Searching for What I Want
Understanding the Impact of Anticipatory Search Control on Search Efficiency

Liu, Fei; Xiao, Bo Sophia; Lim, Eric; Tan, Chee-Wee

Summer 6-15-2016

SEARCHING FOR WHAT I WANT: UNDERSTANDING THE IMPACT OF ANTICIPATORY SEARCH CONTROL ON SEARCH EFFICIENCY

Fei Liu
Hong Kong Baptist University, fliu09@comp.hkbu.edu.hk

Bo Sophia Xiao
University of Hawaii at Manoa, boxiao@hawaii.edu

Eric Lim
University of New South Wales, e.t.lim@unsw.edu.au

Chee-Wee Tan
Copenhagen Business School, cta.itm@cbs.dk

Follow this and additional works at: http://aisel.aisnet.org/ecis2016_rp

SEARCHING FOR WHAT I WANT: UNDERSTANDING THE IMPACT OF ANTICIPATORY SEARCH CONTROL ON SEARCH EFFICIENCY

Liu, Fei, Hong Kong Baptist University, Kowloon Tong, Hong Kong, China, fliu09@comp.hkbu.edu.hk

Xiao, Bo, University of Hawaii at Manoa, 2404 Maile Way, Honolulu HI 96822, United States of America, boxiao@hawaii.edu

Lim, Eric Tze Kuan, University of New South Wales, Sydney NSW 2052, Australia, e.t.lim@unsw.edu.au

Tan, Chee Wee, Copenhagen Business School, Solbjerg Plads 3, DK-2000 Frederiksberg, Denmark, cta.itm@cbs.dk

Abstract

Inefficiencies associated with online information search are amplifying in the current era of big data. Despite growing scholarly interest in studying Internet users' information search behaviour, there is a paucity of theory-guided investigation in this regard. In this paper, we draw on the theory of anticipatory system as our theoretical foundation to articulate the relationships between two salient types of search controls, namely search anticipation and search efficiency. We empirically validate our research model by conducting a field survey with 77 university students on an online restaurant review website that is modelled after its actual counterpart and populated with real restaurant review data. Findings from this study suggest that both search determination control and search manipulation control enhance search result anticipation, which in turn improves search efficiency. Theoretical and practical implications of this study are discussed.

Keywords: Search Behaviour, Theory of Anticipatory Systems, Search Control, Search Efficiency.

1 Introduction

With an explosive growth in both the volume and variety of information in the current Big Data era (McAfee *et al.*, 2012), Internet users are increasingly confronted with the challenges of *information overload* (Hölscher and Strube, 2000), *sub-optimal search performance* (Öörni, 2003), and *false discoveries* (Lohr, 2012). A search bar with a "perfect" search engine cannot satisfy individuals' search needs anymore (Teevan *et al.*, 2004). Rather, there is a growing urgency for the development of advanced search features that can facilitate individuals' search behaviour (Browne *et al.*, 2007).

To design search features that accommodate individuals' search behaviour, an extensive understanding of the search behaviour is necessary (Bates, 1989). Bates (1978, 1979, 1989) summarized 29 search tactics (i.e., monitoring tactics, file structure tactics, search formulation tactics, and term tactics) and 6 search strategies (i.e., footnote chasing, citation searching, journal run, area scanning, subject searches, and author searching) based on personal experience, previous literature, as well as colleagues' opinions. On the basis of her seminal work, many researchers have explored how the formulation of search tactics and strategies are driven by factors such as system design (Hong *et al.*, 2004; Kules and Shneiderman, 2008; Xie and Joo, 2010; Xie and Joo, 2012), search tasks (Vakkari, 2001; Xie and Joo, 2012), search context (Teevan *et al.*, 2011) and searchers' characteristics (Xie and Joo, 2010; Xie and Joo, 2012; Wildemuth, 2004). While the aforementioned research stream extends our knowledge of search behaviour, there is still a paucity of theory-driven investigation that tackles online information behaviours that are shaped by system design (Bates, 2002). Intrigued by the continuously expanding

revenue from search advertising (Xu *et al.*, 2012), IS researchers also began to pay attention to sponsored search, a phenomenon in the context of online search behaviour (Animesh *et al.*, 2010; Animesh *et al.*, 2011; Dhar and Ghose, 2010), customized search (Ho and Bodoff, 2014; Teevan *et al.*, 2005), stopping rules of consumer search (Browne *et al.*, 2007; Ho and Bodoff, 2014), and search results listing (Dou *et al.*, 2010; Xu *et al.*, 2012). To accentuate the missing connection between search feature design and search behaviour, we synthesize past studies to advance a theoretical model for understanding search behaviours that are under the influence of search features.

Search depends on predictions, expectations, or beliefs about the future outcome of the search (Butz *et al.*, 2003). It is thus a goal-oriented, anticipatory behaviour that is essential for living organism to obtain food and resources and survive natural selection (Hantula, 2010). As a result, past studies showed that human brain is structured towards goal-oriented cognition (Hills, 2006) and anticipation (Salimpoor *et al.*, 2011). Prior research has incorporated the consideration of anticipation in studying individual behaviour. For instance, it has been found that individuals' anticipation of extrinsic, intrinsic and social benefits drive their knowledge contribution (e.g., Bock et al. 2005; Chiu et al. 2006; Kankanhalli et al. 2005; Wasko and Faraj 2005), game developers' choice of gaming console depends on their anticipation of increased sales (Anderson *et al.*, 2014), online auction bidders anticipate the impact of their earlier bids before deciding future bids (Goes *et al.*, 2010), virtue team coordinators anticipate work-flow problems when playing their leadership role (Wakefield *et al.*, 2008), and finally, competitors' anticipation of postadoption monopolistic profits drives their choice of lock-in strategy (Zhu and Zhou, 2012). There has also been a prominent stream of IS research that investigates the impact of anticipation from the angle of expectation disconfirmation (Brown *et al.*, 2012; Brown *et al.*, 2014; Bhattacherjee, 2001; Venkatesh and Goyal, 2010; Venkatesh *et al.*, 2008). This stream of research concludes that individuals' satisfaction with and intention towards the use of an IT artefact are determined by the extent to which their actual experiences coincide with or deviate from their prior expectations (Brown *et al.*, 2014). Browne et al. (2007) implied that eliciting anticipation helps quicken searchers' goal reaching process. Nevertheless, to our knowledge, how to elicit and facilitate an individual's anticipation remains largely unexplained in extant IS research (particularly in the context of online information search), an additional research gap that we aim to address in this study.

In this paper, we aim to tackle knowledge gaps in prior research on information searching behaviour by answering the following two research questions: First, *what search features can be implemented to facilitate individuals' online information search in terms of fulfilling search result anticipation*? Second, *what is the outcome of facilitating individuals' online information search*? subscribing to the *theory of anticipatory systems* (TAS) as our theoretical lens, we theorize how search features shape *search result anticipation*, which refers to the degree to which a searcher foresees the search results, by inducing two types of *anticipatory search controls* (i.e., *search determination control* and *search manipulation control*), the combination of which improves *search efficiency*.

