Memory Priming and User Preferences

Evangelia Anagnostopoulou
evagelia@mail.ntua.gr

Efthimios Bothos
mpthim@mail.ntua.gr

Babis Magoutas
elbabmag@mail.ntua.gr

Gregoris Mentzas
gmentzas@mail.ntua.gr

National Technical University of Athens,
Institute of Communication and Computer Systems, Athens, Greece.

ABSTRACT
In this paper we provide a preliminary analysis of the effects of priming on user preferences and we describe two experiments that show such effects in test environments. Our first results demonstrate that small stimuli which primes the process of item rating leads to varying average ratings.

Keywords
Recommendations; Memory effects; Priming; Human decisions.

1. MEMORY EFFECTS
Recommendation and personalization systems support human decisions by analysing and processing past user behaviour in order to filter and highlight items that users may like the most. Recent approaches increasingly focus not only on past behaviour but also on other aspects that affect human decisions including human cognition and the important role of cognitive biases in information systems use and understanding [1]. The study of human psychology has provided a rich literature on the impact of non-rational decisions that can lead to sub optimal selections. Commonly, the reason is that humans make choices using heuristics that can be misleading or lack the complete information required to reach the optimal decision. As modern information systems are increasingly characterized by richness of information and interactive decision making, human behavioural aspects need to be considered and cognitive restrictions to be supported.

A cognitive element shown to affect human decision making and potentially impact the performance of recommendation and personalization systems refers to "memory effects" [2]. These are related to our memory system that possesses a key role in the decision-making process especially in cases where humans constantly choose among alternatives. Memories can alter our decisions while residing in the unconscious system and can invoke automatic reactions although decisions seem to be rational and intentional. Information related to how past decisions have been made is recorded in our minds and is subsequently used for future decisions, resulting to a main distinction between memory availability and their accessibility ([2], [3]). In order for a piece of information to be available it has to be comprehended and stored in the "long-term" memory. From this point onwards, the information can potentially be retrieved to support judgmental decisions. However, only a small proportion of available memories is accessible at any point in time [3], depending on the time and the context. Past studies have provided evidence that important factors determining the accessible information are the amount of competing information learned in the same content domain as well as self-generated and externally generated retrieval cues present at the time.

A main memory effect affecting decisions is "priming" which refers to cues that activate internal mental representations while influencing subsequent behaviour [4]. Priming may take various forms which have been documented in the psychology literature [4, 5], including visual objects, goals and stereotypes. When the targeted mental representations are activated, individual behaviour can be altered and when properly used they can improve decision-making or performance on tasks [6]. With respect to recommendation and personalization systems, priming is commonly omnipresent and may lead to choices that are intentionally or unintentionally changed. For example in [7] the authors present an experiment where an attribute based recommendation agent provided suggestions for the purchase of a tent in a virtual e-shop. They manipulated (primed) the attributes (e.g. weight, durability) that were presented to participants in order to build the recommender model and found that participants tend to purchase the tents that scored higher on the presented attributes compared to those that scored higher on the excluded attributes. Based on the above, understanding the impact of memory effects on user preferences provides opportunities to further improve recommender systems, which is the focus of our work. In the following section we present two experiments with evidences that memory effects can alter user ratings. Our inaugural experiments show that small stimuli which primes the process of item rating leads to varying average ratings.

2. EXPERIMENTS AND RESULTS
We designed two small scale experiments with the purpose of identifying the impact of memory effects on the expression of user preferences, focusing on associative and repetition priming. Associative priming refers to stimuli that appear to be unrelated, but due to their common appearance, one will prime the other. Repetition priming concerns alternations in the content of the short term memory, rendering information readily available. The experiments were deployed on Amazon Mechanical Turk (AMT) that provides access to a large user base. Past studies have shown that the quality of the results compares to that of laboratory experiments when the setup is carefully explained and controlled [8]. Moreover AMT has been used in past studies of recommender systems [9]. Note that we set geographic restrictions in order to involve users from the US and Europe only.

