The results showed that product popularity had a significant difference on consumers' attitude (H4a) ($F(1,264) = 80.013$, $p < 0.001$) and purchase intention (H4b) ($F(1,294) = 45.658$, $p < 0.001$). Negative online reviews affected consumers' attitude (unpopular $M = 4.061$, $SD = 0.9307$) (Popular $M = 5.154$, $SD = 1.1568$) and purchase intention (unpopular $M = 4.370$, $SD = 1.5575$) (Popular $M = 3.250$, $SD = 1.4497$) relating to an unpopular product significantly more than to a popular product. Therefore, hypotheses H4a and H4b postulating that product popularity would not influence the way negative online reviews affect consumers' attitude and purchase intention were rejected, as depicted in Fig. 4.

The research then probed further by conducting a series of tests using one-way ANOVA, in order to fulfill the requirements for direct comparisons to attain more reliable results for the various different attributes used in each of the hypotheses.

5.1.4 The effects of the number and proportion of negative online reviews of popular and unpopular products

Consumers' attitude relating to popular and unpopular products was affected by the proportion of negative online review. The decrease of consumers attitude when they are exposed to high proportions of negative online review was significantly different ($F(1,134) = 39.548$, $p < 0.001$) for popular ($M = 4.92$, $SD = 1.281$) and unpopular product ($M = 3.72$, $SD = 0.915$) . Additionally, low proportions of negative online review exhibited a similar effect ($F(1,134) = 40.855$, $p < 0.001$), in which the unpopular product ($M = 4.40$, $SD = 0.820$) was affected more than the popular one ($M = 5.39$, $SD = 0.972$). Therefore, the hypothesis relating to the interaction between the proportion of negative online review and product popularity and its effect on consumers' attitude (H4c) was rejected.

Purchase intention for popular and unpopular products was also affected by the proportions of negative online review, with a significant difference between popular

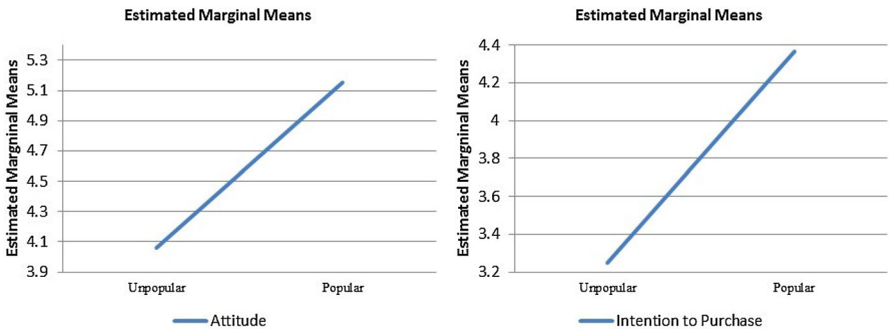

Fig. 4 Estimated marginal means of unpopular and popular product

($F(1,134) = 32.085$, $p < 0.001$) and unpopular product ($F(1,134) = 10.692$, $p < 0.001$). When exposed to high proportions of negative online review, the unpopular product ($M = 2.81$, $SD = 1.386$) was affected more than the popular one ($M = 4.21$, $SD = 1.478$). A similar outcome was seen upon exposure to low proportions of negative online review, in which the unpopular product ($M = 3.69$, $SD = 1.388$) had a graver effect than the popular one ($M = 4.53$, $SD = 1.627$). Therefore, the hypothesis relating to the interaction between the proportion of negative online review and product popularity and its effect on purchase intention (H4d) was rejected. The relationship between review proportions and product popularity is visualized in Fig. 5.

5.1.5 The effects of the quality of negative online reviews of popular and unpopular products

Consumers' attitude relating to popular and unpopular products was affected by the quality of negative online review. The decrease of consumers attitude when they are exposed to high quality negative online review was significantly different ($F(1,134) = 25.148$, $p < 0.001$) for popular ($M = 5.02$, $SD = 1.209$) and unpopular product ($M = 4.04$, $SD = 1.054$). Additionally, low quality of negative online review exhibited a similar effect ($F(1,134) = 54.447$, $p < 0.001$), in which the unpopular product ($M = 4.08$, $SD = 0.796$) was affected more than the popular one ($M = 5.29$, $SD = 1.094$). Therefore, the hypothesis relating to the interaction between the quality of negative online review and product popularity and its effect on consumers' attitude (H4e) was rejected.

