IMPACT OF INFORMATION PRESENTATION ON THE USERS' INTENTION TO EXPLORE BUSINESS INTELLIGENCE SYSTEM

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CERTIFICATE OF ORIGINALITY

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it reproduces no material previously published or written, nor material that has been accepted for the award of any other degree or diploma, except where due acknowledgement has been made in the text.

_________________ (Signed)

_YANG Junyi______(Name of student)

ABSTRACT

Business intelligence system (BIS) is rated as one of the most significant technologies for organizations. Many organizations have invested in BIS implementation to support their data analysis and decision making. Despite organizations' tremendous investments in BIS, employees within the organizations are reported to encounter a number of challenges when using BIS, such as complexity in utilizing the system functions, and difficulty in finding relevant data sets, and using only limited number of functions available in BIS. Information presentations of BIS are likely to facilitate the users' information processing and thus improve the users' decision making and usage experience. However, our understanding about the influence of information presentation on BIS implementation remains limited. Hence this study aims to examine how information presentation affects the extent to which users are willing to explore BIS functions.

Given that information presentation plays an important role in the initial use of systems, this study theorizes at the pre-adoptive stage of information systems (IS) implementation, and examines the effect of information presentation on the users' intention to explore BIS functions. Drawing upon the cognitive fit theory, I proposed a research model to elaborate how the interaction between information presentation (i.e., text-based or visual) and task type (i.e., symbolic or spatial) could affect the users' intention to explore BIS functions. Drawing on the theoretical perspective of regulatory compatibility, I proposed that the interaction

between style of processing (i.e., visual or verbal) and information presentation might also affect users' intention to explore BIS. Synthesizing the above, I further proposed a 3-way interactive effect of information presentation, task type and style of processing on users' intention to explore BIS functions.

I tested the research model and associated hypotheses through a lab experiment with 297 subjects. The results showed that, as expected, (1) the 2-way interaction of information presentation and task type and (2) the 3-way interactive effect of information presentation, task type, and style of processing both influenced users' intention to explore BIS functions. However, these two interaction effects were fully mediated by (i) perceived usefulness and perceived ease of use and (ii) perceived usefulness, respectively. I further found (a) the 3-way interactive effect of information presentation and task type on users' task performance and task time, (b) the 3-way interactive effect of information presentation and style of processing on users' task time, and (c) the 3-way interactive effect on task time. Finally, I also found that the information presentation directly affected users' intention to explore BIS functions, as well as indirectly through perceive usefulness and perceived ease of use. In other words, perceived usefulness and perceived ease of use partially mediated the influence of information presentation on BIS exploration intention.

This study makes several contributions to both theory and practice. This study examines how technology attribute (i.e., information presentation), task factor (i.e., task type), and user characteristics (i.e., style of processing) jointly affect users' intention to explore BIS from both the theoretical lens of cognitive fit

and regulatory compatibility. It extends the traditional cognitive fit research in the IS field (Vessey 1991; Vessey and Galletta 1991) and is, to our best knowledge, the first study that applies regulatory compatibility in the IS field. As for practice, the results of this study suggest that managers should take into account the congruence of information presentations, task types, and style of processing in order to encourage their employees to better explore rich functions available in BIS, thereby attaining the expected outcomes.

Keywords: BIS, information presentation, style of processing, task type, intention to explore, cognitive fit, regulatory compatibility

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Chapter 1 Introduction

1.1 Practical Problems

Business intelligence system (BIS) and its related areas have obtained increasing importance in the past two decades (Chen et al. 2012). BIS has been rated as one of the top 10 strategic technologies (Gartner 2009), and business analytics has been identified as one of the four popular technical trends (Chen et al. 2012). BIS is a type of data-driven technology that can extract, convert, analyze, visualize, and present large data sets to assist strategic planning and managerial decision making (Deng and Chi 2012). Over the past two decades, BIS has been developing with regard to real-time analysis, effective data analysis, and powerful visualization (Deng and Chi 2012; Turban et al. 2008). BIS can enable organizational users to utilize a number of analytical functions, and the results of the analysis can facilitate the users' decision making (Li et al. 2013; Negash and Gray 2008). Organizations devote substantial resources to implementing BIS due to its strategic roles (Davenport et al. 2010; Li et al. 2013, Negash and Gray 2008). Organizational users, from senior executives to general employees, have been increasingly adopting BIS as their decision support system (Deng and Chi 2012; Elbashir et al. 2008).

Although organizations have made many efforts to implement BIS, organizational users are reported to encounter several challenges when utilizing BIS (Deng and Chi 2012). Employees may have difficulties in understanding the technical functions (e.g., data reporting) and integrating different data sources of

BIS (Deng and Chi 2012). As the data sets become increasingly large, employees may also experience difficulties in finding the most relevant data (Davenport and Beck 2001). While BIS provides the organizational users mass of information, it also has the potential to overwhelm organizational users, leading to information overload (Lucas and Nielsen 1980). Organizational users may spend much time organizing a large amount of information instead of solving the problems. Irrelevant information can distract the users and divert their attention from crucial variables (Lucas 1975). Users may feel the obligation to scan quantities of data (Keim and Kriegel 1994), which can be time-consuming (Lohse 1997).

Appropriate design of information presentations of BIS may address the above-mentioned challenges the organizational users encounter by presenting the data sets in a more user-friendly manner (e.g., Jarvenpaa and Dickson 1988; Tan and Benbasat 1993; Zhu and Watts 2010). The information presentation may allow users to leverage individual information processing more effectively (Tegarden et al. 1999) and perform data analysis more conveniently (Speier and Morris 2003; Zhu and Watts 2010). The information presentation can also affect users' task performance (e.g., Adipat et al. 2011; Speier and Morris 2003; Vessey 1991; Vessey and Galletta 1991; Zhu and Watts 2010), influence users' attitude towards the systems (e.g., Adipat et al. 2011; Hong et al. 2004), and determine users' behavioral intention (e.g., Jiang and Benbasat 2007).

Given the practical and theoretical importance of BIS information presentations, it is crucial for managers as well as scholars to examine the effects of BIS presentations. A comprehensive investigation of information presentation can further leverage the business value of BIS and enhance organizational competitive advantage.

1.2 Research Motivations and Research Objectives

BIS has been identified as a promising research direction, and deserves further exploration (Chen et al. 2012). BIS can change the raw data into valuable information for business purposes, and facilitate employees to process vast amounts of unstructured data to find emerging opportunities (Rud 2009). BIS may also create new opportunities to facilitate the strategic planning which contributes to the competitive advantage and long-term development of the organizations (Li et al. 2013; Negash and Gray 2008). Information presentations play a critical role in facilitating users' information processing (Tegarden et al. 1999), as they can enable users to better understand the data sets and to handle the tasks at hand more effectively (Speier and Morris 2003). Unfortunately, despite of the crucial role of the information presentation, it has received limited attention in previous studies on BIS, thus there is a need to explore the information presentation of BIS.

Prior research on information presentation has examined presentation formats in the context of geographic information systems (e.g., Dennis and Carte 1998), social networks (e.g., Zhu and Watts 2010), databases (e.g., Speier and Morris 2003), e-commerce (Hong et al. 2004; Jiang and Benbasat 2007; Kamis et al. 2008), and mobile websites (Adipat et al. 2011). In addition, previous studies often adopt the cognitive fit theory to examine the possible effects of information presentation (e.g., Adipat et al. 2011; Hong et al. 2004; Speier and Morris 2003; Zhu and Watts 2010). The cognitive fit theory proposes that the decision outcome can be improved if there is a fit between the information presentation and the task characteristics (Vessey 1991; Vessey Galletta 1991). Apart from the task performance, information presentations may affect user perception toward the system (e.g., Adipat et al. 2011; Hong et al. 2004; Jiang and Benbasat 2007) and purchase intention in online shopping (e.g., Jiang et al. 2010; Jiang and Benbasat 2007). There is, however, limited understanding about the effect of information presentation on BIS usage. Prior studies have shown that system utilization can promote employees' service performance (e.g., Hsieh et al. 2011), and influence employees' job satisfaction (Morris and Venkatesh 2010). System utilization may also facilitate the realization of full potential of information systems (IS) (e.g., Bhattacherjee 2001; Burton-Jones and Grange 2012). Given the theoretical importance of system usage and the limited understanding of the impact of presentation on BIS usage, it is necessary to investigate the effect of information presentation on BIS utilization.

With regard to the IS implementation stage, it can be divided into the pre-adoptive and post-adoptive stages (Hsieh et al. 2011; Jasperson et al. 2005). Since the information presentations often receive much more attention from users during the early stage of their interactions with IS (Hong et al. 2004), this study focuses on the pre-adoptive stage of BIS implementation. One important notion in the pre-adoptive stage is the intention to explore. The intention to explore refers to a user's purpose and propensity to explore a new technology and investigate potential uses (Maruping and Magni forthcoming; Nambisan et al. 1999). This notion has been treated as an indicator of technology exploration behavior (Nambisan et al. 1999).

This study will investigate organizational users' intention to explore BIS functions, as BIS is increasing its capability to provide analytics functions and the application of these functions strengthens the organizations' competitiveness (Hannula and Pirttimäki 2003). Therefore this study intends to study the relationship between information presentation and intention to explore BIS functions.

As different types of information presentations have distinct advantages (e.g., Hong et al. 2004; Speier and Morris 2003; Vessey 1991), they may exert differential impacts on the users' intention to explore BIS functions. Two major alternatives to information presentations of BIS are (1) text-based information presentationa and (2) visual information presentations (Shneiderman 1998; Speier and Morris 2003). Visual presentation formats (e.g., graphical presentation) can facilitate users to analyze the information holistically without addressing the elements separately, while text-based formats (e.g., tables) facilitate users to search for specific data values (Vessey 1991; Shneiderman 1998). Therefore, text-based information presentations are suitable for presenting specific values (e.g., a table of production volume or sales performance), while visual information presentations are suitable for analyzing relationships among data sets (e.g., comparison of sales performance or sales growth rate) (Shneiderman 1998).

The information presentation may not generate direct effects on the users' intention to explore BIS functions, as different presentation formats feature differential characteristics. It is possible that the interaction between information presentations and task characteristics influences the users' intention to explore BIS functions, as different tasks match differential information presentations (Vessey

1991). The task can be categorized into two types: 1) spatial tasks that correspond to those involving acquiring information and making simple comparisons among alternatives (i.e. data comparison), and 2) symbolic tasks that correspond to those asking task-doers for specific numeric values (Vessey 1991; Vessey and Galletta 1991). Prior studies provide limited understanding on how information presentations (e.g., text-based and visual) and task types (e.g., symbolic and spatial) interactively affect the users' intention to explore BIS functions. To bridge this gap, the first research question addressed by this research is proposed:

RQ1: *How will the information presentation and the task type interactively influence the users' intention to explore BIS functions?*

In addition to task type, individual characteristics may also shape the impact of information presentations on the users' intention to explore BIS functions (e.g., Speier and Morris 2003; Zhu and Watts 2010). For instance, working memory capacity, the individuals' capacity for cognitive integration, can influence the users' task performance (Zhu and Watts 2010), and individuals' spatial ability can moderate the relationship between information presentations and users' task performance (Speier and Morris 2003). Both working memory capacity and spatial ability reflect individuals' ability to process information, but actually individuals differentiate in both their visual capacity of information processing and visual preference of information processing (Childers et al. 1985). Unfortunately, prior studies predominantly examine the ability of information processing, yet they pay less attention to the individuals' preference toward processing information.