For the purpose of the associative priming experiment we implemented a demo website where users could rate three movies of varying and distinct genres {comedy, sci-fi, documentary}. Before rating the movies, users were asked to read a short story or news item which related to the genre of one of the movies: a funny story (matching comedy), a story about aliens (matching sci-fi) and a news item on drugs (matching a documentary). We selected movies with an intuitive correlation to the stories. Our hypothesis is that the priming effects generated when reading a story or an article will have impact on user ratings. After rating the movies, users were requested to provide their preferences on what kind of movie genres they like to watch. Based on this feedback we removed from the analysis users who didn't like the genres we selected; there were 60 remaining users (20 per group). Figure 1 provides an overview of the results. In the case of sci-fi we detected a significant higher average rating ($p < 0.05$) while in

the case of the documentary there was some evidence of significance (p<0.1)[1].
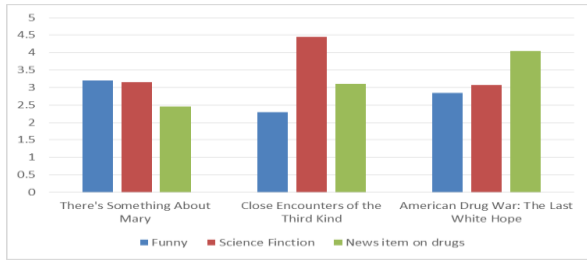
Figure 1: Average ratings according to the story read.

For the purpose of the repetition priming experiment we followed a similar approach with users rating a set of three movies of varying and distinct genres {comedy, action, thriller} at a demo website. Users were divided in two groups: those who rated movies and afterwards provided feedback on the movies genres they like and those who first provided feedback on the movie genres they like and then rated the movies. We removed from the analysis users who didn't like the genres we selected; there were 80 remaining users (40 per group). Our hypothesis is that the priming caused when users were thinking over their preferences yields differences in the provided ratings. Figure 2 presents an overview of the results. We identified a trend for lower ratings when users provided their preferences after rating the movies, although the differences were not significant.
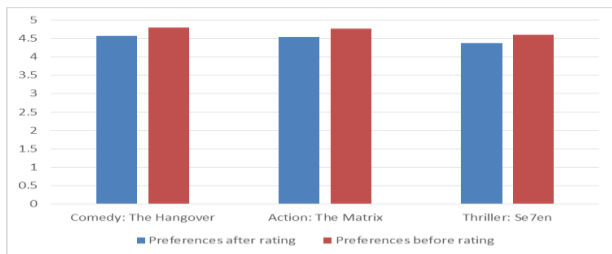
Figure 2: Average ratings for the two experimental groups (stating genre preferences before or after rating movies).

3. RELATED WORK

Recent approaches that study cognitive biases and memory effects include the following. Dennis et al. [10], study the effects of "achievement priming" on user creativity and find evidence of increased number of unique ideas in virtual brainstorming teams. Hsieh et al. [11] build a recommendation model based on the interest development theory. They identify user interests as these are expressed in social media and subsequently improve news recommendations. Cosley et al. [12] and Adomavicius et al. [13] study anchoring effects on human decisions to detect cognitive biases that skew the preferences users express when rating items. Schnabel et al. [14] leverage the short-memory effect and propose a recommendation interface that makes use of shortlists and increases user satisfaction in a movie recommendation task. Pinder et al. [15] suggest the use of subliminal priming for behavioral changes through priming of the unconscious system. The work described in our paper focuses on memory effects related to memory priming.

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[1] Based on pairwise t-tests as performed in previous studies, see e.g. [13].

4. CONCLUSIONS

In our preliminary study we formulated the problem of understanding memory priming effects in recommendation and personalization systems. Our first results from two experiments support the hypothesis that users are affected by priming stimuli. Our next step is to better understand such effects and examine how we can leverage them in real life systems. We are interested in supporting sustainable living decisions through persuasive recommendation systems. More specifically we focus on nudging users towards green transportation choices and centre on two main questions: i) how can we leverage environmental goal priming with recommendations of personalized pro-environmental messages in travel planning applications? ii) how can we understand and leverage the primes users receive in a given context to suggest routes that are environmentally friendly and increase their chances of being selected?

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