Emergent Technology Use in Consumer Decision Journeys

A Process-as-Propensity Approach

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The CBS PhD School is an active and international research environment at Copenhagen Business School for PhD students working on theoretical and empirical research projects, including interdisciplinary ones, related to economics and the organisation and management of private businesses, as well as public and voluntary institutions, at business, industry and country level.

Foreword

The completion of this dissertation commemorates the end of my doctoral education at the Copenhagen Business School (CBS). Having spent the last four years in CBS, I am extremely grateful to the team of dedicated faculty members and professional administrators, who have made my stay both intellectually stimulating and academically rewarding. Particularly, I will like to express my gratitude to a special group of people without whom this achievement would not be possible.

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Abstract

Statement of the Problem/Background

Empowered by rapid advances in Business-to-Consumer (B2C) digital infrastructure, consumers are beginning to follow an increasingly convoluted path when making purchase decisions for products and services. They use technologies on B2C match-making platforms to guide their decision journeys in ways that are neither premeditated nor intended. This emergent technology use has remained poorly understood within extant literature due to the implicit assumption that consumers adhere to well-defined decision-making processes in which the effectiveness of technologies remains constant regardless of how they are used.

Research Question/Hypothesis

How do consumers engage in emergent use of the technologies on B2C match-making platforms during their decision journeys?

Research Design and Methods Used in the Investigation

In this thesis, behavioral analytics, as conceptualized in the computational social sciences field, was employed to empirically validate hypothesized relationships. Process modeling was combined with econometrics to analyze emergent technology usage behavior that was embedded in event log data. Essay 1 is devoted to a field experiment conducted with the goal of examining the emergent use of search features on a custom-made restaurant review platform. Three hundred and seventy-seven crowdworkers were recruited from Amazon Mechanical Turk to participate in the experiment. Essay 2 is an investigation of consumers' emergent use of platform features based on an analysis of a secondary cruise-booking dataset provided by a major travel-planning platform. This dataset contains 117,218 records of bookings made by 74,557 consumers between 2015 and 2017.

Results/Summary of the Investigation

The results show that consumers adjust their emergent search strategies to take advantage of the search features that enable them to find the most desirable restaurants. The effectiveness of each emergent search strategy in economizing the costs and maximizing the benefits of a search depends on the goal specificity of the search task. Likewise, consumers make emergent use of eWOM and the cross-channel

access provided by travel-planning platforms to rebook their trips. How consumers change their previous bookings can be leveraged to predict whether they will switch companies. Additionally, consumers who rebook appear to be less likely to abandon their purchases and more likely to share their experiences via eWOM.

Interpretation/Conclusion of the Investigation

The results of this investigation showed that consumers' emergent technology use is indeed enabled by digital generativities. Moreover, the attention allocation propensity that drives consumers' emergent use of technologies is the key to predicting the outcome of a consumer decision journey. Future studies can leverage the process-as-propensity approach advanced in this thesis to theorize emergent technology use in various contexts, including those of digital innovation and mixed reality. Empirical findings from this thesis can yield insights for enhancing service marketing and platformization in relation to consumers' increasingly emergent decision journeys.

Keywords: Consumer Decision Journey, Digital Generativity, Emergent Behavior, Attention Allocation Propensity, Emergent Search Strategy, Opportunistic Rebooking.

Abstrakt

Erklæring om problemet / baggrunden

Styrket af den hurtige udvikling af den digitale infrastruktur mellem virksomheder og forbrugere (B2C) begynder forbrugerne at følge en stadig mere indviklet vej, når de jager efter produkter og tjenester. De bruger teknologier på B2C-matchingsplatforme til at styre deres beslutningsrejser på måder, der hverken er planlagt eller beregnet. Denne nye teknologibrug er forblevet dårligt forstået i den tidligere litteratur på grund af den implicitte antagelse om, at forbrugerne bruger veldefinerede beslutningslinjer, hvor effektiviteten af teknologier forbliver konstant, uanset hvordan de bruges.

Forskningsspørgsmål / hypotese

Hvordan bruger forbrugerne nye teknologier på B2C-matchingsplatforme under deres beslutningsrejser?

Forskningsdesign og metoder anvendt i undersøgelsen

I denne afhandling blev adfærdsanalyse, som begrebet inden for computational social science, vedtaget for empirisk at undersøge hypoteserne. Processmodellering blev kombineret med økonometri for at analysere beviset for ny teknologi, der var indlejret i hændelseslogdata. Essay 1 afstemmes til et felteksperiment udført med det formål at undersøge den nye brug af søgefunktioner på en skræddersyet restaurantanmeldelsesplatform. Tre hundrede og syvoghalvfjerds crowdworkers blev rekrutteret fra Amazon Mechanical Turk til at deltage i eksperimentet. Essay 2 er en undersøgelse af forbrugernes nye brug af platformfunktioner baseret på en analyse af et sekundært datasæt til cruise-booking leveret af en større rejseplanlægningsplatform. Dette datasæt indeholder 117.218 registreringer af bookinger foretaget af 74.557 forbrugere mellem 2015 og 2017.

Resultater / resumé af undersøgelsen

Resultaterne viser, at forbrugerne tilpasser deres nye søgestrategier for at drage fordel af søgefunktionerne, der gør det muligt for dem at finde de mest eftertragtede restauranter. Effektiviteten af hver nye søgestrategi til at spare omkostningerne og maksimere fordelene ved en søgning afhænger af målopgørelsen af søgeopgaven. På samme måde bruger forbrugerne nye eWOM og den tværkanaladgang, der leveres af rejseplanlægningsplatforme, til at ombooke deres rejser. Hvordan forbrugere ændrer deres tidligere bookinger kan udnyttes til at forudsige, om de skifter virksomhed. Derudover ser det ud til, at for-

brugere, der booker om, er mindre tilbøjelige til at opgive deres køb og mere tilbøjelige til at dele deres oplevelser via eWOM.

Fortolkning / konklusion af undersøgelsen

Resultaterne af denne undersøgelse viste, at forbrugernes nye teknologibrug faktisk er muliggjort af digitale generativiteter. Desuden er den tilbøjelighed, der tildeles opmærksomhed, der driver forbrugernes nye brug af teknologier, nøglen til at forudsige resultatet af en forbrugerbeslutningsrejse. Fremtidige studier kan udnytte den proces-som-tilbøjelighed-tilgang, der er foreslået i denne afhandling, for at teoretisere nye teknologibrug i forskellige sammenhænge, herunder dem inden for digital innovation og blandet virkelighed. Analysen i denne afhandling kan give indsigt i forbedring af servicemarkedsføring og platformisering i forhold til forbrugernes stadig stigende beslutningsrejser..

Nøgleord: Forbrugerbeslutningsrejse, Digital generativitet, Emergent Behavior, Attention Allocation Propensity, Emergent Search Strategy, Opportunistic Rebooking.

Table of Contents

Kappa

1 INTRODUCTION

The rapid advancement of business-to-consumer (B2C) digital infrastructure and Internet connectivity have empowered consumers to play a more proactive role in leveraging technologies and have made more information available to help them hunt for whatever they want (Edelman and Singer 2015; Kleweno et al. 2019). In 2019, over half of all families relied on travel reviews and booking platforms when making travel plans (V12 2019). A large-scale study showed that, on average, consumers took 19 days and engaged in 30 online sessions across 12 platforms to make a single booking decision (Kleweno et al. 2019). It is not uncommon for consumers to follow an "infinitely" convoluted path before making a purchasing decision (Dichter 2018; Kleweno et al. 2019). The increasingly unpredictable *decision journey* of purchasing service offerings on B2C match-making platforms often includes multiple sessions and involves numerous searches and comparisons (Kleweno et al. 2019). Consumer decision journeys pose an enormous challenge to companies attempting to attract and retain consumers (Edelman and Singer 2015).

In a decision journey, consumers harness technologies in ways that are neither pre-planned nor intended by designers. For instance, 30% of consumers deliberately over-purchase and return unwanted items, whereas 19% order multiple versions of the same item so that they can choose which to keep after the items are delivered (Charlton 2020). This unintended "wardrobing" behavior emerges when consumers take advantage of the flexibility afforded by B2C platforms. Similarly, 8% of consumers were found to cancel a previous booking and rebook their trip (Kleweno et al. 2019). In this sense, consumers' technology use is neither planned nor intended by designers (Zittrain 2008, 2005). This emergentuse pattern challenges the well-defined decision-making process in the past literature (Batra and Keller 2016; Stankevich 2017). To address the understudied emergent technology use in consumer decision journey, I aim to examine this phenomenon via behavioral analytics. Gaining a better understanding of emergent technology use is also essential for companies to achieve better personalization and positive outcomes in each interaction with consumers (Dichter 2018; Kleweno et al. 2019; Mittiga et al. 2018).

Emergent technology use can be either *task-oriented* or *opportunistic*. As illustrated in Figure 1, it is common for a decision journey to span multiple sessions with each driven by specific objectives. For example, when consumers seek a desirable restaurant online, they initiate a search session to find one on

a restaurant-booking site (Mittiga et al. 2018). How consumers use search features to specify their preferences and choose from viable alternatives can be considered as an example of the emergent use of such technologies. By design, search features do not force consumers into predetermined action sequences nor should they do so. When provided with a search feature, consumers tend to form emergent strategies regarding when to make use of it in their search processes (Mirabeau and Maguire 2014). These strategies make it difficult to anticipate how search features will affect consumers' search performance. It is not uncommon for search features to hinder consumers' search processes because of unanticipated ineffective use patterns (Farrell 2017; Teevan et al. 2004). For this reason, understanding consumers' emergent strategies is key to identifying and remedying the ineffective use of search features.

Conversely, consumers may also engage in additional sessions and adjust their purchasing decisions for opportunistic reasons (Mittiga et al. 2018). As shown in Figure 1, the opportunistic emergent usage of technologies results in additional decision-making sessions. The ubiquitous presence of real-time information on B2C platforms allows consumers to take advantage of opportunities as they arise, regardless of planning or principle (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). Consumers' purchasing decisions are contingent on their changing preferences and updates in the availability of service offerings. In anticipation of these unforeseeable changes, consumers tend to make temporary decisions that are subject to change in later sessions. For example, it is common for consumers to purchase multiple clothing items in various sizes with the intention of returning those that do not fit (Harris 2008; Ma et al. 2020) or to book flight tickets with no cancellation fees in case of possible changes in their travel plans. Companies that can identify and accomodate consumers' changing preferences can thus gain an edge over competitors.

Consumers' emergent use of technologies in their decision journeys is not well-understood. Past studies were based on the implicit assumption that the influence of technologies on purchasing decisions does not depend on the process of use (Häubl and Trifts 2000). Moreover, within extant literature, consumers' decision journeys are conceptualized as a sequential process consisting of distinct phases (Batra and Keller 2016; Stankevich 2017). In recent studies, researchers have begun to apply behavioral analytics to gain further insights into consumers' decision-making processes (Humphreys et al. 2020). Nonetheless, the implicit assumption that consumers go through well-defined phases in their decision journeys remains largely unchallenged. As illustrated in Figure 1, consumers can decide how to use technologies without premeditation either within a single decision-making session or across multiple ones. In my thesis, I seek to expand on the prior literature on consumer decision journeys by examining both forms of emergent technology use. The overarching research question that I strive to address is this: How do consumers make emergent use of technologies in their decision journeys?

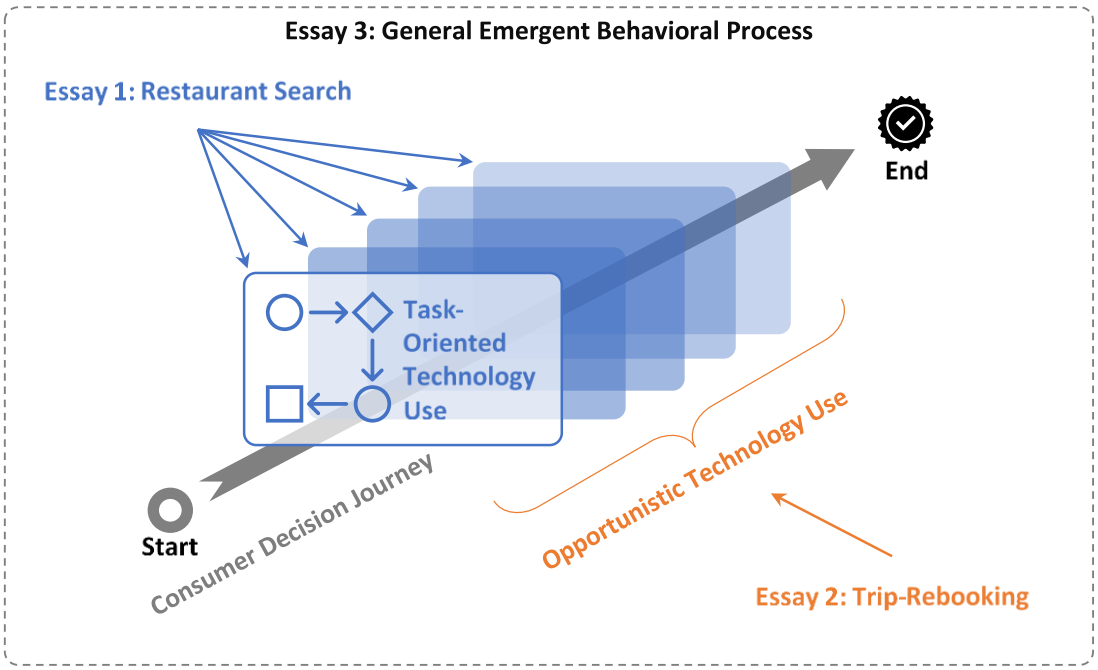


Figure 1. Emergent Behavior in Consumer Decision Journey

As shown in Figure 1, my thesis is composed of three essays that tackle various aspects of emergent technology use in consumer decision journeys on B2C platforms. Essay 1 is based on the *optimal foraging theory* (Hantula 2010; O'Brien et al. 1990; Perry and Pianka 1997), which is used to decode *emergent strategies* for using search features. Emergent strategies refer to consumers' attention allocation propensities, which emerge through interactions with search features. I conducted an online experiment on a custom-made restaurant review site to examine how consumers performed search tasks differently when provided with various search features. I adopted a process modeling approach (i.e., hidden Markov models a.k.a. HMMs) (Breuker et al. 2016) to analyze the action transitions embedded in each participant's search log. The findings in Essay 1 were used to address the following research questions:

- What emergent strategies are employed by consumers to use search features?
- What is the level of effectiveness of each emergent strategy?

Essay 2 draws on the *opportunistic behavior theory*, which posits that self-interested individuals continuously probe their environment in search of ways to serve their welfare (Nagin et al. 2002), to unravel consumers' opportunistic trip-rebooking tendencies. Opportunistic trip-rebooking is prevalent on B2C

platforms because these platforms make service quality transparent while providing multiple channels for consumers to modify bookings. I investigated this phenomenon by conducting an econometric analysis of a dataset provided by a major online travel-planning platform. The findings in Essay 2 shed light on the following research questions:

- How do consumers engage in opportunistic rebooking on trip-planning platforms?
- What is the impact of opportunistic trip-rebooking?

Synthesizing the insights derived from Essays 1 and 2, Essay 3 is a research commentary that advances the *process-as-propensity* method as a novel approach for theorizing *emergent behavioral processes* in general. In Essay 3, I conducted a literature analysis to categorize 42 past studies on such processes into a taxonomy of process types, which includes *deterministic*, *stochastic*, and *emergent processes*, and corresponding theorization approaches, including the *variance*, *mixed*, and *process approaches*. The empirical results in Essay 1 are incorporated into Essay 3 to illustrate how technologies can affect consumers' attention allocation propensities and, in turn, engender emergent use patterns. The approach used in Essay 3 can help to achieve the following research objectives:

- Establish emergent processes as a distinctive technology-use pattern.
- Advance the process-as-propensity approach, a novel method for theorizing emergent processes.
- Shed light on potential research avenues for applying the process-as-propensity approach.

This Kappa is written to summarize the theoretical underpinnings, key empirical findings, and key implications of all three essays in this thesis. This Kappa also highlights the synergy among all three essays in my thesis and provides a broad view of how they contribute to understanding emergent technology use in consumer decision journeys. The empirical context of this thesis is consumers' purchasing of service offerings. Comparing to product purchases, consumer decision journey for service purchases is usually more complicated and unpredictable due to the intangible and heterogeneous nature of services (Grönroos 1984). Furthermore, consumers need to coordinate with service providers prior to making purchases by making appointment due to their personal involvement in the consumption of the purchased services. In particular, Essay 1 focuses on restaurant search because the proportion of consumers who research a restaurant online before making reservation is higher than any other types of services (Resendes 2020). Essay 2 focuses on cruise booking since opportunistic decision changes are more prevalent in such a context. Consumers book their trips 12 weeks in advance on average (Delgado 2019). Consequently, consumers have more opportunities to change their decisions through rebookings over the course of a protracted decision journey. Although this thesis focuses on services for which more consumers make emer-

gent use of technologies in their decision journeys, findings of this thesis can also be generalizable to other types of services.

In the following section, I will provide a literature review to illustrate how my thesis can advance the existing research on technology use in consumer decision journeys. I will then provide an overview of the theory's development across three essays. After that, I will provide a brief description of the research designs employed in Essays 1 and 2 before showcasing the key findings. Last but not least, I will elaborate on the implications pertaining to how examining consumers' emergent technology use can renew our understanding of consumer decision journeys in the digital age.

2 LITERATURE OVERVIEW ON TECHNOLOGY USE IN CONSUERM DECISION JOURNEYS

2.1 Consumer Decision Journeys

Due to rapid technological advancements in the past decade, consumer decision journeys have been constantly evolving. The "consumer decision journey" includes all activities and events relevant to consumers' access to product/service choices through a series of touchpoints (Zomerdijk and Voss 2010). The *marketing funnel* was one of the first well-known frameworks adopted by marketing researchers to navigate opportunities to influence consumers' purchasing decisions throughout their decision journeys (Court et al. 2009). The funnel model posits that consumers gradually shrink their consideration sets through a four-phase process (Court et al. 2009). In the *awareness* phase, consumers recognize their needs and become conscious of all the available products/services that can potentially fulfill them. Subsequently, consumers familiarize themselves with the details of each viable option via an information search in the *familiarity* phase. Consumers then compare a few desirable alternatives in the *consideration* phase and make purchasing decisions in the *purchase* phase. The use of marketing funnels is based on the assumption that, because companies exert influence on consumers in each of the four phases, consumers are likely to become loyal to any brand from which they have made a purchase (Court et al. 2009).

Because of the expansion of choices and digital channels in recent years, consumer decision journeys are increasingly deviating from the rigid funnel that was originally envisioned (Court et al. 2009; Noble et al. 2010). For instance, the size of a consumer's consideration set can become enlarged, rather than shrink, because of the development of enhanced information accessibility (Noble et al. 2010). A new model

called the *customer life cycle* was proposed to relax such assumptions about consumers' pre-purchase information-gathering and evaluation activities through digital channels (Court et al. 2009; Noble et al. 2010). The "customer life cycle" refers to a circular journey in which consumers' post-purchase experiences influence their subsequent purchasing decisions. A stream of marketing research builds upon the consumer life cycle by identifying more key decision moments (Batra and Keller 2016) and examining the impact of social media marketing (Hudson and Thal 2013; Pescher et al. 2014). Nonetheless, the implicit assumption that consumers progress through clearly defined phases sequentially in their decision journeys remains unchanged.

Indeed, consumers' preferences and purchasing behaviors constantly change when engaging with digital touchpoints (Van Bommel et al. 2014). Advances in technologies spur highly contextualized decision journeys so that consumers likely go through different paths even when making the same purchase. Companies that view the consumer decision journey as a rigid, hierarchical process are beginning to risk losing consumers (Van Bommel et al. 2014). Taking advantage of behavioral analytics to keep up with and anticipate consumers' changing decision journeys will be necessary for companies to survive in the digital landscape (Van Bommel et al. 2014). The latest studies have begun to reflect recognition of the value of using behavioral analytics to gain more insights into consumers' varied decision journeys (George and Wakefield 2018; Humphreys et al. 2020). It has been shown that consumers do not usually follow a fixed sequence of phases in a decision journey (Pauwels and van Ewijk 2020). This thesis hence furthers this line of scholarly inquiry by shedding light on the comparatively free-flowing consumer decision journeys enabled by B2C match-making platforms. This thesis is focused on the process occurring between information searches and purchasing decisions, which remains largely a *black box* (Stankevich 2017). Specifically, in this thesis, I examine how consumers use technologies in ways that are neither pre-planned nor pre-determined in relation to information searches and alternative evaluations.

2.2 Emergent Technology Use

The technological features provided on digital platforms are beginning to play an increasingly essential role in determining how consumers make purchasing decisions (Shavitt and Barnes 2020). Nonetheless, in the prior literature, the effect of technologies on consumer decision-making processes did not depend on the manner in which consumers used such technologies (cf. Häubl and Trifts 2000). Prior research on technology use when conducting information searches did not address emergent technology use. Earlier studies focused on digital decision aids, such as adaptive information presentations that functioned consistently once displayed to consumers (Adipat et al. 2011; Mennecke et al. 2000). Subsequent research identified common action sequences through which consumers tended to use search features, such as using search engines to narrow consideration sets, following hyperlinks to extend the scope of searches, and opening multiple browser tabs for multitasking (Thatcher 2006; Xie and Joo 2010). More recent

studies have begun to harness behavioral analytics to infer consumers' search objectives based on their search logs (Cole et al. 2015; Humphreys et al. 2020).

Essay 1 in this thesis contributes to this research stream by presenting an investigation of consumers' spontaneous propensities when using search features. In an information-searching process, consumers determine whether to use a search feature for the next action. Consumers' emergent use of search features is driven by how they allocate their attention. Search features can determine consumers' attention allocation by disseminating information scents or helping them keep track of their search criteria. Consumers pay attention to information scents when attempting to anticipate whether using a search feature can help them identify desirable choices. Consumers can also refer to their previous search criteria as a traceable record to reflect on their choices and make adjustments. Consequently, consumers' use of search features at each step of the search process can be influenced by the characteristics of the search features.

Emergent technology use has also contributed to a rise in consumer opportunism since advances in technology has rendered the cost in accessing information and making transactions negligible. A growing body of literature is being devoted to consumers' opportunistic behaviors (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). Nonetheless, past studies were focused on consumers' opportunistic behaviors in relation to their exploitation of service policies instead of technologies (Macintosh and Stevens 2013; Rosenbaum et al. 2011; Rotman et al. 2018). For instance, it has been shown that consumers exploit product-return policies on B2C e-commerce platforms by engaging in wardrobing behaviors (Shang et al. 2017). That is, consumers deliberately purchase multiple items with the intention to try each of them and return the undesirable ones. Moreover, consumers were found to intentionally exploit service-recovery policies by misrepresenting damage in claims of service failure (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010).

Both electronic word-of-mouth (eWOM) and cross-channel access are platform features that encourage consumers to alter previously made purchases to capitalize on better deals as they emerge (Shavitt and Barnes 2020). Essay 2 in this thesis is focused on identifying consumers' emergent use of platform features for opportunistic purposes. In particular, research on consumers' opportunism in trip-planning is gaining traction (Dichter 2018; Kleweno et al. 2019). Essay 2 furthers this research stream by presenting an examination of how platform features encourage consumers to engage in *trip-rebooking*, which refers to consumers' alterations to previously booked travel packages. Like the attention-steering properties of search features, platform features can also be used to attract consumers' attention by catering to their

opportunism. When provided with various platform features, consumers are more likely to engage in multiple decision-making sessions to change previously made bookings. Essay 2 hence differs from the prior literature that was predominantly focused on isolated consumer decision-making sessions (cf. Ghasemaghaei et al. 2019).

There are two features that encourage opportunistic behavior among consumers that are prevalent on travel-planning platforms. eWOM allows consumers to compare deals on the basis of other consumers' reviews of a product/service (Manning and Raghavan 2009; Wetzer et al. 2007; Yang 2017). Consumers give social endorsements of the quality of a product/service by voicing their satisfaction or dissatisfaction via eWOM (Filieri 2016; Xie et al. 2016). eWOM can be especially beneficial for consumers who are evaluating service providers, such as travel companies, due to the intangible and heterogeneous nature of such services (Grönroos 1984). Opportunistic consumers can be enticed to reverse previously made purchasing decisions in favor of products/services that have received glaringly positive eWOM.

The other platform feature is *cross-channel access*, through which consumers can access available products/services and change their past purchasing decisions across multiple touchpoints, including offline agents, desktop websites, and mobile applications, with a consistent identity (Dichter 2018; Edelman and Singer 2015; Xiang et al. 2015). Cross-channel access helps to maintain a consistent consumer experience across multiple channels so that consumers can engage in their decision journeys whenever and wherever they desire. Consumers who are aware of cross-channel access tend to use their fragmented time to search for more appealing deals (Harvey and Pointon 2017; Oulasvirta et al. 2005). Hence, consumers become more opportunistic in that they make purchasing decisions more casually with the intention of abandoning them for better alternatives.

As evidenced by the literature analysis in Essay 3, there is a paucity of research on consumers' emergent technology use. I identified three studies that employed design science (Lee et al. 2008) and grounded theory building (Austin and Devin 2009; Markus et al. 2002) to develop design principles for digital artefacts that facilitate emergent design process (Lee et al. 2008), knowledge activities (Markus et al. 2002), as well as software development (Austin and Devin 2009). This thesis extends this line of scholarly inqueries, by qualifying consumers' emergent use of technologies in purchase decision-making. In the following section, I elaborate on the theoretical development for understanding emergent technology use patterns embedded in digital traces left by consumers on the digital space.

3 THEORETICAL UNDERPINNINGS

3.1 Attention Allocation Propensity and Emergent Process

In this thesis, I examine the consumer decision journey as an emergent process of technology use. Few previous studies have been devoted to emergent behaviors. Mirabeau and Maguire (2014) investigated how front-line employees' automatic strategic behaviors could be articulated and routinized into an emergent strategy. In the same vein, Wee and Taylor (2018) confirmed that changes made by front-line employees could be amplified and accumulated into organizational changes via an attention-based search mechanism. The term "emergent process" in an organizational context describes how employees exercise their agency and ingenuity to behave in ways that are not intended or anticipated by management.

On B2C match-making platforms, consumers can make emergent use of available features for information searches and opportunistic decision changes. Consumers' emergent technology use is neither premeditated nor forced by the features' design. Consumers exercise their own agency to determine when and how to use technologies to facilitate their decision-making processes (Leonardi, 2011). Consumers are more likely to use a piece of technology when it draws attention to opportunities for personal gain. In this thesis, the consumer decision journey is viewed as an emergent process in which the technological features provided by B2C match-making platforms steer consumers' attention allocation propensities.

As summarized in Table 1, the concept of an *emergent process* differs from the extensively studied idea of a *deterministic process*, in which transitions between states are triggered by predetermined conditions (e.g., Rezazade Mehrizi et al. 2019), and *stochastic processes*, in which states are manifested probabilistically (e.g., Hao et al. 2018). The emergent process is spontaneous and participatory in nature (Markus et al. 2002). It unfolds through the accumulation of a consumer's attention allocation propensities (Lee et al. 2008; Wee and Taylor 2018). Each state in an emergent process is constructed by the consumer, who channels attention toward a potentially beneficial technology, employing what Markus et al. (2002) termed *vigilance to opportunities*. Such a propensity is characterized by its direction and intensity (Wee and Taylor 2018). *Propensity direction* indicates the technological feature toward which a consumer directs their attention. *Propensity intensity* refers to the level of persistence of a consumer in focusing their attention on the same technological feature, which is often reflected in the frequency of technology use.

Table 1. Typology of Processes			
Process Type	**Deterministic Process**	**Stochastic Process**	**Emergent Process**
Definition	A process consisting of pre-determined states and triggers for state transition	A process consisting of probabilistically manifested states	A process consisting of the accumulation of actors' attention allocation propensities
State	Pre-determined states	Probabilistic states	Constructive states
Driver of State Transition	Triggers	Probabilities	Propensities
Role of Digital Artefacts	▪ Frame context ▪ Facilitate process	▪ Reduce uncertainty	▪ Enable generativity
Purpose for Research	▪ Identify states and triggers ▪ Examine input to output transformation	▪ Formulate probabilistic models ▪ Enable simulation and prediction	▪ Derive generativity of emergence ▪ Understand and predict unanticipated outcomes
Example	▪ Information systems discontinuation process (Rezazade Mehrizi et al. 2019) ▪ Organizational learning process (Ramasubbu et al. 2008)	▪ Business process (Breuker et al. 2016) ▪ Healthcare process (Yeow and Goh 2015)	▪ Design process (Lee et al. 2008) ▪ Emergent knowledge process (Markus et al. 2002)

In the search process, consumers shift their attention between three hotspots: orienting features for specifying search criteria, browsing features for listings and traversing the retrieved offerings, and seeking detailed information for each option. Consumers' attention allocation determines which search feature they use to advance the search process. Accordingly, consumers' attention allocation propensities determine the likelihood of them transitioning into use of the next search feature. Coincidentally, animal foraging studies have shown that predators adopt emergent foraging processes when hunting prey (O'Brien et al. 1989, 1990). Predators choose each subsequent move from a repertoire: *turning*, *moving* in the current direction, and *pausing* to locate prey, based on the surrounding terrain and the traces left by the prey.

Likewise, the process through which consumers change previously made decisions (i.e., rebooking travel packages) in a decision journey is emergent in nature. Opportunistic consumers are encouraged to stay vigilant to potentially more desirable deals through eWOM and cross-channel access (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). As new offerings become available, consumers who have been paying attention to opportunities to take advantage of more desirable deals tend to cancel their original bookings and rebook their travel packages (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). There are two ways for consumers to use digital channels to rebook. Consumers engage in *exclusive rebooking* when they modify existing bookings with the same travel company. Alternatively,

consumers engage in *inclusive rebooking* if they abandon existing bookings and book a different travel package offered by a different travel company for the same trip.

3.2 Digital Generativity

Generative technologies allow consumers to decide when and how to use them in their decision journeys (Avital and Te'Eni 2009; Eck et al. 2015; Igamberdiev and Shklovskiy-Kordi 2016). Generative technologies are characterized by several properties, including editability, interactivity, openness, and distributedness (Kallinikos et al. 2013). *Editability* indicates the possibility of technologies being modified or updated systematically. *Interactivity* refers to the process of using the technology being determined by consumers rather than being fixed by design. *Openness* refers to the possibility that the technology can be publicly accessed or modified. Last but not least, *distributedness* pertains to the transient property of technologies, which allows them to be duplicated and moved within an interconnected digital infrastructure (e.g., the Internet).

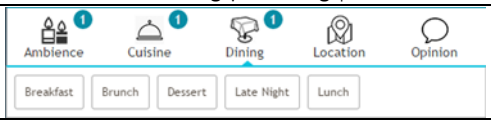
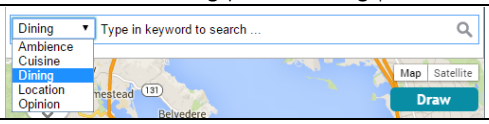
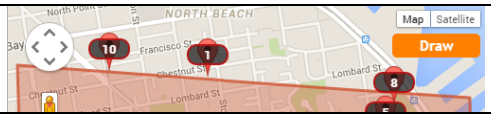
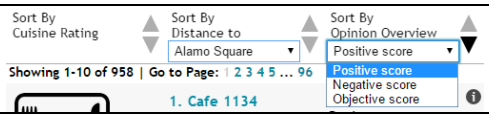
Although there is a growing body of literature focusing on the transformative potential of digital generativity, few researchers have systematically and empirically examined the impact of digital generativity on consumer behavior (Avital and Te'Eni 2009; Henfridsson and Bygstad 2013; Markus et al. 2002). In this thesis, I seek to address this gap by investigating how digital generativity affects consumers' emergent technological use by steering their attention allocation propensities. In particular, Essay 1 in this thesis adopts the *optimal foraging theory* to theorize how the generativities of search features engender consumers' emergent search strategies. For example, a *faceted filter* is a categorical filter that displays preset values for various attributes so that consumers can specify their preference for each attribute as a search criterion (Hearst 2006). A search feature like a faceted filter is editable because users can edit their search criteria by selecting and deselecting filtering options. It is interactive because the results page is rendered through the interaction between the filtering options specified by consumers and the dynamically indexed service offerings.

Two generativities of search features can draw consumers' attention in their search processes. Search features can disseminate *information scents* to alleviate consumers' uncertainty about available service offerings (Moody and Galletta 2015; Pirolli and Fu 2003). A search feature can either disseminate information scents about the attributes of the available options or minimize the dissemination of information scents to avoid interfering with consumers' expression of search criteria (Cothey 2002; Wang et al. 2000). Simultaneously, search features can make it easier for consumers to recollect and

adjust past search actions by retaining *traceable memory*. Search features can either retain consumers' search queries (e.g., selected filtering options) as an explicit memory or impose an implicit memory by rearranging the consideration set in a logical order (e.g., an ordered list of results) (Teevan et al. 2004). Table 2 summarizes the various configurations of the generativities provided by search features.

Essay 2 draws on the the opportunistic behavior theory to examine how the generativities of platform features influence consumers' opportunistic rebooking tendencies. The generativities of platform features can be attributed to their openness and distributedness (Kallinikos et al. 2013). For instance, B2C match-making platforms allow consumers to share their experiences with a service offering in the form of eWOM (Manning and Raghavan 2009). Additionally, the distributed infrastructure of B2C match-making platforms enables cross-channel access (Cao and Li 2015). Both eWOM and cross-channel access tend to draw consumers' attention and entice them to change previously made decisions to achieve better personal outcomes. eWOM can incentivize decision changes by making more desirable alternatives stand out (Harris and Gupta 2008). In contrast, cross-channel access provides more opportunities for consumers to check the changing availability of services and make changes to previously made decisions whenever and wherever they desire (Dichter 2018).

Table 2. Generativities of Search Features

			Information Scent [Prospective Thinking]	
			Scent Dissemination	**Scent Deprivation**
			Cruising ↓ Saltating ↑	Path-Taking ↓ Path-Seeking ↑
Traceable Memory Retention [Retrospective Thinking]	**Explicit Memory**	Path-Following ↓ Zigzagging ↑		
			Scented Orienting Feature: Disseminate information scents and retain search criteria	**Unscented Orienting Feature**: Disseminate no information scent but retain search criteria
			Example: Faceted filter, 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.	Example: Search bar, a standard tool that allows users to specify a category of keywords and type in one or more keywords to conduct a search.
	Implicit Memory	Sprinting ↓ Marathon ↑		
			Scented Browsing Feature: Disseminate information scents and retain browsing trajectory	**Unscented Browsing Feature**: Disseminate no information scent but retain browsing trajectory
			Example: Interactive map, a feature that allows users to search for information items in two ways: (1) Moving or zooming in on the viewport of the map to find information items within the updated viewport. (2) Drawing boundaries around an area of interest via the cursor to find information items within the area of interest.	Example: List-sorting, a feature that allows users to sort the list of information items according to predefined categories in either ascending or descending order.

3.3 The Process-as-Propensity Approach

As elaborated on in Essay 3, in this thesis, I endeavored to advance a new approach, called *process-as-propensity*, to connect digital generativities and attention allocation propensities. In comparison to the existing approaches for theorizing processes, process-as-propensity is centered on eliciting attention allocation propensities that drive action transitions in emergent behavioral processes. These attention allocation propensities differ in their directions and intensity. The propensity direction indicates a consumer's inclination toward approaching or avoiding a transition. Propensity intensity reflects the probability of carrying out each action transition. Process-as-propensity pertains to the selective attention tendencies (i.e., attention allocation propensities) that can be influenced by digital generativities and can sway consumers' decision-making processes. In this regard, as a natural progression from the established theories for designing generative technologies (Austin and Devin 2009; Lee et al. 2008; Markus et al. 2002), the process-as-propensity approach can be utilized to examine the emergent use patterns enabled by digital generativities. The insights gleaned from investigating emergent technology use through a process-as-propensity lens can further inform design theories and improve the design of generative technologies. Both Essays 1 and 2 in this thesis can serve as illustrative examples for applying the process-as-propensity approach to examining emergent technology use. The next sections will offere an overview on how the process-as-propensity approach is applied to develop the theoreticl foundation for each essay.

4 EMERGENT SEARCH FEATURE USE

Consumers' use of technology in a decision-making session dedicated to a specific task can be emergent. An information search is a task in which consumers use the available search features to shortlist and evaluate the available offerings (Browne et al. 2007). It is a task-driven endeavor through which consumers proactively locate desirable offerings based on their preferences. An information search can be further distinguished as goal-oriented or exploratory, depending on the goal specificity of the search task (Browne et al. 2007; Nadkarni and Gupta 2007; Novak et al. 2003). Both forms of information searches are prevalent in the consumer decision journey.

4.1 Optimal Foraging Theory

The *optimal foraging theory* has been widely adopted by ecologists studying animal foraging behavior to investigate their emergent foraging patterns (O'Brien et al. 1990; Perry and Pianka 1997). Empiricists

studying foraging behavior have extended the classical optimal foraging theory by demonstrating that optimality is not merely genetically determined but rather depends on foragers' behavioral adaptations to ecological factors (Hantula 2010; O'Brien et al. 1990; Perry and Pianka 1997). According to previous studies on animal foraging, predators indeed rely on *emergent search strategies*, unplanned-yet-persistent foraging patterns, to optimize their energy intake over expenditure (O'Brien et al. 1989, 1990). These emergent foraging patterns depend on the varied frequency of predators switching between moving and pausing to scan for prey (O'Brien et al. 1989, 1990). For instance, *cruising* describes a strategy in which predators, such as large fish and soaring hawks, constantly scan for prey while moving. *Ambush* represents the opposite strategy, in which foragers, like herons and rattlesnakes, pause indefinitely and wait for prey to come across their paths. *Saltating* is a strategy that is situated between *cruising* and *ambush*. Saltatory foragers alternate between moving and pausing at a much lower rate and only scan for prey when paused.

Consumers who hunt for desired service offerings share the same evolutionary roots as their animal ancestors (Hantula 2010). Previous information foraging research showed how temporal delays imposed on orienting (e.g., switching between online stores) affected consumers' likelihood of continuing orienting toward the next store after browsing a store's offerings (DiClemente and Hantula 2003; Difonzo et al. 1998; Hantula et al. 2008; Rajala and Hantula 2000). It was found that consumers were reluctant to transition from browsing to orienting if the long temporal delay made it difficult to recollect the effectiveness of previous orienting actions (Hantula 2010). Essay 1 in this thesis examines attention transitions between orienting and browsing as well as between browsing and examining as emergent search strategies that can be steered by digital generativities of search features.

4.2 Emergent Search Strategies

Past research has established the emergent strategy as an alternative mode for strategy formation, which stands in contrast to the intended strategy (Mirabeau and Maguire 2014). The term "strategy" refers to a patterned action of iterated resource allocation (Mirabeau and Maguire 2014). In the same vein, an "emergent strategy" is defined as a pattern in action realized regardless of intentions (Mirabeau and Maguire 2014). Following the prior literature on emergent strategies, in this thesis, an "emergent search strategy" is defined as a spontaneous propensity for using a search feature when proceeding from one action to the next in a search process. Accordingly, a consumer's emergent search strategies are reflected in the transitional probabilities between orienting and browsing and between browsing and examining.

This notion of an emergent search strategy expands on the established literature on search strategies. In past studies, search strategies have been conceptualized as composed of search task characteristics (Fidel et al. 1999; Marchionini 2006), searchers' idiosyncratic preferences (Dumais et al. 2010; Kim 1999; Liu

and Wei 2016; Navarro-Prieto et al. 1999), predominant search actions (Aula et al. 2005; Cothey 2002; Ford et al. 2005; Wang et al. 2000), and specific sequences of search actions (Thatcher 2006; Xie and Joo 2010). In more recent studies, attempts have been made to explore whether search strategies emerge as distinct patterns from searchers' sequences of actions through a process modeling approach (Cole et al. 2015; Xie and Joo 2010).

In a typical search session, consumers begin by specifying search criteria with orienting actions. They proceed by browsing through the retrieved list of offerings. When spotting a potentially desirable option, they may examine more detailed information by inspecting its page. Owing to the continuity of visual attention, consumers shift their attention between approximate visual elements (Yarrow et al. 2001). Because orienting features are placed next to browsing ones, the latter include all available options for close-up examination. Emergent search strategies only concern the transitions between orienting and browsing or those between browsing and examining. Consequently, after browsing, searchers may choose to proceed to examine the details of a potentially desirable item, continue browsing, or revert to orienting to adjust the search criteria.

Since an emergent search strategy determines both the direction and frequency of action transitions, I identified four dyads of plausible emergent search strategies. Each dyad concerns the same action transition but with two opposing propensities of either approaching or avoiding it. The directionality of each dyad depends on whether the transition moves toward the end goal of locating desirable options (i.e., prospective thinking) or moves away from this end goal (i.e., retrospective thinking) (Rollier and Turner 1994). To illustrate this process, transitioning from orienting to browsing helps consumers move closer to the set of potentially desirable options. In contrast, transitioning from browsing to orienting requires consumers to shift their attention away from evaluating options toward previously specified search criteria. Likewise, transitioning from browsing to examining involves shifting one's attention to evaluating the details of a chosen option. Conversely, transitioning from examining to browsing moves one's attention away from assessing the details of a chosen option back to scanning the previously traversed consideration set. The "Propensity Toward Attention Allocation" section in Figure 2 illustrates the four dyads of emergent search strategies as consumers' propensities for approaching or avoiding the four search action transitions.

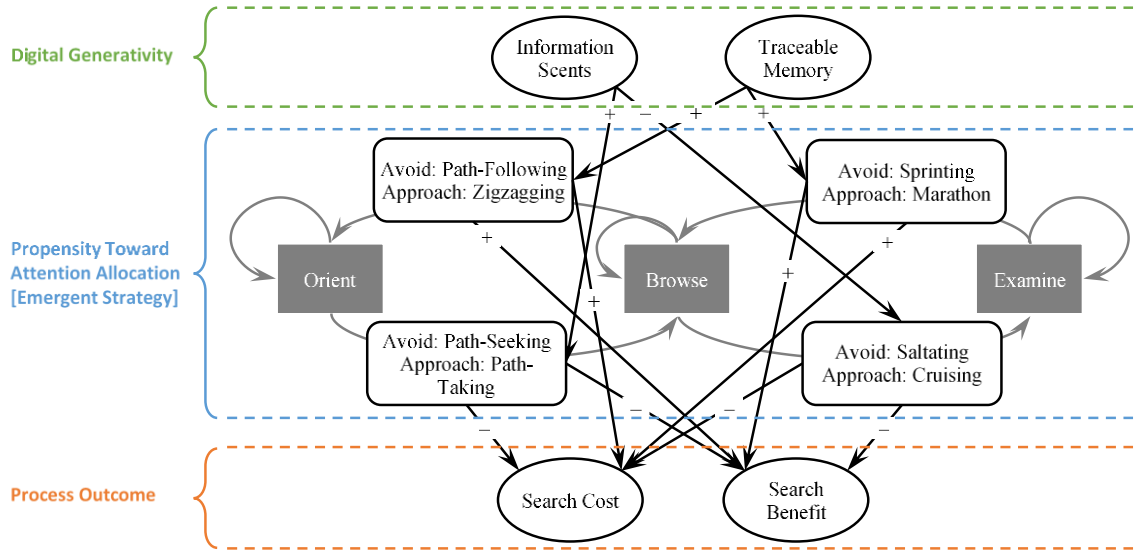


Figure 2. Framework for the Drivers and Outcomes of Emergent Search Strategies

4.3 How Information Scents Affect Emergent Search Strategies

As shown in Figure 2, the generativities of search features (i.e., information scents and traceable memory) can affect consumers' propensities for approaching or avoiding each search action transition. The two strategic planning styles of prospective and retrospective thinking (Rollier and Turner 1994) determine how consumers switch emergent search strategies when provided with digital generativities. Specifically, searchers who provide information scents are encouraged to anticipate future outcomes on the basis of the available information (Einhorn and Hogarth 1987). Conceivably, the availability of information scents can be expected to influence the searchers' propensities for approaching or avoiding specific action transitions.

When deprived of information scents in the orienting phase, consumers tend to focus their attention on specifying search criteria, hence delaying the ensuing browsing phase (Moody and Galletta 2015; Pirolli and Fu 2003). Thus, consumers adhere to a *path-seeking strategy* and avoid the transition from orienting to browsing. In contrast, if the scarcity of information scents is relieved, consumers tend to adhere to a *path-taking strategy*. Consumers tend to shift their focus on browsing a consideration set with more certainty while being informed by information scents, which encourages them to transition from orienting to browsing. This sniff-and-act pattern, in which searchers spontaneously pick up and follow information scents while browsing for potentially desirable options, has been confirmed in previous studies (Fu and Pirolli 2007; Moody and Galletta 2015).

On the other hand, consumers adhere to a *cruising strategy* when they perceive the consideration set as unpredictable. Heightened uncertainty makes it difficult for consumers to focus their attention on brows-

ing the consideration set without shifting their attention to inspecting the details of a specific option, and they display a tendency to approach the transition from browsing to examining. Similarly, animal predators exhibit a foraging pattern that closely resembles the cruising strategy when traversing an unfamiliar environment (O'Brien et al. 1990). Consumers tend to adhere to a *saltating strategy* when the outcome's uncertainty is mitigated by an abundance of information scents (Moody and Galletta 2015; Pirolli and Fu 2003). A more predictable consideration set can hold consumers' attention for an extended period. Thus, it is less likely that consumers will examine specific options in detail throughout the browsing process. Consequently, searchers refrain from transitioning from browsing to examination when adhering to a saltating strategy. This saltatory pattern is prevalent in natural environments where foragers know how to follow the traces left by prey and locate patches where the prey are more concentrated (O'Brien et al. 1990).

4.4 How Traceable Memory Affects Emergent Search Strategies

Consumers who are offered traceable memory tend to make adjustments to past actions with the aim of achieving better outcomes (Wicker, 1979). If a previous search action is made more traceable by the available search features, it becomes more likely that consumers will revisit the search features to make adjustments (Remus and Kottemann 1995). When provided with search features that retain search queries, consumers tend to pay more attention to the retained ones. Therefore, they adjust their search criteria more frequently during browsing. Likewise, the provision of search features that help instill a logical structure in the options in the consideration set tends to encourage consumers to retrace and alter their previous browsing trajectories after examining an option.

If the search criteria specified by consumers are not retained by the available search features, the consumers are less likely to pay attention to these criteria. Therefore, when explicit traceable memory is absent, consumers tend to focus on browsing the consideration set rather than diverting their attention to modifying search queries (Rollier and Turner 1994). In doing so, consumers adhere to a *path-following strategy*, meaning that they avoid transitioning from browsing to orienting to minimize the modification of the consideration set. In contrast, when search criteria are retained by the available search features, consumers tend to engage in a *zigzagging strategy*. With an explicit traceable memory, it is more likely that consumers will shift their attention back to the search queries they specified. Hence, consumers tend to modify the consideration set during the browsing process by adjusting the search criteria (Rollier and Turner 1994). They adhere to a *zigzagging strategy* by approaching the transition from browsing to orienting (Bates 1996).

On the other hand, when implicit traceable memory is absent, it can be challenging for consumers to grasp a comprehensive awareness of how various options relate to each other within the consideration set. Consequently, it is less likely that consumers will pay attention to their browsing trajectories in the consideration set. Hence, they adhere to a *sprinting strategy* to shorten the browsing process and limit the number of alternatives to consider (Dumais et al. 2010; Liu and Wei 2016) by avoiding the transition from examining to browsing (Rollier and Turner 1994). By contrast, consumers tend to adhere to a *marathon strategy* when provided with search features that retain implicit traceable memory by organizing the consideration set. With a sense of direction in the browsing trajectory, consumers tend to pay more attention to the browsing process and, in turn, become more likely to revisit the consideration set for more alternatives (Rollier and Turner 1994). In this sense, consumers are encouraged to approach the transition from examining to browsing by implicit traceable memory.

4.5 Effectiveness of Emergent Search Strategies

Figure 2 illustrates how emergent search strategies can affect the tradeoff between search costs and benefits. In light of the optimal foraging theory, consumers seek to optimize the tradeoff between a search's costs and yields (Hantula 2010; O'Brien et al. 1990; Perry and Pianka 1997). In this regard, effective emergent search strategies can help consumers either save time and energy in the search process or increase their chance of finding desirable options (Dumais et al. 2010; Liu and Wei 2016). Therefore, the intended payoff of an emergent search strategy is either to compromise the desirability of the found options by minimizing search feature use or to help consumers discover more desirable options by making extensive use of search features.

In contrast to the path-taking strategy, in which consumers opt for pre-defined consideration sets by following information scents, adhering to a path-seeking strategy demands extra search actions. Specifically, by adhering to a path-seeking strategy, consumers strive to retrieve a more refined and relevant consideration set. For this reason, they devote more energy to detailing their preferences in their search queries. Furthermore, when specifying customized search criteria without the aid of information scents, consumers require more heuristics and actions in the orienting phase. Repeating orienting actions can increase the use of search features. Consequently, adhering to a path-seeking strategy rather than a path-taking one by reducing the transitional probability from orienting to browsing can inflate search feature use and simultaneously boost the desirability of the purchased options.

Compared to a path-following strategy, in which consumers attempt to avoid modifying the consideration set in the browsing process, adhering to a zigzagging strategy can be costly. Consumers who adhere to a zigzagging strategy expend extra effort in their searches, using orienting features to adjust the consideration set based on their browsing experiences. Moreover, consumers take more actions to manipulate and

check the resulting consideration set after each adjustment to the search criteria. As in the path-seeking strategy, the intended goal of adhering to the zigzagging strategy is to achieve a consideration set with a high concentration of desirable options. Nonetheless, the latter differs from the former in that the latter resembles an anchor-and-adjustment approach (Remus and Kottemann 1995) in which repeated search criteria adjustments are informed by insights gleaned from the browsing process. Adhering to a zigzagging strategy instead of a path-following one, consumers approach the transition from browsing to orienting to achieve a more desirable consideration set with extra orienting feature use.

In a natural environment, a saltatory search is often more taxing than a cruising one (O'Brien et al. 1990). Foragers adopt a saltating strategy and not only traverse a greater distance but also scan a larger area (O'Brien et al. 1990). For this reason, saltatory foragers seek to capture larger prey with higher concentrations of calories (O'Brien et al. 1990). Likewise, consumers who adhere to a saltating strategy make more use of browsing features and scan more extensively to form an impression of the available options before determining which to examine. In contrast, consumers who adhere to a cruising strategy prefer to immediately examine the options they encounter in the browsing process. Consumers adhering to the saltating strategy instead of the cruising one avoid the transition from browsing to examining to locate more desirable options at the cost of additional browsing feature use.

Lastly, adhering to a marathon strategy leads to a prolonged browsing process, as opposed to a sprinting strategy. When adhering to a sprinting strategy, consumers tend to limit the number of options to examine before terminating the search process (Browne et al. 2007). Conversely, consumers who adhere to a marathon strategy exert more energy in continuing to browse after examining each viable option in detail. Adhering to a marathon strategy rather than a sprinting one often yields benefits from extended exposure to more novel and potentially desirable alternatives. At the same time, approaching the transition from examining to browsing requires more browsing feature use, heightening the search costs.

5 EMERGENT PLATFORM FEATURE USE

In a consumer decision journey, consumers are likely to change their decisions across multiple sessions, reflecting post-purchase regret (Connolly and Zeelenberg 2002; Tsiros and Mittal 2000). Consumers change their minds more frequently when purchasing service offerings than products for two reasons. First, consumers are often allowed to indicate their commitment to a service offering by making a booking without paying (Dichter 2018). Second, on average, consumers book service offerings much further in advance (Dichter 2018). Coupled with the changing availability of service offerings, the extended pe-

riod allows for more decision-making sessions to happen, thereby increasing the likelihood of consumers changing their minds opportunistically. In contrast to carrying out a search process within a concentrated period of time, consumers can passively monitor potentially more desirable offerings and make changes whenever they desire by using digital generativities across multiple sessions.

5.1 Opportunistic Behavior Theory

The *opportunistic behavior theory* posits that self-interested individuals tend to continuously probe their environment to search for means of achieving personal gains (Nagin et al. 2002). Accordingly, individuals determine whether to take advantage of an opportunity by assessing whether the marginal benefit of their actions would exceed the marginal cost (Nagin et al. 2002). Due to the unpredictability of opportunism, opportunistic behavior is determined spontaneously with little regard for planning or principle (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010).

Although the concept originated in prior literature on employees' opportunistic behaviors within organizational contexts, such as *shirking* (Cohen et al. 2007; Nagin et al. 2002), there is a growing body of research devoted to examining consumers' opportunistic behaviors (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). Nonetheless, consumers' opportunistic behaviors have been regarded as dysfunctional because the opportunities that consumers seek to take advantage of are exploitable loopholes in service policies (Macintosh and Stevens 2013). Specifically, past studies have been focused on consumers' opportunistic exploitation of product return policies, service recovery policies, and promotional campaigns (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). Essay 2 in this thesis expands on this research stream regarding consumers' opportunistic behaviors by focusing on opportunities for consumers to become aware of and react to opportunities by leveraging digital generativities in the context of eWOM (Manning and Raghavan 2009) and cross-channel access (Cao and Li 2015).

5.2 Trip-Rebooking

The prior IS literature was predominantly focused on how information technologies, such as recommendation agents, affect consumers' purchasing decisions in an isolated instance (cf. Ghasemaghaei et al. 2019). Researchers have only recently begun to pay attention to the transformational role of information technologies in travel-planning (Edelman and Singer 2015; Xiang et al. 2015). It has been shown that consumers are becoming increasingly fickle when carrying out travel-planning activities (Dichter 2018). It is common for consumers to change their minds multiple times before settling on a final decision (Dichter 2018; Edelman and Singer 2015). Essay 2 in this thesis was written with the goal of exploring consumers' trip-rebooking activities across multiple decision-making sessions in a decision journey.

Trip-rebooking refers to the phenomenon of a consumer altering a booking made for a specific trip after the initial choice has been made (see Figure 1). On the one hand, consumers can modify a booking made with a travel company. For example, a consumer may choose to secure their ticket for a cruise trip by booking a less-desirable room type with the intention to later upgrade to a more luxurious one if they find a better deal. This type of rebooking behavior, in which consumers constantly modify a travel package offered by the same travel company, is termed *exclusive rebooking*.

On the other hand, consumers can rebook a trip by booking a package offered by an alternative travel company. To illustrate this phenomenon, after booking a cruise trip with a travel company, a consumer may spot more compelling options offered by competing ones. In such a situation, the consumer may turn to the travel company that offers more compelling options and rebook the trip. This type of rebooking behavior, in which consumers switch to an alternative travel company when rebooking a trip, is termed *inclusive rebooking*. Figure 3 illustrates both exclusive and inclusive rebooking and the transition of attention that occurs when making changes to previously made bookings. In particular, consumers are likely to engage in exclusive rebooking behaviors when they maintain their focus on the travel company with which they made the original booking and modify customizable items to better satisfy their needs. Consumers engage in inclusive rebooking when they focus their attention on other travel companies and are willing to switch companies when more desirable packages become available.

5.3 How eWOM Affects Emergent Rebooking

The intangibility and heterogeneity of service offerings pose a challenge for consumers wishing to assess service quality in advance (Grönroos 1984). eWOM includes reviews posted by consumers online, in which they can express their satisfaction or dissatisfaction with a product or service offering (Manning and Raghavan 2009; Wetzer et al. 2007; Yang 2017). Hence, eWOM is leveraged by consumers as a key quality signal when assessing the desirability of a service offering (Filieri 2016; Xie et al. 2016). Making purchasing decisions on the basis of eWOM can boost consumers' confidence in their decisions, making it easier for them to commit to one (Fan and Miao 2012).

