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Francisco José Martínez-López Irene Esteban-Millat Claudia C. Cabal Charles Gengler

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Francisco José Martínez-López
Department of Management, University of Granada, Grenada, Spain and Marketing Group, Open University of Catalonia, Barcelona, Spain
Irene Esteban-Millat
Marketing Group, Open University of Catalonia, Barcelona, Spain
Claudia C. Cabal
University of Quindio, Quindio, Colombia, and
Charles Gengler
Department of Marketing and International Business, Baruch College, City University of New York, USA

Abstract

Purpose – e-Commerce recommenders have positive benefits both for consumers and the online stores using them. The focus of research in this topic has mostly been technical (e.g. design, type of recommenders, inputs, or outputs). However, a prior key question is what leads a consumer to use an e-vendor's recommender. The consumer process of adoption and use of such recommenders involves subjective factors which need a psychological approach. This perspective has been neglected so far. The purpose of this paper is to discuss and validate an integrative model which adapts various theories and models – i.e. the original formulation of the technology acceptance model (TAM), the integrated trust-TAM model, and the theory of planned behavior (TPB) – in order to explain such a process.

Design/methodology/approach – The field study consisted of a simulated online shopping process undertaken by a valid sample of 300 internet users with a recommender at a real online store (Amazon). Many of the constructs' measurement scales have been adapted from previously validated scales never before applied to this study's context, and the authors have consequently rigorously validated them here too; this also constitutes one of the research's valuable contributions. Detailed exploratory and confirmatory factor analyses are applied to assess the empirical validity of the model.

Findings – The model's core structure and its relationships are proved to be valid for explaining a consumer's intention to use an e-vendor's recommender In particular, trust and perceived usefulness of the recommender stand out as the determining factors of its use, though the consumer's attitude toward the recommender and others' opinion of its use also have significant influence too.

Originality/value – The consumer's psychological angle has been overlooked by previous studies on the adoption and use of online stores' recommendation systems. To the best of the knowledge, this is the first attempt to validate a model aimed at comprehensively approaching the consumer's adoption of an e-vendor's recommender. The findings provide several theoretical contributions and implications for practitioners.

Keywords Consumer, Recommendation system, Adoption and use, E-vendor, Psychological perspective

Paper type Research paper

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1. Introduction

In electronic markets, consumers usually have to deal with huge amounts of information and a wide range of options related to the products or services in which they are interested (e.g. books, computers and electronics, groceries, hotels, beauty, music, movies, clothing, etc.). That is compounded by companies basing their e-commerce business models on the so-called long tail model (Anderson, 2006), a paradigmatic example being the e-tailer Amazon.com. Product information overload tends to cause negative feelings (such as doubt, stress or anxiety) in consumers and makes online shopping processes more difficult for them (Haynes, 2009; Schwartz, 2004). In that context, it is absolutely vital that useful information be found, filtered, organized and conveyed to consumers. Recommendations, as a final outcome of such processes, can actually be very helpful, especially when consumers perform more open, less specific product searches (e.g. Hostler *et al.*, 2011; Liu *et al.*, 2013; Wang and Doong, 2010). That is the main purpose of the intelligent-system-based recommendation systems (RS) used to facilitate decision making for consumers on e-vendors' sites (Aljukhadar *et al.*, 2012; Choi *et al.*, 2011). Also known as recommendation agents, shopping agents, shopping bots and comparison shopping agents, among other things, RS can enhance consumers' shopping experiences by providing them with a personalized set of options that are supposedly relevant to their search interests and preferences (Murray and Häubl, 2009; Xiao and Benbasat, 2007; Zhang *et al.*, 2011). From an e-vendor's point of view, value-added services of the kind that RS provide have positive effects (e.g. improved sales, long tail model reinforcement, greater flexibility to adjust prices and even scope for charging higher prices while increasing demand) (see Fleder and Hosanagar, 2009; Pathak *et al.*, 2010).

Issues related to RS have been intensively researched from technical angles (those of computer science and information systems, e.g.), especially over the last decade. Most research on RS has so far been published in journals associated with management information systems (MIS); Park *et al.* (2012) note the increasing attention paid to RS during the last decade. Nevertheless, despite the importance of the marketing and consumer perspective here, the predominant approach in the literature on RS is technical (i.e. information systems and computer science) (Xiao and Benbasat, 2007); this prevailing approach has usually studied the system (process) algorithms in order to generate personalized recommendations based on the preferences of the user, and on how to improve predictions about these preferences (Knijnenburg *et al.*, 2012). Studies on e-commerce RS with a focus on marketing and, specifically, on consumers and their decision-making are harder to find. However, this approach is important for gaining an understanding of the adoption and use of a recommender.

Our attention focusses on the sequence of psychological variables, in other words the subjective, and not the objective or technical-related, to explain a consumer's use of an e-vendor's recommender to support his/her online shopping process at the e-vendor's site. Given the major influence that the recommender can have on consumers' online decisions (Tan *et al.*, 2012), an understanding of consumers' adoption and use of such systems is essential (Aljukhadar and Senecal, 2011); consumers' interaction with recommenders, and the influence that such systems might have on the online decision process, ultimately depend on the perceptions of consumers (Pu *et al.*, 2012; Murray and Häubl, 2009; Knijnenburg *et al.*, 2012; Martinez-López *et al.*, 2010). The most important theoretical studies that review the factors in adopting and using a recommender include that of Xiao and Benbasat (2007), and its recent revision and update (Xiao and Benbasat, 2014). Nonetheless, it is observed that the consumer's subjective perspective

has frequently been overlooked or dealt with as a secondary issue; there are a few notable contributions focussing on concrete issues of the recommender process of acceptance and/or use (e.g. Bodapati, 2008; Hostler *et al.*, 2012; Köhler *et al.*, 2011; Lepkowska-White, 2013), but the consumer psychological factors involved in the adoption process have yet to be modeled and tested with an integrative approach (Martinez-López *et al.*, 2010). This paper aims to cover that research gap.

The rest of the paper is structured as follows: we first introduce a conceptual model that encompasses 11 constructs and 16 hypotheses. Then, hypotheses are discussed in detail, before describing various aspects of our empirical study methodology (specifically data collection, sample and measurement scales). We have used structural equation modeling (SEM) to rigorously test our conceptual model, and our results section contains an in-depth presentation of our exploratory and confirmatory factor analyses (measurement model, structural model and construct validity). The paper concludes with a final theoretical discussion.

2. Theoretical development

2.1 Integrative theoretical model: an overview

In this paper, we concentrate on and present a detailed discussion of the central part of the integrative theoretical framework proposed by Martinez-López *et al.* (2010 and 2011); to the best of our knowledge this is the first attempt to approach the consumer's psychological factors that explain the process of adoption and use of an e-vendor's recommender. It advocates jointly adapting various theories and models: the theory of reasoned action (TRA), the original formulation of the technology acceptance model (TAM), the integrated trust-TAM model, and the theory of planned behavior (TPB), to explain consumer adoption of online stores' RS. Such a detailed discussion of the model's hypotheses also implies an incremental contribution to the original proposal by Martínez-López *et al.*, which mostly focussed on justifying the integration of the theories of base; i.e. hypotheses were briefly argued or just stated in group, not individually discussed.

