Personal Word of Mouth, Virtual Word of Mouth, and Innovation Use*

Tomoko Kawakami, Kazuhiro Kishiya, and Mark E. Parry

The authors examine the impact of word-of-mouth communication on innovation use. Hypotheses are developed linking both personal and virtual word of mouth (vWOM) directly to innovation use. The authors also examine the mediating role of two additional variables that link word of mouth and innovation use. Existing research suggests that personal word of mouth (pWOM) indirectly influences intensity of innovation use through its impact on consumer perceptions of the size of local adopter population. In addition, both personal and virtual word-of-mouth influence should be positively associated with consumer perceptions of the availability of complementary products, which prior studies have linked to variety of innovation use.

The authors test these hypotheses using data collected from 247 Japanese adopters of new-generation portable gaming devices. Findings indicate that both personal and virtual word of mouth are directly related with variety of innovation use, which is in turn related with intensity of use. In addition, pWOM is positively related with both intensity of use and variety of use through its impact on consumer perceptions of (1) the perceived size of the local adopter population and (2) the availability of complementary products. In contrast, through these same two paths, vWOM is negatively related with both intensity of use and variety of use.

Introduction

In their widely cited review of the adoption literature, Robertson and Gatignon (1986) observed that the speed of new product diffusion is critically dependent on product use. Understanding the determinants of product use is important for several reasons. First, favorable use experience can motivate users to share positive word of mouth with potential users, which can stimulate adoption (Mahajan and Muller, 1979; Mahajan, Muller, and Bass, 1990; Robertson and Gatignon, 1986; Rogers, 2003). Second, innovation use can expand demand for complementary products, which in turn can stimulate the supply of complementary products and speed new product adoption (Katz and Shapiro, 1985; Redmond, 1991). Third, favorable use experience can expand demand among existing adopters for next-generation products introduced by manufacturers (Farrell and Saloner, 1985; Padmanabhan, Rajiv, and Srinivasan, 1997).

In this paper, we examine the impact of word-of-mouth communication on innovation use. Consistent with prior research, we define word-of-mouth communication as the exchange of information and evaluative beliefs between adopters and potential adopters regarding a product in which the communication content is not created or sponsored by the product manufacturer or related marketing organizations (Bloch, Sherrell, and Ridgway, 1986; Bone, 1995; Feick and Price, 1987; Maxham, 2001). We distinguish between two types of word-of-mouth communication. Personal word of mouth (pWOM) refers to communication between individuals who know each other (Allsop, Bassett, and Hoskins, 2007; Bone, 1995; Day, 1971; Engel, Kegerreis, and Blackwell, 1969), while virtual word of mouth (vWOM) refers to communication between individuals who have never met in real life (Gruen, Osmonbekov, and Czaplewski, 2006; Hennig-Thurau, Gwinner, Walsh, and Gremler, 2004; Park and Lee, 2009). In recent years, a number of studies have examined the content of vWOM.

1 Existing studies (e.g., Gruen et al., 2006; Hennig-Thurau et al., 2004; Park and Lee, 2009) sometimes refer to virtual word of mouth (vWOM) as electronic word of mouth (eWOM). Both terms are imperfect because pWOM can be transmitted electronically or virtually. In this paper, we use the term vWOM because it rules out some forms of electronic communication (e.g., landline and cellular telephone calls) that are typically used for pWOM. Nevertheless, because the term vWOM is also imperfect (Internet-based phone services are becoming increasingly popular), the reader should bear in mind that we are using this term to refer specifically to virtual word-of-mouth communication between consumers who do not know each other.
and its impact on consumer adoption decisions (e.g.,
Bickart and Schindler, 2001; Chatterjee, 2001; Chen and
Xie, 2006; Fong and Burton, 2006, 2008; Godes and
Mayzlin, 2004; Hung and Li, 2007; Liu, 2006; Wang and
Wang, 2010).

One unresolved research question concerns the relative
impact of pWOM and vWOM on consumer decision-
making. In this paper, we address this gap in the literature
by examining the impact of pWOM and vWOM on the
innovation usage decisions of consumers. We argue that
the distinction between pWOM and vWOM is important
for three reasons. First, relative to an adopter’s vWOM
sources, an adopter’s pWOM sources are more likely to be
similar to the adopter. As a result, vWOM sources are more
likely (relative to pWOM sources) to expose adopters to
new uses for the innovation they have adopted. Second,
vWOM provides access to a relatively larger pool of
experts, in part because many experts who are not avail-
able physically are available virtually. Moreover, the cost
of accessing these experts through vWOM is relatively
lower than the cost of accessing experts through pWOM.

Third, because pWOM is more likely to come from
local users, pWOM provides a signal to users about the
size of the local installed base. The diffusion literature
indicates that the willingness of consumers to make
initial investments in moving down the innovation use
learning curve is a function of the local help that consum-
ers expect to be available if they encounter usage prob-
lems (Redmond, 1991; Shankar and Bayus, 2003;
Shurmer, 1993; Westland, 1992). The perceived availability
of local help lowers adopter perceptions of the learn-
ing costs associated with product usage, thereby
increasing adopter willingness to invest time in learning
how to use the innovation they have purchased.