Purchase intention for popular and unpopular products was also affected by the quality of negative online review, with a significant difference between popular ($F(1,134) = 16.320$, $p < 0.001$) and unpopular product ($F(1,134) = 21.701$, $p < 0.001$). When exposed to high quality of negative online review, the unpopular product ($M = 3.18$, $SD = 1.525$) was affected more than the popular one ($M = 4.27$, $SD = 1.615$). A similar outcome was seen upon exposure to low quality of negative online review, in which the unpopular product had a graver ($M = 3.32$, $SD = 1.378$) effect than the popular one ($M = 4.47$, $SD = 1.503$). Therefore, the hypothesis relating to the interaction between the quality of negative

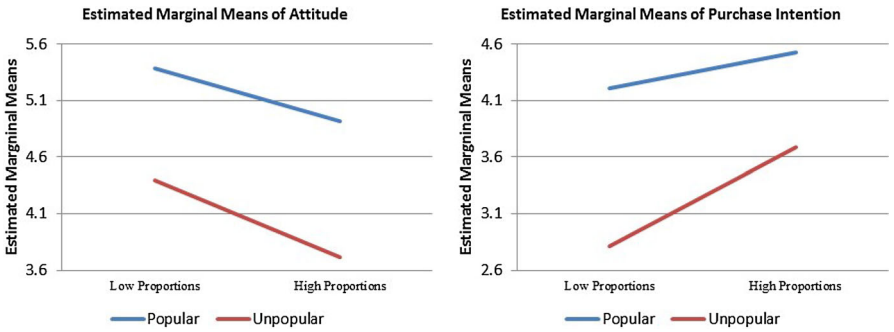

Fig. 5 Estimated marginal means of proportions and product popularity

online reviews and product popularity and its effect on purchase intention (H4f) was rejected. The relationship between review quality and product popularity is visualized in Fig. 6.

5.2 Summary of research findings

This research employed one-way ANOVA, two-way ANCOVA and three-way ANOVA to analyze the data. Out of the total 12 hypotheses defined in Sect. 2, seven were rejected and the other five were accepted, as summarized in Table 3.

6 Discussion

The purpose of this study was to analyze the effects of the proportion and quality of negative online reviews on consumers' attitude and purchase intention, specifically in relation to popular products. Variables identified as potential confounding effects were included in the analysis, and to fulfull the comparative aspect of this research, unpopular products were also included. The results from the hypotheses tested indicate that popular products are largely indifferent to negative online reviews. There are several other key findings worth noting.

6.1 The effects of the proportion of negative online reviews on consumers' attitude and purchase intention in relation to a popular product

The study showed that the proportions (high and low) of negative online reviews affected consumer responses differently. The proportion of negative online reviews affected consumers' attitude, but not their purchase intention, in relation to popular products.

A high proportion of negative online reviews of a popular product was shown to significantly depress consumers' attitude when compared to a low proportion of negative online reviews. This finding confirms previous research [1], which states that consumers' attitude tends to become more unfavorable as the proportion of

