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# An Empirical Study of Online Word of Mouth as a Predictor for Multi-product Category e-Commerce Sales

ALANAH DAVIS AND DEEPAK KHAZANCHI

## INTRODUCTION

Message boards, chat rooms, blogs, user feedback forums and other electronic outlets for customer generated media have become increasingly important for today's online consumers to exchange opinions and experiences related to companies, products, and services with individuals outside their personal communication network of family, friends, acquaintances and colleagues (Dwyer 2007). This ability to exchange opinions and experiences online is known as *online word of mouth* (WOM), otherwise referred to as 'buzz' (Liu 2006) or 'word of mouse' (Dellarocas 2003). WOM has been formally defined as 'all informal communications directed at other consumers about the ownership, usage, or characteristics of particular goods and services or their sellers' (Westbrook 1987). The difference between traditional WOM and *online WOM* is that the communication in online WOM takes place in an anonymous asynchronous online environment. Online WOM allows consumers to share both negative and positive opinions and experiences from multiple sources (Chatterjee 2001). However, online WOM has an

advantage over traditional WOM due to its potential to reach more consumers quite rapidly.

Previous research has shown that there is a high level of consumer acceptance and reliance on online WOM (Henning-Thurau and Walsh 2004) and that online WOM can increase product sales (Chen *et al.* 2004, Chevalier and Mayzlin 2006, Davis and Khazanchi 2007, Liu 2006). In fact, some authors have proposed that online WOM may eventually take the place of traditional advertising (Awad *et al.* 2006). Additionally, it has been suggested that very little is known about the influence of online reviews on consumer evaluations and purchase intentions of products (Chatterjee 2001).

The purpose of this paper is to assess the impact of online WOM on e-commerce multi-product sales and our ability to predict changes in sales attributable to various aspects of online WOM. While some researchers have proposed models for the impact of online WOM on sales, most of them have been category specific (i.e. movies, books, music, video games, beer) (Chevalier and Mayzlin 2006, Clemons *et al.* 2006, Dellarocas *et al.* 2004, Liu 2006, Zhu and Zhang 2006). An

## A b s t r a c t

The ability to exchange opinions and experiences online is known as online word of mouth (WOM) and has been shown in the literature to have the potential to impact e-commerce sales. The purpose of this paper is to expand previous findings by empirically evaluating the impact of online WOM attributes and other related factors (e.g. product views, promotion, and category) on e-commerce sales using real data from a multi-product retail e-commerce firm. Research has previously shown that the introduction of online WOM on a retail e-commerce site can positively impact product sales. We propose and validate a conceptual model of online WOM and its impact on product sales and the impact of moderator variables such as promotion, product category and product views. It is our conclusion that previous research on online WOM has been limited as our research empirically demonstrates the conclusion that it is the interaction of product category, volume and product views, and the interaction of product views and product category which are statistically significant in explaining changes in unit product sales. Pure increase in volume or number of reviewer comments has no significant effect on sales. These conclusions have critical implications for the practical use of online WOM in e-commerce and for internet marketing.

**Keywords:** Online word of mouth, online consumer reviews, online recommendations, online marketing, online retailers

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important contribution of our research is that we use real data from a multi-product retail e-commerce firm to develop and validate our model of *online WOM* and its relationship with sales. Specifically our research addresses the following question: *What attributes of online WOM can be used to predict e-commerce sales?*

The rest of the paper is organized as follows. The next section discusses the notion of WOM and the various attributes of WOM that can be found in *a priori* literature as well as presents our initial conceptual model, followed by a description of the research design and data collection. The following section describes the two stages of model refinement and development followed by an analysis of the collected data in relation to the final proposed model. The final sections discuss the results, conclusions, and implications of our research as well as suggesting directions for future research.

## BACKGROUND

### Previous research

WOM relies on information that is communicated about companies, products, or services among consumers. Figure 1 shows an example of online WOM in which a customer has posted a review and rating based on their experience with a product. The review includes a written opinion from a verified purchaser named Sebastian from

Weatherford, Texas as well as a star rating based on the reviewer's opinion. The review shows the date of the posting as well as an image that was uploaded from the reviewer.

Compared with traditional advertising (e.g. TV, Newspapers, etc.), WOM is apparently perceived by consumers as being more credible than private signals and is often more accessible through social networks (Banerjee 1992, Brown and Reingen 1987, Liu 2006). Table 1 summarizes several additional noteworthy findings that previous WOM researchers have identified.

As illustrated in Table 1, a large number of extant research articles on WOM in the marketing literature have primarily focused on studying personal relationships as the basis of communication about products or services (Stewart *et al.* 1985). These 'ties' among consumers may be based on either strong or weak personal social relationships (Brown and Reingen 1987). In contrast, today's online consumers can exchange opinions and experiences related to companies, products, and services with individuals outside of their personal communication network of family, friends, acquaintances, and colleagues by writing their experiences and opinions in blogs, user feedback forums, search engines, or shopping bot sites (e.g. pricescan.com). In this online environment, the personal ties are always weak due to the fact that the person who wrote the review and the person relying on the review do not have a personal relationship (Chatterjee 2001).