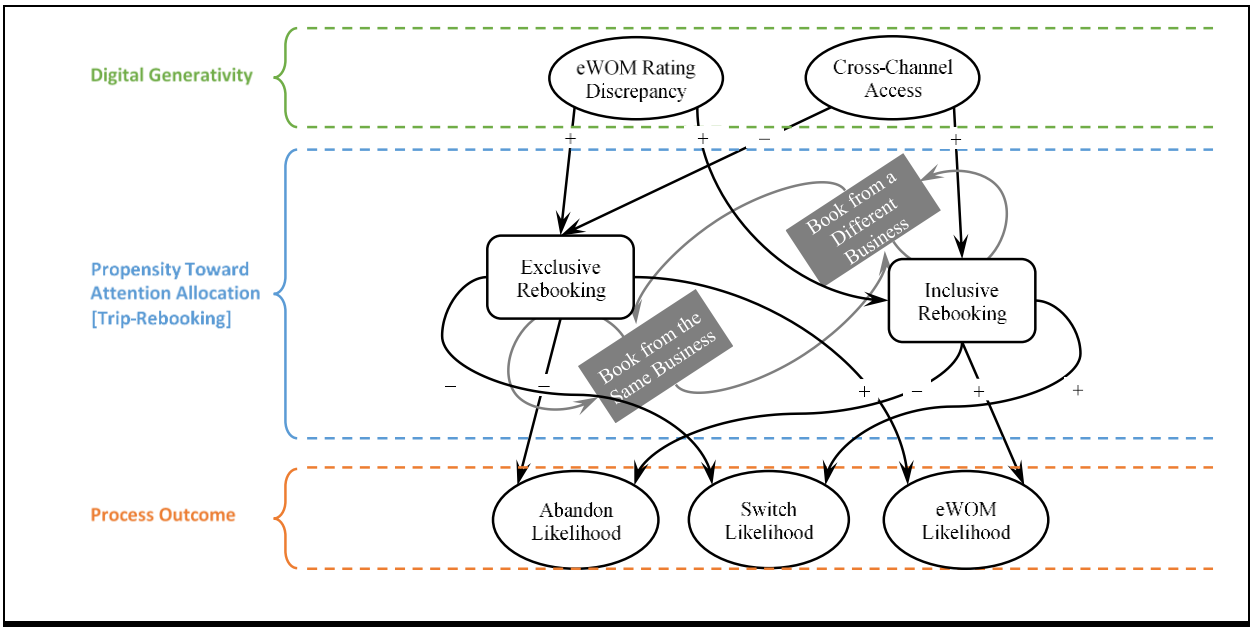


Figure 3. Framework for the Drivers and Outcomes of Trip-Rebooking

Since the eWOM ratings received by a travel company can serve as a key quality indicator of its services (Filieri 2016; Xie et al. 2016), consumers tend to feel more confident with their decisions when they select an option that has received a more favorable eWOM rating than the alternatives (Fan and Miao 2012). The eWOM rating trivializes consumers' quality assessments and thus makes it more intuitive for consumers to compare various options. Therefore, eWOM rating discrepancies between two travel packages can help consumers tangibilize the marginal gain of selecting one over the other. For consumers who have booked a package, the alternative option with a larger positive discrepancy in eWOM ratings tends to be more attention-grabbing. Consequently, consumers show a heightened propensity for rebooking a trip when encountering an alternative option that is more favorably rated than their original choice. In short, eWOM rating discrepancies can boost the propensity toward both exclusive and inclusive rebooking (see Figure 3).

5.4 How Cross-Channel Access Affects Emergent Rebooking

Enabled by the *cross-channel access* of B2C match-making platforms, consumers can access available service offerings and manage their bookings across a variety of touchpoints, including offline agents, desktop websites, and mobile applications, with a consistent identity (Dichter 2018; Edelman and Singer 2015; Xiang et al. 2015). When aware of cross-channel access, consumers show a stronger tendency to use their fragmented time to seek potentially more desirable options (Harvey and Pointon 2017; Oulasvirta et al. 2005). The presence of a unified identity across multiple channels allows consumers to execute timely actions and take advantage of desirable service offerings when the opportunity emerges. Hence, consumers can become more opportunistic in that they make a hasty initial booking to ensure the

availability of a fallback option while continuing to look for more desirable alternatives. As a result, consumers' opportunity-seeking tendencies can be rendered more prominent by cross-channel access.

Consumers who have booked an option offered by a travel company through a channel tend to associate the booked option with the channel through which the booking was made. When accessing a travel-planning platform via the same channel, consumers tend to recall the travel company with which they previously booked a trip due to the recency effect (Baddeley and Hitch 1993). It is also more likely that consumers will consider the customization options offered by the same travel company because of the priming effect of the company-channel association (Domke et al. 1998). Accordingly, as illustrated in Figure 3, consumers who access a travel-planning platform through the same channel have a higher propensity for exclusive rebooking.

On the contrary, if consumers access a travel-planning platform through a channel that is different from the one through which they made their previous booking, they may become exposed to the offerings of various travel companies. Consumers who become aware of alternative travel companies tend to consider these companies' offerings and grab the ones they deem more desirable. Thus, a consumer's cross-channel access to a travel-planning platform can be expected to diminish their tendency to stay with the same travel company (i.e., exclusive rebooking) while strengthening their propensity to consider a different travel company (i.e., inclusive rebooking) when rebooking a trip (see Figure 3).

5.5 Impact of Trip-Rebooking

Trip-rebooking can be expected to influence consumers' purchasing decisions at the end of their decision journeys. In accordance with the opportunistic behavior theory, consumers tend to take advantage of opportunities with optimal utility (Nagin et al. 2002). Consumers only allocate attention to seeking more options if they anticipate additional marginal benefits from doing so. A consumer's propensity for rebooking the offerings of a travel company is hence proportional to the desirability of the company. Moreover, because of the behavioral *sunk cost effect* (Cunha and Caldieraro 2009), it is more likely that consumers will continue to commit to a travel company as they rebook more packages offered by it. Consequently, it becomes less likely that consumers will abandon their bookings as their propensities toward rebooking intensify.

Exclusive and inclusive rebooking can be expected to impose opposite impacts on the likelihood of consumers switching travel companies when making payments. "Switch likelihood" represents the tendency of consumers to purchase from a travel company other than the one that they primarily considered. Due

to the accumulation of behavioral sunk costs, the more a consumer rebooks with a travel company, the less likely it is that they will purchase offerings from a different one (Cunha and Caldieraro 2009). Thus, if a consumer chooses to continuously rebook options offered by the same travel company, they tend to make a purchase from the company as well. As a result, a consumer's propensity toward exclusive rebooking reduces their likelihood of switching to another company when making the final decision.

On the other hand, governed by an *effort-justification mechanism*, when a consumer rebooks options offered by an alternative travel company (i.e., inclusive rebooking), they tend to overestimate the desirability of the company to justify the effort they invested in booking with the previous one (Cunha and Caldieraro 2009). Once a consumer has decided to rebook with an alternative travel company, it becomes unlikely for them to reconsider the previous company. The previous company can seldomly match the inflated desirability perception resulting from the effort-justification mechanism (Cunha and Caldieraro 2009). Furthermore, the longer a consumer holds a package booked with a travel company, the more exaggerated the perceived desirability of the alternative company with which the consumer later decides to rebook becomes. Therefore, consumers' propensity toward inclusive rebooking heightens their likelihood of switching away from the travel company to which they have paid the most attention when making the purchasing decision.

Since consumers with a more intense propensity for rebooking tend to rebook more frequently, they tend to invest more effort into their decision journeys. The opportunistic nature of rebooking also implies that consumers become more invested in the service offerings they have purchased through a series of rebooking actions (Cunha and Caldieraro 2009). As a result, consumers can be expected to engage more with a travel package purchased after repeated rebooking actions. Since more-involved consumers have a greater likelihood of sharing their experiences through eWOM (Jiewanto et al. 2012), both exclusive and inclusive rebooking can boost the likelihood of consumers providing eWOM (Jiewanto et al. 2012). Thus, consumers who show a more pronounced propensity for either exclusive or inclusive rebooking are more likely to share their experiences with their chosen travel packages in the form of eWOM.

6 OVERVIEW ON RESEARCH METHODOLOGY

The methodology employed in this thesis exemplifies *computational social science* (Lazer et al. 2009). Computational social sciences are "a set of methodologies for exploring human behavior computationally" (Nambisan et al. 2017, p. 231). This thesis incorporates process modeling into econometrics by applying behavioral analytics to an investigation of the emergent behavioral processes embedded in event log data (Nambisan et al. 2017; Pentland et al. 2010). Behavioral tracing has been shown to be an effective method of identifying emergent phenomena (Nambisan et al. 2017). Essay 1 in this thesis is an examination of consumers' emergent use of search features by tracing participants'

search actions in a field experiment in which the provision of search features was manipulated. The field experiment was conducted on a custom-made restaurant review site to achieve *ecological validity* by ensuring the realism of the restaurant-selection settings, features, and procedures (Koh 2019). Process modeling was then employed to extract participants' transitional probabilities between search actions throughout their search processes. Subsequently, multiple linear regression implemented in R was applied to validate all the proposed hypotheses. Likewise, Essay 2 in this thesis is an investigation of consumers' emergent use of platform features focused on an analysis of consumers' booking records on a real travel-planning platform. A similar process modeling approach was adopted to identify consumers' transitional probabilities between booking actions. The hypotheses developed in Essay 2 were validated via a logit regression implemented in R generalized linear models (Hosmer Jr. et al. 2013).

6.1 Research Design for Examining Emergent Use of Search Features

In Essay 1, I conducted an online experiment employing a "*2* [*Scented Orienting Feature*: Present and Absent] × *2* [*Unscented Orienting Feature*: Present and Absent] × *2* [*Scented Browsing Feature*: Present and Absent] × *2* [*Unscented Browsing Feature*: Present and Absent] *between-subjects*" factorial design. An experimental online restaurant review site was constructed for each of the 16 treatment groups. For each site, I manipulated the configuration of four features (i.e., faceted filter, search bar, ranked list, and interactive map) (see Table 2 for a summary of the search features). The experimental sites were populated with real data extracted from a popular online restaurant review website via web scraping. The dataset includes detailed descriptions of 1,079 restaurants in the San Francisco region along with approximately 268,000 reviews of them written by an estimated 91,000 diners.

To capture potential variations in the effectiveness of emergent search strategies under various task conditions, the experiment consisted of two stages, one in which participants were asked to complete a *goal-oriented* search task and one in which they completed an *exploratory* search task in a randomized order. Whereas the goal-oriented search task requested the participants to search for a restaurant with specific predefined criteria, the exploratory one permitted them to freely explore the restaurants on the artificial sites and select one according to their own preferences, hence creating conditions with low goal specificity (Browne et al. 2007; Nadkarni and Gupta 2007; Novak et al. 2003).

The participants for the experiment were recruited from Amazon Mechanical Turk (AMT), a crowdworking marketplace that connects individual workers and human intelligence task (HIT) requesters (Paolacci and Chandler 2014). Researchers have increasingly recognized AMT as a viable avenue for gaining ac-

cess to a heterogeneous, untapped pool of study participants (Chandler et al. 2014; Paolacci and Chandler 2014). Compared to traditional college student samples, AMT is more appropriate for investigating digital phenomena (including online searches) due to the diversity of workers' demographic characteristics and their rich experiences with digital services (Paolacci and Chandler 2014). Recent studies have shown that laboratory behavioral experiments can be successfully replicated with subjects recruited from AMT when the participants make individual decisions (Lee et al. 2018). Some have even concluded that the quality of AMT samples is equal to, or even better than, that of both student and professional panel samples for behavioral studies (Kees et al. 2017). Compared to traditional college student samples, those of participants recruited via AMT are more appropriate for investigating digital phenomena (including online information searches) due to the diversity of the workers' demographic characteristics and their rich experiences with digital services (Paolacci and Chandler 2014). To ensure adequate data quality, I adhered to stricter screening criteria than those recommended by past researchers by recruiting workers who had completed at least 10,000 HITs and had a 99% approval rate (Peer et al. 2014). The workers were adequately compensated, receiving USD $4.00 for spending an average of 36 minutes on the experiment on the basis of best practices (Kees et al. 2017; Lee et al. 2018). Figure 4 depicts the diagrammatic flow of the experimental procedures. A total of 288 out of the 377 participants completed both search tasks. Table 3 summarizes the demographic distribution of the 288 samples, whereas Table 4 lists the definitions of all the relevant constructs.

6.2 Research Design for Examining the Emergent Use of Platform Features

In Essay 2, the empirical examination was carried out by analyzing a dataset provided by a major online travel-planning platform in China (i.e., ctrip.com). This dataset contains 117,218 booking records of 74,557 consumers for 998 cruise packages involving 119 vessels from December 22, 2015 to December 28, 2017. To analyze the emergent use of platform features for rebooking, each consumer's booking records registered before an intended embarkment date were grouped as a single decision journey. As a result, 75,218 decision journeys involved in purchasing cruise packages were identified. All these decision journeys were included as samples for data analysis.

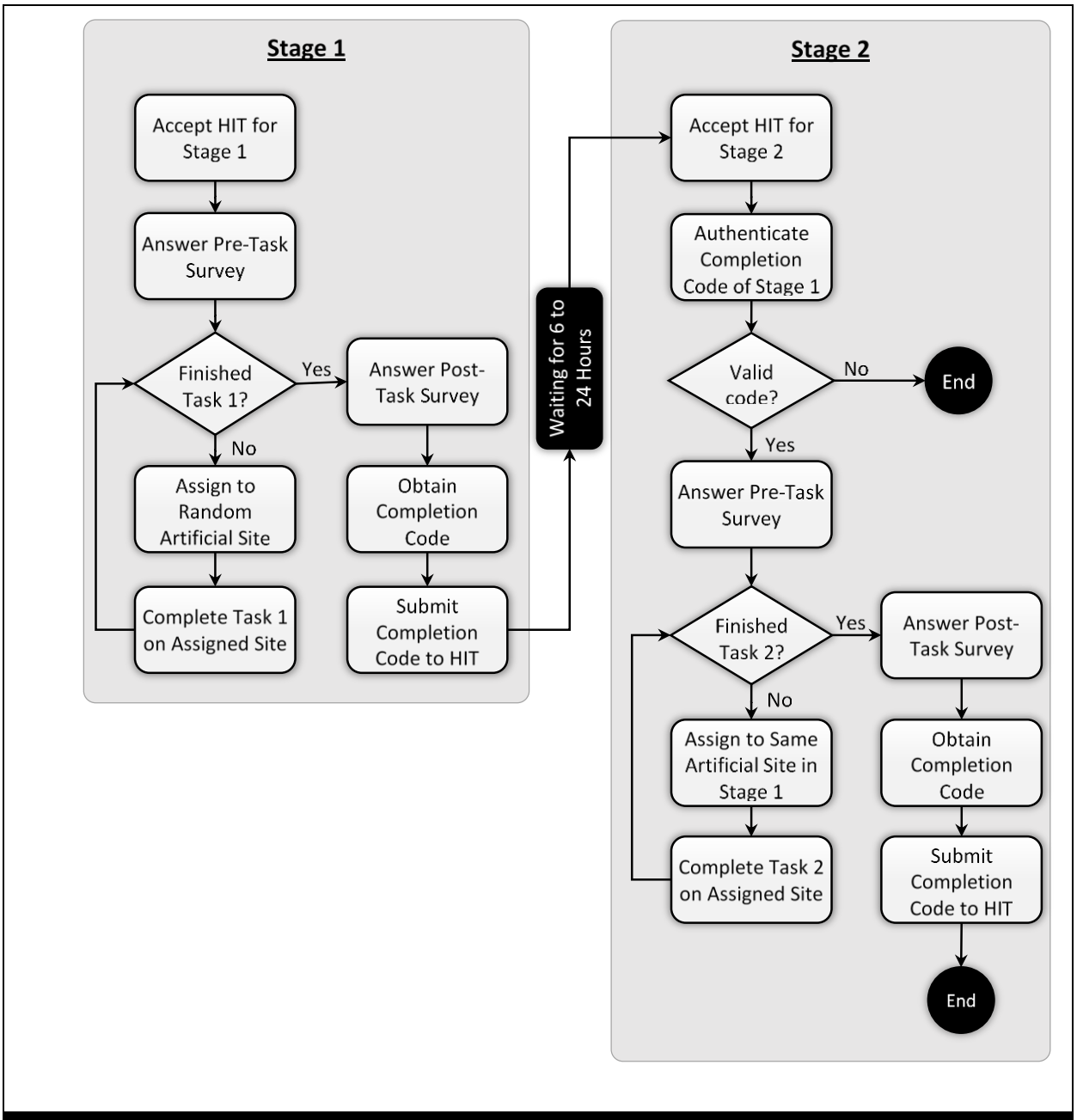


Figure 4. Diagrammatic Flow of Experimental Procedures in Essay 1

Table 3. Descriptive Statistics of Data Samples in Essay 1 [Sample N = 288]

Demographics		No. Samples	%	Goal-Oriented Task				Exploratory Task			
				Faceted Filter	Search Bar	Ranked List	Interactive Map	Faceted Filter	Search Bar	Ranked List	Interactive Map
Gender	Male	142	49.30%	290	143	213	271	400	109	140	77
	Female	140	48.60%	439	153	210	377	558	188	163	87

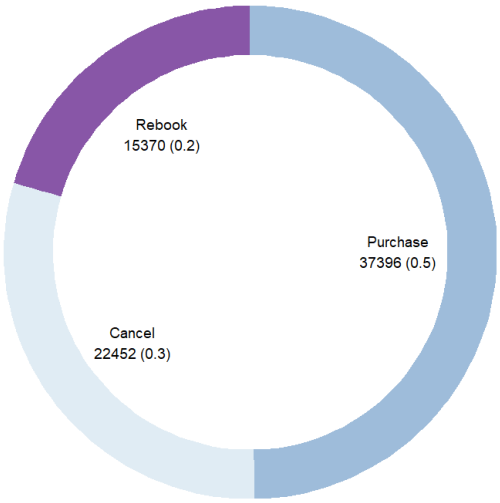
	Unwilling to disclose	6	2.10%	12	3	3	4	6	0	8	1
Age	Age 19 - 29	80	27.80%	136	53	125	101	168	39	81	49
	Age 30 - 49	165	57.30%	442	154	246	444	576	173	163	81
	Age 50 - 64	35	12.20%	146	91	52	106	179	83	65	32
	Age 65+	3	1%	5	1	3	1	35	2	2	3
	Unwilling to disclose	5	1.70%	12	0	0	0	6	0	0	0
Education	Less than college education	38	13.20%	106	78	77	135	144	80	50	171
	College education or higher	247	85.80%	623	221	340	515	814	217	256	55
	Unwilling to disclose	3	1%	12	0	9	2	6	0	5	21
Income	$0 to $30,000	139	48.30%	343	154	202	289	435	161	171	41
	$30,000 to $50,000	71	24.70%	175	84	72	180	195	60	55	23
	$50,000 to $75,000	39	13.50%	115	40	83	105	160	54	21	0
	$75,000+	28	9.70%	86	7	44	69	140	11	41	27
	Unwilling to disclose	11	3.80%	22	14	25	9	34	11	23	9
Experience in San Francisco	More than 5 years	4	1.40%	7	0	1	12	9	0	0	1
	1 - 5 years	23	8%	10	11	30	13	20	8	27	6
	A few months	15	5.20%	22	0	17	8	37	7	9	3
	Less than a month	49	17%	138	47	84	115	199	42	66	28
	Never	197	68.40%	564	241	294	504	699	240	209	127
Restaurant Knowledge	Very low	1	0.30%	0	4	2	0	0	2	1	0
	low	8	2.80%	27	2	6	17	36	2	17	2
	Somewhat low	11	3.80%	28	2	9	14	41	0	13	3
	Medium	138	47.90%	355	214	281	388	437	199	193	95
	Somewhat high	72	25%	193	40	64	156	330	56	55	35
	High	45	15.60%	127	35	61	73	91	37	20	15
	Very high	13	4.50%	11	2	3	4	29	1	12	15

Table 4. Definitions of Key Constructs in Essay 1

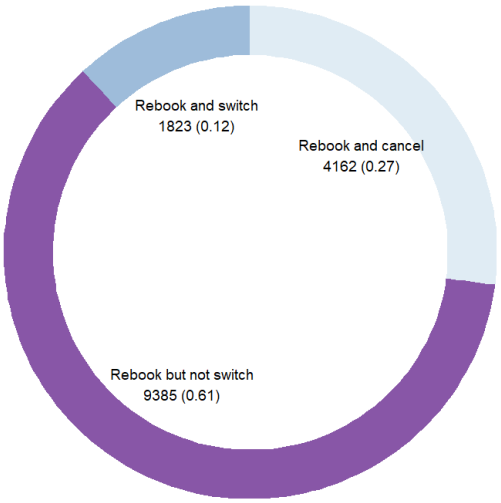
Term	Definition
Search Feature	Generative digital artefact that enables a more granular categorization and arrangement of information items. This study focuses on four types of features: scented orienting, unscented orienting, scented browsing, and unscented browsing.
Information Scent	Proximal cues that signal the availability of relevant information
Traceable Memory	Traces left by searchers for them to recollect and adjust
Search Action	One or a handful of actions made to further a search process
• Orienting	A search action intended to manipulate search criteria
• Browsing	A search action intended to traverse the consideration set
• Examining	A search action intended to examine an information item
Emergent Search Strategy	Unpremeditated propensities for selecting the next search tactic to transit to in reaction to unanticipated situations
• Path-Taking	High transiting propensity from orienting to browsing for exploiting readily available consideration sets
• Path-Seeking	Low transiting propensity from orienting to browsing for continuous refinement of a consideration set
• Saltating	Low transiting propensity from browsing to examining for deriving awareness of the composition of alternatives in a consideration set
• Cruising	High transiting propensity from browsing to examining for traversing less predictable consideration sets
• Zigzagging	High transiting propensity from browsing to orienting for adjusting the consideration set basing on the insights gleaned from browsing

• Path-Following	Low transiting propensity from browsing to orienting for fixating on a consideration set
• Marathon	High transiting propensity from examining to browsing for exhausting viable alternatives
• Sprint	Low transiting propensity from examining to browsing for limiting the scope of browsing
Search Benefit	Desirability of the outcome of a search process
Search Cost	Amount of search activities performed by a searcher throughout a search process

As demonstrated in Figure 5, among all the decision journeys that were included in the data analysis, 37,396 corresponded to direct purchases made without rebooking, whereas 22,452 corresponded to direct cancellations after a single booking. Notably, 20% of all decision journeys, 15,370 to be exact, were found to contain trip-rebooking activities. As shown in Figure 5, among the journeys involving rebooking, consumers purchased cruise packages involving the vessels they initially chose in 9,385 journeys. Consumers purchased cruise packages involving a different vessel in 1,823 journeys. In the remaining 4,162 journeys, all the bookings were eventually canceled. Moreover, the length of each decision journey varied from 1 to 11 in terms of the number of canceled bookings. Figure 5 also includes a tiered breakdown for the length of the decision journeys. Taken together, there were 26,207 rebooking sessions in 15,370 decision journeys that contained trip-rebookings. Multiple channels were used to make bookings in 5,276 decision journeys (see Figure 5). Additionally, among all the other decision journeys in which only a single channel was accessed, 20,467 were conducted through offline venues, 13,208 were conducted on desktop websites, and the remaining 36,267 were performed via mobile applications (see Figure 5).



Breakdown of Post-Book Decisions



Breakdown of Rethink Types

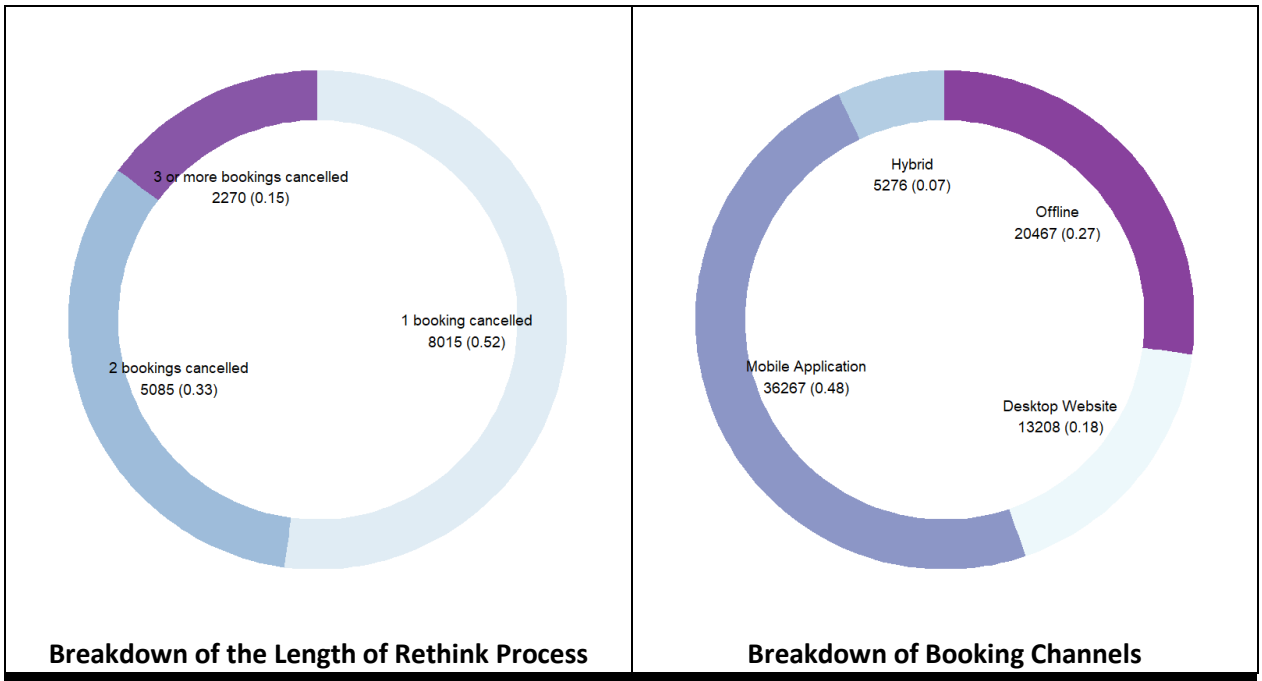


Figure 5. Overview of Cruise Booking Records in Essay 2

Table 5 displays the descriptive statistics of all the focal variables examined in Essay 2. The logit regression implemented in R generalized linear models was applied to test all the hypotheses (Hosmer Jr et al. 2013). The data-analysis procedure is illustrated in Figure 6. The data samples were filtered according to the hypotheses being tested to ensure the validity of the testing results. Particularly, the relations between digital generativities and rebooking propensities were tested with data points at the session level. Therefore, the unit of analysis was every rebooking decision made by each consumer. In contrast, the unit of analysis for the hypothesized impacts of rebooking propensities was the entire decision journey for a trip of each consumer. The relations between rebooking propensities and likelihood of abandonment, or "abandon likelihood," were examined with samples that contained at least one rebooking. The relationships between rebooking propensities and the likelihood of switching, or "switch likelihood," were verified using samples in which at least one rebooked cruise package had been purchased. Last but not least, the relations between rebooking propensities and the likelihood of participating in eWOM, or "eWOM likelihood," were validated using all the samples with purchased cruise packages.

Table 5. Descriptive Statistics of Focal Variables in Essay 2

Variable	Definition	Min	Max	Mean	s.d.
Session Level Focal Variables					
eWOM Rating Discrepancy	Extent to which an alternative travel package differs from the previously booked package in eWOM rating	-3.606	5.000	0.029	0.444
Cross-Channel Access	Whether a consumer changed the channel when accessing a travel planning platform	0.000	1.000	0.230	0.421
Exclusive Propensity	Whether a consumer chose a travel	0.000	1.000	0.820	0.384

	package offered by the same travel company when rebooking a trip				
Inclusive Propensity	Whether a consumer chose a travel package offered by a different travel company when rebooking a trip	0.000	1.000	0.155	0.361
Session Level Control Variables					
Package Price (CNY)	The price of a travel package that a consumer previously booked	0.000	705614	15707	15237
Time Until Embark (Day)	The time left before the embark date when a consumer booked the previous travel package	0.000	331.000	42.100	35.168
Booking Cancellations	The number of bookings previously cancelled by a consumer when rebooking a trip	1.000	11.000	1.685	1.337
Process Level Focal Variables					
Exclusive Propensity	The probability for a consumer to choose travel packages offered by the same travel company through a rebooking process	0.000	0.975	0.387	0.263
Inclusive Propensity	The probability for a consumer to choose travel packages offered by a different travel company through a rebooking process	0.000	0.750	0.016	0.075
Abandon Likelihood	Whether a consumer cancelled all bookings for a trip	0.000	1.000	0.708	0.455
Switch Likelihood	Whether a consumer purchased a travel package that is not offered by the travel company to which they paid the most attention	0.000	1.000	0.044	0.204
eWOM Likelihood	Whether a consumer posted eWOM for the travel package that they purchased	0.000	1.000	0.415	0.493
Process Level Control Variables					
Average Rating	The average eWOM rating received by each travel package that a consumer booked throughout a rebooking process	0.000	5.000	4.249	0.687
Average Price (CNY)	The average price of all travel packages that a consumer booked throughout a rebooking process	0.000	969600	16087	16864
Time Until Embark (Day)	The average time left before the embark date when a consumer booked each of the travel packages throughout a rebooking process	1.000	453.500	37.510	32.339
Booking Cancellations	The number of bookings cancelled by a consumer throughout a rebooking process	0.000	11.000	0.608	0.832

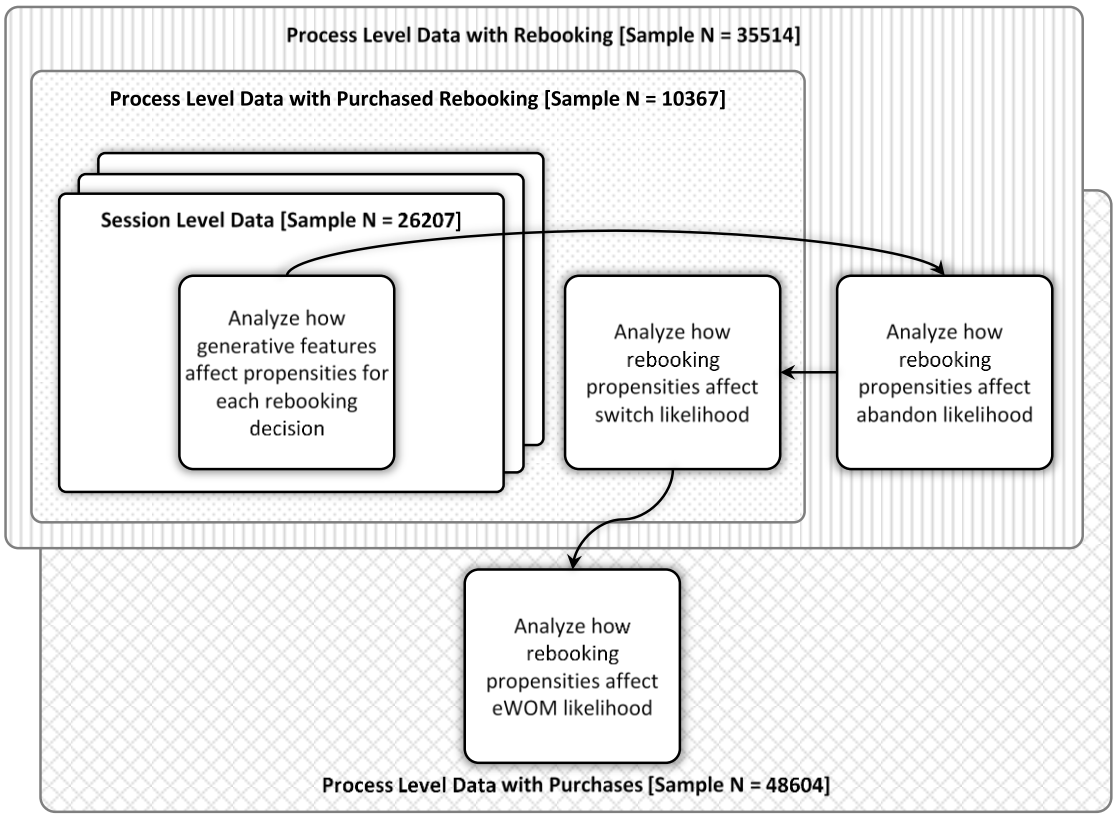


Figure 6. Illustration of the Data Analysis Procedure in Essay 2

7 SUMMARY OF FINDINGS

7.1 Key Findings Regarding Emergent Search Feature Use

Figure 7 offers an illustrative overview of the findings in Essay 1 based on the hypothesis-testing results summarized in Tables 6 and 7. The findings substantiate the seminal role of emergent search strategies induced by digital generativities in determining search performance. For goal-oriented consumers, search features that disseminate information scents and offer explicit traceable memory (i.e., the faceted filter) appear to be the most effective because they encourage goal-oriented consumers to adhere to the zigzagging strategy without invoking the saltating one (see H2a and H3a). Under goal-oriented conditions, the zigzagging strategy is more beneficial for consumers seeking to locate service offerings that more closely mirror their preferences without imposing the need for additional effort (see H6). In contrast, the saltating strategy is not worthwhile because it entails additional costs without offering extra benefits (see H7).

Consumers who are provided with search features that minimize the dissemination of information scents while retaining explicit traceable memory (i.e., the search bar) adhere to both the zigzagging and path-seeking strategies (see H1a and H3b). The benefit of the zigzagging strategy can be canceled out by the path-seeking one, which heightens search costs without boosting search benefits (see H5). Search features that retain implicit traceable memory (i.e., ranked lists and interactive maps) seem to encourage the marathon strategy (see H4) while stimulating saltating and path-seeking strategies, respectively, depending on whether information scents are disseminated (see H1b and H2b). For goal-oriented consumers, the marathon, saltating, and path-seeking strategies are ill-suited because these strategies demand more effort without producing adequate payoffs (see H5, H7, and H8).

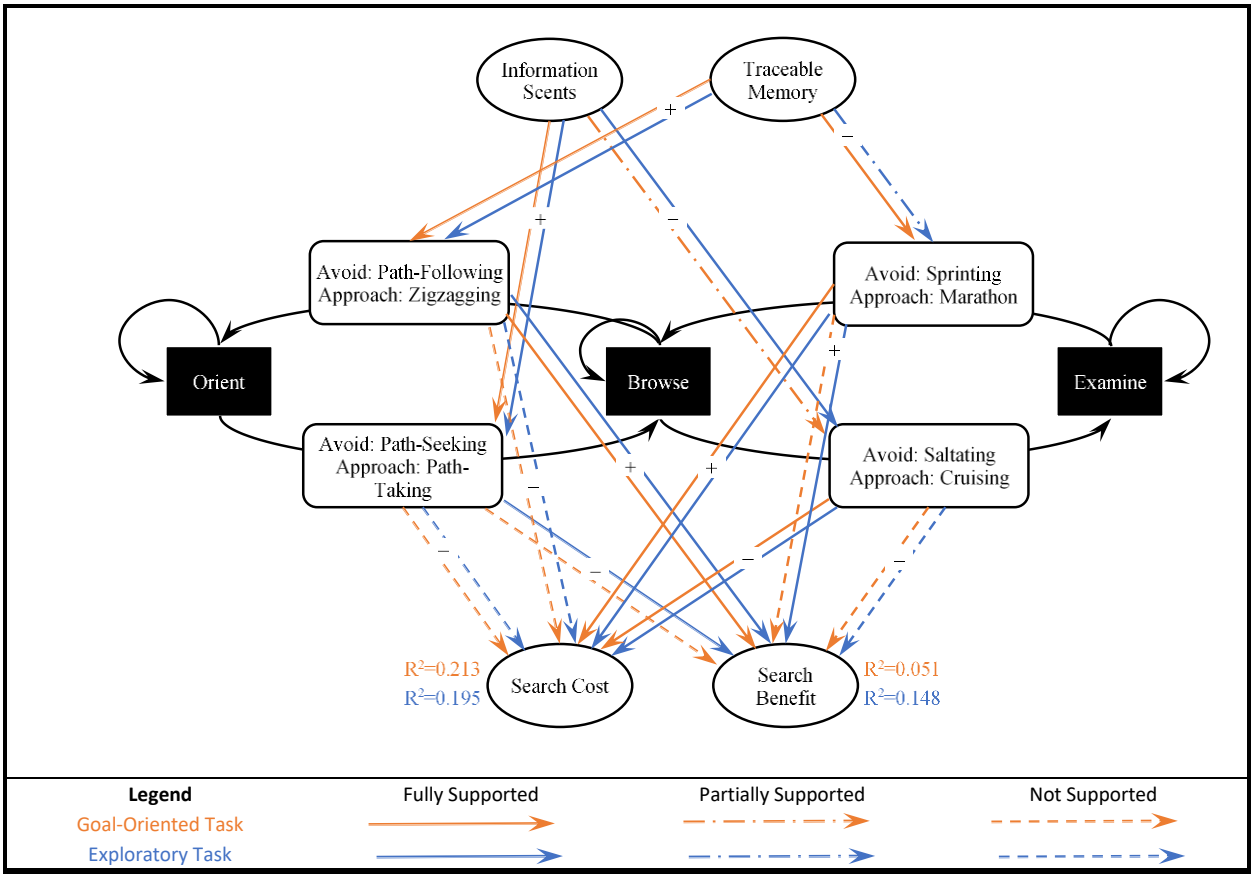


Figure 7. Illustrating Data Analysis Result in Essay 1

Table 6. Summary of the Hypotheses on the Effects of Search Features [Sample *N* = 288]

Hypotheses	Goal-Oriented Task			Exploratory Task			Supported
	$\mu_{Absence}$	$\mu_{Presence}$	F-Test	$\mu_{Absence}$	$\mu_{Presence}$	F-Test	
H1a: UOF → ↓O2B	0.719	0.466	44.730***	0.727	0.442	56.357***	Yes
H1b: UBF → ↓O2B	0.651	0.544	7.073**	0.626	0.555	2.994†	Yes
H2a: SOF → ↓B2E	0.100	0.095	0.271 n.s.	0.126	0.092	6.840**	Partially

H2b: SBF → ↓B2E	0.109	0.085	6.248*	0.127	0.091	7.510**	Yes
H3a: SOF → ↑B2O	0.085	0.127	13.277***	0.068	0.132	25.753***	Yes
H3b: UOF → ↑B2O	0.093	0.118	4.733*	0.084	0.116	5.973*	Yes
H4a: UBF →↑E2B	0.477	0.602	7.843**	0.485	0.558	2.551 n.s.	Partially
H4b: SBF →↑E2B	0.489	0.592	5.127*	0.457	0.589	8.550**	Yes

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

Note: UOF → Unscented Orienting Feature; UBF → Unscented Browsing Feature; SOF → Scented Orienting Feature; SBF → Scented Browsing Feature; O2B → Orienting to Browsing; B2O → Browsing to Orienting; B2E → Browsing to Examining; E2B → Examining to Browsing

Table 7. Summary of Hypotheses on the Effectiveness of Emergent Search Strategies [Sample N = 288]

Hypotheses	Goal-Oriented Task			Exploratory Task			Supported
	β	*t* value	R^2	*β*	*t* value	R^2	
H5a: ↓O2B → ↑OSC	0.006	0.228 n.s.	0.213	-0.025	-0.987 n.s.	0.195	No
H5b: ↓O2B → ↑OSB	-0.005	-0.299 n.s.	0.051	0.064	1.728†	0.148	No
H6a: ↑B2O → ↑OSC	0.112	1.204 n.s.	0.213	0.069	0.869 n.s.	0.195	No
H6b: ↑B2O → ↑OSB	0.177	2.772**	0.051	0.225	1.890†	0.148	Yes
H7a: ↓B2E → ↑OSC	-0.666	-5.905***	0.213	-0.447	-5.734***	0.195	Yes
H7b: ↓B2E → ↑OSB	-0.078	0.912 n.s.	0.051	0.102	0.885 n.s.	0.148	No
H8a: ↑E2B →↑OSC	0.074	3.055**	0.213	0.055	2.406*	0.195	Yes
H8b: ↑E2B →↑OSB	0.018	0.017 n.s.	0.051	0.195	5.781***	0.148	Partially

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

Note: O2B → Orienting to Browsing; B2O → Browsing to Orienting; B2E → Browsing to Examining; E2B → Examining to Browsing; OSC → Objective Search Cost; OSB → Objective Search Benefit

Exploratory consumers face a tradeoff between efficiency and effectiveness when selecting search features. The results indicate that path-seeking, zigzagging, and marathon strategies can help consumers gain exposure to more novel alternatives (see H5b, H6b, and H8b). The marathon strategy leads to increased search feature use (see H8a). Conversely, the cruising strategy reduces search feature use without affecting the size of consumers' consideration set (see H7). Therefore, consumers who prioritize efficiency should be provided with unscented orienting features (i.e., the search bar), which encourage the use of both the path-seeking and zigzagging strategies (see H1b and H3b). In contrast, scented orienting features (i.e., the faceted filter) encourage the use of both the zigzagging and saltating strategies (see H2a and H3a). Consequently, scented orienting features drive search feature use while unveiling fewer alternatives compared to unscented ones.

On the other hand, consumers who seek to maximize their consideration sets should be provided with scented browsing features (i.e., the interactive map) that stimulate the marathon strategy (see H4b). Although the marathon strategy can be cost-intensive, it is effective in expanding consumers' exposure to novel options (see H8). Nonetheless, scented browsing features encourage the use of the saltating strategy (see H2b), which increases search feature use without enhancing search benefits (see H7). In contrast, unscented browsing features (i.e., the ranked list) do not induce the marathon strategy under exploratory

conditions (see H4a). Hence, it is unlikely for exploratory consumers to benefit from unscented browsing features (i.e., the ranked list).

7.2 Key Findings Regarding Emergent Platform Feature Use

Figure 8 illustrates the key findings in Essay 2 in accordance with the hypothesis-testing results summarized in Table 8. Overall, both exclusive and inclusive rebooking propensities are key determinants of consumers' decisional outcomes. Particularly, consumers who hold a booking show a weaker tendency toward exclusive rebooking (see H1) yet show a stronger tendency toward inclusive rebooking (see H2) when encountering an alternative travel package with a higher eWOM rating. Moreover, the results confirmed that consumers who switched access channels when rebooking on a travel-planning platform showed a weaker propensity for exclusive rebooking (see H3) and a stronger one for inclusive rebooking (see H4).

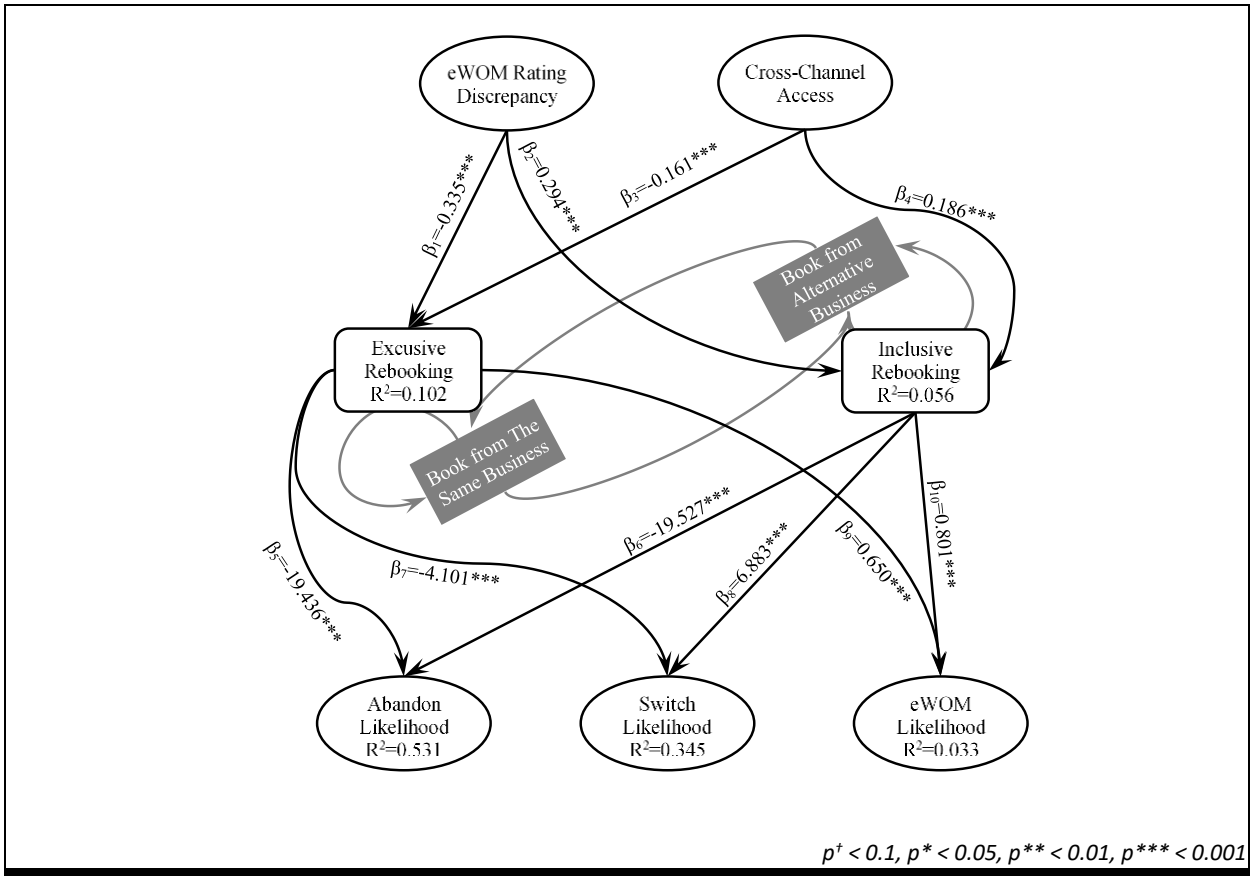


Figure 8. Illustrate Data Analysis Result in Essay 2

Consistent with H5 and H6, as the propensity for either exclusive or inclusive rebooking expressed by consumers intensifies, the likelihood of consumers abandoning their bookings without making payments diminishes. As predicted, if consumers' propensity for exclusive rebooking in a decision journey increases, it becomes more likely that they will purchase something from the travel company they paid the most attention to (see H7). In contrast, as consumers begin to demonstrate a stronger propensity for inclusive rebooking in their decision journeys, the likelihood that they will pay for travel packages offered by a travel company other than the one to which they have paid the most attention rises (see H8). Last but not least, both H9 and H10 were confirmed, since consumers are more likely to provide eWOM ratings for a travel package that they have purchased after a series of exclusive and inclusive rebookings during their decision journeys.

Table 8. Summary of Hypothesis Testing Results in Essay 2

Hypothesis	β	SE	t-Statistics	R^2	Supported
Session Level Hypotheses					
H1: ↑ eWOM Rating Discrepancy → ↑ Exclusive Rebooking	-0.335	0.050	-6.656***	0.102	No
H2: ↑ eWOM Rating Discrepancy → ↑ Inclusive Rebooking	0.294	0.051	5.788***	0.056	Yes
H3: ↑ Cross-Channel Access → ↓ Exclusive Rebooking	-0.161	0.040	-4.026***	0.102	Yes
H4: ↑ Cross-Channel Access → ↑ Inclusive Rebooking	0.186	0.041	4.570***	0.056	Yes
Session Level Controls					
Package Price → Exclusive Rebooking	0.000	0.000	-1.534 n.s.	0.102	-
Time Until Embark → Exclusive Rebooking	0.003	0.001	5.488***	0.102	-
Booking Cancellations → Exclusive Rebooking	0.335	0.020	16.695***	0.102	-
Package Price → Inclusive Rebooking	0.000	0.000	-1.553 n.s.	0.056	-
Time Until Embark → Inclusive Rebooking	-0.003	0.001	-5.663***	0.056	-
Booking Cancellations → Inclusive Rebooking	-0.344	0.022	-15.097***	0.056	-
Process Level Hypotheses					
H5: ↑ Exclusive Rebooking → ↓ Abandon Likelihood	-19.436	0.333	-58.320***	0.531	Yes
H6: ↑ Inclusive Rebooking → ↓ Abandon Likelihood	-19.527	0.410	-47.629***	0.531	Yes
H7: ↑ Exclusive Rebooking → ↓ Switch Likelihood	-4.101	0.500	-8.198***	0.345	Yes
H8: ↑ Inclusive Rebooking → ↑ Switch Likelihood	6.883	0.684	10.065***	0.345	Yes
H9: ↑ Exclusive Rebooking → ↑ eWOM Likelihood	0.650	0.128	5.076***	0.033	Yes
H10: ↑ Inclusive Rebooking → ↑ eWOM Likelihood	0.801	0.200	4.000***	0.033	Yes
Process Level Controls					
Average Rating → Abandon Likelihood	-0.270	0.035	-7.712***	0.531	-
Average Price → Abandon Likelihood	0.000	0.000	-2.064*	0.531	-
Time Until Embark → Abandon Likelihood	0.010	0.001	11.246***	0.531	-
Booking Cancellations → Abandon Likelihood	1.290	0.027	47.448***	0.531	-
Average Rating → Switch Likelihood	-0.202	0.052	-3.847***	0.345	-
Average Price → Switch Likelihood	0.000	0.000	1.064 n.s.	0.345	-
Time Until Embark → Switch Likelihood	-0.003	0.002	-1.634 n.s.	0.345	-
Booking Cancellations → Switch Likelihood	0.348	0.038	9.079***	0.345	-
Average Rating → eWOM Likelihood	0.198	0.018	10.738***	0.033	-
Average Price → eWOM Likelihood	0.000	0.000	7.455***	0.033	-
Time Until Embark → eWOM Likelihood	-0.015	0.000	-36.653***	0.033	-
Booking Cancellations → eWOM Likelihood	0.038	0.018	2.192*	0.033	-

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

To better evaluate the unsupported H1, I conducted a post-hoc analysis to distinguish between the two types of exclusive rebooking (see Table 9). Upon closer examination, I found that consumers who re-booked a travel package from the same company either chose to modify the previously made booking or book a different travel package. The result of this post-hoc analysis shows that how an eWOM rating discrepancy affects consumers' propensity for rebooking the same package is indeed consistent with H1. In contrast, rebooking a different package offered by the same company is similar to inclusive rebooking. In particular, consumers' propensity for rebooking the same travel package decreases if they encounter more favorably rated alternatives (i.e., an eWOM rating discrepancy negatively influences exclusive re-booking for the same package). The propensity for rebooking the same travel package can also be re-duced if consumers access the travel-planning platform through a different channel (i.e., cross-channel access negatively influences exclusive rebooking for the same package). On the contrary, consumers show a heightened propensity for rebooking a more highly rated travel package offered by the same company (i.e., an eWOM rating discrepancy positively influences exclusive rebooking for a different package). Notably, cross-channel access does not seem to affect consumers' propensity to rebook a dif-ferent travel package from the same company. In addition, both types of exclusive rebooking consistently decrease the likelihood of abandonment while increasing the likelihood of providing eWOM. Notably, consumers who rebook the same travel package tend to stay with the same company. Once consumers show a propensity for booking multiple travel packages offered by the same company, the likelihood of them eventually switching to a different company increases.

Table 9. Post-Hoc Analysis of the Two Types of Exclusive Rebooking

Hypothesis	β	SE	t-Statistics	R^2
Session-Level Main Effects				
eWOM Rating Discrepancy → Exclusive Rebooking for the Same Package	-0.509	0.048	-10.692***	0.097
eWOM Rating Discrepancy → Exclusive Rebooking for Different Packages	0.436	0.070	6.191***	0.041
Cross-Channel Access → Exclusive Rebooking for the Same Package	-0.155	0.034	-4.521***	0.097
Cross-Channel Access → Exclusive Rebooking for Different Packages	0.076	0.048	1.581 n.s.	0.041
Price Discrepancy → Exclusive Rebooking for the Same Package	-4.57×10^{-6}	1.42×10^{-6}	-3.219**	0.097
Price Discrepancy → Exclusive Rebooking for Different Packages	3.18×10^{-6}	1.89×10^{-6}	1.687†	0.041
Session-Level Controls				
Package Price → Exclusive Rebooking for the Same Package	0.78×10^{-6}	1.09×10^{-6}	0.712 n.s.	0.097
Time Until Embark → Exclusive Rebooking for the Same Package	-2.99×10^{-4}	4.21×10^{-4}	-0.710 n.s.	0.097
Booking Cancelations → Exclusive Rebooking for the Same Package	0.357	0.017	20.905***	0.097
Package Price → Exclusive Rebooking for Different Packages	1.20×10^{-6}	1.42×10^{-6}	0.845 n.s.	0.041
Time Until Embark → Exclusive Rebooking for Different Packages	0.004	0.001	7.490***	0.041
Booking Cancelations → Exclusive Rebooking for Different Packages	-0.243	0.025	-9.641***	0.041
Process-Level Main Effects				
Exclusive Rebooking for the Same Package → Abandon Likelihood	-18.766	0.353	-53.227***	0.561
Exclusive Rebooking for Different Packages → Abandon Likelihood	-13.039	0.405	-32.217***	0.561

Exclusive Rebooking for the Same Package → Switch Likelihood	-9.288	0.624	-14.894***	0.393
Exclusive Rebooking for Different Packages → Switch Likelihood	2.812	0.510	5.516***	0.393
Exclusive Rebooking for the Same Package → eWOM Likelihood	0.680	0.181	3.763***	0.033
Exclusive Rebooking for Different Packages → eWOM Likelihood	0.721	0.331	2.179*	0.033
Process-Level Controls				
Average Rating → Abandon Likelihood	-0.249	0.035	-7.116***	0.561
Average Price → Abandon Likelihood	-4.83×10^{-6}	2.28×10^{-6}	-2.118*	0.561
Time Until Embark → Abandon Likelihood	0.010	0.001	11.435***	0.561
Booking Cancelations → Abandon Likelihood	1.335	0.028	47.669***	0.561
Average Rating → Switch Likelihood	-0.192	0.053	-3.602***	0.393
Average Price → Switch Likelihood	5.00×10^{-6}	4.36×10^{-6}	1.147 n.s.	0.393
Time Until Embark → Switch Likelihood	-0.003	0.002	-1.573 n.s.	0.393
Booking Cancelations → Switch Likelihood	0.689	0.048	14.232***	0.393
Average Rating → eWOM Likelihood	0.198	0.018	10.738***	0.033
Average Price → eWOM Likelihood	0.000	0.000	7.455***	0.033
Time Until Embark → eWOM Likelihood	-0.015	0.000	-36.653***	0.033
Booking Cancelations → eWOM Likelihood	0.038	0.018	2.192*	0.033

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

8 DISCUSSION AND CONCLUSION

As B2C match-making platforms begin to offer more flexibility and customizability through the provision of generative technologies, consumers' use of technologies in their decision journeys is becoming increasingly emergent (Dichter 2018). In this thesis, I strove to uncover consumers' spontaneous attention allocation propensities for technologies with generativity when making purchasing decisions regarding service offerings. I identified two categories of emergent technological use: task-oriented and opportunistic. In Essay 1, I investigated consumers' task-oriented use of search features, whereas in Essay 2, I examined consumers' opportunistic use of platform features. In both studies, I leveraged a novel process-as-propensity approach, which is detailed in Essay 3, to theorize how technologies can influence attention allocation propensities and, in turn, affect consumers' decision-making processes. Overall, the contribution of this thesis is rooted in the discovery that consumers' emergent technology use is indeed enabled by digital generativities. Moreover, the results in this thesis show that the attention allocation propensities that drive consumers' emergent use of technologies are the key to predicting the outcome of a consumer decision journey.

This thesis demonstrates how behavioral analytics can be leveraged to empirically examine the emergent technology use embedded in consumers' digital traces. In Essay 1, by utilizing behavioral analytics to analyze the search logs collected in a controlled online experiment, I identified the emergent strategies employed by consumers in the use of search features when searching for desirable restaurants. The results show that information scents and traceable memory, the two main digital generativities of search features, can indeed affect consumers' choice of emergent search strategies. Scented search features (i.e., the faceted filter and the interactive map) encourage consumers to approach the saltating strategy while

avoiding the cruising one. Unscented search features (i.e., the search bar and the ranked list) encourage consumers to approach the path-seeking strategy while avoiding the path-taking one. Search features that retain explicit traceable memory (i.e., the faceted filter and the search bar) encourage consumers to approach the zigzagging strategy while avoiding the path-following one. Search features that retain implicit traceable memory (i.e., the ranked list and the interactive map) encourage consumers to approach the marathon strategy while avoiding the sprinting one. Consumers' emergent use of search features is largely consistent across various search tasks. The only two exceptions are the use of scented orienting features under goal-oriented conditions and the use of unscented browsing features under exploratory ones. In particular, scented orienting features fail to encourage goal-oriented consumers to switch from the cruising strategy to the saltating one. Unscented browsing features do not affect exploratory consumers' choice between the marathon strategy and the sprinting one either.

Nonetheless, the goal specificity of the search task has a significant impact on the effectiveness of emergent search strategies. For goal-oriented search tasks, zigzagging appears to be the dominant strategy when using search features to find more desirable options without expending extra effort. Other emergent search strategies (i.e., path-seeking, saltating, and marathon) encourage goal-oriented consumers to use search features more intensively without helping them find better options to purchase. Under exploratory conditions, there is no single optimal strategy for using search features. On the one hand, both the path-seeking and zigzagging strategies can help consumers discover more viable alternatives without demanding greater use of search features. On the other hand, the marathon strategy can be more effective in helping consumers expend their scope of exploration at the expense of more intense search feature use. The saltating strategy should be avoided because it escalates search feature use without improving the scope of exploration.