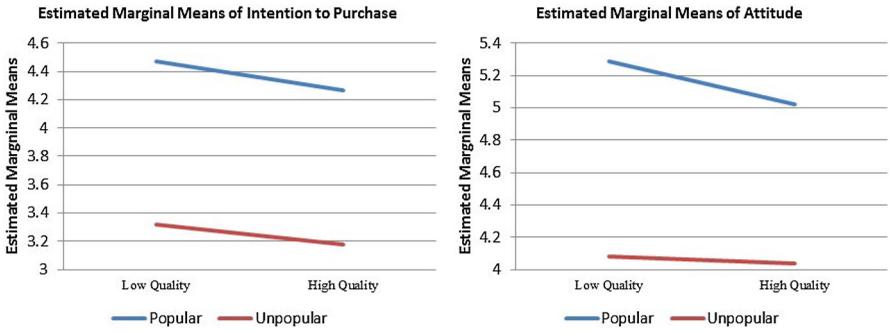

Fig. 6 Estimated marginal means of quality and product popularity

Table 3 Summary of hypotheses test results

H	Hypotheses	Results
H1 (a)	A higher proportion of negative online reviews of popular products does not decrease consumer attitudes significantly compared to a low proportion.	Reject
H1 (b)	A higher proportion of negative online reviews of popular products does not decrease consumer purchase intention significantly compared to a low proportion.	Accept
H2 (a)	Higher quality of a negative online review of a popular product does not decrease consumer attitudes significantly compared to low quality.	Accept
H2 (b)	Higher quality of negative online review on popular products does not decrease consumer purchase intention significantly compared to low quality.	Accept
H3 (a)	High proportion–low quality negative online reviews have the same effect as low proportion–high quality negative online reviews on lowering customers' attitude.	Accept
H3 (b)	High proportion–low quality negative online reviews have the same effect as low proportion–high quality negative online reviews on lowering customers' purchase intention.	Accept
H4 (a)	Negative online reviews of popular products affect consumers' attitude in the same way as negative reviews of unpopular ones.	Reject
H4 (b)	Negative online reviews of popular products affect consumers' purchase intention in the same way as negative reviews of unpopular ones.	Reject
H4 (c)	The proportion of negative online reviews of popular products affects consumers' attitude in the same way as the proportion of negative reviews of unpopular ones.	Reject
H4 (d)	The proportion of negative online reviews of popular products affects consumers' purchase intention in the same way as the proportion of negative reviews of unpopular ones.	Reject
H4 (e)	The quality of negative online reviews of popular products affects consumers' attitude in the same way as reviews of unpopular ones.	Reject
H4 (f)	The quality of negative online reviews of popular products affects consumers' purchase intention in the same way as reviews of unpopular ones.	Reject

negative online reviews increases. The present research has extended this understanding more specifically to popular products. Thus, it is safe to assume that consumer attitudes to popular products are affected by the number of negative online reviews to which they are exposed.

Consumers' purchase intention yielded a different result. High or low exposure to negative online reviews of popular products had no significant effect on consumers' purchase decision. This outcome is somewhat at odds with previous arguments that negative online reviews may lead to a decline in purchase intention [14, 15, 60]. However, it should be noted that previous studies related to general products, not specifically popular ones. The present study has demonstrated that, when it comes to popular products, consumers' purchase intention was indifferent to exposure to high or low proportions of negative online reviews.

Customers' attitude and purchase intention differ considerably in the way they are generally understood. Based on [43], customer attitude is the customer's tendency to give responses in a non-comittal or reflective way. Meanwhile, customer purchase intention may be defined as the customer's plan or willingness to purchase the desired product [46, 47]. Thus, consumer attitude may lead to purchase intention.

6.2 The effects of the quality of negative online reviews on consumers' attitude and purchase intention in relation to a popular product

Consumers' responses in terms of attitude and purchase intention were largely unaffected by the quality of negative online reviews of popular products.

High proportions of negative online reviews did not produce the same effects on consumers' attitudes as high quality of such reviews; in other words, attitudes were affected more by the proportion of negative reviews than by their quality.

The present results showed that the quality of negative online reviews (high and low) also had little impact on purchase intention in relation to popular products. This finding differs somewhat from that of previous studies such as [18], which suggested that detailed negative online reviews, thereby defined as high quality, may depress purchase intention. Additionally, Lee et al. [1] found that high quality negative online reviews affect consumers' attitude more than low quality negative reviews. These two findings were not the outcomes of research on specific product characteristics, whereas the present study on popular products found that the quality (high or low) of negative reviews made no significant difference to either consumers' attitude or purchase intention.

A logical explanation of the different perspectives offered in the present study is that product popularity plays a significant role. According to [22], popular products are highly anticipated, thus arousing higher consumer expectations. Despite the quality of negative online reviews of popular products, consumers' expectations of the products were not affected.

6.2.1 The effect of the proportion and quality of negative online reviews on consumers' attitude and purchase intention in relation to a popular product

This research also analyzed the interaction between the proportion and quality of negative online reviews and their impact on consumer responses for popular products. Analysis of the interaction was carried out by means of null hypothesis verification relating to high quality–low proportion negative online reviews and low quality–high proportion negative online reviews. It was found that the proportion and quality of negative online reviews were closely related. High quality–low proportion negative online reviews depressed consumers' responses in the same manner as low quality–high proportion negative online reviews.