Figure 1. Online word of mouth example

Table 1. List of noteworthy examples of previous research findings from WOM studies

<i>Article</i>	<i>Key Findings</i>
Amblee and Bui 2007a	Expert reviews and user reviews are nearly identical in significance and importance when predicting sales; existence of either type of review matters, however valence does not
Amblee and Bui 2007b	Book sales are correlated to the number of reviews, the reputation of the author, and the reputation of complementary goods; book ratings by readers are not a good predictor of book sales
Awad <i>et al.</i> 2006	Participation in and use of online WOM is complementary to participation in and use of offline WOM; the use of online WOM is a substitute for traditional advertising
Awad and Zhang 2006	Online ratings on a website are significantly correlated with online purchases; a firm's filtering strategy effects the impact of ratings on purchases
Clemons <i>et al.</i> 2006	Variance of ratings plays a significant role in determining which new product sales grow the fastest in a review of the beer industry
Hu <i>et al.</i> 2006	The average ratings score does not necessarily reveal a product's true quality and may provide misleading recommendations
Liu 2006	WOM activities are at their highest during the prerelease of a movie and opening week; audiences hold high expectations before a release and become more critical during the opening week; the volume of WOM offers explanatory power for both aggregate and weekly box office revenue more so than the valence of WOM
Zhu and Zhang 2006	Online reviews have a significant influence on sales; one point increase in average rating is associated with a 4% increase in sales; negative ratings have a larger impact than positive ratings; reviews are more influential for less popular products
Chen <i>et al.</i> 2004	More recommendations improve sales; consumer ratings are not related to sales; the number of consumer reviews is positively associated with sales; recommendations work better for less-popular products
Godes and Mayzlin 2004	The more conversation there is about a product the more likely someone is to be informed about it and the greater the sales
Henning-Thurau and Walsh 2004	Consumers read online articulations to save decision making time and make better buying decisions; these motives influence their behaviour
Anderson and Salisbury 2003	Advertising, WOM, market growth, and purchase frequency have a significant moderating influence on adaptation rate
Chevalier and Mayzlin 2003	WOM from customers has a causal impact on consumer purchasing behaviour
Bowman and Narayandas 2001	Engaging in WOM behaviour following customer initiated contact, the median number of customers influenced is approximately three regardless of factors; there is substantial variation in whether customers tell others about customer initiated contact experiences and the number of people they tell
Chatterjee 2001	WOM search depends on the consumer's reasons for choosing an online retailer; the influence of negative WOM on perceived reliability and intentions is determined largely by retailer familiarity
Dellarocas 2000	The combination of controlled anonymity and cluster filtering is a powerful technique for improving the reliability of reputation systems
Duhan <i>et al.</i> 1997	There are different influences on the likelihood of consumers choosing different types of recommendation sources; choosing strong tie sources is influenced by task difficulty and prior knowledge; choosing weak tie sources is influenced by the importance of instrumental cues and subjective prior knowledge
Ellison and Fudenberg 1995	WOM may lead people to adopt an action that is on average superior
Banerjee 1992	People will do what others are doing (herd behaviour) rather than rely on their own information
Anderson 1998	Dissatisfied customers engage in greater WOM than satisfied customers, however this difference appears to be exaggerated
Brown and Reingen 1987	Strong ties are more influential and more likely to be used than weak ties
Westbrook 1987	Affective response is related to the favourability of consumer satisfaction in judgments, the extent of seller directed complaint behaviour, and the extent of WOM transmission
Richins 1983	The nature of dissatisfaction, consumers' attributions for blame, and perceptions of complaint situations are related to dissatisfaction responses.

## CHARACTERISTICS OF ONLINE WORD OF MOUTH

WOM research has shown that WOM has an influence on an assortment of cognitive conditions that includes

awareness, attitude, expectations, perceptions, intentions, and behaviour (Buttle 1998, Liu 2006). These cognitive conditions can be influenced by various characteristics of online WOM as suggested by Liu

(2006). For example, Liu (2006) suggests that the WOM characteristic of volume (i.e., *the total amount of WOM*) produces the cognitive consequence of awareness while the WOM characteristic of valence (i.e., *whether the attitude is positive or negative*) produces the cognitive consequence of attitude. Furthermore, previous research has clearly demonstrated that the notions of volume and valence are two of the most important WOM attributes (Amblee and Bui 2007a, Liu 2006). The following subsections will discuss volume and valence in greater detail as well as two additional attributes of online WOM, visual cues and reviewer type.

