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The influence of online product recommendations on consumers' online choices

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Abstract

This study investigates consumers' usage of online recommendation sources and their influence on online product choices. A 3 (websites) × 4 (recommendation sources) × 2 (products) online experiment was conducted with 487 subjects. Results indicate that subjects who consulted product recommendations selected recommended products twice as often as subjects who did not consult recommendations. The online recommendation source labeled "recommender system," typical of the personalization possibilities offered by online retailing, was more influential than more traditional recommendation sources such as "human experts" and "other consumers". The type of product also had a significant influence on the propensity to follow product recommendations. Theoretical and managerial implications of these findings are provided.

Keywords: Online product; Recommendation; Consumers

Introduction

Among all possible advantages offered by electronic commerce to retailers, the capacity to offer consumers a flexible and personalized relationship is probably one of the most important (Wind & Rangaswamy, 2001). Online personalization offers retailers two major benefits. It allows them to provide accurate and timely information to customers which, in turn, often generates additional sales (Postma & Brokke, 2002). Personalization has also been shown to increase the level of loyalty consumers hold toward a retailer (Cyber Dialogue, 2001; Srinivasan, Anderson, & Ponnavolu, 2002). While there are several ways to personalize an online relationship, the capacity for an online retailer to make recommendations is certainly among the most promising (The e-tailing Group, 2003). Online, recommendation sources range from traditional sources such as other consumers (e.g., testimonies of customers on retail websites such as Amazon.com) to personalized recommendations provided by recommender systems (West et al., 1999). To date, no study has specifically investigated and compared the relative influence of these online recommendation sources on consumers' product choices. Therefore, the main objective of this study is to investigate the influence of online product recommendations on consumers' online product choices. In addition, we explore the moderating influence of variables related to recommendation sources and the purchase decision.

Literature review

Research on the use and influence of recommendations on consumers has typically been subsumed under personal influence or word-of-mouth (WOM) research. In addition, as noted by Rosen and Olshavsky (1987), research on opinion leadership and reference groups also relates to the study of recommendations and to influence in general.

Recommendation sources are considered primarily as information sources. Andreasen (1968) proposes the following typology of information sources: (1) Impersonal Advocate (e.g., mass media), (2) Impersonal Independent (e.g., *Consumer Reports*), (3) Personal Advocate (e.g., sales clerks), and (4) Personal Independent (e.g., friends). Although research on personal influence and WOM focuses on the latter two information sources, it is noteworthy that impersonal independent information sources such as *Consumer Reports* can also serve as recommendation sources. Moreover, the Internet can provide consumers with

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an additional type of impersonal information source. For instance, electronic decision-making aids such as recommender systems are impersonal information sources that provide personalized information to consumers (Ansari, Essegaier, & Kohli, 2000). In an effort to extend Andreasen's (1968) typology to computer-mediated environments, we assert that information sources can be sorted into one of four groups: (1) Personal source providing personalized information (e.g., "My sister says that this product is best for me."); (2) Personal source providing non-personalized information (e.g., "A renowned expert says that this product is the best."); (3) Impersonal source providing personalized information (e.g., "Based on my profile, the recommender system suggests this product."); (4) Impersonal source providing non-personalized information (e.g., "According to *Consumer Reports*, this is the best product on the market."). In consumer research, studies on personal influence, social influence, or WOM, can be categorized as studies investigating personal sources providing personalized or non-personalized information. Furthermore, studies dealing with reference groups encompass such sources as well as impersonal sources that provide non-personalized information. Thus, a new area has emerged in consumer research, arising mainly from information technologies such as the Internet: that of impersonal sources that provide personalized information (Alba et al., 1997; Ansari et al., 2000; Häubl & Trifts, 2000; Maes, 1999; Urban, Sultan, & Qualls, 1999; West et al., 1999).

Research on information sources suggests that personal and impersonal information sources influence consumers' decision-making (Ardnt, 1967; Duhan et al., 1997; Gilly et al., 1998; Olshavsky & Granbois, 1979; Price & Feick, 1984). For instance, Price and Feick (1984) found that consumers planned to use the following information sources for their next durable good purchase: (1) Friends, relatives, and acquaintances, (2) Salespeople, (3) Publications such as *Consumer Reports*. However, if much is known about the relative likelihood of consumers to consider recommendations in the course of their decision making process, little is known about how recommendations, especially in a computer-mediated environment, impact consumers' product choices.

Determinants of recommendation influence

The current study focuses on three determinants that could influence the impact of computer-mediated recommendations on consumers' online product choices: the nature of the product recommended, the nature of the website on which the recommendation is proposed, and the type of recommendation source.

Prior research has shown that the type of product affects consumers' use of personal information sources and their influence on consumers' choices (Bearden & Etzel, 1982; Childers & Rao, 1992; King & Balasubramanian, 1994). Nelson (1970) suggests that goods can be classified as possessing either search or experience qualities. Search qualities are those that "the consumer can determine by inspection prior to purchase," and experience qualities are those that "are not determined prior to purchase" (Nelson, 1974, p. 730). Since it is difficult or even impossible to evaluate experience products before purchase, consumers should rely more on product recommendations for these products than for search products. In support of this view, King and Balasubramanian (1994) found that consumers assessing a search product (e.g., a 35-mm camera) are more likely to use own-based decision-making processes than consumers assessing an experience product, and that consumers evaluating an experience product (e.g., a film-processing service) rely more on other-based and hybrid decision-making processes than consumers assessing a search product.

