2004

A Process Tracing Study on Trust Formation in Recommendation Agents

Sherrie Xiao Komiak
Memorial University of Newfoundland, Canada, skomiak@mun.ca

Izak Benbasat
University of British Columbia, Canada, benbasat@sauder.ubc.ca

A Process Tracing Study on Trust Formation in Recommendation Agents

Sherrie Xiao Komiak
Memorial University of Newfoundland, Canada
skomiak@mun.ca

Izak Benbasat
University of British Columbia, Canada
benbasat@sauder.ubc.ca

ABSTRACT

This study utilizes a processing tracing method to explore the processes of trust formation in web-based product-brokering recommendation agents (RAs). We compare and contrast the processes of trust/distrust formation in an attribute-based RA (a typical content-based RA) versus a need-based RA (a content-based RA plus need-based questions). Concurrent verbal protocols from 49 subjects were collected, transcribed, and analyzed. Our protocol analysis results show that the need-based RA elicits significantly more trust formation processes and fewer distrust formation processes than the attribute-based RA does, which explains why the level of customer trust in the need-based RA is significantly higher than the level of customer trust in the attribute-based RA. Interestingly, our results show that, for both types of RAs, the top three processes of trust formations are different from the top three processes of distrust formations. Suggestions are given on how to design more trustworthy RAs.

Keywords

Trust, recommendation agents, electronic commerce, protocol analysis, process tracing.

INTRODUCTION

Trust is crucial in the use of web-based product-brokering recommendation agents (RAs), defined as personalized computer agents that give online customers recommendations on which products to buy based on their personal needs (Maes, Guttman and Moukas, 1999). In general, many MIS and management researchers posit trust as an important antecedent of IT usage in electronic commerce (ecommerce) (e.g. Gefen, Karahanna and Straub, 2003; Komiak and Benbasat, 2004; McKnight, Choudhury and Kacmar, 2002). To be specific, in the context of RA usage, online customers have to decide whether to *depend* on RAs' recommendations *before* the recommendations' correctness is actually assessed by using the recommended products. *Risk* arises because customers are consciously aware the information is of uncertain quality and that relying on poor information renders them vulnerable to errors in their decisions (Chopra and Wallace, 2003). Thus, whether customers will depend on the RAs' information for their decision-making largely relies on their trust in the RAs. In order to convince customers to use RAs, one critical question for information systems researchers and designers is how to design more trustworthy RAs.

One effective way to answer the question is to examine the processes of trust formation in RAs. However, despite the steady interest in trust among researchers and practitioners, the process of trust formation is still a black box. To our best knowledge, no prior research has used a process tracing method to empirically trace the processes of trust formation, although prior researchers theoretically proposed some possible processes (e.g. Chopra and Wallace, 2003; Doney and Cannon, 1997; McKnight, Cummings and Chervany, 1998). This study contributes by empirically exploring how customers form their trust and distrust in RAs and how different RA designs affect these processes.

HYPOTHESES AND LITERATURE REVIEW

The RA literature identifies two major types of RAs: collaborative filtering RAs and content-based RAs (e.g. Ansari, Essegaier and Kohli, 2000; Schafer, Konstan and Riedl, 1999). Collaborative filtering RAs make recommendations based on the opinions of like-minded people; they predict a consumer's preference as a linear, weighted combination of other people's preferences (Ansari et al., 2000). For example, at www.amazon.com, a consumer who is browsing a book will get recommendations: "Consumers who bought this book also bought: …" Content-based RAs make recommendations based on consumer preferences for product attributes (Ansari et al., 2000). Examples include RAs at www.dell.com and www.travelocity.com. In addition, Maes et al. (1999) mentioned rule-based RAs (RAs use simple rule-based techniques to personalize product offerings for individual customers) and data-mining RAs (RAs use data-mining techniques to discover patterns in customer purchasing behavior, exploiting these patterns to help customers find other products that meet their needs).