In agreement with previous studies, such as that of [1], this study found, specifically in relation to popular products, that proportions and quality affected consumers' responses in the same manner. In other words, consumers of popular products had the same attitude and purchase intention when encountering any proportion or quality of negative online reviews.

6.2.2 Comparison between popular and unpopular products

This part of the study investigated further the effects of negative online reviews of popular and unpopular products. Consumers' responses seemed similar in every test

conducted on popular and unpopular products. However, negative online reviews had more effect with regard to unpopular products than popular products.

Further tests were conducted to explore the interaction between proportion (high and low) and quality (high and low) of negative online reviews and product popularity (popular and unpopular). The results showed that consumers' attitude and purchase intention were more affected by the proportion and quality of negative online reviews when it came to unpopular products than popular ones. Furthermore, unpopular products depressed consumers' attitude and purchase intention more than popular ones.

This study adds to outcomes from previous studies, such as that of [27], that popular products carry connotations of high quality and that therefore negative online reviews will have minor effects. The results of this study provided empirical evidence to support this notion, namely that negative online reviews affected consumers' responses to unpopular products more than to popular ones.

Despite exposure to high quality negative online reviews, consumers' responses to popular products tended to be stronger. However, responses to popular products were affected if consumers were exposed to larger numbers (proportion) of negative online reviews. This was found to have decreased consumers' attitude, but not their purchase intention.

6.3 Research limitations and suggestions

Like any research, this study has several limitations. One is the demography of respondents who participated in this study, most of whom were students enrolled in the Faculty of Computer Science, Universitas Indonesia. Although having students as research respondents may be justified, as in [53], this may raise concerns in terms of the generalizability of the results. The present results, therefore, cannot necessarily be attributed to all consumer segments. Future research may explore a wider demographic spread of respondents, with a larger range of cultural characteristics.

7 Implications

7.1 Theoretical implications

Numerous previous studies have demonstrated the effects on consumers' responses of negative online review. The present study has extended our understanding of such effects [1], and showed that negative online reviews do not affect consumers' responses to popular products in the same way as to unpopular ones. Popular products are deemed to carry stronger brand awareness, making consumer responses to them less affected by the number or the quality of negative online reviews. This study illustrated, specifically in relation to popular products, that consumers' attitude tends to decline with the increasing proportion of negative online reviews. On the other hand, no significant differences in consumers' attitude were found from exposure to either high or low quality of negative online reviews.

This study also augments our understanding of the impact of negative online reviews on purchase intention. The works of [14, 15] explored the decline of purchase intention due to negative online reviews. The present research, however, found that, in relation to popular products, there was no significant decline in consumers' purchase intention due to the number or the quality of negative online reviews. This confirms the argument of [22], based on Prospect Theory, that consumers have a high anticipation of the quality of a popular product and therefore have higher preconceived expectations of it. Other researchers argue that popular products signal higher quality, and therefore assume that negative online reviews will have less impact [27]. The present research provided empirical evidence of this assumption, confirming that negative online reviews affected popular products less than unpopular ones.

This study has thus provided new theoretical insights into the relationship between the quality, number, and proportion of negative online reviews and consumers' attitude and purchase intention in relation to popular products. Moreover, it has shown that unpopular products are more vulnerable to negative online reviews than popular ones on every response (attitude and purchase intention) and variable (proportion and quality) tested.

7.2 Practical implications

The proportion of negative online reviews seems to be the most important factor that sellers should have regard to, because it has the most significant effect on consumers' attitude to popular products. Although the proportion of negative online reviews does not appear to have the same effects on purchase intention, the decline of consumers' attitude must still be considered, because consumers' purchase intentions arise partly from attitude.

It is unethical for online marketplaces or sellers to revise the text of reviews to improve their quality, because they are written by reviewers. In any case, the quality of negative online reviews does not play a significant role in determining consumers' responses to popular products. The proportion of negative online reviews, on the other hand, is something that marketplaces and sellers could alter in order to manipulate consumer responses. Manipulation of proportions was advised by [1], and could be applied in the case of negative online reviews of popular products, by allowing more positive online reviews on the first page of sites, which is where consumers tend to direct their main focus.