Building on this logic, we develop a conceptual model
that incorporates both pWOM and vWOM as antecedent
variables associated with new product use. Based on the
work of Shih and Venkatesh (2004), we distinguish
between two types of innovation use. Variety of use refers
to the different ways in which consumers use an innova-
tion, while intensity of use refers to the amount of time
the consumer spends using an innovation. We hypoth-
esize that both types of word of mouth directly influence
variety of use. In addition, drawing on arguments regard-
ing the level of homophily among the generators and
recipients of pWOM (Brown and Reingen, 1987; Duhan,
Johnson, Wilcox, and Harrell, 1997), we reason that
vWOM will have a stronger impact on variety than on
intensity of innovation use (Brown and Reingen, 1987;
Duhan et al., 1997).

Drawing on the network externalities literature, we
also examine the mediating role of two variables that
indirectly link word of mouth and innovation use. We
argue that pWOM positively influences consumer percep-
tions of the size of the local adopter population, which is
a resource that users can turn to for help when encoun-
tering usage problems. The ability to access local help
should reduce the learning costs and comprehension dif-
culty associated with innovation use, thereby increasing
variety and intensity of use (Mick and Fournier, 1998;
Mukherjee and Hoyer, 2001; Shih and Venkatesh, 2004).
In addition, we expect that both pWOM and vWOM will
influence consumer perceptions of the availability of
complementary products, which prior research has linked
to innovation use (Basu, Mazumdar, and Raj, 2003; Katz
and Shapiro, 1985; Shankar and Bayus, 2003). In the
process of accessing vWOM and pWOM, users will learn
about new complementary products, some of which
involve new uses, and therefore may lead to an increased
variety of product use.

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We test these hypotheses using data collected from 247 Japanese adopters of portable gaming devices. Findings indicate that both pWOM and vWOM are positively and significantly related with variety of innovation use. In addition, pWOM has an indirect positive relationship with both intensity of use and variety of use through its impact on consumer perceptions of (1) the perceived size of the local adopter population and (2) the availability of complementary products. In contrast, through these same two paths, vWOM is negatively related with both intensity of use and variety of use.

The remainder of our discussion is organized as follows. In the next section, we briefly review the pWOM and vWOM literatures. We then describe our model and research hypotheses. After discussing our research methodology, we present our findings. We close with a discussion of implications, limitations, and directions for future research.

Literature Review

pWOM

pWOM communication involves the exchange of information between people, typically through conversation, and often between people who know each other. For example, Arndt (1967) found that exposure to favorable comments on a new product from other residents in an apartment complex increased the probability of adoption. Moreover, relative to company-sponsored communication, such as advertising and sales, pWOM has a greater impact on consumer purchase behavior (Katz and Lazarsfeld, 1955). In addition, consumers tend to be more sensitive to negative than to positive pWOM (Richins, 1983).

Subsequent research has addressed the influence of social relationships on the kinds of information communicated through pWOM and the impact of that information on behavior. Building on the work of Granovetter (1973), Brown and Reingen (1987, p.351) defined tie strength as the “intensity of a social relation between consumers.” Tie strength varies depending on several factors, including the “importance attached to the social relation, frequency of social contact, and type of social relation” (Brown and Reingen, 1987, p. 351). In a natural experiment involving word of mouth for three piano teachers, the authors found that weak ties allowed information to travel between groups, but pWOM obtained from strong tie sources was more likely to influence consumer decision making. The authors attributed the latter result to the higher source credibility of strong tie sources. Duhan et al. (1997) examined consumer reliance on strong and weak tie information sources in the selection of obstetric services. As classified by the authors, “strong tie” sources included friends, relatives, neighbors, and coworkers, while “weak tie” sources were experts, such as nurses, doctors, government agency personnel, and reference librarians. Findings indicated that the consumer’s level of subjective prior knowledge was positively correlated with reliance on weak tie sources and negatively correlated with reliance on strong tie sources.

Electronic Word of Mouth (vWOM)

Recent research has addressed the role of vWOM, which we define as virtual communication between consumers who have never met in real life (Gruen et al., 2006; Park and Lee, 2009). As Internet use has expanded, the importance of vWOM has increased with the rapid proliferation of Web sites offering consumer reviews of products and online forums featuring discussions of product use. Hennig-Thurau et al. (2004) identified three characteristics that distinguish vWOM from pWOM: (1) vWOM is typically anonymous, (2) the same message can be received by many individuals, and (3) the same message can be accessed by different consumers at different points in time.

Recent research has examined consumer motivations for supplying and accessing vWOM (e.g., Bickart and Schindler, 2001; Hennig-Thurau et al., 2004; Li, Elliot, and Choi, 2010). For example, Hennig-Thurau et al. (2004) concluded that active contributors to Web-based opinion platforms are motivated in part by a concern to help others, and by desires for social connectedness and self-enhancement (i.e., projecting an image of an intelligent shopper). In contrast, Bickart and Schindler (2001) focused on recipients of vWOM and reported that online forums generate more product category interest than exposure to corporate Web sites. The authors attributed this finding to the fact that, relative to corporate Web sites, the content of Internet forums is more relevant to consumers, has greater credibility, and generates more empathy among forum visitors.