Our theoretical model is depicted in Figure 1, where its components and relationships are clearly set out.

2.2 Hypotheses

Because of the complexity or our model, with its eleven constructs and sixteen hypotheses, rather than a separate discussion of hypotheses these have been structured following the theoretical logic used to design the conceptual model. First, due to their centrality in our model, we deal with hypotheses involving constructs and variables adapted from TAM and trust-TAM models (Section 2.2.1). Then we treat the hypotheses dealing with constructs that we call "external variables", based on TAM premises, (Section 2.2.2). Finally, Section 2.2.3 discusses the direct antecedents of the consumer's intention to use an e-vendor's recommender.

2.1.1 TAM and trust-TAM model adaptation. TAM (Davis, 1986) is designed to explain the process of acceptance and use of information systems and tools of any type. TAM has been used extensively in research on information system usage.

According to Taylor and Todd (1995), users who are new to an information system initially focus on perceived ease-of-use (PEOU), as they are unfamiliar with the system and are evaluating how much effort using it will take. In contrast, users who are familiar with a system focus more on its usefulness for obtaining certain benefits.

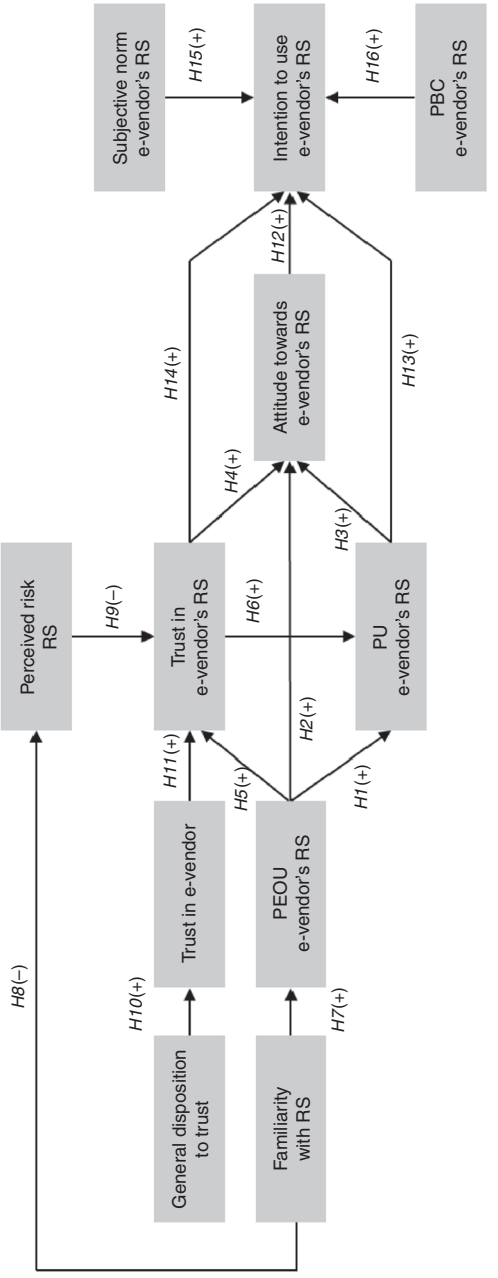


Figure 1.
Theoretic model

On that basis, the PEOU of a technology or tool will be greater in the eyes of a frequent user, as their knowledge of it enables them to use it with less effort. Furthermore, if a consumer finds a tool useful for fulfilling a goal (perceived usefulness, PU), they will use it to that end.

Gefen *et al.* (2003) point out that PEOU is a key aspect in the use of systems and tools related to B2C e-commerce. It influences such use, with indirect effects through trust and PU, aspects that e-vendors can control. For example, the design of a company's web site and the level of difficulty involved in using its RS or recommender are matters for the company itself to decide upon. The company can also choose whether or not to use interfaces similar to those to which consumers are accustomed so as to facilitate consumption processes on its web site.

Based on the above, we put forward the following hypotheses:

H1. The higher a consumer's perception of the ease of use of an e-vendor's recommender, the higher his/her perception of the recommender.

H2. The higher a consumer's perception of the ease of use of an e-vendor's recommender, the more positive his/her attitude toward the recommender.

Neither the general TAM model nor the trust-TAM model (Gefen *et al.*, 2003) considers attitude (toward the e-vendor's recommender in our model) as one of the factors that explains the intention to use a RS (Wang and Benbasat, 2005); this was probably for reasons of model simplification. Nonetheless, a formulation that allows for its explanation is required. Here, regardless of the direct effects that a consumer's trust in an e-vendor's RS and their perception of its usefulness have on their intention to use it, we propose a framework, inspired by the original TAM (Davis, 1986), encompassing the relationships between the variables PEOU, attitude and trust in an online store's RS (see also section 2.2.3.). We therefore hypothesize that:

H3. The higher a consumer's perception of the usefulness of an e-vendor's recommender, the more positive his/her attitude toward the recommender.

The integrated trust-TAM model introduces and supports the concept of trust as a component with a bearing on predictions of information system use. Trust represents an individual's expectation that others will behave reliably and ethically rather than opportunistically (see Gefen *et al.*, 2003). A consumer's trust in an e-vendor plays an important role in the context of B2C e-commerce (Gefen, 2000; Kollock, 1999), as it generates a positive attitude toward the latter in the former (Reichheld and Schefter, 2000).

The concept of trust in an e-vendor, or in particular aspects of an e-vendor (e.g. its recommender) is approached in different ways in the literature (see, as e.g.: Gefen, 2000; Jarvenpaa and Tractinsky, 1999; McKnight *et al.*, 2002). In this study, we regard trust as a general belief in or evaluation of the trustworthiness of something, namely an e-vendor's web site or its recommender. Specifically, where our model's relationships are concerned, our suggestion that a consumer's trust in an e-vendor's RS can influence their attitude toward the system is based on studies carried out in the context of B2C e-commerce (Jarvenpaa *et al.*, 2000) and on the generic beliefs-and-attitude sequence corresponding to TRA and the original TAM. To support that relationship, we have adapted conclusions from previous studies that have successfully analyzed the relationship between trust and consumers' attitudes toward online stores, companies'

web sites and B2C e-commerce in general (see: Elliot and Speck, 2005; Lim *et al.*, 2006; Teo and Liu, 2007). On that basis, we hypothesize that:

H4. The more a consumer trusts an e-vendor's recommender, the more positive his/her attitude toward the recommender.

Finally, our model's relationships between a consumer's perception of the ease of use and the usefulness of an e-vendor's RS, on one hand, and their trust in the system, on the other, are based on the general trust-TAM model for online shopping (Gefen *et al.*, 2003) (see also Wang and Benbasat, 2005). In particular, a user-friendly recommender facilitates the consumption process, and consumers would be expected to view that as a sign of the company caring about them. This is something they should value positively, leading to greater trust in the RS. We therefore hypothesize that:

H5. The higher a consumer's perception of the ease of use of an e-vendor's RS, the greater his/trust in the recommender.