One typical notion to represent individuals' preference of information processing is the "style of processing", which has been widely applied in the marketing literature, and is conceptualized as a preference and propensity to conduct visual or verbal information processing (Childers et al. 1985). It is possible that users who prefer the visual style of processing probably experience a state of regulatory compatibility with the visual information presentation (Keller and Bless 2008). By contrast, users who prefer the verbal style of processing probably may experience a state of regulatory compatibility with the text-based information presentation (Keller and Bless 2008). Users who experience a regulatory compatibility enjoy the tasks or activities they engage in, are willing to spend additional time and effort on the tasks or activities (Keller and Bless 2008), and are thus more willing to explore BIS functions (Nambisan et al. 1999). Therefore, the information presentation and the style of processing may interactively influence the users' intention to explore BIS functions. However, prior studies have not provided comprehensive illustrations of the interactive impact of information presentations and style of processing. To fill this gap, the second research question is proposed:

RQ2: *How will the information presentations and the style of processing interactively influence the users' intention to explore BIS functions?*

Several studies propose that information presentations and task characteristics can interactively influence the users' task performance or user perception toward IS (e.g., Dennis and Carte 1998; Hong et al. 2004; Jiang and Benbasat 2007; Speier and Morris 2003), and that information presentations and individual characteristics interactively impact the users' task performance (e.g., Speier and Morris 2003). Nevertheless, these studies often disregard the 3-way interactive impact of information presentation, task type, and style of processing on users' task performance and user perception. To fully understand this complex interaction effect, it is necessary to make a further step to investigate the 3-way interactive effect on the users' intention to explore BIS functions. It is possible that the users' intention to explore BIS functions is strengthened to the largest extent when there is a fit among information presentation, task type, and style of processing. Therefore the third research question is proposed accordingly:

RQ3: *How will the task type, the style of processing, and the information presentation jointly influence the users' intention to explore BIS functions?*

1.3 Structure of the Proposal

The following chapters of this proposal are organized as follows. Chapter 2 reviews the literature on the IS implementation stage, the IS usage behavior, the individual differences of information processing, the cognitive fit theory and the flow experience. After the theoretical background is introduced, the research model and hypotheses are provided in Chapter 3. Specifically, the definition of each construct, the rationale for each hypothesis are presented. Chapter 4 introduces the research methodology employed in this study. It includes the design of information presentation, the design of task type, the measurement, the experimental procedure, the manipulation check, and the data analysis method. Chapter 5 presents the results of the lab experiment. ANCOVA, MANCOVA, and structural equation modeling are used to analyze the data sets. Chapter 6 discuses the research findings, gives the theoretical and practical implications, and points out the limitations of this study. Finally, chapter 7 gives a conclusion on this entire study.

Chapter 2 Literature Review

2.1 IS Implementation Stage

The IS Implementation stage can generally be divided into the pre-adoptive stage and the post-adoptive stage (e.g., Hsieh et al. 2011; Jasperson et al. 2005; Morris and Venkatesh 2010). Concretely, a six-stage model of IS implementation has been introduced, and the six stages include initiation, adoption, adaptation, acceptance, routinization, and infusion (Cooper and Zmud 1990) (see Figure 1). Initiation refers to the process that organizational problems or opportunities are identified and IT solutions are undertaken (Cooper and Zmud 1990). Adoption corresponds to the process that organizations invest recourses to support IS implementation (Cooper and Zmud 1990). In the adaptation stage, IS applications are developed, installed with related revision and development of organizational procedures, and organizational employees are trained to get familiar with the new procedures and IS (Cooper and Zmud 1990). In the acceptance stage, organizational employees are induced to use IS applications (Cooper and Zmud 1990). The last two stages (e.g., routinization and infusion) are beyond the pre-adoptive stage and refer to the process that organizational employees use IS applications as a normal activity and in a more sophisticated and comprehensive approach to support higher levels of organizational work (Cooper and Zmud 1990).

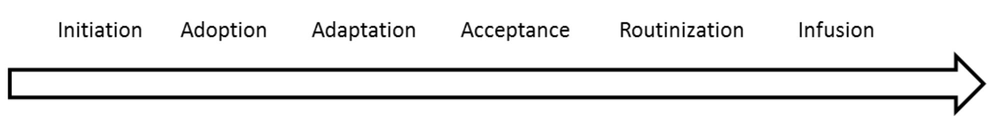


Figure 1 IS implementation process stage (Cooper and Zmud 1990)

While the post-adoptive stage is critical for organizations to achieve expected return from IS investment (Bhattacherjee 2001; Hsieh et al. 2011; Jasperson et al. 2005), the pre-adoptive stage is considered as the fundamental milestone toward realizing success (Thong 1999). In addition, the information presentation is paid for more attention at the initial stage (Hong et al. 2004). Therefore, this study conceptualizes at the pre-adoptive stage of IS implementation.

2.2 IS Usage Behavior

There are a number of research investigating the IS usage behavior. According to the theory of reasoned action (TRA), attitudes and subjective norms determine intentions that in turn predict usage behavior (Fishbein and Ajzen 1975). Technology acceptance model (TAM) has been applied to predict user acceptance as a robust and well-established model (Venkatesh and Davis 2000). TAM theorizes that individuals' intention to use IS can be predicted by perceived usefulness, defined as the extend to which an individual believes the IS usage will facilitate his or her job performance, and by perceived ease of use, defined as the extent to which an individual believes that IS usage will be free from effort (Davis 1989; Davis et al. 1989). Theory of planned behavior (TPB) further extends TRA and proposes that human beings' behavioral intention depends on attitudes, subjective norms and perceived behavioral control (Ajzen 1991). Venkatesh and Davis (2000) later extended TAM and find that both social influence factors (e.g., subjective norm and image and voluntariness) and cognitive instrumental factors (e.g., perceived ease of use, job relevance, output quality, and result demonstrability) significantly affect user acceptance of IS. TAM 3 may better predict behavioral intention and IS use behavior by incorporating numerous determinants of perceived ease of use and perceived usefulness (Venkatesh and Bala 2008). Nambisan et al. (1999) have examined the significance of intention to explore IS, defined as users' willingness and propensity to explore IS and identify their potential uses, and propose that the acquisition of firm specific IT knowledge can contribute to intention to explore IS. System exploration is an ongoing process (Hsieh and Wang 2007; Maruping and Magni forthcoming; Nambisan et al. 1999), so intention to explore can be located in both pre-adoptive stage and post-adoptive stage.

Apart form the abundant research in the pre-adoptive stage, numerous studies have been conducted in the post-adoptive stage. Trying to innovate with information technology (IT), defined as users' goal of finding novel uses for IT, is determined by the overload and the autonomy at work (Ahuja and Thatcher 2005). Jasperson et al. (2005) propose the concept of individual feature extension, defined as individuals' applying features that go beyond delineated feature from the applications' designers or implementers. Emergent usage, defined as users' applying IS to perform tasks that are not solvable or feasible prior to IS applications at work (Saga and Zmud 1994), can be promoted by perceived usefulness, symbolic adoption, and extended use (Wang and Hsieh 2006). The extended use that stands for users' application of more IS features to support more thorough tasks at work can be amplified by employees' sense-making about IT (Hsieh et al. 2011). Sun (2012) demonstrates that triggers (e.g., novel situations, discrepancies, and deliberate initiatives) can promote the adaptive system use which corresponds to modifying the content of features and modifying the spirit of feature, and these relationships are moderated by facilitating conditions and personal innovativeness in IT. Drawing on the motivation theory, Li et al. (2013) have compared the differential effect of intrinsic motivation and extrinsic motivation on routine use and innovative use respectively. Table 1 provides a summery of the abovementioned IS usage behavior.

Table 1 Summery of IS usage behavior

Study	Construct Definition	Major Findings
Fishbein and Ajzen 1975	Behavioral Intention: the extent to which an individual is willing to conduct a behavior.	Individuals' behavioral intention can be determined by the attitude toward the behavior and the subjective norms.
Davis 1989, Davis et al. 1989	IS usage intention: the extent to which an individual is willing to conduct IS usage behavior.	Individuals' intention to use IS depends on the perceived usefulness and the perceived ease of use of IS.
Ajzen 1991	Behavioral Intention: the extent to which an individual is willing to perform a behavior.	Human beings' behavioral intention depends on their attitudes toward the behavior, subjective norms and perceived behavioral controls.
Venkatesh and Davis 2000	Intention to use: the extent to which an individual intends to perform IS usage behavior.	Both social influence factors (e.g., subjective norm, image and voluntariness) and cognitive instrumental factors (e.g., perceived ease of use, job relevance, output quality, result demonstrability) significantly affected user acceptance of IS.
Venkatesh and Bala 2008	Intention to use: the extent to which an individual intends to conduct IS usage behavior.	Individual differences, system characteristics, social influences, and facilitating conditions can affect perceived usefulness and perceived ease of use, thus influencing the users' intention to use IS..
Maruping and Magni forthcoming ; Nambisan et al. 1999	Intention to explore: users' willingness and propensity to explore IS and identify their potential uses.	The acquisition of firm specific IT knowledge can contribute to intention to explore IS

Ahuja and Thatcher 2005	Trying to innovate with IT: users' objective of finding new uses for IT.	Trying to innovate with IT is determined by the overload and the autonomy at work.
Jasperson et al. 2005	Individual feature extension : individuals' application of features that go beyond delineated feature from the applications' designers or implementers	Most IS users employ a narrow range of features, perform at low levels of feature usage, and seldom extend their feature use. Aggressive tactics are required to promote users to expand the IS features they employ.
Wang and Hsieh 2006	Emergent use: users' applying IS to perform tasks that are not solvable or feasible prior to IS applications at work.	Emergent use can be promoted by perceived usefulness, symbolic adoption, and extended use.
Hsieh et al. 2011	Extended use: users' application of more IS features to support more thorough tasks at work.	Extended use can be amplified by employees' sense-making about information technology.
Sun 2012	Adaptive system use: individuals' modifying the content of features and modifying the spirit of feature	Triggers (e.g., novel situations, discrepancies, and deliberate initiatives) could promote adaptive system use, and these relationships are moderated by facilitating conditions and personal innovativeness in IT.

Li et al. 2013	Routine use: individuals' use of IS in a standardized manner to assist their work. Innovative use: individuals' application of IS in a novel manner to assist their work.	There are three major findings: (1) perceived usefulness, as compared to constructs on intrinsic motivations, has a stronger influence on the routine use, (2) intrinsic motivation to know and intrinsic motivation to experience stimulation each has a stronger influence on innovative use than perceived usefulness or intrinsic motivation toward accomplishment, and (3) perceived innovativeness with IT has a positive moderation effect on the relationship between constructs on intrinsic motivations (e.g., intrinsic motivation to know and intrinsic motivation to experience stimulation) and innovative use.