Gruen et al. (2006) focused on the exchange through online forms of customer know-how, which they defined as “the accumulated practical skill or expertise that allows one to do something smoothly or efficiently” (p. 451). Findings indicate that the level of “know-how exchange” enhances customer perceptions of product value and increases the probability of recommending the product, but does not affect repurchase intention. Park and Lee (2009) concluded that the impact of vWOM on
product adoption is greater for negative messages than for positive ones. In addition, vWOM has a greater impact on consumer behavior when the message involves good experience and originates from a Web site with an established reputation.

Several important themes emerge from this brief review of the literature. First, existing research has focused on the relationship between word of mouth and adoption behavior. With one exception (Shih and Venkatesh, 2004), the impact of word-of-mouth behavior on innovation use has not been explored. Second, existing studies have tended to focus either on pWOM or on vWOM. Nevertheless, based on existing research, there are several reasons to expect the impact of pWOM and vWOM to differ. In the next section, we elaborate on these reasons and use the resulting insights to develop a model linking pWOM and vWOM with innovation use.

Theoretical Model and Hypotheses

Figure 1 summarizes our theoretical model, which features two “innovation use” variables. Variety of use, which refers to the different ways in which consumers use an innovation, is assumed to positively influence intensity of use, which refers to the amount of time the consumer spends using an innovation. The linkage between variety of use and intensity of use is based on the work of Shih and Venkatesh (2004, p. 66), who observed that “[a]ll else being equal, less variety of use can lead to lower rate of use because users simply have less to do.” We further hypothesize that variety of use will be positively correlated with the consumer’s exposure to pWOM and vWOM. In addition, we expect that consumer perceptions of the size of the local adopter population will mediate the relationship between pWOM and intensity of use. Finally, we hypothesize that both types of word of mouth will be positively correlated with consumer perceptions of the availability of complementary products, which will in turn affect both intensity and variety of use. In the remainder of this section, we develop the theoretical rationale behind these research hypotheses.

Word of Mouth on Innovation Use

Consumer adoption is often driven by a subset of an innovation’s set of potential uses. For example, a consumer may initially purchase a home computer for work reasons, but over time begin to use the same computer for family communication, entertainment, home management, home shopping, education, and other applications (Shih and Venkatesh, 2004). Word-of-mouth communication can contribute to this kind of usage evolution in two ways. First, through pWOM and vWOM, consumers can learn about new uses for an innovation they have adopted. Second, pWOM and vWOM can encourage consumers to try new uses by increasing the perceived value of those uses and reducing perceived risk (Arndt, 1967; Hung and Li, 2007; Redmond, 1991; Shih and Venkatesh, 2004). Thus we hypothesize that:

H1a: pWOM is positively associated with variety of use after adoption.
H1b: vWOM is positively associated with variety of use after adoption.

Based on existing research, there are several reasons to expect the impact of pWOM and vWOM on variety of use to differ. One important difference between pWOM and vWOM involves homophily, which refers to “the degree to which a pair of individuals are similar in terms of certain attributes, such as age, sex education, and social status” (Brown and Reingen, 1987). In the physical world, a consumer knows the identity of a physical word-of-mouth source, and therefore can assess or verify
homophily (or at least some aspects of homophily) by talking to the sources, talking to trusted others who know the source, accessing secondary information on the source, etc. Moreover, potential adopters have the opportunity to seek information from friends, relatives, colleagues, and others whom they believe have similar tastes and preferences. On the Web, a potential adopter is exposed to many information sources that are far removed from their social circle. Moreover, the opportunity to assess source homophily depends on (1) whether sources choose to remain anonymous and (2) how much sources choose to reveal about themselves. In many cases, online word of mouth is anonymous (Hennig-Thurau et al., 2004; Park and Lee, 2009). From postings, one might be able to assess shared interests and shared values (in a narrow sense), but assessing other aspects of homophily is often much more difficult than with physical sources of word of mouth.

Differences in homophily between pWOM and vWOM sources are important because existing research indicates that high-homophily sources are less likely to expose consumers to new information (Brown and Reingen, 1987; Duhan et al., 1997). As a result, vWOM is more likely to expose the adopter to new uses. A similar argument is used to explain the “strength of weak ties,” namely weak tie sources are more likely to expose people to nonhomophilous information sources (Brown and Reingen, 1987; Granovetter, 1973).

A second important difference between pWOM and vWOM involves access to expert information (Gruen et al., 2006). Many experts who are not reachable via physical word of mouth are accessible through vWOM. In addition, relative to pWOM, the time cost is often lower. Accessing pWOM can be time-consuming, especially when it involves scheduling a meeting and traveling to and from that meeting. In contrast, virtual word of mouth can often be accessed quickly by using a search engine. Finally, apart from the time expended to access pWOM, there is an opportunity cost associated with the time gap between initiating an expert search and receiving feedback from an expert. This time gap is often longer for pWOM (because the expert may not be instantly available). In contrast, expert opinions posted on Web sites are typically available instantly for review. Because experts are relatively more likely to be familiar with multiple uses of an innovation, vWOM will have a stronger relationship with variety of innovation use. Thus, we hypothesize that:

$$H1_c: \text{Relative to } pWOM, \text{ vWOM will have a stronger relationship with variety of product use after adoption.}$$
function of the local help that consumers expect to be available if they encounter usage problems.