Additionally, a consumer's trust in an e-vendor's RS would be expected to result in a positive perception of its usefulness as an aid for their consumption and decision-making processes on the e-vendor's web site. When a RS is reliable, consumers tend to have a higher opinion of the information it provides on items that might be of interest to them (see Wang and Benbasat, 2008) and the opposite applies in the case of an unreliable RS (see Wang and Benbasat, 2005). Thus, we hypothesize that:

H6. The more a consumer trusts an e-vendor's RS, the greater his/her perception of the system's usefulness.

2.2.2 External variables. In addition to the set of variables that TAM-related models typically regard as core to explanations of an individual's intention to adopt a technology, there are others that could indirectly influence that intention through some of those core variables. Davis *et al.* (1989) first referred to variables of the second kind as "external". Since then, a few notable attempts to develop TAM have considered the idea in question and incorporated a small number of external variables into their models. Examples include the theoretical extension of TAM called TAM2 (Venkatesh and Davis, 2000) and the trust-TAM model (Gefen *et al.*, 2003). The external variables mentioned or explicitly included in each model vary, and there are none in particular that feature in the majority of models. Depending on each study's approach, the external variables identified may be mainly linked to technology, society, a job, etc., or even a combination of fields. Their relationships in terms of influence on TAM or trust-TAM model core variables vary too. Our model includes two external variables associated with a consumer's perception of RS in general, namely familiarity with RS and perceived risk entailed by e-commerce RS in general, in line with the kind of technology-focussed external variables suggested by Davis *et al.* (1989).

We also put forward two variables related to consumer trust as antecedents of trust in an e-vendor's RS, namely a consumer's general disposition to trust and their trust in the e-vendor.

2.2.2.1 Familiarity. Familiarity is related to the concept of automaticity, understood as the absence of conscious thought in performing an act (Verplanken and Orbell, 2003), and to individuals' acts that become habits and are carried out spontaneously. It is thus the result of the repetition over time of acts or experiences involving

something or someone. That generates automatic processes in people, something that positively influences their trust as time goes by (McKnight *et al.*, 1998).

Based on the above, we deduce that a consumer's familiarity with RS is the accumulated result of their past experiences with such systems (see also Gefen, 2000). Accumulated knowledge of interaction enables an individual to associate goals with acts (Anderson, 1993), creating a relationship between means and end where a given behavior is concerned. People are more at ease when they are familiar with things, enabling them to deal with problems and carry out tasks using cognitive maps they have acquired over time (Anderson, 1985). In other words, familiarity facilitates the application of patterns learned in the past. In the context of our research, an online store's recommender will be easier to use when doing so requires less effort in terms of cognitive learning; or, to put it another way, in a state of "situational normality" that allows for the application of well-established cognitive patterns (Gefen *et al.*, 2003) when interacting with and using such systems. Less cognitive effort will be necessary when using RS if a consumer has a good knowledge of their typical structure, their standard procedures and how they work (see Karahanna *et al.*, 1999). We therefore hypothesize that:

H7. The greater the familiarity with e-commerce RS, the greater the consumer's perceived usefulness of an e-vendor's recommender.

2.2.2.2 Perceived risk. Whereas familiarity is understood to be characterized by knowledge of an environment, risk has been defined as the perception of uncertainty and of a consumption-related decision's potential adverse effects (Dowling and Staelin, 1994). Risk is the fear to which being unable to anticipate the outcome of a form of consumer behavior gives rise. It is associated with the possibility of an individual suffering an economic loss or a loss of security or privacy as a result of actions beyond their control. Specific cases notwithstanding, consumers generally tend to avoid involvement in activities they regard as risky (Wu and Chang, 2007).

A consumer's perception of the risk entailed by a particular object (e.g. a recommender) can be the result of the accumulation of experiences therewith. In general, the more familiar an individual finds something, the more secure he/she would be expected to feel about using or interacting with it (e.g. Mourali *et al.*, 2005; Park and Stoel, 2005). Hence, we hypothesize that:

H8. The greater the familiarity of a consumer with e-commerce RS, the less his/her perceived risk about using such systems.

Risk is directly related to individuals' beliefs, especially in the context of online shopping (e.g. Biswas and Biswas, 2004; Drennan *et al.*, 2006). A consumer's perception of risk is lower when an e-vendor's web site has a secure structure, i.e. when they perceive that it abides by the law and offers the necessary guarantees (McKnight *et al.*, 1998).

Perceived risk plays a fundamental role in conditioning consumers' behavior and decisions (Bland *et al.*, 2007). There is basically an inverse relationship between the perceived risk that a particular act or interacting with something entails and a consumer's trust in the relevant object (e.g. a company, a product, a RS, etc.). In our proposed model, a consumer's trust in an e-vendor's recommender depends not only on their specific beliefs related to the e-vendor in question and its recommender (i.e. trust in an e-vendor and PEOU of an e-vendor's RS, respectively), but also on

their general belief regarding the use of e-commerce RS. That idea is inspired by the classic elaboration likelihood model (ELM) of information processing (Petty and Caccioppo, 1986). The consumer's overall perception of the risk that these systems entail may thus have an influence (peripheral route) on their level of trust in the e-vendor's recommender, in a way that complements the influence of the aforementioned specific beliefs (central route). On that basis, we hypothesize that:

H9. The greater the consumer's perception of the risk that e-commerce RS entail, the less his/her trust in an e-vendor's recommender.

2.2.2.3 Antecedents of trust in an e-vendor's RS. Our model includes two more trust-related concepts as antecedents of a consumer's trust in a given e-vendor's recommender. The first is a construct that previous marketing studies on trust have habitually overlooked, namely a consumer's general disposition to trust or their dispositional trust. This is a personality trait consisting of an individual's general, consistent predisposition to trust, whatever the object of trust may be (McKnight *et al.*, 1998). In the context of our conceptual model, a consumer's dispositional trust is expected to influence their level of trust in a particular e-vendor and, indirectly, in particular aspects of the e-vendor, such as its recommender. That relationship would be even more logical in the case of the consumer having little or no prior experience with the e-vendor and, consequently, having not yet formed trust-related beliefs concerning the latter (see Gefen, 2000; Reichheld and Schefter, 2000).

On the other hand, as mentioned above, a consumer's trust in particular aspects of an e-vendor (e.g. its recommender) is expected to be directly conditioned by their overall trust-related beliefs concerning the said e-vendor. Furthermore, individuals usually regard information provided by sources they deem reliable as more credible (Howard and Kerin, 2004). Recommenders are basically tools via which companies provide consumers with information during online consumption processes. We therefore hypothesize that:

H10. The greater a consumer's general disposition to trust is, the greater his/her trust in an e-vendor.

H11. The more a consumer trusts an e-vendor, the more they will trust its recommender.