### Volume

According to Liu (2006), *volume measures the total amount of WOM interactions*. Referring back to Figure 1 this would mean the number of comments from reviewers about a specific product or service. The existence of online WOM results in an increase in awareness and a positive (or negative) attitude towards a product resulting in a change in sales (Álvarez *et al.* 2007). Thus, the more conversation in the form of online comments there is about a product, the more likely someone will be informed about it, i.e., there is increased awareness of the product (Godes and Mayzlin 2004). This will in consequence result in higher product sales. Many previous studies have shown that the WOM volume significantly correlates with consumer behaviour and market outcome (Amblee and Bui 2007b, Anderson and Salisbury 2003, Bowman and Narayandas 2001, Liu 2006). Additionally, Mayzlin (2006) has found that rational consumers still pay attention to anonymous on-line posts, even when it is possible for firms to pose as online consumers. For the most part, researchers have concluded that online customer reviews have a significant influence on the sale of products (Awad and Zhang 2006, Zhu and Zhang 2006). However, some researchers have argued that only the volume of the reviews matter (Chen *et al.* 2004, Duan *et al.* 2005).

### Valence

Valence is the idea that WOM can be either positive or negative (Buttle 1998). According to Liu (2006), *valence measures the nature of the WOM message and whether it is positive or negative*. In the example provided by Figure 1, the valence of online posting is positive as the reviewer rated the product with five stars and has corresponding comments that are also positive. Behavioural research has shown that it is unclear whether positive WOM leads to increased sales (Anderson 1998). Various studies have shown that

valence does not have an effect on product sales (Amblee and Bui 2007a, Davis and Khazanchi 2007). However, Chen and Singh (2001) suggest that online ratings have become increasingly important because they 'allow users to harvest the wisdom of the community in making decisions.' Zhu and Zhang (2006) studied the influence of consumer ratings on video game sales and showed that a higher rating by only one point was associated with a 4% increase in sales. Furthermore, there is some evidence to suggest that valence is the best predictor of sales among all of the WOM attributes (Dellarocas *et al.* 2004).

### Visual cues

We define visual cues as *any image (a form of communication) posted by a reviewer and directed at other consumers when evaluating the characteristics of a particular good or service*. The image included with the reviewers' rating of a product in Figure 1 illustrates this additional ability to verify that their dog enjoys the bean bag. This notion of visual cues as an attribute of online WOM initially emerged when we asked ourselves if sales would be impacted when reviewers' comments could include images of products that they purchased online from the e-commerce site. Our initial conclusion that visual cues should be part of our online WOM model is supported by research in the marketing field by Fang and Salvendy (2003) which concludes that 'pictures of products are necessary to provide customers visual cues and richer information.' This belief is further supported by results from previous research of image use in an online environment. For example, a study by Zheng *et al.* (2002) suggests that in virtual teams exposure to photographs prior to team interaction increases trust. Similarly, another study found that in newly formed virtual teams images of team members promoted affection and social attraction (Walther *et al.* 2001). Could this same idea be true for increasing trust of reviewer comments and ratings (i.e., online WOM)? In contrast, a study of Amazon.de (the German Amazon e-commerce shopping site) found that displaying photos of people or employees of an e-commerce site is generally not advisable as study participants reacted with suspicion; however this negative perception may partly be due to the local cultural context (Riegelsberger and Sasse 2002). Instead of individual team members in this example, if consumers of online products write reviews and have the opportunity to upload images of their products in use, would the result be different? In this vein, a recent study by Lurie and Mason (2007) has specifically related visual cue research to WOM research, think 'a picture is worth a thousand words.' Specifically, Lurie and Mason (2007) present the characteristics of 1) visual perspective – the interactivity and detailed extent of a product representation and 2) information

context – the vividness, evaluability, and information framing. For example, Lands' End website offers users the ability to interact with clothes as though 'trying on' clothes. The e-commerce site used in our study offers users the ability to see products in the homes and other locations of users who are both satisfied and dissatisfied with the product as another form of online WOM and passing along to the user visual cues in terms of product expectations. Lurie and Mason (2007) propose that this visual perspective leads to a customer's process of decision making.

### Reviewer type

Previous research has shown that the influence of WOM can be so strong that it overrides private signals and results in individuals relying solely on the information provided by 'reviewers' (Banerjee 1992, Ellison and Fudenberg 1995). The notion of a 'reviewer type' is not a new concept as previous studies have empirically tested models of WOM which consider expert reviews versus user reviews (e.g. Amblee and Bui 2007a, Kumar and Benbasat 2006, Smith *et al.* 2005). In contrast, we define reviewer type as *the nature of the individual participating in online WOM*. Referring back to Figure 1, the individual relying on the review can see that the reviewer in this case was a 'verified purchaser.'

Online reviews originate from various sources and are generally provided by either expert reviewers or individuals who have had either a very negative or very positive experience (Clemons *et al.* 2006). Researchers have studied the various sources that reviews come from including peer reviews, editorial reviews or recommendations, website recommendations, or online agent recommendations (Kumar and Benbasat 2006, Senecal and Nantel 2004, Smith *et al.* 2005). In their research, Pollach (2006) asserts that reviewers may be either manufacturers or merchants attempting to promote their own products and therefore need to convince readers that they are both experts and trustworthy. Smith *et al.* (2005) in particular suggest that peer reviews (or recommendations) are the most preferred by consumers. They found that even when the peer is described as being low in rapport and expertise, peer recommendations are still used more than editorial recommendations (Smith *et al.* 2005). On the other hand, Senecal and Nantel (2004) found that online recommendation systems are the most influential source in consumers' product choice process, although peer consumers were perceived more trustworthy. Despite the differences in motivation for posting reviews both reviews from professional reviewers (i.e. experts) and consumers (i.e. users) are nearly identical in significance and importance when it comes to impacting product demand (Amblee and Bui 2007a).