In addition, the size of the installed base can have several psychological effects that stimulate product use. First, the size of the local adopter population may serve as a signal of ease of use that lowers the perceived cost of learning how to use an innovation, and thus leads to increased usage intensity (Smallwood and Conlisk, 1979). Second, for social goods like video games, the size of the installed base can influence the desire of adopters to achieve social acceptance among relevant peers through product use (Dickerson and Gentry, 1983). These arguments suggest the following hypothesis.

H2a: The perceived size of the local adopter population is positively associated with intensity of product use after adoption.

Because vWOM is typically anonymous (Hennig-Thurau et al., 2004), consumers do not know whether vWOM originates locally or from another region of the country. As a result, vWOM is unlikely to influence a consumer’s estimate of the size of the local user population. In contrast, because pWOM often originates from local users (Arndt, 1967; Duhan et al., 1997), higher levels of pWOM are likely to positively influence consumer estimates of the size of the local adopter population. This reasoning suggests the following hypotheses:

H2b: pWOM is positively associated with the perceived size of the local adopter population.

H2c: Relative to vWOM, pWOM will have a stronger relationship with the perceived size of the local adopter population.

Perceptions of the Availability of Complementary Products

The availability of complementary products can also increase the variety of innovation use. In part, the perceived availability of complementary products is a function of word-of-mouth communication (Song et al., 2009). Users can learn about complementary products that friends and acquaintances have already purchased or are evaluating for possible purchase (Shankar and Bayus, 2003). Similarly, by visiting Internet bulletin boards and chat rooms, consumers can learn about other complementary products available for the innovation they have adopted.

In the process of learning about complementary products for one use, information sources often introduce the potential adopter to complementary products designed for different uses. For example, in response to a request for information about a complementary product for a specific use (e.g., game playing for the Nintendo DS), a friend may provide information about a complementary product for a different use (say, education or health) that he or she finds exciting and thinks might appeal to the other person. Similarly, many Nintendo Web sites focus on more than one use for the Nintendo game player. A user who visits one of these sites to learn about complementary products for one use has the opportunity to learn about complementary products for other uses, and awareness of these products can motivate the user to expand the number of ways in which they use an innovation. Thus, we hypothesize that:

H3a: The perceived availability of complementary products is positively associated with variety of product use after adoption.

H3b: pWOM is positively associated with consumer perceptions of the availability of complementary products.

H3c: vWOM is positively associated with consumer perceptions of the availability of complementary products.

We have argued above that, relative to pWOM sources, vWOM is (1) relatively more likely to arise from nonhomophilous information sources and (2) more likely to expose adopters to a large number of experts. Thus, vWOM is more likely to introduce adopters to information sources who use their innovation in ways that are new to the adopter. Returning to our previous example, in the process of searching vWOM sources for and acquiring information about complementary products for a specific use (e.g., game playing for the Nintendo DS), the user is more likely to encounter information sources who describe complementary products for new uses (say, education or health), and this awareness of alternative uses is likely to increase the adopter’s variety of use. This reasoning is consistent with the work of Shih and Venkatesh, who argue that “higher intensity of communication with other users about the product leads to higher variety of use” (2004, p. 61). Thus, we hypothesize that:

H3d: Relative to pWOM, vWOM will have a stronger relationship with consumer perceptions of the availability of complementary products.

Research Methodology

To test our hypotheses, we collected data from Japanese adopters of new-generation portable game players (i.e., portable game players with a wireless telecommunication function), such as the Nintendo DS and the Sony
Play Station Portable (PSP). We choose this product category for several reasons. First, in 2004, both Sony and Nintendo introduced new-generation game players in Japan and other countries. By December 2009, the sales for the Nintendo DS totaled just under 30 million units in Japan. During the same time period, the sales of PSP totaled almost 14 million units. According to the Computer Entertainment Supplier’s Association, at the time of our data collection (March 2009), the Nintendo DS had a household penetration rate of 50.1%. Because there were about 50.3 million households in Japan as of December 2009, the maximum possible household penetration rate for the Sony PSP in 2009 was about 27.8% (this estimate assumes only one Sony PSP per household).

Second, a variety of software applications have been introduced for these game players, including entertainment, education, and health management titles. In Japan alone, over 1500 software titles have been introduced for the Nintendo DS. According to Nintendo’s annual report, 91 of these titles have sold over one million units. A number of popular applications lie outside of the entertainment category. For example, Brain Age: Train Your Brain in Minutes a Day!, and its sequel Brain Age 2: More Training in Minutes a Day!, have together sold over 31 million units. The variety of applications has enabled companies like Nintendo to attract new consumer segments, including young females, middle-aged adults, and senior citizens.

**Scale Development**

A number of the measures used in our study were drawn from prior research. Personal word-of-mouth is a three-item scale, adapted from Maxham (2001), that asks respondents about the information they received from people around them both before and after they purchased their game player. Virtual word-of-mouth is also a three-item scale, adapted from Park and Lee (2009), that measures respondents’ use of Web pages, blogs, and online forums to collect information about portable game players. Size of the local adopter population (ADOPTERS) was measured by asking respondents to estimate the number of local people and local homes that own the same portable gaming system as the respondent. Perceived availability of complementary products (COMPLEMENTS) is a three-item scale, adapted from Song et al. (2009), that asks respondents about the variety and easy availability of software for their gaming systems. Following Shih and Venkatesh (2004), intensity of use was computed as the product of two measures that asked respondents to estimate (1) the number of times they use their gaming system per week and (2) average hourly use per day. Variety of use was measured using a three-item scale, created based on discussions with adopters, that asked respondents about the creativity of their product use, the variety of their product use relative to other consumers, and their comfort in using the product in ways that differ from their normal product usage. We also included four control variables in our analysis: age, gender, maker, and experience. Age is the calendar age reported by respondents. Male is a dummy variable that assumes the value one if the respondent is a male and zero otherwise. Nintendo is a dummy variable that assumes the value one if the respondent owns a Nintendo DS and zero otherwise. Months of Use is the amount of time, measured in months, that respondents have owned their game hardware. (For further details, please see the Appendix.)