2.2.3 Intention to use an e-vendor's RS: direct antecedents. Studies aimed at explaining individuals' intention to adopt and use information technologies, and e-commerce RS in particular, are broadly based on the parsimonious TAM or extensions thereof (e.g. the trust-TAM model). In their conceptual model, however, Martinez-López *et al.* (2010) point out that such approaches omit variables that are useful for predicting a consumer's intention to use an e-vendor's RS. To address that shortcoming, it is suggested that the explanation be strengthened by using the original TAM and adapting TPB (Ajzen, 1991), as an addition to the standard TAM and trust-TAM models. TPB has already been successfully applied to analyses of consumer acceptance of various e-commerce-related technologies and tools (see Herrero Crespo and Rodríguez del Bosque, 2008). We thus expect it to be effective in the context of this study too, although, to the best of our knowledge, it has yet to be proven.

In summary, our proposal is that the direct antecedents of a consumer's intention to use an e-vendor's RS consist of a combination of elements identified as such in the original TAM, the trust-TAM model and TPB.

Our model includes three variables based on the original TAM and the trust-TAM model, namely a consumer's trust in an e-vendor's RS, their perception of its usefulness and their attitude toward it. The model features attitude but not PEOU as a direct antecedent of intended use for two important reasons. First, the original TAM (Davis, 1986) considers attitude to be a variable that mediates the effects of individuals' beliefs on their intention to adopt technologies. However, TAM-based research has tended to omit attitude (Gefen *et al.*, 2003) ever since Davis *et al.* (1989) put forward a TAM with three components (PU, PEOU and intention). Nevertheless, despite that model having a more parsimonious causal structure, it does not state that attitude must be discarded. On the contrary, based on their mixed results, Davis *et al.* (1989) recognized that, while further research was necessary, attitude might partially mediate the relationships between individuals' beliefs and their intention to use a technology. We believe that the inclusion of this mediating variable helps improve the explanation of a consumer's intention to use an e-vendor's RS. We therefore hypothesize that:

H12. The more positive a consumer's attitude toward an e-vendor's recommender, the greater his/her intention to use the recommender.

Second, on the basis of the original TAM, the effect of PEOU on a consumer's intention to use an e-vendor's recommender should be indirect rather than direct. In addition, the influence of PEOU has proven to be weak, especially if compared to the effect of PU in TAM (see Davis *et al.*, 1989) and extensions thereof (see Venkatesh and Davis, 2000), or to the effect of trust on intention in the particular case of trust-TAM research (see Gefen *et al.*, 2003). Furthermore, Davis *et al.* (1989) concluded that the effect of PEOU on an individual's intention to use a new technology becomes insignificant as they gain experience with it (proven by conducting studies just 14 weeks apart). Gefen *et al.* (2003) reached a similar conclusion in relation to experienced users. Most importantly, in the specific context of e-commerce RS, Wang and Benbasat (2005) found that PEOU has a non-significant direct effect on consumers' intention to use a virtual advisor, although it has an indirect effect through trust and PU. We thus put forward the following hypotheses:

H13. The greater a consumer's perception of the usefulness of an e-vendor's recommender, the greater his/her intention to use the recommender.

H14. The more a consumer trusts an e-vendor's recommender, the greater his/her intention is to use the recommender.

On the basis of TPB, meanwhile, our model includes two direct antecedents of a consumer's intention to use a given RS, namely social norms (SN) and perceived behavioral control (PBC).

With regard to the former, while TAM is adapted from TRA, it does not take the possible effect of social influence on users' acceptance and use of a technology into account. Nonetheless, Davis *et al.* (1989) suggested that further research should be carried out to analyze whether SN could have a significant influence in a context involving more multi-person, group decision support systems and the like. The RS used in e-commerce often provide consumers with other consumers' feedback and comments

on items for which they have searched online. A number of more recent studies have suggested and proven the predictive capability of SN in relation to the use both of ITs (e.g. Brown and Venkatesh, 2005; Venkatesh and Davis, 2000; Venkatesh *et al.*, 2003) and of specific e-commerce-based services and applications (e.g. Bhattacherjee, 2000; Grandón *et al.*, 2011; Hsu and Chiu, 2004; Lim and Dubinsky, 2005). Hence, we hypothesize that:

H15. A consumer's subjective norms related to an e-vendor's recommender will positively influence his/her their intention to use the recommender.

Finally, as indicated previously, TPB supports the idea that PBC has a positive influence on intention, so we can hypothesize that the same relationship exists in our model's context. In particular, consumers who experience a higher level of PBC over an e-vendor's recommender would be expected to be more willing to use the recommender to assist them during their shopping processes on the seller's web site. Additionally, previous studies have suggested and demonstrated that PBC has a significant effect on a consumer's intention to shop online (Limayem *et al.*, 2000) or to use a shopbot (Gentry and Calantone, 2002), a price comparison web site with certain features in common with RS. We therefore hypothesize that:

H16. PBC over an e-vendor's recommender will positively influence a consumer's intention to use the recommender.

3. Research methodology

3.1 Data collection

We carried out our fieldwork in two stages. In the first, we met with our participants in a room with IT equipment, where we informed them of our interest in evaluating their opinion on aspects of the online shopping process, but did not tell them about our specific interest in matters related to RS. We placed them in a situation in which we asked them to carry out a task related to a purchase decision. Specifically, the activity, which they had to complete in 15-20 minutes, consisted of undertaking an information search and fictitious purchase process at Amazon (version in Spanish), the world's leading e-tailer. Our study therefore does not involve a laboratory experiment with a fictitious online store and a recommender designed ad hoc (e.g. Cooke *et al.*, 2002). We opted to work with a real web site and e-vendor instead. Other studies have done likewise, and have used Amazon.com to that end too (e.g. Gefen, 2000; Mudambi and Schuff, 2010).

To ensure that the participants would use the recommender, we asked them to base their information search and fictitious purchase process on the recommendations provided by Amazon.

To control possible variability in participants' levels of involvement with the object of their search, rather than specifying a product that they were all to look for, we asked them to choose, from Amazon's vast range, one that they needed and were thinking of acquiring in the near future. We could thus be utterly certain that the search process would be credible and of interest to the participants.

In the second stage, which took place after completion of the purchase process, we presented the participants with a questionnaire, which was the same for all of them (see Section 3.3).

3.2 Sample

Our study's sample consisted of 300 individuals (male: 50.4 percent; female: 49.6 percent). We applied a convenience sampling procedure among university students, all

of them internet users (sample mean number of years as an internet user = 9), at various universities in Colombia, including Corporación Universitaria Empresarial Alexander von Humboldt, Universidad de Manizales, Universidad de La Salle and Universidad del Quindío. Around 99 percent of the sample were in the 18-30 age group, the largest proportion of internet users in general; while other age groups may use a particular e-tailer or e-commerce site, people aged 18-30 should still be significant given the proportion of internet users this age group accounts for (Pew Research Center, 2013).

3.3 Measurements

Due to the new nature of most of our model's constructs, appropriate scales used in earlier studies were hard to come by. We thus adapted validated scales that had previously been applied to the same concepts but in relation to objects of measurement other than that of our study, i.e. an e-vendor's RS. For our purposes, we basically changed each such scale's object of measurement (e.g. an e-vendor) to Amazon's RS. Full details of all the measurement scales we used for our constructs are set out in the Appendix to this study. We applied seven-point Likert-type scales anchored at strongly disagree (1) and strongly agree (7) for all measurements.