### INITIAL CONCEPTUAL MODEL

As discussed in the previous sections, research has shown that WOM has an influence on an assortment of cognitive conditions including awareness, attitude, expectations, perceptions, intentions and behaviour (Buttle 1998, Liu 2006). These cognitive conditions can be influenced by various characteristics of online WOM (Liu 2006). For example, Liu (2006) suggests that the WOM characteristic of volume produces the cognitive consequence of awareness while the WOM characteristic of valence produces the cognitive consequence of attitude. We further propose that the cognitive consequences of expectation and perception, which have been identified in the literature (Buttle 1998, Liu 2006), can potentially influence the relationship between online WOM attributes of visual cues and reviewer type on product sales. It is important to note here that the four of these cognitive consequences do not mediate the relationship between online WOM and product sales, but instead explain why volume and valence can impact online behaviour (this is why the middle box has a dotted line). Figure 2 shows our initial conceptual model based on previous research.

Figure 2 shows a '+' in the relationship between volume and sales because previous research has shown that volume is a reliable predictor of sales (Amblee and Bui 2007a, Davis and Khazanchi 2007, Liu 2006). The three other dimensions of online WOM show a '?' since the relationship between the online WOM attributes and product sales is either unknown or previous research on these relationships has been inconclusive or ambiguous.

Figure 2 also depicts three variables (promotion – i.e. whether or not the product is on sale, product views – i.e., the number of product page impressions each week, and product category) that have the potential of moderating the relationship between online WOM attributes and sales. Prior research on WOM has shown that the inability to deal with promotion and product views can be a limiting factor in generalizing results (Davis and Khazanchi 2007). Since we were given access to real e-commerce sales data from a multi-product retail e-commerce web site we are able to overcome this limitation. Additionally, many proposed models have only been able to explain the impact of online WOM on e-commerce sales in terms of one product category (e.g., movies, books, music, video games, beer) (Chevalier and Mayzlin 2006, Clemons *et al.* 2006, Dellarocas *et al.* 2004, Liu 2006, Zhu and Zhang 2006).

In terms of differences in the impact of online WOM across product categories, researchers have proposed that consumers are likely to search online for *search goods* such as books and toys, in fact they may prefer to shop online (Choi *et al.* 2006, Girard *et al.* 2003). Additionally, consumers like to take the time and effort to see, smell, test, and feel *experience goods* like jewellery and perfume (Choi *et al.* 2006, Girard *et al.* 2003).

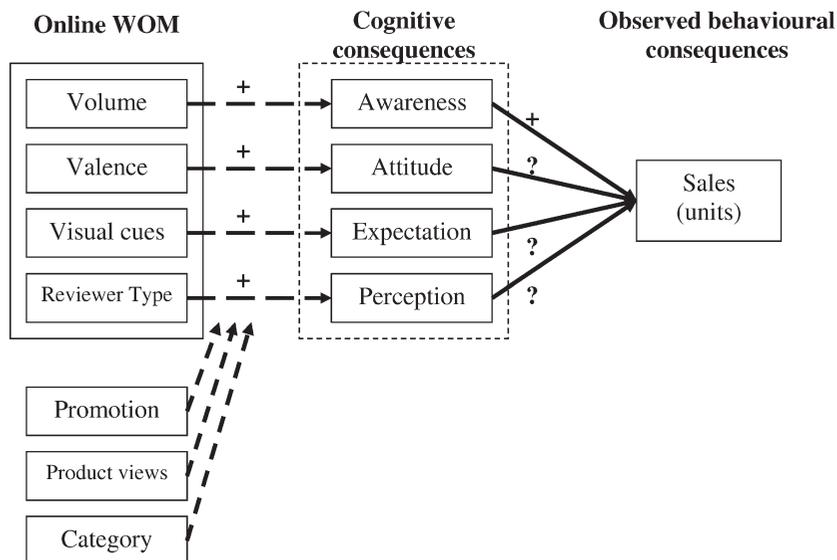


Figure 2. The impact of online word of mouth measures on potential sales: Initial conceptual model

Researchers have also found that *credence goods* such as vitamins or air purifiers involve brand consciousness, risk and uncertainty; in this case consumers prefer to base searches on WOM and/or the experience of others (Choi *et al.* 2006, Girard *et al.* 2003). In the data used for research study, products are categorized by the formal attributes given by the subject organization. These categories include hammocks, benches, Adirondack chairs, wind chimes, dartboards, globes, bean bags, barstools, dog houses, pot racks, clocks, toy boxes, kitchen islands, wine racks, hand trucks and computer desks. If we think about these in terms of product classifications such as search goods, experience goods and credence goods (Choi *et al.* 2006, Girard

*et al.* 2003), most of our subject firm’s products would be classified under *credence products* as they are all significant investments in terms of price and present a potential risk to the customer. This is new and is in contrast with previous research which has primarily focused on online WOM with regards to products that are generally considered *search goods*.