2   Theory of Anticipatory Systems

Anticipation, or the specious present, is regarded as one of the three fundamental components that constitutes consciousness (Husserl, 1991). Studies in theoretical biology and physics suggested that "anticipation contribute to the essence of complexity and life itself as well as to the stabilization of chaotic control processes" (Butz et al. 2003, p. 2). The *Ideo-Motor Principle* (IMP), in particular, posits that anticipation, rather than stimuli, precedes and dictates voluntary behaviour (Stock and Stock, 2004), especially for goal-oriented behaviour such as search (Hantula, 2010). There are two opposing factors that shape one's anticipation, namely *retention*: individuals' reflection on what happened in the past, and *pretention*: individuals' expectation regarding what is going to happen in the future (Husserl, 1991; Bloch, 1995). From an anticipation viewpoint, future is an extension of the past and can be best understood as a projection of the past through the present (Poli, 2010).

Given that anticipation entails dual considerations for the past and the future, Rosen (2012) advanced the *Theory of Anticipatory Systems* (TAS), to explain how *homomorphism* can be achieved between a

natural system and a *formal system*. According to Rosen (2012), a *natural system* encompasses everything in the environment from an individual to the entire ecosystem. Conversely, a *formal system* refers to a systemic representation of a natural system by drawing inferences from the properties of the natural system (Rosen, 2012). A formal system can thus be construed as an *anticipatory system* if it "contains a predictive model of itself and/or of its environment, which allows it to change state at an instant in accord with the model's predictions pertaining to a later instant" (Rosen 2012, p. 313). In turn, the *predictive model* refers to "a conjugacy between the properties of a natural system, and the properties of its formal system which are linked to it" (Rosen 2012, p. 313). The anticipatory power of a formal system can thus be gauged by how well the prediction of the formal system coincides with the future state of this natural system (Rosen, 2012).

2.1 Controllers in Anticipatory System

An anticipatory system relies on four distinct types of controllers with varying degree of anticipatory capability to realise the *retention* and *pretention* aspects of anticipation (Poli, 2010; Rosen, 2012). For instance, *retention* indicates to which extent a controller reflects on past state of system it controls, whereas *pretention* represents how well a controller adapts to possible changes in its environment. Both aspects contribute to a better synchronisation, or *conjugacy*, between the system and its environment, and in turn achieve a more accurate anticipation. To better explain and contextualize TAS, contemporary search features implemented on websites that offer information retrieval service are utilized as examples when illustrating each type of controller below (see Table 1 for illustrative examples).

Feedback controllers determine the future state of the system by forcing environmental variables into predefined categories. In other words, a feedback controller approximates inputs to a predetermined set of values. Therefore, feedback controllers offer no anticipation because it relies on static relations between inputs and outputs thus are not able to predict and adapt to the changes in the environment. The *faceted search*, which refers to a filter with a set of labels representing "categories used to characterize information items in a collection" (Hearst, 2006), can be categorized as *feedback controllers*. The reasoning behind is that faceted search rely on the static links between a set of labels and the categories of information items they refer to when deciding the next state of the website (i.e., display information items that belong to a certain category) (Abel *et al.*, 2011).

On the contrary, *feed-forward controllers* embrace the possible changes in the environment and determine the future state of the system according to the inference drawn from the environment. Feed-forward controllers utilize a predictive model instead of predetermined responses to anticipate and respond to the changes in the environment. Hence feed-forward controllers strive to fulfil the *pretention* aspect of anticipation. The *feed-forward controllers* comprise *keyword search*, which is basically a text field that allows users to specify their information need through keywords (Teevan *et al.*, 2004). Keyword search achieves *pretention* via employ predictive models to infer searchers' expectations expressed in the keywords in order to return relevant information items. To better elicit a searcher's intent, search engines may allow searcher specify the category of his/her query (Jansen *et al.*, 2007).
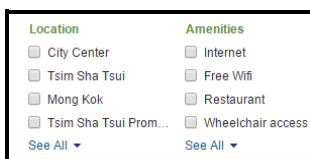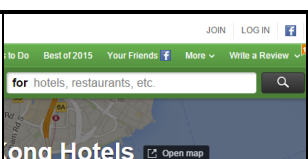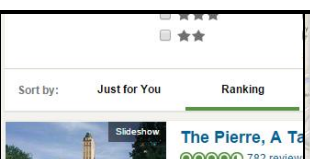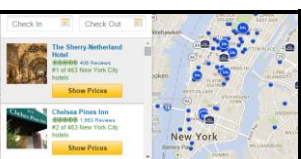
Faceted Search	Keyword Search	Ranking Search	Interactive Search

Table 1. Examples of Contemporary Search Features

Unlike feedback controllers, *feedback controllers with memory* is able to trace the history of the system, and in turn determines the future state of the system via drawing inference from its memory. In

other words, a feedback controller with memory possess a predictive model of itself, which helps it achieve the *retention* aspect of anticipation by reflecting on its past. The *ranking search*, which allows the users to browse through information items in a search space that are arranged in a logical order (Bates, 1989), constitutes *feedback controllers with memory*. A *search space* basically refers to the entire collection of search items that a user is able to browse. *Ranking search* fulfils *retention* because it tracks the current information items viewed by the user and retrieves items higher/lower in rank if the upper/lower end of the list is reached. Twitter can be regarded as one example of ranking search. Specifically, Twitter sorts all the available tweets in chronicle order so that it retrieves tweets that were posted earlier than those being currently viewed by a user if this user reached the end of the list.

The last controller is *feed-forward controllers with memory*, which not only adapts to its environment, but also learns from its past experience, thus attaining *pretention* and *retention* at the same time when determining the future state of the system. *Feed-forward controllers with memory* can be represented by *interactive search* (e.g., Yelp.com), which can be a map that permits the users to define an intended search space (e.g. one region on the map) via manipulating the map such as moving the map in different directions, zooming in and out, or even defining boundaries around an area of interest, and browse geographically distributed information items (e.g., restaurants) within such a search space. When predicting users' intent of map manipulation, interactive search not only tries to interpret the meaning behind users' actions (e.g., what does this user mean when he/she zoom out the map, does he/she want to check restaurants in a larger area or try to find another place of interest), but it also leverages on the past state of the map (e.g., previous location) as an anchor point for prediction.

