6-2017

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ABSTRACT

Filter bubble which may be described as technology-induced selective exposure has become a prevalent topic of discussion in our time. Selective exposure or an individual's tendency to seek confirmatory (as opposed to non-confirmatory) information related to a choice, leads to ill-informed decisions. Ill-informed decisions entail unintended consequences for individuals, communities that they belong to, and the larger society. Selective exposure also debilitates integrative complexity which is an individual's tendency to perceive and process different views on a specific topic. Breaking filter bubbles, alleviating selective exposure, and enhancing integrative complexity can lead to sustained societal progress. IT field with the vast number of controversial topics can help students practice seeking non-confirmatory information and processing them when making arguments or choices. In this study we report set up and preliminary results of field experimentation that were designed to investigate selective exposure and integrative complexity of information elaborations in asynchronous online discussions.

Keywords (Required)

Filter bubble, Selective Exposure, Integrative Complexity, Information Elaboration

INTRODUCTION

Regardless of their outcomes, high quality decision processes involve perceiving and processing multiple and/or opposing views of the topic. Perceiving opposing views requires exposure thereto. Humans, however, seek cognitive consistency and consistency is persevered by seeking and processing only the information that confirms preexisting beliefs (Adams, 1961; Festinger 1957). Processing information contrary to pre-existing beliefs often causes cognitive dissonance and to avoid cognitive dissonance, humans engage in selective exposure.

Selective exposure, also referred to as confirmation bias (or my-side bias), is the individual's tendency to seek only confirmatory information and ignore non-confirmatory information. Selective exposure is believed to be a stronger force in the digital era. Individuals who seek information in the electronic world have much more freedom in choosing the information to which they expose themselves (Clay *et al.* 2013). Also, with the shift from information scarcity to information richness (Hansen & Haas 2001), intelligent recommender systems, aiming to help individuals filter through massive amount of information, lead information seekers to sources that are more likely to be consistent with their belief systems (Nguyen *et al.* 2017). The push for relevancy over novelty, has created a new form of selectivity which may be labeled as "technology-induced" or "technology-imposed" selective exposure. This technology-induced selective exposure have become prominent in social media and search engines; the resulted personalized information worlds of individuals have been called filter bubbles (Praise 2011). Filter bubbles are increasingly skewed maps of reality that are results of over-fitted models of an individual's information seeking history. In other words, filter bubbles have transformed a unit global village to isolated islands (Abbassi *et al.* 2009)

Bursting the filter bubble and overcoming selectivity (McCroskey *et al.* 2006) cultivates *state* (as opposed to *trait*) integrative complexity. Integrative complexity is an individual's tendency to perceive and process decision-relevant information from more than one dimension (Suedfeld *et al.* 1992). Defined as a cognitive or information processing style (Driver & Streufert 1969; Harvey *et al.* 1961), many researchers believe integrative complexity has dimensions of both trait and state (Streufert & Swezey, 1986) with state component being the malleable one. Integrative complexity has been identified by two phases of differentiation and integration. Differentiation is the perception of different aspects of a subject, and integration is the recognition of connections among those aspects (Suedfeld *et al*. 1992). While integrative complexity does not always involve examining opposing views, integrating opposing views is a specific type of integrative complexity that we focus on in this research study; this type of integrative complexity is more conspicuous and can be measured by examining information

elaborations that individuals provide to support their stance and/or counter the opposing side (Homan *et al.* 2007) when discussing a controversial topic. Highly integrative information elaborations, here, are defined as elaborations that show higher levels of integration of facts and/or analyses from both sides (Baker Brown *et al.* 1992).

The reported field experiments investigate the impact of information presentations style on selective exposure, and ultimately on integrative complexity of the ideas shared by students in online discussions. The study has implications for effective information presentation and instructor-led interventions to counterbalance selective exposure and segmentation (islands) among students. Research findings will also contribute to the broader body of work in the fields of selective exposure, creative idea integration, and online brainstorming.