This study focuses on the design of content-based RAs. One shortcoming of content-based RAs is that customers, especially product novices, may not know how to appropriately configure their preferred product attributes. In order to overcome this shortcoming, Grenci and Todd (2002) suggest to include need-based questions in the content-based RAs; such need-based RAs (i.e. content-based RAs including need-based questions) will either use a set of rules to interpret customer-specific information or

intentions into a recommended product configuration, or translate customer-specified preferences into alternative product configurations. Grenci and Todd (2002) theoretically suggest that, compared to the attribute-based RAs (i.e. typical content-based RAs that ask customers to specify product attribution levels without the help of any need-based questions), the need-based RAs would be the preferred method for recommending products, especially for novice customers. However, the empirical studies to test the value of such need-based RAs have produced inconsistent results: Felix et al. (2001)'s experiment failed to find that novice customers are more satisfied with need-based RAs than with attribute-based RAs, while Stolze and Nart (2004)'s experiment observed that novice customers regard need-based RAs as more helpful than attribute-based RAs. Given the inconsistent empirical results, the current study will empirically compare customer trust in need-based RAs vs. customer trust in attribute-based RAs. We tend to agree with Grenci and Todd (2002)'s view, because need-based RAs can link customers' personal needs to product attribute configuration, thus facilitating the customers' expression of their information needs and making the need-based RAs' rationale easy to understand. The added facilitation and the greater transparency will make the need-based RAs more trustworthy than the attribute-based RAs.

H1: The level of customer trust in a need-based RA will be higher than the level of customer trust in an attribute-based RA.

H2: A need-based RA will elicit more processes of trust formation than an attribute-based RA does.

H3: A need-based RA will elicit fewer processes of distrust formation than an attribute-based RA does.

Regarding the processes of trust formation, prior literature conceptualizes the processes in two schemes: one is categorization of the processes in terms of their inputs (antecedents of trust) and outputs (trusting beliefs), while the other is categorization of trust formation processes in terms of the trustor's subjective construal processes, i.e. the psychological processes that the inputs are transformed to outputs in the trustor's mind. A thorough review of the antecedents of trust is found in Gefen et al. (2003), McKnight et al. (2002), Swan et al. (1999), and Chopra et al. (2003). In addition, prior research has theoretically discussed trust formation processes in terms of the trustor's subjective construal processes (e.g. Chopra and Wallace, 2003; Doney and Cannon, 1997; McKnight et al., 1998). However, a process tracing study is needed to empirically test these hypothesized processes. This paper fulfills such a need by conducting a process tracing study to examine the processes of trust formation in need-based RAs vs. attribute-based RAs.

A process of RA assessment may produce either positive or negative beliefs about the RA (i.e. trust or distrust in this context). Compared to trust, distrust is a much under-addressed concept. Some researchers define distrust as the absence of trust (e.g. McAllister, 1995), while others conceptualize distrust as the negative of trust – one's confident negative expectation that other actors will behave in ways that endanger the perceiver's safety and security (e.g. Kramer, 1999). Many prior research assumes that the processes to decrease distrust are the same processes to increase trust (e.g. Hsiao, 2003; Kramer, 1999; McAllister, 1995). However, it is not clear how true this contention is. So far, there is no empirical evidence that the main processes of trust formation are the same as the main processes of distrust formation. If they are different, then RA designs that elicit more processes of trust formation may not result in fewer processes of distrust formation; thus, they may not decrease distrust simultaneously. Therefore, while we accept that trust and distrust are the positive and negative ends of the same measuring scale, the current study intends to contribute by empirically tracing the processes of trust and distrust formation in RAs in order: (1) to identify the main processes of trust and distrust formation, and (2) to test if different processes lead to trust formation and distrust formation processes, and if so to what extent. Based on prior research suggesting that the processes to decrease distrust are the same processes to increase trust (Hsiao, 2003; Kramer, 1999; McAllister, 1995), we hypothesize,

H4: For an attribute-based RA, there will be no difference in the extent of the processes that will lead to trust formation and to distrust formation.

H5: For a need-based RA, there will be no difference in the extent of the processes that will lead to trust formation and to distrust formation.

BUILDING CATEGORY SCHEME

A category scheme of trust/distrust formation processes is needed to code the verbal protocols we collected in the experiment. We built up the scheme in two steps. Step one was to get a tentative category scheme based on prior literature on trust formation processes. Step two was to conduct a pilot test, during which 17 subjects were asked to think aloud while interacting with an RA. Their talks were recorded, transcribed, and then analyzed independently by two judges using the tentative category scheme. Based on the protocol analysis results of the pilot test, the tentative category scheme was modified by deleting processes that seldom showed up in pilot test and adding new processes that showed up in the pilot test but were not included in prior research. The result is the following category scheme.