2.2 Impact of anticipatory Search Controls on search result Anticipation

Control is one of the predominant drivers of goal-oriented anticipatory behaviour (Ajzen and Madden, 1986). According to Campion and Lord's (1982) control systems model, the performance of goal-oriented behaviour (e.g., search) is determined by one's ability to mitigate the discrepancy between his/her search goal and current state of search. Therefore, two types of control are essential for achieving successful information search: (1) control over goal setting, and; (2) control over manoeuvring in accordance with feedback. Both types of control are subjected to the influence of the anticipatory capabilities associated with distinct search features. When using search features that attain *pretention* (e.g., keyword search), users feel less restricted when expressing their search goals because, as *feed-forward controllers*, these search features are less likely to force the users to improvise their input in accordance with provided options (Poli, 2010; Rosen, 2012). Consequently, users will perceive more control over defining their search goals because these search features allow flexibility and agency in specifying search criteria (Sundar and Marathe, 2010; Godek *et al.*, 2002; Nidumolu and Knotts, 1998; Marathe and Sundar, 2011). We introduce the notion of *search determination control* to reflect the degree to which a user perceives being in charge of specifying search criteria. Conversely, search features supporting *retention* (e.g., ranking search) allow users to explore information items that relate to the items they have viewed in a search space. As *controllers with memory*, these search features take users' past search experience into consideration before determining the future information retrievals. By using these search features, users are likely to obtain more flexibility in the search process (i.e. search via browsing). In addition, a user's traversal among the information items in the search space will be more continuous and predictable since the upcoming information items are relevant to the items he/she has viewed. As a result, a user who uses search features, which resemble *controllers with memory*, is more likely to perceive greater control over manoeuvring among information items in the search space due to the reduced uncertainty during the information browsing process (Rothbaum *et al.*, 1982; Bordia *et al.*, 2004). We hence define the degree to which a user perceives being in charge of arriving at their search goals via traversing the search space as *search manipulation control*.

Consistent with TAS, we posit that a website offering information retrieval service can better synchronize with its users in terms of anticipating their search goals if it offers appropriate search features with various degree of *search determination control* and *search manipulation control* (Rosen,

2012). Due to improved synchronization between the website and its users, the website often returns information items that meet users' expectation, thus facilitating *search result anticipation*. Figure 1 gives an overview of our research model.
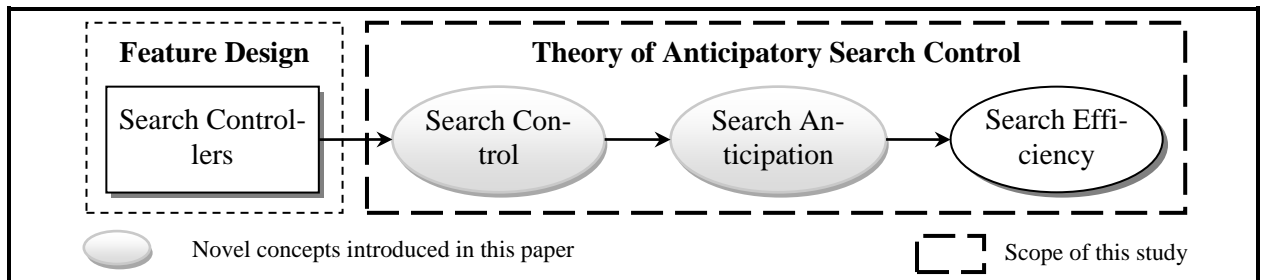

Figure 1. Overview of Research Model

3   Theory Development and Hypotheses

3.1   Search Determination Control and Search Result Anticipation

Search determination control reflects the degree of customizability permitted by search features in specifying search criteria. Search features that grant users high *search determination control* utilize the *pretention* aspect of users' anticipation for the search results by allowing greater variance in their search criteria (Rosen, 2012). Users who perceive high *search determination control* feel empowered in terms of maintaining their search goals through the search process on the website (Carton and Aiello, 2009). Conceivably, the search results that users obtained are likely to resemble their search goals more closely because their search goals are interpreted more accurately. On the contrary, a lack of *search determination control* often leads to a distortion of the users' search goals, because the users are forced to improvise their search criteria by adopting predetermined options (Rosen, 2012), hence amplifying the discrepancy between search results and users' anticipations. We thus hypothesize that,

Hypothesis 1: A searcher's perceived search determination control positively influences his/her search result anticipation.

3.2   Search Manipulation Control and Search Result Anticipation

Search manipulation control represents the extent to which a searcher is able to arrive at search goal via browsing information items in a logical order. Search features, which grant *search manipulation control*, fulfil the *retention* aspect of users' anticipation for the search results by inducing relevance between the information items viewed in the future and those viewed in the past (Rosen, 2012). Users who perceive high *search manipulation control* feel capable in maintaining the search space (Carton and Aiello, 2009). Due to the fluidity and continuity during the traversal of the search space, the information items a user is about to encounter can be easily anticipated. In contrast, browsing an unorganized search space, a result of insufficient *search manipulation control*, often brings abrupt and unexpected information items, and in turn disrupts the search flow and impedes comparison. All the aforementioned negative effects are consequences of the inability for the website to draw implication from users' browsing history due to an absence of logical connection between adjacent information items (Rosen, 2012). As a result, users likely perceive the search results obtained through traversing the search space more anticipatable when provided with higher *search manipulation control*. We thus hypothesize that,

Hypothesis 2: A searcher's perceived search manipulation control positively influences his/her search result anticipation.

3.3 Interaction between Search Determination Control and Search Manipulation Control

Browne and Pitts (2004) proposed a two-stage model to explain the essential phases involved in choice making tasks, such as search. Specifically, the first stage is *information acquisition*, which aims to create a knowledge foundation, or search space, for all possible alternatives (Browne and Pitts, 2004). The second stage is *alternatives evaluation*, of which the purpose is to examine and select viable alternatives (Simon, 1996). *Search determination control* can enhance the first stage because allowing more flexible and accurate search criteria tend to retrieve the alternatives that a searcher intends to evaluate. *Search manipulation control* facilitates the second stage, since arranging all possible alternatives in a logical order helps the searcher select viable alternatives via comparisons. Since both stages resemble a complete process, the enhancement of the first stage should contribute to second stage. A more refined and relevant search space, which stemmed from a higher degree of *search determination control* in *information acquisition* stage, can benefit the *alternatives evaluation* stage. More particularly, a user's traversal through the search space is more manageable and fruitful because of the improved concentration of relevant information items. Consequently, a user is more capable of zeroing in on the desired information items, leading to a heightened perception of *search manipulation control*. We thus hypothesize that,

Hypothesis 3: A searcher's perceived search determination control positively influences his/her perceived search manipulation control.

3.4 Search Result Anticipation and Search Efficiency

According to Browne et al. (2007), information searchers adopt certain *stopping rules* to terminate their information search. Particularly, for goal-oriented searchers who have a clear mind set for determining the sufficiency of the information gathered (Browne and Pitts, 2004), their search stopping rule is basically mental criteria they wish to fulfil by gathering information (Browne *et al.*, 2007). Therefore, an information search is considered completed if the searcher obtained information items that coincide with his/her anticipated search results. Hence, with higher *search result anticipation*, a searcher will likely spend less time and efforts before the search concludes because the search results are more anticipatable. Finding sufficient information according to the stopping rules with less time and efforts represents higher *search efficiency*. Consequently, facilitating search result anticipation can benefit online information searchers by boosting their *search efficiency*. We thus hypothesize that,

Hypothesis 4: A searcher's search result anticipation positively influences his/her search efficiency.