RESEARCH MODEL, DATA, AND PRELIMINARY ANALYSES

Prior research studies have investigated the role of user interface features and information presentation on selective exposure. Liao and Fu (2014), for instance, used a position indicator which identified both valence (agree vs. disagree) and magnitude (moderate vs. extreme) of an idea shared on online discussion forums (2014). Information presentation is the style for arranging confirmatory and non-confirmatory information on screen. In the "mixed" condition, confirmatory and non-confirmatory information are interleaved. In the "dichotomous" condition, confirmatory and non-confirmatory information will be presented on visually separable sections. It is proposed that a mixed information presentation style will discourage selective exposure, because it reduces visibility of confirmatory information (Javadi *et al.* 2013; Santanen *et al.* 2004). Seeking confirmatory information, therefore, will require more perceptive effort when confirmatory and non-confirmatory information are interleaved. Dichotomous style, however, will encourage selective exposure, because the system has taken a step toward separating confirmatory and non-confirmatory information, which makes selective exposure easier to achieve. Figure 2 depicts the way in which dichotomous and mixed information presentation styles were manipulated. The snapshots are for demonstrations purposes only. The actual discussion forums include students' names and different labels for posts (Agree/Disagree). This study's research model is illustrated in Figure 1 and the propositions are listed below:

Proposition 1: The information presentation style will impact selective exposure in that mixed information presentation (interleaved confirmatory and non-confirmatory) will lessen the selective exposure effect when compared to dichotomous information presentation (confirmatory and non-confirmatory information presented on visually separable sections).
Proposition 2: Selective exposure will negatively impact the integrative quality of information elaborations.

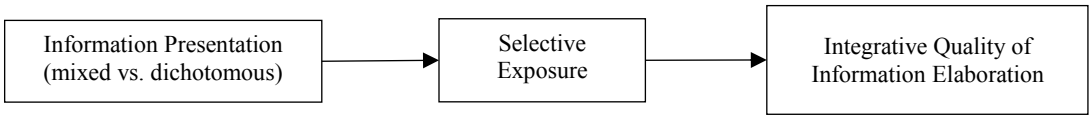

Figure 1: Research Model

Figure 2: Dichotomous (left) & Mixed (right) Information Presentation Styles

Method and Dataset

To investigate the research model presented in Figure 1, field experiments were conducted in classes. Field experiments included three online discussions in three fully Face-to-Face IT courses. In online discussions, students were asked to answer questions related to the course topic and IT in general (Table 1). The first discussion served as practice discussion to help students learn the rules and expectations. In the first discussions, students were asked to make a choice on a 1-5 scale for their preference on a specific topic (1: strongly disagree; 5: strongly agree). The 1-5 preference scale was chosen over a yes/no based on previous recommendations on design of selective exposure studies (Clay *et al.* 2013). Each discussion had two phases. In the first phase, students were given two days to take a positon on the discussion topic and compose an initial argument to support their position, with the expected length of said argument to be 100 words with an allowable range of 80-120 words. As with the other parameters, this length was chosen based on prior studies of course online discussions. In the 2nd phase, students' initial posts were made public and students were asked to read their classmates' opinions and were given a chance to revise their preference (on the 1-5 scale). They were also asked to elaborate on what they read and compose an extended analysis that

supported their (possibly modified) choices. The expected length of the extended arguments in phase 2 was 150 will allowable range of 130-170 words. Based on observations from the first discussions which served as practice discussion and pilot, the neutral option was removed because students' taking sides and argue for it (as opposed to staying neutral) was found to be crucial effective for interactions among ideas during discussion. Students were also sked to list names of those whose posts they read. Discussion topics total number of students who participated are listed in Table 1. During the second phase of the discussions, students were not allowed to stay neutral, therefore only two numbers are listed under Phase 2 in Table 1.

	Phase 1			Phase 2	
N (total) Phase 1/2	N1(Agree)	N0(Neutral)	N2 (Disagree)	N1(Agree)	N2 (Disagree)
(Pilot) Do we live in a simulated environment.					
29/29	3	14	12	5	24
Does mutation testing make indistinguishable systems that are developed using TDD and systems that are developed using a test-after approach?					
30/22	16	0	14	11	11
In the context of software development, do the risks and costs of crowd sourcing outweigh its benefits?					
22/30	9	0	13	8	22
(Pilot) Would you include AI uprising (digital super intelligence) as a risk in your risk management plan?					
S1: 26/27 S2: 12/20	21 11	4 1	1 0	24 18	3 2
Would you recommend combining BSA and PM roles?					
S1: 27/27 S2: 11/16	7 3	0 0	20 8	3 1	24 15
In the context of IT project management, would you choose capability maturity model over agile?					
S1: 26/26 S2: 16/20	10 5	0 0	15 11	8 19	18 1