### RESEARCH DESIGN

Data for this research was collected from a leading multi-product retail e-commerce company that has been in business since 2001 and has over 300 employees. To

Table 2. Data collected from leading e-commerce company

<i>Data Collected</i> (Variable name)	<i>Definition</i>	<i>Instrumentation of model variables</i> (Level of Measurement)
SKU	Product identification, i.e. SKU number of the product	
Name	Name of the product	
Product Category (CatID)	Identification number for the category the product is a part of	Random number value that ranges from 1 to the total number of products sold by the firm (650+)
Product Category Description (CatName)	The name of the category the product falls under	Textual description
Product Views (ProdViews)	The number of product page impressions that week	Numerical value (Scale)
Sales (NumSold)	The number of products sold that week	Numerical value (Scale)
Valence (AvgRat)	Average reviewer rating for the product in the form of 'star ratings'	Numerical value (Ordinal; 1 or Low=*, *****=5 or High)
Volume (NumRev)	Total number of review comments for the product	Numerical value (Scale)
Promotion	Whether or not the product was on sale	Numerical value (Ordinal; 1=On sale; 0=Not on sale)
Reviewer Type (ReviewerType)	The type of reviewers for a product	Numerical value (Ordinal; 1=Verified purchaser; 2=Verified reviewer; 3=Not Verified; 4=Product with more than one type of reviewer)
Visual Cues (Image)	Whether or not the reviews contained reviewer uploaded product images	Numerical value (Ordinal; 1=Visual cue is present; 0=Visual cue is absent)

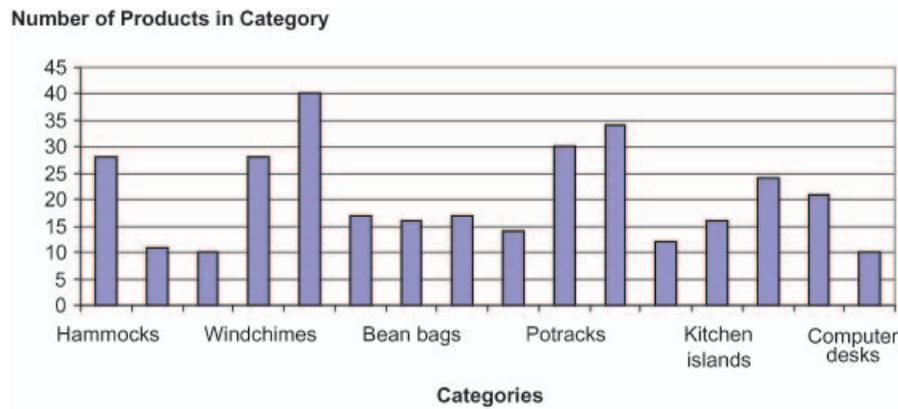


Figure 3. Categories represented in data set

date the organization has served over one million customers in various categories of products. The details of the data that was collected can be found in Table 2.

Online reviews are collected either from the product page of the website or through email (e.g. usually from a reply email after the customer has received the shipment notice email). The collected reviews appear as shown in Figure 1; including a star rating on a five point scale, review title, reviewer name and type (i.e. either verified purchaser, verified reviewer, or not verified), reviewer city and state, date of review, and reviewer's overall recommendation statement. Additionally, reviewers are permitted to suggest pros, cons and write various other statements in terms of best uses or bottom line recommendations. Reviewers can also post images of the product in use as shown in Figure 1.

The particular review system used by the subject organization filters product reviews as do other review systems (Awad and Zhang 2006). This is to say that all reviews related to product quality are posted, including negative ones. However, reviews are filtered to exclude any comments related to price, customer service issues, and other non-product quality data.

To evaluate our initial conceptual model and validate our final refined model, a random set of product data was collected from the subject organization at two

different time periods. In order to minimize the effect of the holiday shopping period on online product sales, we deliberately chose to look at sales and other related data for January 2007 after the winter break, specifically the week beginning 15 January 2007 and prior to the holiday shopping period for Memorial Day in May 2007, specifically the week commencing 14 May 2007. Initially, the data set included about 15% of the products sold from the online retailer (i.e. 546 products from 73 categories). To allow us the ability to use the general linear model (GLM) statistical procedure effectively to analyze our conceptual models, the data set was further reorganized to only include product categories where over 10 products had been sold. A large number (i.e. 70%) of the categories not included in the final data set were ones that had five or fewer items sold. Therefore, the resulting data set included 15 product categories and 328 unique products (refer to Figure 3).

Table 3 provides a summary of the descriptive statistics relating to the first data set, (i.e. products sold the during week beginning 15 January 2007).