I1. *Competence Attribution*: A customer ascribes competence or incompetence to an RA based on observable evidence. This process is partially similar to Competence process (Doney and Cannon, 1997), Attribution process (Chopra and Wallace, 2003), and Cognitive Base of Trust (Lewis and Weigert, 1985;

McAllister, 1995). For example, "The fact that this RA communicates all these brands gives me a sense that it's fairly comprehensive."

I2. *Expectation Confirmation*: When an RA's actions/features confirm or beat a customer's expectations, trust will develop. When an RA's actions/features are below the customer's expectations, distrust will develop. This process is added because behaving as expected is suggested to indicate trustworthiness (Sheppard and Sherman, 1998) and because our pilot test showed that this process was relevant in the context of trust in RAs. Examples include: "Why no IBM? No IBM satisfied my requirements? … But I know IBM does have a qualified model."

I3. *Control*: When customers feel that they have more control over an RA, this feeling builds trust (Ariely, 2000), while the feeling of less control will build distrust. The illusion of control is an unrealistically inflated perception of personal control that helps to build trust (McKnight et al., 1998). In addition, our pilot test showed that the feeling of being in control is more than an illusion – it is for real. The control process involves the customers' interpretations of their perceptions, including their being more familiar with how to use an RA, also including being more comfortable with the functions and more choices given by the RA. Examples include: "That would reduce my trust in the RA's goodwill a little because I lose a little bit of the sense of control."

I4. *Awareness of the Unknown Processes*: The process of how customers deal with their awareness of the unknown during their interactions with an RA. Trust is particularly relevant in conditions of ignorance or uncertainty with respect to unknown or unknowable actions of others (Gambetta, 1988), thus the impact of awareness of the unknown on trust/distrust should be included in trust research. Examples include: "I don't know why, it makes me uncomfortable."

I5. *Integrity Attribution*: A customer ascribes integrity to an RA based on observable evidence. It is similar to Intentionality process (Doney and Cannon, 1997) and Affect-based Trust (McAllister, 1995). Examples include: "I trust the integrity of the RA, because I can get info about different vendors for the specified price. There seem no particular interests of one particular retailer or vendor".

I6. *Information Sharing*: When an RA explains its reasoning process explicitly or shares detailed product information with customers, trust will build. However, too much information may confuse or overwhelm the customers, then distrust will develop. Information sharing is suggested as a trust antecedent (Doney and Cannon, 1997). Examples include, "Okay, that's pretty good; the RA explains it to me so that's pretty cool."

I7. *Verification*: When customers are able to verify that the information provided by an RA is true or good, their trust builds. Negative verification builds distrust. For example: "I trust this RA's IBM recommendation. I had an IBM notebook and I was happy with it."

I8. *Interface Process*: Pleasant interface helps to build trust, while unpleasant interface helps to build distrust. Interface (appearance) has been suggested as an antecedent of trust (e.g. Swan et al., 1999). For example, "The presentation of this RA is pleasing to the eyes. I feel comfortable."

I9. *Benevolence Attribution*: A customer ascribes benevolence to an RA based on observable evidence. It is similar to Intentionality process (Doney and Cannon, 1997), Emotion Base of Trust (Lewis and Weigert, 1985), and Affect-based Trust (McAllister, 1995). For example, "The RA cares about my interests."

RESEARCH METHOD

Concurrent verbal protocols were collected and analyzed to examine the processes of trust/distrust formation, because they provide a rich set of data about the customers' psychological processes. We conducted the main experiment in February and March 2002. Subjects used two commercial RAs from http://www.activebuyersguide.com/ to shop for notebook computers. These two RAs were chosen because they were real RAs instead of simulations, they were independent from any retailers, and they were largely unknown to our potential subjects. One RA was an attribute-based RA while the other was a need-based RA. The product attributes specified in these two RAs were the same; the terminology explanations for each product attribute were the same; they seemed to use the same method to filter product formation; they also use similar interfaces. However, the need-based RA had need-based questions to help customers to specify each product attribute while the attribute-based RA did not have any need-based questions.

49 students subjects enrolled at a North American business school participated in the main experiment. All subjects were randomly assigned to one of the two RAs, including 22 subjects using the attribute-based RA and 27 subjects using the need-based RA. Because this study aims at a population, customers with online shopping experience, volunteering subjects were prescreened. Only those who had shopped online before and those who were interested in buying notebook computers were invited to participate. Based on a background questionnaire, the average participant was 23 years old, spent $300 shopping online in the previous year, and reported 4.8 on a 7-point scale for being comfortable with shopping online and 6.4 for being comfortable with using computers. About 50% subjects were male. About 70% subjects were senior undergraduate students and the other 30% were graduate students. None of the subjects had used any RA at www.activebuyersguide.com before our experiment.