Unlike the emergent search feature use that can be identified within a single decision-making session, emergent platform feature use manifests itself in multiple sessions throughout consumers' decision journeys. I indeed observed consumers' emergent use of platform features for opportunistic rebooking on separate occasions by analyzing their cruise-booking records on a travel-planning platform in Essay 2. The findings in Essay 2 confirmed the predominant role played by emergent platform use in determining consumers' purchasing decisions and post-purchase engagement. The results show that an eWOM rating discrepancy can increase the likelihood of consumers rebooking a trip by choosing a different travel package rather than modifying the previously booked one. On the other hand, cross-channel access indicates a higher likelihood of consumers rebooking travel packages with a different company while indicating a lower likelihood of modifying a previously booked travel package.

The findings in Essay 2 also show how aggregated rebooking propensities can determine consumers' purchasing decisions and post-purchase engagement. The propensities for both exclusive and inclusive rebooking can reduce the likelihood of consumers abandoning their decision journeys without making a payment. While consumers are likely to pay for a booking that they have repeatedly modified, they tend to abandon the travel company they are primarily considering in favor of more desirable deals if they show a propensity for rebooking various travel packages for the same trip. Last but not least, both exclusive and inclusive rebooking propensities stimulate post-purchase engagement in the form of utilizing eWOM to express opinions about the purchased travel package.

8.1 Theoretical Implications

This thesis offers several implications for research on emergent technology use in consumer decision journeys. First, this thesis highlights the prevalence of emergent technology use on B2C match-making platforms along with its prominent role in determining the outcome of consumer decision-making processes. This emergent use pattern is enabled by generative technologies that allow consumers to decide how to use these technologies in their decision journeys. Consumers' emergent technology use is driven by the attention allocation propensities embedded in their digital traces. As technologies allow for more possible use scenarios, their effectiveness in facilitating consumers' decision-making processes can vary when technologies are used in unintended ways. Understanding consumers' emergent technology use is key to predicting the impact of implementing a specific technology. This knowledge can be a valuable addition to that contributed by past studies in which it was assumed that how technologies were used by consumers did not affect their effectiveness in facilitating consumers' decision-making journeys.

This thesis illustrates that emergent technology use can manifest within a single decision-making session or span multiple ones. Consequently, it becomes increasingly rare for consumers to go through a rigid process when making purchasing decisions. On the one hand, consumers make emergent use of search features to optimize the utility of navigating all the available options available for purchase to locate the most desirable ones. This type of emergent technology use is task-oriented because of its focus on completing a specific task. On the other hand, consumers use platform features in an emergent fashion to change previously made purchasing decisions in reaction to unforeseeable situations. This variation in emergent technology use is opportunistic because it encourages consumers to constantly hunt for more appealing deals rather than committing to their initial decisions. This thesis expands on the prior literature that was predominantly focused on planned technology use in well-defined decision-making processes by shedding light on emergent technology use in an increasingly flexible consumer decision journey.

In this thesis, I advanced a process-as-propensity approach for investigating consumers' attention allocation propensities based on their digital traces. These attention allocation propensities are the underlying drivers of consumers' emergent technology use. By adopting the process-as-propensity approach, I gained the ability to examine how consumers' attention allocation propensities shift when provided with generative technologies. For instance, the generativity of a search feature determines its intensity and timing in attracting consumers' attention when searching for desirable options on B2C match-making platforms. How consumers decide to change previously made purchasing decisions can be determined by the various attention-steering generativities of the platforms' features. In this thesis, I also uncovered the salient role of consumers' attention allocation propensities in determining the outcome of their decision journeys.

Last but not least, this thesis also points to potential research avenues for applying the process-as-propensity approach to investigations of emergent technology use. For instance, the process-as-propensity approach can help advance research on *digital innovation*, which refers to a perceived novel product, process, or business model that is embodied in or enabled by information technologies and requires adopters to undergo transformations (Fichman et al. 2014). In past studies, researchers faced challenges in theorizing digital innovation due to its unpredictability and recent emergence (Nambisan et al. 2017). In light of the process-as-propensity approach, future studies can explore attention allocation propensities among key innovation activities, including developing, packaging, and configuring, as key determinants of the innovation's outcome. *Mixed reality* is another potential research area for applying the process-as-propensity approach. Mixed reality includes digitally augmented real environments, such as augmented reality (AR), and virtually emulated real environments, a.k.a. virtual reality (VR) (Milgram et al. 1995). Research on the emergent experiences enabled by mixed reality is gaining traction. Many recent studies have been focused on examining how players engage in emergent gameplay, in which complex behavioral patterns emerge from interactions with pre-defined game mechanisms and rules, in mixed reality games (Kickmeier-Rust and Albert 2009; Misteli et al. 2018; Wagner et al. 2009). In future studies, researchers can also leverage the process-as-propensity approach to theorize the emergent use of immersive technologies.

8.2 Managerial Implications

This thesis offers actionable insights for service marketing and platformization in light of consumers' increasingly emergent decision journeys in today's digital age. B2C match-making platforms can better accommodate consumers' emergent use of search features when searching for desirable options by

nudging them towards more effective use patterns based on their tasks. For goal-oriented consumers, platforms should prioritize the provision of scented orienting features that encourage the use of the zigzagging strategy. For exploratory consumers, unscented orienting features should be provided by default to encourage the use of path-seeking and zigzagging strategies. Scented browsing features should be offered to more dedicated consumers who prefer devoting more effort to maximizing the scope of exploration. On the other hand, since genuine eWOM is valuable for both consumers and companies, B2C match-making platforms can benefit from making consumers more engaged with their purchases. Platforms can achieve this objective by making venues for eWOM more accessible and simultaneously ensuring cross-channel access. Furthermore, consumers tend to be more engaged with their purchasing decisions if they can easily change previously made purchases on the platform.

For companies that compete for consumers on B2C match-making platforms, the findings in this thesis suggest that, instead of attempting to shortcircuit consumers' decision journeys and jump right to sales by locking them into a loyalty loop (Edelman and Singer 2015; Kleweno et al. 2019), service providers can gain competitive advantages by engaging consumers in their decision journeys. Companies can better retain consumers by encouraging them to further modify and customize their initial bookings. They can also seek to attract consumers away from their competitors by recommending more enticing alternatives to them. Furthermore, accumulating favorable eWOM is key for companies wishing to compete for consumers' attention on B2C match-making platforms. Favorable eWOM can simultaneously help retain existing consumers and attract new ones. Companies are also recommended to streamline their offerings to prevent self-cannibalization, which is found to encourage consumers to switch to competitors. Instead, companies can offer more customizable options for each offering and grant consumers more flexibility in modifying their purchases.

Last but not least, this thesis sheds light on novel designs that aid companies and B2C match-making platforms detect and manage consumers' emergent technology use. For instance, technologies can incorporate process modeling and data visualization to help consumers become aware of and consciously manage their own emergent use patterns. It is also possible for platforms to provide AI assistants that monitor consumers' emergent use of technologies and provide recommendations on effective use patterns in a conversational format. It is also possible for AI assistants to adjust the configuration of technologies in real time to nudge consumers into more effective emergent use patterns. To remain a step ahead of increasingly sophisticated consumers, in this study, it is recommended that companies invest in service personalization based on behavioral analytics. Proactively engaging consumers in their decision journeys can contribute tremendously to retaining existing consumers and attracting new ones.

8.3 Limitations

This thesis is not free of limitations, which must be considered when generalizing the findings. First, restaurant selection and cruise package-booking were selected as the empirical settings for investigating task-oriented and opportunistic emergent behaviors, respectively. Since restaurants provide service offerings with well-defined attributes, using restaurant selection as the empirical context allowed for well-structured, consistent, and reliable experimental tasks. Hence, this choice of context ensured the internal validity of the experimental procedures for investigating task-oriented emergent behaviors. On the other hand, cruise packages do not depend on other service offerings because they are integrated offerings that include travel, accommodations, and tours. For this reason, it can be guaranteed that consumers' rebooking is mostly based on the desirability of cruise packages rather than changes that have occurred in complementary offerings, such as flight tickets and hotel rooms. Likewise, investigating opportunistic emergent behavior in the context of cruise bookings helped ensure the internal validity of the analysis results. Nonetheless, choosing specific service offerings as the research context may have limited the applicability of the findings. Future research can expand on my study by including other contexts, such as those of other service or product offerings, in the empirical investigation.

Second, by recruiting participants from AMT for the experiment in Article 1, I sought to diversify the demographics of the sample and bolster its external validity. Nonetheless, it is possible that the cultural factors affecting consumers' emergent behaviors may have been overlooked, since most of the respondents were based in the United States. In future studies, researchers may attempt to identify such cultural factors by recruiting participants with various cultural backgrounds and examining how such factors shape their emergent behaviors.

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Beyond Keywords: Untangling Emergent Onsite Search Strategies

Essay 1

Abstract

As the digital transformation of the service sector accelerates, match making platforms are looking beyond drawing traffic through offsite search engines and focusing on onsite search optimization. Unlike the extensively studied keyword based offsite search, the onsite search process through which consumers hunt for the most desirable service offering is not well understood. It bears the question how consumers decide which search feature to use at each step of the onsite search process without premeditation. In light of optimal foraging theory, this study conceptualizes *emergent search strategy* as consumers' unpremeditated propensities for making use of a search feature when proceeding from action to action in an onsite search process. Each emergent search strategy reflects a consumer's approach or avoidance of one of four search action transitions. Consumers' choice of emergent search strategies depends on generativities of available search features: *information scent dissemination* and *traceable memory retainment*. It is expected to affect how consumers economize the tradeoff between search benefit and cost. This study validated the proposed hypotheses via a controlled online experiment in which the provision of search feature is manipulated. By analyzing 288 participants' search logs through a process modeling approach, we confirmed that participants indeed switch emergent search strategies when given search features with different generativities. We then evaluated the effectiveness of emergent search strategies for onsite search processes. While one dominant strategy was found for the goal-oriented condition, two opposing strategies, of which one reduces search cost and the other boosts search benefit, surfaced for the exploratory condition. Surprisingly, two strategies effective for foraging in natural environments are no longer viable due to the availability issue and vocabulary misalignment in onsite search.

Keywords: *Onsite Search, Digital Generativities, Emergent Search Strategies, Information Scents, Traceable Memory*

1 INTRODUCTION

The ever accelerated digital transformation of the service sector has empowered consumers to leverage Information Technologies (ITs) to hunt down what they desire (Edelman and Singer 2015, Kleweno et al. 2019). Search is playing an increasingly predominant role in consumers' purchase journeys. The number of consumers who start their purchase journeys with search has increased by 35% from 2017 to 2018 (Dichter 2018). Moreover, a consumer on average carries out 33 searches across 12 platforms for a single purchase decision (Kleweno et al. 2019). It is hence imperative for *match making platforms* to look beyond drawing traffic through *offsite search* engines and devote more attention to *onsite search* optimization (Farrell 2017). Match making platforms offer a multitude of *search features* to facilitate the categorization and rearrangement of available offerings (Chernev et al. 2015, Scheibehenne et al. 2010). For example, on TripAdvisor.com, consumers can express their preferences for categorization (e.g., cuisine, ambience, and location) by typing keywords in a search bar (Teevan et al. 2004), and fine-tune the categorization by specifying preferred attributes of restaurant in a faceted filter (Hearst 2006). Consumers can also rearrange available restaurants in a consideration set through ranking the restaurants or superimposing them to their corresponding locations on an interactive map (Mennecke et al. 2000).

Different from the keyword driven offsite search, onsite search resembles a process of navigating available offerings on match making platforms (Farrell 2017). Offsite search is a relative straightforward process in which consumers leverage on preplanned keywords to reach a match making platform. Onsite search processes on a match making platform however can be much more complicated. Most consumers do not act according to a preplanned roadmap when navigating a platform. For instance, although consumers understand the intended functionalities of each search feature beforehand, they decide when to make use of each search feature in their onsite search on the fly. Consequently, consumers stay vigilant to opportunities (Markus et al. 2002) that may emerge during the onsite search processes for making use of search features. Consumers' use of search features in onsite search processes can hence be considered emergent, in a sense that the timing of using a search feature is neither stipulated by the feature design nor preconceived by consumers.

In consumers' onsite search processes that are emergent rather than planned, consumers play an active role in determining when to use a search feature based on information made available by the search feature. This *generative* property of search features (Avital and Te'Eni 2009, Eck et al. 2015, Igamberdiev and Shklovskiy-Kordi 2016) may induce ineffective use of search features in the search process (Farrell 2017, Teevan et al. 2004). These emergent ineffective usage patterns of search features may undermine

the intended purposes of search features (Farrell 2017, Teevan et al. 2004), which include helping consumers focus on fewer and more relevant alternatives, simplifying tradeoffs, and alleviating choice overload (Scheibehenne et al. 2010). For example, due to the lack of information scents in the search bar, even when a consumer knows exactly what to search for, he/she often has difficulties specifying his/her preferences in search terms (Teevan et al. 2004). It is not uncommon for even veteran consumers to excessively adjust search terms and end up hitting empty result lists, a.k.a., consideration sets (Farrell 2017). Likewise, concise labels offered by the faceted filter tend to make it difficult for consumers to grasp the vocabulary used to characterize available offerings (Farrell 2017). Consequently, consumers often feel compelled to learn how to make use of the vocabulary of a match making platform to express their search criteria via trial and error.

To better understand consumers' onsite search as an *emergent process* that is neither stipulated by search features nor premeditated by consumers, this study draws on *optimal foraging theory* (Hantula 2010, O'Brien et al. 1990, Perry and Pianka 1997) to conceptualizes consumers' spontaneous tendencies towards making use of a search feature in a subsequent action as *emergent search strategies*. In other words, this type of search strategies resembles emergent propensities for allocating attentions among available search features rather than preconceived plans for using search features. Emergent search strategies hence determine how consumers transit from action to action in their search processes. Past animal foraging studies confirmed that emergent strategies for traversing habitat terrains and tracking preys are essential for predators' survival (O'Brien et al. 1990, Perry and Pianka 1997). Likewise, emergent strategies can help to decode how consumers navigate a match making platform and hunt for desirable offerings.

We quickly overviewed the theorization of search process in prior literature to surface why it is inadequate to understand emergent search strategies for onsite search. Past studies viewed search as an *implicit process*, which can be short-circuited into the transformation from inputs to outputs (Adipat et al. 2011, Browne et al. 2007, Mennecke et al. 2000); a *deterministic process*, which is a search action sequence following a premeditated plan (Thatcher 2006, Xie and Joo 2010); and a *stochastic process*, which consists of search actions driven by random and unobservable objectives (Cole et al. 2015). In contrast to earlier work, this study advances an *emergent process* perspective for onsite search on match making platforms. The probability of each action-to-action transition in the onsite search process is determined by *emergent search strategies*. Consumers leverage on emergent search strategies to channel attention towards opportunities for zeroing in on desirable options that emerge in the search process. The first research question that we strive to tackle is: *What are the emergent search strategies employed by consumers for onsite search*?

Search features provided on match making platforms are characterized by their generative properties that steer consumers' attention to the next action that would best advance the search process. Generativities of search features can hence affect consumers' emergent propensities for transiting from action to action in the search process. This study focuses on two key generativities of search features: information scent and traceable memory. *Information scents* are proximal cues that signal availability of desirable offerings (Galletta et al. 2006, Moody and Galletta 2015) like traces left by prey in food foraging context. Search features, like a faceted filter, that disseminate information scents can encourage consumers to pay attention to available options in the consideration set that match their preferences whereas those that do not, such as a search bar, steer consumers' attention on expressing their preferences through search terms (Galletta et al. 2006, Moody and Galletta 2015). As predators can backtrack the foraging paths they left, *traceable memory* represents traces left by consumers for them to recollect and adjust past actions (Teevan et al. 2004). Search features can retain explicit memory such as a search query previously entered in a search bar, or implicit memory like a logical structure imposed on available options by a sorting option. Search features, like a search bar, that retain explicit memory can draw consumers' attention on their search criteria. Those search features, like a ranked list, that offer implicit memory can hold consumers' attention on browsing available options. The second research question that this study strives to answer is: *How do search features affect the likelihood of each emergent search strategy*?

Third, to substantiate the significance of identifying emergent search strategies, this study examines their impacts on search performance. The effectiveness of emergent search strategies is determined by whether consumers can economize the tradeoff between gaining exposure to novel and desirable options while saving time and effort (Hantula 2010, O'Brien et al. 1990, Perry and Pianka 1997). Consequently, this study evaluates the effectiveness, in the form of the tradeoff between benefit and cost, of each distinct emergent search strategy and address the third research question: *What is the effectiveness of each emergent search strategy*?

By adopting *optimal foraging theory* (Hantula 2010, O'Brien et al. 1990, Perry and Pianka 1997) as the theoretical underpinning, this study theorizes emergent search strategy as each consumer's unpremeditated propensities for making use of a search feature when proceeding from action to action in an onsite search process. We seek to unravel how generative properties of search features, namely information scent dissemination and traceable memory retainment, affect the likelihood of each emergent search strategy and its cost-benefit tradeoff. We employ a process modelling approach (i.e., Hidden Markov models a.k.a. HMMs) (Breuker et al. 2016) to analyze search action transitions embedded in search logs collected in an online experiment to test our hypotheses. Each participant in the experiment performed

search tasks on an experimental matchmaking platform with a random configuration of search features that exhaust four possible combinations of generativities (scent dissemination vs. scent deprivation and explicit memory vs. implicit memory). Our findings corroborated the pivotal role of emergent search strategy enabled by digital generativities in steering the emergent development and outcome of search process.

2 THEORETICAL FOUNDATION

2.1 Search as an Emergent Processes

Along with the prevalence of digital artefacts with generativities, such as search features, as well as the availability of digital traces, such as search logs, investigating emergent processes in the likes of search processes becomes increasingly imperative. As shown in Table 1, one research stream treats search as an *implicit process;* these studies evaluate the impact of factors such as information presentation (Adipat et al. 2011, Mennecke et al. 2000) and stopping rules (Browne et al. 2007) that remain *invariant* through the process on search tasks. Examples include the impact of adaptive presentation (Adipat et al. 2011) and map presentation (Mennecke et al. 2000) on task objectives, or the impact of search context supported by digital artifacts (Browne et al. 2007). A second stream investigated search as a *deterministic process*; studies identified predominant action sequences that are produced by premeditated search strategies (Thatcher 2006, Xie and Joo 2010) and the role of digital artifacts in supporting search actions, including narrowing down search by using search engines, extending search by following hyperlinks, or branching search by opening multiple browser tabs (Thatcher 2006, Xie and Joo 2010). A third stream leveraged predictive modeling techniques to investigate search as a *stochastic process*; studies identified search task objectives that manifest probabilistically in a sequence of search actions supported by digital artifacts (Cole et al. 2015).

In contrast to these perspectives, we suggest that when provided with search features, consumers decide on whether to make use of a search feature in the next move in a search process on the fly. Consumers' spontaneous propensities for making us of a search feature is determined by the proportion of attention they allocate on that feature. A search process hence emerges through recursive accumulation action transitions and culminates to an outcome that has not been preconceived. Both the direction, which is underpinned by search actions performed before and after a transition, and the intensity of a consumer's attention allocation propensity are the key to shaping the emergent search process. As a result, this study puts forth the notion of *emergent search strategy* to capture such attention allocation propensity influenced by search features that drives action-to-action transitions in emergent search processes.

Table 1. Comparing Our Theorization of Information Search to Previous Approaches				
Nature of Search	**Implicit Process**	**Deterministic Process**	**Stochastic Process**	**Emergent Process**
Assumption	Search outcome can be affected by factors characterizing the search process	Predominant or optimal sequences of search actions can be identified and prescribed	Sequences of search actions depend on probabilistically manifested motivations and mental states	Sequences of search tactics emerge based on consumers' sustained propensities in allocating attention resources
State in Process	N/A	Search actions Moves that further a search process	Search tasks Objectives undertaken by consumers in a search process	Search actions Moves that further a search process
State Transition in the Process	N/A	Action-to-action transition	Task-to-task transition	Action-to-action transition
Driver of State Transition	N/A	Premeditated search strategies Premeditated sequences of search actions	Motivating tasks Objectives that consumers choose to focus on in a search process	Emergent search strategies Unpremeditated and sustained propensities for choosing the next search action to transit to
Outcome of Process	Task performance	Reaching a terminating state of a search process	Task completion	Economizing search benefit and cost
Role of Digital Artifacts	Task specific or serving as a research context	Supporting search actions	Supporting search actions	Affecting likelihood of emergent search strategies
Exemplary Studies	Adipat et al. (2011), Browne et al. (2007), and Mennecke et al. (2000)	Thatcher (2006), Xie and Joo (2010)	Cole et al. (2015)	This study

Past foraging studies have documented that sentient organisms' foraging strategies are not genetically fixed, but rather, depends on environmental conditions (Hantula 2010, O'Brien et al. 1990, Perry and Pianka 1997). Predators choose among three basic actions at each step of a foraging process: *turning*, *moving* in the current direction, as well as *pausing* to locate preys (O'Brien et al. 1989, 1990). In light of *optimal foraging theory*, predators rely on emergent strategies to determine the next action on the fly in response to unforeseeable circumstances in the natural environment (O'Brien et al. 1990, Perry and Pianka 1997). On one hand, traces left by prey act as prospective generativity for anticipating the location of prey. On the other hand, predators also look back to their travelled paths, which represent retrospective generativity, before deciding the next move. In a way, predators' emergent strategies stem from their attention allocation steered prospectively by tracks left by preys and retrospectively by their own past tracks. For this reason, predators' foraging patterns are emergent since each of their next move is deter-

mined spontaneously basing on their emergent strategies. The accumulation of predators' moves manifests into their travelled paths, of which both the exact route and destination are not preplanned.

Extrapolating to the onsite search context, this study postulates that consumers leverage emergent search strategies to make use of search features on match making platforms. Both information scents and traceable memory, generativities of search features, allow consumers to navigate through a collection of offerings and land on the desirable ones via chaining search actions recursively. Previous studies established three types of search actions: *orienting*, *browsing*, and *examining* (e.g., Xie and Joo 2010) that correspond to predators' actions of turning, moving, and pausing. Consumers orient by retrieving a consideration set to browse available options and examine potentially desirable ones in detail (see Table A1 for a detailed summary). Particularly, orienting actions concern how search terms can be formulated (e.g., Booth 2008, Carstens et al. 2009, Vakkari 2001, Wildemuth 2004). Browsing actions are pertaining to scanning items in a consideration set (Booth 2008, Choo et al. 2000, Hsieh-Yee 2001) as well as traversing through linked web pages (Hölscher and Strube 2000, Xie and Joo 2010). The remaining search actions, including directly accessing a relevant information source (Ellis 1989, Hsieh-Yee 2001), evaluating the desirability of a retrieved option against preferences (Kules and Shneiderman 2008, Xie and Joo 2010), and assessing the status of a search in progress (Hsieh-Yee 1998, Wilson 2009, Xie and Joo 2010), fit into the category of examining.

Search features on match making platforms can disseminate information scents and track consumers' search criteria hence enabling prospective and retrospective generativities. Not unlike predators, consumers can leverage on prospective generativity (i.e., information scents) to anticipate if performing a search action can zero in on desirable options. Consumers can also make use of retrospective generativity (i.e., traceable memory) to reflect on previous search actions and adjust afterwards. Both generativities are expected to affect the propensities for a consumer to make use of a search feature at every step of the search process. A consumer's exact sequence of search actions is as undetermined as his/her information gain and effort expenditure prior to starting a search process.

Overall, as illustrated in Figure 1, consumers choose emergent search strategies to navigate offerings on match making platforms under the influence of generativities of available search features (i.e., information scents and traceable memory). Each emergent search strategy represents a propensity for approaching or avoiding using a search feature in the upcoming search action transition (i.e., transiting between orienting and browsing, or between browsing and examining). Four pairs of opposing strategies, a.k.a. four dyads of strategies, determine consumers' propensities for spontaneous usage of different search features in the search process. Consequently, each emergent search process varies in the tradeoff between search benefit and cost. For convenience of reference, we provide a glossary of terminologies in Table 2.

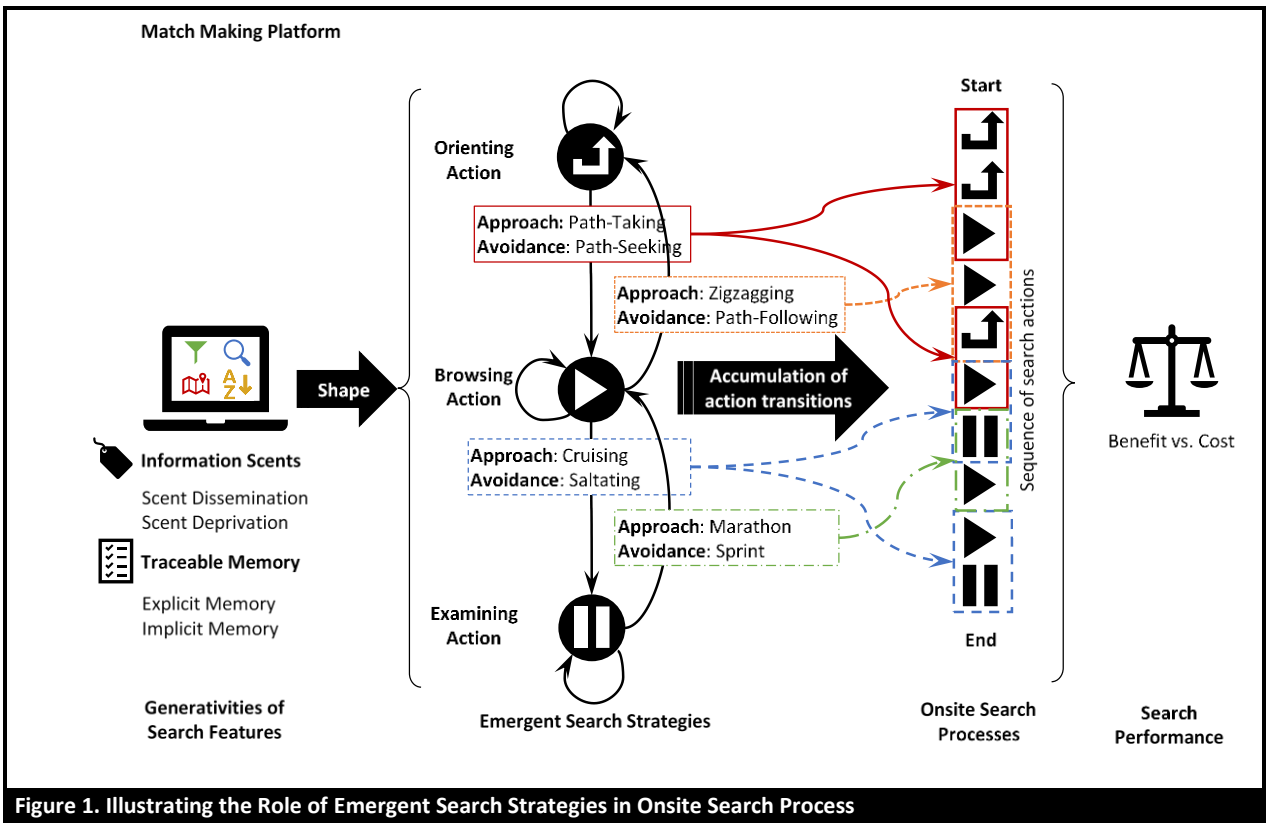


Figure 1. Illustrating the Role of Emergent Search Strategies in Onsite Search Process

Table 2. Definitions of Key Terminologies

Term	Definition
Search Feature	Generative digital artefact that enables a more granular categorization and arrangement of information items. This study focuses on four types of features: scented orienting, unscented orienting, scented browsing, and unscented browsing.
Information Scent	Proximal cues that signal the availability of relevant information
Traceable Memory	Traces left by consumers for them to recollect and adjust
Search Action	One or a handful of moves made to further a search process
Orienting	A search action intended to manipulate search criteria
• Browsing	A search action intended to traverse the consideration set
• Examining	A search action intended to examine an information item
Emergent Search Strategy	Unpremeditated propensities for making use of a search feature when proceeding from action to action in an onsite search process
• Path-Taking	Approach the transition from orienting to browsing by paying attention to browsing available options when specifying preferences
• Path-Seeking	Avoid the transition from orienting to browsing by keeping attention away from browsing available options when specifying preferences
• Saltating	Avoid the transition from browsing to examining by keeping attention away from examining options in detail when browsing available options
• Cruising	Approach the transition from browsing to examining by paying attention to examining options in

	detail when browsing available options
• Zigzagging	Approach the transition from browsing to orienting by paying attention to specifying preferences when browsing available options
• Path-Following	Avoid the transition from browsing to orienting by keeping attention away from specifying preferences when browsing available options
• Marathon	Approach the transition from examining to browsing by paying attention to browsing available options when examining options in detail
• Sprint	Avoid the transition from examining to browsing by keeping attention away from browsing available options when examining options in detail
Search Benefit	Desirability of options found via a search process
Search Cost	Amount of search actions performed throughout a search process

Past studies on animal foraging demonstrated that each predator's emergent search strategy manifests in how frequently its attention shifts between two actions: moving and pausing for prey location (O'Brien et al. 1989, 1990). For instance, cruising describes the strategy in which predators, such as large fishes and soaring hawks, constantly scan for preys while moving. Ambush represents the opposite strategy in which foragers, like herons and rattlesnakes, pause indefinitely and wait for preys to come across. Saltating is the strategy that situates between cruising and ambush. Saltatory foragers alternate between moving and pausing at a much lower rate and only scan for preys when paused.

Consumers share the same evolutionary root with their foraging ancestors who hunt in the wilds (Hantula 2010). Prior literature on information foraging zeroed in on how temporal delay entailed by orienting (e.g., switching between online stores) affects the likelihood for consumers to continue orienting after browsing the list of offered products in the current online store (DiClemente and Hantula 2003, Difonzo et al. 1998, Hantula et al. 2008, Rajala and Hantula 2000). It was found that consumers are reluctant to transit from browsing to orienting if the long temporal delay makes it difficult to recollect and assess the previously performed orienting action (Hantula 2010). Conversely, transitions between the equivalent actions of turning and moving in food foraging are much more random (O'Brien et al. 1990). Therefore, the transition between turning and moving is largely omitted in the theorization of emergent search strategies in foraging context (O'Brien et al. 1990). Taken together, this study incorporates both transitions between connecting actions (i.e., the transition between orienting and browsing and that between browsing and examining) in the theorization of emergent information search strategies.

2.2 Emergent Search Strategies

Figure 2 illustrates our theorization of emergent search strategies in the form of attention allocation propensities that precede transitions between connecting search actions, that is, between orienting and browsing as well as between browsing and examining. Our theorization is also informed by extensive literature on search strategy. As illustrated in Table A2, past studies looked into search strategy through the lenses of search task characteristics (Fidel et al. 1999, Marchionini 2006), consumers' idiosyncratic

preferences (Dumais et al. 2010, Kim 1999, Liu and Wei 2016, Navarro-Prieto et al. 1999), predominant search tactics (Aula et al. 2005, Cothey 2002, Ford et al. 2005, Wang et al. 2000), as well as specific sequences of search tactics (Thatcher 2006, Xie and Joo 2010). In more recent studies, attempts have been made to explore if search strategies emerge as distinct patterns from consumers' sequences of actions through a process modeling approach (Cole et al. 2015, Xie and Joo 2010).

In a typical search session, consumers start by specifying search criteria with orienting. They proceed by browsing through the retrieved consideration set. When spotting a potentially desirable item, they may examine the target by entering its detail page. Orienting and browsing can be considered connected since the latter is a natural follow-up to the former. Browsing and examining can also be considered connected for the same rationale. After performing a search action, in addition to proceeding to the subsequent connecting action, it is possible for consumers to continue the current action or to revert to the preceding action. For instance, after browsing, consumers may choose to proceed to examine details of a potentially desirable item, to continue browsing, or to revert to orienting to adjust the search criteria.

Since emergent search strategy determines both the direction and intensity of action transitions, we advance four dyads of plausible emergent search strategies. Each dyad concerns the same action transition but with two opposing attention allocation propensities: approaching or avoiding (see Figure 2). The directionality of each dyad depends on if the transition involves anticipating under uncertainty (i.e., prospective thinking) or revisiting and adjusting past actions (i.e., retrospective thinking) (Rollier and Turner 1994). To illustrate, transiting from orienting to browsing compels consumers to pay attention to the yet uncertain composition of retrieved offerings. In contract, transiting from browsing to orienting requires the consumers to shift attention to the search criteria they previously specified before deciding how adjustments should be made. Likewise, transiting from browsing to examining is driven by attention on anticipating unknown details of the chosen option. Conversely, transiting from examining to browsing is evoked by attention remained on the previously traversed consideration set, hence allows consumers to continue or adjust browsing trajectories.

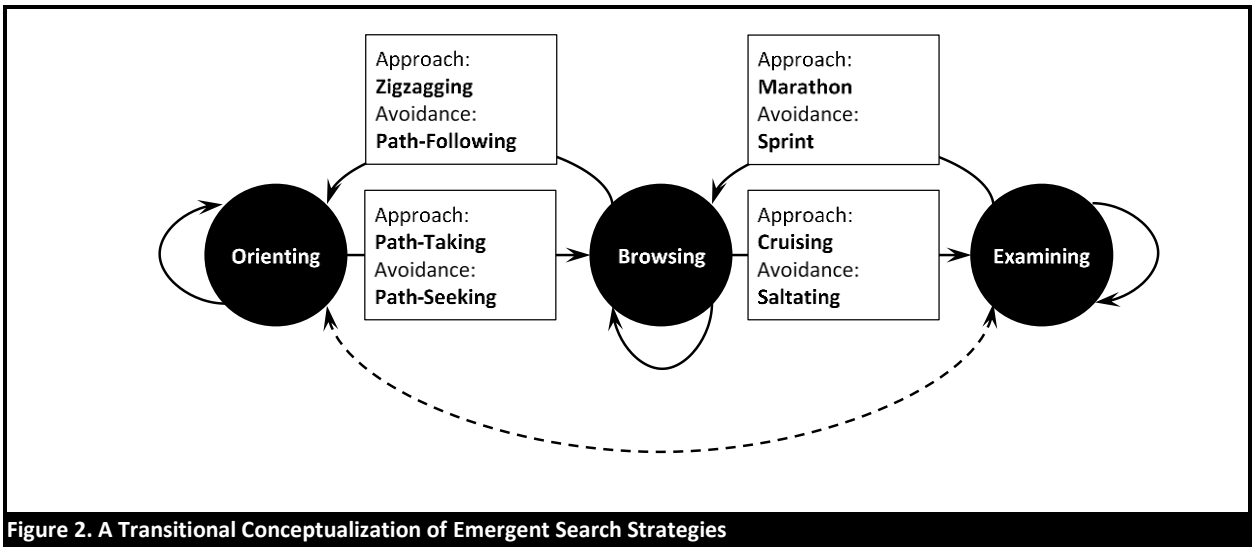


Figure 2. A Transitional Conceptualization of Emergent Search Strategies

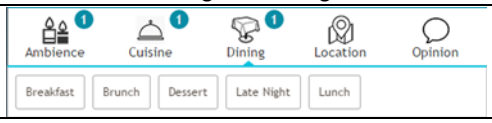
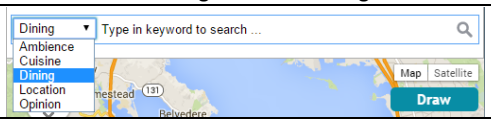
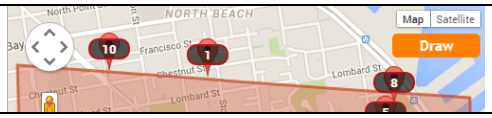
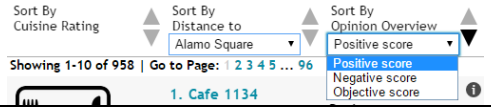
We choose not to consider the transitional probabilities between orienting and examining as indicative of emergent search strategies since they fall out the scope of our theoretical underpinning. Additionally, the tendency of transiting from orienting to examining is contingent on the likelihood for a potentially desirable option to appear in top slots of the consideration set. Therefore, the transitional probability from orienting to examining is contingent on the concentration of desirable options rather than the provision of search features. If a platform amasses more desirable options, consumers would be more likely to transit directly from orienting to examining. Likewise, the probability of transiting from examining to examining is contingent on whether multiple potentially desirable options are located adjacently in the consideration set so that the consumers can examine consecutively without the need for performing orienting and browsing actions. Consequently, as desirable options become more concentrated, the likelihood for consecutive examining would likely raise. The transitional probability from examining to examining thus remains relatively invariant if the choice base on a platform is unchanged. For this reason, we exclude from our taxonomy of emergent search strategies the direct transition from examining to orienting since it mirrors that from examining to browsing.

2.3 Generativities of Search Features

In light of optimal foraging theory, consumers' emergent search strategies can change based on generativities of available search features since generativities shift consumers' attention allocation propensities in the search process. Specifically, search features can disseminate information scents to alleviate consumers' uncertainty (Moody and Galletta 2015, Pirolli and Fu 2003) and retain their search criteria as a traceable memory (Teevan et al. 2004). Accordingly, we identify four categories of search features that differ in the availability of information scents as well as the tangibility of traceable memory (see Table 3).

A scented orienting feature signals desirability of available options with information scents while retaining the search criteria specified by consumers. One example of this type of search feature is faceted filter, a categorized filter that displays pre-defined categories of attributes with corresponding values for consumers to determine their search criteria by selecting one or more values for each attribute (Hearst 2006). Faceted filter disseminates attributes of available options as information scents for consumers to express their preferences. Additionally, by allowing consumers to manipulate the queries, faceted filter retains a snapshot of the most recently executed query as a traceable memory. Since these queries are explicitly kept, consumers can later revisit these queries to make adjustment.

Table 3. Generativities of Search Features

			Information Scent [Prospective Thinking]	
			Scent Dissemination	**Scent Deprivation**
			Cruising ↓ Saltating ↑	Path-Taking ↓ Path-Seeking ↑
Traceable Memory Retainment [Retrospective Thinking]	**Explicit Memory**	Path-Following ↓ Zigzagging ↑		
			Scented Orienting Feature: Disseminate information scents and retain search criteria	**Unscented Orienting Feature**: Disseminate no information scent but retain search criteria
			Example: Faceted filter, 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.	Example: Search bar, a standard tool that allows users to specify a category of keywords and type in one more multiple keywords to conduct search
	Implicit Memory	Sprint ↓ Marathon ↑		
			Scented Browsing Feature: Disseminate information scents and retain browsing trajectory	**Unscented Browsing Feature**: Disseminate no information scent but retain browsing trajectory
			Example: Interactive map, a feature that allows the users to search for information items in two ways: (1) Moving or zooming the viewport of the map to find information items within the updated viewport. (2) Drawing boundaries around an area of interest via mouse cursor to find information items within this area of interest.	Example: Ranked list, a feature that allows users to sort the list of information items according to pre-defined categories in either ascending or descending order.

In contrast, an unscented orienting feature does not interfere with the expression of search criteria with information scents. Search bar belongs to this category since it retains search criteria customized by consumers despite giving off little information scents (Teevan et al. 2004). In this sense, search bar retains explicit traceable memory while depriving information scents. Consumers hence bear more uncertainty when specifying search criteria on a search bar as comparing to doing so on scented orienting features.

A scented browsing feature represents search features that can impose a logical structure on available options to retain consumers' browsing trajectories while disseminating information scents. An exemplary feature in this category is interactive map, which superimposes a consideration set onto geographical metadata (i.e., a map) (Mennecke et al. 2000). These metadata function as information scents that help consumers establish an awareness of location (Teevan et al. 2004) and render their browsing trajectories more sensible and trackable. Since such a traceable memory is retained via spatial awareness of structured options, it resembles an implicit flow that consumers can retrack, such as panning the map towards a certain direction.

On the other hand, an unscented browsing feature imposes a structure on available options without offering information scents. For example, a ranked list allows consumers to arrange options in the consideration set in accordance with certain attributes (e.g., distances to the current location) in an ascending or descending order by specifying sorting options. Except for the labels of sorting options, this feature does not give off information scents that hint at the sorting outcome or guide the browsing process. For this reason, from glancing at the sorted list, consumers can gauge the desirability of each option in comparison to other alternatives based on the pertinent attribute (e.g., distances to the current location), albeit being uncertain about the exact value. Nonetheless, ordering options still helps consumers to establish a spatial awareness of the structure underneath options in the consideration set (i.e., an implicit traceable memory) for them to retrack their browsing trajectories (Teevan et al. 2004).

The prospective and retrospective attention allocation mechanisms (Rollier and Turner 1994) serve as the foundation for theorizing how generativities of provided search features spur each emergent search strategy. Specifically, consumers who are provided prospective generativity are compelled to anticipate future outcome on the basis of available information (Einhorn and Hogarth 1987). Conceivably, the availability of information scents is expected to influence consumers' propensities for approaching or avoiding certain action transitions. For instance, when provided with search features that disseminate information scents, consumers can better envision the ensuing consideration set of available options (Moody and Galletta 2015, Pirolli and Fu 2003). Consequently, they would allocate more attention on browsing options in the consideration set, hence diminishing the propensity to enter a detail page to examine.

On the other hand, retrospective generativity would encourage consumers to pay attention to past actions (Wicker 1979). Consumers likely think about how adjustment can be made to locate more desirable options (Wicker 1979). We hence posit that if available search features attract consumers' attention to past search actions, it would be more likely for consumers to revisit and tweak these actions (Remus and Kottemann 1995). Specifically, when provided with search features that retain search queries, including scented and unscented orienting features, consumers' attention would be drawn on adjusting search criteria when browsing the consideration set. Likewise, the provision of search features that help to instill an

awareness of the logical structure underneath available options, such as scented and unscented browsing features, would retain consumers' attention on their previous browsing trajectories when examining a potentially desirable option.

3 RESEARCH FRAMEWORK AND HYPOTHESIS DEVELOPMENT

3.1 Information Scent Dissemination and Emergent Search Strategy

Figure 3 depicts an overview for our hypothesized effects of search features on consumers' emergent search strategies as well as their effectiveness. Deprivation of information scents can drive up the likelihood for consumers to adhere to a *path-seeking* strategy while diminishing the probability for a *path-taking* strategy. When deprived of information scents in the orienting phase, consumers tend to focus their attention on specifying search criteria and be more reluctant to transit to browsing the consideration set (Cothey 2002, Wang et al. 2000). Moreover, consumers spend more effort on heuristics in the orienting phase to compensate for the heightened uncertainty, which delays the ensuing browsing phase (Moody and Galletta 2015, Pirolli and Fu 2003). With this inclination towards a path-seeking strategy, consumers are expected to avoid the transition from orienting to browsing.

In contrast, if the scarcity of information scents is relieved, consumers tend to adhere to a path-taking strategy. The alleviated uncertainty of available options encourages consumers to shift their attention to browsing the consideration set. This sniff-and-act pattern, in which consumers spontaneously pick up and follow information scents through browsing for potentially desirable options, has been confirmed in previous studies (Fu and Pirolli 2007, Moody and Galletta 2015). For this reason, consumers likely approach the transition from orienting to browsing. As a result, when provided with search features devoid of information scents, such as a search bar and a ranked list, consumers tend to counter the increased uncertainty by adhering to the path-seeking strategy rather than the path-taking one. We hence hypothesize:

H1a: Unscented orienting feature encourages path-seeking (avoiding orienting to browsing transition) while discouraging path-taking (approaching orienting to browsing transition) strategy.

H1b: Unscented browsing feature encourages path-seeking (avoiding orienting to browsing transition) while discouraging path-taking (approaching orienting to browsing transition) strategy.

On the other hand, abundance of information scents is expected to bolster the likelihood for consumers to adhere to a *saltating* strategy while reducing the probability for a *cruising* strategy. Consumers adhere to

the cruising strategy when they perceive the consideration set as unpredictable. The heightened uncertainty makes it difficult for consumers to maintain their attention on browsing the consideration set without drifting into inspecting details of a specific option. They hence tend to approach the transition from browsing to examining. Similarly, animal predators also exhibit a foraging pattern that closely resembles the cruising strategy when traversing an unfamiliar environment (O'Brien et al. 1990).

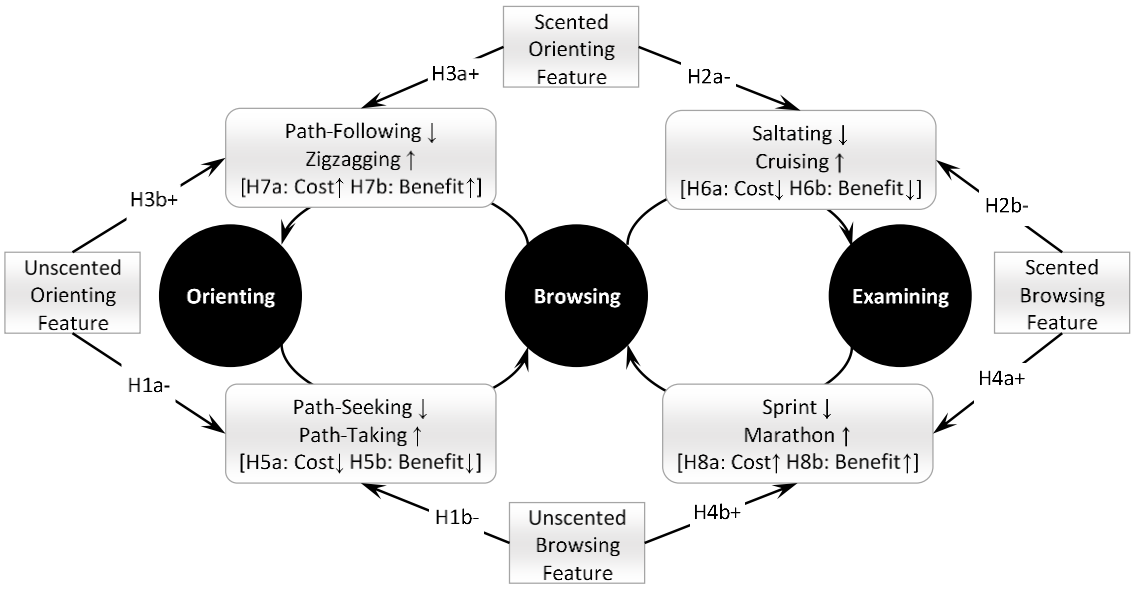


Figure 3. Illustrating Hypothesized Effects of Search Features and Effectiveness of Emergent Search Strategies

Conversely, consumers prefer a saltating strategy when the uncertainty in available options is alleviated by the abundance of information scents (Moody and Galletta 2015, Pirolli and Fu 2003). A more structured and predictable consideration set can hold consumers' attention for a longer period of time. It is thus less likely for the consumers to examine specific options in detail throughout the browsing process. Consequently, consumers refrain from transiting from browsing to examining as a result of adopting a saltating strategy. This saltatory pattern is prevalent in natural environments where foragers know how to follow traces left by preys and locate patches where preys are more concentrated (O'Brien et al. 1990). Therefore, when provided with search features that disseminate information scents, including scented orienting and scented browsing features, consumers tend to allocate more attention to browsing the consideration set by adhering to saltating rather than cruising strategy. We hence hypothesize:

H2a: Scented orienting feature encourages saltating (avoiding browsing to examining transition) while discouraging cruising (approaching browsing to examining transition) strategy.

H2b: Scented browsing feature encourages saltating (avoiding browsing to examining transition) while discouraging cruising (approaching browsing to examining transition) strategy.

3.2 Traceable Memory Retainment and Emergent Search Strategy

Retaining explicit traceable memory is expected to stimulate consumers to adhere to a *zigzagging* strategy while reducing the probability for a *path-following* strategy. If the search criteria specified by consumers are not retained by available search features, it would be less likely for consumers to retain their attention on these criteria. Thereby, when facing insufficient traceable memory, consumers would not look back and adjust the queries they input when focusing on browsing (Rollier and Turner 1994). In so doing, consumers adhere to a path-following strategy, meaning that they avoid transiting from browsing to orienting to modify the consideration set.

On the other hand, when search criteria are retained by available search features, consumers tend to engage in a zigzagging strategy. The explicit memory can attract consumers' attention on the search criteria they specified. Consumers would hence be more likely to revisit their search criteria during the browsing process to make adjustment (Rollier and Turner 1994). They would adhere to a zigzagging strategy in which consumers approach the transition from browsing to orienting to update the consideration set repeatedly (Bates 1996). For this reason, when either scented or unscented orienting features are made available, consumers tend to be swayed by explicit memory to adhere to a zigzagging rather than a path-following strategy to capitalize. We hence hypothesize:

H3a: Scented orienting features encourage zigzagging (approaching browsing to orienting transition) while discouraging path-following (avoiding browsing to orienting transition) strategy.

H3b: Unscented orienting features encourage zigzagging (approaching browsing to orienting transition) while discouraging path-following (avoiding browsing to orienting transition) strategy.

Last but not least, consumers will more likely adhere to a *marathon* strategy rather than a *sprint* strategy when they can rank order options in the consideration set with available search features. If such an implicit traceable memory is absent, it can be challenging for consumers to grasp a spatial awareness of how options relate to each other in the consideration set. Consequently, consumers would not be able to form a coherent impression when browsing the consideration set. Such a hinderance encourages consumers to adhere to a sprint strategy to shorten the browsing process and limit the number of alternatives to consider (Dumais et al. 2010, Liu and Wei 2016). Consumers would try to avoid transiting from examining to browsing since a consideration set without a coherent and logical structure can hardly draw consumers' attention after they have examined an option in detail (Rollier and Turner 1994).

In contrast, consumers tend to opt for a marathon strategy when provided with search features that retain implicit traceable memory via structuring the consideration set. Consumers can establish a sense of direction due to the continuity of browsing ordered consideration set (Carton and Aiello 2009). This sense of direction can encourage consumers to refocus their attention on browsing the consideration set after examining an option in detail (Rollier and Turner 1994). Consumers are hence encouraged to approach the transition from examining to browsing. As a result, when provided with scented or unscented browsing features, the likelihood for consumers to adhere to the more exhaustive marathon strategy heightens whereas that for the more economical sprint strategy subsides. We hence hypothesize:

H4a: Scented browsing features encourage marathon (approaching examining to browsing transition) while discouraging sprint (avoiding examining to browsing transition) strategy.

H4b: Unscented browsing features encourage marathon (approaching examining to browsing transition) while discouraging sprint (avoiding examining to browsing transition) strategy.

3.3 Effectiveness of Emergent Search Strategy

In light of optimal foraging theory, consumers seek to economize the tradeoff between search cost and the yield of search (Hantula 2010, O'Brien et al. 1990, Perry and Pianka 1997). In this regard, effective emergent search strategies can help consumers either save energy in the search process or locate more desirable options (Dumais et al. 2010, Liu and Wei 2016). Therefore, the intended payoff of an emergent search strategy is either to minimize search cost by compromising the yield or to maximize search benefit with extra effort and time. Since emergent search strategies that increases search feature usage entails additional search cost, consumers who adopt these strategies seek to invest more search cost in exchange for better search benefit.

In contrast to the path-taking strategy, in which consumers opt for pre-defined consideration sets by following information scents, adhering to a path-seeking strategy demands extra search cost. Specifically, by adhering to path-seeking strategy, consumers focus their attention on specifying search criteria by using search features. For this reason, they devote more energy in expressing preferences in the search queries. Furthermore, when specifying customized search criteria without the aid of information scents, consumers would require more heuristics for orienting, hence ramping up search cost. In exchange for the inflated search cost, consumers who adhere to a path-seeking strategy expect to gain more payoff from the resulting consideration set, which is smaller, more refined, and contains options more accurately matching their preferences. We hence hypothesize:

H5a: Switching from path-taking (approaching orienting to browsing transition) to path-seeking (avoiding orienting to browsing transition) strategy increases search cost.

H5b: Switching from path-taking (approaching orienting to browsing transition) to path-seeking (avoiding orienting to browsing transition) strategy increases search benefit.

Compared with a path-following strategy, in which consumers try not to modify the consideration set in the browsing process, adhering to a zigzagging strategy can be costlier. Consumers who adhere to a zigzagging strategy would pay more attention on revisiting their search criteria on the basis of the browsing experience. Moreover, it takes energy to check the resulting consideration set after each adjustment made to the search criteria. Similar to a path-seeking strategy, switching to a zigzagging strategy can help to arrive at a consideration set with higher concentration of desirable options. Comparing to the former strategy, the later resembles an anchor-and-adjustment approach (Remus and Kottemann 1995) that can inform search criteria adjustment with insights gleaned from browsing available options. The anchor-and-adjustment approach helps consumers zero in towards a more desirable consideration set while incurring additional search cost. As a result, consumers who switches to a zigzagging strategy can enjoy a boost in search benefit at the cost of extra energy. We hence hypothesize:

H6a: Switching from path-following (avoiding browsing to orienting transition) to zigzagging (approaching browsing to orienting transition) strategy increases search cost.

H6b: Switching from path-following (avoiding browsing to orienting transition) to zigzagging (approaching browsing to orienting transition) strategy increases search benefit.

In a natural environment, saltatory search is often more taxing comparing to cruise search (O'Brien et al. 1990). Foragers adopt a saltating strategy not only travels more distance, but also scans for a larger area (O'Brien et al. 1990). For this reason, saltatory foragers happen to capture larger preys with higher concentration of calories (O'Brien et al. 1990). Likewise, consumers who adhere to a saltating strategy maintain their attention on browsing alternatives for a prolonged period before deciding on a target to examine in detail. In contrast, consumers who adhere to a cruising strategy can lose attention on browsing more easily and tend to inspect individual options more frequently. To this end, consumers adhere to a saltating strategy can achieve a better understanding regarding how an option that they chose to examine in a greater depth differs from other alternatives. As a result, these consumers seek to locate more desirable options at the cost of additional browsing actions. We hence hypothesize:

H7a: Switching from cruising (approaching browsing to examining transition) to saltating (avoiding browsing to examining transition) strategy increases search cost.

H7b: Switching from cruising (approaching browsing to examining transition) to saltating (avoiding browsing to examining transition) strategy increases search benefit.

Lastly, adhering to a marathon strategy would lead to a prolonged browsing process as opposed to a sprint strategy. When adhering to a sprint strategy, the number of options they may cover before terminating the search process is limited (Browne et al. 2007). Conversely, consumers who switch from a sprint to a marathon strategy exert more energy due to their more sustained attention on the browsing process after each detailed examination of a select option. Adhering to a marathon strategy can often expand exposure to more novel and potentially more desirable alternatives, hence boosting the yield from the search. Nonetheless, it requires more time and energy to prolong the browsing process after each examination. For this reason, consumers switching to a marathon strategy end up expending extra search cost in exchange for a boosted search benefit. We hence hypothesize:

H8a: Switching from sprint (avoiding examining to browsing transition) to marathon (approaching examining to browsing transition) strategy increases search cost.

H8b: Switching from sprint (avoiding examining to browsing transition) to marathon (approaching examining to browsing transition) strategy increases search benefit.

4 RESEARCH METHODOLOGY

4.1 Overview of Sampling and Experimental Procedure

To empirically validate our hypotheses, we conducted an online experiment that employs a *2* [*Scented Orienting Feature*: Present and Absent] x *2* [*Unscented Orienting Feature*: Present and Absent] x *2* [*Scented Browsing Feature*: Present and Absent] x *2* [*Unscented Browsing Feature*: Present and Absent] *between-subjects* factorial design. An experimental online restaurant review site (see Appendix B for an illustrative example) was constructed for each of the sixteen treatment groups. For each site, we manipulated the configuration of four features (i.e., faceted filter, search bar, ranked list, and interactive map) (see Table 1). We populated the sites with real data extracted from a popular online restaurant review website via web scrapping. Our dataset includes detailed descriptions of 1,079 restaurants in the San Francisco region together with approximately 268,000 reviews for these restaurants written by an estimated 91,000 diners. Together, the experimental sites can help us achieve *ecological validity* by ensuring that the realism of the restaurant selection settings, features, and procedures (Koh 2019).