Table 1: Discussion Questions and Number of Responses on Each Side

Manipulating Information Presentations, Measuring Selective Exposure, and Measuring Information Elaboration

In dichotomous information presentation conditions, all *agree* posts were listed first followed by all *disagree* posts (or vice versa). In continuous information presentations, *agree* and *disagree* posts were interleaved. This arrangement was done by the researcher using students' initial confidential posts. To measure selective exposure, students were asked to list all names whose posts they read in the 2nd phase of discussions. To measure integrative quality of information elaboration, this study uses a modified integrative complexity measure based on the measure developed by Baker-Brown and colleagues (1992). Coding rules are listed in Table 2.

Rating	Criteria
5	You show that you understand both sides of the argument. You provide analysis and justification for why you reject one side and support the other.
4	You show that you understand both sides of the argument; but you focus only on supporting your side and you provide analysis and justification for it.
3	You show that you understand both sides of the argument. You only summarize facts that you read, you do not provide analysis or justification for rejecting one side or supporting the other.
2	You focus only on repeating facts related to one side of the argument without presenting any analysis.
1	There is a superficial argument with an emphasis on value statements/personal opinion instead of substantiated facts. Statements are not presented in a coherent manner.

Table 2: Coding of Integrative Complexity of Information Elaboration

Preliminary Analyses

Currently, all discussions have been coded according to the rubric in Table 2. Students self reported measures of exposure were transformed as it follows. Number of non-confirmatory posts read from the opposing side were normalized by dividing it by the total number of opposing posts. The same procedure was followed for the number of confirmatory posts read. The two

numbers were divided to create the independent variable: $selective\ exposure = \frac{normalized\ confirmatory\ reads}{normalized\ non-confirmatory\ reads}$. The higher the number for an individual, the stronger their selective exposure. An alternative measure for selective exposure is $\frac{normalized\ confirmatory\ reads}{normalized\ total\ reads}$. While the reported preliminary analyses have used the former measure, we plan to re-run analyses using the latter. We performed ANOVA to compare the two groups (discussion 2 & 3) for the difference between selective exposure. Discussion 2 had an interleaved information presentation style and Discussion 3 had a dichotomous information presentation style (all disagree posts were shown at the top followed be agree posts at the bottom). From the three class sections, only for one section the ANOVA results are significant and in the direction consistent with this study's proposition 1 ($p<0.05$). We then performed ANOVA to compare integrative complexity of phase 2 posts in Discussion 1 & 2. The difference between the two vectors were significant in all three section ($p<0.01$, $p<0.05$, $p<0.05$). While these preliminary results are mixed, it is necessary that control groups are added to the analyses to disentangle main effects from confounding factors (e.g., total number of posts on each side, timing of the discussion, discussion topic). Also it is essential to examine improvement in quality of posts from phase 1 to phase 2 when investigating the impact selective exposure and information presentation style on the outcome. Furthermore, students' familiarity data is available and needs to be included for further analyses, perhaps in form of social network analyses that would help compare dynamics in exposure networks and familiarity networks. The authors hope that further analyses will be conducted by May and more insight will be shared with the MWAIS audience on this topic.

SUMMARY AND CONCLUSION

Individuals' information seeking and processing patterns impact their state integrative complexity, hence quality of their decision making processes will vary based on it. Despite availability and ease of access to diverse perspectives, selective exposure is still a persistent obstacle to effective arguments and decisions (Fischer *et al.* 2008). This study uses online discussion in class as an instrument for promoting processing of diverse information and enhancing state integrative complexity. Discussing controversial topics requires decision-making (on any point in the spectrum of choices) and thereafter providing a rationale for said choice, discussing controversial topics can help students practice. Creating an effective rationale requires attending to different perspectives, processing diverse and/or opposing views, and synthesizing those views to create a coherent argument which will provide a basis for the proposed choice. The preliminary analyses show a possible link between information presentation, selective exposure, and integrative quality of information elaboration. The insight can inform optimal information presentations and grouping of students in order to alleviate selective exposure and enhance quality of information elaboration in online discussions, hence creating more effective learning experiences for students. Research findings will also contribute to the broader body of work in the fields of selective exposure, creative idea integration, and online brainstorming.

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