4 Methodology

To validate the aforementioned hypothesized relationships, we employ a field survey approach to gather data from online searchers. Since it is challenging for respondents to recall their past search process, we opted to develop a custom made online restaurant review website to minimize challenges in recollection. To populate this website, we extracted, via web scrapping, detailed descriptions of 1,079 restaurants in the San Francisco area along with about 268,000 reviews for these restaurants, which are written by approximately 91,000 diners. We then implemented contemporary search features that correspond to the four distinct types of controllers outlined above (see Table 2).

Through our custom made website, we provide an equal opportunity for each respondent to get acquainted with the search features and develop relevant perceptions. This in turn will not only reduce recall error in respondents' answers to the survey questions, but also control for potential confounding effects caused by respondents' *priori* knowledge about various search features.

4.1 Development of Survey Measures

Measurement items for *search determination control* and *search manipulation control* were adapted from control measures in past studies (Agarwal and Karahanna, 2000). Measures for *search result anticipation* were generated in accordance with standard psychometric procedures and its definition: *extent to which a searcher is able to anticipate the search results*. Lastly, items for measuring *search efficiency* were also newly developed in this study to assess whether searchers perceive their search process to be quick and effortless. Table 3 depicts the list of measurement items for this study.

Search Feature	Type of Controller	Description
Faceted Search (FS)	Feedback Controller	Faceted filter is a categorized filter that displays pre-defined categories of attributes and corresponding attribute values for users to determine their search criteria by selecting one or more values for each attribute.
Keyword Search (KS)	Feed-Forward Controller	Search engine is a standard search bar that allows users to specify a category of keywords and type in one more multiple keywords to conduct search.
Ranking Search (RS)	Feedback Controller with Memory	List sorting allows users to sort the list of information items according to pre-defined attributes in either ascending or descending order.
Interactive Search (IS)	Feed-Forward Controller with Memory	Interactive map allows the users to search for information items in two ways: (1) Moving or zooming the view port of the map to find information items within the updated view port. (2) Drawing boundaries around an area of interest via mouse cursor to find information items within this area of interest.

Table 2. List of Contemporary Search Features

Construct	Definition	Reflective Measures [7-point Likert scale]	Mean (S.D.)	Loading [before]	Loading [after]
Search Determination Control (SDC)	Extent to which an individual perceives himself or herself as being in charge of determining search criteria	I felt in control when determining the search criteria that I applied to search for restaurants on the website.	5.78 (1.06)	0.955	0.970
		I felt that I had NO control when determining the search criteria that I applied to search for restaurants on the website. (R)	5.29 (1.63)	0.508	Dropped
		The website allowed me to be in charge of the search criteria that I applied to search for restaurants on the website.	5.83 (0.94)	0.940	0.968
Search Manipulation Control (SMC)	Extent to which an individual perceives himself or herself as being in charge of traversing the search space	I felt in control when deciding how to go through the list of restaurants on the website.	5.78 (1.06)	0.949	0.957
		I felt that I had NO control over how to look through the list of restaurants on the website. (R)	5.17 (1.71)	0.522	Dropped
		The website allowed me to be in charge of how I navigate the list of restaurants on the website.	5.75 (0.99)	0.929	0.954
Search Result Anticipation (SRA)	Extent to which an individual is able to anticipate the search results	I felt that I was able to anticipate the results of each search.	5.21 (1.27)	0.950	0.950
		I felt that I was able to foresee the results of each search.	5.01 (1.35)	0.957	0.957
		I felt that I was able to predict the results of each search.	4.95 (1.30)	0.961	0.961
Search Effi-	Extent to which an	The search process for restaurants is efficient.	5.92 (1.02)	0.887	0.886

ciency (SE)	individual is able to find sufficient information according to the stopping rules with less time and efforts	The search process for restaurants is fast.	5.92 (1.13)	0.873	0.873
		The search process for restaurants is free of hassle.	5.32 (1.60)	0.878	0.880
		The search process for restaurants is effortless.	5.34 (1.46)	0.889	0.889

Table 3. Instrument and Measurement Properties

4.2   Field Survey Procedures

Before accessing the online restaurant review website, respondents were asked to provide demographic information. Next, respondents were directed to the website and instructed to take as long as they require to complete a well-structured, goal-oriented search task (Browne *et al.*, 2007; Campbell, 1988) (see Table 4). All respondents will be provided with all four search features listed in Table 2, and they are free to utilize any combination of the available search features. After respondents have selected what they deem to be the most suitable restaurant that fulfils the criteria set forth in the search task, they were presented with an online survey questionnaire that captures their perceptions of the search experience as well as qualitative feedback on the search process. We also logged respondents' usage of different search features during the search process. 98 undergraduate students from a large university in the United States were recruited as respondents. 21 out of the 98 responses were removed due to incompletion or data runs, therefore yielding a final sample of 77 (or 78.6%) data points for analysis. Among 77 respondents, 10 did not use any search feature, 32 used only one search feature, 30 used two search features, and 5 used three search features. Table 5 summarises descriptive statistics for the sample.

Your high school teacher Mrs. Martha Melvin called you and invited you to join a high school reunion in San Francisco. Because she is busy with her teaching lately, she asks you to search for a restaurant for a reunion **dinner**. Since she does not own a car at the moment, she does not wish to go beyond the neighbourhoods around the **Mission** area, where she lives. She usually prefers **American** cuisine but she is willing to try other **popular** cuisines as well. She usually neglects negative reviews of a restaurant, as long as the majority of the dinners expressed a strong **positive** attitude towards the restaurant and recognized its **authenticity**. For a reunion dinner, she thinks a **casual** atmosphere would be a wonderful fit. Because you are unfamiliar with the restaurants in San Francisco, you decide to turn to a newly set up online review website for restaurants in the San Francisco area, 'TasteSF', to find an appropriate restaurant.

Table 4. Search Task Scenario

Demographic	No. Respondents	Percentage	Use of Search Features			
			FS	KS	RS	IS
Gender						
Male	37	48.1%	25	1	14	6
Female	40	51.9%	32	4	15	8
Age						
Age 19 – 29	77	100%	57	5	29	14
Education						
Less than college education	8	10.4%	7	1	2	3
College education or higher	69	89.6%	50	4	27	11
Income						
$0-30,000	68	88.3%	50	3	25	12
$30,000-$50,000	2	2.6%	2	0	1	1
$50,000-75,000	1	1.3%	1	0	0	0
Unwilling to disclose	6	7.8%	4	2	3	1

Table 5. Descriptive Statistics for Online Survey [Sample *N* = 77]

5   Data Analysis

SmartPLS 2.0 was utilized to validate both the measurement and nomological properties of our research model (Chin, 1998). Partial least squares (PLS) analysis is preferred over other analytical techniques because it simultaneously analyses the psychometric properties of the measures (i.e., the measurement model) as well as both the direction and strength of each hypothesized relationship (i.e., the structural model) (Wixom and Watson, 2001).