4.2 Overview of Sampling and Experimental Procedures

To capture the potential variation in the effectiveness of emergent search strategies in different task conditions, our experiment comprises two stages whereby each participant was asked to complete a *goal-oriented* search task and an *exploratory* search task in a randomized order. Whereas the goal-oriented search task requested participants to search for a restaurant with specific predefined criteria, the exploratory search task permitted participants to freely explore the restaurants on the artificial sites and select one according to their own preferences, hence creating a condition with low goal specificity (Browne et al. 2007, Nadkarni and Gupta 2007, Novak et al. 2003). Participants for our experiment were recruited from Amazon Mechanical Turk (AMT), a crowdworking marketplace that connects individual workers and Human Intelligence Tasks (HIT) requesters (Paolacci and Chandler 2014). Recent studies have showed that laboratory behavioral experiments can be successfully replicated with subjects recruited from AMT when participants make individual decisions (Lee et al. 2018). Some even concluded that AMT samples are of equal or even better quality in comparison to both student samples and professional panel samples for behavioral studies (Kees et al. 2017). Compared to traditional college student samples, AMT is more appropriate for investigating digital phenomena (including online information search) due to greater diversity in workers' demographic composition and their rich experience with digital services (Paolacci and Chandler 2014). To ensure adequate data quality, we adhere to a stricter screening criteria than recommended by past research by recruiting workers who had completed at least 10,000 HITs with 99% approval rate (Peer et al. 2014). Workers were adequately compensated by USD $4.00 dollars for spending 36 minutes on average in our experiment on the basis of best practices (Kees et al. 2017, Lee et al. 2018).

To begin, potential participants were directed from our HIT page on AMT to an introductory page containing detailed description of the study procedures. Demographic data was then extracted from those who consented to participate in the experiment. Next, participants were randomly assigned to one of the four experimental sites for completing the first search task. To complete the search task, participants must bookmark all restaurants that they had considered, select what they deem to be the best choice from this consideration set and justify how they arrived at their eventual decision. Upon completing the search task, participants were presented with an online survey questionnaire to evaluate their search experience on the assigned experimental site. At the end of the survey, participants were given a completion code that qualifies them for the next stage of the study. We imposed a temporal separation of 6 to 24 hours between the two stages to reduce participants' likelihood of recalling their previous responses. The lower

bound of temporal separation is set to 6 hours to ensure forgetting of short term memory, which lasts less than 30 seconds, and encourage participants to engage in other activities to create a psychological separation (Podsakoff et al. 2003). The upper bound of temporal separation is set to 24 hours to encourage participation in the second stage hence reducing attrition rate. In the second stage, each participant was again assigned to the same version of the experimental site and instructed to complete the remaining search task. Afterwards, participants were presented with an online survey that is identical to the post-task questionnaire in the first stage. Upon the completion of the second stage, participants obtained a second completion code to claim their reward on AMT. Appendix C depicts a diagrammatic flow of the experimental procedures.

4.3 Search Feature Design

Faceted filter is a filter with a set of labels/tags representing "categories used to characterize items in a collection" (Hearst 2006). It is designed to operationalize a *scented orienting feature*. These tags were generated from analytics performed on the attribute values of available restaurants on our experimental site. Following conventional design, we organized the tags into five categories: ambience, cuisine, dining option, location, and diners' opinion. Participants can select tags in each category to specify search criteria. By doing so, participants can filter out restaurants with attributes that do not fit the chosen tags from the consideration set.

To represent an *unscented orienting feature*, we implemented a standard *search bar* that takes input of customized keywords as search criteria (Teevan et al. 2004). In line with contemporary design, we not only allow participants to specify the category of their keywords but also provide autocompletion function, which suggests keywords matching their input. The addition of autocompletion function helps to mitigate the possible confound of human error without giving off too much information scents.

Ranked list represents a list sorting feature that allows users to organize the list of options according to certain attributes in either an ascending or a descending order. Ranked list is implemented to operationalize an *unscented browsing feature*. We offer three options for participants to sort the restaurant list, including the rating of cuisine, the distance to a specific district, as well as the sentiment valence of diners' reviews.

Last but not least, we implemented a *scented browsing feature* in the form of *interactive map*, which allows participants to carry out browsing actions by manipulating an interactive map while supplying rich geographical data as information scents. Participants were allowed to manipulate the interactive map in two ways. First, participants can pan and zoom the viewport of the map to retrieve restaurants located within the updated viewport. Second, participants can draw boundaries around an area of interest by moving mouse cursor to retrieve restaurants within the boundaries.

4.4 Search Task Manipulation

For the manipulation of task types, we formulated two distinct search tasks. Guided by previous formulation of search tasks (Browne et al. 2007, Nadkarni and Gupta 2007, Novak et al. 2003), we introduced a *goal-oriented* task and an *exploratory* task for each participant to complete in the experiment (see Table 4). The goal-oriented task directs each participant to search for a restaurant for having dinner with one of his/her old friends. This task mirrors a structured goal-oriented task by imposing a specific goal for participants to accomplish: to locate a restaurant which fulfils certain criteria (e.g., cuisine, location and atmosphere) (Browne et al. 2007, Nadkarni and Gupta 2007, Novak et al. 2003). In contrast, the exploratory task does not come with explicit instructions and goals; rather, it encourages each participant to freely explore the restaurants on the assigned experimental site and select one according to their own preferences (Browne et al. 2007, Nadkarni and Gupta 2007, Novak et al. 2003).

To certify the effectiveness of our treatments, manipulation checks were conducted based on adapted measurement items for the goal-oriented and exploratory task conditions (see Appendix D) from past studies (Nadkarni and Gupta 2007). Additionally, we incorporated measures for *task realism* to establish if participants view one task to be more realistic than the other (see Appendix D). All in all, the manipulation checks helped to verify that participants indeed correctly assessed the goal specificity of each task and viewed them as equally realistic.

Table 4. Information Search Tasks Presented to Experimental Participants

Goal-Oriented Search Task: Find a restaurant for your friend
Sebastian was your best friend from high school, but you have not seen him for quite a while because he moved to another city right after his graduation. Last night, you received a surprise call from Sebastian who happens to be in town on business and would like to invite you to dinner this weekend. Because Sebastian has been away from San Francisco for many years, he wants you to pick a restaurant that is located midway between Sebastian's hotel and where you live. You live in the Bernal Heights neighborhood, which is located at the central area of San Francisco whereas Sebastian's hotel is situated in the Tenderloin neighborhood, which is to the north-east of your place. Also, even though Sebastian usually prefers authentic American cuisine, he finds other popular cuisines to be equally appealing so long as they are authentic. Likewise, he is easygoing and likes to follow the opinions of the majority. As your old friend, Sebastian wishes to have an enjoyable conversation with you in a casual atmosphere during your dinner. Please utilize the search features on this website to find a desirable restaurant for your dinner with Sebastian.
Exploratory Search Task: Find a restaurant for yourself
There is no scenario for this task, simply take the time to explore the restaurants featured on the website by utilizing its search features. At the end this task, select the "best" restaurant for yourself to have a meal (according to your own preference for choosing restaurants).

4.5 Objective Behavioral Measures

A custom-tailored experimental site presents us with the opportunity of monitoring participants' behavioral actions throughout his/her search process. By incorporating a search log into our data analysis, we can capture emergent search strategies as transitional probabilities between search actions via a Bayesian approach. All indicators of search performance in our hypotheses (i.e., search cost and search benefit) can be assessed through objective metrics. We operationalized search cost as proportion of time spent on using search features, such as specifying search criteria or scrolling the result list, throughout the search process.

Search benefit was objectively operationalized differently for goal-oriented and exploratory conditions. Goal-oriented search benefit was captured by the extent to which the restaurant selected by each respondent matched the criteria stipulated in task description. Specifically, we contrast the attribute values of the restaurant selected by a participant to six predefined criteria. First, we ascertained whether the distance from 'Tenderloin' neighborhood (i.e., location of Sebastian's hotel) to the restaurant is equal to that from 'Bernal Heights' neighborhood (i.e., location of participants' residence) to the restaurant. Second, we estimated the extent to which the total distances from Tenderloin and Bernal Heights neighborhoods to the restaurant are minimized. Third, we discerned whether the cuisine of the restaurant is 'American' and if the cuisine received good rating. Fourth, we gauged the extent to which reviews for the restaurant expressed positive sentiment. Fifth, we judged whether the ambience of the restaurant is 'Casual' and 'Intimate'. Last but not least, we established whether the restaurant is suitable for 'Dinner' and 'Late Night'. By calculating the mean for each of the abovementioned six dimensions, ranging from a minimum of 0 to a maximum of 1, we can arrive at a numerical value of a participant's goal-oriented search benefit.

Due to the absence of a specified goal in the exploratory search task, the objective measurement of exploratory search benefit is operationalized as the proportion of unique restaurants among all restaurants that were retrieved and evaluated by each participant. This operationalization is intended to capture the yield of exploration as the amount of novel and viable options retrieved in a search process. A search process that frequently leads to redundant options is deemed to be less worthwhile because of the low rate of retrieving novel and relevant information in relation to the effort expenditure. To be assured of the viability of each restaurant, be it unique or recurrent, we only considered the restaurant that a consumer had evaluated in detail by inspecting its dedicated page. Appendix E summarizes the objective measures employed in our study.

5 DATA ANALYSIS

A total of 377 participants were recruited from AMT, among which 288 participants completed both search tasks, resulting in an attrition rate of 33%. We validated our research model with these 288 data points. Demographic distribution for our sample is summarized in Table 5 below.

Table 5. Descriptive Statistics of Data Sample [Sample N = 288]

Demographics		No. Samples	%	Goal-Oriented Task				Exploratory Task			
				Faceted Filter	Search Bar	Ranked List	Interactive Map	Faceted Filter	Search Bar	Ranked List	Interactive Map
Gender	Male	142	49.30%	290	143	213	271	400	109	140	77
	Female	140	48.60%	439	153	210	377	558	188	163	87
	Unwilling to disclose	6	2.10%	12	3	3	4	6	0	8	1
Age	Age 19 - 29	80	27.80%	136	53	125	101	168	39	81	49
	Age 30 - 49	165	57.30%	442	154	246	444	576	173	163	81
	Age 50 - 64	35	12.20%	146	91	52	106	179	83	65	32
	Age 65+	3	1%	5	1	3	1	35	2	2	3
	Unwilling to disclose	5	1.70%	12	0	0	0	6	0	0	0
Education	Less than college education	38	13.20%	106	78	77	135	144	80	50	171
	College education or higher	247	85.80%	623	221	340	515	814	217	256	55
	Unwilling to disclose	3	1%	12	0	9	2	6	0	5	21
Income	$0 to $30,000	139	48.30%	343	154	202	289	435	161	171	41
	$30,000 to $50,000	71	24.70%	175	84	72	180	195	60	55	23
	$50,000 to $75,000	39	13.50%	115	40	83	105	160	54	21	0
	$75,000+	28	9.70%	86	7	44	69	140	11	41	27
	Unwilling to disclose	11	3.80%	22	14	25	9	34	11	23	9
Experience in San Francisco	More than 5 years	4	1.40%	7	0	1	12	9	0	0	1
	1 - 5 years	23	8%	10	11	30	13	20	8	27	6
	A few months	15	5.20%	22	0	17	8	37	7	9	3
	Less than a month	49	17%	138	47	84	115	199	42	66	28
	Never	197	68.40%	564	241	294	504	699	240	209	127
Restaurant Knowledge	Very low	1	0.30%	0	4	2	0	0	2	1	0
	low	8	2.80%	27	2	6	17	36	2	17	2
	Somewhat low	11	3.80%	28	2	9	14	41	0	13	3
	Medium	138	47.90%	355	214	281	388	437	199	193	95
	Somewhat high	72	25%	193	40	64	156	330	56	55	35
	High	45	15.60%	127	35	61	73	91	37	20	15
	Very high	13	4.50%	11	2	3	4	29	1	12	15

5.1 Manipulation Check

We conducted manipulation checks for the manipulation of search features and task types. To ensure that participants were indeed prompted to make use of search features that were present in their assigned experimental site, we captured their interactions with search features during the experiment process. Doing so allows us to compare the average number of search feature usages between a treatment group where a certain search feature is provided and a control group where the said feature is absent through ANOVA. Table 6 summarizes the results of manipulation checks for search feature configuration.

Table 6. Manipulation Check for Search Feature Configuration

	Search Feature	Condition	Use of Faceted Filter		Use of Search Bar		Use of Ranked List		Use of Interactive Map		Number of Examinations	
			N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
Goal-Oriented Task	Scented Orienting Feature	Absent	**147**	**0**	147	1.7	147	2.01	147	2.38	147	5.83
		Present	**141**	**5.28**	141	0.33	141	0.91	141	2.19	141	5.03
		F-Test	**135.31*** **		17.52***		8.26**		0.09 n.s.		0.117 n.s.	
	Unscented Orienting Feature	Absent	150	2.69	**150**	**0**	150	1.35	150	2.17	150	5.75
		Present	138	2.45	**138**	**2.15**	138	1.62	138	2.36	138	6.12
		F-Test	0.19 n.s.		**46.98*** **		0.52 n.s.		0.09 n.s.		0.38 n.s.	
	Unscented Browsing Feature	Absent	145	2.45	145	1.06	**145**	**0**	145	2.43	145	5.47
		Present	143	2.73	143	1.01	**143**	**2.97**	143	2.15	143	6.38
		F-Test	0.26 n.s.		0.02 n.s.		**74.66*** **		0.19 n.s.		2.376 n.s.	
	Scented Browsing Feature	Absent	148	2.14	148	1.07	148	1.65	**148**	**0**	148	5.86
		Present	140	3.06	140	0.99	140	1.29	**140**	**4.71**	140	5.99
		F-Test	2.78 n.s.		0.07 n.s.		0.89 n.s.		**65.55*** **		0.05 n.s.	
Exploratory Task	Scented Orienting Feature	Absent	**147**	**0**	147	1.67	147	1.54	147	0.82	147	6.55
		Present	**141**	**6.84**	141	0.37	141	0.6	141	0.32	141	6.49
		F-Test	**119.59*** **		22.64***		6.83**		6.11*		0.01 n.s.	
	Unscented Orienting Feature	Absent	150	2.91	**150**	**0**	150	1.17	150	0.64	150	6.50
		Present	138	3.82	**138**	**2.15**	138	0.99	138	0.5	138	6.54
		F-Test	1.49 n.s.		**72.14*** **		0.25 n.s.		0.48 n.s.		0.00 n.s.	
	Unscented Browsing Feature	Absent	145	3.06	145	1.12	**145**	**0**	145	0.53	145	6.20
		Present	143	3.64	143	0.94	**143**	**2.17**	143	0.62	143	6.84
		F-Test	0.63 n.s.		0.44 n.s.		**41.36*** **		0.17 n.s.		0.95 n.s.	
	Scented Browsing Feature	Absent	148	2.83	148	0.96	148	0.95	**148**	**0**	148	6.21
		Present	140	3.89	140	1.11	140	1.21	**140**	**1.18**	140	6.85
		F-Test	2.05 n.s.		0.27 n.s.		0.52 n.s.		**38.08*** **		0.93 n.s.	

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

As illustrated by the comparison results highlighted in bold in Table 6, participants were indeed compelled to use a search feature in their search processes when it was present, hence substantiating the effectiveness of our manipulation of search feature configurations across both goal-oriented and exploratory conditions. Table 6 also unveils the suppressing effect of the scented orienting feature on use of other search features especially in the exploratory condition. Specifically, when devoting effort in taking advantage of the faceted filter, participants tended to depend less on search bar and ranked list in goal-oriented condition, as well as search bar, ranked list, and interactive map in exploratory condition.

To verify if the provision of a specific search feature facilitates or inhibits the examining action, we also test if the average number of times participants examined detail pages changes when each search feature becomes available. As shown in Table 6, participants examined roughly the same number of restaurants regardless of the assigned search features across both task conditions. We can therefore confirm that the provision of search features poses no impact on consumers' examining action.

We also performed within-subject comparisons on task conditions via ANOVA. As shown in Table 7, participants' assessment of task type aligns with our anticipations. Participants reported significantly heightened goal-oriented condition after completing the goal-oriented task and indicated significantly higher exploratory condition after completing the exploratory task. To further augment the validity of our task manipulation, we also evaluated if both goal-oriented and exploratory tasks were deemed to be realistic. Results depicted in Table 7 point to a lack of significant discrepancy in realism between two tasks. Additionally, a one-sample test was carried out to examine whether the average rating for task realism deviates significantly from the neutral point. As testified by Table 8, realism of both goal-oriented and exploratory tasks indeed significantly surpasses the neural point, suggesting that respondents viewed both tasks as reasonable and believable.

Table 7. Manipulation Check of Search Tasks [N = 290]

Manipulation Check	Goal-Oriented Task		Exploratory Task		Comparison	F-Test
	Mean	S.D.	Mean	S.D.		
Goal-Oriented Condition	6.247	0.481	5.923	0.770	0.324	24.340***
Exploratory Condition	4.649	1.306	5.025	1.389	-0.377	15.255***
Task Realism	5.737	1.143	5.792	1.219	-0.056	0.320 n.s.

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

Table 8. One-Sample Test for Task Realism [N = 290]

Task Condition	Mean	S.D.	Comparison	t-Test
Goal-Oriented Task	5.737	1.143	1.737	25.868***
Exploratory Condition	5.792	1.219	1.792	25.047***

5.2 Search Feature and Search Action

To further demonstrate how search processes can be shaped by the provision of search features, we extract each participant's search trajectory from the search log captured and stored in our experimental platform. Each search action in the search log is categorized into three categories: orienting, browsing, and examining (see Table 9). By incorporating timestamp of each logged action, we are able to visualize trajectories of search actions along three axes. The x axis indicates the time (normalized in the range

between 0 and 1) when each search action was performed. The y axis denotes search actions that are devoted to orienting. The z axis resembles search actions that are conducted for browsing. Figure F1 visualizes and compares participants' search trajectories among different treatment groups across goal-oriented and exploratory conditions. For each treatment group, four sub-plots are shown. One plot shows all three dimensions whereas each of the remaining three depicts a side view comprising two of three dimensions. Each thin trend line in the plot reflects the temporal accumulation of a participant's orienting and browsing actions. The round dots peppered along each trend line represents a participant's in-depth examination of a restaurant via assessing its detail page. In addition, the thick trend line obtained through polynomial regression of individual search trajectories in each treatment group highlights the dominant search trajectory.

Table 9. Categorizing Search Actions

Search Action	Definition	Action Log
Orienting	A search move intended to manipulate search criteria	• Typing keywords in search bar • Selecting tags in faceted filter • Specifying sorting option • Drawing a customized boundary on the interactive map • Updating the consideration set by panning and/or zooming the interactive map • Removing search criteria • Resetting by going to homepage
Browsing	A search move intended to traverse the consideration set	• Scrolling the consideration set • Changing page of the consideration set • Panning the map • Zooming the map
Examining	A search move intended to examine an information item	• Opening a restaurant detail page

Figure 4 isolates all eight dominant search trajectories for both goal-oriented and exploratory conditions. As suggested by Figure 4, the role of each search feature in shaping emergent search process was relatively consistent across goal-oriented and exploratory conditions. When provided with a search bar, participants performed more orienting actions in comparison with those who were not. Although the presence of search bar in goal-oriented condition induced little influence on participants' propensity towards browsing, it alleviated the need to rely on browsing in the exploratory condition. The presence of ranked list encouraged participants to browse more for both search tasks. It also appears that ranked list helped to evoke participants' orienting actions at the early stage of goal-oriented task as well as at the late stage of exploratory task. Providing an interactive map to participants stimulated browsing actions. This facilitating effect is more salient in the goal-oriented condition in contrast to its exploratory counterpart. Moreover, the interactive map also promoted orienting actions at the late stage of goal-oriented task and throughout the exploratory task. Surprisingly, the provision of faceted filter appears to diminish both orienting and browsing actions across both search tasks. This unexpected finding alludes to a *locked-in*

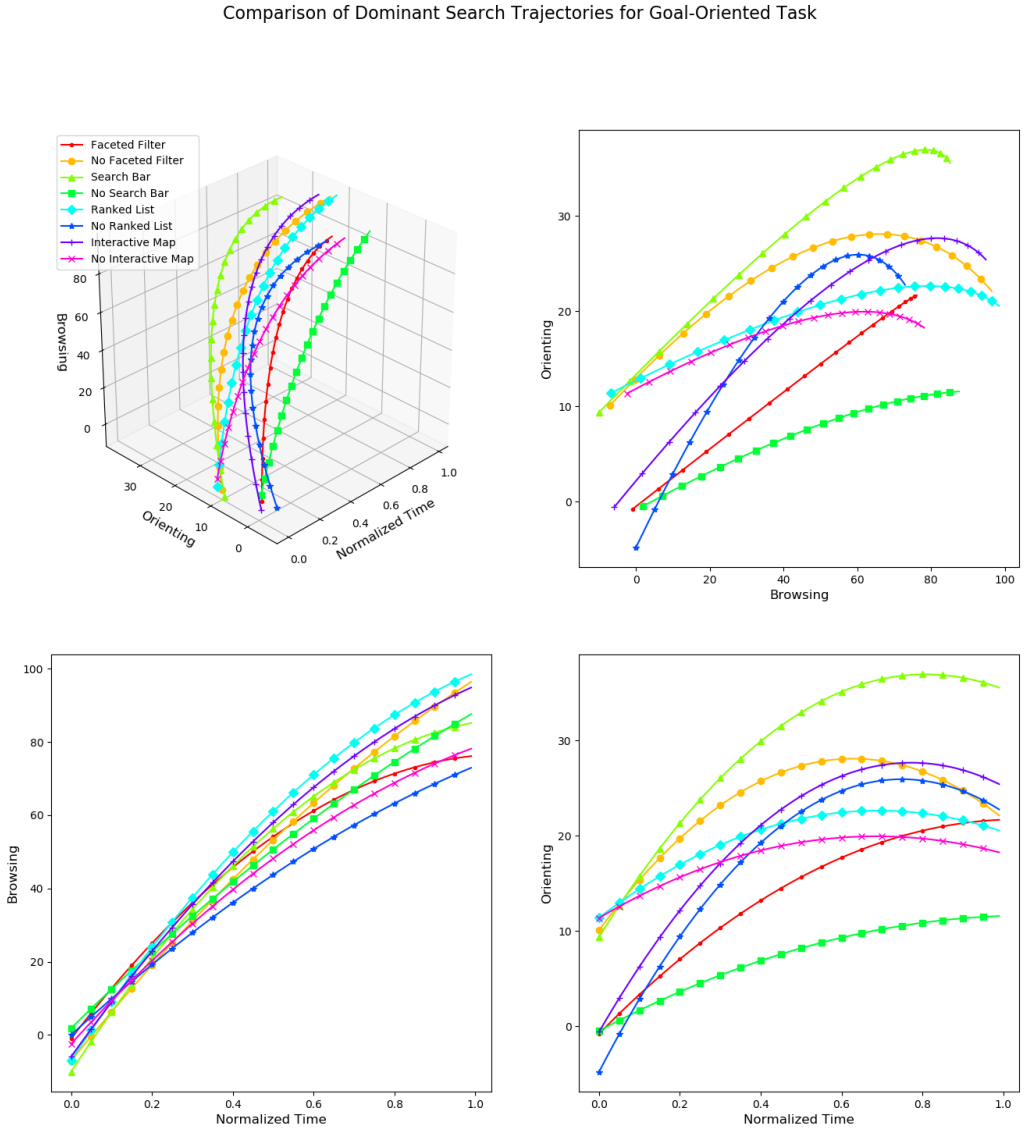
effect (Zhou et al. 2012) engendered by the information scents disseminated through tags in the faceted filter that suppresses the use of other search features.

To further substantiate the distinction between search features that gear towards the same search action, we performed a more granular comparison between the faceted filter and the search bar as well as one between the ranked list and the interactive map (see Figure 5). In goal-oriented condition, the sole presence of the search bar is the most effective in eliciting orienting actions, followed by the provision of both orienting features, and the sole provision of the faceted filter. As we anticipated, providing neither faceted filter nor search bar limited the performance of orienting actions. Likewise, participants were more likely to carry out browsing actions when provided with the ranked list and/or the interactive map. The provision of both browsing features was the most effective in eliciting browsing actions, followed by the sole provision of the ranked list and the interactive map respectively.

In the exploratory condition, how the faceted filter and the search bar facilitated orienting tactics remained consistent with the goal-oriented condition. Nonetheless, it appears the provision of orienting features also helped to subside the use of browsing tactics. On the other hand, participants tend to perform more browsing tactics when offered browsing features. Nonetheless, providing both browsing features simultaneously did not seem to outperform the sole provision of the ranked list in terms of driving up browsing actions. Furthermore, we observed an inhibiting effect on orienting tactics exerted by offering no browsing feature. This surprising finding implies that the capability to traverse the consideration set in a structured fashion plays a pivotal role in gauging the benefit of orienting tactic. Lacking such capability can hence discourage the use of orienting tactics.

Figure 4. Dominant Search Trajectories

Goal-Oriented Task



Exploratory Task

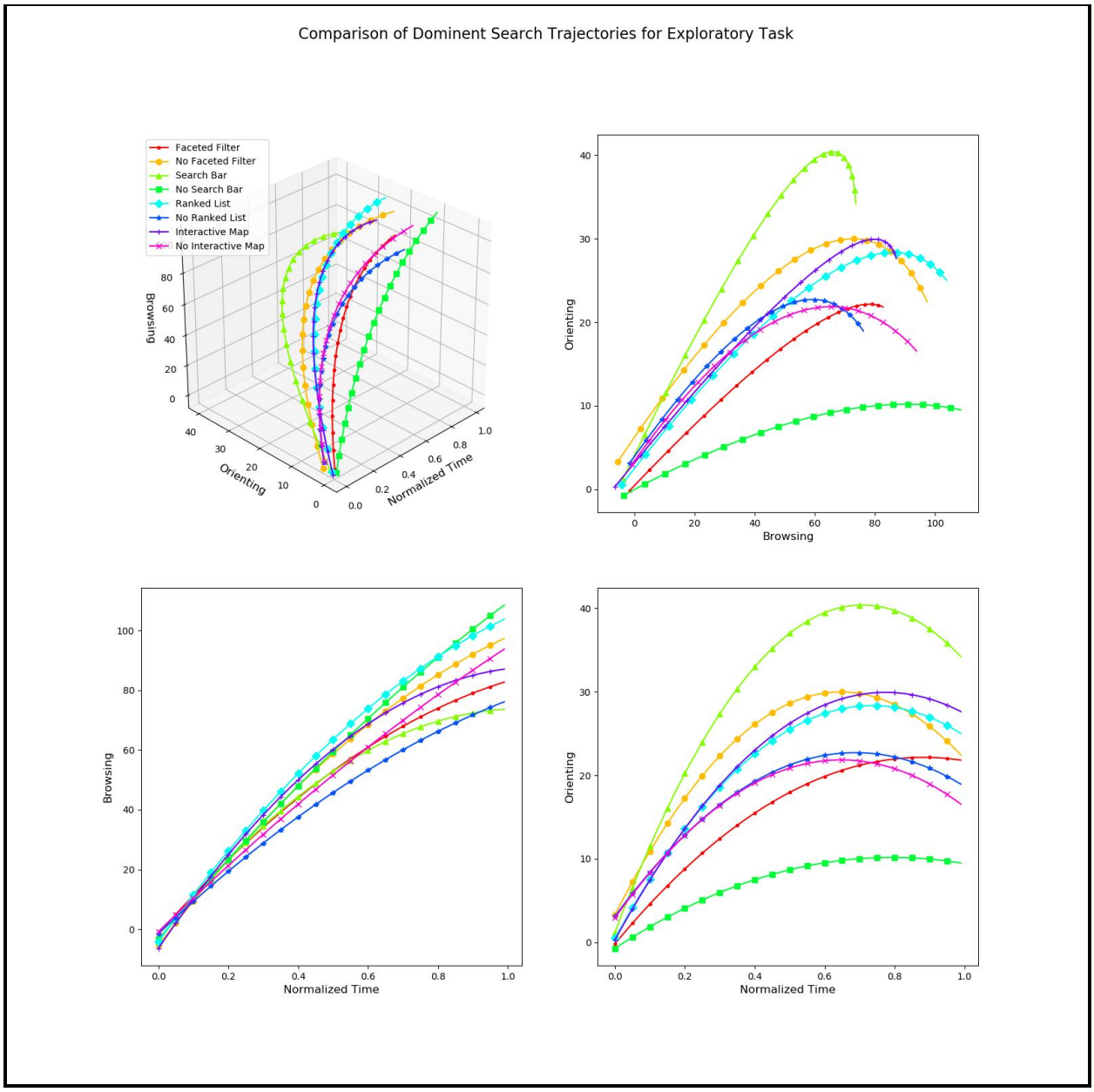
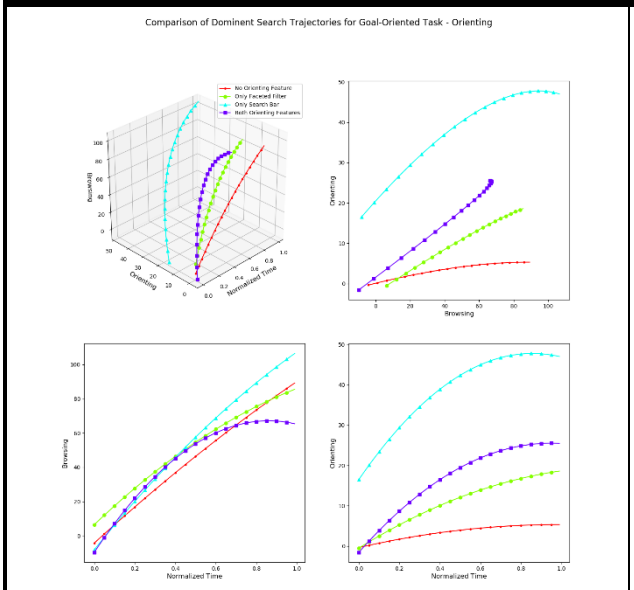
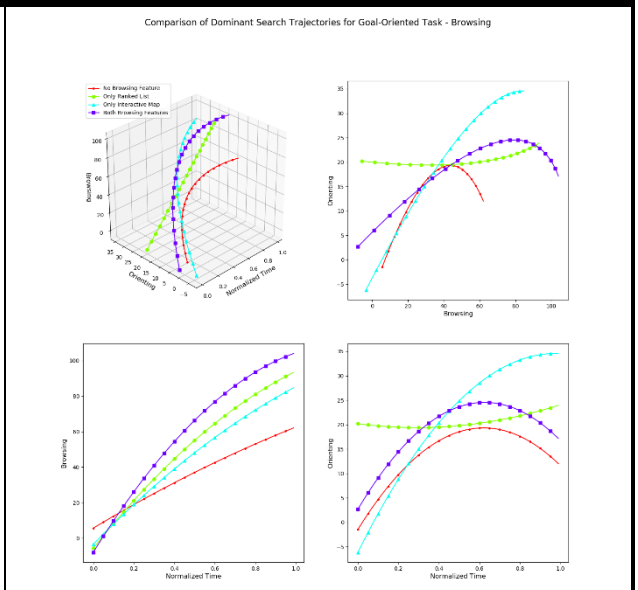

Comparison of Dominent Search Trajectories for Exploratory Task
Faceted Filter
No Faceted Filter
Search Bar
No Search Bar
Ranked List
No Ranked List
Interactive Map
No Interactive Map
Browsing
Orienting
Normalized Time
Orienting
Browsing
Browsing
Normalized Time
Orienting
Normalized Time

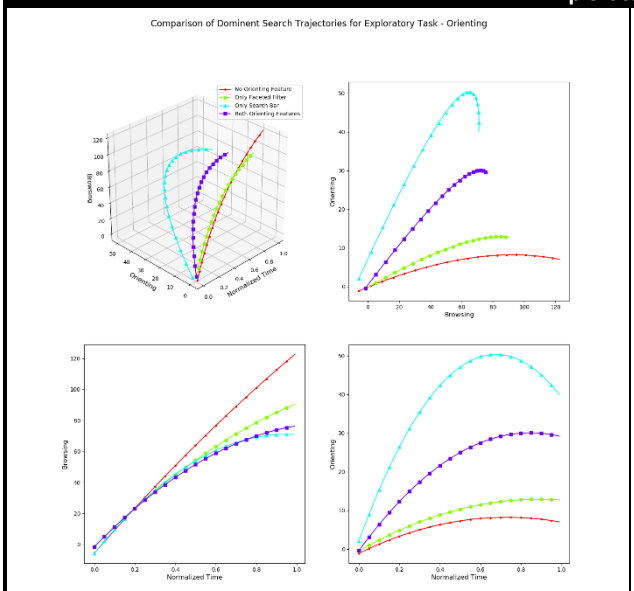
Figure 5. Dominant Search Trajectories for Search Features Geared towards Same Search Tactic

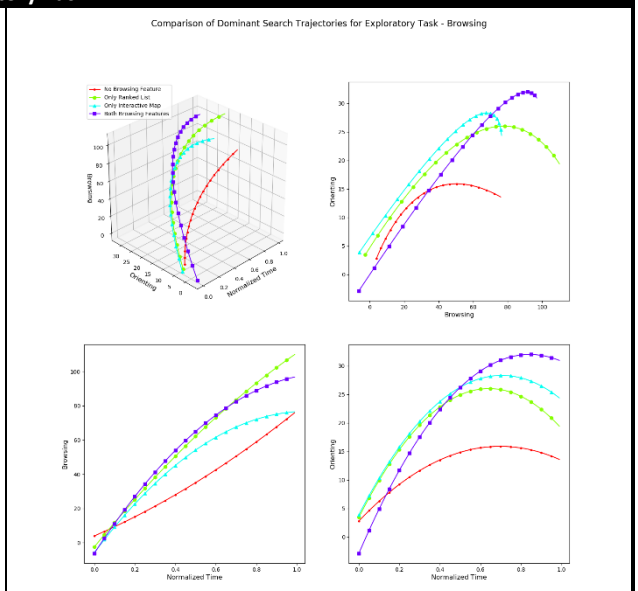
Goal-Oriented Task





Exploratory Task





5.3 Search Feature and Emergent Search Strategy

In light of our transitional view of emergent search strategy as consumers' propensities of transiting between related search actions, we adopt a Bayesian-based process modeling approach to extract the transitional probabilities between search actions from each participant's search log (Breuker et al. 2016, Rebuge and Ferreira 2012, Xie and Joo 2010). We employed a widely applied Python implementation of

Hidden Markov Model (HMM) algorithm, namely hmmlearn[1], to infer each participant's transitional probabilities throughout the search process. As shown in Table 10, inferred transitional probabilities are relatively consistent across both search tasks.

Table 10. Descriptive Statistics of Inferred Transitional Probabilities [Sample N = 288]

Transition	Goal-Oriented Task				Exploratory Task			
	Min.	Max.	Mean	Std.	Min.	Max.	Mean	Std.
Orienting → Browsing	0.000	1.000	0.598	0.343	0.000	1.000	0.591	0.352
Orienting → Orienting	0.000	0.976	0.333	0.331	0.000	0.972	0.345	0.334
Orienting → Examining	0.000	1.000	0.069	0.172	0.000	1.000	0.065	0.164
Browsing → Browsing	0.000	0.980	0.797	0.119	0.000	0.989	0.792	0.150
Browsing → Orienting	0.000	0.500	0.105	0.099	0.000	1.000	0.099	0.112
Browsing → Examining	0.000	0.500	0.097	0.082	0.000	1.000	0.109	0.112
Examining → Browsing	0.000	1.000	0.539	0.385	0.000	1.000	0.521	0.386
Examining → Orienting	0.000	1.000	0.271	0.364	0.000	1.000	0.286	0.368
Examining → Examining	0.000	1.000	0.190	0.237	0.000	1.000	0.193	0.239

We then compared transitional probabilities between treatment groups to uncover how each search feature affects likelihoods of emergent search strategies (see Appendix G). Due to the absence of information scents, the presence of an unscented orienting feature, like the search bar, ($\Delta\mu_{goal\text{-}oriented}$ = -0.252, F = 44.730***, $\Delta\mu_{exploratory}$ = -0.285, F = 56.357***) and an unscented browsing feature, like the ranked list, ($\Delta\mu_{goal\text{-}oriented}$ = -0.107, F = 7.073**, $\Delta\mu_{exploratory}$ = -0.071, F = 2.994†) leads participants to adhere to a path-seeking strategy across both task conditions, thus validating H1a and H1b. As we hypothesized, the provision of a scented orienting feature, like the faceted filter, ($\Delta\mu_{goal\text{-}oriented}$ = -0.005, F = 0.271 n.s., $\Delta\mu_{exploratory}$ = -0.034, F = 6.840***) and scented browsing feature, like the interactive map, ($\Delta\mu_{goal\text{-}oriented}$ = -0.024, F = 6.248*, $\Delta\mu_{exploratory}$ = -0.036, F = 7.510**) can encourage a saltating strategy by disseminating information scents, albeit the former is only effective in exploratory condition. With a specific search goal, participants can leverage on information scents disseminated by the faceted filter to achieve a much concise consideration set with a concentration of desirable options. Consequently, there is little reason for participants to hold attention on browsing the consideration set for long. This result partially supports H2a and fully supports H2b.

In line with our expectation, a scented orienting feature, like the faceted filter, ($\Delta\mu_{goal\text{-}oriented}$ = 0.042, F = 13.277***, $\Delta\mu_{exploratory}$ = 0.064, F = 25.753***) and an unscented orienting feature, like the search bar, ($\Delta\mu_{goal\text{-}oriented}$ = 0.025, F = 4.733*, $\Delta\mu_{exploratory}$ = 0.032, F = 5.973*) encourage a zigzagging strategy as they both retain search criteria as an explicit memory, hence supporting H3a and H3b. Additionally, fac-

[1] See http://hmmlearn.readthedocs.io/en/latest/ for the documentation of hmmlearn

eted filter evokes a saltating strategy ($\Delta\mu_{goal\text{-}oriented}$ = -0.005, F = 0.271 n.s., $\Delta\mu_{exploratory}$ = -0.034, F = 6.840***). How browsing features shape participants' emergent search strategies also largely aligns with our hypotheses. The presence of an unscented browsing feature, like the ranked list, ($\Delta\mu_{goal\text{-}oriented}$ = 0.126, F = 7.843**, $\Delta\mu_{exploratory}$ = 0.072, F = 2.551 n.s.) in the goal-oriented condition and the provision of a scented browsing feature, like the interactive map, ($\Delta\mu_{goal\text{-}oriented}$ = 0.102, F = 5.127*, $\Delta\mu_{exploratory}$ = 0.131, F = 8.550**) encourages a marathon strategy. As a result, H4a is partially supported whereas H4b is fully supported. The partially supported H4a suggests that the traceable memory enabled by ranked list is only impressionable when consumers undertake specific goals. See Table 11 for a summary of the testing results of aforementioned hypotheses.

Table 11. Summary of Hypotheses on Effect of Search Features [Sample *N* = 288]

Hypotheses	Goal-Oriented Task			Exploratory Task			Supported
	$\mu_{Absence}$	$\mu_{Presence}$	F-Test	$\mu_{Absence}$	$\mu_{Presence}$	F-Test	
H1a: UOF → ↓ O2B	0.719	0.466	44.730***	0.727	0.442	56.357***	Yes
H1b: UBF → ↓ O2B	0.651	0.544	7.073**	0.626	0.555	2.994†	Yes
H2a: SOF → ↓ B2E	0.100	0.095	0.271 n.s.	0.126	0.092	6.840**	Partially
H2b: SBF → ↓ B2E	0.109	0.085	6.248*	0.127	0.091	7.510**	Yes
H3a: SOF → ↑ B2O	0.085	0.127	13.277***	0.068	0.132	25.753***	Yes
H3b: UOF → ↑ B2O	0.093	0.118	4.733*	0.084	0.116	5.973*	Yes
H4a: UBF → ↑ E2B	0.477	0.602	7.843**	0.485	0.558	2.551 n.s.	Partially
H4b: SBF → ↑ E2B	0.489	0.592	5.127*	0.457	0.589	8.550**	Yes

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

Note: UOF → Unscented Orienting Feature; UBF → Unscented Browsing Feature; SOF → Scented Orienting Feature; SBF → Scented Browsing Feature; O2B → Orienting to Browsing; B2O → Browsing to Orienting; B2E → Browsing to Examining; E2B → Examining to Browsing

5.4 Robustness Check for Transitions Between Orienting and Examining

Transitional probabilities detailed in Appendix G can help to substantiate our decision to exclude the direct transitions between orienting and examining from our taxonomy of emergent search strategies. In particular, the transitional probabilities from orienting to examining remain small and invariant across different search feature manipulations (i.e., faceted filter, search bar, and ranked list) among both task conditions (i.e., goal-oriented and exploratory tasks). Surprisingly, the provision of the interactive map appears to significantly reduce the transitional probability from orienting to examining ($\Delta\mu_{goal\text{-}oriented}$ = -0.038, F = 3.653†, $\Delta\mu_{exploratory}$ = -0.072, F = 14.530***). This unexpected finding can be attributed to the design of the interactive map in which participants can pan the map around to reveal restaurants located in the vicinity. The provision of an interactive map could hence draw participants' attention on browsing restaurant availability in the vicinity of the focal area. Consumers can better concentrate their attention on exploring the map due to the absence of visual and textual representations of restaurants, except for markers, on the map for prompting immediate examination. For this reason, browsing actions are more

likely to be performed before examining actions, rendering the manifestation of the direct transition from orienting to examining less frequent.

On the other hand, the Appendix G shows that despite the significance level, if the transitional probability from examining to browsing changes due to the provision of a search feature, the transitional probability from examining to orienting also changes yet in the opposite direction. Additionally, the transitional probabilities from examining to examining are contingencies that remain relatively small and invariant across all combinations of search feature manipulations (i.e., faceted filter, search bar, ranked list, and interactive map) and task conditions (i.e., goal-oriented and exploratory tasks). We can thus corroborate that the transition from examining to orienting mirrors the transition from examining to browsing.

5.5 Evaluating Effectiveness of Emergent Search Strategies

We employed multiple linear regression implemented in R to test how switching to a certain emergent search strategy as manifested in altered transitional probability between search actions affects search performance. Prior to hypothesis testing, we evaluated correlations between all focal constructs to ensure that our data analysis is free from unexpectedly high inter-construct correlations (see Table 12). As shown in Table 13, H6b ($\beta_{goal\text{-}oriented}$ = 0.177, t = 2.772**, $\beta_{exploratory}$ = 0.225, t = 1.890†), H7a ($\beta_{goal\text{-}oriented}$ = -0.666, t = -5.905***, $\beta_{exploratory}$ = -0.447, t = -5.734***), and H8a ($\beta_{goal\text{-}oriented}$ = 0.074, t = 3.055**, $\beta_{exploratory}$ = 0.055, t = 2.406*) are fully supported across both goal-oriented and exploratory conditions. H8b ($\beta_{goal\text{-}oriented}$ = 0.074, t = 1.374 n.s., $\beta_{exploratory}$ = 0.283, t = 6.294***) is only supported in the exploratory condition, indicating the benefit of a marathon strategy in boosting search benefit is only rendered salient when conducting the exploratory task. In the goal-oriented condition, consumers seek to locate options that match their preferences (Browne et al. 2007). Therefore, prolonging the browsing process after hitting a desirable target contributes little to achieving the pre-determined objective.

Testing H5a ($\beta_{goal\text{-}oriented}$ = 0.006, t = 0.228 n.s., $\beta_{exploratory}$ = -0.025, t = -0.987 n.s.), H5b ($\beta_{goal\text{-}oriented}$ = -0.005, t = -0.299 n.s., $\beta_{exploratory}$ = 0.064, t = 1.728†), H6a ($\beta_{goal\text{-}oriented}$ = 0.112, t = 1.204 n.s., $\beta_{exploratory}$ = 0.069, t = 0.869 n.s.), and H7b ($\beta_{goal\text{-}oriented}$ = -0.067, t = 0.912 n.s., $\beta_{exploratory}$ = 0.098, t = 1.904 n.s.) produces largely non-significant results. In light of these findings, neither path-seeking nor zigzagging strategies incurs additional search cost since the time allocated on examining and selecting viable options appears to be proportional to time expended on specifying search criteria. This implies that the heuristic nature of both path-seeking and zigzagging strategies can be a remedy to the vocabulary misalignment issue prevalent in onsite search for service offerings (Farrell 2017). Repeatedly adjusting search criteria

may seem effortful, it nonetheless facilitates vocabulary calibration (Farrell 2017) and helps consumers to more accurately express their preferences with vocabulary recognized by the search feature.

Interestingly, path-seeking strategy was found to marginally increase search benefit in the exploratory condition. One plausible explanation to this surprising finding is that due to the low goal specificity characterizing exploratory tasks, it falls on the searchers to decide whether to formulate more extensive and detailed search criteria or to use vague and concise search terms to jumpstart browsing. Those who adhere to path-seeking strategy would focus on formulating search criteria before browsing the result list. They are hence expected to achieve a consideration set with a higher concentration of viable options and in turn yield more search benefit. Additionally, saltating strategy helped little in boosting search benefit in comparison to cruising strategy. As suggested by this unexpected finding, prolonged browsing of the consideration set before examining each option in detail contributes little to boosting search benefit.

Table 12. Inter-Construct Correlation Matrix [Sample N = 288]

Construct		O2B	B2O	B2E	E2B	BSC	OSB
Goal-Oriented Task	**O2B**	1.000					
	B2O	-0.237	1.000				
	B2E	-0.006	-0.158	1.000			
	E2B	-0.080	0.256	-0.293	1.000		
	OSC	-0.160	0.107	-0.370	0.251	1.000	
	OSB	-0.062	0.204	-0.116	0.138	0.135	1.000
Exploratory Task	**O2B**	1.000					
	B2O	-0.284	1.000				
	B2E	-0.040	-0.107	1.000			
	E2B	-0.148	0.220	-0.197	1.000		
	OSC	-0.213	-0.011	-0.258	0.249	1.000	
	OSB	-0.022	-0.186	0.071	0.215	0.635	1.000

Note: O2B → Orienting to Browsing; B2O → Browsing to Orienting; B2E → Browsing to Examining; E2B → Examining to Browsing; BSC → Behavioral Search Cost; OSB → Objective Search Benefit

Table 13. Summary of Hypotheses on Effectiveness of Emergent Search Strategies [Sample *N* = 288]

Hypotheses	Goal-Oriented Task			Exploratory Task			Supported
	β	*t* value	R^2	*β*	*t* value	R^2	
H5a: ↓ O2B → ↑ OSC	-0.155	3.151**	0.182	-0.235	4.192***	0.164	Yes
H5b: ↓ O2B → ↑ OSB	-0.016	0.266 n.s.	0.054	-0.048	0.806 n.s.	0.116	No
H6a: ↑ B2O → ↑ OSC	-0.019	0.371 n.s.	0.182	-0.147	2.456*	0.164	No
H6b: ↑ B2O → ↑ OSB	0.171	2.867**	0.054	-0.251	4.972***	0.116	Partially
H7a: ↓ B2E → ↑ OSC	-0.331	9.264***	0.182	-0.244	6.041***	0.164	Yes
H7b: ↓ B2E → ↑ OSB	-0.067	0.912 n.s.	0.054	0.098	1.904 n.s.	0.116	No
H8a: ↑ E2B → ↑ OSC	0.146	2.969**	0.182	0.199	4.070***	0.164	Yes
H8b: ↑ E2B → ↑ OSB	0.074	1.374 n.s.	0.054	0.283	6.294***	0.116	Partially

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

Note: O2B → Orienting to Browsing; B2O → Browsing to Orienting; B2E → Browsing to Examining; E2B → Examining to Browsing; BSC → Behavioral Search Cost; OSB → Objective Search Benefit

Figure 6 offers an overview of our data analysis result. The result substantiates the key role played by emergent search strategies induced by search features in affecting search performance. For goal-oriented consumers, both unscented and scented orienting features (i.e., search bar and faceted filter) are effective in boosting search benefit by encouraging a zigzagging strategy that helps consumers find alternatives that more closely match their preferences without imposing additional cost. Both unscented and scented browsing features (i.e., ranked list and interactive map) seem to be ill-suited for the goal-oriented task since they drive a marathon strategy that increases search feature usage without providing extra benefit. Scented browsing features (i.e., interactive map) can be more taxing by encouraging a saltating strategy.

Exploratory consumers' choice of search features is less straightforward. Although all search features were found to encourage emergent search strategies that improve consumers' exposure to novel and viable alternatives, they vary in effectiveness in enhancing search benefit and the incurred search cost. In particular, scented orienting feature (i.e., faceted filter) provides minimal boost in search benefit while demanding more search cost since it encourages both zigzagging and saltating strategies. In contrast, unscented orienting feature (i.e., search bar) encourages zigzagging and path-seeking strategies, of which both boost search benefit without incurring additional search cost. Likewise, unscented browsing feature (i.e., ranked list) also enhances search benefit, albeit to a less extent, without inflating search cost by only encouraging the path-seeking strategy. Last but not least, only scented browsing feature (i.e., interactive map) was found to encourage marathon strategy, which gives the highest search benefit while demanding more time spent on search feature usage. The incurred search cost can be further increased since scented browsing feature (i.e., interactive map) also drives the saltating strategy. Taken together, consumers can choose between unscented orienting feature and scented browsing feature depending on whether they prioritize efficiency or exhaustiveness for an exploratory search process.

6 DISCUSSION AND CONCLUSION

Drawing on optimal foraging theory, this study employed a process modelling approach to investigate emergent search strategies for onsite search. We conceptualize emergent search strategy, which generates emergent search processes, as consumers' unpremeditated propensities for making use of a search feature when proceeding from action to action in an onsite search process. This novel theorization allows us to identify four dyads of strategies (i.e., path-taking vs path-seeking, zigzagging vs. path-following, cruising vs. saltating, and marathon vs. sprint) employed by online consumers. This typology of emergent search strategies serves as the centerpiece for us to explore consumers' emergent use of search features and evaluate the effectiveness of their search endeavors.

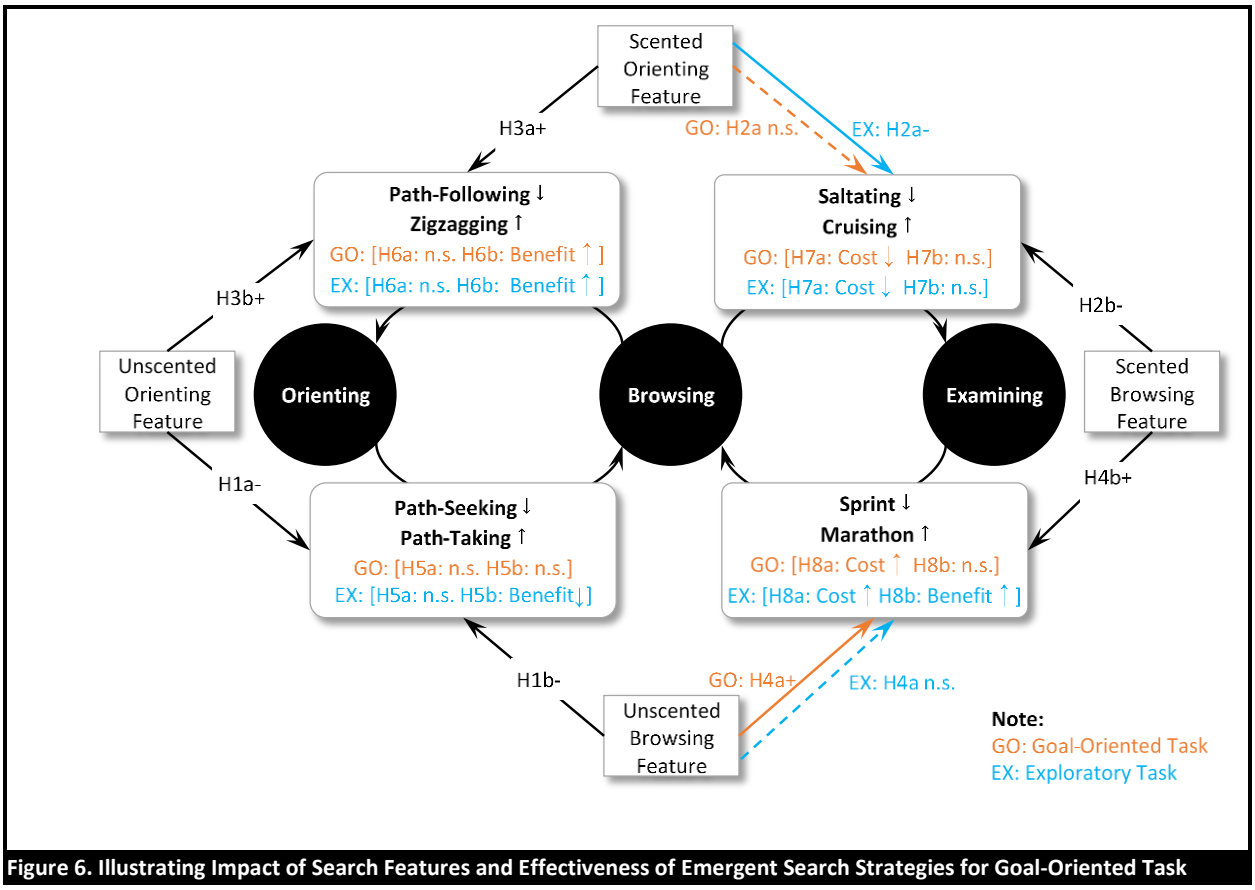


Figure 6. Illustrating Impact of Search Features and Effectiveness of Emergent Search Strategies for Goal-Oriented Task

By collecting and analyzing consumers' behavioral data in a controlled online experiment, we identified generativities of search features, namely information scent dissemination and traceable memory. Results showed that scented features (i.e., a faceted filter and an interactive map) evoke a saltating strategy whereas unscented ones (i.e., a search bar and a ranked list) encourage a path-seeking strategy. Moreover, search features retain explicit traceable memory (i.e., a faceted filter and a search bar) encourage a zigzagging strategy whereas those retain implicit traceable memory (i.e., a ranked list and an interactive map) promote a marathon strategy. The effect of search features on consumers' emergent search strategies remains largely consistent regardless whether they are driven by specific imposed objectives. The only two exceptions are the insignificant connection between scented orienting feature and saltating strategy in the goal-oriented condition as well as the lack of capability for unscented browsing feature to elicit a marathon strategy in the exploratory condition.

Noteworthily, the effectiveness of different emergent search strategies turns out to be more complicated than we anticipated. When carrying out a goal-oriented task, zigzagging appears to be the dominant strategy as it allows consumers to locate a target that more accurately resembles their preferences without exerting more time using search features. Adhering to other three strategies (i.e., path-seeking, saltating,

and marathon) in a goal-oriented condition does not seem to yield more desirable result despite the heightened search cost.

Conversely, there is no single winning strategy in the exploratory condition. For instance, path-seeking and zigzagging strategies can both expend consumers' exposure to viable alternatives without making exploration more costly. In contrast, marathon strategy is more effective in expending the range of viable alternatives that consumers may uncover by requiring more search feature usage. The remaining strategy evoked by search features (i.e., saltating strategy) only serve to increase consumers' use of search features without improving the payoff.

6.1 Theoretical Implication

Findings from this study bear implications for research on five fronts. First, this study advances a transitional view of search strategy to contribute to a better understanding of the increasingly prevalent emergent use of search features that is neither intended by the designers nor preconceived by consumers. This study formulates this novel view as a typology of emergent search strategies that consists of four strategic dyads. By theorizing emergent search strategy as the unpremeditated propensity for making use of a search feature when proceeding from action to action throughout a search process, we achieve a distinct typology that differs from search task (Marchionini 1997), consumers' characteristics (Dumais et al. 2010, Liu and Wei 2016), predominant tactic (Aula et al. 2005, Cothey 2002, Ford et al. 2005, Wang et al. 2000), or a rigid sequence of actions (Thatcher 2006, Xie and Joo 2010).

Second, this study leverages on the transitional view on strategies Doing so also helps us look beyond the more deterministic task-technology fit paradigm (Goodhue and Thompson 1995). Rather, this study theorizes onsite search as a process that emerges from the interaction between consumers' human agency for attention allocation interacts with the technological agency enabled by search features on match making platforms. This distinct theorization of process a distinct typology that sets this study apart from others that investigate search as implicit, deterministic, or stochastic processes (see Table 1). Consumers' propensities for allocating attention on search features in each action transition can be steered by information scents disseminated and tracible memories retained by search features. Each search process manifests distinctively as consumers approach certain action transitions while avoiding the others. Future studies can leverage propensity of attention allocation to examine consumers' emergent use of technologies. This study can hence serve as an example for future studies that seek to leverage the increasingly prevalent digital traces to contribute to this scholarly endeavor.