The nature of the website can also influence the impact of a given recommendation. Based on previous website classifications (Hoffman, Novak, & Chatterjee, 1995; Spiller & Lohse, 1998), Senecal and Nantel (2002) suggest that recommendation sources can be used and promoted by three different types of websites: sellers (e.g., retailer or manufacturer websites such as Amazon.com), commercially linked third parties (e.g., comparison shopping websites such as MySimon.com), and non-commercially linked third parties (e.g., product or merchant assessment websites such as Consumerreports.org). More independent websites such as non-commercially linked third parties that facilitate consumers' external search effort by decreasing search costs are assumed to be preferred by consumers (Alba et al., 1997; Bakos, 1997; Lynch & Ariely, 2000). By providing more alternatives to choose from and more objective information, independent websites should be perceived as more useful by consumers. In addition, prior research on attribution theory suggests that consumers discredit recommendations from endorsers if they suspect that the latter have incentives to recommend a product (for reviews, refer to Folkes, 1988; Mizerski, Golden, & Kernan, 1979). According to the discounting principle of the attribution theory (Kelley, 1973), which suggests that a communicator will be perceived as biased if the recipient can infer that the message can be attributed to personal or situational causes, consumers would attribute more non-product related motivations (e.g., commissions on sales) to recommendation sources that are promoted by commercially linked third parties and sellers than independent third party websites. Consequently consumers would follow product recommendations in a greater proportion when shopping on more independent than on less independent websites.

In light of research on consumers' use of relevant others in their pre-purchase external search efforts (Olshavsky & Granbois, 1979; Price & Feick, 1984; Rosen & Olshavsky, 1987) and in consideration of the emergence of online information sources providing personalized recommendations (Ansari et al., 2000), Senecal and Nantel (2002) assert that online recommendation sources can be sorted into three broad categories: (1) other consumers (e.g., relatives, friends

and acquaintances), (2) human experts (e.g., salespersons, independent experts), and (3) expert systems such as recommender systems. We posit that these online recommendation sources will have different levels of influence on consumers' online product selection. Brown and Reingen (1987) suggest that information received from sources that have some personal knowledge about the consumer have more influence on the latter than sources that have no personal knowledge about the consumer. Thus, a recommendation source providing personalized information to consumers (e.g., recommender system) should be more influential than a recommendation source providing non-personalized information (e.g., other consumers).

The fact that both factors, the origin (source) of a recommendation as well as the type of website on which it is made, have an impact on the likelihood it has to be followed may find its explanation in Kelman's (1961) work on source credibility. Kelman (1961) suggests that credibility is a product of expertise and trustworthiness. Expertise can be viewed as the perceived ability of an information source to know the right answer and trustworthiness as the perceived information source's motivation to communicate this expertise without bias (McGuire, 1969). Although moderated by contextual factors (for a review, refer to Sternthal, Phillips, & Dholakia, 1978), source expertise and trustworthiness have been found to be positively correlated with consumers' attitude toward the brand, and consumers' behavioral intentions and behaviors (Gilly et al., 1998; Harmon & Coney, 1982; Lascu, Bearden, & Rose, 1995; Tybout, 1978).

Hypotheses

Based on the preceding review of the literature we postulate that personal information sources as well as impersonal information sources providing product recommendations (Price & Feick, 1984) will influence consumers in computer-mediated environments such as the Internet and the World Wide Web. We thus formulate the following general hypothesis.

H1. Consumers who consult an online information source recommending a given brand will select that brand in a greater proportion than consumers who do not consult an online recommendation source.

As for the impact that such a recommendation will have on consumers' choice, we formulate three additional hypotheses. First, we posit that the nature of the product for which a recommendation is provided will influence the likelihood that it will be followed. Based on prior research on the relationship between product type and personal information source influence (Bearden & Etzel, 1982; Childers & Rao, 1992; King & Balasubramanian, 1994), we put forward the following hypothesis.

H2. Online recommendations for experience products will be followed in a greater proportion than online recommendations for search products.

Second, based on Alba et al. (1997), Bakos (1997) and Lynch and Ariely (2000), we propose that online product recommendations from more independent websites are more influential than those from less independent websites. We therefore put forth the following hypothesis.

H3. Online product recommendations consulted on "non-commercially linked third party" websites will be followed in a greater proportion by consumer than if consulted on "commercially linked third party" websites, and online product recommendation consulted on the latter type of websites will be followed in a greater proportion than if consulted on "seller" websites.

Finally, we believe, based on the literature which has dealt with the issue of consumers' use of relevant others in their pre-purchase external search efforts, that personalized recommendations will have a greater influence on consumers than non-personalized ones (Brown & Reingen, 1987). Thus follows hypotheses four.

H4. Recommendations from information sources offering personalized recommendations (e.g., recommender system) will be followed in a greater proportion by consumers than recommendations from information sources providing non-personalized recommendations.

In addition to this set of hypotheses, which pertains to the variables that moderate the influence of an online recommendation, we formulate a set of three hypotheses which consider potential reasons for which various online recommendation sources may differ in their influence on consumers' choices. First, we expect that the recommendation source "other consumers" will be perceived as less expert than "human experts" and "recommender systems". However, based on the discounting principle of attribution theory (Kelley, 1967), the recommendation source "other consumers" should be perceived as more trustworthy than human experts and recommender systems since the latter two recommendation sources are more susceptible to non-product related attributions. Second, since consumers may also attribute non-product related motivations more easily to recommendation sources promoted by websites that are not clearly independent, we predict that the type of website will have an impact on the perception of the recommendation source's trustworthiness. For instance, a human expert who recommends a product on a seller website may be perceived by consumers as less trustworthy than if that person recommended the same product on an independent third party website. Thus, the following hypotheses are posited.

H5a. The online recommendation sources "human experts" and "recommender system" will be perceived as possessing more expertise than the online recommendation source "other consumers."

H5b. The online recommendation sources "human experts" and "recommender system" will be perceived as less trustworthy than the online recommendation source "other consumers."

H6. Consumers' trust in the recommendation source will be greater when shopping on a "non-commercially linked third party" type of website than on a "commercially linked third party" type of website, which in turn will be perceived as more trustworthy than the "seller" type of website.