Each subject participated in the experiment individually. Subjects were allowed to take as much time as needed to

finish the shopping. The procedures were as follows: (1) the subject completed a consent form and a background questionnaire. (2) The subject was given a tutorial to practice thinking aloud and to learn how to use an RA. To minimize potential validity problems, we instructed each subject only to think aloud while interacting with an RA and not to explain their thought process, and did not probe for specific facts (Shaft and Vessey, 1995). The subject was asked to practice thinking aloud until he/she felt comfortable. (3) The subject thought aloud while using an RA to shop for notebook computers. Verbal protocols were collected by recording the subject's talks. (4) The level of trust in the RA was measured by asking the subject to indicate his/her agreement degree (a 7 point scale: 1 - strongly disagree, 7 - strongly agree) with a statement: "I trust this recommendation agent."

The tape-recorded verbal protocols were transcribed and then analyzed. An average subject's verbalizations last about 25 minutes. 2,000 processes, including 1,057 processes of trust formation and 943 processes of distrust formation, were coded by utilizing the category scheme described above. To provide a basis for reliability assessment, two judges (the first author and a Ph.D. student majoring in MIS) independently coded the protocols. Cohen's coefficient of agreement was 79% (Cohen, 1960), which indicates a good inter-judge agreement.

RESULTS AND DISCUSSIONS

The level of customer trust in the need-based RA is significantly higher than the level of customer trust in the attribute-based RA: means 5.1 vs. 4.3 out of 7.0, one-tailed t-test, $p<0.05$. Thus H1 is supported. The results also support H2: the need-based RA elicits significantly more trust formation processes than the attribute-based RA does: process numbers per subject: 24.0 vs. 18.5, one-tailed t-test, $p<0.05$. The need-based RA elicits significantly fewer distrust formation processes than the attribute-based RA does: process numbers per subject: 16.1 vs. 23.2, one tailed t-test, $p<0.01$; H3 is supported. Taking H1, H2, and H3 together, customers trust the need-based RA more than they trust the attribute-based RA, and that such a difference can be explained by the fact that the need-based RA triggers more trust formation processes and fewer distrust formation processes. Hence, it is possible to design more trustworthy RAs by increasing the number of trust formation process while decreasing the number of distrust formation process.

Interestingly, our protocol analysis results show that, for the attribute-based RA, the percentage distribution of trust formation processes is significantly different from that of distrust formation processes: Chi square = 17.6, df = 8, $p<0.05$. Thus H4 is not supported. For the need-based RA, the percentage distribution of trust formation processes is also significantly different from the percentage distribution of distrust formation processes: Chi square = 44.3, df = 8, $p<0.001$. Thus H5 is not supported. This means that the main processes of trust formation are different from the main processes of distrust formation in RAs. The top three processes of *trust* formations are competence attribution, information sharing, and verification; together they account for 66% processes of trust formation in the attribute-based RA and 65% processes of trust formation in the need-based RA. The top three processes of *distrust* formation processes are awareness of the unknown, competence attribution, and expectation confirmation; together they account for 72% processes of distrust formation in the attribute-based RA and 67% of distrust formation in the need-based RA.

Since the way to increase customer trust in an RA is to trigger more processes of trust formation and fewer processes of distrust formation, our protocol analysis results suggest that, in order to design more trustworthy RAs, we should make sure that the RA functions well (i.e. competence attribution), includes detailed but not-overwhelming information such as personalized information (i.e. information sharing) and questions or explains by using the examples which the customers can verify with their prior-knowledge (i.e. verification), is understandable and transparent to the customer (i.e. awareness of the unknown), and does not behave unexpectedly (i.e. expectation confirmation).

CONCLUSIONS

The potential limitations of this study center on the sample size and the use of student subjects. First, 49 is a small number of subjects, which limit our ability to use a regression or SEM method to analyze the relationships between the trust level and the number of different trust/distrust formation processes. However, a small number of participants are the norm for protocol analysis studies, given the huge efforts and time spent on protocol analysis. Actually, our sample size and the volume of the protocols analyzed are larger than in the majority of protocol analysis studies reported in the literature. Thus this limitation is also strength when it is compared with other protocol analysis studies. Second, this study used university students as subjects, which might affect the generalizability of the results. However, all these subjects were prescreened to make sure that they are potential customers.