Third, by adapting optimal foraging theory as a scaffold for building our research model, we extended this theory to the onsite search context. In a food foraging situation, although three key foraging actions (i.e., turning, moving, and pausing) exist, past studies do not distinguish between turning and moving (O'Brien et al. 1990). Consequently, predators' foraging strategies are categorized solely by the transition propensities between moving and pausing (O'Brien et al. 1990). However, the equivalents of turning and moving actions (i.e., orienting and browsing) become much more distinguishable in onsite search scenarios (Hantula 2010). Identifying this contextual distinction, we incorporate the transitions between orienting and browsing in addition to those between browsing and examining in the typology of emergent search strategies. In so doing, we are able to capture both the directionality and intensity of attention allocation propensities among three key search actions and identified four dyads of emergent search strategies, including path-taking vs. path-seeking, zigzagging vs. path-following, cruising vs. saltating, and marathon vs. sprint. Each dyad capsulates consumers' approaching or avoiding of a search action transition that shapes search processes recursively.

Fourth, this study uncovered how different search features that vary in information scent dissemination and traceable memory retainment encourage vastly different emergent search strategies. Interestingly, our results suggest that consumers are unlikely hindered by vocabulary misalignment (Farrell 2017) when using scented orienting features (i.e., faceted filter) for goal-oriented tasks. In other words, vocabulary misalignment manifests mainly in exploratory conditions where goal specificity is low. Consequently, scented orienting features evoke a saltating strategy by which consumers calibrate their search vocabulary only in exploratory conditions. Additionally, unscented browsing features (i.e., ranked list) encourage a marathon strategy only in goal-oriented conditions, implying that they are not as effective as their scented counterparts for exploratory tasks. Overall, search features rich with information scents (i.e., faceted filter and interactive map) encourage the switch from cruising to saltating strategy, whereas those devoid of information scents (i.e., search bar and ranked list) lead to the switch from path-taking to path-seeking strategy. Search features retaining explicit traceable memory (i.e., faceted filter and search bar) evoke the switch from path-following to zigzagging strategy, whereas those retaining implicit traceable memory (i.e., ranked list and interactive map) drive the switch from sprint to marathon strategy.

Fifth, this study identifies zigzagging as a strategy that is both effective and efficient for onsite search regardless of the search tasks. This strategy helps consumers to probe option availability and learn the appropriate vocabulary for search in a recursive and heuristic fashion. On the contrary, the saltating strategy inflates search features usage without providing additional payoffs across both task conditions. This finding suggests that examining more options in detail is more efficient than perpetually browsing the consideration set. The effectiveness of the remaining emergent search strategies varies across different task conditions. In goal-oriented condition, switching from path-taking to path-seeking strategy does not affect search performance. Moreover, adhering to marathon strategy drives up costs without producing

additional benefits. In the exploratory condition, path-seeking becomes a preferable strategy that allows consumers to be exposed to more novel options without demanding more search feature usage. Additionally, switching from sprint to marathon strategy simultaneously heightens search benefit and cost.

6.2 Practical Implication

This study offers three actionable guidelines for match making platforms to improve consumers' search experience and move towards taking into consideration consumers' emergent behaviors. First, our findings highlight the most effective emergent search strategies. Specifically, for consumers who undertake goal-oriented tasks, zigzagging, cruising, and sprint is likely to be the optimal combination of emergent search strategies. That is, we recommend consumers to more frequently adjust search criteria when browsing the consideration set, examine options in detail more frequently when browsing the consideration set, and limit the scope of browsing to efficiently retrieve options that fit their needs. For exploratory consumers, they may adopt a combination of path-seeking, zigzagging, cruising, and sprint to maximize efficiency or a combination of path-seeking, zigzagging, cruising, and marathon to discover more viable alternatives. Consumers may minimize the overhead costs of search features usage by carefully specifying search criteria, frequently examining options in detail, as well as limiting the scope of browsing. Alternatively, consumers can prioritize for exposure to viable alternatives by browsing the consideration set more extensively.

Second, we encourage match making platforms to pay more attention to the crucial role played by search features in affecting consumers' search experience. For instance, platforms can personalize the provision of search features to encourage the most effective emergent search strategies in accordance with the task undertaken by each consumer. For consumers who undertake specific search goals, a platform can provide scented orienting features to encourage the zigzagging strategy, the dominant strategy for tackling goal-oriented tasks. For consumers who are more exploratory, unscented orienting features can be provided together with scented browsing features to help them maximize search benefit.

Third, search feature design can be further improved to enhance search performance. Our findings shed light on the possibility of designing for emergent behavior through configuring digital generativities. Match making platforms can leverage on predictive analytics to monitor and steer each consumer's attention allocation propensities in their search processes. For example, to support a path-seeking strategy, platforms should avoid distracting consumers with excessive information scents when expressing their search criteria. A cruising strategy can be better facilitated by guiding consumers' attention to details of

each option during the browsing process. Platforms can display curated details of each option directly in the consideration set rather than a separate page. To accommodate a zigzagging strategy, platforms can prompt consumers' attention to adjust their search criteria when they browsed a consideration set for too long. It is also possible to draw consumers' attention to their scopes of browsing to nudge them towards sprint or marathon strategies by tracking and visualizing the number of options they have browsed. AI assistant can be leveraged to facilitate these strategy-centric designs by monitoring consumers' attention allocation propensities and provide recommendations on the fly in a conversational style. AI assistants can also personalize the provision of search features in real-time basing on consumers' attention allocation propensities to nudge them into more effective emergent search strategies. The current study hence contributes towards this advancement by identifying effective and ineffective emergent search strategies.

6.3 Limitation and Future Research

This study is not free of limitations that need to be considered when generalizing our findings. First, since restaurants come with well-defined attributes, setting our empirical context to online restaurant search allows us to design well-structured, consistent, and reliable experimental procedure. This in turn ensures the internal validity of our findings. Nonetheless, choosing such an experimental setting can limit the applicability of search features we incorporated in our experiment. For example, the interactive map would not be useful for searching service providers to which geographical locations are not essential. Future research could expand our study by targeting alternate empirical settings where different search features are required.

Second, by recruiting participants from AMT, we seek to diversify the demographics of our sample and in turn bolster the external validity. Nonetheless, it is possible for us to overlook cultural factors that can potentially affect online users' information search behaviour since the majority of the respondents are from United States. Future studies may try to identify these cultural factors by recruiting participants with different cultural backgrounds and examining how cultural factors can shape their emergent search strategies.

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8 APPENDICES

8.1 Appendix A Summary of Prior Research on Information Search Tactics and Strategies

Table A1. A Summary of Information Search Tactics

Author	Search Tactic	Description	Search Tactic Categories			Nature of Study	Context
			Orienting	Browsing	Examining		
Bates (1979)	Monitoring tactics	Comparing the search question and a search in progress			X	Theory building	Article search
	File structure tactics	Threading through the file structure of the information facility		X			
	Search formulation tactics	Designing or redesigning the formulation of search terms	X				
	Term tactics	Selection and revision of search terms	X				
Bates (1979)	Idea tactics	Exploring new ideas or solutions in the search		X		Theory building	Article search
Bates (1989)	Berrypicking	Satisfying informational needs via a series of directed queries	X			Theory building	Article search
	Browsing	An involving undirected search via continuous sampling and selecting		X			
Bates (1990)	Monitoring tactics	Comparing the search question and a search in progress			X	Theory building	Article search
	File structure tactics	Threading through the file structure of the information facility		X			
	Search formulation tactics	Designing or redesigning the formulation of search terms	X				
	Term tactics	Selection and revision of search terms	X				
	Idea tactics	Exploring new ideas or solutions in the search		X			
Bates (2002)	Searching	Actively attempting to satisfy informational needs via a series of directed queries	X			Theory building	Article search
	Browsing	Actively exposing ourselves to possibly novel information		X			
	Monitoring	Maintaining a back-of-the-mind alertness for relevant information			X		
Booth (2008)	Most specific facet first	Selecting the most specific search term first	X			Literature review	Article search
	Lowest posting facet first	Selecting the search term with the least hits first	X				
	Successive fractions	Narrowing the search by incorporating more search terms	X				
	Drop a concept	Broadening the search by eliminating the least relevant search	X				

		term					
	Berry picking	Satisfying informational needs via a series of directed queries	X				
	Interactive scanning	Satisfying unspecified informational needs by scanning retrieved information items		X			
Carstens et al. (2009)	Search formulation tactics	Designing or redesigning the formulation of search terms	X			Log file analysis	Article search
	Term tactics	Selection and revision of search terms	X				
Choo et al. (2000)	Undirected Viewing	Scanning broadly a diversity of sources, taking advantage of what's easily accessible		X		Survey + Tracking + Interview	Web navigating in work place
	Conditioned Viewing	Browsing in preselected sources on pre-specified topics of interest		X			
Ellis (1989)	Starting	Activities characteristic of the initial search for information	X			Interview	Article search
	Chaining	Following chains of citations or other forms of referential connection between material	X				
	Browsing	Semi-directed searching in an area of potential interests		X			
	Differentiating	Using differences between sources as filters on the nature and quality of the material examined	X				
	Monitoring	Maintaining awareness of developments in a field through the monitoring of particular sources			X		
	Extracting	Systematically working through a particular source to locate material of interest			X		
Garcia and Sicilia (2003)	Ontology-based query	Information seeking aided by structured knowledge representations	X			Design science	Article search
	Ontology-based exploration	Navigating through structured knowledge representations		X			
Golovchinsky (1997)	Query-mediated links	Selecting links that embeds search terms	X			Experiment	Article search
	Explicit query	Manually formulating the search terms	X				
Hölscher and Strube (2000)	Query-based search	Requesting information via a set of search terms	X			Experiment	Search engine search
	Browsing	Navigating through Web pages via links		X			

Hsieh-Yee (1993)	Search formulation tactics	Designing or redesigning the formulation of search terms	X			Experiment + Concurrent verbal protocols + Search log analysis + Observation	Article search
	Term selection tactics	Selection and revision of search terms	X				
	Search monitoring tactics	Comparing the search question and a search in progress			X		
Hsieh-Yee (1998)	Term modification tactics	Narrowing the search by modifying search terms	X			Experiment	Text and image search
	Browsing	Sifting through information items		X			
Hsieh-Yee (2001)	Direct access tactics	Direct retrieval of relevant information			X	Literature review	Internet search
	Navigational tactics	Sifting through information items		X			
	Query formatting	Formatting the set of search terms	X				
Kuhlthau (1993)	Browsing	Sifting through information items		X		Field study	Library search
	Querying	Retrieving information via a set of search terms	X				
Teevan et al (2004)	Orienteering	Searching by localized or situated navigation		X		Interview + Observation	Internet search
	Teleporting	Trying to jump directly to that information	X				
Kules and Shneiderman (2008)	Broad queries	Typing broader queries in the search box	X			Experiment on a custom-made search system	Topical search
	Organize examination by overview	Determining the order in which results subsets are examined	X				
	Overview as backup	Examining the overview to identify subsets to examine	X				
	Preview before narrowing	Examining the subcategory information before narrowing results to that category	X				
	Assess result set	Scanning categorized overview of the search results		X			
	Probe using categorized overview	Examining the specific categories to assess subsets of the results			X		
Spink et al (2001)	Keyword query	Requesting information via a set of search terms	X			Search log analysis	Internet search
	Browsing page of results	Locating relevant information via browsing query results		X			
Vakkari (2001)	Beginning a session	Beginning a search session with only one or all relevant search terms derived from the search problems	X			Longitudinal study on a database	Topical information search
	Search formulation tactics	Designing or redesigning the formulation of search terms	X				
	Limiting	Limiting the query by operational moves	X				
Wildemuth (2004)	Narrowing search set	Modifying the set of search terms to narrow down the search scope	X			Field study + Search log analysis	Clinical information search
	Broadening search set	Modifying the set of search terms to broaden up the search scope	X				
	Term tactics	Selection and revision of search	X				

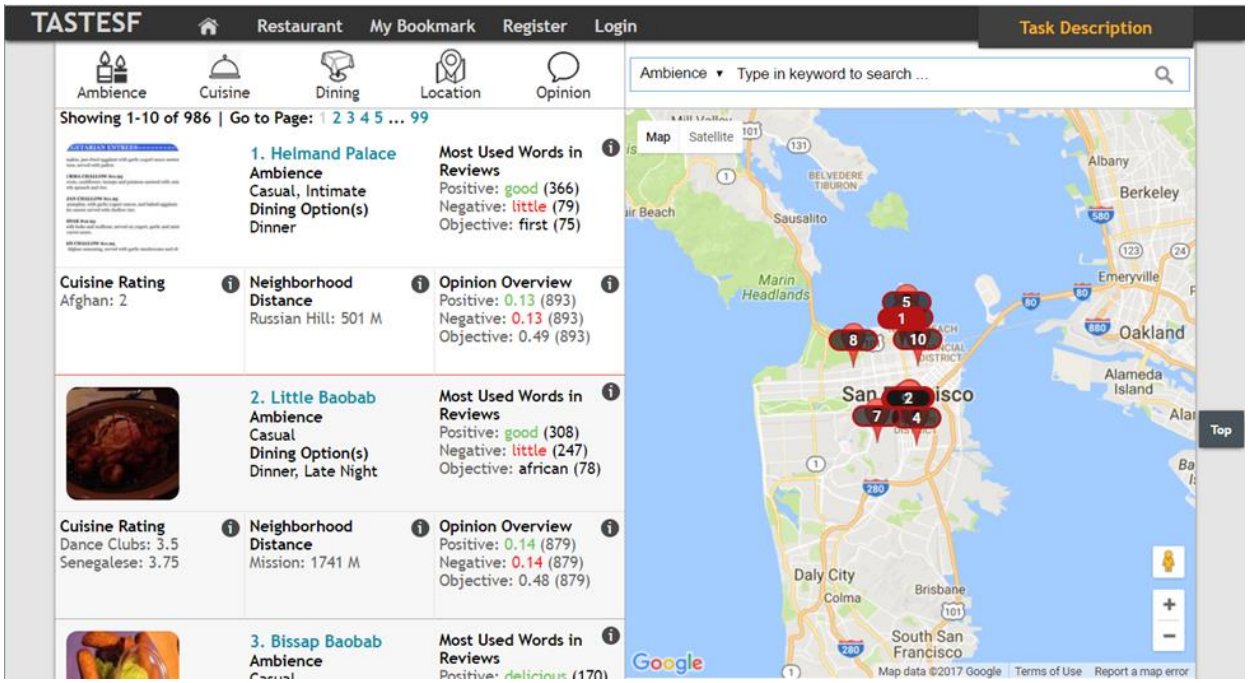
		terms					
Wilson (2009)	Monitoring tactics	Comparing the search question and a search in progress			X	Usability test	Search interface design
	File structure tactics	Threading through the file structure of the information facility		X			
	Search formulation tactics	Designing or redesigning the formulation of search terms	X				
	Term tactics	Selection and revision of search terms	X				
	Idea tactics	Exploring new ideas or solutions in the search		X			
Xie and Joo (2010)	Creating search statement	Coming up with a search statement for searching	X			Experiment + Survey + Interaction diary + Concurrent verbal protocol + Search log analysis	Internet search
	Modifying search statement	Changing a previous search statement to narrow search results or broaden search results	X				
	Evaluating search results	Assessing the relevance of search results			X		
	Accessing forward	Going to a specific item or Web page that has not been accessed in the search by using direct location, tracking meta-information, or hyperlinks			X		
	Accessing backward	Going back to a previous page by using direct location, tracking meta-information, or hyperlinks		X			
	Exploring	Surveying information/items in a specific site		X			
	Organizing	Sorting out a list of items with common characteristics	X				
	Monitoring	Keeping track of the search process or check the current status			X		

Table A2. A Summary of Information Search Strategies

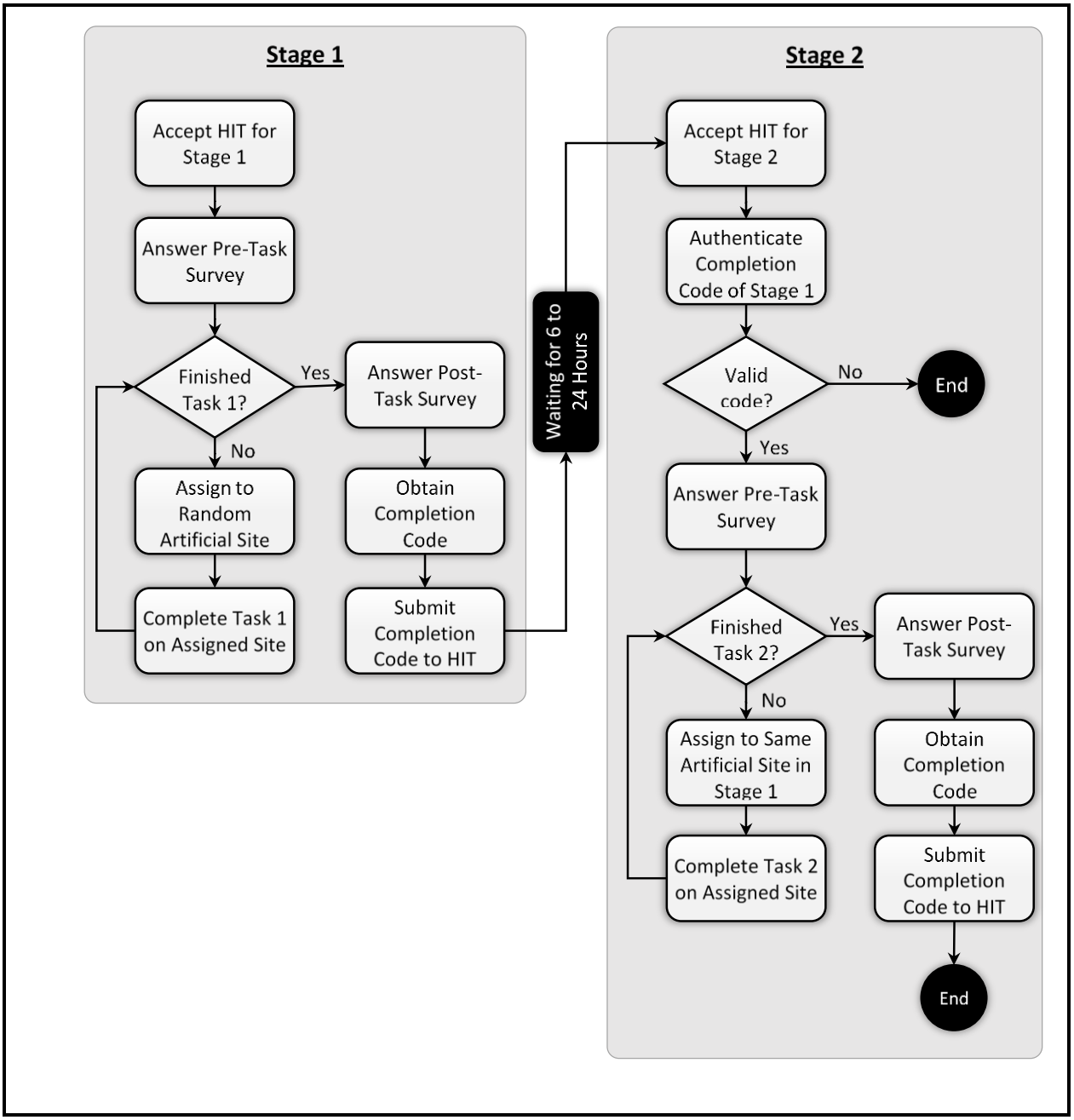
Author	Conceptualization of Search Strategy	Nature of search Strategy				Nature of Study	Context of study
		Task Type	Consumer Type	Predominant Tactic	Sequence of Tactics		
Marchionini (1997)	• Analytical search • Browsing search	X				Theory Building	Internet Search
Navarro-Prieto et al. (1999)	• Top-down search • Bottom-up search • Mixed search		X			Retrospective verbal protocol analysis	Internet Search
Kim (1999)	• Spoke-and-hub • Breadth first		X			Screen recording analysis	Internet Search

	• Depth first						
Fidel et al. (1999)	• Intuitive scanning • Analytical • Known site • Empirical • Similarity • Focused search • Swift and flexible	X	X	X		Concurrent verbal protocols + Observation + Interviews	Internet Search
Wang et al. (2000)	• Search engine starting • Link-following • Known page search • Hub-and-spoke			X		Concurrent verbal protocol	Internet Search
Cothey (2002)	• Search querying • Link clicking			X		Search log analysis	Internet Search
Aula et al. (2005)	• Multi-tab search • Search engine usage • URL usage • History log usage			X		Survey	Internet Search and re-access
Ford et al. (2005)	• Boolean search • Best-match search • Combined search			X		Search log analysis	Search Engine Usage
Thatcher (2006)	• Safe player • Parallel player • Link-dependent • To-the-point • Known address • Sequential player • Deductive reasoning • Virtual tourist • Parallel hub-and-spoke				X	Search log analysis + Observation + Screen recording analysis + Retrospective verbal protocol	Internet Search
Dumais et al. (2010)	• Exhaustive search • Economic-results search • Economic-ads search		X			Eye-tracking experiment	Search Engine Usage
Xie and Joo (2010)	• Query initiation strategy • Know-item exploration strategy • Iterative result evaluation strategy • Iterative exploration strategy • Result evaluation strategy • Exploration strategy				X	Experiment + survey + Interaction diary + Concurrent verbal protocol + Search log analysis	Internet Search
Liu and Wei (2016)	• Exhaustive search • Economic search		X			Lab experiment	Search Engine Usage

8.2 Appendix B - Illustrative Example of Experimental Online Restaurant Review Site



8.3 Appendix C – Diagrammatic Flow of Experimental Procedures



8.4 Appendix D – Manipulation Check Instrument and Properties

Construct	Definition	Reflective Measure [7-Point Likert Scale]	Goal-Oriented Task		Exploratory Task	
			Mean (S.D.)	Item Loading	Mean (S.D.)	Item Loading
Goal-Oriented Condition [GOA]	Extent to which consumers perceive the undertaken task is goal-oriented	When I was at the website, I had a distinct identifiable purpose.	6.103 (0.943)	0.713	5.728 (1.134)	0.809
		When I was at the website, I had a specific target in mind.	6.034 (1.055)	0.783	5.638 (1.363)	0.823
		When I was at the website, I was very focused on the goal I want to achieve.	6.383 (0.750)	0.866	6.062 (0.965)	0.858
		When I was at the website, I was concentrated on attaining my objective.	6.341 (0.756)	0.865	6.117 (0.876)	0.843
Exploratory Condition [EXP]	Extent to which consumers perceive the undertaken task is exploratory	When I was at the website, I was clicking through many different webpages.	4.541 (1.906)	0.569	4.700 (1.888)	0.704
		When I was at the website, I was absorbed in seeing where I could go next.	5.548 (1.333)	0.913	5.576 (1.259)	0.938
		When I was at the website, I was randomly surfing.	2.566 (1.778)	0.498	2.759 (1.730)	0.208
Task Realism [TR] (Newly Developed)	Extent to which consumers perceive the scenario in the undertaken task is realistic.	The scenario depicted in the task may happen to me in real life.	5.762 (1.226)	0.915	5.814 (1.259)	0.946
		I am likely to encounter the scenario depicted in the task in real life.	5.697 (1.224)	0.935	5.752 (1.305)	0.964
		I may have to deal with the scenario depicted in the task in real life.	5.752 (1.217)	0.955	5.810 (1.260)	0.959

8.5 Appendix E – Summary of Objective Measures

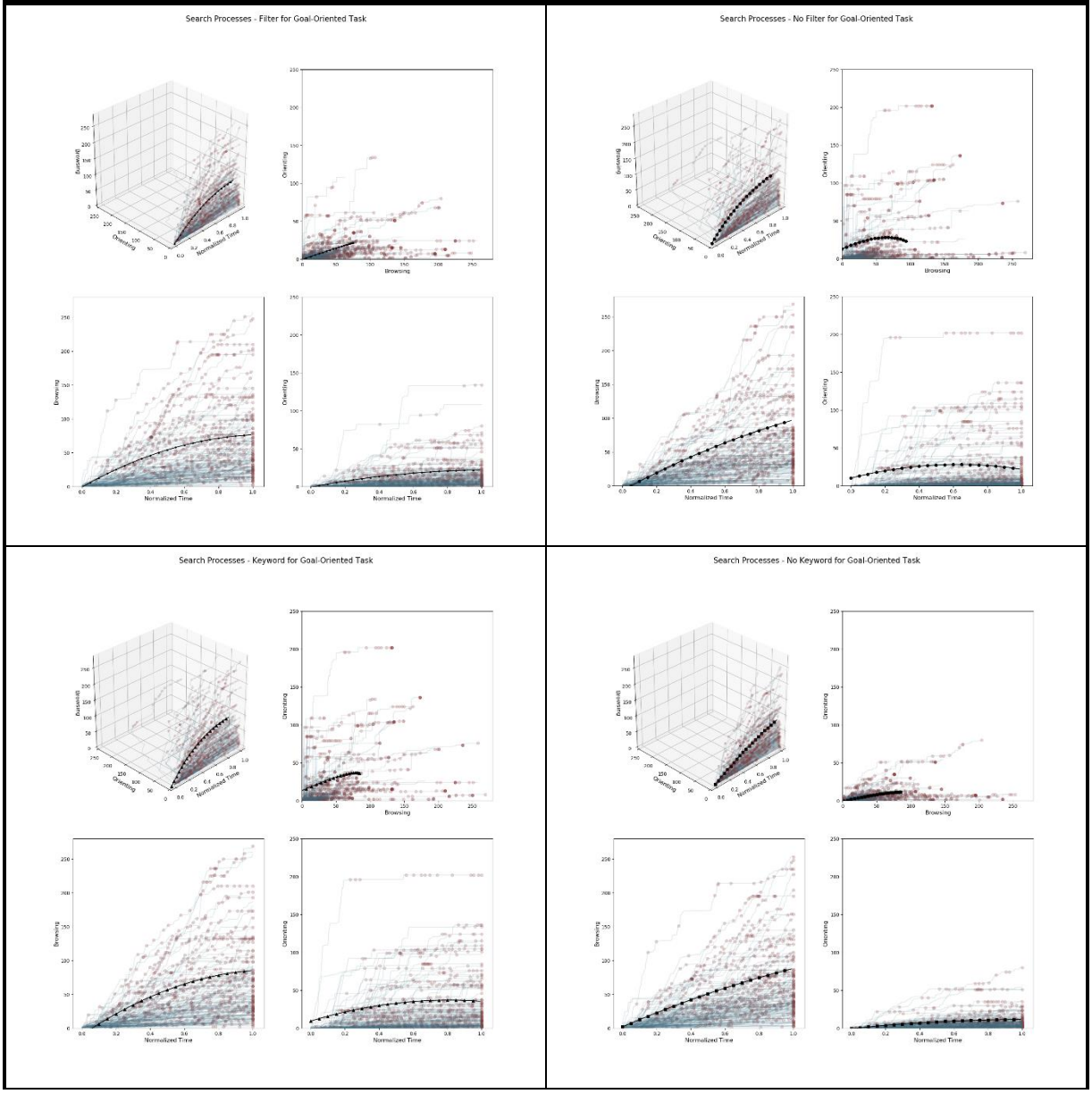
Construct	Definition	Operationalization	Goal-Oriented Task Mean (S.D.)	Exploratory Task Mean (S.D.)
Objective Search Cost (OSC)	Amount of search activities performed by a consumer throughout a search process	$No.\ of\ search\ actions$	92.410 (77.631)	91.517 (78.728)
Goal-Oriented Search Accuracy [Discrepancy in Distances] (GSAD)	Extent to which the distance from *Tenderloin* neighborhood to the restaurant is equal to that from *Bernal Heights* neighborhood to the restaurant	$1 - \frac{\lvert d_t - d_b \rvert}{d_t + d_b}$	0.586 (0.322)	N/A
Goal-Oriented Search Accuracy [Total Distance] (GSAT)	Extent to which the distance from *Tenderloin* neighborhood to the restaurant and that from *Bernal Heights* neighborhood to the restaurant are minimized in accordance with the distance between the two neighborhoods	$\frac{4680}{d_t + d_b}$	0.824 (0.173)	N/A
Goal-Oriented Search Accuracy [Cuisine] (GSAC)	Extent to which the cuisine of the restaurant is *American* or received good rating	$\frac{\frac{r_{cuisine}}{5} + boolean_{1:American\mid 0:Others}}{2}$	0.719 (0.213)	N/A
Goal-Oriented Search Accuracy [Diner Opinion] (GSAO)	Extent to which the reviews for the restaurant expressed *positive* or *neutral* opinion	$\mu_{positive\ valence} + \mu_{neutral\ valence}$	0.612 (0.077)	N/A
Goal-Oriented Search Accuracy [Ambience] (GSAA)	Extent to which the ambience of the restaurant is *Casual* and *Intimate*	$1: Both\ Casual\ and\ Intimate \mid$ $0.75: Casual \mid$ $0.5: Intimate \mid$ $0: Neither\ Casual\ nor\ Intimate$	0.581 (0.334)	N/A
Goal-Oriented Search Accuracy [Dining Option] (GSAN)	Extent to which the restaurant is suitable for *Dinner* and *Late Night*	$1: Both\ Dinner\ and\ Late\ Night \mid$ $0.75: Dinner \mid$ $0.5: Late\ Night \mid$ $0: Neither\ Dinner\ nor\ Late\ Night$	0.697 (0.222)	N/A

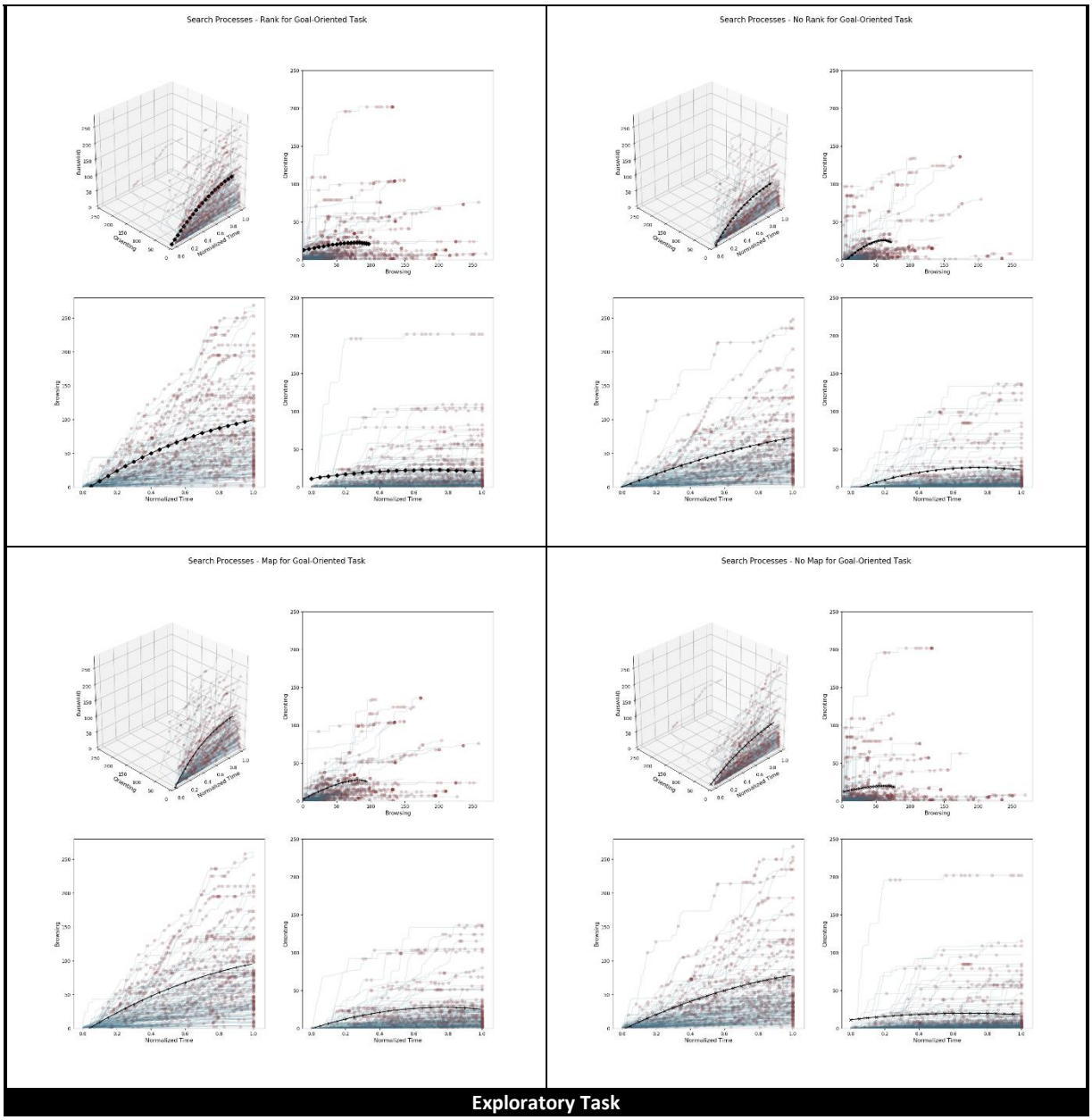
Goal-Oriented Search Benefit (GSU)	Extent to which the search results conform to the search goal in accordance with stopping rules	$\frac{SAD + SAT + SAC + SAO + SAA + SAN}{6}$	0.670 (0.104)	N/A
Exploratory Search Benefit (ESU)	Extent to which the search process yields informational gains in turns of gaining exposure to unique restaurants	$No.\ of\ unique\ restaurants\ evaluated$	N/A	4.455 (3.682)

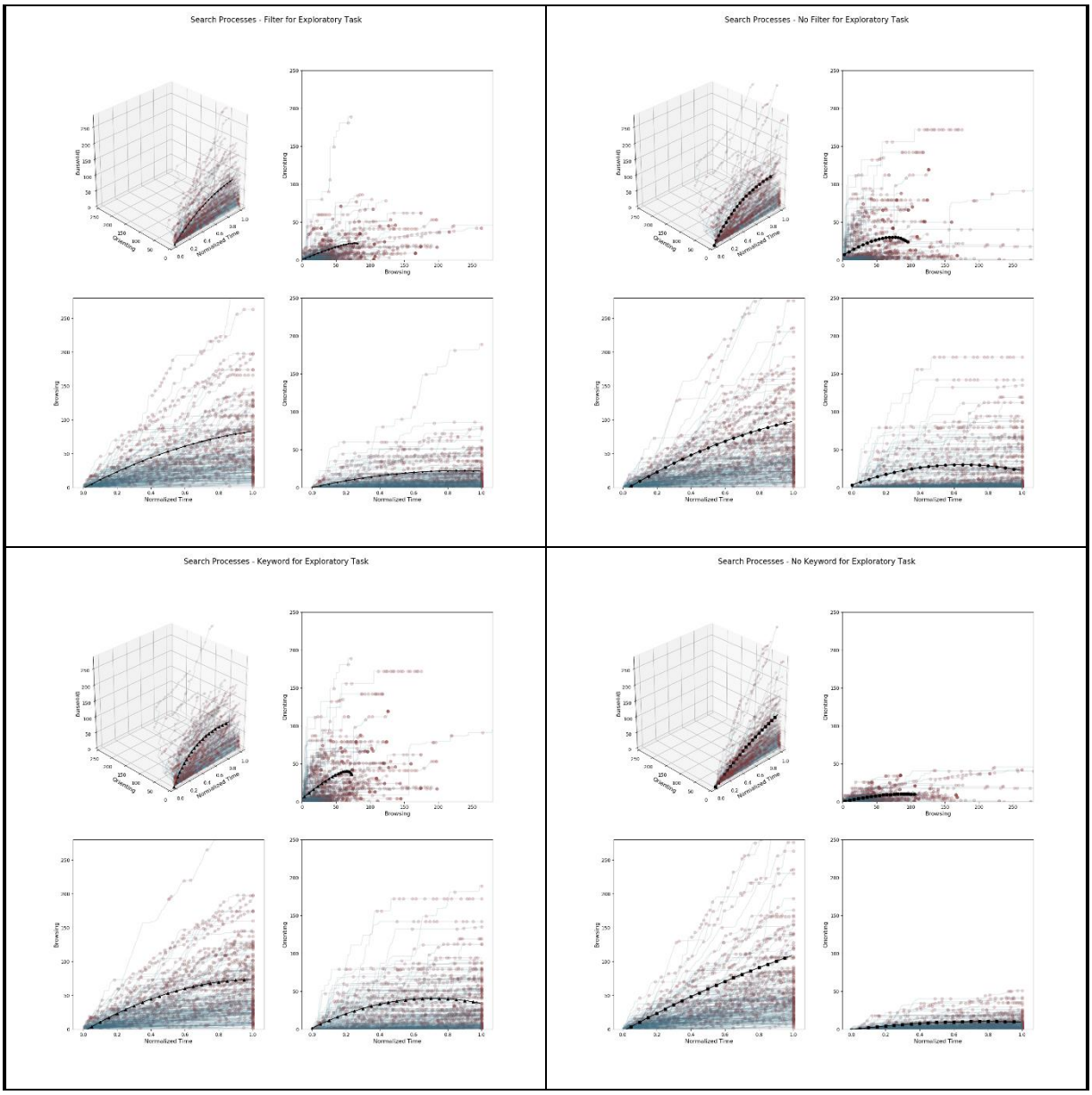
8.6 Appendix F – Search Trajectories

Figure F1. Search Trajectories for Both Search Tasks

Goal-Oriented Task




Search Processes - Rank for Goal-Oriented Task
Search Processes - No Rank for Goal-Oriented Task
Search Processes - Map for Goal-Oriented Task
Search Processes - No Map for Goal-Oriented Task
Exploratory Task


Search Processes - Filter for Exploratory Task
Search Processes - No Filter for Exploratory Task
Search Processes - Keyword for Exploratory Task
Search Processes - No Keyword for Exploratory Task
Normalized Time
Browsing
Orienting
Bursting

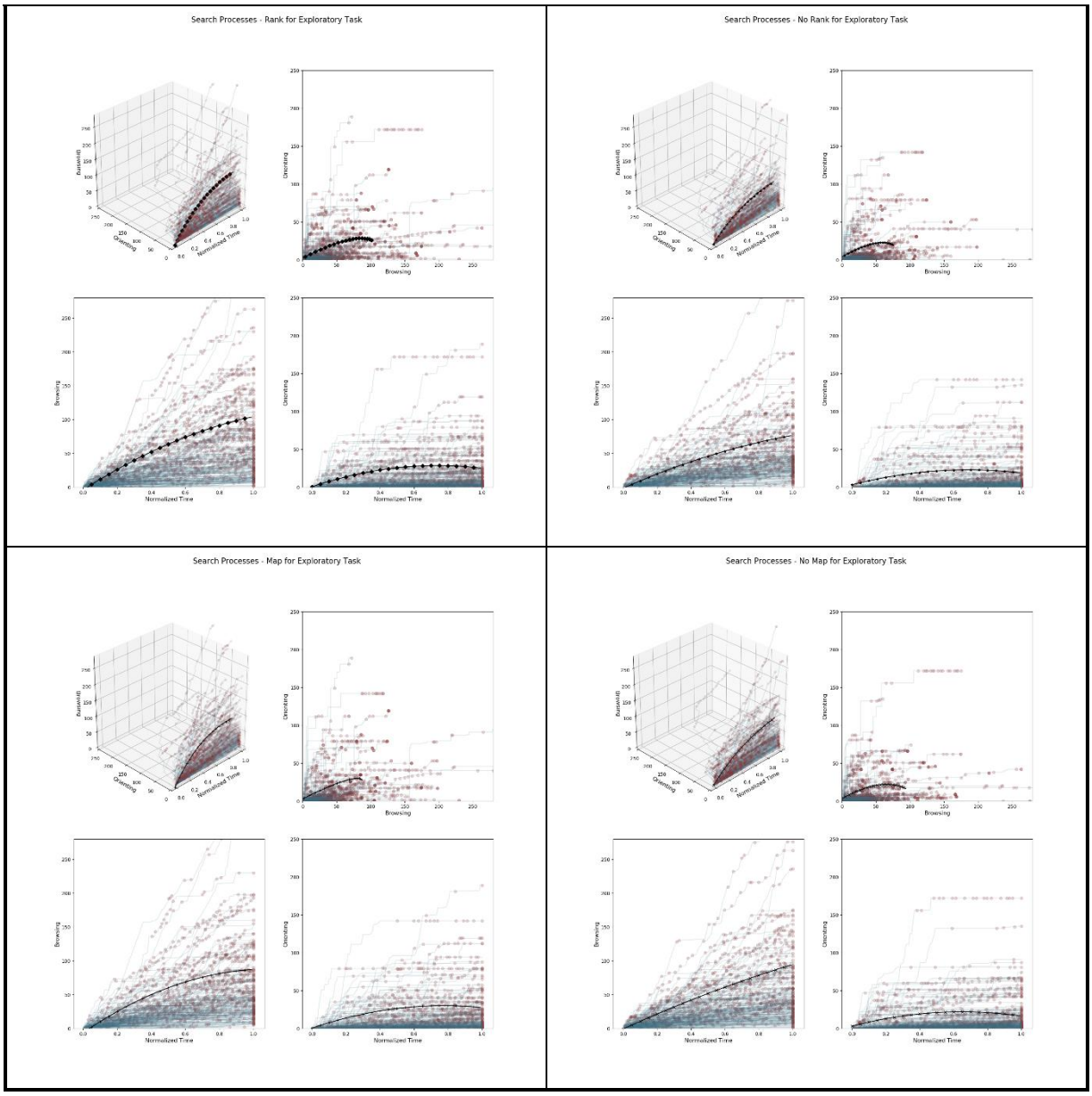
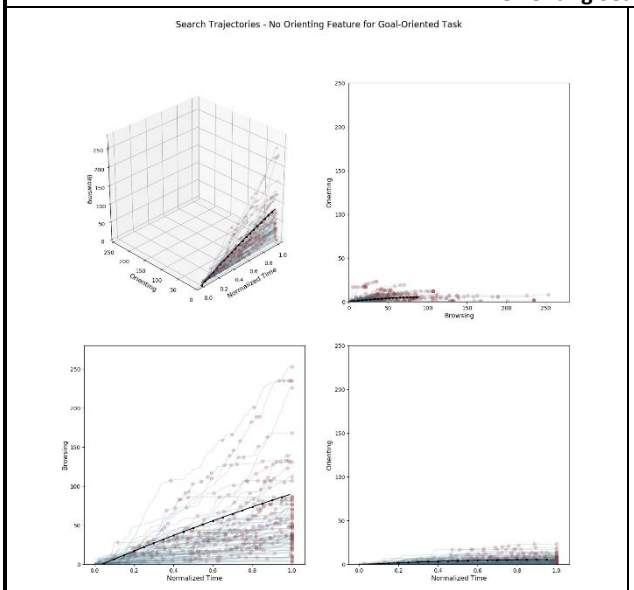
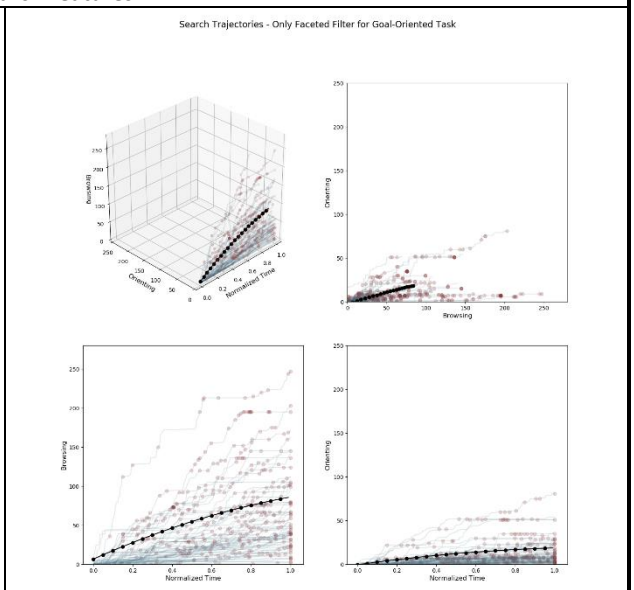

Search Processes - Rank for Exploratory Task
Search Processes - No Rank for Exploratory Task
Search Processes - Map for Exploratory Task
Search Processes - No Map for Exploratory Task
Normalized Time
Orienting
Browsing

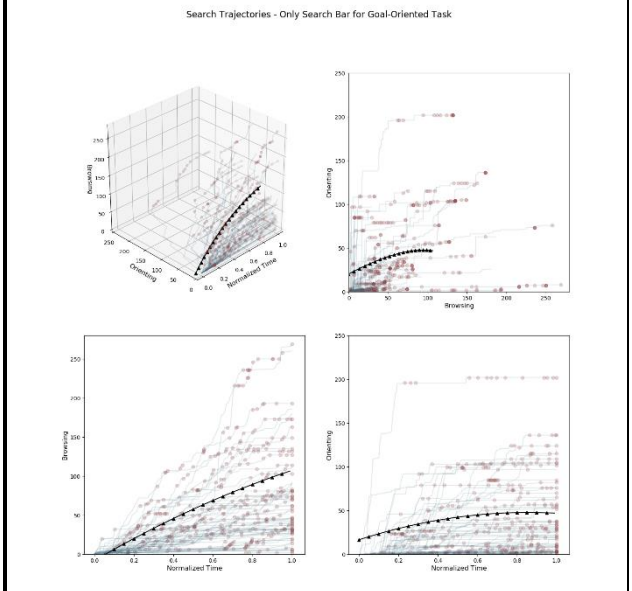
Figure F2. Search Trajectories for Search Features Geared towards Same Search Tactic

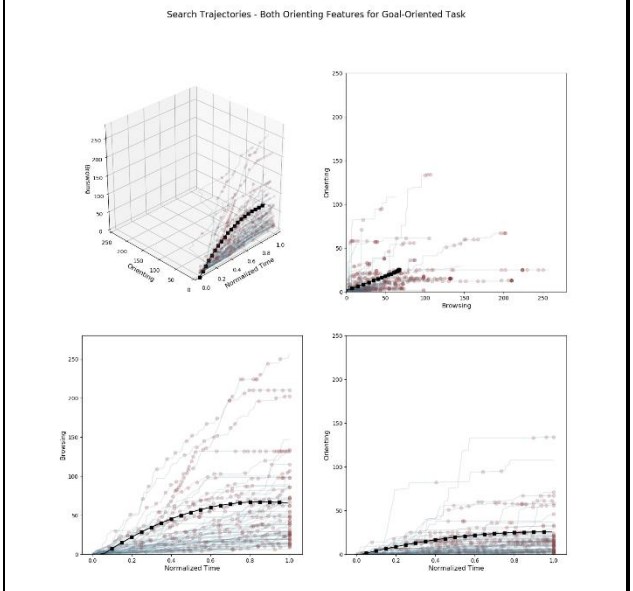
Goal-Oriented Task

Orienting Search Features

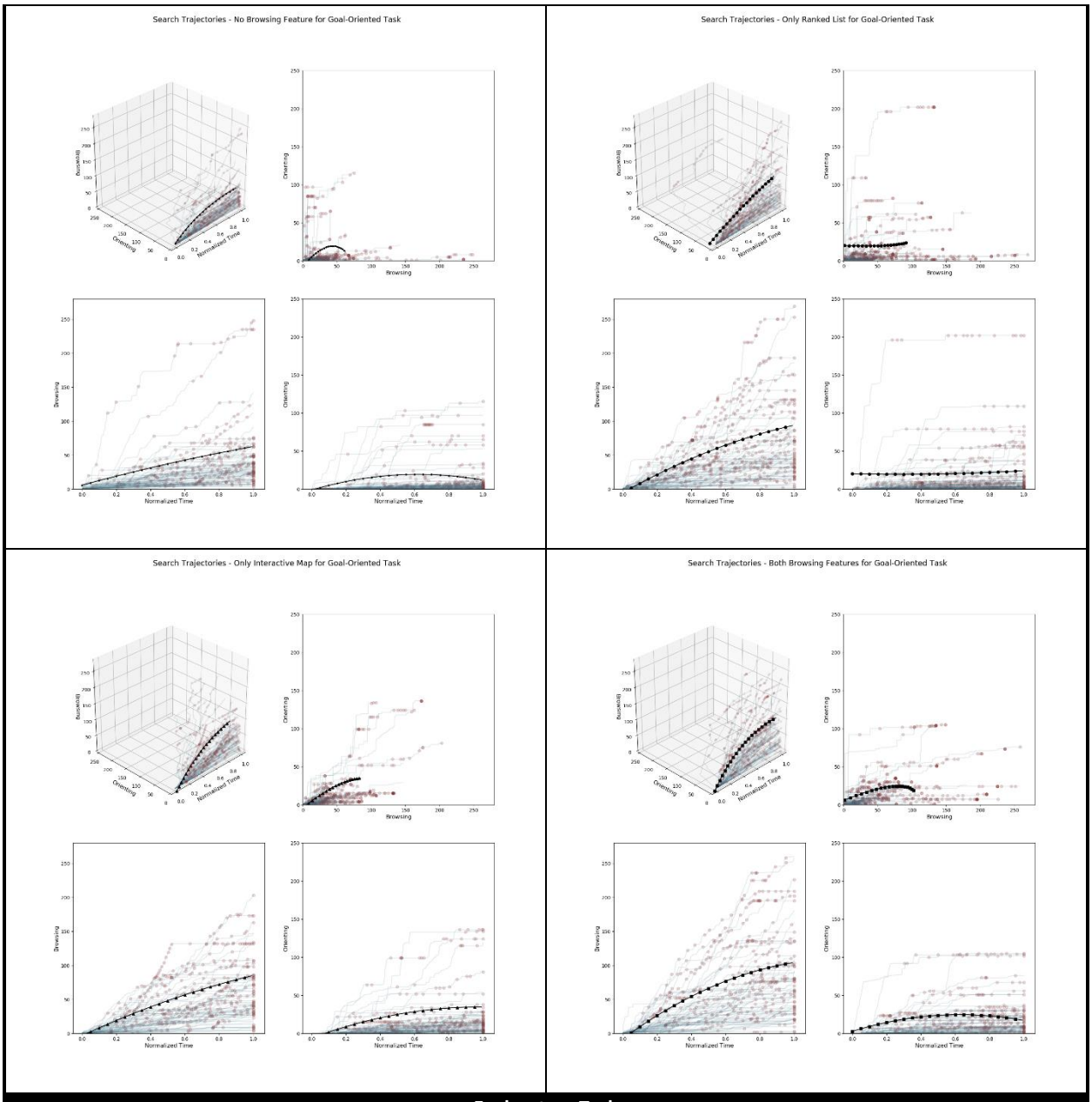






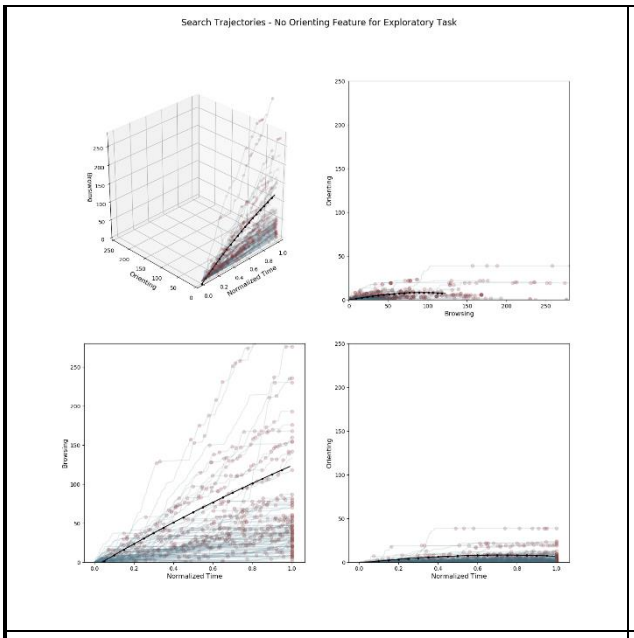


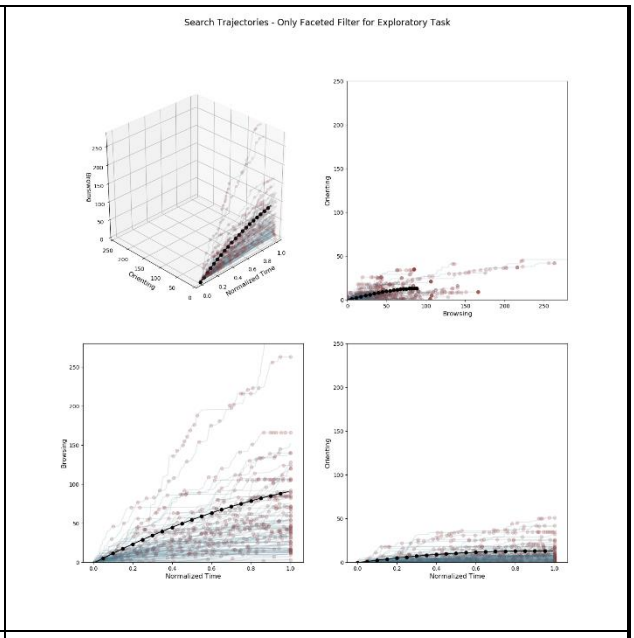
Browsing Search Features

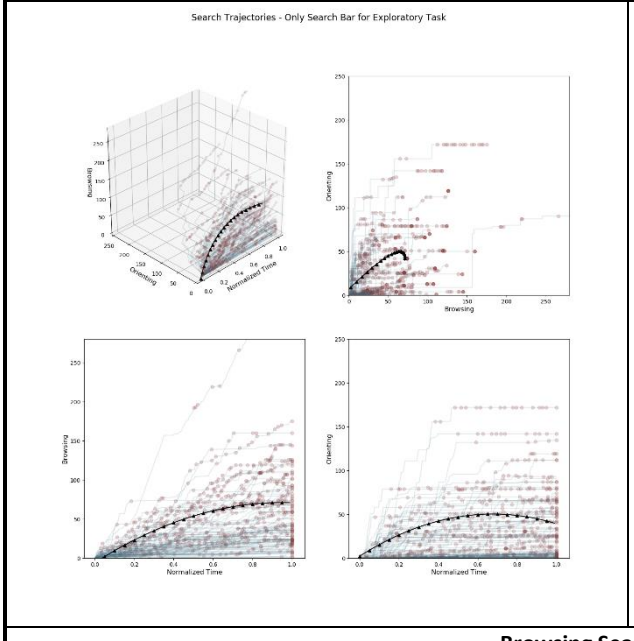


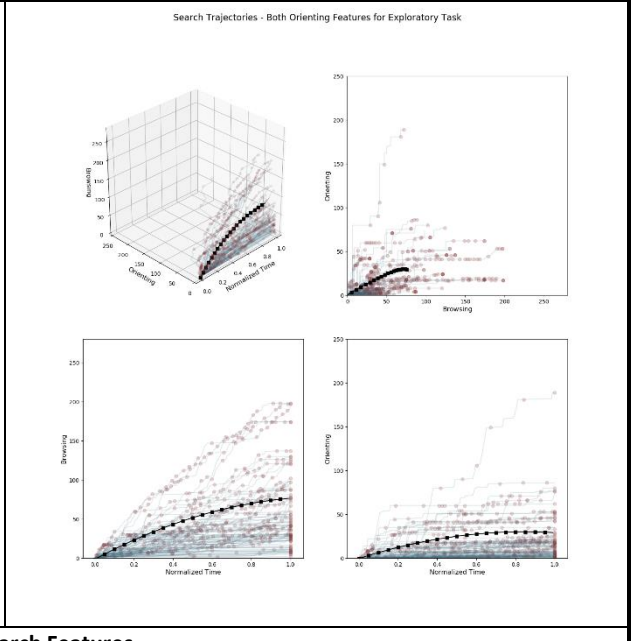
Exploratory Task

Orienting Search Features

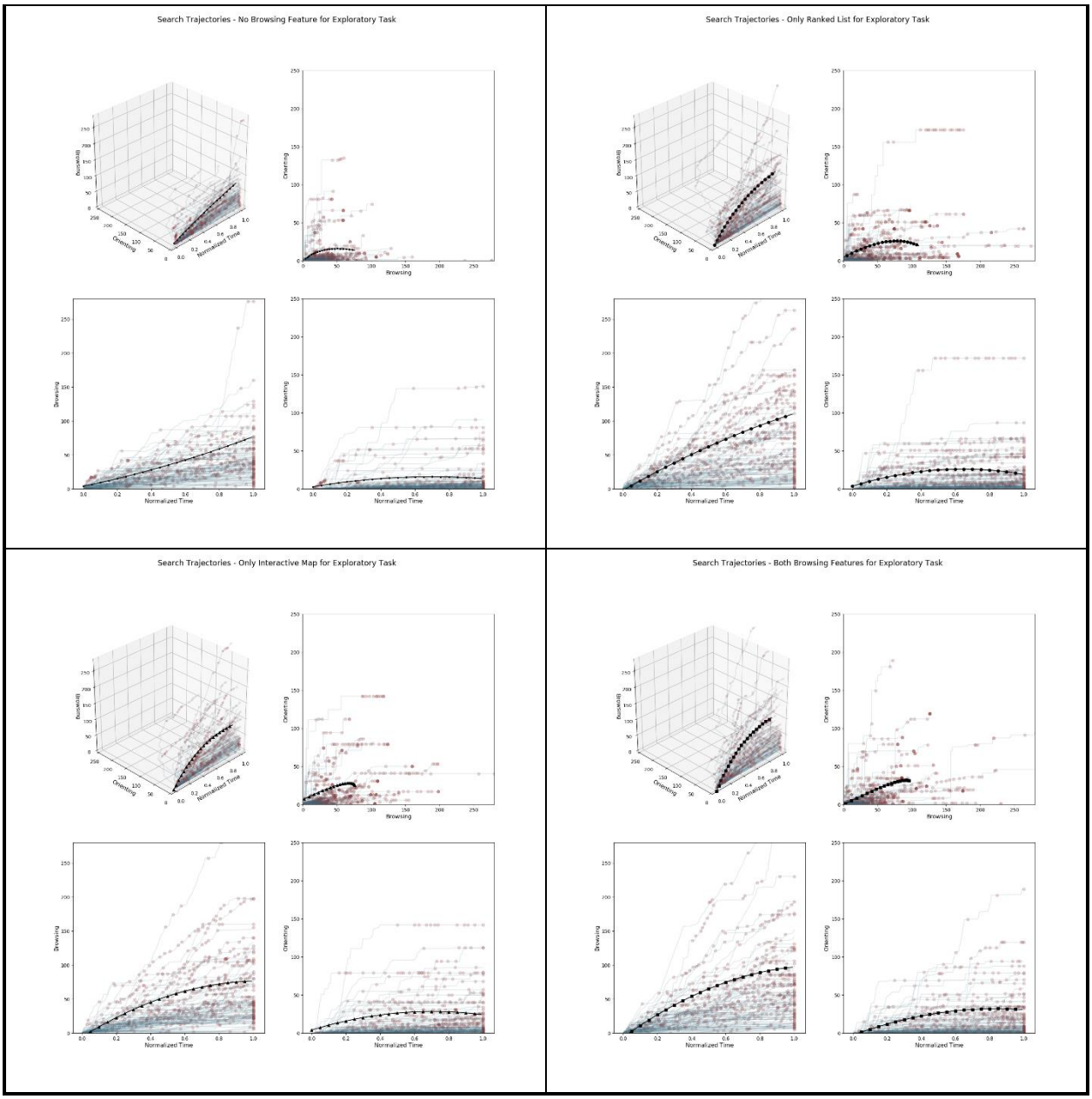








Browsing Search Features


Search Trajectories - No Browsing Feature for Exploratory Task
Search Trajectories - Only Ranked List for Exploratory Task
Search Trajectories - Only Interactive Map for Exploratory Task
Search Trajectories - Both Browsing Features for Exploratory Task
Normalized Time
Browsing
Orienting

8.7 Appendix G – Impact of Search Features on Search Strategies

	Transition	Goal-Oriented Task			Exploratory Task		
		$\mu_{Absence}$	$\mu_{Presence}$	F-Test	$\mu_{Absence}$	$\mu_{Presence}$	F-Test
Faceted Filter	Orienting → Browsing	0.577	0.619	1.072 n.s.	0.578	0.604	0.385 n.s.
	Orienting → Orienting	0.338	0.328	0.066 n.s.	0.364	0.325	0.981 n.s.
	Orienting → Examining	0.085	0.053	2.491 n.s.	0.058	0.072	0.466 n.s.
	Browsing → Browsing	0.815	0.779	7.053***	0.807	0.776	2.921†
	Browsing → Orienting	**0.085**	**0.127**	**13.277*** **	**0.068**	**0.132**	**25.753*** **
	Browsing → Examining	0.100	0.095	0.271 n.s.	**0.126**	**0.092**	**6.840** **
	Examining → Browsing	0.488	0.592	5.296*	0.492	0.552	1.734 n.s.
	Examining → Orienting	0.317	0.223	4.823*	0.300	0.272	0.409 n.s.
	Examining → Examining	0.195	0.185	0.130 n.s.	0.208	0.176	1.299 n.s.
Search Bar	**Orienting → Browsing**	**0.719**	**0.466**	**44.730*** **	**0.727**	**0.442**	**56.357*** **
	Orienting → Orienting	0.209	0.467	51.663***	0.201	0.500	71.897***
	Orienting → Examining	0.072	0.066	0.087 n.s.	0.071	0.058	0.506 n.s.
	Browsing → Browsing	0.811	0.783	4.081*	0.808	0.774	3.863*
	Browsing → Orienting	**0.093**	**0.118**	**4.733***	**0.084**	**0.116**	**5.973***
	Browsing → Examining	0.096	0.099	0.082 n.s.	0.108	0.111	0.037 n.s.
	Examining → Browsing	0.530	0.549	0.681 n.s.	0.520	0.523	0.004 n.s.
	Examining → Orienting	0.296	0.244	1.449 n.s.	0.285	0.287	0.001 n.s.
	Examining → Examining	0.174	0.207	1.391 n.s.	0.195	0.190	0.024 n.s.
Ranked List	**Orienting → Browsing**	**0.651**	**0.544**	**7.073** **	**0.626**	**0.555**	**2.994†**
	Orienting → Orienting	0.295	0.371	3.840*	0.305	0.384	4.073*
	Orienting → Examining	0.054	0.085	2.274 n.s.	0.069	0.061	0.150 n.s.
	Browsing → Browsing	0.786	0.809	2.829 n.s.	0.798	0.785	0.546 n.s.
	Browsing → Orienting	0.108	0.102	0.217 n.s.	0.117	0.106	0.663 n.s.
	Browsing → Examining	0.106	0.088	3.464†	0.108	0.110	0.030 n.s.
	Examining → Browsing	**0.477**	**0.602**	**7.843** **	0.485	0.558	2.551 n.s.
	Examining → Orienting	0.336	0.205	9.553**	0.316	0.256	1.928 n.s.
	Examining → Examining	0.187	0.192	0.033 n.s.	0.199	0.186	0.194 n.s.
Interactive Map	Orienting → Browsing	0.596	0.599	0.006 n.s.	0.579	0.603	0.317 n.s.
	Orienting → Orienting	0.316	0.351	0.834 n.s.	0.321	0.370	1.527 n.s.
	Orienting → Examining	0.088	0.050	3.653†	0.100	0.028	14.530***
	Browsing → Browsing	0.800	0.795	0.167 n.s.	0.780	0.804	1.888 n.s.
	Browsing → Orienting	0.091	0.120	6.577**	0.093	0.105	0.769 n.s.
	Browsing → Examining	**0.109**	**0.085**	**6.248***	**0.127**	**0.091**	**7.510** **
	Examining → Browsing	**0.489**	**0.592**	**5.127***	**0.457**	**0.589**	**8.550** **
	Examining → Orienting	0.319	0.220	5.360*	0.329	0.240	4.252*
	Examining → Examining	0.191	0.188	0.015 n.s.	0.253	0.222	2.287 n.s.