Given our emphasis on BIS usage behavior in the pre-adoptive stage, intention to explore may be a construct of interest for this study. In the context of BIS, quantities of BIS functions (e.g., predictive analysis, competitive analysis, data reports and online analytical processing) enable users to perform thorough data analysis. Users who display higher intention to explore may incorporate more system functions into their work, thus leveraging the value potential of BIS (Jasperson et al. 2005). Therefore, this study chooses the users' intention to explore BIS functions as the dependent variable.

2.3 Individual Differences of Information Processing

There has been numerous concepts to depict individuals' visual ability of information processing and their preference of information processing. For instance, the style of processing refers to an individual's preference and tendency to employ a verbal and/or visual manner of processing information on one's environment (Childers et al. 1985). Vividness of visual imagery refers to one's ability to construct mental images (Marks 1973). Other concepts on the ability of information processing include spatial orientation, visual memory, and visualization ability. Spatial orientation refers to the capacity to handle spatial patterns in regard to objects in space (Ekstrom et al. 1976). Visual memory corresponds to the ability to bear in mind the fabric, position, and direction of image materials (Ekstrom et al. 1976). Visualization ability refers to the capacity to control or reform the figures of spatial patterns into other arrangements (Ekstrom et al. 1976). Visualizer-verbalizer cognitive style differentiates individuals into three categories: verbalizers, spatial visualizers and object visualizers (Kozhevnikov et al. 2005). Verbalizers refer to people who rely heavily on verbal-analytical strategies; Spatial Visualizers refer to individuals who excel in operating and reforming complex spatial images; Object Visualizers are defined as individuals who excel in recalling imagery, such as the objects' accurate format, size, shape, color and brightness (Kozhevnikov et al. 2005).

This study explores the role of style of processing, since from a communication perspective, understanding the interaction of information presentation and individual preference on information processing lead to a more effective information system design (Capon and Lutz 1979; Childers et al. 1985). Evaluating individuals' style of processing (e.g., verbal vs. visual) may lead to an improvement of the manner in which the information presentation is presented (Childers et al. 1985). Therefore, this study investigates the influence of style of processing.

2.4 Cognitive Fit Theory

2.4.1 Conceptualization of Cognitive Fit

Cognitive fit theory elaborates how information presentations affect the decision outcomes: when there is a fit between the information emphasized in the information presentations and the information needed to perform the task, the task-doers' performance can be strengthened (Vessey 1991). In contrast, when a mismatch between the information presentations and the tasks occurs, task performance will be decreased (Vessey 1991). When the information presentation fits the task, same mental representations and decision processes can be used for interpreting the presentation and the task, which often leads to faster and more precise outcomes (Vessey 1991). When a mismatch between information presentation and task occurs, task-doers may transform the presented information to better fit the task at hand, which can increase the decision time and reduce the decision accuracy due to possible errors caused by the data transformation (Vessey 1991).

In the context of BIS, there have been two major alternatives to information presentations: text-based presentation formats and visual presentation formats (Shneiderman 1998; Speier and Morris 2003). The visual information presentations employ visualization techniques, and include graphical presentation and manipulation of data (Card et al. 1999; Speier and Morris 2003), whereas the text-based information presentation uses text and tables that can present more detailed information (Shneiderman 1998). Visual presentation formats (e.g., graphical presentation) facilitate users to view the information holistically, while text-based formats facilitate extracting specific data values (Shneiderman 1998; Vessey 1991). Therefore, text-based information presentations (e.g., tables) are suitable for presenting specific values (e.g., a table of production volume or sales performance), while visual information presentations (i.e., graphs) are suitable for depicting relationships among date sets (e.g., change in production volume over time or the comparisons of sales growth rate among different products) (Shneiderman 1998; Vessey and Galletta, 1991).

There are two major categories of tasks used in studies on information presentation: “1) elementary tasks that involve basic perceptual cognitive information processes (e.g., retrieval of data value or comparison of two data values), and 2) decision activities that involve formal higher mental processes such as judgment, integration of information, and/or inference (e.g., forecasting)” (Jarvenpaa and Dickson 1988, p. 767). This study focuses on elementary tasks, since it is easier to generalize the findings based on the use of elementary tasks than the use of complex decision tasks (Cleveland 1985; Tan and Benbasat 1993). According to cognitive fit theory, the task can be categorized into two types: spatial tasks and symbolic tasks, based on the information needed to solve the problem (Vessey 1991). Spatial tasks correspond to those involving acquiring information and making simple comparisons among alternatives (i.e. data comparison), wheares symbolic tasks correspond to those asking task-doers for specific numeric values (Vessey 1991; Vessey and Galletta 1991). In the context of BIS, spatial tasks may include data comparison, analysis of data trend, and symbolic task may include extraction of specific numeric value from the system (Liautaud and Hammond 2000).

The cognitive fit theory categorizes decision making processes for tasks into the process analytical and the perceptual process (Vessey 1991). The analytical process focuses on the information processing based on its meaning (e.g., numeric values), whereas the perceptual process is holistic with an emphasis on visual assessments of magnitudes (e.g., data that is interpreted as distances between two points in the display) (Dennis and Carte 1998). Effort can be reserved if task-doers use decision processes that fit information presentations or tasks, as using inappropriate decision processes requires the task-doers to make more effort for information transformation (Dennis and Carte 1998).

2.4.2 Studies on Information Presentation

There have been numerous studies on the information presentation. Drawing on the cognitive fit theory, Dennis and Carte (1998) reported that adopting a map-based information presentation, task-doers made faster and more precise decisions when performing geographic adjacency tasks, but less precise decisions when performing geographic containment tasks in geological information system. The cognitive fit theory has also been applied to the study on query interface design. For instance, Speier and Morris (2003) demonstrated that the performance of decision makers was more precise when they used the text-based query interface to conduct the task with low complexity, whereas their performance was more precise when they use visual query interface to perform the task with high complexity. Prior studies on the information presentations of e-commerce websites have also taken the theoretical lens of cognitive fit. Hong et al. (2004) found that consumers using list format presentations could seek for information in the e-commerce website more efficiently and recall the product information better when performing browsing tasks, whereas consumers employing matrix format presentations performed better when handling searching tasks. Petrova and Cialdini (2005) found that consumers displayed higher purchase intention when their information processing strategies (imagining vs. analytical) matched the types of product information presentation format (images vs.

numbers). Kamis et al. (2008) reported that consumers using an attribute-based decision support system (DSS) displayed higher perceived usefulness and perceived enjoyment than consumers using an alternative-based one. Drawing on the theory of multimedia learning, Jiang and Benbasat (2007) demonstrated that as compared to static pictures, videos and virtual product experience contributed to higher perceived website diagnosticity which further led to higher consumers' intention to revisit the website. Furthermore, network visualizations with high cognitive fit can balance the differences of task performance caused by the individual differences in working memory capacity, and can also compensate the negative influence of high information load (Zhu and Watts 2010). Moreover, presentation adaptation in the mobile websites positively influences user performance and perception of mobile web browsing, and the positive influence of presentation adaptation can be moderated by the complexity of the information search task (Adipat et al. 2011). Table 2 provides a summary for the studies on the information presentations.

Table 2 Summary of studies on cognitive fit theory and information representation

Study	Information Representation	Result
Dennis and Carte 1998	Map-based presentations v.s. Tabular presentations in geographical information systems (GIS)	Adopting a map-based information presentation, task-doers make faster and more precise decisions with geographic adjacency tasks; Task-doers employing a map-based information presentation make faster but less precise decisions when performing geographic containment tasks.
Speier and Morris 2003	Text-based v.s. Visual query interface	1) Decision makers' performance is more precise using the text-based query interface when handling task with low complexity; decision makers' performance is more precise using visual query interface when handling task with high complexity; 2) they experience less subjective mental workload when using the visual query interface, regardless of the task complexity. 3) When task complexity is low, they spend less time with visual query interface; when task complexity is high, they spend less time with text-based query interface.
Hong et al. 2004	List v.s. Matrix information format in e-commerce websites	Consumers using list format can seek for information in the e-commerce website more efficiently and recall the product information better, when performing browsing tasks; whereas consumers employing matrix format perform better when handling searching tasks.
Petrova and Cialdini 2005	Images vs. Numbers	Consumers display higher purchase intention when their information processing strategies (imagining vs. analytical) matched the types of product information presentation format (images vs. numbers).

Jiang and Benbasat 2007	Static picture v.s. Video-Without Narration v.s. Video with Narration v.s. Virtual product experience (VPE) on e-commerce websites	1) Videos and VPE, as compared to static picture, contribute to higher perceived website diagnosticity. 2) Videos and VPE lead to the same level of actual product knowledge under the condition of moderate tasks, however both lead to higher product knowledge than static pictures. 3) When task complexity is high, all four presentation formats lead to the same level of actual product knowledge. 4) Perceived website disgnosticity influences the perceived usefulness of e-commerce websites which further makes influence on consumers' intention to return.
Kamis et al. 2008	Attribute-based v.s. Alternative-based decision support system (DSS) for e-commerce websites	1) Influence of attribute based DSS on consumers' behavioral intentions is fully mediated by perceived enjoyment and perceived usefulness, but not by perceived control. 2) Consumers using an attribute-based DSS display higher perceived usefulness and perceived enjoyment than consumers using an alternative-based DSS.
Zhu and Watts 2010	Force v.s. Circle interface of social networks	Network visualizations with high cognitive fit can equalize the differences of task performance cased by the individual differences in working memory capacity. In addition, network visualizations with high cognitive fit can compensate the negative influence of high information load.

Adipat et al. 2011	Presentation Adaptation: highest (T+H+S), high (T+H, T+S), low (T), lowest (O). Note: T=Tree-view adaptation, H=Colored keyword highlighting, S= Hierarchical text summarization, O=Original display without any adaptation for mobile websites	1) Presentation adaptation positively influences user performance and perception of mobile web browsing. 2) The positive influence of presentation adaptation is moderated by the complexity of the information search task.

2.5 Flow experience

The state of flow is an experiential state that includes the following characteristics: 1) The individuals intensely focus on what they are doing; 2) the individuals experience a loss of self-consciousness; 3) the individuals experience a deep sense of control; 4) individuals feel that time flies; 5) worries disappear; and 6) the individuals engage in the activity which is perceived as rewarding (Nakamura and Csikszentmihalyi 2002; Keller and Bless 2002). The notion of flow experience plays an important role in understanding human-technology interactions and serves as crucial antecedent of attitude toward technologies (e.g., Trevino and Webster 1992; Agarwal and Karahanna 2000). For instance, Trevino and Webster (1992) showed that the state of flow could predict attitudes toward information technology and extent of technology use. Agarwal and Karahanna (2000) demonstrated that cognitive absorption, defined as a state of deep involvement with information technology, could determine two important beliefs toward information technology use: perceived usefulness and perceived ease of use.

The emergence of flow experience depends on establishing a balance between personal action capacities (e.g., level of skills) and perceived action opportunity (e.g., task demands) (see figure 2) (Csikszentmihalyi 2000; Nakamura and Csikszentmihalyi 2002; Keller and Bless 2008). If the task demands are high but the individual's level of skill is low, individuals can experience anxiety (Nakamura and Csikszentmihalyi 2002). By contrast, if the task demands are low but the level of skill is high, individuals can feel boredom (Nakamura and Csikszentmihalyi 2002).