Table 4 provides a summary of the descriptive statistics relating to the data set from the second time period (i.e. products sold during the week beginning 14 May 2007). The data from the second time period includes the exact

Table 3. Initial model descriptive statistics (N=328)

	Range	Minimum	Maximum	Mean	Std. deviation
Product category	102	1	103	N/A	N/A
Product views	1326	0	1326	185.86	204.570
Promotion	1	0	1	N/A	N/A
Reviewer type	3	1	4	N/A	N/A
Sales	85	1	86	N/A	N/A
Valence	2	3	5	4.50	.485
Visual cue	1	0	1	N/A	N/A
Volume	60	1	61	3.74	5.046

Table 4. Refined model descriptive statistics (N=328)

	Range	Minimum	Maximum	Mean	Standard deviation
Product category	102	1	103	N/A	N/A
Product views	2554	0	2554	124.44	206.76
Promotion	1	0	1	N/A	N/A
Reviewer type	3	1	4	N/A	N/A
Sales	176	0	176	8.16	15.38
Valence	4	1	5	4.44	.53
Visual cue	1	0	1	N/A	N/A
Volume	110	0	110	8.54	10.48

Table 5. GLM results for initial conceptual model (No interaction terms included)

Source		Type III Sum of squares	df	Mean square	F	p-value
Intercept	Hypothesis	41.513	1	41.513	1.102	.295
	Error	11988.254	318.129	37.684		
Reviewer type	Hypothesis	11.532	3	3.844	.105	.957
	Error	11153.216	304	36.688		
Visual cues	Hypothesis	178.088	1	178.088	4.854	.028*
	Error	11153.216	304	36.688		
Product category	Hypothesis	2075.511	15	138.367	3.771	.000*
	Error	11153.216	304	36.688		
Valence	Hypothesis	46.759	1	46.759	1.274	.260
	Error	11153.216	304	36.688		
Product views	Hypothesis	878.638	1	878.638	23.949	.000*
	Error	11153.216	304	36.688		
Volume	Hypothesis	3538.964	1	3538.964	96.461	.000*
	Error	11153.216	304	36.688		
Promotion	Hypothesis	1.741	1	1.741	.047	.828
	Error	11153.216	304	36.688		

Notes: \*=significant WOM attributes

same set of products and categories as from the first set of data; the data is just based on the sales from a different weekly period.

## MODEL REFINEMENT AND DEVELOPMENT

### Data analysis for initial conceptual model

The initial conceptual model (refer to Figure 2) was evaluated using the data from the January time frame. As stated previously, we utilized the GLM univariate procedure and used the statistical package, SPSS, to analyze the following initial model:

Model: Intercept + Reviewer Type + Visual Cues (Images) + Category + Valence (Average Rating) + Product Views + Volume (Number of Reviews) + Promotion

An analysis of the data to evaluate the homogeneity of variances using Levene's test of equality of error variances shows that there is no significant difference in variance across the groups of scores ( $p$ -value=.23). This along with the residual plot confirms that the data is distributed normally and that error variances are equal. An analysis of the scatter plot of online WOM volume and product sales shows no apparent non-linear relationship. These assessments satisfy the primary data assumptions for interpreting the results of the standard GLM procedure. The results of the GLM analysis are shown in Table 5.

The statistical analysis of our initial conceptual model shows that the main effects for online WOM attributes, visual cues and volume, and moderator variables product category and product views are statistically significant

( $p < .05$ ) predictors of the number of products sold. However, the online WOM attributes reviewer type, valence, and moderator variable promotion do not have a significant effect on unit product sales. The lack of significance of valence is in line with previous research which has shown that it is unclear whether positive WOM in terms of valence or average reviewer ratings leads to increased sales (Amblee and Bui 2007a, Amblee and Bui 2007b, Anderson 1998).

### Refined conceptual model and hypotheses

Based our findings of an initial analysis of the January data using GLM, we developed a new conceptual model. Figure 4 displays a refined, more parsimonious version of the initial conceptual model after removing all independent and moderator variables that were not statistically significant in the initial analysis.

Based on the refined conceptual model shown in Figure 4, we propose the following hypotheses:

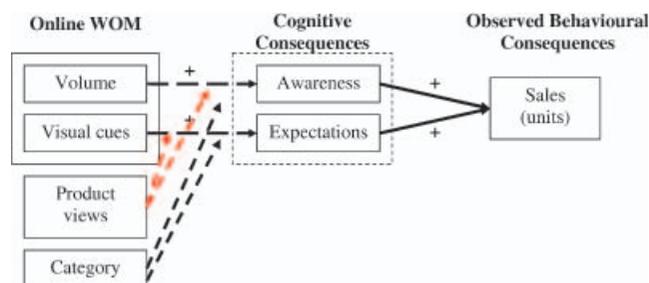


Figure 4. The impact of online word of mouth measures on potential sales: Refined conceptual model