Method

Sample

A convenience sample of 487 subjects was generated on the basis of 25 742 e-mails sent to three populations of web users. The initial e-mail stated that two researchers from a large business school were conducting a study on electronic commerce, and that participants had a chance of winning one of the products about which the experiment was designed. Potential participants did not know in advance the types of products that were to be tested. They were told that they would be asked to participate in two sessions in order to complete the study. Overall, 630 subjects participated in the first session and 487 subjects participated in both sessions. Subjects who participated in both sessions did not significantly differ from subjects who only participated in the first session with regards to their socio-demographic profile ($X^2_{\text{gender}}(2) = 0.009$, $X^2_{\text{age group}}(4) = 2.138$, $X^2_{\text{profesional situation}}(6) = 7.482$, $X^2_{\text{income}}(7) = 11.683$; all p-values > .05), their product class familiarity ($F_{\text{wine}}(1, 629) = 0.316$, $F_{\text{calculator}}(1, 630) = 0.951$; all p-values > .05), and their product class subjective knowledge ($F_{\text{wine}}(1, 629) = 0.758$, $F_{\text{calculator}}(1, 630) = 0.000$; all p-values > .05). Subjects took an average of 6–8 days to complete both sessions of the online experiment, which included a 5-day delay between email invitations of sessions 1 and 2. Of the 487 participants, 173 were from a specialized firm list (response rate: 0.6%), 59 originated from an e-commerce research center list (response rate: 12.0%), 203 were from an undergraduate student list (response rate: 7.7%) and 52 could not be traced since they used a different email address than the ones on the lists. Subjects participated in both sessions of the study from the location where they usually use the Internet. The majority of subjects were between the ages of 18 and 29 years (84%). Fifty percent were female, one third were working full time (31%); 26% of subjects were full-time students and another 31% were part-time workers and students. On average, subjects had been using the Internet for 4.5 years and currently used it 18 hours per week.

Procedure

Experiment overview

In the first session of the experiment, subjects were simply asked to complete an online questionnaire. In the second session, subjects were asked to perform online shopping tasks on a specific website. During that second session a $3 \times 4 \times 2$ online experiment was conducted. The first between-subject factor was the website manipulation. Subjects were assigned to one of three types of websites: retailer, third party commercially linked to retailers, or non-commercially linked third party. The second between-subject factor manipulated the source of recommendation. Subjects were assigned to one of the four following conditions: other consumers, human experts, recommender system, or no recommendation source. Finally, the last factor, a within-subject factor, was the product manipulation. During their first online shopping task, subjects were randomly assigned to either a search or experience product, and they were assigned to the remaining product type for their second shopping task.

Experiment description

To motivate subjects to participate without mentioning the precise goal of the experiment (i.e., the influence of recommendation on product choice), a cover story was used. Subjects were told that a two-session study was being conducted to assess the commercial potential of various products that a foreign company (i.e., Maximo) was interested in introducing to local markets via their website. In addition, participants were informed that they would be asked in the second session of the study to select three products, and that they had a one in three chance of winning one of the products selected. This procedure was used to maximize the involvement of subjects with their online shopping tasks. Subjects were informed that the average product value was $45. The first session questionnaire measured their knowledge and familiarity with the computer mouse, calculator and wine product classes,[2] their Internet usage, and some demographics. At the end of the questionnaire, subjects were asked to provide their email address and were told that they would be contacted in the following days for the second session.

Five days after the first session, subjects were sent an email providing a hyperlink to the second session website. Once on the website, they were asked to logon by entering their email address. Following a brief introduction to the experimental website to remind them of the goal of the study (i.e., cover story), they were randomly assigned to one of three Maximo websites. Once on the website, subjects were

[2] In the first session, subjects were asked to complete a subjective knowledge measurement scale (Flynn & Goldsmith, 1999) and a familiarity measurement scale (Park, Mothersbaugh, & Feick, 1994) for each product category.

Table 1
Brands used in the experiment

Computer Mice	Calculators	Red Wine
Kensington Mouse In A Box Optical Pro	Canon P23-DH	Ceuso Custera 1998
Targus Optical Stroller Mini Mouse	Casio HR-8L[a]	Les Longeroies 1998
Microsoft Intellimouse Optical	Texas Instruments TI5019	Callabriga 1995[a]
Logitech Wheel Mouse Optical[a]	Casio HR100LC	Coteaux du Languedoc, Les Hauts de Lunes 1996

[a] Product recommended by all recommendation sources.

instructed to read a description of the company to clearly understand which of the three types of websites they were visiting. During the experiment, the information and its presentation (e.g., website layout) were held constant across the different treatments levels. Thus, all three Maximo websites were graphically identical. Subjects were then advised that within the next few minutes they would be asked to shop on Maximo's website and select three products from three different product classes. Although Maximo was presented as a real European company with a professional looking website it was in fact a fictitious company. However, all products used in the experiment were actual brands available online (see Table 1).

As recommended by Nosek, Banaji, and Greenwald (2002), the first online shopping task was a warm-up task. Its goal was to familiarize subjects with the structure and functionalities of Maximo's website. Subjects were shown four computer mice and asked to choose one. They were able to evaluate mice based on their attributes and they were also randomly assigned to one of the four recommendation source treatment levels. Hence, most subjects had the opportunity to consult a recommendation page. Subjects were free to consult or not the recommendation page (i.e., Click or not on the "Our recommendation" button). Remaining subjects were assigned to the control group condition, i.e., they were randomly assigned to one website treatment level and to the "no recommendation" condition of the recommendation source factor. On the recommendation page, the recommendation source (e.g., human experts) was described to the subject and it recommended one of four products within the product class. Note that the same product was recommended by all recommendation sources (see Table 1). After this initial product assessment, subjects were asked to choose one of the four mice presented.

The warm-up task was followed by a second online shopping task. Subjects were randomly assigned to a product class (i.e., calculator or wine[3]). Product classes were randomized to control for any order effect. The second shopping task essentially followed the same procedure as the warm-up shopping task. Subjects were assigned to the same recommendation source treatment level and were asked to select one product out of four within the product class (see Table 1). The product recommended by all recommendation sources was again the same. Following the second product choice, subjects not assigned to the control group condition and who had consulted the recommendation page (i.e., subjects who clicked on the "Our recommendation" button) were asked to complete a recommendation source credibility measurement scale.