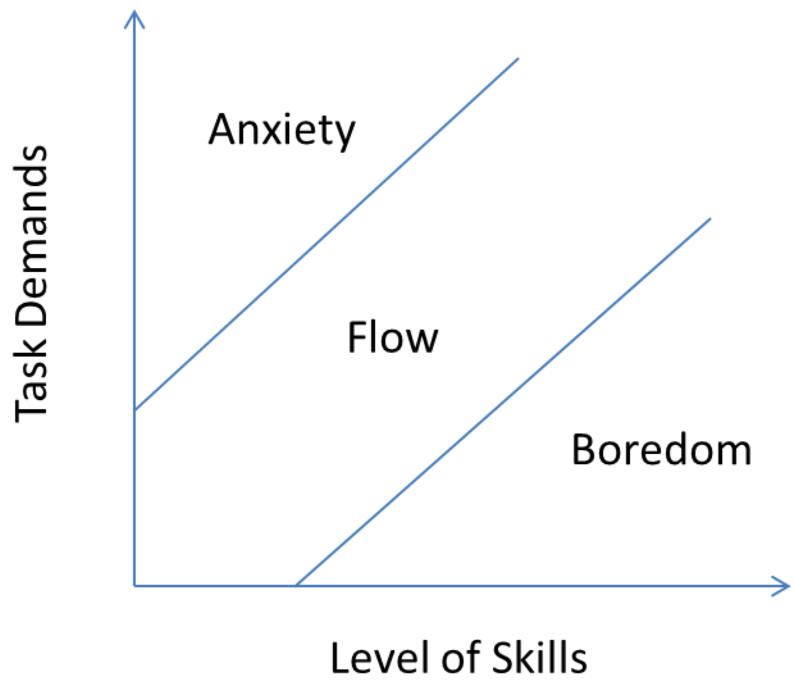


Figure 2 The flow channel (Keller and Bless 2008, p. 198)

A state of flow represents a regulatory compatibility experience which corresponds to the compatibility of personal characteristics (e.g., level of skills, habitual goal orientation, personal needs or standards) and environmental characteristics (e.g., task demands, task framing, availability of distinct means, salience of specific outcomes or incentives) (Keller and Bless 2008). In general, the experience of a regulatory compatibility occurs when individuals experience a compatibility of personal and environmental factors that are involved in conducting a task or activity (Keller and Bless 2008). Personal factors can be reflected in strategic orientations of goad pursuit (e.g., focus on avoiding error ensuring hits), skills and competencies (e.g., experience in playing a game, driving a car, and playing piano), personality trait (e.g., patience, tenaciousness), and habitual orientations (e.g., a chronic promotion or prevention focus, action- vs. state-orientation) (Keller and Bless 2008). Environmental factors can be reflected in the means of goal pursuit (e.g., eagerly striving vs. carefully proceeding), the level of task demands or challenges involved in a task (e.g., the difficulty level of a game), the framing of relevant outcomes (e.g., gaining vs. not losing points, save $x vs. Get $x off), or other structural characteristics involved in a task or activity (e.g., time pressure, distraction) (Keller and Bless 2008; Ramanathan and Dhar 2010).

Regulatory compatibility may lead to deep involvement and eager task pursuit (Keller and Bless 2008). It may also result in a positive state of relaxation and quiet (Keller and Bless 2008), a greater willingness to purchase relevant products (Avnet and Higgins 2003, 2006), greater persuasion (Aaker and Lee 2006; Zhao and Pechmann 2007), and stronger motivational intensity (Forster et al. 2001, Ramanathan and Dhar 2010). Individuals are willing to spend additional time experiencing a state of regulatory compatibility, and are thus intrinsically motivated to engage in such activities or tasks (Keller and Bless 2008). When individuals feel engaged in an activity, they perceive lower cognitive burden, since they enjoy the experience from the activity and are willing to spend more effort on it (Agarwal and Karahanna 2000; Deci 1975).

2.6 Review Summary

This study focuses on the impact of information presentations in the context of BIS. The information presentation of BIS is recognized as a promising research direction deserving further exploration. At the same time, system utilization helps leverage the business value of IS. Therefore, this study emphasizes on the effect of information presentation on the users' intention to explore BIS functions.

Intention to explore is identified as a predictor of technology exploration, a usage behavior that is of vital importance for realizing the value of BIS (Maruping and Magni forthcoming; Nambisan et al. 1999). The users' intention to explore BIS functions represents a good foundation for initial IS success. Despite of the importance of the users' intention to explore in BIS functions, little is known about the effect of information presentations on the users' intention to explore BIS functions. Previous studies demonstrate that information presentations and task types can interactively influence the users' task performance, perception toward the IS and purchase intention. In the context of BIS, the text-based presentation and the visual presentation are two typical alternatives. Tasks are divided into spatial tasks and symbolic tasks in this study. It is possible that the cognitive fit between BIS presentations and task types can promote the users' intention to explore BIS functions, as users can experience benefits (e.g., facilitation of information processing) from this fit. Hence, this study investigates how information presentations and task types interactively influence the users' intention to explore BIS functions, which corresponds to RQ1, as proposed in the first chapter.

As suggested in this review, the style of processing, defined as the individual's preference to process information in a visual or verbal manner, is a typical construct to represent individual's propensity of information processing. Users experiencing a state of regulatory compatibility between personal factors and environmental factors better enjoy the activities or tasks they engage, and spend more time and effort on the activities or tasks. Considering the characteristics of text-based information presentation and visual information presentation, it is likely that users who feature a visual style of processing prefer the visual presentation, whereas users who feature a verbal style of processing prefer the text-based presentation. Hence, this study examines the interactive impact of information presentations and the users' style of processing on the users' intention to explore BIS functions, which corresponds to RQ2, as proposed in the first chapter.

A further issue to consider is the 3-way interactive impact of information presentations, task types, and the style of processing on the users' intention to explore BIS functions. One the one hand, cognitive fit theory proposes that a fit between the information representation and the task type can enhance the task performance. On the other hand, the regulatory compatibility between information presentation and style of processing may lead to deep involvement and eager task pursuit. Individuals are willing to spend more time experiencing the regulatory compatibility, and are thereby intrinsically motivated to conduct such activities or tasks. Following this line of reasoning, the congruence among information presentations, task types and the style of processing may further amplify the effect on users' intention to explore BIS functions. Therefore, this study examines the joint interactive impact of information presentation, task type and style of processing on the users' intention to explore, which corresponds to RQ3, as proposed in the first chapter.

Chapter 3 Research Model and Hypotheses

Figure 3 presents the research model, and table 3 presents the definitions of constructs in the research model.

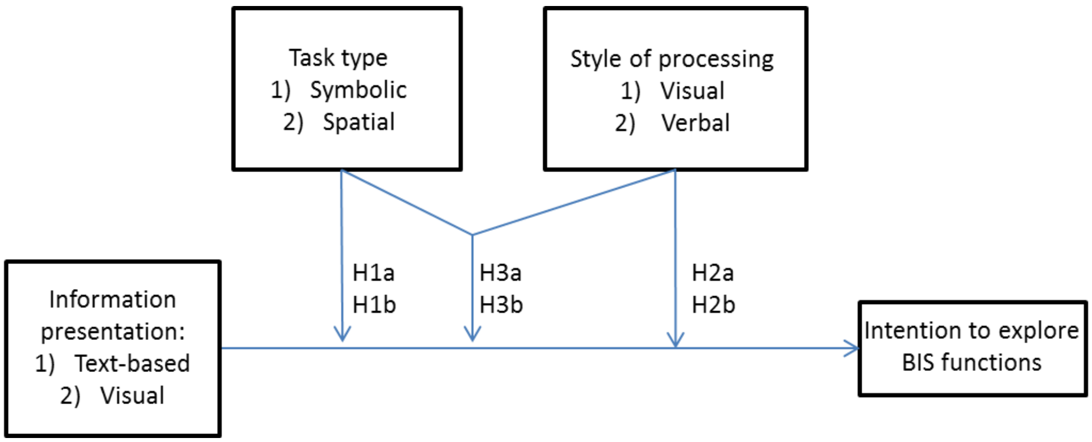


Figure 3 Research model

Table 3 Constructs and definitions		
Construct	**Definition**	**Reference**
Informatio n presentatio n	The information presentation refers to the interface to present data and information, which can be divided into two categories: 1) the text-based information presentation which refers to an interface mainly depicted by text, or numbers, and 2) the visual information presentation which refers to an interface in a graphic manner.	Shneiderman 1998; Speier and Morris 2003
Task type	The task type can be divided into to two categories: 1) the spatial tasks that correspond to those involving acquiring information and making comparisons among alternatives, and 2) the symbolic tasks that correspond to those asking task-doers for specific numeric values.	Vessey 1991

Style of processing	Style of processing refers to the individual's preference to adopt a verbal and/or visual mode of information processing.	Childers et al. 1985
Intention to explore BIS functions	Intention to explore BIS functions refers to a user's motivation and willingness to engage in the exploration of BIS functions to find potential uses in his/her work.	Maruping and Magni forthcoming; Nambisan et al. 1999

3.1 The Interactive Effect of Information Presentation and Task Type

According to cognitive fit theory, task performance is improved if there is a match between the information presentation and the task at hand (Vessey 1991). Text-based information presentation and visual information presentation are two typical formats of BIS interface. The text-based formats feature text and tables that can present information with details, while the visual formats feature graphical presentation or data manipulation functions (Card et al. 1999; McCormick et al. 1987; Speier and Morris 2003). With regard to task type, spatial tasks involve with comparisons among alternatives or information acquisition, whereas symbolic tasks involve with extracting specific numeric values (Vessey 1991; Vessey and Galletta 1991; Dennis and Carte 1998).

When performing symbolic tasks, users need to search for specific values (Vessey 1991; Vessey and Galletta 1991; Dennis and Carte 1998). Since analytical processes focus on the meaning (e.g., numeric values) during the information processing (Dennis and Carte 1998), they are more likely to be adopted to solve the symbolic tasks. As text-based information presentations emphasize information with details (Shneiderman 1998), they match the analytical processes, which can minimize users' effort (Vessey 1991; Vessey and Galletta 1991). Therefore, when users conduct symbolic tasks, their efforts can be saved using text-based information presentation and analytical processes. As users may perceive benefits of saving efforts when employing the text-based information presentation, they may be motivated to participate in the system development (Maruping and Magni forthcoming; Nambisan et al. 1999). Users may consider that the text-based information presentation facilitates their work and thus increases their propensity of exploring the BIS functions (e.g., predictive analysis, competitive analysis, data reports and online analytical processing) (Venkatesh et al. 2008). Therefore, the users' intention to explore BIS functions can be enhanced by the perceived benefits they derive from BIS utilization (Maruping and Magni forthcoming; Nambisan et al. 1999).

Visual information presentations are appropriate for presenting relationships among data sets (Shneiderman 1998; Vessey and Galletta 1991). When performing the symbolic tasks, users often adopt analytical processes to search for specific values (Dennis and Carte 1998). If visual information presentations are employed for analytical decision processes, users should make more efforts to transform the information emphasized in visual presentations (e.g., relationships among data sets) to solve the symbolic tasks. As the user's efforts are increased, they may perceive that the visual information presentations impede their work and thus decrease the willingness to explore the systems (Maruping and Magni forthcoming; Nambisan et al. 1999). The users will be less motivated to explore the new features or functions in the BIS. Therefore, the following hypothesis is proposed:

H1: The information presentation and the task type will interactively affect the users' intention to explore BIS functions, such that

H1a: when conducting symbolic task, users will display higher intention to explore BIS functions for the text-based information presentation than for the visual information presentation.