**Data Collection**

Survey development followed the procedures recommended by Dillman (1978), and Douglas and Craig (1983). First, we developed an English version of our questionnaire and translated it into Japanese. Second, following the double-translation procedure, the Japanese version was translated into English by a professional translator. A comparison of the original and translated English versions led to a few minor modifications in the Japanese questionnaire.

The finalized questionnaire was sent to a marketing research company, which administered the survey in March 2009. This process yielded 639 usable responses, including 247 from consumers who had adopted a new-generation portable gaming device (an adoption rate of 38.7%). Of the 247 adopters, 126 were males and 121 were females. In addition, 86 respondents were in their 20s, 95 respondents were in their 30s, and 66 were aged 40 or older.

**Analyses**

**Measurement Model**

Our analysis followed the two-step approach for structural equation modeling recommended by Anderson and Gerbing (1988). Tables 1 and 2 summarize the results of our measurement model analyses. A confirmatory factor analysis using the four multi-item scales in our study yielded satisfactory fit statistics (chi-square = 137.33, d.f. = 67, goodness-of-fit index [GFI] = 0.93, comparative
fit index \([\text{CFI}] = 0.96\), incremental fit index \([\text{IFI}] = 0.96\), normed fit index \([\text{NFI}] = 0.93\), and root mean square error of approximation \([\text{RMSEA}] = 0.06\). In particular, the overall fit indices exceeded 0.90, while the RMSEA was less than 0.10. The ratio \(\chi^2/df\) was 2.04, which is less than the critical value of 3 identified by Carmines and McIver (1981). In addition, each item loaded on the appropriate construct (the smallest \(t\)-value was 7.12), demonstrating adequate convergent validity.

Table 1 also reports the composite reliability for each measure. These reliabilities range from 0.77 to 0.89, indicating that the measures are highly reliable. The standardized residuals are also consistent with the external consistency criteria of Anderson and Gerbing (1982). We assessed discriminant validity by computing the square root of the average variance explained (\(\sqrt{\text{AVE}}\)) for each construct in our measurement model. As shown in Table 2, for each construct, the relevant \(\sqrt{\text{AVE}}\) is larger than the correlation between any pair of constructs in the measurement model. Thus, each multi-item scale used in our study satisfies the Fornell and Larcker (1981) criteria for discriminant validity. In particular, our analysis clearly indicates that vWOM and pWOM are distinct constructs. Finally, to check for the presence of common method bias, we applied Harman’s one-factor test. The estimation of a single-factor model yielded the following fit statistics: \(\chi^2(77) = 1065.19\), GFI = 0.60, NFI = 0.46, and CFI = 0.47. A comparison of these statistics with those reported in Table 2 for the five-factor model indicates that common method bias was not a problem in our data (Podsakoff and Organ, 1986).

### Hypotheses Testing

Having established the validity of our measurement model, we used structural equation modeling to test our

### Table 1. Measurement Model Summary

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Item</th>
<th>Standardized Factor Loading</th>
<th>Composite Reliability</th>
<th>Goodness-of-Fit Statistics</th>
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<tr>
<td>pWOM</td>
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<td>.80</td>
<td>.89</td>
<td>(\chi^2 = 137.33)</td>
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<td>pWOM2</td>
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</table>

pWOM, personal word of mouth; vWOM, virtual word of mouth; ADOPTERS, perceived size of the local adopter population; COMPLEMENTS, consumer perceptions of the availability of complementary products; INTENSITY, intensity of use; VARIETY, variety of use; GFI, goodness-of-fit index; CFI, comparative fit index; IFI, incremental fit index; NFI, normed fit index; RMSEA, root mean square error of approximation.

### Table 2. Discriminant Validity: Construct Correlations and AVE

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
<th>(f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pWOM (a)</td>
<td>4.09</td>
<td>2.63</td>
<td>.86*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vWOM (b)</td>
<td>3.62</td>
<td>2.29</td>
<td>.48*</td>
<td>.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADOPTERS (c)</td>
<td>47.97</td>
<td>22.76</td>
<td>.15*</td>
<td>-.14*</td>
<td>.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPLEMENTS (d)</td>
<td>6.37</td>
<td>1.89</td>
<td>.21*</td>
<td>.05</td>
<td>.21*</td>
<td>.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTENSITY (e)</td>
<td>114.91</td>
<td>159.26</td>
<td>.31*</td>
<td>.19*</td>
<td>.15*</td>
<td>.26*</td>
<td>-.</td>
<td></td>
</tr>
<tr>
<td>VARIETY (f)</td>
<td>3.34</td>
<td>2.20</td>
<td>.53*</td>
<td>.55*</td>
<td>-.21</td>
<td>.21*</td>
<td>.32*</td>
<td>.81</td>
</tr>
</tbody>
</table>

* Off-diagonal elements are construct correlations; on-diagonal elements are the square root of the AVE for each construct.

