A Literatural Overview on Explanation Types in Personalization

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Abstract— This paper provides a literatural overview of two explanation types in personalization. The first type, detailed explanation, is mainly used in desktop scenario, while the second type, short explanation, is more suitable for mobile or automobile scenario. //TODO

Index Terms—Explanation types, Recommender system, Personalisation

1 Introduction

Personalization has already existed for a long time. The first emergence of this phenomena can be traced back to antiquity, when experienced merchants provided different customers with different products or services[1]. However, the real interest of personalization arose in the mid to late 1990s with the advancement of the Web technologies[6]. From then on, more efforts have been investigated in this field in order to decode the essence of personalization.

In the world of personalization, the most common form of it is recommender systems (RS), which can intelligently give users personalized suggestions. Based on different algorithms, the recommender systems can also be different. Content-based recommendation and collaborative filtering recommendation are two popular types of recommendation, on which large amount of researches have been done. The first one, content-based recommendation, observes utility of items experienced previously and their attributes for a given user is taken as input to predict the utility of other items to that user[4]. A simpler explanation can be "User A has bought a novel. And based on this history, a magazine is more likely to be recommended to him than a pair of shoes, because novels and magazines are more in common than novels and shoes ". The second type, collaborative filtering, observes utility for user-item pairs is taken as input to predict utility for unobserved user-item pairs[4]. One example can be "User A(1,2) has bought items 1 and 2, user B(1,2,3) has bought items 1,2 and 3 and user C(2,4) has bought items 2 and 4. Thus, item 3 is more likely to be recommended to user A than item 4, because user A and user B are more similar than user A and user C".

A good recommendation algorithm is no doubt indispensable for a recommender system and the way of explaining its complex algorithm to users plays also an important role. With the development of the Internet, the privacy issue gains more and more importance in the society and people are willing to know which information is "consumed" by the system. They may lose their trust on the system if it behaves another way as they expected. In this case, a good explanation of the behaviors of a recommender system can help inspire user trust and loyalty, increase satisfaction, make it quicker and easier for users to find what they want[20].

The following content are divided into four parts. The first part provided an overview of different researches on explanations in recommender systems. The second part focused on detailed explanation and its criterion, while short explanation and its possible criterion are emphasized the third part. In the end, the last part discussed on some limitations in recent researches, proposed several research questions for future research and provided a summary of this whole paper.

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2 Overview

User experience research is increasingly attracting researchers attention in the recommender system community. Some researchers, like Li Chen[17] and Bart P. Knijnenburg[10], focus on a larger scale and try to figure out what constitutes an effective and satisfying recommender system. Other researchers focus on a more detailed part, that is the explanation of the system. They have proved that a good explanation can boost users' trust towards the system and help them in decision making process[20][22][16].

David Mcsherry proposed a case-based reasoning (CBR) approach[15] to product recommendation that offers important benefits in terms of the ease with which the recommendation process can be explained and the system's recommendations can be justified.

Another perspective focused on how the soundness and completeness of the explanations impacts the fidelity of end users' mental models[12], where the soundness means the extend to which an explanation describes all of the underlying system and the completeness means how truthful each element in an explanation is with respect to the underlying system.

And Brian Y. Lim and Anind K. Dey dived into question types. In their work, Toolkit Support Intelligibility in Context-Aware Applications[14], they divided explanation types based on different questions types, that is Why, Why Not, How To, What, What If, Inputs, Outputs and Certainty.

Finally, a great breakthrough has been made by Nava Tintarev and Judith Masthoff. They have proposed what they called "seven possible advantages of an explanation facility"[20]. These seven advantages are often taken as a standard criterion to evaluate different types of explanation in other researchers' works.

3 Detailed Explanation

In this part, we take a look at "detailed explanation" and try to figure it out which factors should be taken into consideration when we start to design a good detailed explanation. And an example is also provided in order to illustrating how these factors are used in industrial product nowadays.

3.1 Seven Explanatory Criterion

Like what we have already mentioned in the overview, the "seven explanatory criterion"[20](see table 1) from Nava Tintarev and Judith Masthoff is the most popular standard used to evaluate the explanation. It is also comprehensive since it takes all aspects, which is relevant to design a good explanation, into consideration. Thus these seven explanatory criterion are useful if we want to design a detailed explanation.

Although they may called differently in different research works ("explanation attributes"[2], "seven possible aims for explanations"[21] or "quality factors"[8]). The basic idea is the same, which aims at making system more understandable by users.

Transparency: Transparency in a recommender system is related to the capability of a system to expose the reasoning behind a recommendation to its users[9]. A recommender systems without explanation works like a "black box", which may lost trust from user. Thus, transparency is considered as an important factor to build user's trust in the system[19].