When performing the spatial tasks, users need to make comparisons among data sets (Vessey 1991; Vessey and Galletta 1991). As perceptual processes emphasize on visual evaluations of magnitudes (e.g., data which is presented as distances between tow points in the display) and analysis of relationships among data sets, users are likely to adopt perceptual processing when conducting spatial tasks (Dennis and Carte 1998). As visual information presentations (e.g., graphical presentations) facilitate presenting the information holistically and comparing data sets in the display (Shneiderman 1998; Vessey and Galletta 1991), users don't need to transform the information of visual presentations to conduct perceptual processing. So users' effort to handle the spatial tasks can be reduced (Dennis and Carte 1998). As users' efforts are reduced, they may evaluate that the visual information presentations facilitate their work, thus increasing the likelihood that they are willing to explore the systems (Maruping and Magni forthcoming; Nambisan et al. 1999; Venkatesh et al. 2008).

Conversely, the text-based information presentation will display detailed information on the computer screen (Shneiderman 1998; Speier and Morris 2003).

Since perceptual processes for spatial tasks emphasize on visual evaluations of magnitudes and analysis of relationships among data sets, users need to transform the information presented in text-based information presentations to facilitate the solutions for spatial tasks (Dennis and Carte 1998). Users need to pay more efforts in the decision-making processes as they need to adjust their mental representation of text-based information presentations so as to handle the tasks. Users are likely to perceive the text-based information presentation as an inhibitor for their work, thus decreasing the probability to explore the systems (Venkatesh et al. 2008). The users' purpose and motivation to explore BIS functions will be decreased as the text-based information presentation may not facilitate their work. Therefore, the H1b is proposed as below:

H1b: when conducting spatial tasks, users will display higher intention to explore BIS functions for the visual information presentation than for the text-based information presentation.

3.2 The Interactive Effect of Information Presentation and Style of Processing

The regulatory compatibility experience is defined as the compatibility of personal characteristics (e.g., level of skills, habitual goal orientation, personal needs or standards) and environmental characteristics (e.g., task demands, task framing, availability of distinct means, salience of specific outcomes or incentives) (Csikszentmihalyi 2000, Keller and Bless 2008). When individuals are engaged in an activity, they feel lower cognitive burden, so they enjoy the experience from the activity and are willing to spend more effort on it (Agarwal and Karahanna 2000;

Deci 1975). In addition, individuals who experience regulatory compatibility are willing to spend additional time on the activity or task (Keller and Bless 2008). In this study, style of processing can be regarded as a personal characteristic on information processing (Childers et al. 1985). The information presentation can be regarded as an environmental characteristic. When there is a fit between the information presentation and style of processing, BIS users will experience a state of regulatory compatibility. Thus, they will display stronger engagement in the tasks, better enjoy the tasks, and spend more time and effort on the tasks (Agarwal and Karahanna 2000; Keller and Bless 2000).

For users who prefer verbal style of processing, they may experience a state of regulatory compatibility with text-based information presentation, as the text-based presentation format fits their preference on information processing (Childers et al. 1985). In this case, they will experience pleasure and are willing to spend more time and effort on the tasks (Agarwal and Karahanna 2000; Keller and Bless 2000). Users may perceive that the BIS is useful and beneficial for them (Agarwal and Karahanna 2000). As the BIS is perceived as beneficial and enjoyable for users, they may be more willing to participate in the system development, and be motivated to explore the BIS functions (Maruping and Magni forthcoming; Nambisan et al. 1999).

However, if users who prefer verbal information processing are provided with visual information presentations, the regulatory incompatibility can emerge, because the preference for verbal information processing does not fit with the visual information presentation (Keller and Bless 2008). This incompatible experience will negatively influence users' feeling toward the BIS. Therefore, users who prefer verbal style of processing are less motivated to conduct explorative behavior using visual information presentations, as they do not enjoy this experience, will not spend more effort on the BIS, and may not experience benefits from the systems (Agarwal and Karahanna 2000; Keller and Bless 2008; Nambisan et al. 1999). Thus, H2a is proposed as below.

H2: The information presentation and the style of processing will interactively affect users' intention to explore BIS functions, such that

H2a: for users who prefer verbal style of processing, they will display higher intention to explore BIS functions for the text-based information presentation than for the visual information presentation.

For users who prefer visual style of processing, they may experience a state of regulatory compatibility with visual information presentation, as the visual presentation format fits their preference on information processing (Childers et al. 1985). In this case, they will experience pleasure and are willing to spend more time and effort on the tasks (Agarwal and Karahanna 2000; Keller and Bless 2000). Users may perceive that the BIS is useful and beneficial for them (Agarwal and Karahanna 2000). As the BIS is perceived as beneficial and enjoyable for users, they may be more willing to participate in the system development, and be motivated to explore the BIS functions (Maruping and Magni forthcoming; Nambisan et al. 1999).

However, if users who prefer visual style of processing are provided with text-based information presentations, the regulatory incompatibility may emerge, because the preference for visual information processing does not fit with the text-based information presentation (Keller and Bless 2008). This incompatible experience will negatively influence users' feeling toward the BIS. Therefore, users who prefer visual style of processing are less motivated to conduct explorative behavior using text-based information presentations, as they do not enjoy this experience, will not spend more effort on the BIS, and may not experience benefits from the systems (Agarwal and Karahanna 2000; Keller and Bless 2008; Nambisan et al. 1999). Thus, H2b is proposed as below.

H2b: for users who prefer visual style of processing, they will display higher intention to explore BIS functions for the visual information presentation than for the text-based information presentation.

3.3 The 3-way Interactive Effect of Information Presentation, Task Type and Style of Processing

When the 3-way interactive effect of information presentation, task type and style of processing on users' intention explore BIS functions is taken into account, the users' intention to explore may be enhanced to the largest extent. To predict this 3-way interactive influence, four scenarios are summarized in table 4: 1) in Scenario1 users prefer verbal style of processing and conduct symbolic tasks, 2) in Scenario 2 users prefer visual style of processing and perform symbolic tasks,

3) in Scenario 3 users prefer verbal style of processing and conduct spatial tasks, 4) in Scenario 4 users prefer visual style of processing and conduct spatial tasks. These four scenarios are discussed with regard to text-based information presentations and visual information presentations respectively.

Table 4 The congruence between task type and style of processing

	Verbal style of processing	**Visual style of processing**
Symbolic task	Scenario 1: users prefer verbal style of processing and conduct symbolic tasks	Scenario 2: users prefer visual style of processing and conduct symbolic tasks.
Spatial task	Scenario 3: users prefer verbal style of processing and perform spatial tasks	Scenario 4: users prefer visual style of processing and perform spatial tasks

Text-based information presentation-Scenario 1: When users conduct symbolic tasks using text-based information presentations, they will experience cognitive fit between the information emphasized in presentation formats and the symbolic tasks (Vessey 1991). Users can employ analytical processes which match the text-based formats to save their efforts to perform symbolic tasks (Dennis and Carte 1998). Thus, their effort to solve the tasks can be retained (Dennis and Carte 1998). Meanwhile, users who prefer verbal style of processing can experience regulatory compatibility with the text-based representation, and thus better enjoy the text-based information presentation (Keller and Bless 2008). These perceived benefits, including experiencing regulatory compatibility and saving efforts, may facilitate the users' motivation to explore the systems (Maruping and Magni forthcoming; Nambison et al. 1999). Therefore, users in Scenario 1 will display higher intention to explore BIS functions using text-based information presentations, as compared to users in the following three scenarios.

Text-based information presentation-Scenario 2: When users who prefer visual style of processing use text-based information presentations, they will experience regulatory incompatibility, and thus do not enjoy this information presentation, and are not willing to spend more time and effort on it (Keller and Bless 2008). This may negatively influence the user's assessment of the text-based information presentations and the systems. Therefore, users are less motivated to explore BIS functions, as their perceived benefits from the BIS are reduced by the regulatory incompatibility (Maruping and Magni forthcoming; Nambisan et al. 1999). Therefore, users in scenario 2 will display lower intention to explore BIS functions as compared to those in scenario 1 when using text-based information presentations.

Text-based information presentations-Scenario 3: When users conduct spatial tasks with text-based information presentations, a mismatch between the information format and the task occurs (Vessey 1991). Users need to pay more efforts in decision-making processes as they need to adjust their mental representation to accommodate the mismatch (Vessey 1991; Hong et al. 2004), that is, they should transform the information emphasized in text-based presentations to match the information needed for handling spatial tasks (Dennis and Carte 1998). Therefore, users' perceived benefits from BIS may be reduced due to the mismatch between presentations and tasks, thus decreasing the users' probability to explore

BIS functions (Nambison et al. 1999; Venkatesh et al. 2008). Therefore, in Scenario 3, users may display lower intention to explore BIS functions as compared to those in scenario 1.

Text-based information presentation-Scenario 4: When users conduct spatial tasks with text-based presentation formats, they will consume more efforts, as they should transform the information emphasized in text-based presentations to facilitate the solutions for spatial tasks (Dennis and Carte 1998). Meanwhile, users who prefer visual style of processing will experience regulatory incompatibility with the text-based presentations (Keller and Bless 2008). Users' perceived benefits from BIS will be decreased due to the regulatory incompatibility they experience and the increasing efforts they have to pay. Therefore, in scenario 4, users will display lower intention to explore BIS functions as compared to those in scenario 1, when text-based information presentation is used.

According to the above justifications, when using text-based information presentations, users in Scenario 1 will display higher intention to explore than users in other scenarios. Therefore, Hypothesis 3a is proposed as below:

H3a: For text-based information presentations, the highest intention to explore BIS functions will be shown for users who prefer verbal style of processing and conduct symbolic tasks, as compared to (1) users who prefer verbal style of processing and conduct spatial tasks, (2) users who prefer visual style of processing and conduct spatial tasks, and (3) users who prefer visual style of processing and conduct symbolic tasks.

For hypothesis 3b, scenario 4 is firstly discussed, as when visual information presentation is provided, users in scenario 4 are predicted to display higher intention to explore BIS functions as compared to other three scenarios.

Visual information presentation-Scenario 4: When users conduct spatial tasks with visual information presentations, their efforts can be minimized, since they can experience cognitive fit between visual information presentations and spatial tasks (Dennis and Carte 1998; Vessey 1991). Meanwhile, users who prefer visual style of processing may experience regulatory compatibility using the visual information presentations (Keller and Bless 2008). Therefore, users in scenario 4 have strong tendency to appreciate the benefits of saving efforts, and this tendency can be further strengthened by the regulatory compatibility between visual presentations and users' visual style of processing (Keller and Bless 2008). As these perceived benefits may promote users' evaluation of visual presentations, users in scenario 4 may be more willing to explore BIS functions (Nambisan et al. 1999), as compared to users in the following three scenarios.