Following this second shopping task, subjects were asked to perform the third and final shopping task. As part of this task, subjects were exposed to four products of the remaining product class (i.e., calculator or wine). The third shopping task essentially followed the same procedure as the second shopping task. Subjects were assigned to the same recommendation source as that of previous shopping tasks. Following their final product selection, subjects who consulted the recommendation page were again asked to evaluate the recommendation source's credibility. After having completed all three shopping tasks, subjects were asked to complete a short final questionnaire in which they were prompted to guess the main objective of the experiment.[4] They then accessed a debriefing page explaining the actual goal of the experiment and were logged out of the second session. The debriefing page explained the real goal of the experiment (i.e., influence of recommendations on product choices), reassured subjects about their chance to win one of the products they selected, indicated that the collected data would remain confidential, and that all researchers performing the study had signed a confidentiality agreement. Finally, subjects were provided the University Ethics Comittee phone number in order for them to call if they had any questions or comments on the study.

The website treatment

Subjects were assigned to one of the three following website treatment levels presented in Table 2. We purposely used a fictitious company in order to control for any past experience.

The recommendation source treatment

Four treatment levels were used for the recommendation source manipulation: other consumers, human experts, recommender system, and no recommendation. During the

[3] The data collection was performed in Canada where the legal age for drinking is 18 years old. In addition, no significant relationship was found between subjects' professional situation (e.g., part time worker, full time worker, full time students, etc.) and their subjective knowledge of wine ($F(6, 473) = 1.322$; $p > .05$).

[4] The following open-ended question was asked to subjects at the end of the second session: "To your knowledge, what is the main goal of this study?"

Table 2
The website treatment levels

Treatment Level	Description Provided to Subjects
Retailer	"Maximo is a large European store selling products on the Internet. It is currently assessing the feasibility of offering new products on its website to consumers in your area. Therefore, it is very interested in learning your product preferences. In the region, Maximo competes with The Bay, Staples and Wal-Mart, which also offer their products on the Internet."
3rd party commercially linked to retailers	"Maximo is a large European buying group. It is currently assessing the feasibility of offering new products on its website to consumers in your area. Therefore, it is very interested in learning your product preferences. Being an intermediary between consumers and a limited number of partner-retailers offering their products on the Internet, Maximo offers the best products available at its partner-retailers. In the region, Maximo has the following partners: The Bay, Staples and Wal-Mart."
Non-commercially linked 3rd party	"Maximo is a large European independent organization offering a product comparison service on the Internet. It is currently assessing the feasibility of offering new products on its website to consumers in your area. Therefore, it is very interested in learning your product preferences. Being independent, Maximo selects for you the best products available on all sites offering products on the Internet. Hence, Maximo offers a service similar to that of *Consumer Reports*."

experiment, if subjects were assigned to a recommendation source, and if they elected to see the product recommendation (i.e., clicked on the "Our recommendation" button), they were exposed to a recommended product and a description of the recommendation source. Based on pretest results of consumers' preferences, the second best preferred product was always proposed by recommendation sources. For the "other consumers" treatment level, the recommendation source for the mouse product class was described as follows.

"This recommendation is based on other consumer selections. In fact, based on the choices of consumers in your area, we have determined the following preferences:

Product	Consumers who have selected the product (%)
Kensington's Mouse In A Box Optical Pro	9
Targus' Optical Scroller Mini Mouse	2
Microsoft's Intellimouse Optical	18
Logitech's Wheel Mouse Optical	71

When subjects were assigned to the "human experts" condition, the recommendation source was presented as follows: "This recommendation is based on an evaluation by our team of experts. Our advisors, experts in this product class, highly recommend this product over the others." The "recommender system" treatment level was described as follows: "This recommendation results from the analysis of the answers to the questionnaire that you completed a few days ago during the first phase of the study. Our computer system analyzed your answers and, based on your personalized profile, the system highly recommends this product over the others." Thus, subjects were led to believe that the recommendation from the recommender system was personalized based on their answers to the questions of the first session. Subjects assigned to the "no recommendation" treatment level did not have the opportunity to consult a recommendation source during their sopping tasks, i.e., no "Our recommendation" button was present on the Maximo website they visited.

Product type treatment

The product type was manipulated by using two different product classes. Based on pretest results, the search product class used for the experiment was the calculator, and wine was used for the experience product class. Since it is the only within factor of the experiment, after their warm-up task, subjects were randomly assigned to either the calculator or the wine product class on their first shopping task and assigned to the other product class for their second shopping task.

Measures

The first dependent variable was the influence of the recommendation source on consumers' online product choices. The influence was measured by a dichotomous variable. Each product choice was categorized as either a decision to follow or not to follow the product recommendation. The remaining dependent variables were related to the credibility of recommendation sources. The measurement scale developed by Ohanian (1990) was used to assess recommendation sources' expertise and trustworthiness. Results from a pretest ($n = 39$) and from the experiment ($n = 487$) both show that the measurement scale is reliable. The Cronbach's alphas for the expertise dimension ranged from 0.88 to 0.91 and from 0.84 to 0.88 for the trustworthiness dimension.

Manipulation checks

Following Perdue and Summers (1986), all manipulation checks were performed during pretests. A series of four pretests were necessary to achieve effective online manipulations. After each pretest, necessary iterations were made on

manipulations (e.g., Website descriptions) to ensure their effectiveness. Results from the last pretest are presented below. For this pretest, a non-student sample of 33 consumers was used. The pretest followed the same procedure as the main experiment (i.e., online questionnaires and $3 \times 4 \times 2$ mixed design online experiment) except that it was conducted in only one session. Pretest subjects were not included in the final sample.

