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User-controllable personalization: A case study with SetFusion ☆

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ABSTRACT

In this research we investigated the role of user controllability on personalized systems by implementing and studying a novel interactive recommender interface, SetFusion. We examined whether allowing the user to control the process of fusing or integrating different algorithms (i.e., different sources of relevance) resulted in increased engagement and a better user experience. The essential contribution of this research stems from the results of a user study ($N=40$) of controllability in a scenario where users could fuse different recommendation approaches, with the possibility of inspecting and filtering the items recommended. First, we introduce an interactive Venn diagram visualization, which combined with sliders, can provide an efficient visual paradigm for information filtering. Second, we provide a three-fold evaluation of the user experience: objective metrics, subjective user perception, and behavioral measures. Through the analysis of these metrics, we confirmed results from recent studies, such as the effect of trusting propensity on accepting the recommendations and also unveiled the importance of features such as being a native speaker. Our results present several implications for the design and implementation of user-controllable personalized systems.

1. Introduction

The purpose of recommender systems is helping a user or a group of users to choose items from a large item or information space (McNee et al., 2006a) by proactively suggesting personalized relevant items. Recommender systems were introduced in the early 90s with systems like Tapestry for filtering e-mails (Goldberg et al., 1992), GroupLens for netnews recommendations (Resnick et al., 1994), or Ringo for music recommendation (Shardanand and Maes, 1995), and several factors have helped to increase their popularity over time. For one thing, the exponential growth of the Internet makes it an ideal "large information space" to create recommendations for several applications and domains, such as the product recommendation of e-commerce websites like Amazon.com, the movie recommendations of Netflix, or the video recommendations of the web portal YouTube. Another factor that has popularized recommenders in areas beyond their original niches has been online open competitions such as the "Netflix Prize" (Bennett et al., 2007) –a movie recommendation challenge that awarded one million dollars to the most accurate recommendation approach. Despite their success, recommender systems also face several challenges. One such challenge is incorporating Human Factors in order to increase user acceptance of the systems and the items recommended. Historically, the focus on recommender systems' research has been on improving the algorithms' predictive accuracy (Parra and Sahebi, 2013), but as McNee et al. (2006b) highlighted in the paper "*Being accurate is not enough: how accuracy metrics have hurt recommender systems,*" accuracy does not always correlate with a good user experience, making the study of recommender interfaces one of the areas in need for improvement.

The work on increasing user acceptance of recommender systems through better recommendation interfaces started with the exploration of visually-rich recommendation interfaces that go beyond the paradigm of static ranked lists. PeerChooser (O'Donovan et al., 2008), and SmallWorlds (Gretarsson et al., 2010) are examples of interactive visual interfaces that represent a collaborative filtering paradigm, where users increased their satisfaction under the visual interactive interface compared to a more static condition. More recent work has focused on providing users control over the recommendation interface by allowing users to sort the recommendation list based on different item features in an energy-saving application (Knijnenburg et al., 2011), by letting users indicate their preferences at different

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levels of granularity in a music recommender (Hijikata et al., 2012), or by permitting them to combine several recommendation sources using sliders in a music and a job recommender (Bostandjiev et al., 2012, 2013). These approaches have shown in particular domains how user controllability and user characteristics affect the user acceptance of recommendations.

Our work extends past research on both visual recommender interfaces and user controllability in two important directions. First, it suggests a new approach to user-controllable hybrid recommendation that combines more traditional *sliders* with a new way to inspect and control a fusion of recommendations through a *Venn diagram visualization*, inspired by our recent results in Verbert et al. (2013). Second, it examines the effect of controllability and user characteristics on the user experience by using objective, subjective and behavioral measures. This second contribution helps to bridge the gap of previous studies that consider only objective, only subjective, or at most both types of metrics, but that do not explain the user experience by describing how users interact with available widgets.