8 Conclusion

The goal of this research was to understand how the quality, number, and proportion of negative online reviews affect consumers' attitude as well as purchase intention, more specifically in relation to popular products. Consumers' attitude was found to decline along with an increasing proportion of negative online reviews received. Purchase intention, however, was not affected by the proportion of negative online reviews. The quality (high and low) of negative online reviews was shown to have

an insignificant effect on responses, attitude, and purchase intention in relation to popular products.

The study also concluded that there is a high correlation between the proportion and the quality of negative online reviews in terms of their effect on consumers' responses. A similar decline was found in consumers' attitude as well as purchase intention in relation to popular products for low quality–high proportion and high quality–low proportion negative online reviews.

Furthermore, unpopular products were used as a benchmark to compare consumers' response against popular products. Attitudes to unpopular products were found to be more affected by negative online reviews than to popular ones. There was a significant difference in the decline of consumers' attitude and purchase intention in relation to popular and unpopular products, although attitudes to unpopular products declined more sharply compared to popular products after exposure to negative online reviews of various proportions and quality.

The results suggest that it is advisable for online marketplaces and sellers, more specifically those carrying popular products, to anticipate the effects of negative online reviews on their consumers' responses. Despite some previous evidence that popular products are not affected by negative online reviews, this research has shown that the proportion of such reviews does indeed affect consumers' attitude.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Appendix 1

See Table 4.

Appendix 2

See Table 5.

Appendix 3

See Table 6.

Appendix 4

See Table 7.

Table 4 Correlation of constructs

	Prior product knowledge	*Attitude to online review 1*	*Attitude to online review 2*	Brand awareness 1	Brand awareness 2	*Attitude 1*	*Attitude 2*	*Attitude 3*	*Purchase intention 1*
Prior product knowledge	1.000								
Attitude to online review 1	0.425	1.000							
Attitude to online review 2	0.256	0.437	1.000						
Brand awareness 1	0.294	0.053	0.110	1.000					
Brand awareness 2	0.257	0.062	0.120	0.807	1.000				
Attitude 1	0.189	0.011	0.131	0.493	0.524	1.000			
Attitude 2	0.175	− 0.010	0.109	0.465	0.489	0.901	1.000		
Attitude 3	0.144	0.057	0.124	0.378	0.393	0.721	0.721	1.000	
Purchase intention 1	0.130	0.015	0.114	0.405	0.468	0.652	0.678	0.664	1.000
Purchase intention 2	0.090	− 0.011	0.107	0.363	0.410	0.613	0.617	0.638	0.842
Purchase intention 3	0.133	− 0.040	0.091	0.460	0.452	0.669	0.692	0.650	0.827
Product popularity 1	0.196	− 0.035	0.058	0.751	0.791	0.577	0.574	0.410	0.505
Product popularity 2	0.229	− 0.042	0.053	0.782	0.804	0.585	0.587	0.418	0.517
Review quality 1	− 0.045	0.059	0.053	− 0.080	− 0.094	− 0.208	− 0.192	− 0.191	− 0.146
Review quality 2	− 0.026	0.005	0.055	− 0.033	− 0.031	− 0.135	− 0.134	− 0.176	− 0.133
Review proportion 1	− 0.021	− 0.045	− 0.036	− 0.024	− 0.032	− 0.197	− 0.195	− 0.144	− 0.149
Review proportion 2	− 0.020	− 0.058	− 0.083	− 0.060	− 0.066	− 0.275	− 0.257	− 0.204	− 0.184