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

Last Mile Stretched: Investigate Trip Rebooking on Travel Planning Platforms

Essay 2

Abstract

Consumers in the digital age are empowered to leverage on information technologies to hunt down what they want. As a result, consumers are becoming increasingly opportunistic thus pose challenges for travel companies that attempt to shortcut consumers' decision journeys and lock them in a loyalty loop. In light of opportunistic behavior theory, this study focuses on a less understood form of consumer opportunistic behaviors, namely trip rebooking, that is enabled by digital generativities rather than exploitable service policies. Rebooking can be either exclusive or inclusive depending on whether consumers focus their attention on one or many travel companies. Accordingly, this study formulates a research framework regarding how generative features of travel planning platforms, namely eWOM rating discrepancy and cross-channel access, influence exclusive and inclusive rebookings. Moreover, our research framework illustrates how exclusive and inclusive rebookings affect consumers' abandon, switch, as well as eWOM decisions. All proposed hypotheses are empirically evaluated by analyzing 117,218 booking records made by 74,557 consumers on a leading travel planning platform from 2015 to 2017. Results indicate that eWOM rating discrepancy diminishes exclusive rebooking and boosts inclusive rebooking whereas cross-channel access encourages the former and discourages the latter. Moreover, while exclusive rebooking encourages consumers to focus on one travel company, inclusive rebooking acts in a reversed manner. Nonetheless, both exclusive and inclusive rebookings reduce the likelihood for consumers to abandon their rebooked trips and motivate them to post eWOM post trip.

Keywords*: Consumer Decision Journey, Travel Planning, Trip Rebooking, Consumer Opportunistic Behavior, Digital Generativity*

1 INTRODUCTION

The rapid advancement of digital infrastructure and internet connectivity has empowered consumers to play a more proactive role in leveraging on features and information available to hunt down what they want (Edelman and Singer 2015). Despite the efforts devoted by retailers and service providers in an attempt to shortcut *consumer decision journey* and to lock consumers in a loyalty loop (Edelman and Singer 2015), consumers are growing more fickle minded. Latest eCommerce statistics confirmed a drastic increase of return rate from 8% to 25% for consumers who buy products online (Charlton 2020). This heightened return rate is largely attributed to *opportunistic consumer behavior*, by which self-interested consumers continuously probe their environment to search for means for personal gains (Macintosh and Stevens 2013; Nagin et al. 2002; Wirtz and McColl-Kennedy 2010). It has been reported that 30% of shoppers deliberately over-purchase and return unwanted items afterwards whereas 19% ordered multiple versions of the same item so that they may decide which to keep when the items are delivered (Charlton 2020).

In contrast to eCommerce, consumers' opportunistic behavior is more prevalent in service booking scenarios, such as trip planning. This can be attributed to the intangibility, heterogeneity, and especially consumers' personal involvement in the process of simultaneous consumption and production of services (Grönroos 1984). For this reason, consumers may make opportunistic bookings in anticipation of contingencies as well as the changing availabilities of service offerings (Dichter 2018). As a large scale digital travel study shows, on average, a consumer spent 19 days through 30 online sessions across 12 platforms for making a single booking (Kleweno et al. 2019). During the extensive decision journey, it is not uncommon for consumers to book a trip based on a tentative plan and subsequently rebook the trip upon changes to the plan. Consumers also often book a trip as a backup and later rebook the trip when more desirable alternative options become available. In fact, 8% of the consumers were found to cancel a previous made booking and rebook their trip (Kleweno et al. 2019). More recently, due to the impact of COVID-19 pandemic, 46% of the consumers who have cancelled their bookings planned to rebook their trip (Turner 2020). The first research question this study strives to address is: *How does consumers' opportunistic behavior manifest on trip planning platforms?*

In light of *opportunistic behavior theory*, consumers pay attention to the emergence of opportunities for them to take advantage of (Nagin et al. 2002). Such opportunistic behavior is determined on the fly with little regards to planning or principle (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). Past studies on consumers' opportunism focused on how consumers exploit companies' lack of monitoring or policy loopholes with behaviors labelled "dysfunctional" and "deviant" (Reynolds and Harris 2009). This stream of research investigated how consumers abuse return policies and service recovery policies (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). Regardless, the understanding

about how consumers' opportunism enabled by generativities on digital platforms is limited. *Digital generativity* refers to the capacity of a technology or a system to be malleable by actors in unanticipated ways, enabled by the features and information made available on platforms (Zittrain 2008, 2005). Accordingly, the second research question this study seeks to investigate is: *How do digital generativities affect opportunistic trip rebooking*?

The ever more prevalent consumer opportunism enabled by digital generativity shaped the landscape of the travel industry. For travel companies, it is increasingly difficult for travel companies to predict consumers' commitment and retain consumers in a their winding decision journeys (Charlton 2020; Dichter 2018). Simultaneously, there are more opportunities for travel companies to convert consumers from their competitors in the extended consumer decision journey (Charlton 2020; Dichter 2018). For travel planning platforms, it is yet unclear if opportunistic consumer behavior should be inhibited. may bring additional benefits to offset the extra resources it entails. Consequently, insights into how trip rebooking affects consumer abandonment (Albrecht et al. 2017; Kukar-Kinney and Close 2010) and consumer switching (Panther and Farquhar 2004; Shah and Schaefer 2006). For travel planning platforms that expend extra bandwidth and computational resources to facilitate consumers' increasingly elaborated decision journeys, it is imperative to confirm if they can benefit from encouraging trip rebooking. This research may contribute in this regard by explicating the connection between trip rebooking and consumer engagement (Brodie et al. 2013), since engaging consumers are more likely to share their experience in electronic Word-of-Mouth (eWOM) on a platform (Wu et al. 2018). Taken together, the third research question this study strives to answer is: *What is the impact of opportunistic trip rebooking*?

To summarize, this study draws on opportunistic behavior theory to investigate consumers' opportunistic trip rebooking. This study further differentiates between *exclusive rebooking*, by which a consumer stays with the same service provider when rebooking a trip, and *inclusive rebooking*, by which a consumer considers alternative service providers when rebooking a trip. This study then examines digital generativities that drive opportunistic trip rebooking as well as the ensuing impact on travel companies and travel planning platforms alike. All the hypotheses pertinent to consumers' opportunistic trip rebooking on travel planning platforms were empirically validated by analyzing cruise booking records on a major travel planning platform with Logit regression (Hosmer Jr et al. 2013).

In the following section, we establish the theoretical foundation for our research framework by consolidating prior literature on consumer opportunistic behavior. Subsequently, a research framework is formulated for the development of hypotheses. After that, we go through the methodology for the empirical

examination of this study. In the following section, the data analysis results are presented. As the conclusion of this study, we lay out both the theoretical and managerial implications on the basis of the findings.

2 THEORETICAL UNDERPINNING

2.1 Consumer Opportunistic Behavior

Opportunistic behavior theory posits that self-interested individuals tend to continuously probe their environment to search for means for personal gains (Nagin et al. 2002). The individual opportunistic behavior was initially investigated in the organizational context. As pointed out by prior literature, it is not uncommon for employees to probe their working environment for potential means to increase their welfare due to their self-interested nature (Nagin et al. 2002). In essence, rational individuals would be compelled to engage in opportunistic behavior when the anticipated marginal benefits of doing so exceeds the incurred marginal costs (e.g., risk of being punished and identity incongruence) (Cohen et al. 2007; Nagin et al. 2002). For example, without being offered a performance based bonus, employees would more likely shirk at work given a reduction in monitoring (Nagin et al. 2002).

In spite of its origin in employee behavior research (Cohen et al. 2007; Nagin et al. 2002), there is a growing body of literature that aims to examine consumer opportunistic behavior (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010). Likewise, past studies focused on consumer opportunistic behaviors that come with a negative connotation, that are labelled as dysfunctional and unethical (Macintosh and Stevens 2013; Rosenbaum et al. 2011; Rotman et al. 2018). Specifically, they investigated consumers' exploitation of product return policies through wardrobing in the eCommerce context (Shang et al. 2017). Additionally, a number of studies delved into consumers' misrepresentation in damage claims for service failure through exploiting service recovery policies (Macintosh and Stevens 2013; Wirtz and McColl-Kennedy 2010).

This study aims to extend this research stream by shedding light on consumer opportunistic behaviors that are encouraged by digital generativities on travel planning platforms. Unlike opportunistic exploit of loopholes, consumers' opportunistic use of platform resources is not yet well understood. Although consumer opportunistic behaviors inevitably drive up operation cost of travel planning platforms, it is unclear if those behaviors can bring about extra benefit to offset the cost. Furthermore, past literature on the facilitating role of digital technologies in consumer decision making predominantly focused on isolated decision making (c.f. Ghasemaghaei et al. 2019). This study can hence contribute in this regard by investigating consumers' opportunistic behaviors as recurrent decision makings across multiple sessions. Particularly, this study examines how consumers take advantage of platform resources in the form of digital

generativities to identify opportunities and reconsider previously made decisions. This study theorizes opportunistic trip rebooking as a process through which consumers changes their bookings for the same trip regardless of planning.

2.2 Trip Rebooking as An Emergent Process

Recent studies began to pay attention to the transformational role played by digital technologies in the travel planning process (Edelman and Singer 2015; Xiang et al. 2015). Facing the choices expended by digital technologies, a consumer's path to purchase can become "infinitely" convoluted in the travel sector (Dichter 2018; Kleweno et al. 2019). Furthermore, it becomes more common for consumers to be compelled by the emergence of unforeseen options to repeatedly change their mind before committing to the final purchase decision (Dichter 2018; Edelman and Singer 2015).

Trip rebooking refers to the phenomenon where consumers alter a booking made for a given trip (see Figure 1). On one hand, consumers can alter a made booking by booking an alternative option offered by the same travel company. For example, a consumer may choose to secure their ticket for a cruise trip by booking a less desirable room type so they may later switch to a more desirable room type if they so desire. This type of rebooking behavior, by which consumers stay with the same travel company when rebooking a trip, is termed *exclusive rebooking*.

On the other hand, consumers can rebook a trip by booking an option offered by an alternative travel company. To illustrate, after booking a cruise trip with a travel company, a consumer may spot more compelling options offered by other travel companies. Under such a situation, the consumer may turn to the travel company that offer the more compelling options and rebook the trip. This type of rebooking behavior, by which consumers switch to an alternative travel company when rebooking a trip, is termed *inclusive rebooking*.

Different to the extensively studied planned decision making, trip rebooking is a spontaneous process driven by consumers' opportunity seeking tendencies. Recent studies began to tackle emergent phenomena in organizational context. Mirabeau and Maguire (2014) invested how front-line employees' automatic strategic behavior can be articulated and routinized into emergent strategy. In the same vein, Wee and Taylor (2018) confirmed that changes made by front-line employees can be amplified and accumulated into organizational changes via the attention based search mechanism. Taken together, emergent process describes how a system gains a property through the interaction among its actors, which do not

individually own the said property. Additionally, the interaction that gives rise to emergent properties is driven by attention allocation mechanisms.

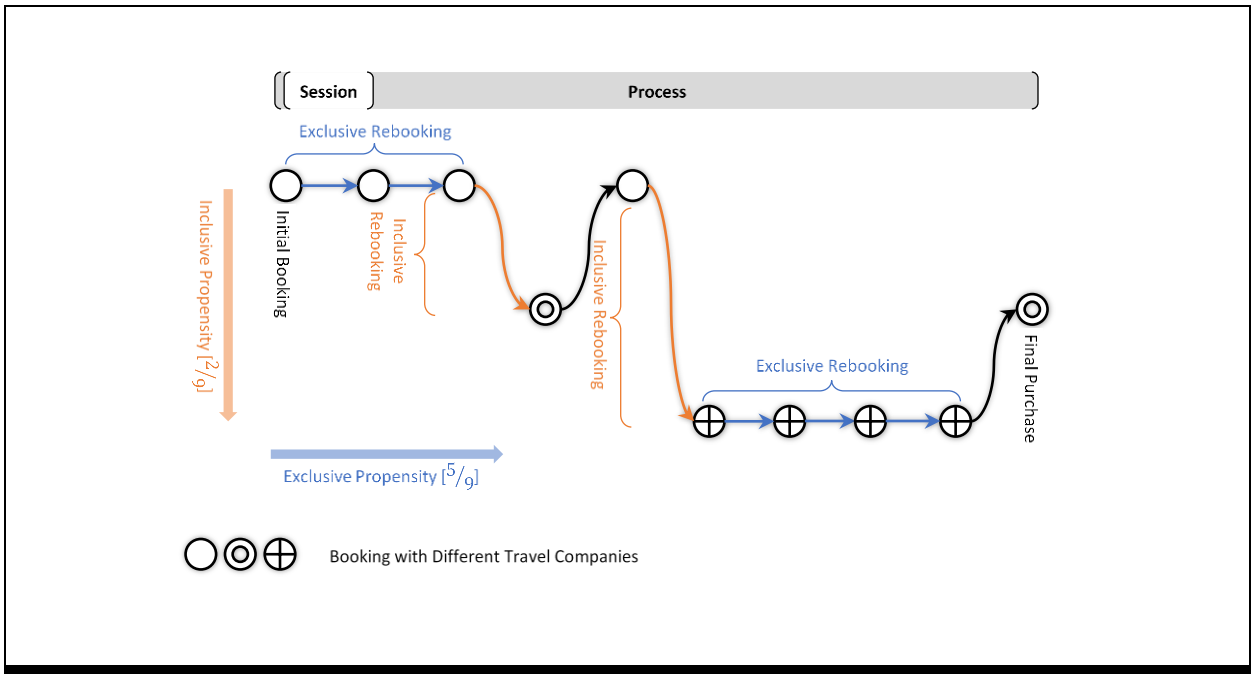


Figure 1. An Illustration of Trip Rebooking

Trip rebooking can be regarded as an *emergent property* occurred in consumers' travel planning processes. As two parts of a system, neither consumers nor travel companies had planned or intended for trip rebooking. Trip rebooking emerged when consumers' human agency for seeking opportunities of personal gains interacts with the technological agency enabled by travel planning platforms for consumers to monitor and react to options offered by competing travel companies (Leonardi 2011). In other words, trip rebooking is driven by consumers' propensity for allocating attentions on seeking more desirable options that may become available on a travel planning platform. Taken together, this study theorizes trip rebooking as an emergent process that is driven by consumers' spontaneous opportunity seeking attentions reinforced by generative features on travel planning platforms.

As the driving mechanism for trip rebooking, each consumer's opportunity seeking attentions can be characterized by both the *direction* and the *intensity* of attention allocation propensity (Wee and Taylor 2018). Two directions exist for a consumer's propensity of allocating attentions to seek for potential opportunities. On one hand, a consumer expresses an *exclusive propensity* when they focus the attention to alternative options offered by the same travel company that they have booked with. On the other hand, a consumer is said to express an *inclusive propensity* if they direct the attention to options offered by other travel companies that they have not booked with. Each consumer's attention allocation propensity also

differs in its *intensity*, which indicates the likelihood for maintaining the attention to the same action, which is often reflected by the frequency of rebooking.

2.3 Digital Generativities on Travel Planning Platforms

The emergent nature of trip rebooking dictates the role played by platform features to be a *generative* one, in a sense that they are malleable beyond their intended purposes (Zittrain 2008, 2005). Despite being designed for facilitating consumers' selection of and transaction with travel companies, generative features unintendedly give rise to trip rebooking via exposing opportunistic consumers to potentially more enticing options. In this sense, digital generativities enabled by travel planning platforms can contribute to the unintended trip rebooking by reinforcing consumers' opportunity seeking attentions.

Past studies on digital generativity called for more empirical examination on its impact on consumer behavior (Avital and Te'Eni 2009; Henfridsson and Bygstad 2013; Markus et al. 2002). Two generative features existing on travel planning platforms are expected to affect trip rebooking. eWOM is one such generative feature that is realized by allowing consumers to voice their satisfaction or dissatisfaction of a product or a service provider (Manning and Raghavan 2009; Wetzer et al. 2007; Yang 2017). The intended purpose of eWOM is to serve as a quality signal that facilitates consumers' assess of service providers (Filieri 2016; Xie et al. 2016). It is especially challenging for consumers who evaluate travel companies due to the intangibility and heterogeneity of service (Grönroos 1984). Noteworthily, eWOM can encourage consumers' opportunism by making highly rated travel companies more distinguishable and attention grabbing.

The other generative feature is the *cross-channel access* to a digital platform, through which consumers can access available service offerings and manage their bookings across a variety of touchpoints, including offline agents, desktop websites, as well as mobile applications with a consistent identity (Dichter 2018; Edelman and Singer 2015; Xiang et al. 2015). The intended purpose of cross-channel access is to ensure unified identity across multiple channels so that the consumers can book trips ubiquitously. Nonetheless, being aware of the cross-channel access, consumers are more inclined to make use of their fragmented time to look for more desirable options to switch to (Harvey and Pointon 2017; Oulasvirta et al. 2005). The unified identity across different channels allows consumers to take timely actions to snatch enticing offerings when the opportunity rises. Consumers can hence become more opportunistic in a way that they may make bookings more hastily just to get a hold of desirable options while looking out for

more alternatives. As a result, consumers' opportunity seeking tendencies can be rendered more prominent by cross-channel access.

3 HYPOTHESIS DEVELOPMENT

As depicted in Figure 2, this study put forth a research framework that focuses on how generative features affects each rebooking decision in a consumer decision journey as well as the consequences of the rebooking process, which may include multiple rebooking instances, as a whole. This research framework centers at two distinct rebooking propensities: exclusive rebooking, which refers to the propensity for a consumer to stay with a travel company when rebooking a trip, and inclusive rebooking, which represents the propensity for a consumer to switch to a new travel company they had not booked from when rebooking a trip.

Both exclusive and inclusive rebookings are subject to the influence of generative features on travel planning platforms. For each rebooking decision, as the discrepancy in eWOM ratings between the option a consumer is currently holding and an alternative option widens, the likelihood for this consumer to rebook would increase. On the other hand, consumers who access the trip planning platform through the same channel would show a higher propensity for exclusive rebooking whereas those who change the access channel express a higher propensity for inclusive rebooking.

The accumulated rebooking propensities throughout a decision journey as a whole are expected to shape its outcome. This study identified three key consequences of exclusive and inclusive propensities in rebooking process. Specifically, this study examines how a consumer's exclusive and inclusive rebooking propensities can help to predict abandon likelihood, which indicates the likelihood for the consumer to abandon all bookings for a trip; switch likelihood, which reflects whether the consumer purchases options offered by travel companies other than the one they have paid the most attention to; as well as eWOM likelihood, which represents the tendency for the consumer to share the experience of the trip they booked by posting eWOM on a travel planning platform.

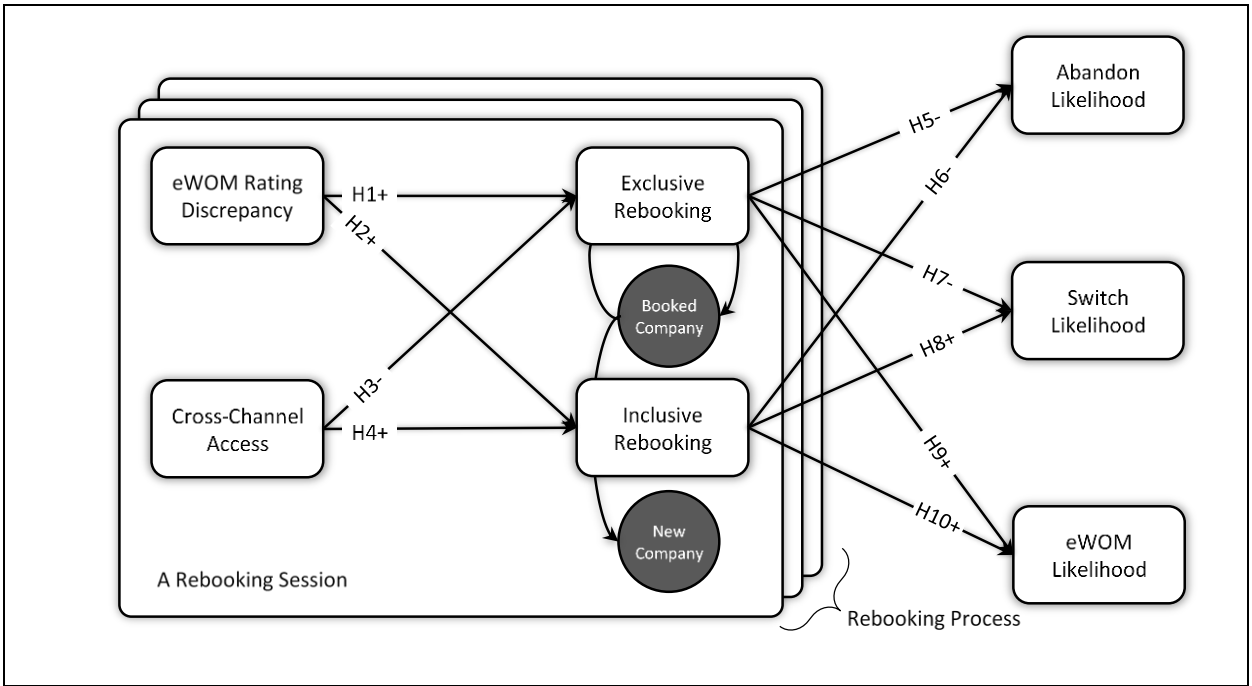


Figure 2. The Research Framework

3.1 eWOM Rating Discrepancy and Rebooking Propensity

Since eWOM rating received by a travel offering can serve as a key quality indicator of its desirability (Filieri 2016; Xie et al. 2016), consumers feel more confident with their decision if when selecting an option that received a more favorable eWOM rating than other alternatives (Fan and Miao 2012). eWOM rating trivializes consumers' quality assessment of service offerings and thus makes it more intuitive for consumers to compare different options. Thereby, eWOM rating discrepancy between two travel offerings makes it intuitive for consumers to tangibilize the marginal gain of selecting one over another. For consumers who are holding a booked option, the alternative option that displays a larger positive discrepancy in eWOM rating is more attention grabbing. Resultingly, consumers show a heightened propensity for rebooking a trip when encountering an alternative option that is more favorably rated. In short, eWOM rating discrepancy can boost the propensity for both exclusive and inclusive rebookings. This study hence hypothesizes:

Hypothesis 1: The eWOM rating discrepancy of one option in contrast to the one booked by a consumer positively influences their propensity for exclusive rebooking.

Hypothesis 2: The eWOM rating discrepancy of one option in contrast to the one booked by a consumer positively influences their propensity for inclusive rebooking.

3.2 Cross-Channel Access and Rebooking Propensity

Provided with the cross-channel access, consumers would be encouraged to capitalized on the ubiquitous accessibility to monitor the real-time updates of available offerings (Harvey and Pointon 2017; Oulasvirta et al. 2005). Upon spotting more desirable options, consumers can capture the emerging opportunity by taking immediate actions to rebook. Whether a consumer accesses a travel planning platform is expected to affect the propensity for exclusive rebooking and inclusive rebooking differently.

For consumers who booked an option offered by a travel company through one channel, they tend to associate the booked option with the channel through which the booking was made. When accessing the travel planning platform via the same channel, the consumers tend to recall the travel company they previously booked with due to the recency effect (Baddeley and Hitch 1993). It is also more likely for the consumers to consider alternative options offered by the same travel company because of the priming effect of the company-channel association (Domke et al. 1998). Accordingly, consumers who access the travel planning platform through the same channel have a higher propensity for exclusive rebooking.

On the contrary, if the consumers access the travel planning platform through a channel that is different from the one through which they made their booking previously, they would be exposed to options offered by different travel companies. Their attention diverted on other travel companies increases the likelihood for them to consider the options these companies offered and get a hold of the ones they deem more desirable. Taken together, a consumer's cross-channel access to a travel planning platform is expected to diminish the tendency for them to stay with the same travel company (i.e., exclusive rebooking) while strengthening their propensity for considering a different travel company (i.e., inclusive rebooking) when rebooking a trip. This study hence hypothesizes:

Hypothesis 3: A consumer's cross-channel access to a travel planning platform negatively influences their propensity for exclusive rebooking.

Hypothesis 4: A consumer's cross-channel access to a travel planning platform positively influences their propensity for inclusive rebooking.

3.3 Impact of Rebooking Propensity

The process of rebooking as a whole is expected to influence consumers' purchase decisions at the end of their decision journeys. In alignment with the opportunistic behavior theory, consumers take advantage of opportunities to maximize the utility of their actions (Nagin et al. 2002). In this sense, consumers

would allocate extra efforts to rebooking if they wish to eventually pay for their bookings since giving up after making a series of rebookings means a considerable loss of time and efforts. Put in another way, showing a propensity for rebooking greatly reduces the likelihood for a consumer to abandon their bookings without making payment. Due to the behavioral *sunk cost effect* (Cunha and Caldieraro 2009), it is more likely for consumers to commit to purchasing their bookings as their propensity for rebooking intensifies. Furthermore, rebooking entails *opportunity costs* due to the need to cancel previously made bookings (Cunha and Caldieraro 2009), consumers' propensity for both exclusive and inclusive rebookings dampens the likelihood for them to abandon their decision journeys. This study hence hypothesizes:

Hypothesis 5: A consumer's propensity for exclusive rebooking negatively influences the likelihood for them to abandon their bookings.

Hypothesis 6: A consumer's propensity for inclusive rebooking negatively influences the likelihood for them to abandon their bookings.

Exclusive and inclusive rebooking propensities are expected to impose opposing impacts on the likelihood for consumers to switch travel companies when making payment. Such switch likelihood represents the tendency for consumers to purchase not from a travel company that they primarily considered. Due to the accumulation of behavioral sunk cost, the more a consumer rebooks from a travel company, the less likely this consumer would purchase from a different travel company (Cunha and Caldieraro 2009). Conceivably, if a consumer chooses to continuously rebook options offered by the same travel company, they tend to purchase from this company as well. Resultingly, a consumer's propensity for exclusive rebooking from a travel company would reduce the likelihood for them to switch away from this company when making the purchase decision. This study hence hypothesizes:

Hypothesis 7: A consumer's propensity for exclusive rebooking negatively influences the likelihood for them to switch away from the most attended travel company.

Conversely, governed by an *effort-justification mechanism*, when a consumer rebooks options offered by an alternative travel company (i.e., inclusive rebooking), they would inflate the desirability of this company to justify the effort they invested in booking the previous company (Cunha and Caldieraro 2009). Once the consumer has decided to rebook from an alternative travel company, it would be unlikely for them to reconsider the previous company, which can hardly match the inflated desirability perception attributed to the effort-justification mechanism (Cunha and Caldieraro 2009). In a sense, as the attention devoted by a consumer to a travel company accumulates, this consumer would inflate the desirability of

an alternative company they later decide to rebook to a greater extent. Therefore, consumers' propensity for inclusive rebooking would heighten the likelihood for them to switch away from the travel company to which they have paid the most attention when making the purchase decision. This study hence hypothesizes:

Hypothesis 8: A consumer's propensity for inclusive rebooking positively influences the likelihood for them to switch away from the most attended travel company.

Since consumers with a more prominent propensity for either exclusive rebooking or inclusive rebooking tend to invest more efforts in scrutinizing and selecting options offered by travel companies. The extra time and efforts required for making rebooking implies that consumers who rebook more will be more invested in the decision journey (Cunha and Caldieraro 2009). As a result, consumers are likely to be more engaged with the experience of the service offering they purchased through multiple rebookings. In addition, it has been shown that consumers feel more engaged if they are granted more choices to make (Christofi et al. 2018). Therefore, consumers who show a higher propensity for rebooking will be more engaged in their purchases because they make more choices with each additional rebooking. Since more engaged consumers have a greater intention to share their experience (Jiewanto et al. 2012), both exclusive and inclusive rebookings can boost the likelihood for consumers to post eWOM for their purchases (Jiewanto et al. 2012). Driven by the heightened post-purchase engagement, consumers who show a more pronounced propensity for either exclusive rebooking or inclusive rebooking are more likely to share their experience with the purchased travel services on the travel planning platform in the form of eWOM. This study hence hypothesizes:

Hypothesis 9: A consumer's propensity for exclusive rebooking positively influences the likelihood for them to post eWOM for their purchased trip.

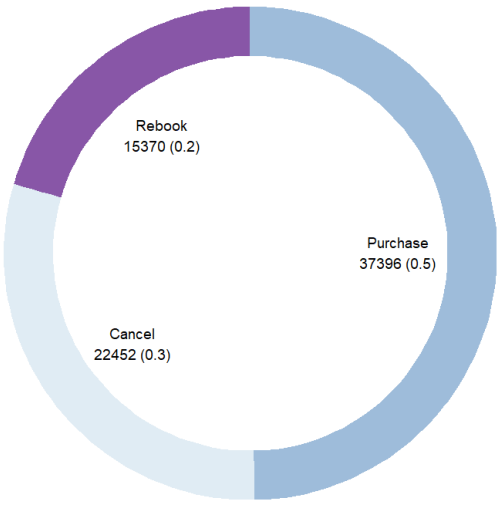
Hypothesis 10: A consumer's propensity for inclusive rebooking positively influences the likelihood for them to post eWOM for their purchased trip.

4 RESEARCH METHODOLOGY

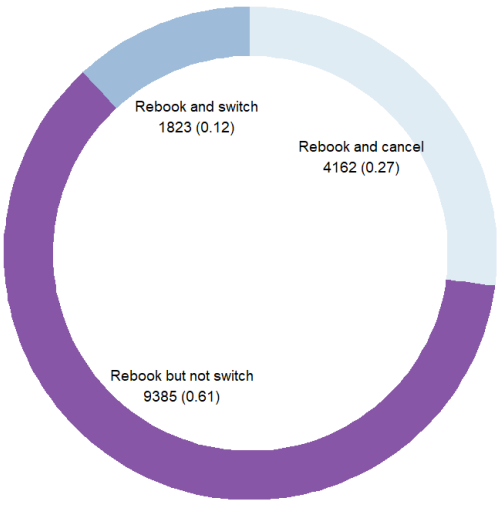
To empirically validate the hypotheses this study posits, a secondary data analysis was carried out to examine a dataset provided by a major online travel planning platform in China. This dataset contains 117,218 booking records made by 74,557 consumers for 998 different cruise packages offered by 119 vessels from 22 December 2015 to 28 December 2017. In order to analyze the rebooking process, each consumer's bookings made before an intended embark date are considered as states in a single decision journey. As a result, 75,218 decision journeys for purchasing cruise packages are identified.

4.1 Sample Overview

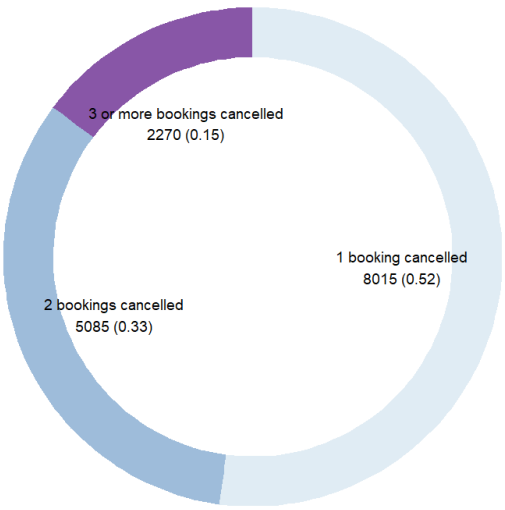
As demonstrated in Figure 3, among all decision journeys that were included in the data analysis, 37,396 are direct purchases made without rebooking whereas 22,452 are direct cancels after a single booking. Noteworthily, 20% of all decision journeys, 15,370 to be exact, are found to contain trip rebookings. Among these rebooking processes, consumers purchased cruise packages from the vessels they initially booked in 9,385 journeys; purchased cruise packages for a different vessel in 1,823 journeys; and abandoned all bookings in 4,162 journeys. Moreover, the length of each rebooking process varies from 1 to 11 in terms of the number of cancelled bookings. Figure 3 illustrates a breakdown for the length of rebooking process. There are 26,207 rebooking sessions in the 15,370 decision journeys that contain trip rebookings. Last but not least, multiple channels were accessed to make bookings in 5,276 rebooking processes. Among all the other decision journeys that remained in a single channel, 20,467 contain only offline bookings, 13,208 were made entirely on desktop websites, and the remaining 36,267 comprise merely bookings made via mobile applications.



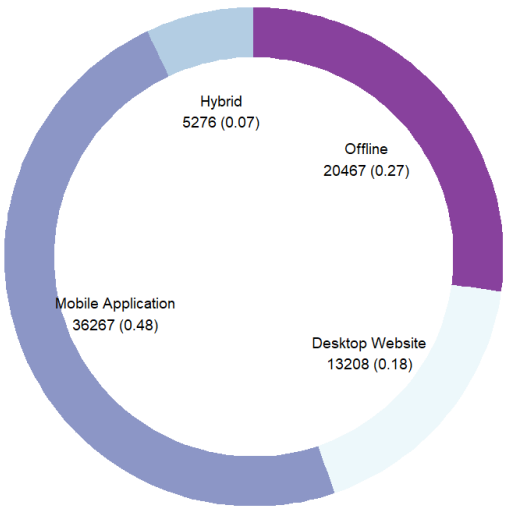
Breakdown of Decision Journeys



Breakdown of Rebooking Outcomes



Breakdown of Rebooking Process Length



Breakdown of Booking Channels

Figure 3. Overview of Cruise Booking Records

4.2 Data Analysis Procedure

Logit regression implemented in R Generalized Linear Models is applied to test all hypotheses (Hosmer Jr et al. 2013). The data analysis procedure is illustrated in Figure 4. Different data samples were selected for analysis according to the hypotheses being tested to ensure the validity of the testing results. Particularly, the unit of analysis for testing the relationships between generative features and rebooking propensities is each rebooking decision made by each consumer. Accordingly, Hypothesis 1 to 4 were tested with the session level data. In contrast, the unit of analysis for the hypothesized impacts of rebooking propensities is each consumer's entire process of rebookings for a trip. Therefore, Hypothesis 5 to 10 were evaluated with the process level data. the relationships between rebooking propensities and abandon likelihood were examined with samples that contain at least one rebooking instance. The relationships between rebooking propensities and switch likelihood were verified using samples in which consumers made purchases at the end of the rebooking process. Lastly, the relationships between rebooking propensities and the likelihood for posting eWOM were validated using samples in which consumers purchased cruise packages.

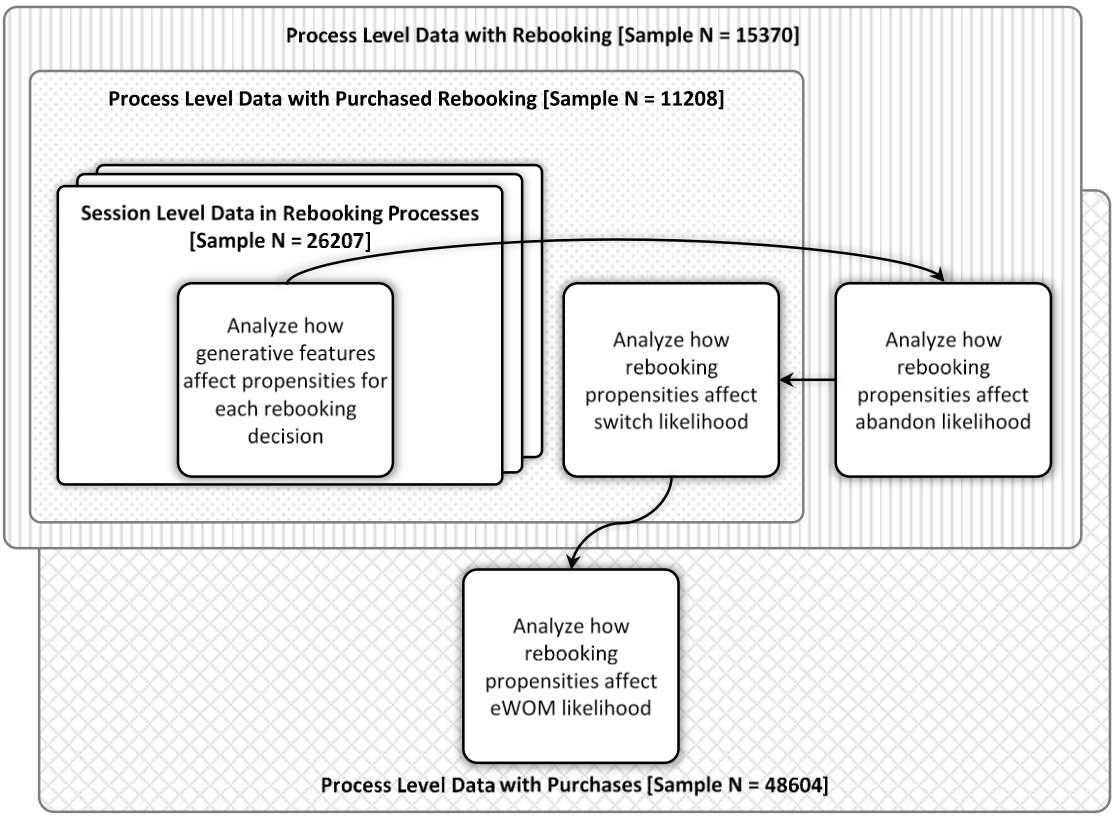


Figure 4. Illustration of the Data Analysis Procedure

5 DATA ANALYSIS RESULTS

5.1 Descriptive Statistics

Table 1 displays descriptive statistics of all variables that are relevant to the hypotheses. Hypothesis 1 to 4 are operationalized with variables at the level of rebooking sessions. For instance, eWOM rating discrepancy represents the difference between the average rating received by a rebooked travel package and that received by the previously booked package. Cross-channel access is a binary indicator for whether a consumer rebooked a travel package through a channel (i.e., offline agents, desktop websites, or mobile applications) that differs from the channel through which they booked the previous package. Likewise, both exclusive and inclusive propensities are binary variables that denote whether a rebooked travel package and the previously booked package are offered by the same vessel or two different ones. The

price of a previously booked travel package, the time left before the embark date when a consumer booked the previous travel package, as well as the number of cancelled bookings up to the current rebooking decision are included as control variables.

To operationalize the remaining six hypotheses, variables at the level of rebooking processes are utilized. Both exclusive and inclusive propensities at this level represent the proportions of exclusive and inclusive rebookings throughout each consumer decision journey respectively. Abandon likelihood is a binary variable that indicates whether a consumer did not purchase the travel packages they booked. Similarly, switch likelihood is a binary variable that indicates whether a consumer end up purchasing travel packages that are not offered by the vessel to which the consumer paid the most attention to. The vessel that a consumer rebooked most frequently in their decision journey is identified as this consumer's most attended vessel. eWOM likelihood is a binary variable that indicates whether a consumer rated the travel package they purchased. Four control variables are incorporated to rule out possible confounds to the hypothesis testing results, namely the average eWOM rating, average price, average time remained until the date of embark, as well as the total number of cancelled bookings throughout each rebooking process.

Table 1. Descriptive Statistics

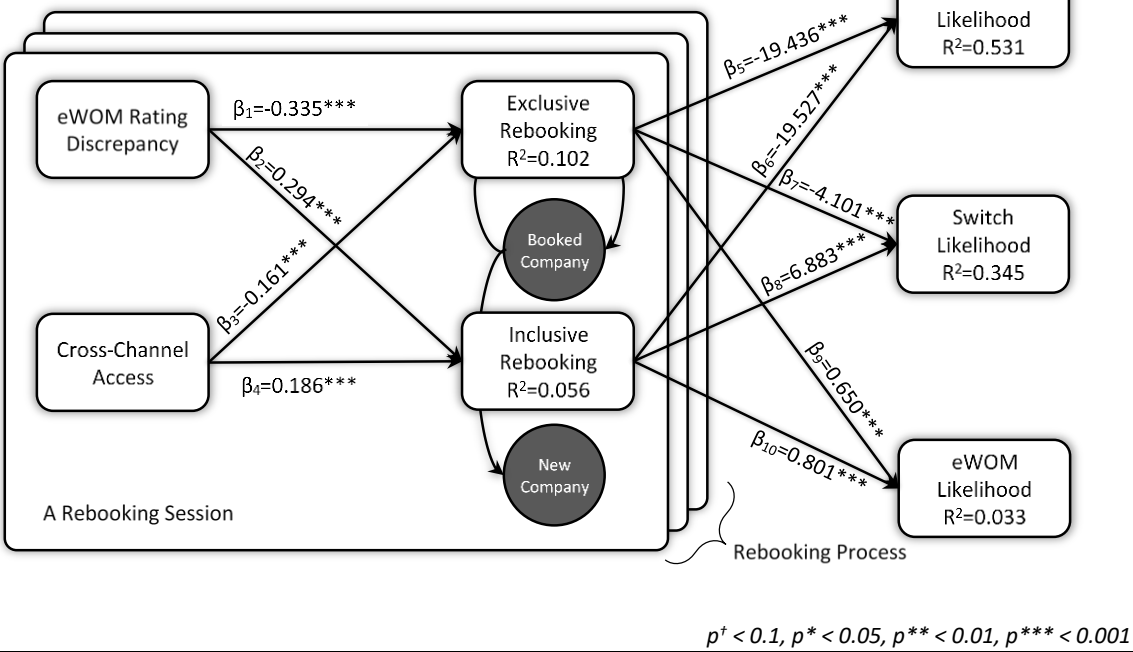
Variable	Definition	Min	Max	Mean	s.d.
Session Level Focal Variables					
eWOM Rating Discrepancy	Extent to which an alternative travel package differs from the previously booked package in eWOM rating	-3.606	5.000	0.029	0.444
Cross-Channel Access	Whether a consumer changed the channel when accessing a travel planning platform	0.000	1.000	0.230	0.421
Exclusive Propensity	Whether a consumer chose a travel package offered by the same travel company when rebooking a trip	0.000	1.000	0.820	0.384
Inclusive Propensity	Whether a consumer chose a travel package offered by a different travel company when rebooking a trip	0.000	1.000	0.155	0.361
Session Level Control Variables					
Package Price (CNY)	The price of a travel package that a consumer previously booked	0.000	705614	15707	15237
Time Until Embark (Day)	The time left before the embark date when a consumer booked the previous travel package	0.000	331.000	42.100	35.168
Booking Cancellations	The number of bookings previously cancelled by a consumer when rebooking a trip	1.000	11.000	1.685	1.337
Process Level Focal Variables					
Exclusive Propensity	The probability for a consumer to choose travel packages offered by the same travel company through a rebooking process	0.000	0.975	0.387	0.263
Inclusive Propensity	The probability for a consumer to choose travel packages offered by a different travel company through a rebooking process	0.000	0.750	0.016	0.075

Abandon Likelihood	Whether a consumer cancelled all bookings for a trip	0.000	1.000	0.708	0.455
Switch Likelihood	Whether a consumer purchased a travel package that is not offered by the travel company to which they paid the most attention	0.000	1.000	0.044	0.204
eWOM Likelihood	Whether a consumer posted eWOM for the travel package that they purchased	0.000	1.000	0.415	0.493
Process Level Control Variables					
Average Rating	The average eWOM rating received by each travel package that a consumer booked throughout a rebooking process	0.000	5.000	4.249	0.687
Average Price (CNY)	The average price of all travel packages that a consumer booked throughout a rebooking process	0.000	969600	16087	16864
Time Until Embark (Day)	The average time left before the embark date when a consumer booked each of the travel packages throughout a rebooking process	1.000	453.500	37.510	32.339
Booking Cancellations	The number of bookings cancelled by a consumer throughout a rebooking process	0.000	11.000	0.608	0.832

5.2 Hypothesis Testing Results

Figure 5 illustrated the hypothesis testing results summarized in Table 2. Overall, the findings substantiated both exclusive and inclusive rebookings as opportunistic propensities reinforced by generative features of travel planning platforms. Both exclusive and inclusive rebookings play a critical role in determining the outcome of consumer decision journey. Particularly, for every 1 point in eWOM rating an alternative travel package surpasses a booked package, consumers would express a 33.5% (β_1 = -0.335, t-value = -6.656***) less propensity for exclusive rebooking yet a 29.4% (β_2 = 0.294, t-value = 5.788***) more propensity for inclusive rebooking. These results reject Hypothesis 1 while supporting Hypothesis 2. One possible explanation for the unsupported Hypothesis 1 is that consumers who rebook from the same travel company often choose a similar travel package with small variations that better satisfies their demands. For example, it is not uncommon for a consumer to rebook a trip by changing from a twin bedroom to a double bedroom when the latter becomes available. Consequently, the alternative travel package a consumer chose to book from the same travel company likely comes with a similar rather an a more favorable eWOM rating comparing to the package they previously booked.

Except for Hypothesis 1, all the remaining hypotheses were substantiated by our data analysis results. For instance, Hypothesis 3 and 4 were supported as accessing a travel planning platform through a different channel would undercut consumers' propensity for exclusive rebooking by 16.1% (β_2 = -0.161, t-value = --4.026***) while boosting their propensity for inclusive rebooking by 18.6% (β_2 = 0.186, t-value = 4.570***). Consistent with Hypothesis 5 and 6, for every 1% propensity for either exclusive or inclusive rebooking expressed by consumers throughout their decision journeys, the likelihood for the consumers to abandon their bookings without making payments would diminish by around 19% (β_5 = -19.436, t-value = -58.320***; β_6 = -19.527, t-value = -47.629***). As predicted by Hypothesis 7, if consumers strengthen the propensity for exclusive rebooking by 1% in a decision journey, it would be 4.1% (β_7 = -4.101, t-value = -8.198***) more likely for them to purchase from the travel company they paid the most attention to. In contrast, as consumers demonstrate a 1% higher propensity for inclusive rebooking in their decision journeys, the likelihood for them to pay for travel packages offered by a travel company different from the company which they revisited most frequently would raise by 6.9% (β_8 = 6.883, t-value = 10.065***), thus supporting Hypothesis 8. Last but not least, both Hypothesis 9 and 10 were confirmed since it has been found that consumers are 0.65% (β_9 = 0.650, t-value = 5.076***) and 0.80% (β_{10} = 0.801, t-value = 4.000***) more likely to post eWOM for travel packages that they purchased via a decision journey if there has been a 1% more propensity for exclusive and inclusive rebookings respectively in this journey.



p† < 0.1, p < 0.05, p** < 0.01, p*** < 0.001*

Figure 5. Illustration of Data Analysis Results

Table 2. Summary of Hypothesis Testing Results					
Hypothesis	**β**	**SE**	**t-Statistics**	**R^2**	**Supported**
Session Level Hypotheses					
H1: ↑ eWOM Rating Discrepancy → ↑ Exclusive Rebooking	-0.335	0.050	-6.656***	0.102	No
H2: ↑ eWOM Rating Discrepancy → ↑ Inclusive Rebooking	0.294	0.051	5.788***	0.056	Yes
H3: ↑ Cross-Channel Access → ↓ Exclusive Rebooking	-0.161	0.040	-4.026***	0.102	Yes
H4: ↑ Cross-Channel Access → ↑ Inclusive Rebooking	0.186	0.041	4.570***	0.056	Yes
Session Level Controls					
Package Price → Exclusive Rebooking	0.000	0.000	-1.534 n.s.	0.102	-
Time Until Embark → Exclusive Rebooking	0.003	0.001	5.488***	0.102	-
Booking Cancellations → Exclusive Rebooking	0.335	0.020	16.695***	0.102	-
Package Price → Inclusive Rebooking	0.000	0.000	-1.553 n.s.	0.056	-
Time Until Embark → Inclusive Rebooking	-0.003	0.001	-5.663***	0.056	-
Booking Cancellations → Inclusive Rebooking	-0.344	0.022	-15.097***	0.056	-
Process Level Hypotheses					
H5: ↑ Exclusive Rebooking → ↓ Abandon Likelihood	-19.436	0.333	-58.320***	0.531	Yes
H6: ↑ Inclusive Rebooking → ↓ Abandon Likelihood	-19.527	0.410	-47.629***	0.531	Yes
H7: ↑ Exclusive Rebooking → ↓ Switch Likelihood	-4.101	0.500	-8.198***	0.345	Yes
H8: ↑ Inclusive Rebooking → ↑ Switch Likelihood	6.883	0.684	10.065***	0.345	Yes
H9: ↑ Exclusive Rebooking → ↑ eWOM Likelihood	0.650	0.128	5.076***	0.033	Yes
H10: ↑ Inclusive Rebooking → ↑ eWOM Likelihood	0.801	0.200	4.000***	0.033	Yes
Process Level Controls					
Average Rating → Abandon Likelihood	-0.270	0.035	-7.712***	0.531	-
Average Price → Abandon Likelihood	0.000	0.000	-2.064*	0.531	-
Time Until Embark → Abandon Likelihood	0.010	0.001	11.246***	0.531	-
Booking Cancellations → Abandon Likelihood	1.290	0.027	47.448***	0.531	-
Average Rating → Switch Likelihood	-0.202	0.052	-3.847***	0.345	-
Average Price → Switch Likelihood	0.000	0.000	1.064 n.s.	0.345	-
Time Until Embark → Switch Likelihood	-0.003	0.002	-1.634 n.s.	0.345	-
Booking Cancellations → Switch Likelihood	0.348	0.038	9.079***	0.345	-
Average Rating → eWOM Likelihood	0.198	0.018	10.738***	0.033	-
Average Price → eWOM Likelihood	0.000	0.000	7.455***	0.033	-
Time Until Embark → eWOM Likelihood	-0.015	0.000	-36.653***	0.033	-
Booking Cancellations → eWOM Likelihood	0.038	0.018	2.192*	0.033	-

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

When testing Hypothesis 1 to 4 at the level of each rebooking session, price of the previously booked travel package, the timing of the previous booking relative to the embark date, as well as the number of cancelled bookings were included as control variables. Interestingly, while package price exerts no influence on rebooking, booking timing together with booking cancellations impose opposite influences on exclusive and inclusive propensities. In particular, for each day further from the embark date when a consumer made the previous booking, their propensity for exclusive rebooking would increase by 0.3% (β = 0.003, t-value = 5.488 ***) whereas their propensity for inclusive rebooking would decrease by 0.3% (β

= -0.003, t-value = -5.663***). Additionally, each cancelled booking that a consumer made for a trip would boost exclusive rebooking by 33.5% (β = 0.335, t-value = 16.695***) while diminishing inclusive rebooking by 34.4% (β = -0.344, t-value = -15.097***). These findings suggest that exclusive rebooking tends to be leveraged by consumers to get an early hold of a trip and repeatedly zero in on options that are more tailored to their preferences. In contrast, consumers who continuously monitor the travel planning platform for desirable offerings for an extended period of time and refrain from making repeated rebookings often make use of inclusive rebooking to snatch travel packages offered by more reputable companies as they emerge close to the embark date.