* denotes \(p < .05\).
hypotheses (Anderson and Gerbing, 1988). Initial testing revealed the need to add one path to the hypothesized model in Figure 1. In particular, an $\chi^2$ test ($\chi^2 = 16.73$, $p < 0.05$) revealed the existence of a negative and significant path between vWOM and the perceived size of the adopter population. This path is included in the estimated model reported in Figure 2. The fit statistics for the model in Figure 2 meet well-established thresholds ($\chi^2 = 282.11$, $d.f. = 139$, CFI = .93, Tucker–Lewis index [TLI] = .91, IFI = .93, RMSEA = .065), indicating that our model fits the data well. With regard to the model’s control variables, months of use was positively and significantly associated with perceptions of the size of the local adopter population ($\beta = .15$, $p < .05$) but not with the perceived availability of complementary products. The Nintendo dummy variable was not correlated with perceptions of either the size of the local adopter population or the availability of complementary products. Intensity of use was negatively and significantly related with both age ($\beta = -.19$, $p < .05$) and the male dummy variable ($\beta = -.23$, $p < .05$), while variety of use is positive and significantly different from zero ($\beta = .15$, $p < .05$).

The model in Figure 2 contains two additional paths that were not addressed in our hypotheses. Consistent with results obtained by Shih and Venkatesh (2004), variety of use was positive and significantly related with intensity of use ($\beta = .39$, $p < .05$). In addition, as noted above, the path from vWOM to ADOPTERS is negative and significant ($\beta = -.40$, $p < .05$). With regard to our hypotheses, the coefficients linking variety of use with pWOM ($\beta = .25$, $p < .05$) and vWOM ($\beta = .55$, $p < .05$) are both positive and significantly different from zero. These results support H1a and H1b. The magnitude of these coefficients is consistent with H1c, which states that, relative to pWOM, vWOM will have a stronger relationship with variety of use. As described in Table 3, to formally test this hypothesis, we (1) estimated a constrained model in which the path coefficients linking variety of use with both word-of-mouth variables were equal, and (2) compared the resulting $\chi^2$ fit statistic with the $\chi^2$ statistic from the unconstrained model. The difference between these two fit statistics is significant at the 10% level of confidence ($\chi^2(1) = 3.80$, $p = .051$).

Hypotheses 2a–2c involve the relationships among pWOM/vWOM, the perceived size of local adopter population, and intensity of use. The coefficient linking ADOPTERS with intensity of use is positive and significantly different from zero ($\beta = .11$, $p < .05$). Similarly, the coefficient linking pWOM with ADOPTERS is positive and significant ($\beta = .41$, $p < .05$). Thus, hypotheses H2a and 2b are supported. Finally, the difference between the path coefficients linking ADOPTERS with (1) pWOM and (2) vWOM is significantly different from zero ($\chi^2(1) = 11.92$, $p = .001$) at the 1% level of confidence. This result supports H2c.

Hypotheses 3a–3d deal with the antecedents and consequences of respondent perceptions of complementary products. The coefficient linking COMPLEMENTS with variety of use is positive and significantly different from zero ($\beta = .21$, $p < .05$), as is the coefficient linking pWOM with COMPLEMENTS ($\beta = .36$, $p < .05$). These results support H3a and H3b. In contrast, the coefficient linking vWOM with COMPLEMENTS ($\beta = -.25$, $p < .05$) is negative and significant, which is inconsistent with H3c. According to H3d, relative to pWOM, vWOM has a larger positive relationship with

![Figure 2. Structural Equation Model Coefficients](image-url)

*Note: Circles report significant standardized coefficients. * denotes $p < .05$. $\chi^2 = 282.11$, $d.f. = 139$, CFI = .93, TLI = .91, IFI = .93, RMSEA = .065*
Robustness Tests

The perceived availability of complementary products. As noted above, the signs of the coefficients linking COMPLEMENTS with pWOM and vWOM are inconsistent with this hypothesis. Moreover, an examination of the appropriate test statistic reveals that the difference between these coefficients is significant ($\chi^2 = 22.39, p < 0.05$), indicating that, relative to vWOM, pWOM has a stronger association with consumer perceptions of the perceived availability of complementary products. Thus, our analysis does not support H3d.

Tests of Model Robustness

To examine the robustness of the model in Figure 2, we tested several alternative models. In particular, we relaxed each constraint (one at a time) that restricted a path coefficient to be zero, and compared the resulting fit with the base model reported in Figure 2. The results of these additional tests are reported in Table 3. For example, the model in Figure 2 assumes that pWOM and vWOM do not have direct relationships with intensity of use. When we relaxed each of these assumptions (see Models 5 and 6), the relevant test statistic comparing the revised model with the base model was insignificant. When we relaxed the assumption of no relationship between ADOPTERS and VARIETY (Model 7), the relevant test statistic was again insignificant. These results suggest that the hypothesized model is robust.