4. Results

4.1 Measurement model analysis

4.1.1 Exploratory factor analysis (EFA). We performed a principal component EFA with varimax rotation (see DeVellis, 2003). The results confirmed that the number of factors equaled the number of latent variables under consideration, and that the explained variance value was over 0.6 in every case. We also found that most of the indicators were significant, with factor loadings of around or above 0.5, the exceptions being three items related to the constructs of attitude toward an e-vendor's RS (items attitude_1 and attitude_2) and general disposition to trust (item gentrust_2). We therefore eventually decided to remove it from its scale.

After refining the scales on the basis of studying their unidimensionality, we evaluated their reliability by analyzing each one's internal consistency. In general, the reliability of the analyzed scales comfortably exceeded 0.7, the minimum acceptable threshold for Cronbach's α (see Table I).

4.1.2 Confirmatory factor analysis (CFA). Given the model's conditions (e.g. non-multinormal distribution of data, rating scales and the use of a polychoric correlation matrix), we applied the robust weighted least squares (RWLS) estimation method, which is recommended as the most appropriate means of dealing with the relevant shortcomings and providing proper solutions (see Martinez-Lopez *et al.*, 2013).

We verified that the model was correctly identified, that its degrees of freedom were above zero, that its error variances were significant and positive in every case, and that the (standardized) parameter estimations all gave values of over 0.5 (Hair *et al.*, 2008). The confirmatory model's goodness of fit indicated that our proposed factor structure had been correctly specified. Our results pointed to a good model fit ($\chi^2/df = 1.663$; GFI = 0.905; RMSEA = 0.047; CFI = 0.949; TLI = 0.939; NFI = 0.922; IFI = 0.950).

In accordance with Steenkamp and Van Trijp (1991), we tested the scales' convergent validity by verifying that the loadings corresponding to the observable variables (indicators) with the latent variables were significant and above 0.5. We also analyzed the average variance extracted (AVE) to confirm the convergence of the

	General disp. trust	Familiarity	Trust e-vendor	Perceived risk RS	Attitude RS-WS	PEOU	PU	Trust RS-WS	Intention	Subjective norm	PBC
General disp. trust 1	0.68										
General disp. trust 3	0.63										
General disp. trust 4	0.69										
Familiarity RS 1		0.71									
Familiarity RS 2		0.73									
Familiarity RS 3		0.91									
Familiarity RS 4		0.91									
Trust e-vendor 1			0.77								
Trust e-vendor 2			0.82								
Trust e-vendor 3			0.62								
Perceived risk RS 1				0.83							
Perceived risk RS 2				0.82							
Perceived risk RS 3				0.82							
Attitude e-vendor's RS 3					0.83						
Attitude e-vendor's RS 4					0.84						
Attitude e-vendor's RS 5					0.77						
Attitude e-vendor's RS 6					0.66						
PEOU e-vendor's RS 1						0.75					
PEOU e-vendor's RS 2						0.75					
PEOU e-vendor's RS 3						0.88					
PEOU e-vendor's RS 4						0.77					
PU e-vendor's RS 1							0.86				
PU e-vendor's RS 2							0.87				
PU e-vendor's RS 3							0.77				
PU e-vendor's RS 4							0.74				
Trust e-vendor's RS 1								0.77			
Trust e-vendor's RS 2								0.77			

(*continued*)

Table I.
Lambda loadings and reliability

Table I.

	General disp. trust	Familiarity	Trust e-vendor	Perceived risk RS	Attitude RS-WS	PEOU	PU	Trust RS-WS	Intention	Subjective norm	PBC
Intention e-vendor's RS 1									0.78		
Intention e-vendor's RS 2									0.87		
SN e-vendor's RS 1										0.84	
SN e-vendor's RS 2										0.80	
PBC e-vendor's RS 1											0.79
PBC e-vendor's RS 2											0.91
PBC e-vendor's RS 3											0.88
Cronbach's α	0.66	0.90	0.77	0.86	0.85	0.86	0.89	0.75	0.85	0.80	0.89
Composite reliability (CR)	0.70	0.89	0.79	0.86	0.86	0.87	0.89	0.75	0.85	0.80	0.89
Variance extracted (AVE)	0.64	0.67	0.56	0.68	0.61	0.62	0.66	0.60	0.66	0.67	0.74

model's scales (Ping, 2004), obtaining satisfactory results for all of them. The constructs' CR results, meanwhile, were above the recommended cut-off value of 0.7 (Hair *et al.*, 2008) in every case (see Table I).

With regard to the discriminant validity of the model's latent variables, we applied two methods (see Table II), consisting of a confidence interval (95 percent) for the correlation between pairs of constructs, without detecting unity in any case; and the square root of each construct's AVE, the value of which exceeded the relevant construct's correlations with the model's other constructs.

4.2 Structural model testing

Our model fit indices were generally quite satisfactory (χ^2/df = 2.539; GFI = 0.881; RMSEA = 0.052; CFI = 0.953; TLI = 0.939; NFI = 0.888; IFI = 0.954). The estimation of the model's structural coefficients showed our hypotheses to be significant, with the exception of *H2* and *H16*, a point on which we wish to briefly comment here.

First, in the initial formulation of our model, we suggested that PEOU directly affects attitude toward an e-vendor's RS. However, our results indicated a non-significant relationship. Consequently, the indirect influence of PEOU, through attitude, on intention to use an e-vendor's RS was not supported either, contrary to our expectations.

Nonetheless, we did obtain confirmation of the indirect effect of PEOU, through the mediator variables PU and trust in an e-vendor's RS, on both attitude and intention to use the RS. These results were in keeping with the research carried out by Wang and Benbasat (2005), who found no empirical evidence of the relationship formulated in their model between the PEOU of an e-vendor's RS and its use. Additionally, as other studies had done beforehand in other contexts, the authors in question showed that the effect of PEOU on intention is not direct but mediated by PU (see Davis *et al.*, 1989) and trust (see Gefen *et al.*, 2003).

Our results did not support our hypothesis on the way PBC over an e-vendor's RS influences a consumer's intention to use the system (*H16*) either. It is basically the model's only variable originally from TPB, as all the other variables and relationships are based on TRA and TAM-related proposals. This outcome therefore suggested that the said component of TPB, which is regarded as the main extension of TRA, does not contribute to making it possible to predict a consumer's intention to use a RS. There would thus be no support for TPB in our proposed integrated model, a point we cover in detail in our final theoretical discussion.