Four variables were incorporated as controls for the validation of Hypothesis 5 to 10 at the level of each rebooking process, including the average rating, average price, average time before embark, as well as the amount of cancelled travel packages in each decision journey. The likelihood for abandoning a decision journey without making payment appeared to be influenced by average rating, average price, time until embark, as well as booking cancellations. Consumers' abandon likelihood would drop by 0.27% (β = -0.270, t-value = -7.712***) if the average rating of all travel packages booked for a trip increases by 1 point. Similarly, consumers' abandon likelihood decreases by 0.0005% (β = 0.463 x 10^{-6}, t-value = -2.064*) for every 1 CNY increase in the travel package price. Conversely, consumers' abandon likelihood would grow by 1% (β = 0.010, t-value = 11.246***) and 129% (β = 1.290, t-value = 47.448***) respectively for making the bookings 1 day earlier before the embark date and for cancelling 1 more booking. Likewise, the likelihood for consumers to switch away from the travel company to which they devoted the most attention when making purchases can be affected by average rating and booking cancellations. Particularly, consumers' switch likelihood may decline by 20% (β = -0.202, t-value = -3.847***) as the average rating of all booked travel packages grows by 1 point. In contrast, cancelling 1 more booking in a decision journey can lead to a 34.8% (β = 0.348, t-value = 9.079***) increment in consumers' switch likelihood. Lastly, the likelihood for consumers to post eWOM for the travel package they purchased through a rebooking process is found to be affected by all four control variables. Consumers' eWOM likelihood is expected to be boosted by 19.8% (β = 0.198, t-value = 10.738***), 0.0006% (β = 0.6 x 10^{-6}, t-value = 7.455***), and 3.8% (β = 0.038, t-value = 2.192*) respectively for every 1 point increase in average rating, for every 1 CNY increase in average price, and for each additional cancellation of all travel packages in a rebooking process. Conversely, every 1 day increase in the average time duration left before the embark date when a consumer booked each of the travel packages throughout a rebooking process can reduce the consumer's eWOM likelihood by 1.5% (β = -0.015, t-value = -36.653***).

5.3 Post-Hoc Analysis on Exclusive Rebooking

Further examination of our dataset reveals two types of exclusive rebooking. For instance, a consumer may choose either to rebook the same travel package or a different travel package offered by the same travel company. A post-hoc analysis is hence carried out to evaluate how distinguishing between these two types of exclusive rebooking may affect the data analysis results. Findings illustrated in Table 3 indeed helped to corroborate the difference between these two types of exclusive rebooking. Accordingly, both eWOM rating discrepancy (β = -0.509, t-value = -10.692***), and cross-channel access (β = -0.155, t-value = -4.521***) diminishes the exclusive rebooking for the same travel package. In contrast, while eWOM rating discrepancy (β = 0.436, t-value = 6.191***) promotes exclusive rebooking for a different travel package offered by the same company, cross-channel access (β = 0.076, t-value = -1.581 n.s.) does not appear affect this rebooking tendency. This finding can help to explain the unsupported Hypothesis 1. When consumers rebook the same travel package, they would not be concerned with the mostly negligible change in the eWOM rating it received. Further analysis shows that consumers would be enticed to rebook the same package when given a discounted price as price discrepancy was found to negatively influence exclusive rebooking for the same package (β = -4.57 x 10^{-6}, t-value = -3.219**). On the other hand, consumers seem to favor more expensive alternatives offered by the same travel company based on the positive relationship between price discrepancy and exclusive rebooking for a different package offered by the same company (β = 3.18 x 10^{-6}, t-value = 1.687†). This finding implies that consumers' exclusive rebooking of a different package offered by the same company is largely driven by need and quality rather than price.

Table 3. Post-Hoc Analysis for Distinguishing between Two Types of Exclusive Rebooking

Hypothesis	β	SE	t-Statistics	R^2
Session Level Main Effects				
eWOM Rating Discrepancy → Exclusive Rebooking for the Same Package	-0.509	0.048	-10.692***	0.097
eWOM Rating Discrepancy → Exclusive Rebooking for Different Packages	0.436	0.070	6.191***	0.041
Cross-Channel Access → Exclusive Rebooking for the Same Package	-0.155	0.034	-4.521***	0.097
Cross-Channel Access → Exclusive Rebooking for Different Packages	0.076	0.048	1.581 n.s.	0.041
Price Discrepancy → Exclusive Rebooking for the Same Package	-4.57×10^{-6}	1.42×10^{-6}	-3.219**	0.097
Price Discrepancy → Exclusive Rebooking for Different Packages	3.18×10^{-6}	1.89×10^{-6}	1.687†	0.041
Session Level Controls				
Package Price → Exclusive Rebooking for the Same Package	0.78×10^{-6}	1.09×10^{-6}	0.712 n.s.	0.097
Time Until Embark → Exclusive Rebooking for the Same Package	-2.99×10^{-4}	4.21×10^{-4}	-0.710 n.s.	0.097
Booking Cancellations → Exclusive Rebooking for the Same Package	0.357	0.017	20.905***	0.097
Package Price → Exclusive Rebooking for Different Packages	1.20×10^{-6}	1.42×10^{-6}	0.845 n.s.	0.041

Time Until Embark → Exclusive Rebooking for Different Packages	0.004	0.001	7.490***	0.041
Booking Cancellations → Exclusive Rebooking for Different Packages	-0.243	0.025	-9.641***	0.041
Process Level Main Effects				
Exclusive Rebooking for the Same Package → Abandon Likelihood	-18.766	0.353	-53.227***	0.561
Exclusive Rebooking for Different Packages → Abandon Likelihood	-13.039	0.405	-32.217***	0.561
Exclusive Rebooking for the Same Package → Switch Likelihood	-9.288	0.624	-14.894***	0.393
Exclusive Rebooking for Different Packages → Switch Likelihood	2.812	0.510	5.516***	0.393
Exclusive Rebooking for the Same Package → eWOM Likelihood	0.680	0.181	3.763***	0.033
Exclusive Rebooking for Different Packages → eWOM Likelihood	0.721	0.331	2.179*	0.033
Process Level Controls				
Average Rating → Abandon Likelihood	-0.249	0.035	-7.116***	0.561
Average Price → Abandon Likelihood	-4.83×10^{-6}	2.28×10^{-6}	-2.118*	0.561
Time Until Embark → Abandon Likelihood	0.010	0.001	11.435***	0.561
Booking Cancellations → Abandon Likelihood	1.335	0.028	47.669***	0.561
Average Rating → Switch Likelihood	-0.192	0.053	-3.602***	0.393
Average Price → Switch Likelihood	5.00×10^{-6}	4.36×10^{-6}	1.147 n.s.	0.393
Time Until Embark → Switch Likelihood	-0.003	0.002	-1.573 n.s.	0.393
Booking Cancellations → Switch Likelihood	0.689	0.048	14.232***	0.393
Average Rating → eWOM Likelihood	0.198	0.018	10.738***	0.033
Average Price → eWOM Likelihood	0.000	0.000	7.455***	0.033
Time Until Embark → eWOM Likelihood	-0.015	0.000	-36.653***	0.033
Booking Cancellations → eWOM Likelihood	0.038	0.018	2.192*	0.033

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

The impact of two types of exclusive rebooking on consumers' purchase decision and post-purchase engagement are consistent except for the likelihood for consumers to switch travel companies. For instance, exclusive rebooking for the same travel package (β = -18.766, t-value = -53.227***) or for a different one (β = -13.039, t-value = -32.217***) both decrease the likelihood for consumers to abandon the booked packages. Likewise, the likelihood for consumers to exclusive rebooking for both the same travel package (β = 0.680, t-value = 3.763***) or for a different one (β = 0.721, t-value = 2.179*). Nonetheless, while consumers who rebooked the same travel package are more likely to stay with the same travel company (β = -9.288, t-value = -14.894***), those who rebooked a different package from the same company likely end up switching to other companies (β = 2.812, t-value = 5.586***).

6 DISCUSSION AND CONCLUSION

Encouraged by the advancement of digital generativity, consumers are becoming more opportunistic in their decision journeys for travel planning (Dichter 2018). This study strives to uncover consumers' rebooking behavior driven by spontaneous attention allocation propensities reinforced by generative features on travel planning platforms. Overall, this study discovered that, despite their intended purposes, generative features may indeed give rise to consumers' opportunistic behavior. Moreover, this study demonstrates the importance of understanding the unintended impact of generative features in terms of

evoking consumer opportunistic behaviors. This study found that the opportunistic rebooking reinforced by eWOM and cross-channel access can lead to outcomes that are desirable for travel companies and travel planning platforms. Travel companies are hence recommended to take advantage of consumers' opportunistic rebooking to convert consumers and boost sales. Platforms that host travel companies can also benefit from stimulating consumers' engagement via encouraging opportunistic rebooking.

Findings obtained from analyzing consumers' booking records for cruise packages on a major travel planning platform confirmed the predominant role played by opportunistic rebooking in determining consumers' purchase decision and post-purchase engagement. eWOM ratings hosted by travel planning platforms were found to affect exclusive and inclusive rebookings differently. Results indicated that consumers are more likely to cancel a booked travel package to rebook a more favorably rated package regardless whether the package is offered by a different company or not. In contrast, consumers tend to refrain from rebooking the same travel package offered by the same company if they encounter more favorably rated packages. On the other hand, cross-channel access influences exclusive and inclusive rebookings distinctively. Whereas consumers show a stronger propensity for exclusive rebooking the same travel package when accessing a travel planning platform through the same channel, those who changed the channel when accessing a travel planning platform have an enhanced propensity for inclusive rebooking. Noteworthily, cross-channel access does not seem to affect the propensity for exclusive rebooking a different travel package offered by the same company.

The aggregated propensity for exclusive and inclusive rebookings can determine consumers' purchase decisions and post-purchase engagement. As the findings indicate, both exclusive and inclusive propensities substantially reduce the likelihood for consumers to abandon their decision journeys without making payment. Moreover, while exclusive rebooking for the same package drives up the likelihood for consumers to purchase from the company with which they repeatedly rebooked, both exclusive rebooking for a different package offered by the same company and inclusive rebooking encourages consumers to switch away from the business with which they repeatedly rebooked when making the payment. Last but not least, both exclusive and inclusive propensities stimulate post-purchase engagement in the form of posting eWOM for the purchase travel offering.

6.1 Theoretical Implications

This study can offer several implications for research on consumer opportunistic behavior. Firstly, this study accentuates consumers' opportunistic rebooking as a form of emergent behavior reinforced by gen-

erative features provided by travel planning platforms. In contrast to the consumer opportunistic behaviors that are driven by insufficient monitoring and exploitable policy loopholes (Macintosh and Stevens 2013; Rosenbaum et al. 2011; Rotman et al. 2018), this study sheds light on consumer opportunistic behavior (i.e., trip rebooking) encouraged by digital generativities. Particularly, the driving mechanism for consumers' opportunistic rebooking is the attention allocation propensity reinforced by generative features. Depending on whether a consumer chooses to focus their attention exclusively on offerings of one travel company (i.e., exclusive propensity) or to shift their attention to other competing companies (i.e., inclusive propensity), their decision journeys vary. Such opportunistic rebooking is emergent in nature, hence can only manifest through recurrent decision makings in consumers' decision journeys. Further studies that aim to investigate consumer opportunistic behaviors reinforced by digital generativities can refer to this study as an example for examining consumers' each decision making episode as part of a decision journey rather than an isolated instance.

Second, this study explicated how generative features provided by travel planning platforms steer consumers' opportunistic rebooking. By allowing consumers to rate available travel offerings via posting eWOM, future consumers can leverage eWOM ratings as quality signals to benchmark travel offerings against each other. The eWOM rating discrepancy between a booked travel offering and an alternative offering would diverge consumers' attention from the offering that they booked, hence diminishing exclusive rebooking for the same offering. The said eWOM rating discrepancy would attract consumers' attention to alternative offerings that are more favorably rated regardless whether they are offered by the same travel company, thus encouraging exclusive rebooking for different offerings and inclusive rebooking.

The other generative feature, namely cross-channel access, also exerts opposing influences on exclusive and inclusive rebooking propensities. Specifically, consumers access a travel planning platform through the same channel tend to retain their attention on the offering they booked, therefore boosting exclusive rebooking for the same offering. Conversely, consumers who select a different channel to access a travel planning platform likely allocate more attention on other available travel companies, which drives inclusive rebooking. Noteworthily, the channel consumers choose to access a travel planning platform does not seem to influence whether they rebooking a different offering of the same travel company. Taken together, findings of this study help to confirm the prevalence of emergent consumer behavior that is neither intended nor foresaw by designers of digital features. These features can hence be deemed as generative since consumers may make use of these features in unintended ways. This study thus helped to unveil the underlying attention-based mechanism that govern consumers' emergent use of generative features.

Third, this study attests to the importance of understanding consumers' opportunistic rebooking by substantiating its impact on consumers' decision outcome and post-purchase engagement. To illustrate, both exclusive and inclusive rebooking propensities discourage consumers from abandoning all travel offerings booked throughout a decision journey. Moreover, while exclusive rebooking for the same offering boosts the likelihood for consumers to purchase travel offerings that they repeated rebooked from a travel company, inclusive rebooking makes it more likely for consumers to purchase from an alternative travel company which they did not considered extensively. Last but not least, consumers appear to be more engaged with the travel offering that they purchased through opportunistic rebooking, hence are more likely to post eWOM about their trip on the travel planning platform. These findings help to demonstrate how consumers' opportunistic rebooking can be leveraged to predict consumers' unplanned decision outcomes.

6.2 Managerial Implications

This study can offer actionable guidelines for travel companies and travel planning platforms alike to manage consumers' increasingly unpredictable decision journeys for travel planning (Dichter 2018). First, our findings highlight the potential value for travel companies to proactively approach consumers who have made bookings for their trips. The data analysis result of this study shows that it is not uncommon for consumers to rebook their trips. Those who did so would rebook more than once on average and only 61% of them ended up paying for the travel offering that they initial booked. It can hence be imperative for travel companies to accommodate consumers' opportunism in order to survive and thrive in the current digital age.

Second, findings of this study may inform travel companies about how existing generative features offered by travel planning platforms can be leveraged to predict and steer consumers' decision journeys. Travel companies that aim to retain consumers who booked their offerings can stimulate the consumers' exclusive rebooking for the same offering they booked by offering discount or upgrade options as the earliest possible occasion. However, travel companies should refrain from recommending alternatives to consumers who have already booked with them. In addition, the travel companies may try to encourage or even incentivize consumers to stick to one channel when accessing the travel planning platform. On the other hand, travel companies that seek to convert consumers from their competitors may promote their most highly rated offerings to consumers who have booked with their competitors. Moreover, these travel companies can prioritize their marketing resources on consumers who switched channels when visiting a travel planning platform. We would also recommend travel planning platforms to assist travel

companies in their endeavors of encouraging consumers' opportunistic rebooking since doing so can boost the likelihood for consumers on these platforms to purchase their bookings and to offer voluntary eWOM.

Third, by unveiling consumers' opportunistic rebooking, this study can inspire travel companies to take advantage of consumers' opportunistic rebooking strategically. For instance, travel companies are recommended to embrace the increasingly prevalence of rebooking by ensuring the dynamic capability of their booking and scheduling systems. Likewise, travel companies may benefit from simplifying the booking procedure. Doing so allows travel companies to leverage on consumers' bookings more as indicators of their travel interests and preferences and less as their commitments to a travel plan. To keep one step ahead of the ever more sophisticated consumers, this study recommends travel companies to invest in service personalization based on behavioral analytics. Proactively accompanying consumers in their decision journeys can contribute tremendously to retaining existing consumers and converting new consumers.

6.3 Limitations and Future Studies

This study has a few limitations that may point to potential opportunities for future studies. First, to ensure the internal validity of our findings, this study chose the cruise sector as its empirical setting since a cruise package is the most comprehensive travel offering. It is hence unlikely for consumers' rebooking of cruise packages to be influenced by other related bookings. For example, consumers often need to change their accommodation bookings once they have changed their flight tickets. Nevertheless, future study can help to bolster the external validity of our findings by investigating consumers' opportunistic behavior in other service and/or product sectors.

Second, since the number of travel planning platforms for cruise is quite limited. it is common for consumers to stay within one travel planning platform throughout their decision journeys. Therefore, examining consumers' decision journey on one travel planning platform not only ensures a manageable empirical design, but also accurately reflects consumers' real-world cruise booking journeys. Future study can extend the present study by investigating consumers' decision journeys for other travel sectors across multiple platforms.

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Understanding Emergence in Behavioral Process as Generativity Reinforced Attention Allocation Propensity

Essay 3

Abstract

Leveraging on digital behavioral analytics to predict consumers' increasingly emergent decision journeys and to respond swiftly with personalized services is becoming the key to satisfying and retaining consumers. This study elaborates on process-as-propensity as a fitting method for theorizing emergent behavioral process. This study conducts a literature analysis to categorize 42 past studies on process with an extended taxonomy of process types, which includes deterministic process, stochastic process, as well as emergent process. and corresponding theorization approaches, which consist of variance approach, mixed approach, as well as process approach. An empirical study on emergent search strategies employed by consumers in their decision journeys is incorporated as an illustrative example. This illustrative example analyzed 288 participants' search logs through a process modeling approach and found that participants switch emergent search strategies when provided with different search features. We then leverage on emergent search strategies to evaluate the effectiveness of each search feature. This study concludes by highlighting four potential research avenues for applying the process-as-propensity approach, namely digital innovation, immersive computing, digital activism, and collective emergence.

***Keywords**: Emergent Behavioral Process, Digital Generativity, Propensity-as-Process.*

1 INTRODUCTION

Emergent usage patterns of *digital artefacts* (Kallinikos et al. 2013) are becoming ever more prevalent due to the continuous penetration of digital artefacts with *generativity* (Avital and Te'Eni 2009; Eck et al. 2015; Henfridsson and Bygstad 2013; Igamberdiev and Shklovskiy-Kordi 2016). Generativity is defined as the *capacity of a technology or a system to be malleable by actors in unanticipated ways* (Zittrain 2008, 2005). Unlike *technological affordance*, which represents the *material property enabling possibilities for actions* (Leonardi 2011; Volkoff and Strong 2013), *technological generativity* allows for *emergent use*, which is neither stipulated by the digital design nor preconceived by users. To illustrate, the use of *immersive technology*, such as using mobile applications with Augmented Reality (AR) capabilities to experience products in real world settings (Xu et al. 2018) or to navigate a physical environment with the assistance of virtual elements (Berkemeier et al. 2019), is emergent in nature. Moreover, interacting with Artificial Intelligence (AI) technology, like conversing with a chatbot (Watson 2019) or seeking recommendations from a smart assistant (Li et al. 2017), can also be considered a process that allows for emergence.

Only few studies on processes of technology use have shed light upon the concept of emergence (Austin and Devin 2009; Lee et al. 2008; Markus et al. 2002). Unlike planned technology use, emergent technology use is characterized by the unanticipated timing and purpose of use. This uncertainty of emergence does not requires improvised use of digital artefacts though, which is the result of absent or inadequate affordance (Volkoff and Strong 2013). Rather, it stems from the flexible chaining of actions permitted by technological generativity. Emergence can be exemplified as building Lego bricks without a plan. In this scenario, even when a builder adheres to actions afforded by the design of Lego bricks (i.e., attaching bricks together), the timing when each brick is added as well as the purpose of doing so is determined by the builder on the fly based on how previous bricks are attached together. The builder can hence produce constructions are neither described in an instruction nor pre-conceived by him/herself.

Although design principles for generativity enabling emergence have been explored in prior literature (Avital and Te'Eni 2009; Henfridsson and Bygstad 2013; Markus et al. 2002), emergence only began to draw scholarly interests as personal digital traces become increasingly more accessible (Hsieh et al. 2016; Settanni et al. 2018). Unraveling emergence is key to understanding how seemingly unanticipated outcomes, such as emergent strategies (Mirabeau and Maguire 2014) and bottom up organizational changes (Wee and Taylor 2018) come to existence. Furthermore, accommodating emergence resembles a increasingly more essential and effective approach to the personalization of digital services like e-commerce and recommendation (Zhang et al. 2011). As consumers are becoming more equipped with technologies, it is increasingly difficult to short circuit their purchase journeys (Dichter 2018; Kleweno et al. 2019). Accommodating consumers' emergent behavior is also indispensable for satisfying customers'

demands (Hsieh et al. 2016; Settanni et al. 2018), creating serendipity (Ge et al. 2010), as well as facilitating value co-creation (Payne et al. 2008). This study hence strives to advance the understanding of the emergent behavioral process enabled by digital generativity so it can be better predicted and accommodated.

Emergent process differs from the extensively studied *deterministic process*, which unfolds via transitions among pre-determined states triggered by pre-anticipated conditions (e.g., Rezazade Mehrizi et al. 2019), and *stochastic process*, which unfolds as states manifest probabilistically (e.g., Hao et al. 2018). Past research on deterministic processes predominantly chose between the *variance* approach and the *process* approach (Markus and Robey 1988; Mohr 1982; Webster and Watson 2002). When the variance approach is adopted, the process of interest is short circuited as direct transformations of inputs into outputs or performance attributes, such as effectiveness and efficiency (Sabherwal and Robey 1995). In contrast, the process approach focuses on identifying the specific sequence of states leading to the expected outcome (Sabherwal and Robey 1995). Studies that rely on *predictive modelling* to examine stochastic processes by formulating pertinent probabilistic models begin to gain tractions (e.g., Breuker et al. 2016). The purpose of predictive modelling is to render stochastic processes comprehensible, reproducible, and predictable (Breuker et al. 2016).

Unlike deterministic and stochastic processes, emergent processes are driven by accumulation of actors' *attention allocation propensities* for state transitions (Lee et al. 2008; Wee and Taylor 2018). As the seminal driving mechanism beneath emergence, attention allocation propensity represents an actor's focusing of attention resources on opportunities for making use of technologies for fulfilling desires (Wee and Taylor 2018). This study posits propensity as a foothold to theorize actors' emergent attention on utilizing technologies at each next step throughout a process. In particular, propensity encapsulates both the *directionality*, the selection of which action to transit to from the previous one, and *intensity*, the frequency of each transition, of emergence (Wee and Taylor 2018). Put in another way, this approach of investigating emergent processes through attention allocation propensity, which this study named *process-as-propensity*, allows us to elicit attention allocation propensity as a quantifiable factor to explicate unanticipated development and outcome of a process. In this sense, process-as-propensity can also contribute to reconciling between the variance and process approaches (Delone and McLean 2003; Sabherwal and Robey 1995; Seddon 1997).

To summarize, this study endeavors to achieve three main objectives: (1) *Establish emergent process as a distinctive behavioral pattern enabled by technological generativity*; (2) *advance process-as-propensity*

as an innovative method to theorize emergent process; and (3) *shed light on potential research venues for applying process-as-propensity*. To achieve these research objectives, this study offers a typology of processes in which emergent process is contrasted to the more extensively investigated deterministic and stochastic processes. We then consolidate key methods employed by past studies to theorize different types of processes in order to substantiate the unique insights to be gleaned via process-as-propensity. In addition, we map all solicited methods for theorizing process to pertinent process types adopted by studies published in leading Information System (IS) journals since 2000 to highlight the uncharted territory for applying process-as-propensity. An illustrative example, in which we investigated information search patterns on digital platforms, is then provided to demonstrate how process-as-propensity can be applied to understand emergence embedded in digital traces. Last but not least, potential research venues where investigating emergence promise abundant implications are outlined.

2 THEORY DEVELOPMENT

2.1 Generative Digital Artefacts

The generative digital artefacts can be characterized by four general properties, namely editability, interactivity, openness, and distributedness (Kallinikos et al. 2013). *Editability* indicates the possibility for digital artefacts to be modified or updated continuously and systematically. *Interactivity* means that the process of making use of a digital artefact is determined by users rather than fixated by design. *Openness* refers to the possibility for a digital artefact to be accessed or modified through other digital artefacts. Last but not least, *distributedness* pertains to the transient property of digital artefacts that allows them to be duplicated and moved in interconnected information infrastructure (e.g., Internet).

As illustrated by Kallinikos et al. (2013), generative digital artefacts can be exemplified by search engine, a digital artefact that allows for accessing and rearranging informational content of indexed web pages. Search engine together with the result page is editable since both its algorithm and the retrieved information are subject to editing (Kallinikos et al. 2013). Search engine is interactive since the result page is rendered through the interaction between the keywords supplied by users and the dynamically indexed web pages (Kallinikos et al. 2013). Search engine is open because the content displayed in the result page depends on the constantly changing content on indexed pages (Kallinikos et al. 2013). Last but not least, since the result page produced by search engine is a contingent assembly of content snippets of, and links to, indexed pages (Kallinikos et al. 2013).

Past studies shed light on how generative design principles give rise to emergent usage patterns. That is, why is it possible to use generative digital artefacts in a way that is neither stipulated by design nor preconceived by users. Avital and Te'eni (2009) advocated that generativity design is *evocative*, meaning it

relies on diverse frames to inspire creative thinking through visualization, simulation, abstraction, integration, and communication (Avital and Te'Eni 2009). Subsequently, generative design should be *adaptive* to the diverse users, environments, tasks, as well as usage scopes by enabling customization and automation (Avital and Te'Eni 2009). Moreover, generative design is *open* in a sense that endless configurations are allowed via peer-production and rejuvenation (Avital and Te'Eni 2009).

According to Markus et al. (2002), in order to effectively support emergent knowledge process, which is unpredictable, participatory, and distributed in nature, the design of digital artefacts should fulfill three requirements. First, the design should not depend on assumed roles or motivations. Second, the design needs to accommodate complex, distributed, and evolving knowledge bases. Third, the design should allow users to deliberate and tradeoff in an unstructured and dynamical fashion. Likewise, Lee et al. (2008) proposed a process grammar on the basis of two design principles that enables design of process in an emergent fashion. First, the grammar refrains from providing too many alternatives for designers to choose from at one time (Lee et al. 2008). Second, the grammar prioritizes plausible alternatives depending the context of design (Lee et al. 2008).

Taken together, although prior literature underpinned the digital generativity that gives rise to emergent behavioral patterns, few have examined these emergent behavioral patterns. As parts of a system, neither users nor generative digital artefacts had planned or intended for emergent behavioral patterns. Emergent processes emerge when users' human agency for allocating attention on opportunities for fulfilling personal desires interacts with the technological agency enabled by generative digital artefacts (Leonardi 2011). This study hence theorizes that users' emergent behavioral process is driven by their spontaneous opportunity seeking attentions reinforced by digital generativity. In particular, the *malleability* enabled by digital generativity afford users a multitude of possibilities for actions. The *interactivity* allows users to play a participatory role in determining how the artefact functions. Interactivity also implies an unstructured usage pattern in which accumulation of attention allocation propensities drives the development and outcome of a behavioral process. The *openness* of generative digital artefacts allows multiple parties to make unanticipated modifications. Last but not least, the *distributedness* of generative digital is essential for enabling ubiquitous access that gives rise to spontaneous usage patterns.

2.2 Typology of Process

To elucidate how emergent process differs from both deterministic and stochastic processes, this study seeks to put forth a typology of process to distinguish among these three process types in four key di-

mensions (see Table 1). Specifically, each process type comprises states in different nature together with a distinctive mechanism that drives the transition from state to state. Moreover, the potential roles played by digital artefacts for each process type are unique, which in turn gives rise to different purposes for IS researchers to tackle different type of processes.

Table 1. Typology of Process

Process Type	Deterministic Process	Stochastic Process	Emergent Process
Definition	A process consisting of pre-determined states and triggers of state transition	A process consisting of probabilistically manifested states	A process of the accumulation of resource allocation propensities
State	Pre-determined states	Probabilistic states	Constructive states
Drive of State Transition	Triggers	Probabilities	Propensities
Role of Digital Artefacts	▪ Frame context ▪ Facilitate process	▪ Reduce uncertainty	▪ Enable generativity
Purpose for Research	▪ Identify states and triggers ▪ Examine input to output transformation	▪ Formulate probabilistic models ▪ Enable simulation and prediction	▪ Derive generativity of emergence ▪ Understand and predict unanticipated outcome
Example	▪ Information systems discontinuation process (Rezazade Mehrizi et al. 2019) ▪ Organizational learning process (Ramasubbu et al. 2008)	▪ Business process (Breuker et al. 2016) ▪ Healthcare process (Yeow and Goh 2015)	▪ Design process (Lee et al. 2008) ▪ Emergent knowledge process (Markus et al. 2002)

Deterministic process comprises of pre-determined states, such as activities and procedures, that are connected in a certain sequence. The transition from state to state is often triggered by specific conditions. The outcome of deterministic process is usually specified explicitly in advance. The *IS discontinuation process* investigated in Rezazade Mehrizi et al.'s work (2019) is one example of deterministic processes contextualized by digital artefacts. By conducting a fieldwork in four companies for 18 months, Rezazade Mehrizi et al. (2019) uncovered key stages, namely realization, marginalization, practicing, reversion, and handover, that each company goes through in a particular sequence to break free from the *self-reinforcing mechanisms* in organizational paths and discontinue its legacy IS. A wide array of internal triggers, such as acquaintance with new IS and high maintenance cost of legacy IS, as well as external triggers, like technological changes and new customer demands, are also identified for each state (Rezazade Mehrizi et al. 2019).

Organizational learning process investigated by Ramasubbu et al. (2008) can help to exemplify deterministic processes facilitated by digital artefacts. For instance, it was examined that facilitating *key process areas* of *capability maturity model* can trigger pertinent states in learning process, including

knowledge acquisition, information distribution, information interpretation, organizational memory, and social interaction (Ramasubbu et al. 2008). By analyzing internal data collected from a leading offshore software service company, Ramasubbu et al. (2008) validated investments in *key process areas* as inputs of organizational learning process that can translate into better offshore software project performance, the desired outcome. These two examples help to demonstrate that digital artefacts can play a role in framing the context for as well as facilitating specific states of a deterministic process. Suitably, research on deterministic processes are motivated to identify interconnected states together with triggers of state transitions and to examine the transformation from inputs to outputs.

Stochastic process is formed by states that manifest probabilistically, such as prices and events. For this reason, states in a stochastic process are not inherently connected. Instead, the connection between states are inferred based temporal order in which they manifest. Each state in a stochastic process is driven solely by probability. Nonetheless, the probability of each state can be either independent or dependent on the manifestation of other states. Some studies attempted to investigate business process as a stochastic process (e.g., Breuker et al. 2016). Particularly, Breuker et al. (2016) aimed to infer business process via predictive modelling (i.e., RegPFA Predictor and Analyzer) on the basis of logged events in business operations. As a result, Breuker et al. (2016) are able to model business processes probabilistically and to make business processes more comprehensible by visualizing them in the form of Petri Net. Digital artefacts such as *early warning systems* can then be implemented to reduce the uncertainty in the execution of business processes by detecting anomalies (Breuker et al. 2016).

Yeow and Goh's (2015) investigation of healthcare process can serve as another example of research on stochastic processes. In their study, healthcare process is examined as a production process in which each state resembles the number of patients consulted in a clinic each day (Yeow and Goh 2015). Yeow and Goh (2015) are then able to formulate a probabilistic model that simulates and predicts daily consultation outputs via resource allocative efficiency. Their findings attested to the effectiveness of implementing telemedicine program in improving allocative efficiency and reducing the wait-time uncertainty (Yeow and Goh 2015). The above exemplary studies help to corroborate uncertainty reduction as the main role digital artefacts targeting stochastic processes can play. Consequently, research on stochastic processes often aim to formulate the probabilistic model that governs the manifestation of states so it can be simulated and predicted.

Unlike deterministic and stochastic processes, emergent process is unstructured and participatory in nature (Markus et al. 2002). It unfolds through the amplification and accumulation of actors' emergent pro-

pensities in state transitions (Lee et al. 2008; Wee and Taylor 2018). Each state in an emergent process is constructed by the actor who channels attention towards desired direction, which Markus et al. (2002) termed *vigilance to opportunities*, and acts accordingly (Wee and Taylor 2018). An actor's propensity is characterized by its direction and intensity (Wee and Taylor 2018). *Propensity direction* indicates the potential of realizing intrinsic desires to which an actor directs his/her attention. It emerges from each actor's situational awareness and sense-making and in turn instantiates in his/her selection regarding the next action. *Propensity intensity* resembles the persistency for an actor to direct his/her attention to a specific potential of realizing intrinsic desires. It can be reflected by the frequency for a specific state transition to iterate in an emergent process. In this sense, the outcome of an emergent process takes shape gradually as the actor iterates transitions recursively rather than being explicitly deliberated in advance (Markus et al. 2002).

Markus et al. (2002) are among the first to investigate *knowledge process* as an emergent process. In so doing, they construe knowledge process as a series of trial-and-error interpretations, deliberations, as well as actions iterated recursively by actors in an unstructured and unpredictable manner (Markus et al. 2002). Despite offering plentiful insightful accounts on the emergent nature of knowledge process, Markus et al. (2002) focused on soliciting design principles for generative systems that implicitly guide users' knowledge activities in their desired directions without explicitly forcing them into a pre-determined process.

Not unlike Markus et al.'s (2002) work, Lee et al. (2008) designed a *process grammar* to enable *emergent design process* in which designers can generate viable alternatives to an existing business process. The "Lego-like" generativity of the process grammar allows designers to search through a vast space of possible business process alternatives to zero in to desirable ones and change how the business process is actually carried out accordingly (Lee et al. 2008). Building upon these pioneering studies that help to establish the generativity of digital artefacts in enabling emergent usage patterns (Austin and Devin 2009; Lee et al. 2008; Markus et al. 2002), this study focuses on theorizing emergence in process. By offering a typology that distinguishes among deterministic, stochastic, and emergent processes, this study endeavors to advance a process-as-propensity approach to unravel the driving mechanism of emergence and in turn makes emergent outcomes comprehensible and predictable (Wee and Taylor 2018).

2.3 Process Theorization Methods

Prior studies adopted a number of methods to theorize processes. These methods can be categorized into three approaches in accordance with the underlying ontological assumption for the process of interest (Sabherwal and Robey 1995). *Variance approach* refers primarily to *quantitative method* that converts a process into a system of interrelated variables (Sabherwal and Robey 1995). Quantitative method is usu-

ally achieved by short circuiting the process of interest into connections between inputs and outputs. For example, Poston and Speier (2005) leveraged on the adjustment styles in the content search and evaluation process as the mediator between content rating and decision performance. Ramasubbu et al. (2008) focused on investments in organizational learning routines as predictors of offshore software development performance. Mani et al. (2010) identified information capabilities and information requirement fit as predictors of the performance of both transactional and transformational business process outsourcing. Appan and Browne (2012) distilled requirement gathering techniques and the misinformation effect from the information requirements determination process and examine their impacts on the effectiveness of requirement communication. Kim and Kim (2014) examined how diversity of developers' prior experience affects the performance of malware resolution process. Last but not least, Ramasubbu et al. (2015) focused on software process diversity and compliance as determinants of software development success.

Process approach refers largely to the *qualitative method* that discerns interconnected states in a process as well as the triggers driving state transitions (Sabherwal and Robey 1995). Quantitative method helps to explicate why a process exists, what it is, and how it is carried out. For instance, Iversen et al. (2004) postulated a process model named IDEAL that consists of an initiating state and a loop of diagnosing, establishing, acting, as well as learning states for risk management in software process improvement. Bayerl et al. (2016) theorized the process of group-based technology adoption as transitions of alignments in attitudes and rationales across subgroups triggered by external and internal conditions. Rezazade Mehrizi et al. (2019) advanced a process model of IS discontinuation consisting of four key states, namely realization, reversion, handover, and marginalization.

Method that attempts to synergize both the variance and process approaches can be categorized as *mixed approach* (Sabherwal and Robey 1995). Four mixed approaches were employed by existing studies to integrate both the variance and process aspects of the phenomenon of interest. The first one is *contingency model* with two variations: *variance-centric contingency* and *process-centric contingency* (Sabherwal and Robey 1995). Whereas variance-centric contingency regards variables as contingency factors that alters state sequence in a process, its process-centric counterpart treats stages in the process as contingency factors that moderate relationships among variables. The contingency model was adopted by Xue et al. (2008) to identify how three key contingency factors (i.e., IT investment characteristics, external environment, and internal context) alter the state sequence in IT investment decision processes. Ply et al. (2012) examined how role ambiguity, role conflict, work overload, professional efficacy, as well as job satisfaction change along the advancement in organizational capacity maturity level. Kim et al. (2014)

identified the type of human capital, which includes both firm-specific and industry-specific experiences, as the contingency factor that shapes the process of yearly wage growth.

The second method in the mixed approach category is named *causality-as-process*, which indirectly infers the precedence among stages in the process with causal relationships among variables subsumed in each stage (Sabherwal and Robey 1995). Past studies voiced concerns over the validity of this method due to the incompatibility between representational elements (i.e., entities and relationships) in variance approach and those in process approach (Seddon 1997). Nonetheless, Delone and McLean's (2003) IS success model is one widely acknowledged example of applying this method. For instance, they formulated a variance model to examine the IS success process consisting of IS quality, IS use, individual impact, and organizational impact (Delone and McLean 2003).

The third method that falls into the mixed approach category is *joint application*, which was proposed by Sabherwal and Robey (1995) to retrospectively integrate implications gleaned independently from both the variance and process approaches to enrich interpretation of findings. As illustrated by Sabherwal and Robey (1995), variance and process approaches can be mutually informative, meaning insights emerged through one approach can help to explain those obtained from the other. In particular, when investigating the information system development process, the levels of participation (i.e., joint, user-led, top-down in house, IS-led traditional, and top-down outsourced development) discerned via the variance approach can be used to explain the action sequence in the process and vice versa (Sabherwal and Robey 1995). Dennis and Garfield (2003) also employed a similar method by utilizing quantitative survey data to complement and enhance their qualitative analysis of how group support systems can enable a more participative team decisional process and lead to decisional outcomes that better represent team members' collective interests.

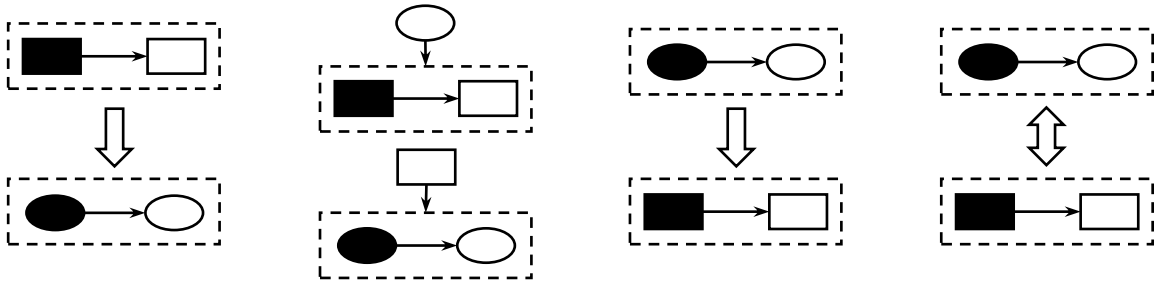
Predictive modelling widely adopted by studies on stochastic processes can be considered as the fourth mixed approach. Predictive modelling blurs the boundary between variance and process approaches since it helps to formulate the manifestation of state sequences with probabilistic variables (e.g., Hao et al. 2018). To illustrate, Yeow and Kim (2015) modelled healthcare process as a production function that predicts daily number of consulted patients with the aggregated time expended by physicians with varying experiences minus the hindering technical inefficiency. Breuker et al. (2016) implemented a probabilistic mode named RegPFA for inferring business processes from event logs by redesigning the probabilistic finite automation (PFA), a variation of hidden Markov model (HMM) (Verwer et al. 2014). Hao et al. (2018) modelled technology implementation process as a Bayesian learning process, which predicts a physician's experienced quality of a new technology as function of three quality signals from direct experience, general peers, as well as early adopters.

This study aims to advance a new mixed approach, namely *process-as-propensity*, for theorizing emergence in process. In comparison to aforementioned approaches, process-as-propensity is geared towards eliciting the propensities in state transitions as the driving mechanism of emergent process and incorporating them in variance-based models. Propensity direction is determined by the selection of state transitions as variables to be included into a variance-based model. Propensity intensity can be reflected by variance in the probability of each state transition. Process-as-propensity can hence enable the theorization of both the causes and consequences of the emergence driven by actors' selective attentions (i.e., propensities). In this regard, as a natural progression from the established design theories for emergence enabling generative digital artefacts (Austin and Devin 2009; Lee et al. 2008; Markus et al. 2002), process-as-propensity directly tackles the ensuing emergent process. Furthermore, insights gleaned from investigating emergent processes with process-as-propensity can inform design theories regarding how the manifestation of emergence can be predicted and engineered.

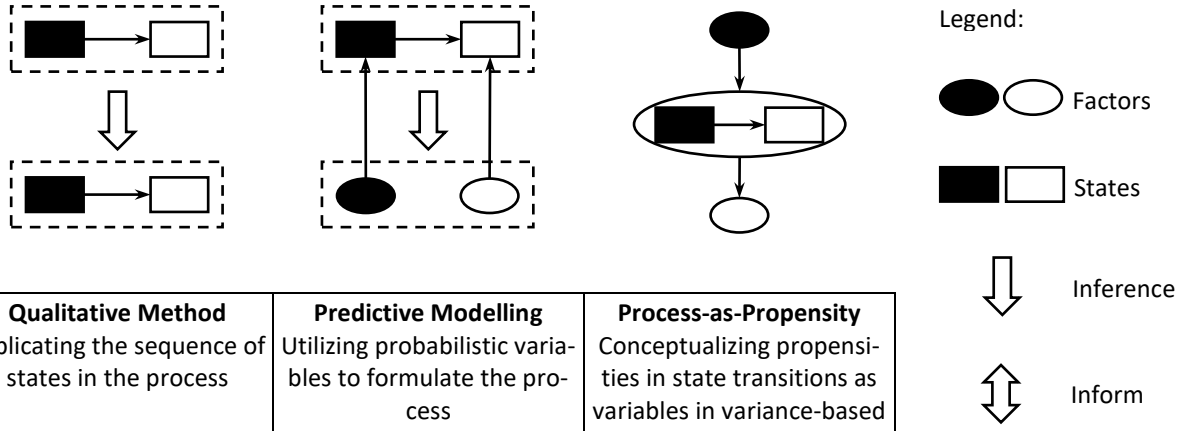
2.4 Mapping Process Theorization Approaches to Process Types

Basing on the process types and process theorization approaches we consolidated, we conducted a literature search for articles published on premium journals in IS discipline (i.e., MISQ and ISR) since 2000. We then mapped the 42 articles we found according to the types of processes they investigate together with the methods they employed (see Table 3). Accordingly, the majority of existing process research (i.e., 18 articles) employed quantitative methods to investigate deterministic processes. The quantitative methods employed by this vein of research include econometrics (Kim and Kim 2014; Liu and Aron 2014; Ramasubbu et al. 2008, 2015; Sen and Raghu 2013; Slaughter and Kirsch 2006; Venkatesh et al. 2018), experiment (Appan and Browne 2012; Kim et al. 2000; Kuechler and Vaishnavi 2006; Poston and Speier 2005), simulation (Jayanth et al. 2011; Raghu et al. 2004), survey (Bharadwaj et al. 2007; Bhattacherjee and Sanford 2006; Ray et al. 2005; Tanriverdi et al. 2007), as well as theory building (Dennis et al. 2008). In contrast, there are 8 studies that employed qualitative methods to unveil how deterministic processes take shape through specific state transitions. These studies explored a wide range of empirical settings through case study (Bayerl et al. 2016; Nickerson and Muehlen 2006; Rezazade Mehrizi et al. 2019; Slaughter et al. 2006; Williams and Karahanna 2013), graph-based analysis (Basu and Blanning 2003), and workflow modelling (Sun et al. 2006).

Table 2. Process Theorization Methods



Quantitative Method Eliciting inputs and outputs of the process as a system of interrelated variables	**Contingency Model** Variables or states in the process function as contingency factors that determine emergence of alternative processes or variance-based causal relationships respectively	**Causality-as-Process** Indirectly inferring a process via variance-based causal relationships	**Joint Application** Combining results of both variance and process theories to enrich interpretation



Qualitative Method Explicating the sequence of states in the process	**Predictive Modelling** Utilizing probabilistic variables to formulate the process	**Process-as-Propensity** Conceptualizing propensities in state transitions as variables in variance-based causal relationships

A handful of studies attempted to synergize variance and process approaches in order to derive richer insights from the deterministic process of interest. Case study (Bala and Venkatesh 2007; Xue et al. 2008) and survey (Kim et al. 2014; Ply et al. 2012) are the two most adopted methods for studies that seek to uncover contingency factors that shape the manifested state sequences. In comparison, few studies chose to employ causality-as-process or joint application to theorize deterministic processes. Delone and McLean (2003) is the only noticeable study that adopted the causality-as-process method. They updated their IS Success Model on the basis of decade of IS success research and formulated the interrelation between IS use and user satisfaction in both causal and process fashions (Delone and McLean 2003). Likewise, Dennis and Garfield (2003) is the only noticeable study that adopted the joint application method by combining interview and survey in their field study.

Prior research on stochastic process predominantly adopted predictive modeling as the means of investigation. Among 7 articles that fit into this category, techniques such as agent-based modelling (Nan 2011), Bayesian modelling (Breuker et al. 2016; Hao et al. 2018), econometrics (Rai et al. 2015), economic modelling (Ryu et al. 2005), game theory (Greenwald et al. 2010), as well as process mining (Bai et al. 2013; Yeow and Goh 2015) were employed to render stochastic processes comprehensible, reproducible, and predictable. These objectives can only be achieved though a mixture of variance and process approaches, that is to formulate the manifestation of a stochastic process with probabilistic variables.

Emergent process received a paucity of scholarly attention in prior literature. Among the 42 articles we solicited, only 3 tackled emergent process by applying qualitative methods. Specifically, these studies employed design science (Lee et al. 2008) and theory building (Austin and Devin 2009; Markus et al. 2002) to develop design principles for digital artefacts that facilitate emergent design process (Lee et al. 2008), knowledge activities (Markus et al. 2002), as well as software development (Austin and Devin 2009). Building upon this line of research, this study aims to advance process-as-propensity as a mixed approach for understanding and predicting the unplanned development and outcome of emergent processes. Process -as-propensity synergizes both variance and process approaches since it elicits actors' selective attentions at each state transition (a.k.a. propensities), the driving mechanism for emergence, as variables to be incorporated in variance-based models. In the following section, we will illustrate how this approach can be applied to theorize information search process embedded in digital traces we collected in an online experiment.

Table 3. Mapping Process Theorization Approaches to Process Types

		Process Type		
		Deterministic process	**Stochastic process**	**Emergent process**
Theorization Approach	**Variance Approach**	**Quantitative Method [18]** Investigated Process ▪ Acceptance-related influence process (Bhattacherjee and Sanford 2006) ▪ Business process (Tanriverdi et al. 2007) ▪ Cognitive integration process (Kim et al. 2000) ▪ Communication process (Dennis et al. 2008) ▪ Coordination processes (Bharadwaj et al. 2007) ▪ Customer service process (Ray et al. 2005; Sen and Raghu		

	2013) ▪ Feedback process (Jayanth et al. 2011) ▪ Information requirements determination process (Appan and Browne 2012) ▪ IS development process (Venkatesh et al. 2018) ▪ Knowledge Management Systems content search and evaluation process (Poston and Speier 2005) ▪ Knowledge transfer process (Slaughter and Kirsch 2006) ▪ Malware resolution process (Kim and Kim 2014) ▪ Offshoring outsourcing process (Liu and Aron 2014) ▪ Organizational learning process (Ramasubbu et al. 2008) ▪ Organizational process (Raghu et al. 2004) ▪ Problem solving process (Kuechler and Vaishnavi 2006) ▪ Software process (Ramasubbu et al. 2015)		
	Adopted Method ▪ Econometrics (Kim and Kim 2014; Liu and Aron 2014; Ramasubbu et al. 2008, 2015; Sen and Raghu 2013; Slaughter and Kirsch 2006; Venkatesh et al. 2018) ▪ Experiment (Appan and Browne 2012; Kim et al. 2000; Kuechler and Vaishnavi 2006; Poston and Speier 2005) ▪ Simulation (Jayanth et al. 2011; Raghu et al. 2004) ▪ Survey (Bharadwaj et al. 2007; Bhattacherjee and Sanford 2006; Ray et al. 2005; Tanriverdi et al. 2007) ▪ Review and theory building (Dennis et al. 2008)		
Mixed Approach	**Contingency Model [4]** Investigated Process ▪ Assimilation process of inter-organizational business process standards (Bala and Venkatesh 2007) ▪ Career process (Kim and Kim 2014) ▪ IT investment decision process	**Predictive Modelling [7]** Investigated Process ▪ Business process (Bai et al. 2013; Breuker et al. 2016) ▪ Healthcare process (Yeow and Goh 2015) ▪ IT investment process (Rai et al. 2015) ▪ IT use process (Nan 2011)	**Process-as-Propensity [New]** Investigated Process ▪ Information Search Process (This study)

		(Xue et al. 2008) ▪ Software process (Ply et al. 2012) Adopted Method ▪ Case study (Bala and Venkatesh 2007; Xue et al. 2008) ▪ Survey (Kim et al. 2014; Ply et al. 2012) **Causality-as-Process [1]** Investigated Process ▪ IS success model (Delone and McLean 2003)	▪ Learning process (Ryu et al. 2005) ▪ Procurement auction process (Greenwald et al. 2010) ▪ Technology implementation process (Hao et al. 2018)	
		Adopted Method ▪ Review and theory building (Delone and McLean 2003) **Joint Application [1]** Investigated Process ▪ Participative process (Dennis and Garfield 2003) Adopted Method ▪ Field Study (Dennis and Garfield 2003)	Adopted Method ▪ Agent-based modelling (Nan 2011) ▪ Bayesian modelling (Breuker et al. 2016; Hao et al. 2018) ▪ Econometrics (Rai et al. 2015) ▪ Economic modelling (Ryu et al. 2005) ▪ Game theory (Greenwald et al. 2010) ▪ Process mining (Bai et al. 2013; Yeow and Goh 2015)	Adopted Method ▪ Experiment (This study)
	Process Approach	**Qualitative Method [8]** Investigated Process ▪ Business process (Basu and Blanning 2003; Sun et al. 2006) ▪ Coordinating process (Williams and Karahanna 2013) ▪ Group adoption decision process (Bayerl et al. 2016) ▪ Information systems discontinuation process (Rezazade Mehrizi et al. 2019) ▪ Internet standard making process (Nickerson and Muehlen 2006) ▪ Software process (Iversen et al. 2004; Slaughter et al. 2006)		**Qualitative Method [3]** Investigated Process ▪ Agile development process (Austin and Devin 2009) ▪ Design process (Lee et al. 2008) ▪ Knowledge process (Markus et al. 2002)
		Adopted Method ▪ Case study (Bayerl et al. 2016; Nickerson and Muehlen 2006; Rezazade Mehrizi et al. 2019; Slaughter et al. 2006; Williams and Karahanna 2013) ▪ Graph-based analysis (Basu and Blanning 2003)		Adopted Method ▪ Design science (Lee et al. 2008) ▪ Theory building (Austin and Devin 2009; Markus et al. 2002)

	▪ Workflow modelling (Sun et al. 2006)		

3 AN ILLUSTRATIVE STUDY

To illuminate our process-as-propensity approach and demonstrate the potential benefit of leveraging this approach in theorizing emergent processes, we conducted a study on how emergent search processes change if searchers are provided with different search features.

3.1 Background

The ever-accelerated digital transformation of service sector has led to an explosion of options for online consumers to consider (Chernev et al. 2015). To help consumers to overcome *choice overload* in their decision journeys, digital platforms offer a multitude of search features to enable categorization and arrangement of service offerings (Chernev et al. 2015). Using digital platforms for service review in the likes of TripAdvisor as an example, when trying to find a desirable restaurant, consumers can express their preferences for categorization, such as cuisine, ambience, or location, by typing keywords into a *search bar* (Teevan et al. 2004) and fine-tuning the categorization via specifying preferred attributes of restaurant in a *faceted filter* (Hearst 2006). Consumers can also rearrange the order of enlisted restaurants with *sorting options*, like distance and ranking, or superimpose restaurants to their corresponding locations on an *interactive map* (Mennecke et al. 2000).

Search features embodied key characteristics of generative digital artefacts (Kallinikos et al. 2013). Search features are *malleable* since they grant flexibility for consumers to decide how to formulate search criteria and browse the retrieved consideration set. Search features are *interactive* since the service offerings retrieved and presented to consumers are determined by the intersection between consumers' inputs and the attributes of available options. Search features are also *open* since they allow consumers to access and rearrange available options that are subjected to the modification of multiple parties, including platform operators and business owners. The generativity of search features encourages consumers to zero in on the desired target through an *emergent* search process that is accumulative and recursive. In such a process, each step comes with multiple possible actions for consumers to choose from. For instance, *search bar* and *faceted filter* hold consumers' search queries therefore retaining *explicit traceable memory*, whereas *sorting option* and *interactive map* only retain *implicit traceable memory* by ordering available options in the consideration set (e.g., an ordered result list) (Teevan et al. 2004). Moreover, faceted filter and interactive map are laden with information scents that help consumers in anticipating the actions that can bring them closer to their desired targets. In contrast, search bar and sorting option give off minimal scents, meaning searchers are granted more agency in determining the next search ac-

tion. Altogether, traceable memory and information scents are two key *generative capabilities* offered by search features.

This emergent search pattern resembles animal foraging in natural environment. According to animal foraging research, predators carry out emergent foraging processes in adaptation to surrounding terrains and traces left by prey (O'Brien et al. 1990). Predators instinctively choose among three basic actions: turning, moving in a direction, and pausing to scan for preys, at each step of the journey (O'Brien et al. 1990). Both the direction and intensity of their propensities for action to action transitions are indicative of their *emergent strategies*. These emergent strategies help predators to economize their energy so that energy gained from consuming prey surpasses the energy expended in the foraging process. These emergent strategies manifest recursively and accumulatively into the unplanned path traversed in the physical environment. For example, when traversing a vast space where the location of prey is unknown, predators adopt a *cruising strategy* in which they engage in an exhaustive search pattern by frequently switching from moving to prey scanning (O'Brien et al. 1990). Conversely, when navigating a habitat where predators are more certain about the distribution of prey, they adopt a *saltatory strategy* in which they try a more precise search pattern by lowering the propensity to scan for prey during traveling (O'Brien et al. 1990).

Extrapolating in the context of consumer decision journey, consumers leverage on generativities of search features to navigate through a stochastic digital environment to find desirable offerings. Likewise, consumers instinctively choose among three search actions: orienting, browsing, and examining at each step throughout the search process. Consumers also adopt emergent search strategies that determine the direction and intensity of action transition propensities. In other words, these strategies dictate how consumers chain search actions recursively and accumulatively to satisfy their needs while minimizing the expenditure of efforts. Accordingly, consumers' search for service offerings can be regarded as an emergent process that consists of unplanned action sequences directed by search strategies with an aim to economize the tradeoff of between search cost and benefit (Wee and Taylor 2018).