Table 6. GLM results for refined conceptual model

Source		Type III sum of squares	df	Mean Square	F	p-value
Intercept	Hypothesis	283.909	1	283.909	4.606	.035*
	Error	5124.133	83.127	61.642		
Visual cues	Hypothesis	115.520	1	115.520	1.926	.170
	Error	3947.026	65.806	59.980		
Product category	Hypothesis	1225.475	15	81.698	1.165	.399
	Error	857.034	12.218	70.143		
Volume	Hypothesis	11.727	1	11.727	.216	.643
	Error	15181.094	279	54.413		
Product views	Hypothesis	755.144	1	755.144	13.878	.000*
	Error	15181.094	279	54.413		
Volume * product views	Hypothesis	115.444	1	115.444	2.122	.146
	Error	15181.094	279	54.413		
Visual cues * product views	Hypothesis	838.893	1	838.893	15.417	.000*
	Error	15181.094	279	54.413		
Product category * volume	Hypothesis	2794.326	15	186.288	3.424	.000*
	Error	15181.094	279	54.413		
Visual cues * product category	Hypothesis	903.887	13	69.530	1.278	.226
	Error	15181.094	279	54.413		

Notes: \*=significant WOM attributes

*Hypothesis 1:* Products with higher volume (i.e. number of online customer review comments) have a higher number of online purchases (sales).

*Hypothesis 2:* Products with a higher number of reviewer submitted visual cues (i.e. images) have a higher number of online purchases.

*Hypothesis 3:* Products with a higher number of product views have a higher number of online purchases.

*Hypothesis 3.1:* Product views moderates the relationship between volume and sales. That is, the relationship between volume and sales will change depending on the number of product views.

*Hypothesis 3.2:* Product views moderates the relationship between visual cues and sales. That is, the relationship between visual cues and sales will change depending on the number of product views.

*Hypothesis 4:* Category will have an effect on the number of online purchases.

*Hypothesis 4.1:* Category moderates the relationship between volume and sales. That is, the relationship between volume and sales will change depending on category of product.

*Hypothesis 4.2:* Category moderates the relationship between visual cues and sales. That is, the relationship between visual cues and sales will change depending on category of product.

### Data analysis for refined model

To test our refined model (refer to Figure 4) and the related hypotheses, we used the May data, mentioned earlier, and implemented it for the GLM procedure in SPSS as follows:

Model: Intercept + Visual Cues + Product Category + Volume + Product Views + Visual Cues \* Product Category + Volume \* Visual Cues + Volume \* Product Views.

We specifically include interaction terms in this analysis to test specifically our hypotheses relating to the moderating effects of product views and product category on changes in product sales. Table 6 displays the results from the GLM analysis.

The analysis of data once again demonstrates equality of error variances. Specifically, an analysis of the data to evaluate the homogeneity of variances using Levene's test of equality of error variances shows that there is no significant difference in variance across the groups of scores. The following section presents the statistical analysis and results of the refined conceptual model in detail in relation to our hypotheses.

### DISCUSSION OF RESULTS

The following discussion evaluates our online WOM model overall and the related hypothesis.

*Hypothesis 1:* Products with higher volume (i.e. number of online customer review comments) have a higher number of online purchases (sales).

As shown in Table 6, we fail to reject the null hypothesis. Thus, the main effect for the online WOM attribute, volume, is *not* significant by itself in explaining variances in product sales. This conclusion contradicts extant

research results regarding the positive impact of online WOM volume on sales. Researchers have previously shown that volume measured in terms of the number of online customer reviews does have a significant influence on the online sale of products (Awad and Zhang 2006, Zhu and Zhang 2006). In fact, a study from Duan *et al.* (2005) suggests that only the volume matters in relation to sales interest, not whether the reviews are positive or negative. One explanation for the difference in results is that previous researchers have primarily focused on a single product or product type such as movies, books, music, video games, beer (Chevalier and Mayzlin 2006, Clemons *et al.* 2006, Dellarocas *et al.* 2004, Liu 2006, Zhu and Zhang 2006). Based on our findings it can be concluded that the *interaction of product category and volume is more important* for multi-product ecommerce sites. Though increased volume of online WOM can increase the buzz about a product (there is a high correlation), increased sales are not necessarily guaranteed for all products with consumer comments.

*Hypothesis 2:* Products with a higher number of reviewer submitted visual cues (i.e. images) have a higher number of online purchases.

Table 6 shows that we fail to reject the null hypothesis, i.e., the main effect for ‘visual cues’ is not statistically significant in explaining variances in product sales. Thus, product pages that include reviewer submitted images are not by themselves enough to effect product sales.

*Hypothesis 3:* Products with a higher number of product views have a higher number of online purchases.

*Hypothesis 3.1:* ‘Product views’ moderates the relationship between volume and sales. That is, the relationship between volume and sales will change depending on the number of product views.

*Hypothesis 3.2:* ‘Product views’ moderates the relationship between visual cues and sales. That is, the relationship between visual cues and sales will change depending on the number of product views.

The results in Table 6 show that the overall hypothesis is supported and that the main effect, product views, is statistically significant in explaining the increase in product sales. Furthermore, we can see that the hypothesis about the effect of the interaction between product views and volume on product sales is not rejected. However, the effect of the interaction between product views and visual cues on product sales is statistically significant and we reject the null.