Table 4 continued

	Purchase intention 2	*Purchase intention 3*	*Product popularity 1*	*Product popularity 2*	*Review quality 1*	*Review quality 2*	*Review proportion 1*	*Review proportion 2*
Prior product knowledge								
Attitude to online review 1								
Attitude to online review 2								
Brand awareness 1								
Brand awareness 2								
Attitude 1								
Attitude 2								
Attitude 3								
Purchase intention 1								
Purchase intention 2	1.000							
Purchase intention 3	0.875	1.000						
Product popularity 1	0.448	0.547	1.000					
Product popularity 2	0.456	0.532	0.839	1.000				
Review quality 1	− 0.096	− 0.138	− 0.109	− 0.056	1.000			
Review quality 2	− 0.120	− 0.122	− 0.015	− 0.009	0.683	1.000		
Review proportion 1	− 0.183	− 0.182	− 0.076	− 0.050	0.084	0.178	1.000	
Review proportion 2	− 0.189	− 0.199	− 0.122	− 0.067	0.109	0.179	0.873	1.000

Table 5 Cross loadings of indicators

	Prior product knowledge	Attitude towards review	Brand awareness	Attitude	Purchase intention	Popularity	Review quality	Review proportion
Prior product knowledge	1.000	0.297	0.289	0.184	0.125	0.222	− 0.040	− 0.021
Attitude towards review 1	0.425	0.543	0.060	0.019	− 0.013	− 0.040	0.039	− 0.054
Attitude towards review 2	0.256	0.993	0.121	0.131	0.110	0.058	0.059	− 0.065
Brand awareness 1	0.294	0.110	0.948	0.484	0.434	0.800	− 0.065	− 0.046
Brand awareness 2	0.257	0.120	0.953	0.510	0.469	0.832	− 0.073	− 0.053
Attitude 1	0.189	0.124	0.536	0.950	0.681	0.606	− 0.192	− 0.250
Attitude 2	0.175	0.101	0.502	0.951	0.700	0.605	− 0.182	− 0.238
Attitude 3	0.144	0.123	0.406	0.871	0.687	0.432	− 0.201	− 0.185
Purchase intention 1	0.130	0.108	0.460	0.718	0.939	0.533	− 0.153	− 0.175
Purchase intention 2	0.090	0.098	0.407	0.672	0.953	0.471	− 0.115	− 0.193
Purchase intention 3	0.133	0.080	0.480	0.725	0.951	0.562	− 0.143	− 0.198
Popularity 1	0.196	0.050	0.812	0.567	0.529	0.958	− 0.075	− 0.106
Popularity 2	0.229	0.044	0.835	0.577	0.530	0.960	− 0.039	− 0.062
Review quality 1	− 0.045	0.058	− 0.092	− 0.213	− 0.135	− 0.085	0.940	0.102
Review quality 2	− 0.026	0.052	− 0.034	− 0.159	− 0.132	− 0.012	0.890	0.184
Review proportion 1	− 0.021	− 0.040	− 0.029	− 0.195	− 0.181	− 0.065	0.135	0.957
Review proportion 2	− 0.020	− 0.085	− 0.066	− 0.266	− 0.201	− 0.099	0.151	0.977

Table 6 Fornell–Larcker criterion

	AVE	Prior product knowledge	Attitude towards review	Brand awareness	Attitude	Purchase intention	Popularity	Review proportion	Review quality
Prior product knowledge	1.000	1.000							
Attitude towards review	0.640	0.297	0.800						
Brand awareness	0.903	0.289	0.121	0.950					
Attitude	0.855	0.184	0.125	0.523	0.925				
Purchase intention	0.898	0.125	0.101	0.475	0.745	0.948			
Popularity	0.919	0.222	0.049	0.859	0.596	0.552	0.959		
Review proportion	0.935	− 0.021	− 0.068	− 0.052	− 0.244	− 0.199	− 0.087	0.967	
Review quality	0.839	− 0.040	0.060	− 0.073	− 0.206	− 0.145	− 0.059	0.149	0.916

Table 7 Heterotrait–Monotrait (HTMT) criterion

	Prior product knowledge	Attitude towards review	Brand awareness	Attitude	Purchase intention	Popularity	Review proportion	Review quality
Prior product knowledge								
Attitude towards review	0.516							
Brand awareness	0.307	0.145						
Attitude	0.191	0.126	0.576					
Purchase intention	0.128	0.103	0.516	0.802				
Popularity	0.232	0.078	0.951	0.649	0.594			
review proportion	0.022	0.090	0.054	0.257	0.211	0.092		
Review quality	0.043	0.079	0.080	0.236	0.165	0.062	0.178	

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