In order to address these challenges, we have built a novel user-controllable article recommendation interface for the existent system Conference Navigator, an online web platform that supports attendees and organizers of academic conferences. Using this system, we have conducted a controlled user study to investigate the effect of user controllability on the user experience of a personalized recommender system. The study compares two interfaces, a traditional static list of recommendations (baseline) against a visual interface with controllable features, and also investigates the effect of users' characteristics on the acceptance of recommendations.

The rest of the paper is structured as follows: in Section 2 we survey previous work that motivates and influences our research; then in Section 3 we present in detail the innovations of our work with a focus on our interactive interface. The design of our user study is described in Section 4, including research questions and related metrics, recommendation approaches and the study procedure. The results of our study are split into three sections. Section 5 presents how people used particular features of the interface (sliders, filters through Venn diagram) and how effectively those features improved user engagement, then Section 6 aggregates the results of three sets of regression analyses in order to understand the influence of the interface and user characteristics on objective, subjective and behavioral metrics. Following, Section 7 shows the results of the post-study survey with a qualitative analysis of user comments. Finally, Section 8 summarizes the main lessons and conclusions of our research and it describes our future work.

2. Related work

In this section we present the previous work that motivates our research. Since the areas described might have been explored in different research fields, we focus mainly on summarizing the work directly related to personalization and recommender systems. Hence, we classify the most relevant related work in three areas: (a) controllability, inspectability and user intervention, (b) transparency and explainability, and (c) user-centric evaluation of recommender systems.

2.1. Control, inspectability and user intervention

Though there are existent works on the effect of increased user control in online systems (Ariely, 2000; Sherman and Shortliffe, 1993), only recently has user-control been methodically investigated in the context of recommender and personalized systems. Jameson and Schwarzkopf (2006) studied how much control users prefer on updating a list of recommendations in the context of a conference (UM 2001), but they did not find conclusive preference for one condition over another, but instead discovered several situational and individual factors that might affect the user's preference. Knijnenburg et al. (2011) studied the effect of different interaction mechanisms on an energy-saving recommender system. They concluded that the best interaction mechanisms depend on user characteristics; for instance, expert users (with more domain knowledge) reported higher user satisfaction with interfaces that provided more control compared to novice users, who were more satisfied with an interface that provided the recommendation without many controllable variables. Bostandjiev et al. (2012) introduced a visual hybrid interactive music recommender called TasteWeights and they performed a study to see whether the additional interaction results in a better user experience. Recommendation accuracy, measured as the utility of the recommended list of items after users have "tuned" the importance of different data sources and neighbors using the visualization, was better with bigger interaction and explainability (the full interface), as was the general user experience. Using the same TasteWeights framework, but only considering social recommendation (Facebook contacts) of music, Knijnenburg et al. (2012) performed a user study on the influence of control and inspectability on the user experience. Letting users inspect the full recommendation graph (items, friends, and connections), produced an overall better user experience. In terms of type of control, they conclude that controlling weights and controlling the weight of items are additive, so providing both in a real setting is recommended. Hijikata et al. (2012) also explored control in the context of music recommendation. They explored four different ways to let users intervene the recommendation process: ratings, context, content attribute and user profile edition. Through a user study, they showed that user intervention is correlated to rating prediction and user satisfaction, but user control does not always lead to better prediction and satisfaction. In addition, they found preliminary evidence that only people with high interest in the domain consistently experience better user satisfaction with more control, even when recommendations are less accurate. Another approach to user controllability was studied in Verbert et al. (2013), where an interactive interface was embedded into a conference support system, a visual interactive tool called Aduna.[1] This tool was adapted to aid users in exploring talks in a conference from multiple perspectives of relevance, talks bookmarked by users, suggestions of recommender agents and talks marked with specific tags.

2.2. Transparency and explainability in recommender systems

Herlocker et al. (2000) introduced the idea of explaining recommendations as a mean to make the system more transparent to users' decisions and to improve users' acceptance of recommender systems. Based on successful previous results from expert systems, they expected that interfaces of collaborative filtering recommenders would benefit from explanations as well. They studied different ways to

[1] http://www.aduna-software.com/technology/clustermap.