5.1   Measurement Model

The measurement model was assessed by evaluating the internal consistency as well as the convergent and discriminant validity of the items included in our survey instrument. Because reflective items supposedly capture the effects of the construct under scrutiny, internal consistency can be assessed through standard estimates of Cronbach's alpha, composite reliability and the Average Variance Extracted (AVE) (Nunnally and Bernstein, 1994; Fornell and Larcker, 1981). After dropping two measurement items due to low factor loadings[1] ($< .70$), all latent constructs exceed prescribed thresholds (see Table 6). Furthermore, based on the loading and cross-loading matrix generated via PLS analysis (Chin, 2001), all remaining items loaded higher on the construct they supposedly measured comparing to the cross-loadings on any other unrelated constructs (see Table 7), thus supporting convergent validity. Likewise, discriminant validity appears to hold since the square root of the AVE for each latent construct exceeds its correlation with all other constructs (see Table 6).

Construct	Cronbach's α [> 0.70]	CR [> 0.70]	AVE [> 0.50]	SDC	SMC	SRA	SE
Search Determination Control (SDC)	0.94	0.97	0.94	**0.97**			
Search Manipulation Control (SMC)	0.91	0.95	0.91	0.91	**0.95**		
Search Result Anticipation (SRA)	0.95	0.96	0.91	0.58	0.60	**0.95**	
Search Efficiency (SE)	0.91	0.93	0.78	0.59	0.62	0.60	**0.88**

Table 6. Internal Consistencies and Inter-Construct Correlation Matrix [Sample $N = 77$]

Constructs / Items	Search Determination Control (SDC)	Search Manipulation Control (SMC)	Search Result Anticipation (SRA)	Search Efficiency (SE)
SDC1	**0.97**	0.89	0.62	0.58
SDC3	**0.97**	0.89	0.51	0.56
SMC1	0.88	**0.96**	0.57	0.63
SMC3	0.88	**0.96**	0.57	0.55
SRA1	0.60	0.60	**0.95**	0.58
SRA2	0.54	0.54	**0.96**	0.58
SRA3	0.53	0.56	**0.96**	0.58
SE1	0.59	0.61	0.56	**0.88**
SE2	0.60	0.57	0.53	**0.87**
SE3	0.40	0.48	0.45	**0.88**
SE4	0.47	0.53	0.58	**0.90**

Table 7. Loading and Cross-Loading Matrix [Sample $N = 77$]

---

[1] Our reverse coded items measured the absence of control, which is not simply the opposing valence of perceived control (i.e., low perceived control) (Cenfetelli, 2004). Therefore, the unsatisfactory loading of the reverse coded items is supposedly due to the change of their meaning instead of a lack reliability in our measures for search control.

5.2 Structural Model

Results from the analysis of the structural model, including path coefficients and their statistical significance, are illustrated in Figure 2. Because data was collected via a single survey questionnaire, Common Method Bias (CMB) could threaten the internal validity of our analytical results. Following Richardson et al.'s (2009) recommendation, we applied the *Confirmatory Factor Analysis (CFA) Marker* technique to parcel out common method variance when estimating path coefficients. The CFA marker technique has been empirically proven to be the most accurate statistical remedy for CMB (Richardson *et al.*, 2009), Despite the introduction of a marker variable (i.e., perceived realism of the website), results indicate that the statistical significance of the path coefficients remain relatively constant (see Figure 2), thereby attesting to the robustness of our empirical findings.
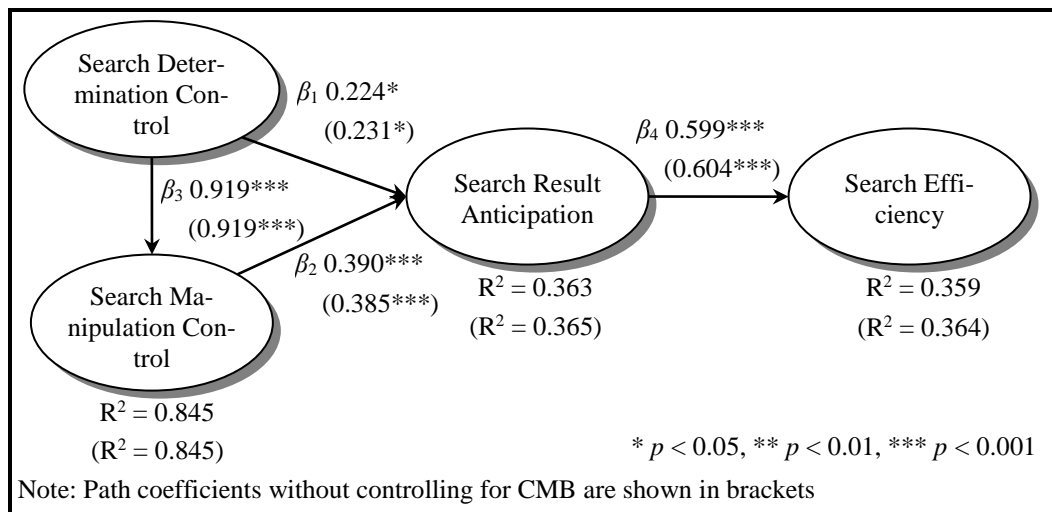

Figure 2. Results of the Structural Model Analysis [Sample $N = 77$]

As shown in Figure 2, both *search determination control* ($\beta = 0.231$, $p < 0.001$) and *search manipulation control* ($\beta = 0.385$, $p < 0.001$) positively impact *search result anticipation*, which in turn corroborates Hypotheses 1 and 2. Likewise, *search determination control* ($\beta = 0.919$, $p < 0.001$) have a positive influence on *search manipulation control*, thereby substantiating Hypothesis 3. Hypothesis 4 is also supported since *search result anticipation* ($\beta = 0.604$, $p < 0.001$) exhibits significantly positive effects on *search efficiency*.

5.3 Mediation Analysis

Adhering to the guidelines prescribed by Baron and Kenny (1986), we performed mediation analysis to ascertain whether *search result anticipation* is a full or partial mediator of the relationships among *search determination control*, *search manipulation control* and *search efficiency*. Table 8 summarizes the results from our mediation analysis. Coefficients in the *independent paths* column for both independent variables (IVs) are significant, which in turn attest to the mediating role of *search result anticipation*. Furthermore, as noted by Baron and Kenny (1986), when the path from IV to the mediator as well as the path from the mediator to the dependent variable (DV) are controlled, the path coefficient from IV to DV should decrease in both magnitude and significance. If the path coefficient between IV and DV becomes non-significant, we can interpret the mediating effect as a full mediation. Otherwise, it should be interpreted as a partial mediation. Our results demonstrate that *search result anticipation* fully mediates the positive impact of *search determination control* on *search efficiency*, but it only partially mediates the positive impact of *search manipulation control* on *search efficiency*. One plausible explanation for the direct relationship between *search manipulation control* and *search*

efficiency is that selecting viable alternatives in a sorted collection of information items requires much less cognitive effort due to lower recall and a smaller consideration set.