These results suggest that, in general, product pages with a higher number of customer views will produce a higher number of purchases. This conclusion seems to make intuitive sense in that more the number of customers viewing a product page the more popular that product may be and therefore the more likely sales of that product will increase. Our results in this regard

are similar to previous research in that the more popular a specific product, the more likely sales will increase (Chevalier and Mayzlin 2003, Zhu and Zhang 2006). However, it is important to note that our research shows that this relationship is moderated by the presence or absence of reviewer uploaded images (visual cues) available for a product. Figure 5 illustrates the post hoc analysis of visual cues as they relate to product sales. Clearly, many of the product categories with images seem to have higher sales.

*Hypothesis 4:* Category will have an effect on the number of online purchases.

*Hypothesis 4.1:* Category moderates the relationship between volume and sales. That is, the relationship between volume and sales will change depending on category of product.

*Hypothesis 4.2:* Category moderates the relationship between visual cues and sales. That is, the relationship between visual cues and sales will change depending on category of product.

Our overall hypothesis about the main effect, product category, is not supported by the data. This implies that the type of product (‘category’) by itself is *not* an important factor in predicting e-commerce product sales. However, we do show that the interaction of products category and volume (i.e. number of comments about a product) has a significant effect on product sales (i.e. Hypothesis 4.1 is supported) and the product category does not moderate the relationship between visual cues and product sales (i.e. Hypothesis 4.2 is not supported).

The previous results imply that product categories with higher online WOM represented by volume of comments will have a higher number of purchases than those categories that have lower volume of comments. This is new to WOM research in that the proposed models have

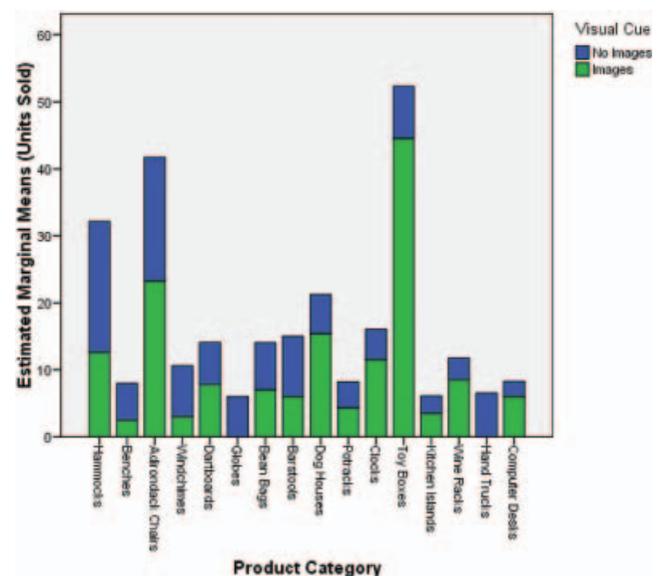


Figure 5. The estimated marginal means of numbers of units sold

all been category specific (i.e. movies, books, music, video games, beer) in the impact of online WOM on sales (Chevalier and Mayzlin 2006, Clemons *et al.* 2006, Dellarocas *et al.* 2004, Liu 2006, Zhu and Zhang 2006).

## CONCLUSION, IMPLICATIONS AND FUTURE RESEARCH

The overarching aim of this study is to explore the influence of online WOM attributes on e-commerce sales using actual data from a multi-product retail e-commerce website. We propose and validate a conceptual model to explain the impact of online WOM attributes on product sales. Our research contributes to the field in five key ways: (1) the use of 'real' e-commerce multi-product sales data to study the impact of online WOM on change in product sales (as opposed to prior research studies which have mostly used perception measures), (2) the accounting of moderator variables such as promotion, product views, and product category in our models, (3) the statistically conclusive finding that main effects due to online WOM attributes volume, valence, visual cues, and reviewer type do not by themselves explain changes in product sales, and (4) the statistically conclusive finding that moderator variables (product category and promotion) do not by themselves explain changes in product sales, but, product views by themselves can explain some of the change in product sales. Furthermore, products that are visited by customers and have visual cues in the form of reviewer images are more likely to result in unit sales, and (5) the statistically conclusive finding that specific products that also have higher online WOM in the form of volume of comments can impact their sales.

One of the most important implications for practice is the idea that e-commerce companies need to have a strategy of combining efforts to increase product views and the volume of comments on specific product pages. This research also points out the value in allowing reviewers to upload product images, probably boosting the cognitive consequence of expectations about a product.

Our research confirms and provides a better understanding of previous conclusions about the attributes of online WOM and its potential impact on product sales and also puts into play the notion that there are other factors (i.e. product views and categories) that influence multi-product e-commerce sales and work in conjunction with online WOM attributes such as visual cues and volume.

Further research needs to be conducted to verify our overall conclusion that online WOM by itself will not increase sales but that such a result can only be obtained by a conjoint increase in product views and an increase in online WOM volume for specific product categories. Another extension to this research may be to better understand how online WOM effects customer loyalty

or satisfaction with purchase. Another important area of researcher that is still unanswered is why valence is sometimes a predictor of sales (Chen and Singh 2001, Dellarocas *et al.* 2004, Zhu and Zhang 2006) and sometimes not (as in this study). Finally, it might be interesting to further explore the impact of online WOM on unit sales for products grouped by classification schemes such as search goods versus credence goods.

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