Product manipulation

First, subjects were asked to evaluate the nature of a set of product classes (calculator, camping cooler, computer mouse, water filter system, bottle of wine, and 35 mm camera). For each product class, subjects were asked whether products could either be evaluated: (1) before purchase; (2) mostly before purchase; (3) mostly after purchase; (4) only after purchase. Results of the pretest indicated that the wine product class was perceived as the most "experience" product (mean = 3.2, median = 3) and the calculator product class was perceived as the most "search" product (mean = 1.4, median = 1). Furthermore, the difference between the evaluations of the two product classes was significant ($t(27) = -7.48$, $p < .001$). The computer mouse was the most balanced product category (mean = 2.1, median = 2).

Website manipulation

Following their first online shopping task, subjects involved in the pretest, were asked to identify the type of website on which they were shopping. They had to select one of three different descriptions representing either a retailer, a third party commercially linked to retailers, or a non-commercially linked third party. Subjects assigned to one type of website (e.g., retailer) mentioned more often that they were shopping on that specific type of website than subjects assigned to the other types of websites ($X^2_{\text{Retailer}}(1) = 4.54$, $p < .05$; $X^2_{\text{Dependent 3rd party}}(1) = 8.42$, $p < .005$; $X^2_{\text{Independent 3rd party}}(1) = 12.44$, $p < .001$; $n = 33$). Thus, pretest results suggested that the website manipulation was effective.

Recommendation source manipulation

After their second shopping task, pretest subjects who had consulted a product recommendation were asked to identify which type of recommendation source they had consulted. They had to select one of three different descriptions representing a recommender system, human experts, or a group of other consumers. Subjects assigned to one recommendation source (e.g., other consumers) more often mentioned that they received a recommendation from that specific source than subjects assigned to the other recommendation sources ($X^2_{\text{Other consumers}}(1) = 7.47$, $p < .01$; $X^2_{\text{Human experts}}(1) = 6.86$, $p < .01$; $X^2_{\text{Recommender system}}(1) = 5.57$, $p < .05$, $n = 16$). Again, pretest results suggested that the recommendation source manipulation was effective.

Results

Hypothesis guessing

Of the 487 participants, 20.3% correctly guessed the goal of the experiment. However, the frequency of choosing a recommended product did not differ between subjects who correctly guessed the goal of the experiment and subjects who did not correctly guess the main goal of the experiment (Wine: $X^2(1) = 3.640$, $p > .05$; Calculator: $X^2(1) = 2.703$, $p > .05$). Furthermore, no significant difference was found between the two groups regarding the perceived recommendation source credibility (Wine: $F(1, 264) = 0.056$, Calculator: $F(1, 261) = 0.03$; all p-values $> .05$). Note that subjects who consulted a product recommendation had a better chance of guessing the experiment's goal since they were asked to complete a source credibility measurement scale after their shopping tasks. Thus, observations from all participants were used to test the hypotheses.

Test of hypotheses

H1 to H4 all suggest relationships between a categorical independent variable (i.e., exposition to a recommendation, type of product, type of website, or recommendation source) and a dichotomous dependent variable (i.e., selection or non selection of a recommended product). In addition, subjects' responses were likely to be correlated since they had to perform two product choices (i.e., correlation between the decision to follow the wine product recommendation and the calculator product recommendation). Because of the nature of the data and because of the repeated treatment used in this study, a Generalized Estimating Equations (GEE) procedure was used in order to test H1 to H4. Introduced by Liang and Zeger (1986), the GEE approach is an extension of generalized linear models designed to handle categorical repeated measurements arising from within-subject designs (for more details on the GEE methodology, see Liang, Zeger, & Qaqish, 1992; Stokes, Davis, & Koch, 2001; Zeger, Liang, & Albert, 1988). GEE analyses were thus performed using the GENMOD procedure of the SAS system version 8.0. Finally, since H5 and H6 dealt with categorical independent variables (i.e., type of recommendation source and type of website) and dependent variables that were continuous and measured twice during the experiment (i.e., perceived trust and expertise), a MANCOVA for repeated measures was performed.

The two online shopping tasks performed by 487 subjects generated 974 observations. Of the 974 observations, 200 observations were collected from the control group that was not assigned to any recommendation sources and 412 observations reflect decisions to consult a product

Table 3
Total number of product choices performed by subjects who consulted a product recommendation and percentages of recommended product selected

Recommendation source/ website manipulations	Other consumers	Human experts	Recommender system	Total
Retailer	33	54	60	147
	C[a]: 20%	C: 35%	C: 43%	C: 35%
	W[a]: 39%	W: 52%	W: 77%	W: 59%
	A[b]: 30%	A: 43%	A: 60%	A: 47%
Dependent 3rd party	43	45	42	130
	C: 30%	C: 36%	C: 42%	C: 36%
	W: 40%	W: 65%	W: 65%	W: 57%
	A: 35%	A: 49%	A: 55%	A: 46%
Independent 3rd party	51	47	37	135
	C: 36%	C: 32%	C: 31%	C: 33%
	W: 55%	W: 52%	W: 57%	W: 55%
	A: 43%	A: 43%	A: 46%	A: 44%
Total	127	146	139	412
	C: 30%	C: 34%	C: 40%	C: 35%
	W: 45%	W: 56%	W: 68%	W: 57%
	A: 37%	A: 45%	A: 55%	A: 46%

[a] C (W): Proportion of subjects who selected the recommended calculator (wine).
[b] A: Weighted average of C and W.

recommendation. Of the latter number of observations, 188 observations represent decisions to follow a product recommendation.

Influence of recommendation on product choice

H1 stipulated that consumers who consult a product recommendation were more likely to select the recommended product than consumers who do not consult a recommendation source. A first GEE analysis using observations from all subjects ($n = 974$) was performed to test this hypothesis. One dichotomous independent variable (exposition to a product recommendation) and one dichotomous dependent variable (selection of the recommended product) were used in the GEE analysis. Results strongly support H1 ($X^2(1) = 52.3$, $p < .001$). Overall only 22.5% of product choices made by subjects who did not see a product recommendation, either because they were assigned to the control group or because they did not click on the recommendation button during their shopping task, favored the recommended product compared to a proportion of 45.6% of product choices made by subjects who consulted a product recommendation. Thus, online product recommendations greatly influenced subjects' product choices.