Discussion

In this paper, we have examined the impact on innovation use of personal and virtual word-of-mouth communication. Our analysis, based on the analysis of 247 Japanese adopters of portable gaming systems, supports the argument that pWOM and vWOM affect innovation use in different ways. In particular, relative to pWOM, vWOM has a stronger relationship with variety of use. In addition, pWOM has a positive relationship, and vWOM a negative relationship, with consumer perceptions of the availability of complementary products, which in turn has a positive relationship with intensity of use. Similarly, pWOM has a positive relationship, and vWOM a negative relationship, with consumer perceptions of the availability of complementary products, which in turn has a positive relationship with variety of use. After discussing the implications of these findings for academics and practitioners, we comment on the limitations of our research and suggest directions for future research.

Academic Implications

From a theoretical perspective, the findings reported here extend our understanding of the relationship between word-of-mouth communication and product use in several important ways. First, existing research has focused on the effectiveness of pWOM or vWOM...
relative to paid marketing communication, such as advertising or company Web sites (e.g., Bickart and Schindler, 2001), but has not compared the relative effectiveness of these two forms of word of mouth. In contrast, the study described here explicitly compared the effectiveness of pWOM and vWOM on innovation use and found that, from a statistical perspective, vWOM has a relatively stronger relationship with variety of use. This finding is consistent with existing theoretical arguments suggesting that nonhomophilous information sources like vWOM will expose consumers to a greater variety of information (Brown and Reingen, 1987; Duhan et al., 1997).

Second, we extended the existing discussion of installed base effects to argue that the perceived size of the local adopter population should influence consumer use by signaling ease of use, social acceptability, and the availability of experienced users whom the consumer can consult when usage problems arise (e.g., Redmond, 1991; Song et al., 2009). This reasoning is supported by the finding that the size of the local adopter population is positively and significantly correlated with intensity of product use.

Third, prior research suggests that vWOM can influence consumer perceptions of product characteristics (Park and Lee, 2009). However, our findings indicate that vWOM was negatively related with the perceived availability of complementary products. One possible explanation for this result is that vWOM plays different roles in the consumer’s adoption and product use decisions. In particular, when considering the purchase of an innovative product, consumers may rely on online forums, chat rooms, and other vWOM sources to evaluate the advantages and risks of purchasing a particular product. However, once they have purchased the product, consumers may rely on vWOM primarily to resolve usage problems, in which case higher levels of vWOM exposure would not necessarily expose users to new uses for the innovation that they have purchased. The validity of this explanation should be explored in future research.

Fourth, while we did not hypothesize a relationship between vWOM and perceptions of the size of the local adopter population, our empirical results suggest that this relationship is negative. Perhaps this negative relationship arises from a tendency to turn to vWOM for usage help when the local adopter population is small, and thus pWOM sources are hard to find. However, it is also possible that, in some product categories (other than portable game players), consumers infer the size of the local adopter population, at least in part, from the observed number of online adopters. Thus, future research should examine whether a negative relationship between vWOM and the perceived size of the local adopter population also exists in other product categories.

Managerial Implications

Our findings have several important implications for innovation management. For many years, marketers have emphasized the importance of pWOM in stimulating product adoption (Arndt, 1967; Katz and Lazarsfeld, 1955). The results presented here suggest that the receipt of pWOM also plays an important role in stimulating both intensity and variety of product use. Encouraging product use is important because higher usage levels can encourage users to purchase complementary products, upgrade to next-generation products, and generate pWOM that helps drive product purchases by other consumers (Farrell and Saloner, 1985; Padmanabhan et al., 1997; Redmond, 1991). Given these effects, marketers should explore the use of promotional programs that encourage innovation users to share their experiences with other adopters in their circle of friends, peers, and acquaintances. Ideally, such programs should complement advertising designed to simulate positive word of mouth (Graham and Havlena, 2007).

Similarly, our findings indicate that vWOM can directly influence variety of product use, which can increase consumer perceptions of a product’s value, thereby stimulating favorable word of mouth and increasing the consumer demand for complementary products and future product upgrades. To harness these benefits, managers can invest in the development of Web sites (or areas within existing sites) that enable users to share their product use experiences. In addition, managers may want to develop promotional programs that encourage users to visit use-related Web sites, read content generated by other users, and add their own content to use-related Web sites. The work of Hennig-Thurau et al. (2004) suggests that consumers can be encouraged to leave feedback by appealing to their desires to enhance their own feelings of self-esteem, and to interact with and help other consumers.

Intriguing managerial questions arise from the negative relationships between vWOM and consumer perceptions of (1) the size of the local adopter population and (2) the availability of complementary products. Perhaps by changing the design of their Web sites, firms can weaken or reverse these negative relationships. For example, by establishing forums for local user groups and incentives for users to join these forums, firms like
Nintendo might positively influence consumer perceptions of the size of the local adopter population. Similarly, by providing incentives for users to visit Web sites that provide information about complementary products, Nintendo and its competitors might create a positive relationship between vWOM and perceptions of the availability of complementary products. The effectiveness of such tactics is an important topic for future research.

Limitations and Directions for Future Research

Our conclusions must be qualified in several ways. First, our findings are based on data collected at a single point in time. As a result, our findings cannot be used to establish causal relationships among variables. This issue might be addressed in future research through a longitudinal design that includes the monitoring of customer access to specific vWOM sites, coupled with periodic surveys of product usage. Alternatively, in some product and service categories, it might be possible to replace product usage surveys with direct observation of service use.