The current study opens the black box of trust and distrust formation by utilizing a protocol tracing method to investigate customer trust in web-based product-brokering RAs. The findings have implications for researchers on trust and on RAs and for RA designers. Academically, prior research has theoretically proposed various frameworks regarding the processes of trust formation but none has empirically traced these processes. We contribute by conceptually building a verified category scheme to classify the trust formation processes. Our results reveal that the need-based RA gains higher customer trust than the attribute-based RA does; this can be explained by the fact that the need-based RA triggers more processes of trust formation and fewer processes of distrust formation. In addition, our results show that the

main processes of trust formation and the main processes of distrust formation are different. Practically, the current study provides empirical evidence that it is valuable to add need-based questions to content-based RAs. It identifies the top three processes of trust formation and distrust formation, which sheds lights on how to design more trustworthy RAs in ecommerce.

REFERENCES

1. Ansari, A., Essegaier, S. and Kohli, R. (2000) Internet recommendation systems, *Journal of Marketing Research,* 37, 3, 363-375.
2. Ariely, D. (2000) Controlling the information flow: Effects on consumers' decision making and preferences, *Journal of Consumer Research,* 27, September.
3. Chopra, K. and Wallace, W. A. (2003) In Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03)IEEE, Hawaii.
4. Cohen, J. A. (1960) A coefficient of agreement for nominal scales, *Educational and Psychological Measurement,* 20, 37-46.
5. Doney, P.-M. and Cannon, J.-P. (1997) An examination of the nature of trust in buyer-seller relationships, *Journal of Marketing,* 61, 2, 35-51.
6. Felix, D., Niederberger, C., Steiger, P. and Stolze, M. (2001) In *Proceedings of IFIP I3e*.
7. Gambetta, D. (1988) In *Trust: Making and breaking cooperative relations*(Ed, Gambetta, D.) Blackwell, Oxford, UK, pp. 154-175.
8. Gefen, D., Karahanna, E. and Straub, D. W. (2003) Trust and tam in online shopping: An integrated model, *MIS Quarterly,* 27, 1, 51-90.
9. Grenci, R. T. and Todd, P. A. (2002) Solutions-driven marketing, *Communications of the ACM,* 45, 3, 64-71.
10. Hsiao, R. L. (2003) Technology fears: Distrust and cultural persistence in electronic marketplace adoption, *Journal of Strategic Information Systems,* 12, 3, 169-199.
11. Komiak, S. X. and Benbasat, I. (2004) Understanding customer trust in agent-mediated electronic commerce, web-mediated electronic commerce, and traditional commerce, *Information Technology and Management,* 5, 1&2, 181-207.
12. Kramer, R. M. (1999) Trust and distrust in organizations: Emerging perspectives, enduring questions, *Annual Reviews of Psychology,* 50, 569-598.
13. Lewis, D. J. and Weigert, A. (1985) Trust as a social reality, *Social Forces,* 63, 4, 967-985.
14. Maes, P., Guttman, R. H. and Moukas, A. G. (1999) Agents that buy and sell, *Communications of the ACM,* 42, 3.
15. McAllister, D. J. (1995) Affect-based and cognition-based trust as foundations for interpersonal cooperation in organizations, *Academy of Management Journal,* 38, 1, 24-59.
16. McKnight, D. H., Choudhury, V. and Kacmar, C. (2002) Developing and validating trust measures for e-commerce: An integrative typology, *Information Systems Research,* 13, 3, 334-359.
17. McKnight, D. H., Cummings, L. L. and Chervany, N. L. (1998) Initial trust formation in new organizational relationships, *Academy of Management Review,* 23, 3, 473-490.
18. Schafer, J. B., Konstan, J. and Riedl, J. (1999) Recommender systems in e-commerce, *E-Commerce,* 99.
19. Shaft, T. M. and Vessey, I. (1995) The relevance of application domain knowledge: The case of computer program comprehension, *Information Systems Research,* 6, 3, 286-299.
20. Sheppard, B. H. and Sherman, D. M. (1998) The grammars of trust: A model and general implications, *Academy of Management Review,* 23, 3, 422-437.
21. Stolze, M. and Nart, F. (2004) In *CHI 2004*Vienna, Austria.
22. Swan, J. E., Bowers, M. R. and Richardson, L. D. (1999) Customer trust in the salesperson: An integrative review and meta-analysis of the empirical literature, *Journal of Business Research,* 44, 2, 93-107.