Personalized Systems and Illusion of Serendipity: A Sociotechnical Lens

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ABSTRACT
In this position paper we shed light on the problem of the relation between digital environments and serendipity from a sociotechnical perspective. The paper brings attention to a potential impact of personalized information systems on the loss of genuine serendipity as a valued aspect of human information interaction. This issue is presented in the context of a growing sociotechnical environment that increasingly removes a sense of awareness and control from people and formalizes the ways they live their lives.

Keywords
Serendipity; sociotechnical environment; technology control; user awareness; personalization, human-computer interaction; information behavior; information interaction; information encountering

1. INTRODUCTION
In the digital age, digital environments are designed with personalized information. Based on a person's search behavior on the Internet and in Social Media, the person receives recommendations for other products (e.g., Amazon book recommender system) or gets selected advertisements (e.g. Facebook Ads). This kind of personalization in marketing is typically known to the user, and s/he can recognize such approach because it is usually labeled as an "ad." However, other forms of personalization are more difficult to 'see,' especially when they appear in environments that are a mix of digital and traditional spaces. Here is an example:

> Dora and Sandra are researchers and meeting in Sandra's office to collaborate on a project. Dora decides to print out some document from her notebook computer, so they could take a look at the paper copy. Her computer is connected through a wireless network to a shared printer in a communal area outside of Sandra's office, so she expects to pick up the print out there. Surprisingly, a wireless printer in Sandra's office picks up the print task and prints out the document. While this is convenient as Dora doesn't have to walk to the shared printer to pick up the printout, Sandra's printer 'took control' over Dora's printing without her knowledge. Unknown to the two researchers, Sandra's printer was set up to detect wireless print job signals from devices in near

> proximity. What seemed to be serendipity, was a designed system response – fake serendipity. It made both Dora and Sandra confused and uncomfortable. Why wasn't it made clear to Dora where the print job is going? What other printers in faculty offices may be doing unintended printing?

This is a real story and one very simple example of how objects around us are becoming good in detecting and responding to our needs. In our digital age, such sociotechnical environments are becoming increasingly linked with things and content personalized to the person interacting with a digital information system. The "Internet of Things" (IoT) is not limited to the material word of engineering firms anymore. People are used to seeing customized ads showing up in their Facebook and Twitter feeds and also displayed in their web search engine results. As the IoT becomes more integrated in everyday life, digital billboards and other Internet connected devices will be able to identify nearby individuals based on information stored in their cellphones and other personal digital devices and personalize the information content that is presented.

2. SIGNIFICANCE OF THE PROBLEM
The future of personalization of information retrieval systems may have a look and feel of the environment in the shopping mall scene of Spielberg's 2002 movie The Minority Report, where digital wall ads "recognize" the main protagonist of the movie played by Tom Cruise and present him with personalized content as he walks through the mall. The Cruise character is clearly oblivious to this customized information. In 2054, the year depicted in the movie, people have become accustomed to being presented highly individualized information wherever they are. There is no place for surprise, no more serendipity.

However, looking at this future scenario from the perspective of 2018, one wonders how will we control what type of personalization takes place and where? If we are aware that information is in some way pre-selected based on what systems know about us, will this be the end of serendipity as we know it? Similarly, if we are not aware that information we encounter is personalized, will the future bring us a lot of "fake serendipity," as in the story described above?

3. SERENDIPITY – SO WHAT?
Experiences of happy surprises are evolutionary engrained in human existence and far pre-date the modern digital age. Term serendipity emerged first in distant 1754 in a letter by English author and politician Horace Walpole, who referred to it as discovery of things that were not sought for, by accident and sagacity. (Remer, 1965). In centuries that followed serendipity was most prominently associated with unexpected scientific discoveries

and inventions (Campanario, 1996; Merton & Berber, 2004), such as discovery of penicillin and invention of Teflon. Early references to serendipity as an aspect of organized information systems in libraries were discussed by Bernier (1960).

Over last twenty years, interest in serendipity as an important aspect of human information interaction has grown in both human-computer interaction (HCI) and human information behavior (HIB) research. Among HCI researchers the focus was especially on designing and developing information retrieval systems that promote and facilitate serendipity (e.g., Kefalidou & Sharples, 2016; Niu & Abbas, 2017). Since 1990s, library and information science researchers have been developing better conceptual understanding of application of serendipity in the context of information behavior, also known as information encountering (e.g., Erdelez, 1997; Foster & Ford, 2003; Makri & Blandford, 2012; Agarwal, 2015; McCay-Peet & Toms, 2015).