The process-as-propensity approach proposed in this study is suitable for theorizing the emergent search process, which received little attention in prior literature. How a search process unfolds together with the its outcome emerge spontaneously rather than being pre-conceived. Process-as-propensity is leveraged to identify the attention allocation propensities as embodied by emergent search strategies that drive such an emergent process. It also allows to examine how emergent search strategies are shaped by digital generativities of search features and whether they are effective in economizing the tradeoff between search cost

and benefit. Specifically, this illustrative example strives to answer three research questions: (1) *What are the emergent search strategies employed by consumers?* (2) *How do search features affect the likelihood of each emergent search strategy?* (3) *What is the effectiveness of each emergent search strategy?* Employing *optimal foraging theory* (Hantula 2010; O'Brien et al. 1990; Perry and Pianka 1997) as the theoretical underpinning, this illustrative example shows how we conducted an online experiment with a full factorial design in which we manipulated the provision of four contemporary search features. The empirical setting for the experiment an online platform for restaurant reviews. Each participant of this experiment is requested to perform two search tasks with different goal specificities in which he/she tries to find the restaurant that he/she deems desirable. We capture each participant's search actions in a search log, which is then used to extract attention allocation propensities through a process modelling approach.

3.2 Theory Development

3.2.1 Generativity of Search Features

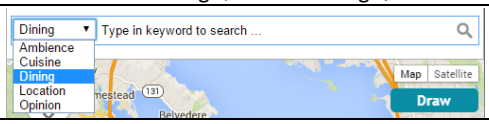
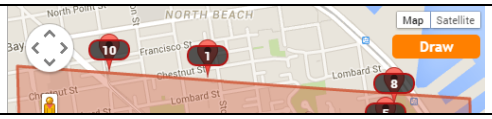
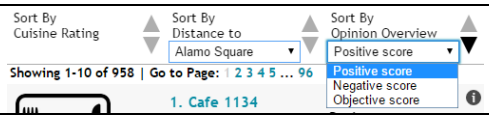
In light of optimal foraging theory, consumers adhere to different emergent search strategies to adapt the digital environment by leveraging on the generativity enabled by available search features (Hantula 2010; Perry and Pianka 1997). Specifically, search features can disseminate information scents to alleviate uncertainty (Moody and Galletta 2015; Pirolli and Fu 2003) and retain consumers' search queries (Teevan et al. 2004). Accordingly, we identify four categories of contemporary search features that differs in the richness of information scents as well as the retained traceable memory (see Table 4).

A scented orienting feature signals information availability with information scents while retaining the search criteria specified by consumers. One example of this type of search features is faceted filter, a categorized filter that displays pre-defined categories of attributes with corresponding values for consumers to determine their search criteria by selecting one or more values for each attribute (Hearst 2006). Faceted filter disseminates attributes of available options as information scents for consumers to grasp an impression of information availability. Additionally, by allowing consumers to manipulate the queries, faceted filter retains a snapshot of the most recently executed query as an explicit traceable memory. It can encourage consumers to allocate attention to revisiting their search queries and make adjustment.

In contrast, an unscented orienting feature does not interfere with the expression of search criteria with information scents. Search bar belongs to this category since it retains the search terms customized by consumers while giving off minimal information scents (Teevan et al. 2004). In this sense, search features in the likes of search bar retains explicit traceable memory while depriving information scents.

Searchers hence bear more uncertainty when specifying search criteria on a search bar as comparing to doing so on scented orienting features.

Table 4. Generativity of Search Features

		Information Scent [Prospective Thinking]	
		Scent Dissemination	**Scent Deprivation**
		Cruising ↓ Saltating ↑	Path-Taking ↓ Path-Seeking ↑
Traceable Memory Retainment [Retrospective Thinking]	**Explicit Memory** Path-Following ↓ Zigzagging ←		
		Scented Oriented Feature: Disseminate information scents and retain search criteria	**Unscented Oriented Feature**: Disseminate no information scent but retain search criteria
		Example: Faceted filter, 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.	Example: Search bar, a standard tool that allows users to specify a category of keywords and type in one more multiple keywords to conduct search
	Implicit Memory Sprint ↓ Marathon ←		
		Scented Browsing Feature: Disseminate information scents and retain browsing trajectory	**Unscented Browsing Feature**: Disseminate no information scent but retain browsing trajectory
		Example: Interactive map, a feature that allows the users to search for information items in two ways: (1) Moving or zooming the viewport of the map to find information items within the updated viewport. (2) Drawing boundaries around an area of interest via mouse cursor to find information items within this area of interest.	Example: Ranked list, a feature that allows users to sort the list of information items according to pre-defined categories in either ascending or descending order.

A scented browsing feature represents search features that can impose a logical structure on available options in the consideration set while disseminating information scents. An exemplary feature in this category is interactive map, which superimposes a consideration set onto geographical metadata (i.e., a map) (Mennecke et al. 2000). These metadata function as information scents that help consumers establish an awareness of location (Teevan et al. 2004) and render their browsing trajectories more sensible and trackable. Since such a traceable memory is retained via spatial awareness of structured data instead of concrete records, it is implicit rather than explicit.

On the other hand, an unscented browsing feature imposes a structure on options in the consideration set without offering information scents. For example, a ranked list allows consumers to arrange items in the consideration set based on certain attributes (e.g., distances to the current location) in an ascending or descending order through sorting options. Except for the labels of sorting options, this feature does not give off information scents that hint at the sorting outcome or guide the browsing process. For this rea-

son, from glancing at the sorted list, searchers can only glean a sense about how each option relates other alternatives without being informed about the exact attribute of each option (e.g., the specific distance to the current location). Nonetheless, ordering available options still helps consumers to establish a spatial awareness of the structure among options in the consideration set (i.e., a implicit traceable memory) for them to retrack their browsing trajectories (Teevan et al. 2004).

3.2.2 Optimal Foraging Theory

Optimal foraging theory is widely adopted by ecologists of animal foraging behavior to investigate animals' emergent foraging patterns (O'Brien et al. 1990; Perry and Pianka 1997). Empiricists of foraging behavior have extended classic optimal foraging theory by demonstrating that the optimality is not merely genetically determined, but rather depends on foragers' behavioral modes that adapt to ecological factors (Hantula 2010; O'Brien et al. 1990; Perry and Pianka 1997). According to past studies on animal foraging, predators indeed rely on *emergent search strategies*, unplanned yet persistent foraging patterns, to optimize their energy intake over energy expenditure (O'Brien et al. 1989, 1990). These emergent foraging patterns manifest in the varying likelihoods for a predator to switch between moving and pausing to scanning for preys (O'Brien et al. 1989, 1990). For instance, *cruising* describes the strategy in which predators, such as large fishes and soaring hawks, constantly scan for preys while moving. *Ambush* represents the opposite strategy in which foragers, like herons and rattlesnakes, pause indefinitely and wait for preys to come across. *Saltating* is the strategy that situates between cruising and ambush. Saltatory foragers alternate between moving and pausing at a much lower rate and only scan for preys when paused.

Consumers who hunt for desired service offerings share the same evolutionary root with their foraging ancestors (Hantula 2010). Previous information foraging research examined how temporal delay imposed on orienting (e.g., switching between online stores) affects the likelihood for consumers to continue orienting for alternative stores after browsing the list of offerings in the current store (DiClemente and Hantula 2003; Difonzo et al. 1998; Hantula et al. 2008; Rajala and Hantula 2000). It was found that consumers are reluctant to transit from browsing to orienting if the long temporal delay makes it difficult to recollect the effectiveness of previously performed orienting action (Hantula 2010). Taken together, Article 1 of this dissertation incorporates the transitional propensities between orienting and browsing actions as well as the transitional propensities between browsing and examining actions in the conceptualization of emergent search strategies (see Figure 1).

3.2.3 Emergent Search Strategies

Past research has established emergent strategy as alternative mode for strategy formation in contrast to intended strategy (Mirabeau and Maguire 2014). Strategy refers to a patterned action of iterated resource

allocation (Mirabeau and Maguire 2014). In the same vein, emergent strategy is defined as a pattern in action realized regardless of intentions (Mirabeau and Maguire 2014). Following prior literature on emergent strategy, this dissertation defines an emergent search strategy as a spontaneous pattern for allocating attention among viable search actions. Accordingly, a consumer's emergent search strategies are reflected by the transitional probabilities between orienting and browsing as well as between browsing and examining.

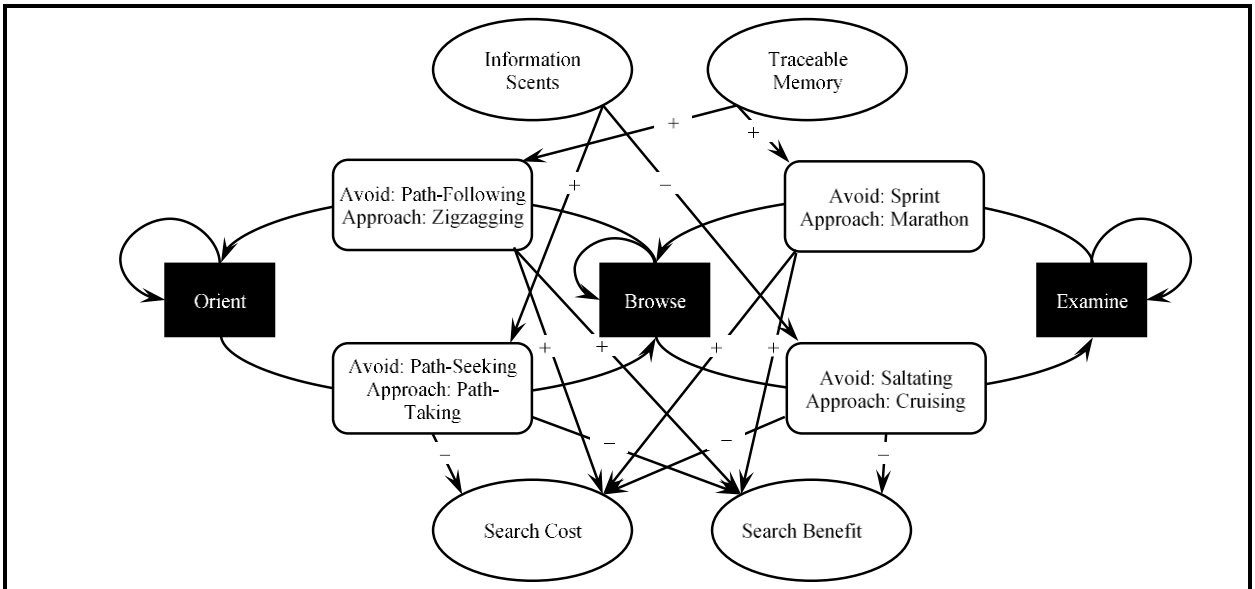


Figure 1. Research Framework for the Illustrative Example

This notion of emergent search strategy extends the established literature on search strategy. Past studies conceptualized search strategies as search task characteristics (Fidel et al. 1999; Marchionini 2006), searchers' idiosyncratic preferences (Dumais et al. 2010; Kim 1999; Liu and Wei 2016; Navarro-Prieto et al. 1999), predominant search actions (Aula et al. 2005; Cothey 2002; Ford et al. 2005; Wang et al. 2000), as well as specific sequences of search actions (Thatcher 2006; Xie and Joo 2010). In more recent studies, attempts have been made to explore if search strategies emerge as distinct patterns from searchers' sequences of actions through a process modeling approach (Cole et al. 2015; Xie and Joo 2010).

In a typical search session, consumers start by specifying search criteria with orienting actions. They proceed by browsing through the retrieved list of offerings. When spotting a potentially desirable option, they may examine the detailed information about it by entering its detail page. Due to the continuity of visual attention, consumers shift attentions between approximate visual elements (Yarrow et al. 2001).

Since orienting features are placed next to browsing features while the browsing features enclose all available options for close examination. Emergent search strategies only concern the transitions between orienting and browsing as well as between browsing and examining. Consequently, after browsing, searchers may choose to proceed to examine details of a potentially desirable item, to continue browsing, or to revert to orienting to adjust the search criteria.

Since emergent search strategy determines both the direction and frequency of action transitions, this illustrative study identified four dyads of plausible emergent search strategies. Each dyad concerns the same action transition but with two opposing propensities of either approaching or avoiding the transition (see Figure 2). The directionality of each dyad depends on if the transition involves anticipation under uncertainty (i.e., prospective thinking) or adjusting past actions (i.e., retrospective thinking) (Rollier and Turner 1994). To illustrate, transiting from orienting to browsing compels consumers to anticipate the uncertain changes in the composition of retrieved information items. In contract, transiting from browsing to orienting allows consumers to revisit the search criteria they previously specified before deciding how adjustments should be made. Likewise, transiting from browsing to examining evokes anticipation since consumers would be exposed to previously unknown details of the option they chose to examine. Conversely, transiting from examining to browsing means returning to the consideration set the searcher previously traversed, hence allows consumers to adjust browsing trajectories.

3.2.4 How Information Scents Affect Emergent Search Strategies

The two strategic planning styles of prospective and retrospective thinking (Rollier and Turner 1994) determine how consumers switch emergent search strategies when provided with digital generativities. Specifically, searchers who are provided information scents are encouraged to anticipate future outcome on the basis of available information (Einhorn and Hogarth 1987). Conceivably, the availability of information scents is expected to influence searchers' propensities for approaching or avoiding certain action transitions.

When deprived of information scents in the orienting phase, consumers spend more effort in heuristics in the orienting phase to compensate for the heightened uncertainty, which delays the ensuing browsing phase (Moody and Galletta 2015; Pirolli and Fu 2003). Consumers hence adhere to a *path-seeking strategy* and avoid the transition from orienting to browsing. In contrast, if the scarcity of information scents is relieved, consumers tend to adhere to a *path-taking strategy*. Consumers can arrive at a consideration set with more certainty if their search queries are informed by information scents, hence encouraging them to transit from orienting to browsing. This sniff-and-act pattern, in which searchers spontaneously pick up and follow information scents through browsing for potentially desirable options, has been confirmed in previous studies (Fu and Pirolli 2007; Moody and Galletta 2015).

On the other hand, consumers adhere to a *cruising strategy* when they perceive the consideration set as unpredictable. The heightened uncertainty compels consumers to scrutinize available options they encounter while browsing the consideration set, a tendency of approaching the transition from browsing to examining. Similarly, animal predators also exhibit a foraging pattern that closely resembles the cruising strategy when traversing an unfamiliar environment (O'Brien et al. 1990). Consumers tend to adhere to a *saltating strategy* when the outcome uncertainty is alleviated by the abundance of information scents (Moody and Galletta 2015; Pirolli and Fu 2003). A more predictable consideration set allows consumers to be more selective in choosing which items to examine throughout the browsing process. Consequently, searchers refrain from transiting from browsing to examining as a result of adhering to a saltating strategy. This saltatory pattern is prevalent in natural environments where foragers know how to follow traces left by preys and locate patches where preys are more concentrated (O'Brien et al. 1990).

3.2.5 How Traceable Memory Affects Emergent Search Strategies

Consumers who are offered traceable memory tend to make adjustments to past actions for better outcomes (Wicker 1979). If a previous search action is retained by available search features, it would be more likely for consumers to revisit and tweak this action (Remus and Kottemann 1995). When provided with search features that retain search queries, consumers would pay more attention to the available traceable memory and then adjust search criteria more frequently during browsing. Likewise, the provision of search features that help to instill a spatial awareness by organizing options in the consideration set would encourage searchers to retrack and alter previous browsing trajectories after examining an option.

If the search criteria specified by consumers are not retained by available search features, searchers are not able to revisit and modify these criteria. Thereby, when explicit traceable memory is absent, consumers would focus on browsing the consideration set rather than diverging attentions to modifying search queries (Rollier and Turner 1994). In so doing, consumers adhere to a *path-following strategy*, meaning that they avoid transiting from browsing to orienting to minimize the modification of the consideration set. In contrast, when search criteria are retained by available search features, searchers tend to engage in a *zigzagging strategy*. With such a explicit traceable memory, it is more likely for consumers to shift their attention back to the search queries they specified. Consumers hence tend to modify the consideration set during the browsing process by adjusting search criteria (Rollier and Turner 1994). They adhere to a *zigzagging strategy* by approaching the transition from browsing to orienting (Bates 1996).

On the other hand, when facing an absence of implicit traceable memory, it can be challenging for consumers to grasp a spatial awareness of how different options relates to each other in the consideration set. Consequently, it is less likely for consumers to allocate attention to their browsing trajectories in the consideration set. They hence adhere to a *sprint strategy* to shorten the browsing process and limit the number of alternatives to consider (Dumais et al. 2010; Liu and Wei 2016) by avoiding the transition from examining to browsing (Rollier and Turner 1994). By contrast, consumers tend to adhere to a *marathon strategy* when provided with search features that retain implicit traceable memory via organizing the consideration set. With a sense of direction in the browsing trajectory, consumers would pay more attention to the browsing process and in turn more likely retrack the consideration set for more alternatives (Rollier and Turner 1994). In this sense, consumers are encouraged to approach the transition from examining to browsing by implicit traceable memory.

3.2.6 Effectiveness of Emergent Strategies

In light of optimal foraging theory, consumers seek to economize the tradeoff between search cost and the yield of search (Hantula 2010; O'Brien et al. 1990; Perry and Pianka 1997). In this regard, effective emergent search strategies can help consumers either to save time and energy in the search process or to increase the chance to find desirable options (Dumais et al. 2010; Liu and Wei 2016). Therefore, the intended payoff of an emergent search strategy is either to minimize search cost by compromising the desirability of the discovered options or to pinpoint the most desirable options with extra effort and time.

In contrast to the path-taking strategy, in which consumers opt for pre-defined consideration sets by following information scents, adhering to a path-seeking strategy demands extra search cost. Specifically, by adhering to path-seeking strategy, consumers strive for retrieving a more refined and relevant consideration set. For this reason, they devote more energy in detailing their preferences in their search queries. Furthermore, when specifying customized search criteria without the aid of information scents, consumers would require more heuristics and actions in the orienting phase. Repeating the orienting actions can ramp up search cost. Consequently, adhering to a path-seeking strategy rather than a path-taking strategy by reducing the transitional probability from orienting to browsing can inflate search cost and simultaneously boost search benefit.

Compared with a path-following strategy, in which consumers try not to modify the consideration set in the browsing process, adhering to a zigzagging strategy can be costlier. Consumers who adhere to a zigzagging strategy would expend extra effort to revisit the orienting actions and adjust the consideration set on the basis of their browsing experience. Moreover, it takes energy to check the resulting consideration set after each adjustment made to the search criteria. Similar to a path-seeking strategy, the intended goal of adhering to a zigzagging strategy is to arrive at a consideration set with higher concentration of rele-

vant options. Nonetheless, the later differs from the former in that the later relies on an anchor-and-adjustment approach (Remus and Kottemann 1995) to inform search criteria adjustment with insights gleaned from the browsing process. Adhering to a zigzagging strategy instead of a path-following strategy, consumers approach the transition from browsing to orienting to achieve a more desirable consideration set with additional search cost.

In a natural environment, saltatory search is often more taxing comparing to cruise search (O'Brien et al. 1990). Foragers adopt a saltating strategy not only travels more distance, but also scans for a larger area (O'Brien et al. 1990). For this reason, saltatory foragers seek to capture larger preys with higher concentration of calories (O'Brien et al. 1990). Likewise, consumers who adhere to a saltating strategy browse for a prolonged time period and scan more extensively to form an impression of available options before determining which to examine. In contrast, consumers who adhere to a cruising strategy prefer frequently examining options they encountered in the browsing process. To this end, consumers adhering to a saltating strategy instead of a cruising strategy avoid the transition from browsing to examining to locate more desirable options at the cost of additional browsing actions.

Lastly, adhering to a marathon strategy would lead to a prolonged browsing process as opposed to a sprint strategy. When adhering to a sprint strategy, consumers tend to limit the number of options to examine before terminating the search process (Browne et al. 2007). Conversely, consumers who adheres to a marathon strategy exert more energy in stretching the browsing process after examining each viable alternative in detail. Adhering to a marathon strategy rather than a sprint strategy often brings more benefits from the extended exposure to more novel and potentially desirable alternatives. At the same time, approaching the transition from examining to browsing requires more time and energy, heightening the search costs.

3.3 Research Methodology

3.3.1 Research Design

To empirically validated the research framework depicted in Figure 1, this illustrative study conducted an online experiment that employs a *2* [*Scented Orienting Feature*: Present and Absent] x *2* [*Unscented Orienting Feature*: Present and Absent] x *2* [*Scented Browsing Feature*: Present and Absent] x *2* [*Unscented Browsing Feature*: Present and Absent] *between-subjects* factorial design. An artificial online restaurant review site was constructed for each of the sixteen treatment groups. For each artificial site, we manipulated the configuration of four features (i.e., faceted filter, search bar, ranked list, and interactive

map) (see Table 1). Furthermore, to preserve the realism in our experimental setting, we populated the sites with real data extracted from a popular online restaurant review website via web scrapping. Our dataset includes detailed descriptions of 1,079 restaurants in the San Francisco region together with approximately 268,000 reviews for these restaurants written by an estimated 91,000 diners. Together, the artificial sites offer a realistic but controlled platform for our experiment.

To capture the potential variation in the effectiveness of emergent search strategies in different task conditions, the experiment comprises two stages whereby each participant was asked to complete a *goal-oriented* search task and an *exploratory* search task in a randomized order. Whereas the goal-oriented search task requested participants to search for a restaurant with specific predefined criteria, the exploratory search task permitted participants to freely explore the restaurants on the artificial sites and select one according to their own preferences, hence creating a condition with low goal specificity (Browne et al. 2007; Nadkarni and Gupta 2007; Novak et al. 2003).

Participants for our experiment were recruited from Amazon Mechanical Turk (AMT), a crowdworking marketplace that connects individual workers and Human Intelligence Task (HIT) requesters (Paolacci and Chandler 2014). Researchers have increasingly recognized AMT as a viable avenue for gaining access to a heterogeneous and untapped pool of study participants (Chandler et al. 2014; Paolacci and Chandler 2014). Compared to traditional college student samples, AMT is more appropriate for investigating digital phenomena (including online search) due to greater diversity in workers' demographic composition and their rich experience with digital services (Paolacci and Chandler 2014). To be assured of data quality, we applied the screening criteria recommended by Chen (2012), meaning that I only recruited workers who had completed at least 10,000 HITs with 99% approval rate. Each worker was rewarded USD $4.00 dollars for participating in our experiment. Figure 2 depicts a diagrammatic flow of the experimental procedures. A total of 288 out of 377 participants have completed both search tasks. Table 5 summarizes the demographic distribution for 288 samples.

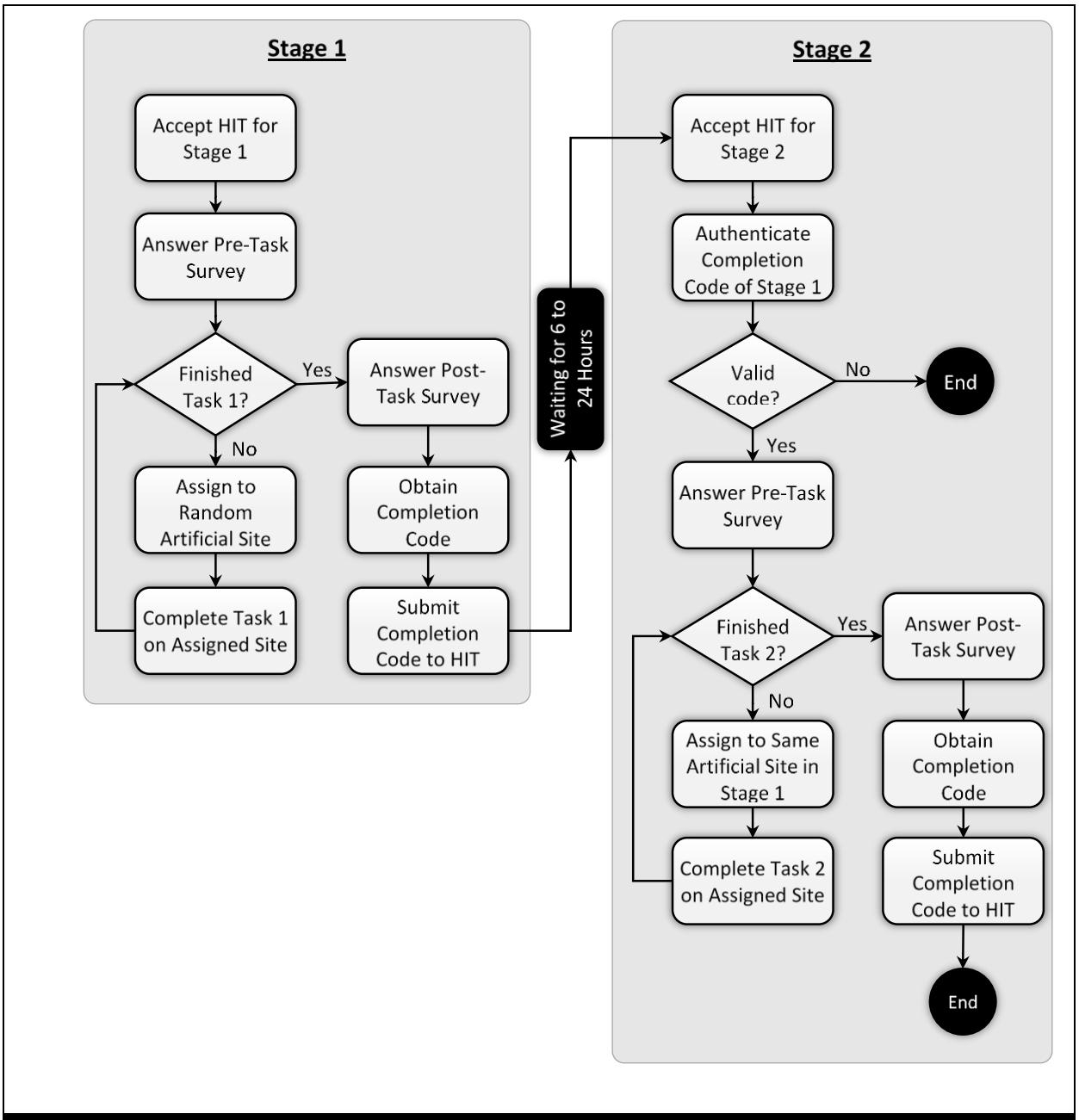


Figure 2. Diagrammatic Flow of the Experimental Procedure

Table 5. Descriptive Statistics of Data Samples [Sample N = 288]

Demographics		No. Samples	%	Goal-Oriented Task				Exploratory Task			
				Faceted Filter	Search Bar	Ranked List	Interactive Map	Faceted Filter	Search Bar	Ranked List	Interactive Map
Gender	Male	142	49.30%	290	143	213	271	400	109	140	77
	Female	140	48.60%	439	153	210	377	558	188	163	87

	Unwilling to disclose	6	2.10%	12	3	3	4	6	0	8	1
Age	Age 19 - 29	80	27.80%	136	53	125	101	168	39	81	49
	Age 30 - 49	165	57.30%	442	154	246	444	576	173	163	81
	Age 50 - 64	35	12.20%	146	91	52	106	179	83	65	32
	Age 65+	3	1%	5	1	3	1	35	2	2	3
	Unwilling to disclose	5	1.70%	12	0	0	0	6	0	0	0
Education	Less than college education	38	13.20%	106	78	77	135	144	80	50	171
	College education or higher	247	85.80%	623	221	340	515	814	217	256	55
	Unwilling to disclose	3	1%	12	0	9	2	6	0	5	21
Income	$0 to $30,000	139	48.30%	343	154	202	289	435	161	171	41
	$30,000 to $50,000	71	24.70%	175	84	72	180	195	60	55	23
	$50,000 to $75,000	39	13.50%	115	40	83	105	160	54	21	0
	$75,000+	28	9.70%	86	7	44	69	140	11	41	27
	Unwilling to disclose	11	3.80%	22	14	25	9	34	11	23	9
Experience in San Francisco	More than 5 years	4	1.40%	7	0	1	12	9	0	0	1
	1 - 5 years	23	8%	10	11	30	13	20	8	27	6
	A few months	15	5.20%	22	0	17	8	37	7	9	3
	Less than a month	49	17%	138	47	84	115	199	42	66	28
	Never	197	68.40%	564	241	294	504	699	240	209	127
Restaurant Knowledge	Very low	1	0.30%	0	4	2	0	0	2	1	0
	low	8	2.80%	27	2	6	17	36	2	17	2
	Somewhat low	11	3.80%	28	2	9	14	41	0	13	3
	Medium	138	47.90%	355	214	281	388	437	199	193	95
	Somewhat high	72	25%	193	40	64	156	330	56	55	35
	High	45	15.60%	127	35	61	73	91	37	20	15
	Very high	13	4.50%	11	2	3	4	29	1	12	15

3.3.2 Summary of Findings

Figure 3 offers an illustrative overview of the findings in Article 1 on the basis of hypothesis testing results summarized in Table 6 and Table 7. The findings substantiate the seminal role played by emergent search strategies induced by digital generativities in determining search performance. For goal-oriented consumers, search features that disseminate information scents and offer explicit traceable memory (i.e., the faceted filter) appear to be the most effective since they encourage goal-oriented consumers to adhere to the zigzagging strategy without invoking the saltating strategy (see H2a and H3a). Under goal-oriented conditions, the zigzagging strategy is more beneficial for consumers seeking to locate service offerings that more closely mirror their preferences without imposing the need for additional effort (see H6). In contrast, the saltating strategy is not worthwhile because it entails additional costs without offering extra benefits (see H7).

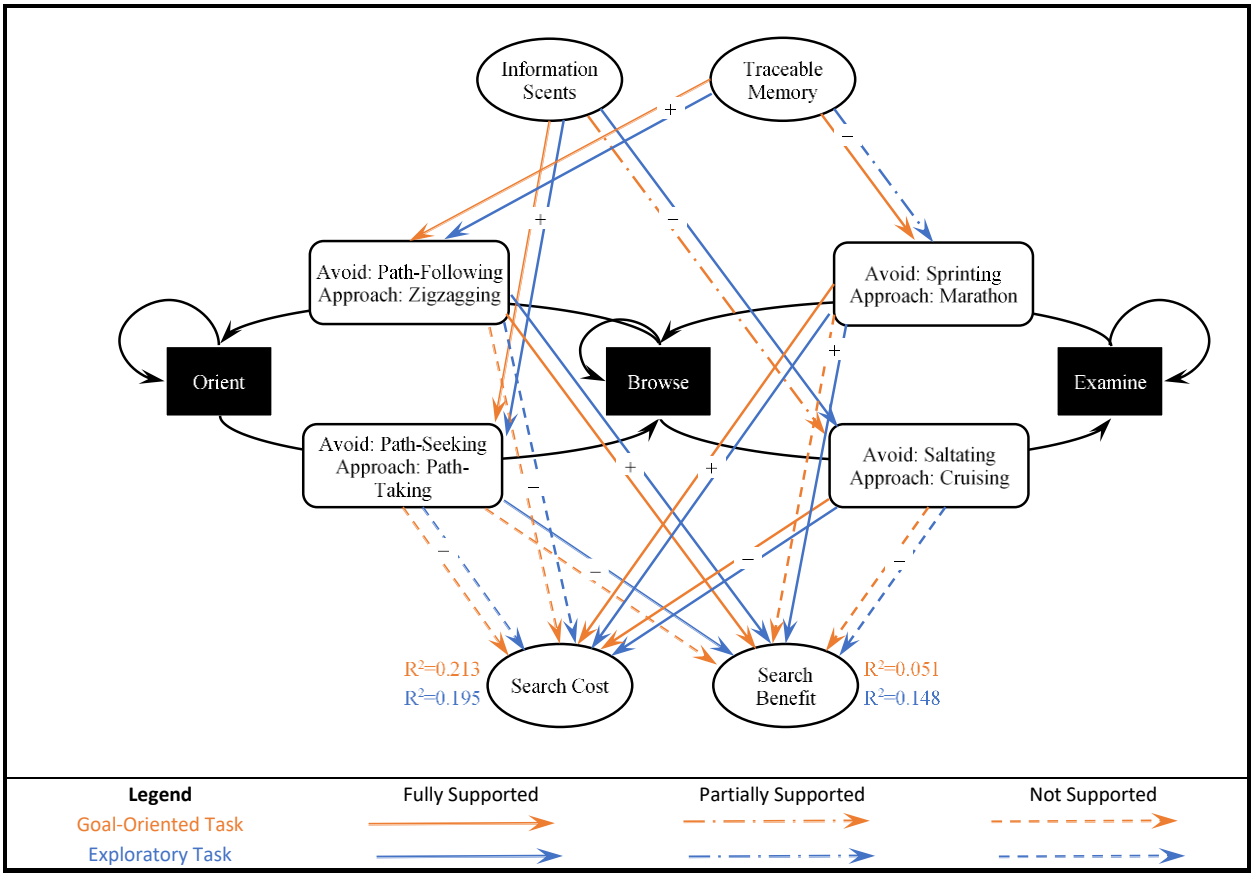


Figure 3. Illustrating the Data Analysis Result

Table 6. Summary of Hypotheses on Effect of Search Features [Sample N = 288]

Hypotheses	Goal-Oriented Task			Exploratory Task			Supported
	$\mu_{Absence}$	$\mu_{Presence}$	F-Test	$\mu_{Absence}$	$\mu_{Presence}$	F-Test	
H1a: UOF → ↓O2B	0.719	0.466	44.730***	0.727	0.442	56.357***	Yes
H1b: UBF → ↓O2B	0.651	0.544	7.073**	0.626	0.555	2.994†	Yes
H2a: SOF → ↓B2E	0.100	0.095	0.271 n.s.	0.126	0.092	6.840**	Partially
H2b: SBF → ↓B2E	0.109	0.085	6.248*	0.127	0.091	7.510**	Yes
H3a: SOF → ↑B2O	0.085	0.127	13.277***	0.068	0.132	25.753***	Yes
H3b: UOF → ↑B2O	0.093	0.118	4.733*	0.084	0.116	5.973*	Yes
H4a: UBF →↑E2B	0.477	0.602	7.843**	0.485	0.558	2.551 n.s.	Partially
H4b: SBF →↑E2B	0.489	0.592	5.127*	0.457	0.589	8.550**	Yes

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

Note: UOF → Unscented Orienting Feature; UBF → Unscented Browsing Feature; SOF → Scented Orienting Feature; SBF → Scented Browsing Feature; O2B → Orienting to Browsing; B2O → Browsing to Orienting; B2E → Browsing to Examining; E2B → Examining to Browsing

Table 7. Summary of Hypotheses on Effectiveness of Emergent Search Strategies [Sample N = 288]

Hypotheses	Goal-Oriented Task			Exploratory Task			Supported
	β	*t* value	R^2	*β*	*t* value	R^2	
H5a: ↓O2B → ↑OSC	0.006	0.228 n.s.	0.213	-0.025	-0.987 n.s.	0.195	No

H5b: ↓O2B → ↑OSB	-0.005	-0.299 n.s.	0.051	0.064	1.728†	0.148	No
H6a: ↑B2O → ↑OSC	0.112	1.204 n.s.	0.213	0.069	0.869 n.s.	0.195	No
H6b: ↑B2O → ↑OSB	0.177	2.772**	0.051	0.225	1.890†	0.148	Yes
H7a: ↓B2E → ↑OSC	-0.666	-5.905***	0.213	-0.447	-5.734***	0.195	Yes
H7b: ↓B2E → ↑OSB	-0.078	0.912 n.s.	0.051	0.102	0.885 n.s.	0.148	No
H8a: ↑E2B →↑OSC	0.074	3.055**	0.213	0.055	2.406*	0.195	Yes
H8b: ↑E2B →↑OSB	0.018	0.017 n.s.	0.051	0.195	5.781***	0.148	Partially

$p^{\dagger} < 0.1$, $p^{*} < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$

Note: O2B → Orienting to Browsing; B2O → Browsing to Orienting; B2E → Browsing to Examining; E2B → Examining to Browsing; OSC → Objective Search Cost; OSB → Objective Search Benefit

Consumers who are provided with search features that deprive information scents while retaining explicit traceable memory (i.e., the search bar) adhere to both the zigzagging and the path-seeking strategies (see H1a and H3b). The benefit of the zigzagging strategy can be cancelled out by the path-seeking strategy, which heightens search costs without boosting search benefits (see H5). Search features that retain implicit traceable memory (i.e., the ranked list and the interactive map) seem to encourage the marathon strategy (see H4) while stimulating the saltating and the path-seeking strategies respectively depending on whether information scents are disseminated (see H1b and H2b). For goal-oriented consumers, the marathon, saltating, and path-seeking strategies are ill-suited since these strategies demand more efforts without producing adequate payoffs (see H5, H7, and H8).

Exploratory consumers face a tradeoff between efficiency and effectiveness when selecting search features. The results indicate that path-seeking, zigzagging, and marathon strategies can help consumers gain exposure to more novel alternatives (see H5b, H6b, and H8b). The marathon strategy leads to increased search feature use (see H8a). Conversely, the cruising strategy reduces search feature use without affecting the size of consumers' consideration set (see H7). Therefore, consumers who prioritize efficiency should be provided with unscented orienting features (i.e., the search bar), which encourage the use of both the path-seeking and zigzagging strategies (see H1b and H3b). In contrast, scented orienting features (i.e., the faceted filter) encourage the use of both the zigzagging and saltating strategies (see H2a and H3a). Consequently, scented orienting features drive search feature use while unveiling fewer alternatives compared to unscented ones.

On the other hand, consumers who seek to maximize their consideration sets should be provided with scented browsing features (i.e., the interactive map) that stimulate the marathon strategy (see H4b). Although the marathon strategy can be cost-intensive, it is effective in expanding consumers' exposure to novel options (see H8). Nonetheless, scented browsing features encourage the use of the saltating strategy (see H2b), which increases search feature use without enhancing search benefits (see H7). In contrast, unscented browsing features (i.e., the ranked list) do not induce the marathon strategy under exploratory conditions (see H4a). Hence, it is unlikely for exploratory consumers to benefit from unscented browsing features (i.e., the ranked list).

3.4 Discussion

Empowered by the advancement of digital generativity, consumer decision journey is becoming increasingly emergent (Dichter 2018). The illustrative study strives to uncover consumers' spontaneous attention allocation propensities steered by digital generativity in their decision journeys for service offerings. This illustrative study leverages on the novel process-as-propensity to pinpoint the attention allocation propensity as the driving mechanism of emergent search process. It showcased that consumers' emergent search strategies can indeed be steered by digital generativities enabled by search features. Moreover, it helps to illustrate that emergent search strategies are the key to predicting the performance of consumers' search processes.

Findings derived from analyzing consumers' search logs collected in the controlled online experiment substantiated the prevalence of emergent search strategies in consumers' search processes for service offerings. Results show that information scents and traceable memory, the two main digital generativities enabled by search features, can indeed shift consumers' emergent search strategies. Scented search features (i.e., the faceted filter and the interactive map) encourage the saltating strategy whereas unscented ones (i.e., the search bar and the ranked list) encourage the path-seeking strategy. Additionally, search features retain explicit traceable memory (i.e., the faceted filter and the search bar) encourage the zigzagging strategy whereas those retain implicit traceable memory (i.e., the ranked list and the interactive map) encourage the marathon strategy. The effectiveness of search features on emergent search strategies is largely consistent regardless of goal specificity. The only two exceptions are the insignificant connection between scented orienting feature and the saltating strategy in the goal-oriented condition as well as the non-existent relation between unscented browsing feature and the marathon strategy in the exploratory condition.

The effectiveness of emergent search strategies depends on consumers' goal specificity. When carrying out a goal-oriented task, zigzagging appears to be the dominant strategy as it allows consumers to locate a more desirable offering without expending extra efforts. Adhering to other three emergent strategies that are reinforced by digital generativities (i.e., path-seeking, saltating, and marathon) in the goal-oriented condition increases search costs without improving search benefits. Conversely, there is no single winning strategy in the exploratory condition. On one hand, both the path-seeking strategy and the zigzagging strategy boost consumers' exposure to novel alternatives without inflating search feature usage. On the other hand, the marathon strategy is more effortful yet are more effective in expending the

scope of exploration. The remaining saltating strategy encouraged by digital generativities only serves to burden searchers without improving the payoff.

3.4.1 Theoretical Implication

Findings from this illustrative study bear implications for research on consumers' emergent behaviors. First, this illustrative study theorizes consumers' attention allocation propensities as emergent search strategies. In so doing, consumers' tendencies in transiting from one action to the next that drive their emergent search processes can be captured. Leveraging on the emergent search strategies elicited through the process-as-propensity approach, this illustrative study theorizes how the emergent search process is subjected to the influence of digital generativities and predict its effectiveness. In a sense, the process-as-propensity approach looks beyond the more deterministic task-technology fit paradigm (Goodhue and Thompson 1995), and explicates how the emergence of spontaneous search actions is steered by consumers' propensities for approaching certain transitions while avoiding the others.

Second, by adapting optimal foraging theory as a theoretical lens, this illustrative study extended this theory in the context of consumers' search process. In a food foraging situation, although three categories of actions (i.e., turning, moving, and pausing) exist, it is not feasible to keep track of the transition between turning and moving (O'Brien et al. 1990). Consequently, predators' foraging strategies are categorized solely by the transition propensities between moving and pausing (O'Brien et al. 1990). However, the equivalents of turning and moving actions (i.e., orienting and browsing) become much more distinguishable in consumers' search scenarios (Hantula 2010). Identifying this contextual distinction, we incorporate the transitions between orienting and browsing in addition to those between browsing and examining in categorizing emergent search strategies. In so doing, this illustrative study distinguishes among four dyads of emergent search strategies based on both then directionality and frequency of action transitions, namely path-taking vs. path-seeking, zigzagging vs. path-following, cruising vs. saltating, and marathon vs. sprint. Each dyad encapsulates searchers' tendencies in approaching or avoiding an action transition (i.e., high vs. low transitional probability) and shapes the emergence of search processes accordingly.

Third, this illustrative study consolidated both prospective and retrospective generativities of search features, which are information scents (Moody and Galletta 2015; Pirolli and Fu 2003) and traceable memory (Teevan et al. 2004). This illustrative study identified four archetypical search features available on digital platforms for service offerings that cover the full spectrum of both dimensions. It in turn explicate how the likelihood of emergent search strategies are determined by generativities of available search features. Digital traces collected from the controlled experiment revealed that search features rich with information scents (i.e., faceted filter and interactive map) encourage the switch from cruising to saltat-

ing strategy, whereas those that are devoid of information scents (i.e., search bar and ranked list) lead to the switch from path-taking to path-seeking strategy. Additionally, search features retaining explicit traceable memory (i.e., faceted filter and search bar) evoke the switch from path-following to zigzagging strategy, whereas those retaining implicit traceable memory (i.e., ranked list and interactive map) drive the switch from sprint to marathon strategy. We further test if the effect of search features holds in different task conditions (Browne et al. 2007; Nadkarni and Gupta 2007; Novak et al. 2003). Results suggest that the scented orienting feature does not evoke the saltating strategy in the goal-oriented condition and the unscented browsing feature does not consistently encourage the marathon strategy in the exploratory condition. Other than these two exceptions, search features encourage emergent search strategies consistently across both goal-oriented and exploratory conditions.

Fourth, this illustrative study identifies zigzagging as a strategy that is both effective and efficient for onsite search regardless of the search tasks. This strategy helps consumers to probe option availability and learn the appropriate vocabulary for search in a recursive and heuristic fashion. On the contrary, the saltating strategy inflates search features usage without providing additional payoffs across both task conditions. This finding suggests that examining more options in detail is more efficient than perpetually browsing the consideration set. The effectiveness of the remaining emergent search strategies varies across different task conditions. In goal-oriented condition, switching from path-taking to path-seeking strategy does not affect search performance. Moreover, adhering to marathon strategy drives up costs without producing additional benefits. In the exploratory condition, path-seeking becomes a preferable strategy that allows consumers to be exposed to more novel options without demanding more search feature usage. Additionally, switching from sprint to marathon strategy simultaneously heightens search benefit and cost.

3.4.2 Practical Implication

This illustrative study offers three actionable guidelines for digital platforms to facilitating consumers' emergent behavior and to improve their search performance. First, our findings highlight the most effective emergent search strategies. Specifically, for consumers who undertake goal-oriented tasks, path-taking zigzagging cruising sprint is likely to be the optimal combination of emergent search strategies. That is, consumers are recommended to spend less effort in specifying search criteria; instead, they should more frequently browse the consideration set and adjust search criteria repeatedly, examine detail pages more frequently when browsing the consideration set, and limit the scope of browsing to efficiently locate offerings that fit their preferences. For exploratory consumers, they may adopt path-taking zig-

zagging cruising sprint to maximize efficiency or path-taking path-following cruising marathon to discover more viable alternatives. Consumers may shorten their search sessions by frequently jumping between specifying search criteria and browsing consideration set, as well as limiting the scope of browsing. Alternatively, searchers can prioritize for exposure to novel alternatives by browsing each consideration set more extensively and restraining from frequently updating search criteria.

Second, this illustrative study encourages digital platforms to pay much attention to the crucial role played by search features in enhancing users' search experience. For instance, digital platforms can personalize the provision of search features to encourage the most effective emergent search strategies in accordance with the task undertaken by each user. For users who are driven by specific search goals, an online platform can provide scented orienting features to encourage the zigzagging strategy, the dominant strategy to tackle goal-oriented tasks. For users who are more exploratory, scented browsing features would be a better choice to provide because these features encourage the marathon strategy and in turn boost search benefit.

Third, this illustrative study discovered that the effectiveness of search feature design in improving search performance can be further enhanced. The findings shed light on the possibility of designing search process by configuring generativities. Digital platforms can leverage on predictive analytics to monitor and steer each consumer's emergent behavior in the search process. For example, to support a path-taking strategy, digital platforms can help to jump start consumers' browsing processes by recommending pre-defined consideration sets in the beginning of their search sessions. A cruising strategy can be better facilitated by smoothening the transition from browsing to examining and allowing consumers to scrutinize details of each available option without entering a separate detail page. To accommodate a zigzagging strategy, digital platforms can prompt consumers to adjust their search criteria when they stayed in one consideration set for too long. Last but not least, it is possible to make the decision between sprint and marathon strategies more explicit by tracking and visualizing each consumer's scope of browsing. Doing so allows digital platforms to offer suggestions to consumers on whether they should terminate or continue their browsing processes respectively. These strategy-centric designs synergize well with AI assistants, which are able to monitor consumers' actions and provide recommendations on the fly in a conversational style. It is also possible for AI assistants to adjust the provision of search features in real-time basing on consumers' attention allocation propensities to nudge them into more effective emergent search strategies.

4 POTENTIAL RESEARCH AVENUES

Recent studies have pointed out that the spontaneous behavioral processes embedded in digital traces promise an unprecedented opportunity to understanding emergent behavior (Kozlowski and Chao 2018).

This study contributes to the paucity of empirical examination of emergence in dynamic processes (Kozlowski and Chao 2018) by advancing a process-as-propensity approach. This novel approach focuses on each individual actor's resource allocation propensity as the driving mechanism of an emergent behavioral process. By leveraging on the process-as-propensity approach, studies can theorize how the direction and intensity of resource allocation propensity are steered by digital generativities and in turn determine the outcome of the emergent process. To assist future studies that strive to examine emergent behavior, this study solicited nascent research areas where emergent behavior is prevalent.

4.1 Digital Innovation

Digital innovation is an emerging concept that is widely recognized as an indispensable core of the Information Systems discipline (Fichman et al. 2014). Digital innovation refers to a perceived novel product, process, or business model that is embodied in or enabled by information technologies and requires adopters to undergo transformations (Fichman et al. 2014). Due to the emergent nature, the digital innovation process is characterized by its uncertainty (McDermott and O'Connor 2002). Research on digital innovation faces challenges when attempting to theorize and empirically analyze the digital innovation process (Lyytinen et al. 2016). The process-as-propensity approach can hence help to address these challenges by shedding light on how attention allocation propensities can render both the process and outcome of digital innovation more predictable.

Prior literature established that in order for a digital innovation to exert impacts, it needs to go though a development process and a diffusion process (Fichman et al. 2014). In the development process, an idea based on a key technology is developed into a usable innovation (Fichman et al. 2014). The development process involves rapid iterative development and refinement of the core technology together with packaging the core technology with complementary products and services or configuring features of the core technology in a specific organizational and technological environment (Fichman et al. 2014). Conceivably, the spontaneous attention allocation propensities of the actors who are involved in the development process are key to determining the development outcome. Leveraging on the process-as-propensity approach, it can be insightful to investigate how the likelihoods of transiting among key activities, such as developing, packaging, as well as configuring, can determine the outcome of the development process.

Subsequent to the development process, it is necessary for an innovation to diffuse across the population of potential users in order to create an impact (Fichman et al. 2014). The diffusion process consists of two key activities. One key activity is deployment, by which innovators mobilize resources to facilitate

the adoption of the innovation (Fichman et al. 2014). The other key activity is assimilation, through which adopters incorporate the innovation in their daily routines (Fichman et al. 2014). Likewise, innovators would express certain propensities in allocating resources among different activities, and in turn determine the likelihood for them to transit from one activity to the next one. The process-as-propensity approach can hence be leveraged to investigate how transitional probabilities among key activities in the likes of deployment and assimilation in the diffusion process affect the impact of a given innovation.

Taken together, this study can serve as an example for future research on emergence in digital innovation process. Adopting the process-as-propensity approach, future studies can discern digital generativities that dictate emergent propensities in transiting among key activities in both the development and diffusion processes. Future studies can also examine if emergent propensities are effective in predicting the success and the eventual impact of a digital innovation. Accordingly, the process-as-propensity suggests the following research questions for future studies to address:

- Is there emergent decision making in the digital innovation process?
- Do innovators show resource allocation propensities among key activities in the digital innovation process?
- How are the resource allocation propensities steered by digital generativities?
- How do the resource allocation propensities determine the outcome of a digital innovation?

4.2 Immersive Computing

Immersive computing is designed to allow users to have a presence in a digitally simulated or augmented environment (Loomis et al. 1999). Immersive computing can create a range of *mixed reality* along a continuum of reality-virtuality (Milgram et al. 1995). Accordingly, mixed reality can either be digitally augmented real environment, a.k.a. Augmented Reality (AR), that superimposes synthetic sensory information on a real environment or digitally augmented virtual environment, a.k.a. Augmented Virtuality (AV) or Virtual Reality (VR), that enhances users' maneuverability in a virtual environment with physical equipment like head mounted display (Milgram et al. 1995).

Recent studies begin to focus on emergence in mixed reality. It has been shown that players of a mixed reality game engage in emergent gameplay, which is defined as complex behavioral patterns that emerge from players' interaction with relatively simple game mechanisms and rules (Kickmeier-Rust and Albert 2009; Misteli et al. 2018; Wagner et al. 2009). Previous research distinguishes between intentional and unintentional emergence (Misteli et al. 2018). Whereas the former refers to the capability for a game design to allow each goal to be achieved in a multitude of ways, the latter represents the unintended use

of a game design (Misteli et al. 2018). Endeavors have been made to explore emergent gameplay and narrative generation by facilitating meaningful and responsive game mechanisms. Emergent experience can be enabled in mixed reality by integrating smart objects that unify both physical and virtual representations, intelligent agents that observe the environment and act according to their Belief-Desire-Intention (BDI) architecture, as well as interaction techniques including gesture, physical object manipulation, and voice commands (Misteli et al. 2018).

Prior literature attempted to leverage on the behavioral tree of BDI to formulate the underlying mechanisms that allow intelligent agents to behave emergently (Misteli et al. 2018). The process-as-propensity approach posited by this study allow future research to advance beyond designing emergent agents in mixed realities and quantify the emergent behavioral process reinforced by immersive features like smart objects, intelligent agents, and interaction techniques (Misteli et al. 2018). Particularly, future studies can investigate how immersive features can be designed to steer users' emergent behaviors and in turn affect their immersive experience in a mixed reality. Resultingly, the process-as-propensity approach suggests the following research questions for future studies on immersive computing to address:

- What emergent behaviors can be identified in a mixed reality?
- Do users express attention allocation propensities among key activities in a mixed reality?
- How are user's attention allocation propensities steered by immersive features?
- How do user's attention allocation propensities determine their immersive experience in a mixed reality?

4.3 Digital Activism

Existing research has established the seminal role played by technologies in fostering social activism (Ciszek 2016; Mora 2014). *Digital activism* refers to a networked and leaderless form of crowd participation in social and political activism (Mora 2014). The spontaneous interaction, engagement, and coordination of the crowd in social and political activism are facilitated by the extensive use of mobile devices equipped with ubiquitous computing and networking (Mora 2014). The emergence of digital activism gave rise to crowds that communicate differently, act differently, and expect differently in the public sphere (Lynch 2011). Unlike activism in traditional settings, leadership in social activism is often emergent among cohorts of activists despite its capability for reaching and mobilizing a larger crowd (Mora 2014).

The difficulty of unravelling the emergent nature at the core of digital activism has been pointed out by recent research (Mora 2014). The process-as-propensity approach can contribute in this regard by decoding the immediacy, dynamics, and amplification of social interaction and information exchange in the cyberspace. The process-as-propensity approach can hence shed light on the emergent process that legitimizes and empowers leadership in digital activism. It can also help to predict the networking and mobilization of crowds that are fundamental to all forms of social movements. Investigating emergence in social activism through the process-as-propensity approach can produce insightful implications for corporations and governments to make the optimal response to social activisms with an aim to reach a win-win resolution. In short, the process-as-propensity approach recommends the following research questions for future digital activism research to tackle:

- What is the emergent process of mobilization in a social movement?
- Do activists show attention allocation propensities among key events in a social movement?
- Can activist's attention allocation propensities be steered by emergent leadership?
- Can activist's attention allocation propensities affect the outcome of a social movement?

4.4 Collective Emergence

A growing body of research is focusing on emergent phenomena at a collective level that manifest through interaction among individual members (Kozlowski and Chao 2018). A methodology that is devised to tackle the emergent process that "originates in the cognition, affect, behaviors, or other characteristics of individuals, is amplified by their interactions" (Kozlowski and Klein 2000, p. 55) is in demand. The process-as-propensity approach proposed in this study can contribute in this regard by unveiling the driving mechanisms of emergent processes that give rise to collective phenomena. One such collective phenomenon is the *composition* and *compilation* of team dynamics. Composition refers to an emergent process through which members in a team converge over time whereas compilation refers to an emergent process through which team members diverge over time in various forms including polarization and networking (Kozlowski and Chao 2018).

Emergent process also plays a prominent role in strategy formation in the organizational context (Mirabeau and Maguire 2014). Unlike the top-down deliberation process for realizing intended strategies, front line and middle managers can articulate autonomous strategic behaviors conducted by front line employees who are granted agencies through discursive practices as emergent strategies (Mirabeau and Maguire 2014). Likewise, emergent process is key in enabling routine changes made by front line employees to amplify and accumulate into substantial changes at the organizational level over time (Wee and Taylor

2018). In particular, routine changes at the front line level can be amplified through either composition or compilation and accumulated through managerial sensemaking (Wee and Taylor 2018).

The process-as-propensity approach can contribute to this stream of research by unravelling how discernable and persistent patterns emerge from individual front line employees' autonomous behaviors. Future research can leverage on the process-as-propensity approach to examine if front line employees' attention allocation propensities emerged in their autonomous behaviors to contribute to outcomes desired by organizations. In addition, it would be possible to identify generative mechanisms that can be implemented by organizations to foster these desirable propensities in front line employees. Accordingly, the process-as-propensity approach points to the following research questions for future studies on collective emergence to investigate:

- What are the emergent employee behaviors in the organizational context?
- Do employees express attention allocation propensities among key activities in the organizational context?
- Can employee's attention allocation propensities be steered by organizational mechanisms?
- Can employee's attention allocation propensities influence the organizational performance?

5 CONCLUSIONS

In summary, this study strives to draw attention to emergent process driven by spontaneous resource allocation propensities. This study established a typology of process that distinguishes emergent process from deterministic process and stochastic process. This study then consolidated variance, process, and mixed approaches employed by past studies to theorize processes to establish process-as-propensity as a mixed approach for theorizing emergent process. To provide a comprehensive overview of past studies that adopted process theorization approaches, this study categorized studies published in leading Information System (IS) journals since 2000 based on the type of processes they theorized together with the approaches they employed. Afterwards, this study offered an illustrative example, which tackles consumers' emergent search processes for service offerings on digital platforms. This illustrative example demonstrated how process-as-propensity can be applied to unravel the underlying driving mechanism of the emergence embedded in digital traces. Doing so can help to shed light on digital generativities that may steer the emergent process and help to predict the outcome of the emergent process. Last but not

least, digital innovation, immersive computing, digital activism, as well as collective emergence are outlined as potential research venues for applying the process-as-propensity approach.

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