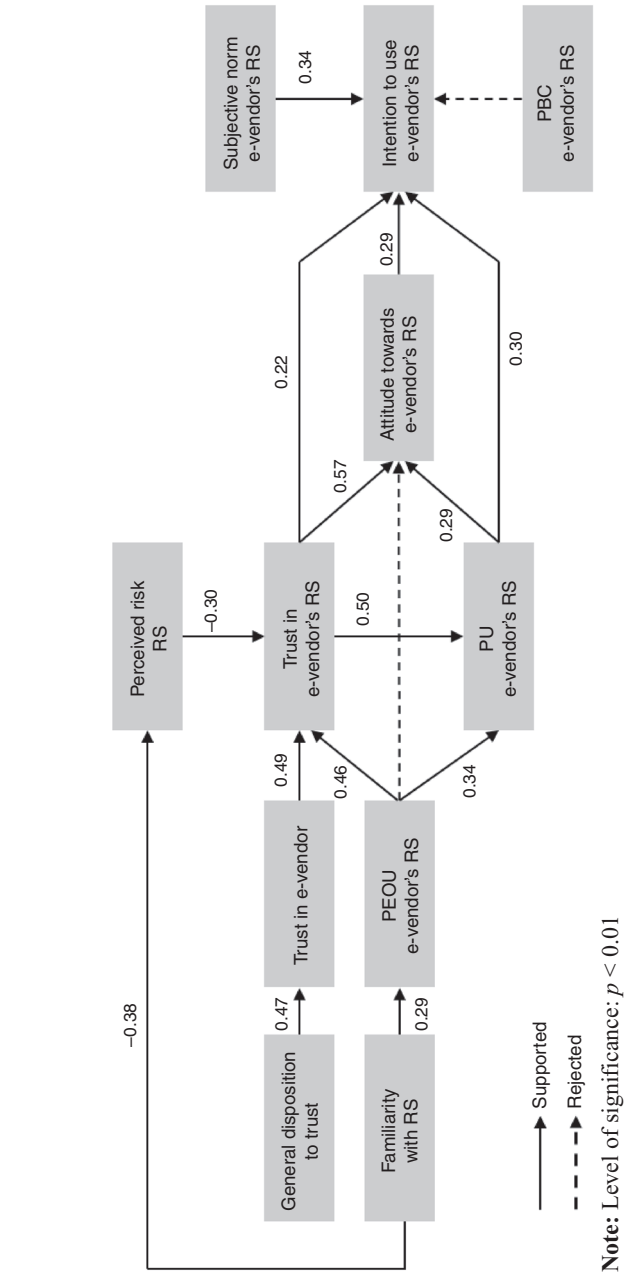
We thus undertook a first reformulation of the model we had initially proposed, excluding only the least significant relationship, that of PBC and intention, entailing the PBC construct's removal from the model. The values of the fit indices improved once the model had been re-estimated, but the results showed that the relationship between PEOU and attitude remained non-significant. We subsequently respecified the model, removing the relationship in question, and re-estimated it once again. The results we obtained this time showed all the model's relationships to be significant, with a better fit than previously (χ^2/df = 2.419; GFI = 0.901; RMSEA = 0.049; CFI = 0.969; TLI = 0.957; NFI = 0.906; IFI = 0.97).

Figure 2 shows the standardized structural coefficients for each envisaged relationship between constructs. Additionally, the high R^2 values of some of the model's endogenous constructs should be noted, particularly those corresponding to intention to use an e-vendor's RS ($R^2 = 0.69$), attitude toward an e-vendor's RS ($R^2 = 0.63$), trust in an e-vendor's RS ($R^2 = 0.60$) and the PU of an e-vendor's RS ($R^2 = 0.54$).

Table II.
Discriminant validity analyses

	General disp. trust	Familiarity	Trust e-vendor	Perceived risk RS	Attitude RS-WS	PEOU	PU	Trust RS-WS	Intention	Subjective norm	PBC
General disp. trust	*0.66*										
Familiarity	(0.08,0.36) 0.22	*0.90*									
Trust e-vendor	(0.22,0.51) 0.37	(0.34,0.56) 0.45	*0.75*								
Perceived risk RS	(−0.57,−0.31) −0.44	(−0.46,−0.22) −0.34	(−0.76,−0.58) −0.67	*0.82*							
Attitude RS-WS	(0.12,0.41) 0.27	(0.29,0.51) 0.40	(0.55,0.73) 0.64	(−0.64,−0.44) −0.54	*0.78*						
PEOU	(0.22,0.49) 0.36	(0.15,0.39) 0.27	(0.38,0.60) 0.49	(−0.52,−0.29) −0.41	(0.48,0.67) 0.58	*0.79*					
PU	(0.02,0.32) 0.17	(0.12,0.36) 0.24	(0.40,0.61) 0.51	(−0.52,−0.29) −0.41	(0.64,0.79) 0.72	(0.58,0.74) 0.66	*0.81*				
Trust RS-WS	(0.23,0.52) 0.37	(0.31,0.54) 0.43	(0.62,0.81) 0.71	(−0.74,−0.54) −0.64	(0.71,0.86) 0.79	(0.57,0.76) 0.66	(0.66,0.80) 0.72	*0.88*			
Intention	(0.10,0.40) 0.25	(0.22,0.46) 0.34	(0.49,0.69) 0.59	(−0.59,−0.38) −0.49	(0.72,0.85) 0.78	(0.47,0.66) 0.57	(0.65,0.80) 0.73	(0.70,0.86) 0.78	*0.81*		
Subjective norm	(−0.03,0.29) 0.13	(0.19,0.44) 0.32	(0.33,0.57) 0.45	(−0.53,−0.29) −0.41	(0.42,0.63) 0.52	(0.22,0.47) 0.34	(0.32,0.55) 0.44	(0.39,0.63) 0.51	(0.56,0.74) 0.65	*0.82*	
PBC	(0.12,0.40) 0.26	(0.28,0.50) 0.39	(0.38,0.60) 0.49	(−0.54,−0.32) −0.43	(0.47,0.66) 0.57	(0.68,0.81) 0.74	(0.46,0.64) 0.55	(0.53,0.73) 0.63	(0.41,0.61) 0.51	(0.19,0.44) 0.31	*0.86*

Notes: Correlations between constructs and 95 percent confidence intervals in brackets. Diagonal italic values are the square root of each construct's AVE



Note: Level of significance: $p < 0.01$

Figure 2.
Final structural model

5. Final discussion

5.1 Theoretical contribution

The model's validity. The model's core components and relationship structure (i.e. constructs and relationships corresponding to *H1-H6*), based on TAM and the trust-TAM model, are valid for explaining the process of the adoption and use of an e-vendor's RS. The only exception, as mentioned previously, is the non-significant effect of PEOU on attitude (*H2*). The consumer's intention to use an e-vendor's recommender, the terminal endogenous variable of our model, is amply explained – around a 70 percent of this construct's variance – by the supported structure of antecedents.

Intermediating role of attitude toward an e-vendor's RS. Our results demonstrate that the original TAM (Davis, 1986), which explicitly considers Attitude to be an intermediating variable between PU and intention (*H3*, $\beta = 0.29$), is clearly supported. It is also supported that Attitude has an intermediary role in the case of the trust-TAM model component of a consumer's trust in an e-vendor's recommender. That is actually the strongest relationship in the whole model (*H4*, $\beta = 0.57$). Over and above the direct effect of trust on intention, this adds to its total indirect effect (see below). Thus, though TAM-based research, even Davis (1989) himself, has tended to drop Attitude for the sake of models' simplicity (see Gefen *et al.*, 2003), Martinez-López *et al.*' (2010) suggestion that reintroducing this variable would improve the explanation of a consumer's intention to use an e-vendor's recommender is proved. This is a major finding of our research.