Visual information presentation-Scenario 2: When users conduct symbolic tasks with visual information presentations, their efforts will increase, as they should transform the information emphasized in visual presentations to fit the information that facilitate the symbolic tasks (Dennis and Carte 1998). As their efforts to perform the tasks increase, users can devalue the importance of BIS, thus decreasing their willingness to explore BIS functions (Nambisan et al. 1999). Thus, users in scenario 2 will demonstrate lower intention to explore BIS functions as compared to those in scenario 4 when using visual information presentations.

Visual information presentation-Scenario 3: When users who prefer verbal style of processing employ visual presentations to perform the tasks, they will experience regulatory incompatibility between visual information presentation and verbal style of processing (Keller and Bless 2008). This incompatibility can reduce users' enjoyment on the information presentation and their willingness to spend more time and effort on it (Agarwal and Karahanna 2000). Users are less motivated to explore BIS functions (Maruping and Magni forthcoming; Nambisan et al. 1999) due to the regulatory incompatibility they experience (Keller and Bless 2008). Therefore, users in scenario 3 will display lower intention to explore BIS functions as compared to those in scenario 4 when using visual information presentations.

Visual information presentation-Scenario 1: When users conduct symbolic tasks with visual presentations, they can experience the mismatch between the information presentations and tasks (Vessey 1991). Users should transform the information emphasized in visual interface so as to facilitate the solutions of symbolic tasks, and thus they consume more efforts to handle the symbolic tasks with visual information presentation. Therefore, their willingness to explore the systems may be reduced (Nambisan et al. 1999). In addition, users who prefer verbal style of processing can experience regulatory incompatibility between verbal style of processing and visual information presentation (Keller and Bless 2008). Users' intention to explore BIS functions may be further reduced because of the regulatory incompatibility they experience (Maruping and Magni forthcoming; Nambisan et al. 1999). Therefore users in scenario 1 will display lower intention to explore as compared to those in scenario 4 when using visual information presentations.

According to the above justifications, users in scenario 4 will display higher intention to explore BIS functions as compared to users in other three scenarios when using visual information presentations. Therefore, Hypothesis 3b is proposed as follows:

H3b: For visual information presentations, the highest intention to explore BIS functions will be shown for users who prefer visual style of processing and conduct spatial tasks, as compared to (1) users who prefer visual style of processing and conduct symbolic tasks, (2) users who prefer verbal style of processing and conduct spatial tasks, and (3) users who prefer verbal style of processing and conduct symbolic tasks.

Chapter 4 Methodology

A 2 x 2 lab experiment were conducted to examine the hypotheses. The two factors were information presentation (text-based vs. visual, between subjects) and task type (spatial vs. symbolic, between subjects). A total of 472 undergraduate students of one university in Hong Kong were recruited as the participants. The incentives for the participants were McDonalds coupons (worth 30 Hong Kong dollar).

4.1 Information presentation: Text-based vs. Visual

The visual and text-based information presentations used in the experiment are shown in Figure 4 and Figure 5 respectively. As illustrated in Figure 4, the information presentation uses the graph to display a report of sales growth rate of product A and product B, and is categorized as a visual information presentation (Sheiderman 1998; Speier and Morris 2003). Figure 5 shows the information presentation which uses a table to display the information. As the presentation in Figure 4 emphasizes data sets with specific values, it is categorized as a text-based information presentation (Sheiderman 1998; Speier and Morris 2003).

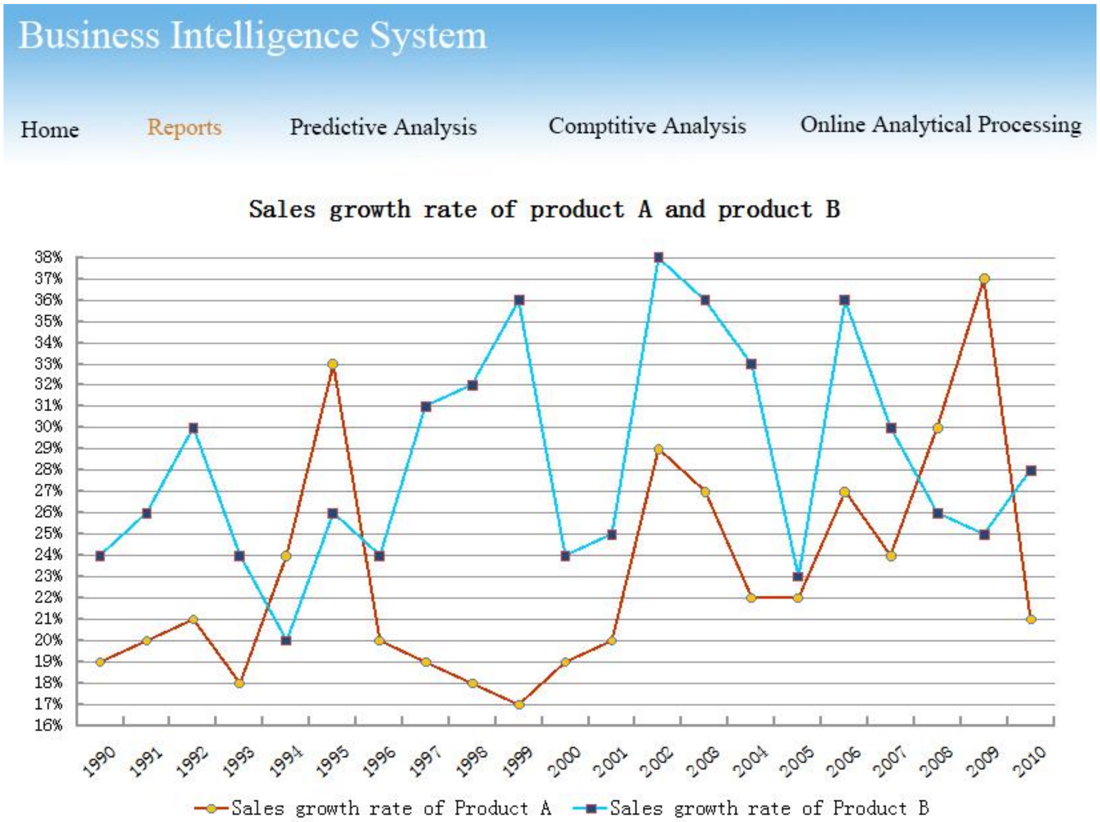
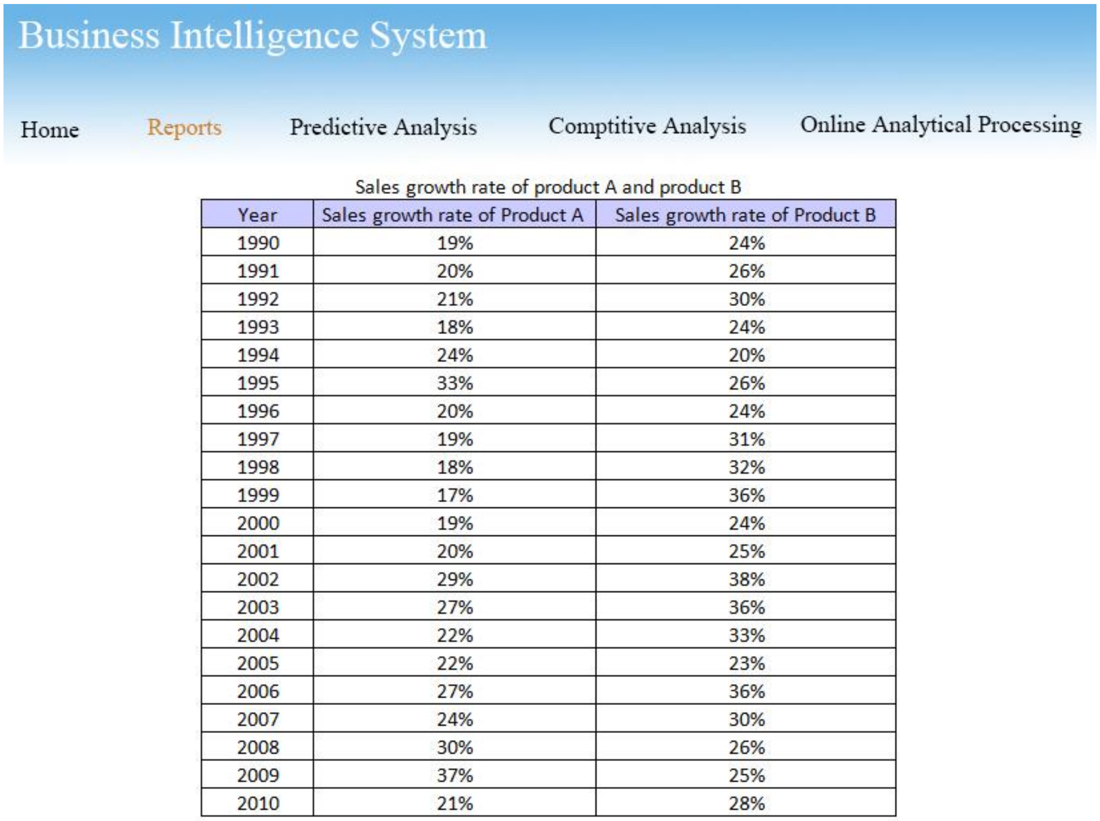


Figure 4. Visual information presentation



Sales growth rate of product A and product B

Year	Sales growth rate of Product A	Sales growth rate of Product B
1990	19%	24%
1991	20%	26%
1992	21%	30%
1993	18%	24%
1994	24%	20%
1995	33%	26%
1996	20%	24%
1997	19%	31%
1998	18%	32%
1999	17%	36%
2000	19%	24%
2001	20%	25%
2002	29%	38%
2003	27%	36%
2004	22%	33%
2005	22%	23%
2006	27%	36%
2007	24%	30%
2008	30%	26%
2009	37%	25%
2010	21%	28%

Figure 5. Text-based information presentation

4.2 Task type

The task type is determined by the information needed to facilitate the solutions for the task (Vessey 1991; Vessey and Galletta 1991). The symbolic task focuses on extracting specific numeric values (Vessey 1991; Vessey and Galletta 1991), therefore this study sets the symbolic tasks as follows (see table 5):

Table 5 Symbolic tasks
1. What was the sales growth rate of product A in the year of 1996?
2. What was the sales growth rate of product B in the year of 2007?
3. What was the sales growth rate of product A in the year of 2002?
4. What was the sales growth rate of product B in the year of 1995?

The spatial task focuses on analyzing the relationship among data sets (e.g., data comparison) (Vessey 1991; Vessey and Galletta 1991), thus this study sets the spatial tasks as follows (see table 6):

Table 6 Spatial tasks
1. Please compare the sales growth rate of Product A and that of Product B. In which year was their difference the greatest?
2. Please compare the sales growth rate of Product A and that of Product B. In which year was their difference the smallest?
3. In which year did product A have the greatest growth rate?
4. In which year did product B have the smallest growth rate?

4.3 Measurement

Style of Processing: The instruments of style of processing were adapted from the existing measures developed by Childers et al. (1985). The style of processing is a 22-item scale, and the items were scored from 1 (always true) to 4 (always false). Eleven items reflect a visual processing style, and the other eleven items reflect a verbal processing style. The scale can be broken down into two components by summing and comparing item scores within components (Childers et al. 1985).