Second, our empirical analysis focused on portable gaming devices. It is possible that some of the findings reported above will not extend to other product categories. For example, in some product categories, the number of adopters influences consumer perceptions of an innovation’s value (Katz and Shapiro, 1985; Shankar and Bayus, 2003; Shurmer, 1993). When this type of direct externality exists, the perceived size of the installed base may influence intensity of use. In addition, the availability of complementary products is a critical component of consumer demand for gaming devices (Shankar and Bayus, 2003). Perhaps a decrease in the importance of complementary products will shift the relative importance of pWOM and vWOM. These possibilities should be explored in future research.

Third, our conclusions are based on data collected from Japanese consumers. On one hand, one might expect the findings reported here to extend to other countries where Internet usage is well advanced. However, in a comparison of U.S. and Chinese discussion boards, Fong and Burton (2008; see also Fong and Burton, 2006) found that postings on Chinese discussion boards were more likely to request, but less likely to supply, product information, a finding that the authors linked to differences between individualistic and collectivist cultures. The authors also noted that these differences could be explained by a relative lack of online experience among Chinese discussion board users. Given these findings, research is needed that sheds light on the ways in which the relationship between vWOM and innovation use may vary across countries depending on differences in cultures and internet experience.

Fourth, in this paper, we have argued that receivers of word of mouth are likely to be, on average, more homophilous with their pWOM sources than with their vWOM sources. Similarly, the network communication literature has argued that recipients of information tend to be more homophilous with strong tie information sources than with weak tie information sources (Brown and Reingen, 1987; Granovetter, 1973). Thus, one potential topic for future research involves an exploration of the potential interactions between tie strength and information source.

Additional research opportunities arise from possible extensions to the model described in Figure 1. For example, several studies have examined the relative impact of negative word of mouth on product adoption (e.g., Arndt, 1967; Brown and Reingen, 1987; Chevalier and Mayzlin, 2006; Richins, 1983). Recently, Park and Lee (2009) reported that, within the context of chat rooms and online forums, negative word of mouth had a larger impact on consumer purchase decisions than positive word of mouth. In contrast, Liu (2006) found that the volume of vWOM was much more important than communication content (percentage of positive and negative messages) in determining movie box office revenues. These results raise several important questions for future research. What is the relative impact of negative word of mouth on product use? Is the magnitude of the impact dependent on the type of word of mouth (personal or virtual)? Should managerial responses to negative word of mouth vary depending on whether that word of mouth is personal or virtual?

Another important issue involves the identification of variables that might moderate the relationship between word of mouth and adoption use. For example, the relative importance of personal and virtual word of mouth may depend on the importance that potential adopters place on hedonic as opposed to utilitarian motivations (Park and Park, 2009). Duhan et al. (1997) found that the level of subjective prior knowledge was positively correlated with reliance on weak tie sources and negatively correlated with reliance on strong tie sources. This result raises several additional interrelated research questions. First, is pWOM more likely than vWOM to originate from strong tie sources? Second, does pWOM have a greater impact on product use among consumers with less product experience? Third, does vWOM have a greater impact among consumers with more product experience?
Conclusion
In summary, we have examined the relationship between two kinds of word of mouth and innovation use among Japanese adopters of portable game players. Our analysis indicates that both personal and virtual word of mouth are directly related with variety of innovation use and indirectly related with intensity of innovation use. In addition, pWOM (but not vWOM) has positive indirect relationships with both variety and intensity of use. We hope the analysis presented here will stimulate future research that expands our understanding of the relationships among pWOM, vWOM, and innovation use.

References
Appendix

Study Measures

<table>
<thead>
<tr>
<th>Concepts and References</th>
<th>Measurement Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal word of mouth (pWOM) adapted from Maxham (2001)</td>
<td>An 11-point scale (0 = strongly disagree, 10 = strongly agree)</td>
</tr>
<tr>
<td>Virtual word of mouth (vWOM) adapted from Park and Lee (2009)</td>
<td>An 11-point scale (0 = strongly disagree, 10 = strongly agree)</td>
</tr>
<tr>
<td>Size of the local adopter population (ADOPTERS) adapted from Song et al. (2009)</td>
<td>An 11-point scale (0 = strongly disagree, 10 = strongly agree)</td>
</tr>
<tr>
<td>Availability of complementary products (COMPLEMENTS) adapted from Song et al. (2009)</td>
<td>An 11-point scale (0 = strongly disagree, 10 = strongly agree)</td>
</tr>
<tr>
<td>Intensity of use (INTENSITY) adapted from Shih and Venkatesh (2004)</td>
<td>An 11-point scale (0 = strongly disagree, 10 = strongly agree)</td>
</tr>
<tr>
<td>Variety of use (VARIETY) new items</td>
<td>An 11-point scale (0 = strongly disagree, 10 = strongly agree)</td>
</tr>
<tr>
<td>Months (EXPERIENCE) Nintendo</td>
<td>For how many months have you used a portable game player equipped with wireless communication? A dummy variable where 1 = Nintendo and 0 = others.</td>
</tr>
<tr>
<td>Age (AGE)</td>
<td>How old are you?</td>
</tr>
<tr>
<td>Gender (GENDER)</td>
<td>A dummy variable where 1 = male and 0 = female.</td>
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