Relationship	IV: SDC		Relationship	IV: SMC	
	Independent Paths	Full Model		Independent Paths	Full Model
SDC → SRA	0.231*	0.230*	SMC → SRA	0.385***	0.385***
SRA → SE	0.604***	0.356***	SRA → SE	0.604***	0.356***
SDC → SE	0.207*	0.024 n.s.	SMC → SE	0.424***	0.390***
Full Mediation			Partial Mediation		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8. Results of Mediation Analysis

5.4 Post-hoc Analysis on Qualitative Feedback

As part of the survey procedures, all respondents were requested to provide feedback on the usefulness of each search feature as well as the reason behind their assessment. We conducted a post-hoc analysis of their qualitative feedback in an attempt to shed light on the extent to which each search features induces varying degrees of *search determination control* and *search manipulation control*. From our analysis, we derived a novel classification of search features that is grounded in the interplay between search determination control and search manipulation control (see Table 9). The remainder of this section will lay out our reasoning for the classification of each search feature together with sample quotes elicited from respondents.

		Search Determination Control	
		Low	High
Search Manipulation Control	Low	Faceted Search	Keyword Search
	High	Ranking Search	Interactive Search

Table 9.   Classification of Search Features

Respondents, who utilized the *faceted search* feature, reported that they feel this search feature aided them in their search processes because it "helped me to filter out a lot of [unrelated] restaurants" and "narrowed down the options to those that met the criteria". For users, faceted search is nothing more than a "representation of what is available" and offers limited anticipatory search controls.

Respondents, who utilized the *keyword search* feature, remarked that this feature "allows [them] to be specific about what [they] want to find" and "makes it fast for people to find the restaurant they are looking for" in addition to "narrowing down the search". Keyword search especially "helps when [they] know what [they] want" due to its provision of *search determination control*, meaning it gives users greater freedom in the specification of the search criteria specification.

According to respondents who utilized the *ranking search* feature, the feature "made it possible to list restaurants in order of rating and distance, which made it easier to find the best suitable dining option" and "lets you sift through various restaurants until you find one you like". By allowing users to "puts the [restaurants] in order according to relevance", the ranking search feature caters to users' sense of *search manipulation control* and facilitates their traversal in search spaces.

Lastly, the *interactive search* feature promotes both *search determination control* and *search manipulation control* based on users' feedback. On one hand, the interactive search feature is "very helpful when determining where to go" because it helps: (1) "make sure the restaurant stays within the area I am looking for", and; (2) "shows me which restaurants were closest to the area I wanted to be near". In other words, the interactive search feature empowers users to feel that they are in charge when specifying their search goals. On the other hand, the interactive search feature "allows you to see how far the other options are from one another" and "makes it easy to locate the restaurant relative to

the area". In this sense, the interactive search feature aids users in visualizing relationships among informational items, thereby culminating in feelings of control when navigating the search space.

Among all respondents, 35 have utilized multiple search features when undertaking their search tasks. Therefore, although each search feature in our classificaiton exerts varying degrees of *search determination control* and *search manipulaiton control*, it seems that respondents tend to integrate multiple search features to facilitate both *information acquisition* stage and *alternatives evaluation* stage of their choice-making process (Browne and Pitts, 2004). Such a usage pattern futher corroborates the positive relationship between *search determination control* and *search manipulaiton control*, testifying to searchers' inclination in configuring their search feature usage to complement *search determination control* with comparable *search manipulaiton control*.

6   Discussion

In this paper, we propose a theory-guided research model to investigate how search features can help individuals maintain their search-related anticipation and thus facilitating their online information search. Expanding on TAS, we advance two salient types of anticipatory search controls (i.e., *search determination control* and *search manipulation control*) and hypothesize their effect in enhancing individuals' *search result anticipation*, and subsequently their *search efficiency*. The research model was empirically validated with a field survey. Results show that both types of search controls exert significant positive impact on *search result anticipation* (explaining 36.3% of the variance), which in turn exerts significant positive influence on *search efficiency* (explaining 35.9% of the variance).

Responding to the inefficiency existed in the current context of online information search, this study introduces the concept of *search result anticipation* as a salient determinant of the efficiency of search process. Investigating the website search features from the perspective of anticipatory systems (Rosen, 2012), we endeavour to elicit two salient types of anticipatory search controls that determine users' *search result anticipation*, and in turn improve their *search efficiency*. For instance, search features that grant *search determination control* facilitate the *pretension* aspect of searchers' anticipations by allowing more freedom in their search criteria specification. On the other hand, search features that accommodate *search manipulation control* boost the *retention* aspect of searchers' anticipations via offering a well-organized search space for them to traverse. Promoting either aspect tends to allow users to find information items they anticipated, and in turn ends their search process more quickly because their stopping rules are more easily satisfied. We believe this study takes a small but concrete step towards understanding the way search features should be design to accommodate individuals' search behaviour. Findings from this study bear implications for both researchers and practitioners.

6.1   Implications for Research and Practice

This study contributes to extant literature in several ways. First, this study represents one of the first efforts to investigate how online information search can be shaped by search features from a theoretical perspective of anticipation. Considering online information search as a goal-oriented anticipatory behaviour (Hantula, 2010), we propose and show empirically that appropriately designed search features (i.e., the two types of anticipatory search controls) can indeed improve individuals' information search efficiency, via their positive influence in fulfilling individuals' search-related anticipations (or their search goals). Empirical findings demonstrate the viability of TAS for guiding the design of features that facilitate online information search. Second, in prior research involving anticipation, there exists a general lack of insights into how individuals' anticipation can be fulfilled (e.g., Brown et al., 2014). By articulating the specific characteristics of search features that help realize users' search related anticipation, this study contributes to the advancement of knowledge in this research stream. Third, this study also explores the preceding effect exerted by *search determination control* on *search manipulation control* in accord to Browne and Pitts' (2004) two-stage choice making model. Our findings demonstrate that searchers' perceived *search manipulation control* can be considerably height-

ened by their perceived *search determination control*. This may explain why it is a dominant logic for most websites to implement keyword search as the most economical search feature (Jansen and Spink, 2006). Specifically, by granting users *search determination control*, keyword search can usually help reduce the search space to a reasonable size, thus inducing a higher *search manipulation control*.

Findings from this study also provide guidelines for search feature designers. First, our findings reveal that a better synchronization between search features and users' search result anticipation through the provision of two types of anticipatory search controls can be the key to a more efficient search process. Specifically, to ensure an efficient search experience, search features should (1) allow flexible specification of search criteria, and (2) ensure that information items in the search space are organized. Second, our findings hint that keyword search might be the most economical search feature (Jansen and Spink, 2006) by providing both types of anticipatory search controls, thus suggesting website developers to regard keyword search as a minimum requirement for search feature implementation. Third, even if keyword search is the most economical in terms of fulfilling both anticipatory search controls, with the explosive growth of information online, the likelihood for a keyword search feature to return a manageable search space is rapidly diminishing (Teevan *et al.*, 2004). This study is among the first to point to the possibility of utilizing data visualization in the design of interactive search features (Telea, 2014) in order to accommodate search behaviour in the big data era (Boyd and Crawford, 2012). The current implement of interactive search features is largely limited to interactive map, therefore designing interactive search features for information items, which cannot be geographically organized, should be an imminent task for practitioners to tackle.