Intention to explore BIS functions: The instruments to measure intention to explore BIS functions were adapted from Maruping and Magni (forthcoming) and Nambisan et al. (1999), and the 7 Point Likert Scale (strongly disagree / strongly agree) was employed.

Personal innovativeness of IT: The instruments to measure personal innovativeness of IT were adapted from Agarwal and Prasad (1998), and the 7 Point Likert Scale (strongly disagree / strongly agree) was employed. Personal innovativeness of IT (PIIT) serves as a control variable, since it can influence users' explorative or innovative usage behavior (Li et al. 2013).

Perceived usefulness of BIS and *Perceived ease of use:* These two variables were both included as control variables, since the technology acceptance model proposes that the individual's belief on information system in terms of usefulness and ease of use can both influence his/her intention to use (Davis 1985, 1989). For both perceived usefulness of BIS and perceived ease of use of BIS, the measures were adapted from Davis (1989), and the 7 Point Likert Scale (strongly disagree / strongly agree) was employed.

Cognitive decision effort: The instruments to measure cognitive decision effort were adapted from (Hong et al. 2004), and the 7 Point Likert Scale (strongly disagree / strongly agree) was employed. Cognitive decision effort is an indicator of user-friendly design of information presentation, and may influence usage intention of technology (Hong et al. 2004). So cognitive decision effort was included as a control variable.

The users' demographics, including gender, age, familiarity of spreadsheet, familiarity of statistical software, familiarity of data management system, and data analysis experience, were also measured to evaluate whether these individual differences affected the users' intention to explore BIS functions. The detailed measurement can be seen in table 7.

Table 7 Measurements		
Construct	**Source**	**Measurement**
Style of Processing	Childers et al. 1985	1. I enjoy doing work that requires the use of words. 2. There are some special times in my life that I like to relieve by mentally "picturing" just how everything looked. 3. I can find the right word when I need it. 4. I do a lot of reading. 5. When I'm trying to learn something new, I'd rather watch a demonstration than read how to do it. 6. I think I often use words in the right way. 7. I enjoy learning new words. 8. I like to picture how I could fix up my apartment or room if I could buy anything I wanted. 9. I often make written notes to myself. 10. I like to daydream. 11. I generally prefer to use a diagram rather than a written set of instructions. 12. I like to doodle (unfocused or unconscious drawings). 13. I find it helps to think in terms of mental pictures when doing many things. 14. After I meet someone for the first time, I can usually remember what they look like, but not much about them. 15. I like to think of synonyms for words. 16. When I have forgotten something I frequently try to form a mental "picture" to remember it. 17. I like learning new words. 18. I prefer to read instructions about how to do something rather than have someone show me. 19. I prefer activities that require a lot of reading. 20. I often daydream.

		21. I spend much time trying to increase my vocabulary. 22. My thinking often consists of mental "pictures" or images. Note: Items 1, 3, 4, 6, 7, 9, 15, 17, 18, 19, and 21 compose the verbal component. Items2, 5, 8, 10 through 14, 16, 20, and 22 compose the visual component. The items are scored from 1 (always true) to 4 (always false).
Intention to explore BIS functions	Maruping and Magni forthcoming ; Nambisan et al. 1999	Assuming that I work in a company which has implemented the BIS… 1. I intend to explore how BIS functions (e.g., reports, predictive analysis, competitive analysis etc.) can be used in my work tasks. 2. I intend to explore other ways that BIS functions may enhance the effectiveness of my work. 3. I intend to spend time and effort in exploring BIS functions for potential applications in my work. 7 Point Likert Scale Strongly (Disagree / Agree)
Personal innovativeness of IT	Agarwal and Prasad 1998	1. If I heard about a new information technology, I would look for ways to experiment with it. 2. Among my peers, I am usually the first to try out new information technologies. 3. I like to experiment with new information technologies. 4. In general, I am hesitant to try out new information technologies. 7 Point Likert Scale Strongly (Disagree / Agree)
Perceived usefulness of BIS	Davis 1989	1. Using the BIS allows me to accomplish my work quickly. 2. Using the BIS allows me to improve my work performance. 3. Overall, I find the BIS useful for accomplishing my work. 7 Point Likert Scale Strongly (Disagree / Agree)

Perceived ease of use	Davis 1989	1. Interacting with the BIS does not require a lot of mental effort. 2. I believe it is easy to get the BIS to do what I want it to do. 3. Overall, I believe the BIS is easy to use. 7 Point Likert Scale Strongly (Disagree / Agree)
Cognitive decision effort	Hong et al. 2004	1. It is frustrating to use the BIS to complete the task. 2. It takes much time to use the BIS to complete the task. 3. It takes much effort to use the BIS to complete the task. 4. It is complex to use the BIS to complete the task. 5. I can hardly find the information I look for. 6. It is difficult to use the BIS to complete the task. 7 Point Likert Scale Strongly (Disagree / Agree)
Demographics	N/A	Gender, Age, Familiarity of spreadsheet, Familiarity of statistical software, Familiarity of data management system, Data analysis experience

4.4 Experimental Procedure

The experiment was conducted in a computer lab with ten seats. Because of the room-size limitation, the experiment was divided into multiple sessions. Each session was administrated by the same experimenters, and followed the standardized protocol. The experiment procedure was performed as follows, as illustrated in Figure 6.

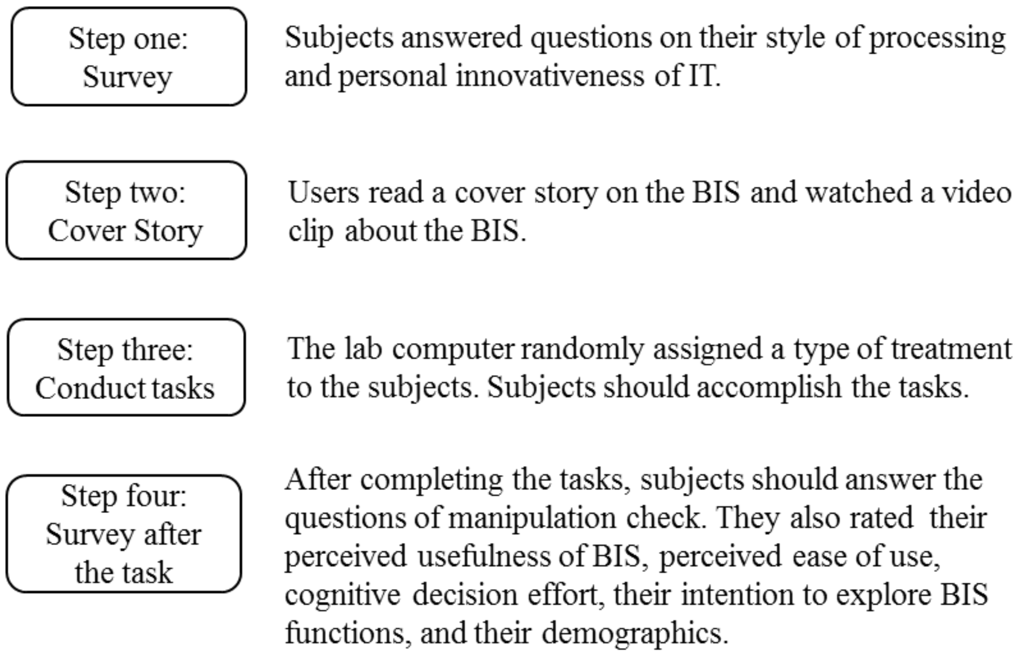


Figure 6. Experimental procedure

Step 1: Subjects conducted a survey on lab computers to rate their style of processing, personal innovativeness of IT.

*Ste*p 2: A cover story was provided for the subjects. A good cover story can set an experimental context that makes sense to subjects, strengthen the influence of experimental manipulation, and offer rational for data collection (Harmon-Jones et al. 2007). Therefore, this study sets the cover story as follows: Business intelligence system (BIS in short) is an information system that can store, analyze, and format information for users; Nowadays many companies adopt BIS to increase their competitive advantage; Supposing that you are market analysts in a company, one of your job responsibilities is analyzing data from BIS system. Now you will experience one BIS interface of this company. As the BIS interface is unique for the subjects, novelty effect which means that a treatment (e.g., the BIS interface) may or may not work because of its uniqueness needs to be considered in this experiment (Bracht and Glass 1968). Thus, a video clip was briefly displayed to introduce the BIS interface (e.g., meaning of the system menus, general description of the table or figure in the BIS interface) to alleviate the novelty effect, if any. The subjects watched a video clip which introduced the functions of BIS, including reporting, predictive analysis, competitive analysis, and online predictive analysis. Therefore, subjects had a preliminary understanding of the essential functions of BIS when performing the tasks.

Step 3: The lab computer randomly assigned a type of treatment to the subjects according to the grouping and treatment illustrated in Table 8. Randomization of treatment assignments serves to control for possible confounding effects. This experiment ensured that a similar number of subjects were assigned to each treatment. Subjects should accomplish their tasks.

Table 8 Grouping and treatments for subjects

	Symbolic task	Spatial task
Text-based presentation	Treatment 1: subjects used text-based presentation and performed symbolic task.	Treatment 2: subjects used text-based information presentation and performed spatial task.
Visual presentation	Treatment 3: subjects used visual presentation and performed symbolic task.	Treatment 4: subjects used visual presentation and performed spatial task.

Step 4: After completing the task, the subjects answered the questions of manipulation check on information presentation and task type. They also evaluated their perceived usefulness of BIS, perceived ease of use, cognitive decision effort, intention to explore BIS function, and demographics (e.g., gender, age, familiarity of spreadsheet, familiarity of statistical software, familiarity of data management

system, and data analysis experience). Finally, subjects leaved with McDonald's coupons.

4.5 Manipulation Check

Subjects answered a question about the category of the information presentation (text-based or visual) after viewing the information presentation. If subjects could not recognize category of the interface correctly, their data should be deleted from further analysis. For instance, if a subject was provided with a text-based presentation but identified it as a visual presentation, his/her data should be excluded. Subjects also answered a question to identify the task type. If subjects could not recognize the task type correctly, their data should also be deleted.

4.6 Data Analysis Method

This study used analysis of covariance (ANCOVA) and multivariate analysis of covariance (MANCOVA) to analyze the effect of information presentation, style of processing, and task complexity on users' intention to explore. ANCOVA is a general liner model that combines analysis of variance (ANOVA) and regression analysis (Howell 2012). ANCOVA can assess whether the means of a dependent variable are equal across different treatment groups, while covariates, variables that are not of primary interest, are controlled.

Figure 7 the procedure

there are significant differences among group means (French et al. 2002). It can assess more than one dependent variables and control the covariates at the same time. The advantage of MANCOVA and ANCOVA over the simple multivariate analysis of variance (MANOVA) and ANOVA is that MANCOVA and ANCOVA can remove the noise or error that could be introduced by covariates (Rutherford 2001).

This study also used structural equation modeling (SEM) to test how perceived usefulness of BIS and perceived ease of use affected intention to explore BIS functions. SEM is a general and powerful multivariate technique for identifying causal relations and conducting path analysis (Bollen 1998). SEM consists of two components: the measurement model and the structural model. The measurement model describes the relationship between observed variables and latent variables. Confirmatory factor analysis (CFA) is used to examine whether the data matches the hypothesized measurement model (Kline 2011). The structural model identifies the association among latent constructs (Bollen 1998). In particular, this study performed descriptive statistical analysis of the variables in the research model. This study also verified the reliability and validity of the measurement model, and examined the structure model.