Aim	Definition
Transparency	Explain how the system works
Scrutability	Allow users to tell the system it is wrong
Trust	Increase users' confidence in the system
Effectiveness	Help users make good decisions
Persuasiveness	Convince users to try
Efficiency	Help users make decisions faster
Satisfaction	Increase the ease of use or enjoyment

Table 1. Explanatory criteria and their definitions

Scrutability: Scrutability means, in short, allow users to tell the system it is wrong. It can also be seen as a kind of User Control, which allows users to correct reasoning from system[5].

Trust: Trust is sometimes linked with transparency. Studies have already shown that transparency and the possibility of interaction with recommender systems increases user trust[7][18].

Effectiveness: An effective explanation can help users to make a better decision. If an item suggested by the system is the one the user really likes, such explanation can be considered as effective.

Persuasiveness: Persuasiveness, sometimes referred to as promotion, is strongly related to effectiveness and can be defined as the ability of an explanation type to convince the user to accept or disregard certain items[8].

Efficiency: An explanation is usually considered to be efficient when it helps the user to decide more quickly or when it helps to reduce the cognitive effort required in the decision process[8]. The most common approach to measure it is to look at the iteration time between users and recommender system before users reach their goals.

Satisfaction: The users overall satisfaction with a recommender system is assumed to be strongly related to the perceived quality of its recommendations and explanations[19].

3.2 Examples of Detailed Explanation

An example of explanation in amazon.com. TODO: (Write Analysis based on seven explanatory criterion)

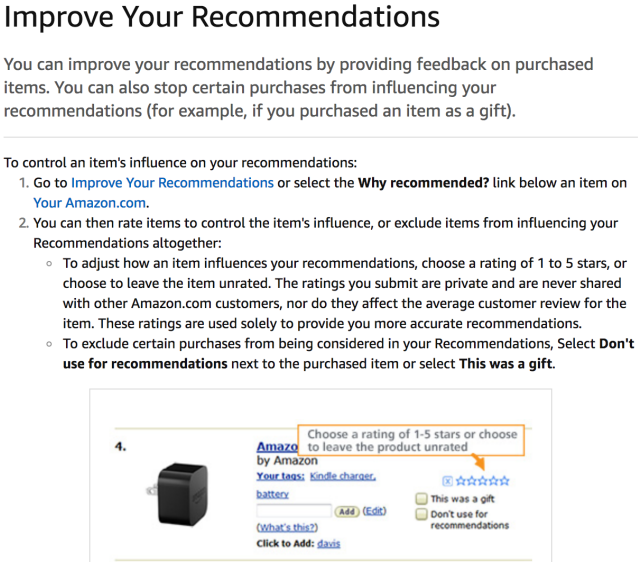

Figure 1. Amazon

An example of explanation of Google Ads. TODO: (Write Analysis based on seven explanatory criterion)

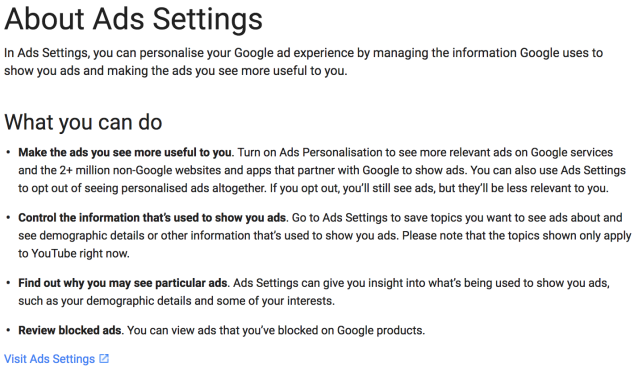

Figure 2. Google

4 Short Explanation

However, in some scenario, a brief explanation is more suitable, for example, driving in a car (why: users have limited attention resource) We can not take all seven explanatory criterion into consideration. How to extract a kind of standards.

4.1 Possible Criterion for Short Explanation

4.2 Examples of Short Explanation

Example1: Explanations in Proactive Recommender Systems in Automotive Scenarios [3] **Extract two criterion out of seven explanatory criterion: Persuasiveness and Efficiency.**

Example2: Why did my car just do that? Explaining semi-autonomous driving actions to improve driver understanding, trust, and performance[11] **Extract two types (what and how)based on question types from Intelligent Toolkit [Brian2010toolkit**, 13]

5 Discussion and Limitations

6 Conclusion

References

[1] Gediminas Adomavicius, Zan Huang, and Alexander Tuzhilin. "Personalization and recommender systems". In: *State-of-the-Art Decision-Making Tools in the Information-Intensive Age*. INFORMS, 2008, pp. 55–107.