In order to test H2 to H4, a second GEE analysis using only observations from subjects who had consulted a product recommendation ($n = 412$) was performed to test the relationships between the type of product (H2), the type of website (H3), or the type of recommendation source (H4) and product choices (Table 3). Thus, three categorical independent variables (type of product, type of website, and type of recommendation source) and one dichotomous dependent variable (selection of the recommended product) were used in the GEE analysis. In addition, the following variables were used as covariates in the analysis: professional status (i.e., student/non-student), order of exposure to products, product class familiarity, and product class subjective knowledge.

As illustrated in Table 4, results of the GEE analysis showed no significant two-way or three-way interactions, but they revealed main effects for the product type and the recommendation source manipulation. The analysis of the covariates revealed that subjects' professional status ($X^2(1) = 0.15$, $p > .05$), subjective knowledge of the product class (($X^2(1) = 0.05$, $p > .05$), and the order in which they were exposed to the two products ($X^2(1) = 3.36$, $p > .05$), did not influence their decision to follow or not the product recommendation. The only covariate with a significant influence on subjects' decision to follow or not the product recommendation was their product class familiarity ($X^2(1) = 8.13$, $p < .005$). Subjects who perceived themselves as more familiar with the products selected the recommended product

Table 4
GEE analysis results for recommendation influence

Main effects and interactions	*df*	X^2
Product	1	20.27[a]
Website	2	0.35
Recommendation	2	11.61[a]
Product × Website	2	0.06
Product × Recommendation	2	0.94
Website × Recommendation	4	6.21
Product × Website × Recommendation	4	1.78
Contrast Tests for Recommendation		
Rec. System vs. Other Consumers	1	11.69[a]
Rec. System vs. Experts	1	4.28[b]
Other Consumers vs. Experts	1	2.05

[a] $p < .005$.
[b] $p < .05$.

more often than subjects who perceived themselves as less familiar with the product category. The differences between the two groups were significant for the wine product class ($F(1, 196) = 18.777$, $p < .05$) but not for the calculator product class ($F(1, 203) = 0.007$, $p > .05$).

H2 stipulated that consumers would be more influenced by recommendations for experience products than for search products. Results provided strong support for H2 ($X^2(1) = 20.27$, $p < .005$). Recommendations for wine were more influential than recommendations for calculators. H3 suggested that product recommendation influence is greater on more independent websites. Results did not support H3: no relationship was found between the type of website and subjects' propensity to follow product recommendations ($X^2(2) = 0.35$, $p > .05$). H4 stipulated that recommender systems are more influential than other consumers and human experts. In support of H4, contrast tests showed that the recommender system was more influential than other consumers ($X^2(1) = 11.69$, $p < .005$) and human experts ($X^2(1) = 4.28$, $p < .05$). As illustrated in Table 3, more subjects followed the product recommendation when the product recommendation came from the recommender system. An additional contrast test also revealed that no significant difference existed between human experts and other consumers relative to their influence on subjects' choices ($X^2(1) = 2.05$, $p > .05$).

Recommendation source credibility

In order to test H5 and H6, a MANCOVA for repeated measures using only observations from subjects who had consulted a product recommendation ($n = 412$) was performed in order to test the relationships between the type of recommendation source (H5) and the type of website (H6) and the perceived trust and expertise of recommendation sources. The order in which subjects were exposed to the two different products was used as a covariate in the analysis. Results showed no significant two-way or three-way interactions, but revealed a main effect for the recommendation source manipulation. As predicted by H5a, differences were observed between perceived expertise of recommendation sources ($F(2, 204) = 14.089$, $p < .001$). Contrast tests revealed that other consumers were perceived as less expert than human experts (Mean (M) = 4.4 and 5.2 respectively; Contrast Estimate (C.E.) = −0.771, $p < .001$) and recommender systems ($M = 4.7$; C.E. = −0.356, $p < .05$). It is noteworthy that human experts were perceived as more expert than recommender systems (C.E. = 0.415, $p < .05$). As stated in H5b, differences in recommendation sources' trustworthiness were also observed ($F(2, 204) = 3.679$, $p < .05$). Contrast tests showed that the recommendation source "other consumers" was perceived as significantly more trustworthy than the recommendation source "recommender system" ($M = 5.1$ and 4.6, respectively; C.E. = 0.438, $p < .01$) but as trustworthy as human experts ($M = 4.9$; C.E. = 0.192, $p > .05$), thus providing partial support to H5b. Interestingly, human experts were perceived as trustworthy as recommender systems (C.E. = 0.245, $p > .05$). Finally, H6 was not supported. No significant differences were found between the trustworthiness of recommendation sources among the different types of websites ($M = 5.0$ (retailer), 4.9 (Third party commercially linked to retailers), 4.9 (Non-commercially linked third party); $F(2, 204) = 1.310$, $p > .05$).

Discussion and conclusion

Results strongly support our contention that consumers are influenced in their online product choices by online recommendations. However, all online recommendation sources are not equally influential. The recommender system was found to be the most influential recommendation source even if it was perceived as possessing less expertise than human experts and as being less trustworthy than other consumers. In addition, recommendations for the experience product were significantly more influential than recommendations for the search product. The type of website on which recommendation sources were used did not affect their perceived trustworthiness and did not influence consumers' propensity to follow the product recommendation.

This paper's main theoretical implication is related to the influence of recommender systems on consumers' online choices. With the emergence of the Internet, consumers now have access to new impersonal sources of influence that can provide personalized product information and recommendations. Results show that this type of information source indeed influences consumers' online product choices, and that it is more influential than conventional recommendation sources. Thus, this study contributes to an emergent consumer research area, namely the use and influence of impersonal information sources providing personalized information (e.g., recommender systems and intelligent agents) on consumers' decision-making processes.