6.2   Limitations and Future Research Directions

There are a number of limitations to this study that should be taken into consideration when interpreting the results of the study. First, in this study, a well-structured search task is used to focus participants on goal-oriented search behaviour. According to Browne et al. (2007), search tasks can range from well-structured to unstructured; the more structured the task is, the more likely for the search process to be goal-oriented. Future studies may explore whether and how characteristics of search tasks influence the impact of search controls on search result anticipation. Second, the sample of this study consists of 77 university students. Additional research involving a larger sample consisting of different types of respondents is advised to validate the findings of this study. Third, we adopt a field survey to empirically validate our research model. Due to the cross-sectional nature of this study, spurious cause-effect inferences may be present.

Reference

Abel F., I. Celik, G.-J. Houben and P. Siehndel (2011). "Leveraging the semantics of tweets for adaptive faceted search on twitter." In: *The Semantic Web-ISWC 2011*. pp. 1–17, Springer.

Agarwal R. and E. Karahanna (2000). "Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage." *MIS quarterly*, 665–694.

Ajzen I. and T. J. Madden (1986). "Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control." *Journal of experimental social psychology* 22 (5), 453–474.

Anderson E. G., G. G. Parker and B. Tan (2014). "Platform Performance Investment in the Presence of Network Externalities." *Information Systems Research* 25 (1), 152–172. Available at: http://pubsonline.informs.org/doi/abs/10.1287/isre.2013.0505 (accessed 20/01/15).

Animesh A., V. Ramachandran and S. Viswanathan (2010). "Research Note-Quality Uncertainty and the Performance of Online Sponsored Search Markets: An Empirical Investigation." *Information Systems Research* 21 (1), 190–201.

Animesh A., S. Viswanathan and R. Agarwal (2011). "Competing 'creatively' in sponsored search markets: The effect of rank, differentiation strategy, and competition on performance". *Information Systems Research* 22 (1), 153–169.

Baron R. M. and D. A. Kenny (1986). "The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations." *Journal of personality and social psychology* 51 (6), 1173.

Bates M. J. (1979). "Information search tactics." *Journal of the American Society for information Science* 30 (4), 205–214.

Bates M. J. (1978). "TESTING OF INFORMATION SEARCH TACTICS." *Proceedings of the American Society for Information Science* 15, 25–27.

Bates M. J. (1989). "The design of browsing and berrypicking techniques for the online search interface." *Online Information Review* 13 (5), 407–424.

Bates M. J. (2002). "Toward an integrated model of information seeking and searching." *The New Review of Information Behaviour Research* 3, 1–15.

Bhattacherjee A. (2001). "Understanding information systems continuance: an expectation-confirmation model." *MIS quarterly* 25 (3), 351–370. Available at: http://www.jstor.org/stable/3250921 (accessed 24/02/15).

Bloch E. (1995). *The Principle Of Hope*

Bock G.-W., R. W. Zmud, Y.-G. Kim and J.-N. Lee (2005). "Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate." *MIS quarterly*, 87–111.

Bordia P., E. Hunt, N. Paulsen, D. Tourish and N. DiFonzo (2004). "Uncertainty during organizational change: Is it all about control?" *European Journal of Work and Organizational Psychology* 13 (3), 345–365.

Boyd D. and K. Crawford (2012). "Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon." *Information, Communication & Society* 15 (5), 662–679.

Brown S. A., V. Venkatesh and S. Goyal (2012). "Expectation confirmation in technology use." *Information Systems ...* 23 (2), 474–487. Available at: http://pubsonline.informs.org/doi/abs/10.1287/isre.1110.0357 (accessed 24/02/15).

Brown S., V. Venkatesh and S. Goyal (2014). "Expectation confirmation in information systems research: a test of six competing models." *MIS Quarterly* 38 (3), 729–756. Available at: http://aisel.aisnet.org/cgi/viewcontent.cgi?article=3190&context=misq (accessed 24/02/15).

Browne G. J. and M. G. Pitts (2004). "Stopping rule use during information search in design problems." *Organizational Behavior and Human Decision Processes* 95 (2), 208–224.

Browne G. J., M. G. Pitts and J. C. Wetherbe (2007). "Cognitive stopping rules for terminating information search in online tasks." *MIS quarterly*, 89–104.

Butz M., O. Sigaud and P. Gérard (2003). "Anticipatory behavior: Exploiting knowledge about the future to improve current behavior." In: *Anticipatory Behavior in Adaptive Learning Systems*. pp. 1–10. Available at: http://link.springer.com/chapter/10.1007/978-3-540-45002-3_1 (accessed 24/02/15).

Campbell D. J. (1988). "Task complexity: A review and analysis." *Academy of management review* 13 (1), 40–52.

Carton A. M. and J. R. Aiello (2009). "Control and Anticipation of Social Interruptions: Reduced Stress and Improved Task Performance1." *Journal of Applied Social Psychology* 39 (1), 169–185.

Cenfetelli R. T. (2004). "Inhibitors and enablers as dual factor concepts in technology usage." *Journal of the Association for Information Systems* 5 (11), 16.

Chin W. W. (1998). "Commentary: Issues and opinion on structural equation modeling."

Chin W. W. (2001). *PLS-Graph Manual, Version 3.0.* [Online] Available at: http://www.pubinfo.vcu.edu/carma/ (accessed 01/05/15).

Chiu C.-M., M.-H. Hsu and E. T. G. Wang (2006). "Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories." *Decision support systems* 42 (3), 1872–1888.

Dhar V. and A. Ghose (2010). "Research Commentary-Sponsored Search and Market Efficiency." *Information Systems Research* 21 (4), 760–772.

Dou W., K. H. Lim, C. Su, N. Zhou and N. Cui (2010). "Brand positioning strategy using search engine marketing." *MIS quarterly* 34 (2), 261–279.

Fornell C. and D. F. Larcker (1981). "Evaluating structural equation models with unobservable variables and measurement error." *Journal of marketing research*, 39–50.

Godek J., J. F. Yates and Y. Yoon (2002). "Customization and personalization: the influence of perceived control and perceived capability on product evaluations." *Advances in Consumer Research* 29 (1), 155–157.

Goes P. B., G. G. Karuga and A. K. Tripathi (2010). "Understanding willingness-to-pay formation of repeat bidders in sequential online auctions." *Information Systems ...* 21 (4), 907–924. Available at: http://pubsonline.informs.org/doi/abs/10.1287/isre.1080.0216 (accessed 24/02/15).

Hantula D. A. (2010). "The behavioral ecology of human foraging in an online environment: of omnivores, informavores, and hunter-gatherers." In: *Evolutionary psychology and information systems research*. pp. 85–99, Springer.

Hearst M. (2006). "Design recommendations for hierarchical faceted search interfaces." In: *ACM SIGIR workshop on faceted search*. pp. 1–5, Seattle, WA.