By the same token, PEOU does not have a direct effect on intention, but rather an indirect effect through other constructs. This result is coherent with Wang and Benbasat (2005) findings, who applied Gefen *et al.*'s Trust-TAM model to explain consumer intention to use an e-commerce recommender; although, no significant effect of PEOU on intention was concluded.

That is what is envisaged in our theoretical model and the modification indices do not suggest otherwise. PEOU has a clear direct (*H1*, $\beta = 0.34$) and indirect effect on PU through a consumer's trust in an e-vendor's recommender (*H5*, $\beta = 0.46$; *H6*, $\beta = 0.50$). The total PEOU-PU effect = 0.57 (0.34+0.46×0.50).

Trust in an e-vendor's RS: the effect of external variables. The effects of each of the external variables considered (*H7-H11*) are as we expected. First, a consumer's familiarity with e-commerce RS positively influences their perception of the ease of use of an e-vendor's recommender (*H7*, $\beta = 0.29$). It also has a logical negative effect on the consumer's perception of the risk entailed by RS (*H8*, $\beta = -0.38$). In turn, the consumer's perception of the risk entailed by RS in general has a negative influence on their trust in the e-vendor's recommender (*H9*, $\beta = -0.30$). Thus, the kind of peripheral, complementary route we suggest to explain how trust in an e-vendor's RS develops is supported. This is other interesting finding, as considering external variables to complement TAM-based models is unusual, with a few exceptions (e.g. Gefen *et al.*, 2003; Venkatesh and Davis, 2000). Also, the concrete external variables used in our model are original, not only in TAM-related models in general, but in this particular study's context, i.e. consumer's adoption process of an e-vendor's recommender.

Trust in an e-vendor's RS: other trust-related variables. The strongest influence clearly comes from the trust-related antecedents considered. In particular, a consumer's trust in an e-vendor has the clearest effect on the construct of trust in the e-vendor's recommender (*H11*, $\beta = 0.49$). Additionally, the consumer's general disposition to trust

has a major influence on their trust in the e-vendor (*H10*, $\beta = 0.47$) and, indirectly, on their trust in the e-vendor's recommender.

Main explaining variables of intention to use an e-vendor's RS. The direct effect that attitude, PU, SN and trust in an e-vendor's recommender have on a consumer's intention to use the system in question has been confirmed. Furthermore, according to their structural coefficients, the degree of influence involved is similar for the antecedents based on TAM (PU: *H13*, $\beta = 0.30$; and attitude: *H12*, $\beta = 0.29$) and TRA (SN: *H15*, $\beta = 0.34$), although somewhat lower in the case of trust in an e-vendor's recommender (*H14*, $\beta = 0.22$). However, trust and PU are the constructs with the greatest total influence (i.e. direct effect+indirect effect through intermediate constructs). Both have a similar total effect of around 0.38.

PBC subsumed into PEOU. As for PBC, there is no need to include it (or, consequently, TPB) as a predictive variable in relation to a consumer's intention to use an e-vendor's recommender. There are various potential explanations for that. First, previous results on the relationship between PBC and intention in e-commerce-related models do not widely support the existence of a significant effect (see Grandón *et al.*, 2011). Another possible explanation involves a consumer's level of PBC and its effect on intention, in that while a low level of PBC over a system can discourage the consumer from using it, a high level of PBC does not seem to encourage such use (see Herrero Crespo and Rodríguez del Bosque, 2008). In our dataset, the mean rating for each of the three items corresponding to PBC is over 5, on a scale of 1-7. Lastly, the finding makes sense in the context of our model, in which there is no hypothesis regarding the TAM-based concept PEOU having a direct effect on intention. It should be borne in mind that despite them having separate measurement scales, with discriminant validity, PEOU and PBC measure similar concepts. PEOU represents a consumer's perception of the ease of use of an e-vendor's RS, while PBC refers to their perception of their ability to use the system. We originally combined those concepts in a single integrated model with a view to providing a richer, more complementary explanation of a consumer's intention to use an e-vendor's recommender. However, the non-significant result we obtained suggests that the essence of consumer PBC could actually be subsumed into PEOU when modeling a user's intention to adopt a system.

5.2 Implications for practitioners

e-Tailers have two challenges when it comes to RS. One involves technical issues related to the design and type of RS (i.e. content-based, collaborative filtering, popularity-based, etc.). Though RS are increasingly common at online stores, unlike Amazon – probably the e-tailer that makes the best use of RS right now – not many e-tailers know how best to design and use it (see Econsultancy and Monetate, 2013). The other has to do with how e-tailers get consumers to make use of their recommenders while shopping at their sites, which is the focus of this research. Diverse practical suggestions related to our findings are highlighted in the following bullet points:

- First and general, the ideal scenario for consumer use of an e-vendor's recommender is when four factors concur: trust, perceived usefulness, attitude and social acquiescence about using the e-vendor's recommender. So, online stores able to stimulate all these factors in the consumer are likely to achieve higher usage rates for their recommenders, yielding the subsequent benefits

already commented on. However, a focus on some of them can be also positive. Next, we point out brief suggestions for each of them.

- Trust and perceived usefulness about the e-vendor's RS stand out. e-Tailers should ensure that their recommenders are trustworthy and useful. The question is how to achieve this. Far from being speculative, our results suggest some paths to reach this goal. A common element that positively affects both is the recommender's ease-of-use. Regardless of the type of RS an e-vendor decides to use, it ought to be intuitive, easy to understand and interact with. For instance, if collaborative filtering were used, as Amazon does – i.e, "Customers who bought this item also bought […]" – the selection of items related to the customer's sought-for item are better shown aside, and in a way that allows viewing of their basic information on the same webpage. Other more complex alternatives to using a recommender – e.g., recommended items not shown at once, or shown at the bottom of a page, requiring scrolling down, or even linking to another page – which make the customer's primary search more difficult to follow, should be avoided. Otherwise, customers would not feel motivated to use it, or could even quit their ongoing shopping process if frustrated, which would be worse.
- Consumers clearly trust recommenders of e-vendors they rely on. Consequently, an online store's RS will be less effective if customers do not feel that such an e-vendor is reliable. This is an issue rooted deeper in the core consumers' perceptions about an e-tailer, which requires it to consider factors broadly accepted to foster a trustful shopping environment; e.g., good reputation, security, web design, accurate information about items, fulfilment, customer service, third-party certification, etc.
- Due to the normative influence of others to use a recommender, e-vendors would be better off using other customers' feedback when presenting recommendations to a customer; this, obviously, also implies inviting customers to rate and assess their purchases. This option, more in line with the Social Web spirit, is more convenient to stimulate consumers to use it rather than other the "dehumanized" designs of recommenders that just provide "cold" recommendations without related feedback from other customers.

5.3 Limitations

Convenience samples do not have the same degree of rigor as those obtained using probability sampling methods, limiting the scope for the generalization of results (Peterson, 2001), but they are useful for studies of online consumer behavior (see Lin and Lu, 2000). Furthermore, this sampling procedure is an acceptable option for successfully testing proposed causal models (Kardes, 1996). Finally, familiarity with the e-vendor (i.e. Amazon) could have been controlled to avoid eventual undesirable effect on any of the dependent variables.