This paper also has implications for marketers. First, results show that online recommendation sources influence consumers' online choices: products were selected twice as often if they were recommended. Second, this influence is moderated by the type of recommendation source and the type of product, but it is not moderated by the type of website. Thus, results suggest that a specific recommendation source will be as effective on a retailer website (e.g., Amazon) as it will be on an independent third party website such as *Consumer Reports*. It seems that consumers focus much more on the recommendation source itself than on the type of website on which the recommendation source is used.

Since research on online recommendation sources is emergent, this study points to many research avenues. First, since impersonal information sources are used by and influence consumers, an effort should be made to develop and/or adapt existing tools related to information source influence. For instance, it would be useful to develop a susceptibility to relevant others influence measurement

scale that would both include personal information sources (Bearden, Netemeyer, & Teel, 1989) and these new information sources. Second, results of the present study suggest that recommender systems are perceived as less trustworthy than other consumers. As suggested by Urban et al. (1999), trust is not instantaneous and increases over multiple successful interactions. Since our purpose was not to perform a longitudinal study, our results must be interpreted with caution. It is plausible that a customer's trust in a specific recommender system would increase over time if he/she were satisfied with products previously recommended by that system. Similarly, it would be of interest to explore if customer loyalty to a specific website (Srinivasan et al., 2002) acts as a moderator of the influence of online recommendation sources. In addition, results of the present study do not provide an explanation as to why recommender systems are more influential than human experts based on the traditional source credibility approach. Additional studies should investigate the effect of information personalization on perceived source trust and expertise. Third, in the present study only a limited product assortment was used (i.e., four products) in each product class. It would be very interesting to study how product assortment (see Simonson, 1999 for a review) affects the influence of online recommendation sources. For instance, an increase in the number of alternatives presented or the presence of a clearly dominant alternative not recommended may affect the credibility and influence of online recommendation sources. Fourth, it would be interesting to examine if the decision to follow (or not to follow) an online product recommendation affects consumers' satisfaction with their online shopping experience (Szymanski & Hise, 2000). Finally, additional variables need to be investigated to better understand why consumers follow online product recommendations. Variables such as online shopping familiarity and experience, past experience with online recommendations, age, and time starvation (Lohse, Bellman, & Johnson, 2000; Wood, 2002) may help explain why consumers use recommendations in their online decision-making process.

This study has some limitations that should be kept in mind before applying the results to real market situations. First, although three different sampling frames were used for this study, they were all used to generate convenience samples. Thus, as with most online studies, due to the possible self-selection bias and low response rates it is not possible to confirm that our participants are representative of the population of Internet shoppers. Second, results of the present study are limited to only one search product (i.e., calculator) and one experience product (i.e., wine). Thus, additional studies conducted with different samples and different products would contribute to the generalization of the present. Finally, this study only investigated consumers' online product choices; it did not investigate online purchases. Thus, additional variables such as product price, product availability or delivery time could also affect how consumers are influenced by online product recommendations.

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References

Alba, J., Lynch, J., Weitz, B., Janiszewski, C., Lutz, R., Sawyer, A., et al. (1997). Interactive home shopping: Consumer, retailer, and manufacturer incentives to participate in electronic marketplaces. *Journal of Marketing*, *61*(3), 38–53.

Andreasen, A. R. (1968). Attitudes and customer behavior: A decision model. In H. H. Kassarjian & T. S. Robertson (Eds.), *Perspectives in consumer behavior* (pp. 498–510). Glenview, IL: Scott, Foresman and Company.

Ansari, A., Essegaier, S., & Kohli, R. (2000). Internet recommendation systems. *Journal of Marketing Research*, *37*(3), 363–375.

Ardnt, J. (1967). Role of product-related conversations in the diffusion of a new product. *Journal of Marketing Research*, *4*(3), 291–295.

Bakos, Y. J. (1997). Reducing buyer search costs: Implications for electronic marketplaces. *Management Science*, *43*(2), 1676–1692.

Bearden, W. O., & Etzel, M. J. (1982). Reference group influence on product and brand purchase decisions. *Journal of Consumer Research*, *9*(2), 183–194.

Bearden, W. O., Netemeyer, R. G., & Teel, J. E. (1989). Measurement of consumer susceptibility to interpersonal influence. *Journal of Consumer Research*, *15*(4), 473–481.

Brown, J. J., & Reingen, P. H. (1987). Social ties and word-of-mouth referral behavior. *Journal of Consumer Research*, *14*(3), 350–362.

Childers, T. L., & Rao, R. (1992). The influence of familial and peer-based reference groups. *Journal of Consumer Research*, *19*(2), 198–212.

Cyber Dialogue (2001). *The personalization consortium's online consumer personalization survey*.

Duhan, D. F., Johnson, S. D., Wilcox, J. B., & Harell, G. D. (1997). Influences on consumer use of word-of-mouth recommendation sources. *Journal of the Academy of Marketing Science*, *25*(4), 283–295.

Folkes, V. S. (1988). Recent attribution research in consumer behavior: A review and new directions. *Journal of Consumer Research*, *14*(4), 548–565.

Flynn, L. R., & Goldsmith, R. E. (1999). A short, reliable measure of subjective knowledge. *Journal of Business Research*, *46*(1), 57–66.

Gilly, M. C., Graham, J. L., Wolfinbarger, M. F., & Yale, L. J. (1998). A dyadic study of personal information search. *Journal of the Academy of Marketing Science*, *26*(2), 83–100.

Harmon, R. R., & Coney, K. A. (1982). The persuasive effects of source credibility in buy and lease situations. *Journal of Marketing Research*, *19*(2), 255–260.

Häubl, G., & Trifts, V. (2000). Consumer decision-making in online shopping environments: The effects of interactive decision aids. *Marketing Science*, *19*(1), 4–21.

Hoffman, D. L., Novak, P. T., & Chatterjee, P. (1995). Commercial scenarios for the web: Opportunities and challenges. *Journal of Computer Mediated Communication*, *1*(1).