Two recently published books by Race & Makri (2016) and McPeet & Toms (2017) focus on serendipity in the digital age. The authors discuss many characteristics of information retrieval systems that facilitate serendipity, such as ease of navigation, content hyperlinking and new content discovery through recommendations. Makri (pg. 107) also specifically recognized the limitations of digital tools to create real serendipitous insight due to their algorithmic nature. A very vocal argument that digital environment also creates barriers for serendipity emerged from political science authors. They point to algorithmic capacity of creating "filter bubbles" (Pariser, 2011) and "echo chambers" Sunstein (2017) that limit access to information reinforcing users' existing political views.

The research in HCI and HIB shows continuing growth in understanding of user experience of serendipity (cognitive, affective, behavioral) as well as the perspective of features important for information system design to preserve and facilitate serendipity. The outcomes from loss of serendipity in digital echo cambers, referenced above, point to the broader impact of this research for future development of personalized information retrieval systems, especially as they migrate from personal digital devices to IoT and augmented reality in shared, public spaces.

4. A SOCIOTECHNICAL SOCIETY – WHERE DO WE GO NEXT?

In an early study of digitalization in 2009, Jahnke made visible how a society attempts to formalize our ways to live, "*Towards a socio-technical society: Shift from informal to formal structures (*page 775). While informal structures give us potential for serendipity, her study shows that in the digital age, organizations tend to formalize the informal. However, the informal structures give us potential of serendipity. Thus, to lose informality would mean to reduce the chance of real serendipity.

Jahnke (2009) studied digital communities and revealed evolution of socio-technical relationships that can be characterized as reinforcements of regulations both socially and technically driven, (see Table 1). In the first phase of a sociotechnical society, we have mainly digital trust-based communities, which are formed by free participation, and few formal rules. In the second phase, clear rules evolve, triggered by social conventions and norms. System boundaries are mainly socially enforced. In the third phase, clear rules will be manifested by technical systems, but for most people the technical determination will be hidden. For example, only a small percentage of people know that Google Page Ranking includes ten factors for ranking web pages, and also algorithms of bank loans, stocks, and so forth. In the third phase, not only social structures but also technical mechanisms enforce people's behavior and a socio-technical society is mainly technically driven but such technical 'rules' manifested in algorithms are hidden or obscure for its people.

New digital environments will create new forms of human information interaction. While bringing new technology into context, it will create new social practices; it is an interwoven co-evolutionary growth of the social and technical aspects (Fischer & Herrmann, 2011). This wicked problem has been studied by sociotechnical approaches that support human behavior through technological and organizational change since its inception in the early 1950s (Trist & Bamforth, 1951). While HCI research investigates the person-tool relationship, the sociotechnical design sheds light on organizational or contextual issues (Grudin, 1994) and studies new forms of human actions or work processes due to a new infrastructure. We argue that an initial set of categories and new *sociotechnical heuristics* will be required to explore and study major challenges of 'Personalized Information Systems and Serendipity' as a *sociotechnical problem*. These categories can be partly derived from existing studies such as sociotechnical design (Eason, 2005; Cherns, 1987; Clegg, 2000, Fox, 1995) principles of job design (Mumford, 1995; Hackman & Oldman, 1975), usability heuristics (Nielsen, 1994), and principles for the design of computer-supported cooperative work (e.g., Herrmann et al., 1996; Baker et al., 2001).

5. FUTURE RESEARCH

Awareness about information personalization affects not only a person's sense of serendipity but also points at a broader problem of yet unexplored, potential drawbacks of personalization. How does a person know that s/he is being recognized by the environment (technical system) and presented with personalized information? How much are people willing to give up control and delegate decision making to personalized technologies? These are some of the urgent questions facing HCI, HIB and other researchers before we collectively drift into a sociotechnical society to be ruled without us knowing. In our future work, we will develop a new set of sociotechnical heuristics with the goal to detect issues as discussed in this position paper. We will apply them, and our empirical work will inform potential revision of the sociotechnical heuristics.

Table 1: Towards a socio-technical society: Shift from informal to formal structures (adopted from Jahnke, 2009)

First phase	Second phase	Third phase	Next?
a) Mainly trust-based virtual communities, very informal rules (architecture of free participation)	b) Clear rules (conventions, borders, etc.) that are mainly socially enforced	c) Clear rules, mainly technically determined but for most people these technical algorithms are obscure	
e.g. Wikipedia's stage in 2005	e.g. Online Language 'Leet', Wikipedia in 2010	e.g. Google page ranking, Algorithms for loans	

→ *Evolving new socio-technical relationships* →

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