[2] MOHAMMED Z Al-Taie. "Explanations in recommender systems: overview and research approaches". In: *Proceedings of the 14th International Arab Conference on Information Technology, Khartoum, Sudan, ACIT*. Vol. 13. 2013.

[3] Roland Bader12, Andreas Karitnig, Wolfgang Woerndl, and Gerhard Leitner. "Explanations in proactive recommender systems in automotive scenarios". In: *First International Workshop on Decision Making and Recommendation Acceptance Issues in Recommender Systems (DEMRA 2011)*. 2011, p. 11.

[4] Marko Balabanović and Yoav Shoham. "Fab: content-based, collaborative recommendation". In: *Communications of the ACM* 40.3 (1997), pp. 66–72.

[5] Marek Czarkowski and Judy Kay. "A scrutable adaptive hypertext". In: *International Conference on Adaptive Hypermedia and Adaptive Web-Based Systems*. Springer. 2002, pp. 384–387.

[6] Peppers Don and Rogers Martha. *Managing customer relationships: a strategic framework*. 2011.

[7] Alexander Felfernig, Erich Teppan, and Bartosz Gula. "Knowledge-based recommender technologies for marketing and sales". In: *International Journal of Pattern Recognition and Artificial Intelligence* 21.02 (2007), pp. 333–354.

[8] Fatih Gedikli, Dietmar Jannach, and Mouzhi Ge. “How should I explain? A comparison of different explanation types for recommender systems”. In: *International Journal of Human-Computer Studies* 72.4 (2014), pp. 367–382.

[9] Jonathan L Herlocker, Joseph A Konstan, and John Riedl. “Explaining collaborative filtering recommendations”. In: *Proceedings of the 2000 ACM conference on Computer supported cooperative work*. ACM. 2000, pp. 241–250.

[10] Bart P Knijnenburg, Martijn C Willemsen, Zeno Gantner, Hakan Soncu, and Chris Newell. “Explaining the user experience of recommender systems”. In: *User Modeling and User-Adapted Interaction* 22.4-5 (2012), pp. 441–504.

[11] Jeamin Koo, Jungsuk Kwac, Wendy Ju, Martin Steinert, Larry Leifer, and Clifford Nass. “Why did my car just do that? Explaining semi-autonomous driving actions to improve driver understanding, trust, and performance”. In: *International Journal on Interactive Design and Manufacturing (IJIDeM)* 9.4 (2015), pp. 269–275.

[12] Todd Kulesza, Simone Stumpf, Margaret Burnett, Sherry Yang, Irwin Kwan, and Weng-Keen Wong. “Too much, too little, or just right? Ways explanations impact end users’ mental models”. In: *Visual Languages and Human-Centric Computing (VL/HCC), 2013 IEEE Symposium on*. IEEE. 2013, pp. 3–10.

[13] Brian Y Lim and Anind K Dey. “Design of an intelligible mobile context-aware application”. In: *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*. ACM. 2011, pp. 157–166.

[14] Brian Y Lim and Anind K Dey. “Toolkit to support intelligibility in context-aware applications”. In: *Proceedings of the 12th ACM international conference on Ubiquitous computing*. ACM. 2010, pp. 13–22.

[15] David McSherry. “Explanation in recommender systems”. In: *Artificial Intelligence Review* 24.2 (2005), pp. 179–197.

[16] Pearl Pu and Li Chen. “Trust-inspiring explanation interfaces for recommender systems”. In: *Knowledge-Based Systems* 20.6 (2007), pp. 542–556.

[17] Pearl Pu, Li Chen, and Rong Hu. “A user-centric evaluation framework for recommender systems”. In: *Proceedings of the fifth ACM conference on Recommender systems*. ACM. 2011, pp. 157–164.

[18] Rashmi Sinha and Kirsten Swearingen. “The role of transparency in recommender systems”. In: *CHI’02 extended abstracts on Human factors in computing systems*. ACM. 2002, pp. 830–831.

[19] Kirsten Swearingen and Rashmi Sinha. “Interaction design for recommender systems”. In: *Designing Interactive Systems*. Vol. 6. 12. 2002, pp. 312–334.

[20] Nava Tintarev and Judith Masthoff. “A survey of explanations in recommender systems”. In: *Data Engineering Workshop, 2007 IEEE 23rd International Conference on*. IEEE. 2007, pp. 801–810.

[21] Nava Tintarev and Judith Masthoff. “Evaluating the effectiveness of explanations for recommender systems”. In: *User Modeling and User-Adapted Interaction* 22.4 (2012), pp. 399–439.

[22] Jeroen Van Barneveld and Mark Van Setten. “Designing usable interfaces for TV recommender systems”. In: *Personalized Digital Television: Targeting Programs to Individual Viewers, Kluwer Academic Publishers, Dordrecht, The Netherlands* (2004), pp. 259–285.