Kelley, H. H. (1967). *Attribution Theory in Social Psychology*. In D. Levine (Ed.), *Nebraska symposium on motivation* (pp. 192–241). Lincoln, NE: University of Nebraska Press.

Kelley, H. H. (1973). The process of causal attribution. *American Psychologist*, *28*, 107–128.

Kelman, H. C. (1961). Processes of opinion change. *Public Opinion Quarterly*, *25*, 57–78.

King, M. F., & Balasubramanian, S. K. (1994). The effects of expertise, end goal, and product type on adoption of preference formation strategy. *Journal of the Academy of Marketing Science*, *22*(2), 146–159.

Lascu, D.-N., Bearden, W. O., & Rose, R. L. (1995). Norm extremity and personal influences on consumer conformity. *Journal of Business Research*, *32*(3), 201–213.

Liang, K.-L., & Zeger, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika*, *73*(1), 13–22.

Liang, K.-L., Zeger, S. L., & Qaqish, B. (1992). Multivariate regression analyses for categorical data. *Journal of the Royal Statistical Society*, *54*, 3–40.

Lohse, L. G., Bellman, S., & Johnson, E. J. (2000). Consumer behavior on the Internet: Findings from panel data. *Journal of Interactive Marketing*, *14*(1), 15–29.

Lynch, J. G., & Ariely, D. (2000). Wine online: Search costs affect competition on price, quality, and distribution. *Marketing Science*, *19*(1), 83–103.

Maes, P. (1999). Smart commerce: The future of intelligent agents in cyberspace. *Journal of Interactive Marketing*, *13*(3), 66–76.

McGuire, W. J. (1969). The nature of attitudes and attitude change. In G. Lindzey & E. Aronson (Eds.), *The handbook of social psychology* (pp. 137–314). Reading, MA: Addison-Wesley Publishing Company.

Mizerski, R. W., Golden, L. L., & Kernan, J. B. (1979). The attribution process in consumer decision making. *Journal of Consumer Research*, *6*(2), 123–140.

Nelson, P. (1970). Information and consumer behavior. *Journal of Political Economy*, *78*(2), 311–329.

Nelson, P. (1974). Advertising as information. *Journal of Political Economy*, *83*(4), 729–754.

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). E-research: Ethics, security, design, and control in psychological research on the Internet. *Journal of Social Issues*, *58*(1), 161–176.

Ohanian, R. (1990). Construction and validation of a scale to measure celebrity endorsers' perceived expertise, trustworthiness, and attractiveness. *Journal of Advertising*, *19*(3), 39–52.

Olshavsky, R. W., & Granbois, D. H. (1979). Consumer decision-making—fact or fiction. *Journal of Consumer Research*, *6*(2), 93–100.

Park, C. W., Mothersbaugh, D. L., & Feick, L. (1994). Consumer knowledge assessment. *Journal of Consumer Research*, *21*(2), 71–82.

Perdue, B. C., & Summers, J. O. (1986). Checking the success of manipulations in marketing experiments. *Journal of Marketing Research*, *23*(4), 317–326.

Postma, O. J., & Brokke, M. (2002). Personalisation in practice: The proven effects of personalisation. *Journal of Database Marketing*, *9*(2), 137–142.

Price, L. L., & Feick, L. F. (1984). The role of recommendation sources in external search: An informational perspective. In T. Kinnear (Ed.), *Advances in consumer research* (Vol. 11, pp. 250–255). Provo, UT: Association for Consumer Research.

Rosen, D. L., & Olshavsky, R. C. (1987). The dual role of informational social influence: Implications for marketing management. *Journal of Business Research*, *15*(2), 123–144.

Senecal, S., & Nantel, J. (2002). *Online influence of relevant others: A framework* (Working Paper). RBC Financial Group Chair of E-Commerce, HEC Montreal, University of Montreal.

Simonson, I. (1999). The effect of product assortment on buyer preferences. *Journal of Retailing*, *75*(3), 347–370.

Spiller, P., & Lohse, J. (1998). A classification of Internet retail stores. *International Journal of Electronic Commerce*, *2*(2), 29–56.

Srinivasan, S. S., Anderson, R., & Ponnavolu, K. (2002). Customer loyalty in E-commerce: An exploration of its antecedents and consequences. *Journal of Retailing*, *78*(1), 41–50.

Sternthal, B., Phillips, L. W., & Dholakia, R. (1978). The persuasive effect of source credibility: A situational analysis. *Public Opinion Quarterly*, *42*(3), 285–314.

Stokes, M. E., Davis, C. S., & Koch, G. G. (2001). *Categorical data analysis using the SAS System*. Cary, NC: SAS Institute Inc.

Szymanski, D. M., & Hise, R. T. (2000). e-Satisfaction: An initial examination. *Journal of Retailing*, *76*(3), 309–322.

The e-tailing Group (2003). *2nd Annual Merchant Survey*.

Tybout, A. M. (1978). Relative effectiveness of three behavioral influence strategies as supplements to persuasion in a marketing context. *Journal of Marketing Research*, *15*(2), 229–242.

Urban, G., Sultan, F., & Qualls, W. (1999). *Design and evaluation of a trust based advisor on the Internet* (Working Paper 40). e-Commerce Research Forum, MIT.

West, P. M., Ariely, D., Bellman, S., Bradlow, E., Huber, J., Johnson, E., et al. (1999). Agents to the rescue? *Marketing Letters*, *10*(3), 285–300.

Wind, J., & Rangaswamy, A. (2001). Customerization: The next revolution in mass communication. *Journal of Interactive Marketing*, *15*(1), 13–32.

Wood, S. L. (2002). Future fantasies: A social change perspective of retailing in the 21st century. *Journal of Retailing*, *78*(1), 77–83.

Zeger, S. L., Liang, K.-L., & Albert, S. (1988). Models for longitudinal data: A generalized estimating equation approach. *Biometrics*, *44*, 1049–1060.