Hills T. T. (2006). "Animal Foraging and the Evolution of Goalâ€•Directed Cognition." *Cognitive Science* 30 (1), 3–41.

Ho S. Y. and D. Bodoff (2014). "The Effects of Web Personalization on User Attitude and Behavior: An Integration of the Elaboration Likelihood Model and Consumer Search Theory." *MIS quarterly* 38 (2), 497–520.

Hölscher C. and G. Strube (2000). "Web search behavior of Internet experts and newbies." *Computer networks* 33 (1), 337–346.

Hong W., J. Y. L. Thong and K. Y. Tam (2004). "Does animation attract online users' attention? The effects of flash on information search performance and perceptions." *Information Systems Research* 15 (1), 60–86.

Husserl E. (1991). *On The Phenomenology Of The Consciousness Of Internal Time (1893–1917)*. Springer Science & Business Media

Jansen B. J., D. L. Booth and A. Spink (2007). "Determining the user intent of web search engine queries." In: *Proceedings of the 16th international conference on World Wide Web*. pp. 1149–1150, ACM.

Jansen B. J. and A. Spink (2006). "How are we searching the World Wide Web? A comparison of nine search engine transaction logs." *Information Processing & Management* 42 (1), 248–263.

Kankanhalli A., B. Tan and K. Wei (2005). "Contributing knowledge to electronic knowledge repositories: an empirical investigation." *MIS quarterly* 29 (1), 113–143. Available at: http://www.jstor.org/stable/25148670 (accessed 24/02/15).

Kules B. and B. Shneiderman (2008). "Users can change their web search tactics: Design guidelines for categorized overviews." *Information Processing & Management* 44 (2), 463–484.

Lohr S. (2012). "The age of big data." *New York Times* 11.

Marathe S. and S. S. Sundar (2011). "What drives customization?: control or identity?" In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. pp. 781–790, ACM.

McAfee A., E. Brynjolfsson, T. H. Davenport, D. J. Patil and D. Barton (2012). "Big Data." *The management revolution. Harvard Bus Rev* 90 (10), 61–67.

Nidumolu S. R. and G. W. Knotts (1998). "The effects of customizability and reusability on perceived process and competitive performance of software firms." *MiS Quarterly*, 105–137.

Nunnally J. C. and I. H. Bernstein (1994). "Psychometric theory." *New York McGraw-Hill*.

Öörni A. (2003). "Consumer search in electronic markets: an experimental analysis of travel services." *European Journal of Information Systems* 12 (1), 30–40.

Poli R. (2010). "The many aspects of anticipation." *Foresight* 12 (3), 7–17. Available at:

http://www.emeraldinsight.com/doi/abs/10.1108/14636681011049839 (accessed 24/02/15).

Richardson H. A., M. J. Simmering and M. C. Sturman (2009). "A tale of three perspectives: Examining post hoc statistical techniques for detection and correction of common method variance." *Organizational Research Methods*.

Rosen R. (2012). *Anticipatory Systems*. New York, NY: Springer New York Available at: http://www.springerlink.com/index/10.1007/978-1-4614-1269-4 (accessed 24/02/15).

Rothbaum F., J. R. Weisz and S. S. Snyder (1982). "Changing the world and changing the self: A two-process model of perceived control." *Journal of personality and social psychology* 42 (1), 5.

Salimpoor V. N., M. Benovoy, K. Larcher, A. Dagher and R. J. Zatorre (2011). "Anatomically distinct dopamine release during anticipation and experience of peak emotion to music." *Nature neuroscience* 14 (2), 257–62. Available at: http://dx.doi.org/10.1038/nn.2726 (accessed 10/07/14).

Simon H. A. (1996). *The Sciences Of The Artificial*. MIT press

Stock A. and C. Stock (2004). "A short history of ideo-motor action." *Psychological research* 68 (2-3), 176–188.

Sundar S. S. and S. S. Marathe (2010). "Personalization versus customization: The importance of agency, privacy, and power usage." *Human Communication Research* 36 (3), 298–322.

Teevan J., C. Alvarado, M. S. Ackerman and D. R. Karger (2004). "The perfect search engine is not enough: a study of orienteering behavior in directed search." In: *Proceedings of the SIGCHI conference on Human factors in computing systems*. pp. 415–422, ACM.

Teevan J., S. T. Dumais and E. Horvitz (2005). "Personalizing search via automated analysis of interests and activities." In: *Proceedings of the 28th annual international ACM SIGIR conference on Research and development in information retrieval*. pp. 449–456, ACM.

Teevan J., A. Karlson, S. Amini, A. J. Brush and J. Krumm (2011). "Understanding the importance of location, time, and people in mobile local search behavior." In: *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*. pp. 77–80, ACM.

Telea A. C. (2014). *Data Visualization: Principles And Practice*. CRC Press

Vakkari P. (2001). "A theory of the task-based information retrieval process: a summary and generalisation of a longitudinal study." *Journal of documentation* 57 (1), 44–60.

Venkatesh V., S. Brown, L. Maruping and H. Bala (2008). "Predicting different conceptualizations of system use: the competing roles of behavioral intention, facilitating conditions, and behavioral expectation." *Mis Quarterly* 32 (3), 483–502. Available at: http://www.jstor.org/stable/25148853 (accessed 24/02/15).

Venkatesh V. and S. Goyal (2010). "Expectation disconfirmation and technology adoption: polynomial modeling and response surface analysis." *MIS quarterly* 34 (2), 281–303. Available at: http://vvenkatesh.com/downloads/papers/fulltext/pdf/venkatesh_goyal_misq_forthcoming.pdf (accessed 24/02/15).

Wakefield R. L., D. E. Leidner and G. Garrison (2008). "Research Note-A Model of Conflict, Leadership, and Performance in Virtual Teams." *Information Systems ...* 19 (4), 434–455. Available at: http://pubsonline.informs.org/doi/abs/10.1287/isre.1070.0149 (accessed 24/02/15).

Wasko M. M. and S. Faraj (2005). "Why should I share? Examining social capital and knowledge contribution in electronic networks of practice." *MIS quarterly*, 35–57.

Wildemuth B. M. (2004). "The effects of domain knowledge on search tactic formulation." *Journal of the american society for information science and technology* 55 (3), 246–258.

Wixom B. H. and H. J. Watson (2001). "An empirical investigation of the factors affecting data warehousing success." *MIS quarterly*, 17–41.

Xie I. and S. Joo (2012). "Factors affecting the selection of search tactics: Tasks, knowledge, process, and systems." *Information Processing & Management* 48 (2), 254–270.

Xie I. and S. Joo (2010). "Transitions in search tactics during the Web-based search process." *Journal of the american society for information science and technology* 61 (11), 2188–2205.

Xu L., J. Chen and A. Whinston (2012). "Effects of the presence of organic listing in search advertising." *Information Systems Research* 23 (4), 1284–1302.

Zhu K. X. and Z. Z. Zhou (2012). "Research Note-Lock-In Strategy in Software Competition: Open-Source Software vs. Proprietary Software." *Information Systems Research* 23 (2), 536–545.