6. Conclusions

Personalization capabilities are necessary for an e-tailer to succeed. It is known that recommenders can be powerful tools for customizing consumers' online shopping processes, with positive effects on sales volumes and the diversity of items purchased, notwithstanding other effects; such as customer's satisfaction and loyalty to the online store. While technical aspects of recommenders are important, consumers'

psychological process explaining their adoption should not be neglected; their perceptions are also key to their use. We discuss and validate an integrative model that helps understand such a process, with valuable theoretical and practical implications. In particular, how reliable and useful an e-vendor's recommender is for a consumer stand out as determining factors for its use, though others, like the attitude toward the recommender and the SN-related to its use also play a significant role.

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Appendix. Measurement scales

Here, we present a breakdown of the measurement scales applied to our model's constructs. Respondents were provided with a questionnaire containing these scales in Spanish. The items that we eventually removed on the basis of the results of our exploratory and confirmatory factor analyses are identified by means of a note to that effect in brackets.

We used the four-item scale validated by Gefen (2000) to measure the construct of a consumer's general disposition to trust:

- I generally trust other people;
- I tend to count upon other people (removed after refinement);
- I generally have faith in humanity; and
- I generally trust other people unless they give me reason not to.

To measure familiarity with RS, we used a four-item scale adapted from the one that Gefen (2000) used to measure a consumer's familiarity with an e-vendor (Amazon). For the purpose of our study, we modified certain aspects of the original items slightly, in addition to changing the object of measurement from an e-vendor to RS in general:

- I am familiar with searching for products on commercial web sites;
- I am familiar with buying via web sites (using recommendation systems);
- I am familiar with the recommendations made by companies (recommendation systems) when searching for a product on their web site; and
- I am familiar with the use of such systems made by companies when searching for a product on their web site.

We measured trust in an e-vendor by adapting the measurement scale that Jarvenpaa *et al.* (2000) validated for an online store's trustworthiness:

- Amazon is trustworthy;
- Amazon wants to be known as a store that keeps promises and commitments; and
- I trust Amazon.com keeps my best interests in mind.

To measure the perceived risk entailed by e-commerce RS, we used a semantic differential scale inspired by the one that Jarvenpaa *et al.* (2000) validated for assessing a consumer's perception of the risk involved in buying from an e-tailer.

In general, how would you characterize the decision of taking the advice provided by e-vendors' recommendation systems into consideration?

- significant opportunity/significant risk;
- high potential for gain/high potential for loss; and
- very positive situation/very negative situation.

We measured attitude toward Amazon's RS by adapting the six-item scale used by Chen and Wells (1999) in relation to attitude toward a site:

- the recommendation system of Amazon makes it easy for me to build a relationship with this company (removed after refinement);
- I would like to use this recommendation system again in the future (removed after refinement);
- I am satisfied with the service provided by this recommendation system;
- I feel comfortable while using this recommendation system;
- I feel using this recommendation system is a good way to spend my time; and
- compared with other companies' recommendation systems, I would rate Amazon's as one of the best.

As is the case where most TAM-related studies are concerned, our four-item scale for measuring the PEOU of Amazon's RS was adapted from that used by Davis (1989):

- interaction with Amazon's recommendation system is clear and understandable;
- interaction with Amazon's recommendation system does not require a lot of mental effort;
- I find Amazon's recommendation system easy to use; and
- I find it easy to get Amazon's recommendation system to do what I want it to do.

Likewise, we measured the PU of Amazon's RS by means of a four-item scale adapted from Davis's (1989) original measurement scale.

Using Amazon's recommendation system:

- I would be better organized in terms of searching for what I want;
- I would enhance my effectiveness in terms of searching for the product/information I want;
- I would spend less time on searching for what I want; and
- I would increase the quality of search results on the product in which I am interested.

Due to the lack of validated scales for a consumer's trust in an e-vendor's RS, with trust viewed as a general belief in such a system, we adapted the original scale on the basis of which we had measured trust in an e-vendor (see above):

- recommendations made by Amazon's recommendation system are trustworthy; and
- I trust Amazon's recommendation system keeps my best interests in mind.

We established a three-item scale to measure intention to use an e-vendor's RS. The first two items were inspired by a two-item scale used by Kim and Malhotra (2005). We then added the third item, which we adapted from one that Mathieson (1991) used to measure willingness to use a spreadsheet instead of a calculator:

- if I visit Amazon in the future, I will follow the suggestions provided by its recommendation system about products of interest to me;
- I will use Amazon's recommendation system in the future; and
- if I visit Amazon in the future, I would use its recommendation system to search for products of my interest rather than avoiding a system-assisted search (removed after refinement).

With regard to SN related to the use of an e-vendor's RS, we adapted a two-item scale used by George (2004) in connection with internet purchasing:

- people who influence my behavior would think that I should use Amazon's recommendation system when searching for products at Amazon; and
- people who are important to me would think that I should use Amazon's recommendation system, rather than avoiding it, when searching for products of interest to me.

Likewise, we adapted a three-item scale used by George (2004) to measure PBC over an e-vendor's RS:

- I am capable of using Amazon's recommendation system;
- I have complete control over Amazon's recommendation system; and
- I have the resources and the knowledge and the ability to use Amazon's recommendation system.

About the authors

Dr Francisco José Martínez-López, MSc in Marketing, and European PhD in Business Administration (2005), with Extraordinary Doctoral Prize, from the University of Granada (Spain), is Professor of Business Administration (Management and Marketing) at the University of Granada and the Open University of Catalonia (Barcelona) in Spain. He is Editor-in-Chief of the *International Journal of Business Environment* (Inderscience Publishers), Associate Editor of the *European Journal of Marketing* (Emerald) and belongs to the Editorial Board of *Industrial Marketing Management* (Elsevier). Dr Martínez-López has co-edited several international

journals' special issues and research books for leading publishers of business and management research as Springer and Elsevier. Likewise, he has published extensively in international journals. Dr Francisco José Martínez-López is the corresponding author and can be contacted at: fjmlopez@ugr.es

Irene Esteban-Millat is an Assistant Professor of Marketing at the Open University of Catalonia (UOC), Spain. She has a PhD in Information and Knowledge Society (2012) and her primary research interests are in the areas of online consumer behaviour, the interface of marketing/e-learning and internet flow experiences. Her work has been published in national and international conferences' proceedings and journals. She has been a visiting scholar at Baruch's Zicklin School of Business (CUNY, USA).

Claudia C. Cabal, PhD in Business Administration at the International University of Andalusia (Spain) (2013) and Assistant Professor of Business Administration at the University of Quindio, Colombia.

Charles Gengler (PhD, University of Texas – Dallas) is a Professor of Marketing in the Department of Marketing and International Business at Zicklin School of Business (City University of New York, NY). His research and teaching interests center on positioning strategies, advertising campaign strategies, motivation research, interviewing strategies and associated analysis, charitable giving, and sales training development.