Chapter 5 Results

5.1 Sample Description

A total of 472 subjects were recruited from a university in Hong Kong and randomly assigned to one of the four treatments. In order to test the 2-way interaction (information presentation * task type and information presentation * style of processing) and the 3-way interaction (information presentation * task type * style of processing) effects on the intention to explore BIS functions, the subjects were divided into 8 cells in the data analysis stage based on their information presentation (text-based vs. visual), task type (symbolic vs. spatial) and style of processing (verbal vs. visual).

To distinguish the verbal style subjects from the visual style subjects, following Gelman and Park (2008), I trichotomized the continuous variable 'style of processing' into a dichotomous variable (verbal vs. visual) (Gelman and Park 2008). Trichotomizing means splitting a variable at the upper third and the lower third, and this approach can save about half the efficiency lost by the commonly used approach of median split (Gelman and Park 2008). The procedure of turning style of processing into a dichotomous variable was as follows. Firstly, the subjects were sorted according to their scores on style of processing, which could be computed in the following way: the sum of visual item scores minus the sum of verbal item scores (e.g., Childers et al. 1985; Darley 1999). Then I ranked the style of processing and categorized it into three levels (high, middle, low) according to the subjects' scores. In particular, the subjects scoring at the high level were labeled as people preferring visual style of processing, the subjects scoring at the low level were labeled as people preferring verbal style of processing, and the subjects scoring at the middle level were dropped. By this approach, a total of 156 data cases were deleted, and data from 316 subjects were retained.

I also deleted the data of 19 subjects who failed to answer the questions of manipulation check. Thus, data from a total of 297 subjects were further analyzed. The number of subjects in each cell is presented in table 9. According to the power analysis for this between-subject design, 32 subjects are needed for each cell. To achieve the statistical power of 0.8 for a medium effect size (f = 0.25), the total number of subjects should be at least 256 (Cohen 1988). Therefore, the sample size of 297 is appropriate for this study.

Table 9. Number of subjects in each cell

Cell	Information presentation		Task type		Style of processing		Number of subjects
	Text-based	Visual	Symbolic	Spatial	Verbal	Visual	
1	√		√		√		33
2	√		√			√	37
3	√			√	√		38
4	√			√		√	37
5		√	√		√		37
6		√	√			√	38
7		√		√	√		40
8		√		√		√	37

The demographic profile of subjects is presented in table 10. Among the subjects, 97 (32.7 percent) were male and 200 (67.3 percent) were female. The average age of the participants was 21.45. More than half of the subjects had data analysis experience. In general, the subjects were familiar with spreadsheets (e.g., Excel) (mean: 4.84/7). However, they were not quite familiar with statistical software (e.g., SPSS, SAS) (mean: 2.37/7) and data management systems (e.g., Access) (mean: 2.80/7). Table 11 summarizes the means, standard deviations, correlations of all variables used in this study, and the square root of average variance extracted (AVE). The correlation between task performance and other variables was not calculated, since subjects didn't know their performance (e.g., whether their answers were correct) of the tasks during the experiment.

Table 10. Demographic Profiles of the Subjects

Variable	Category	Percentage
Gender	Male	32.70%
	Female	67.30%
Data analysis experience	Yes	52.20%
	No	47.80%
	Mean	S.D.
Age	21.45	2.42
Familiarity of spreadsheets	4.84	1.32
Familiarity of statistical software	2.37	1.56
Familiarity of data management systems	2.80	1.76

Table 11. Means, standard deviations, correlations, and square root of AVE														
	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
1. ITEBF	4.48	1.32	0.94											
2. PIIT	4.85	1.08	0.15**	0.84										
3. Gender	1.67	0.47	-0.02	-0.26**	-									
4. Age	21.45	2.42	-0.01	0.00	-0.02	-								
5. FS	4.84	1.32	0.07	0.32**	-0.11*	0.08	-							
6. FSS	2.37	1.56	0.03	0.09*	-0.07	0.20**	0.24**	-						
7. FDMS	2.80	1.76	0.04	0.24**	-0.20**	0.06	0.37**	0.36**	-					
8. DAE	1.48	0.50	0.00	-0.08	0.02	-0.15**	-0.15**	-0.31**	-0.19**	-				
9. PU	4.55	1.52	0.55**	0.08	0.03	-0.02	-0.04	0.02	-0.03	-0.02	0.96			
10. PCE	3.72	1.44	-0.25**	-0.01	-0.02	0.03	0.03	-0.00	0.00	0.00	-0.45**	0.93		
11. PEOU	4.60	1.45	0.50**	0.12**	0.03	-0.03	-0.01	0.02	0.01	0.02	0.68**	-0.42**	0.92	
12. TT	79.83	36.06	-0.09*	-0.01	0.02	0.09*	0.01	-0.02	0.01	-0.04	-0.20**	0.18**	-0.21**	-
13. TP	3.29	1.09	-	-	-	-	-	-	-	-	-	-	-	-

Note:

1) ITEBF: intention to explore BIS functions,
PIIT: perceived innovativeness of information technology,
FS: familiarity with spreadsheets,
FSS: familiarity with statistical software,
FDMS: familiarity with data management systems,
DAE: data analysis experience,
PU: perceived usefulness,
PCE: perceived cognitive effort,
PEOU: perceived ease of use,
TP: task performance,
TT: task time.

2) * : $p < 0.05$, ** : $p < 0.01$.

3) The diagonal represents the square root of AVE.

5.2 Measurement Model Testing

The measures of multi-item constructs, including the intention to explore BIS functions, personal innovativeness of IT, perceived usefulness of BIS, perceived ease of use and cognitive decision effort, were examined in this part. Data in table 12 showed that the measurement model obtained acceptable internal consistency, since both Cronbach's alpha and composite reliability surpassed the threshold of 0.707, and that the measurement model satisfied the requirement of convergent validity, since all AVEs exceeded the threshold of 0.5 (Hair et al. 2006). The measurement model also achieved acceptable discriminant validity, since the square roots of AVEs exceeded all correlation coefficients (John and Benet-Martinez 2000), as can be seen in table 11. Additionally, the confirmatory factor analysis (CFA) results showed that the measurement model achieved good model fit (χ^2/d.f. = 2.39, $p < 0.001$, CFI = 0.973, SRMR=0.0347, RMSEA=0.069). The above results collectively suggests appropriate measurement properties.

Table 12. Cronbach's alpha, composite reliability and AVE

Constructs	Cronbach's alpha	Composite reliability	AVE
Intention to explore BIS functions	0.97	0.96	0.89
Perceived innovativeness of IT	0.898	0.90	0.71
Perceived usefulness of BIS	0.97	0.97	0.92
Perceived ease of use	0.95	0.94	0.85
Perceived cognitive effort	0.98	0.98	0.87

5.3 Hypotheses Testing

The hypotheses were firstly tested using ANCOVA to capture any between-subject differences on the intention to explore BIS functions. The detailed procedures of ANCOVA analysis are as follows. Firstly, the univariate general linear model was used to conduct the analysis. The intention to explore BIS functions was chosen as the dependent variable. Secondly, information presentation, task type, and style of processing were selected as independent variables. Perceived innovativeness of IT, perceived usefulness of BIS, perceived ease of use, perceived cognitive effort, task time and demographic profiles were selected as control variables. Thirdly, the model was specified to test the 2-way interaction of information presentation and task type, the 2-way interaction of information presentation and style of processing, the 3-way interaction of information presentation, task type, and style of processing, and the main effects of all independent variables and control variables. To be comprehensive, I also tested the 2-way interaction of information presentation in this process. Table 13 presents the ANCOVA result on the intention to explore BIS functions.

Table 13. ANCOVA result of intention to explore BIS functions

Source	F(d.f. = 1)	Sig.	Hypotheses
Information presentation * Task type	0.201	0.654	H1a: Not supported. H1b: Not supported.
Information presentation * Style of processing	0.132	0.717	H2a: Not supported. H2b: Not supported.
Task type * Style of processing	0.000	0.990	N/A
Information presentation * Task type * Style of processing	2.403	0.122	H3a: Not supported. H3b: Not supported.
Information presentation	13.952	**0.000**	N/A

Task type	0.368	0.545	N/A
Style of processing	0.924	0.337	N/A
Perceived innovativeness of IT	2.708	0.101	N/A
Gender	0.619	0.432	N/A
Age	0.086	0.769	N/A
Familiarity of spreadsheets	3.638	0.057	N/A
Familiarity of statistical software	0.048	0.827	N/A
Familiarity of data management systems	0.037	0.847	N/A
Data analysis experience	1.437	0.232	N/A
Perceived usefulness	35.797	**0.000**	N/A
Cognitive decision effort	0.458	0.499	N/A
Perceived ease of use	4.283	**0.039**	N/A

Data shown in table 13 indicated that the 2-way interaction effect of information presentation and task type on users' intention to explore BIS functions was insignificant (Sig. > 0.05). Thus, H1a and H1b were not supported. The 2-way interaction effect of information presentation and style of processing on intention to explore was insignificant as well (Sig. > 0.05). Thus, H2a and H2b were also not supported. In addition, the 3-way interaction effect of information presentation, task type, and style of processing on intention to explore was insignificant (Sig. > 0.05). Therefore, H3a and H3b were also not supported.

Interestingly, results in table 13 showed that the information presentation significantly affected the users' intention to explore BIS functions (Sig. < 0.05). So I further examined the main effect of information presentation on intention to explore. The results of an independent-samples T-Test showed that the means of intention to explore BIS functions were significantly different with regard to different types of information presentations (Sig. < 0.05) (see table 14). In particular, users displayed a higher intention to explore BIS functions when employing visual information presentation, as compared to the text-based information presentation.

Table 14. T-Test for intention to explore regarding different information presentations						
Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Text-based information presentation	Visual information presentation	-0.727	0.147	**0.000**	-1.017	-0.438

Results in table 13 also showed that perceived usefulness of BIS and perceived ease of use both significantly affected the users' intention to explore BIS functions (Sig. < 0.05). Since prior studies suggest that perceived usefulness and perceived ease of use can serve as mediators that channel the influence of external factors on users' usage intentions (e.g., Jiang and Benbasat 2007; Venkatesh and Davis 2000), I suspect that perceived usefulness and perceived ease of use may mediate the above-mentioned 2-way and 3-way interaction effect on intention to explore. To better investigate the potential mediations, I conducted a series of post-hoc analyses in the following part.

5.4 Post-Hoc Analysis

5.4.1 Test for Potential Mediators

I adopted the approach by Baron and Kenny's (1986) to test the potential mediators. To establish mediation relationship, the conditions include the following: Frist, the independent variable (e.g., the 2-way interaction of information presentation and task type, the 2-way interaction of information presentation and style of processing, and the 3-way interaction of information presentation, task type, and style of processing tested in this study) should significantly influence the dependent variable (e.g., the intention to explore BIS functions) without the presence of the mediator; second, the independent variable should significantly affect the mediator (e.g., perceived usefulness of BIS and perceived ease of use); finally, when including both the independent variable and the mediator, the mediator should significantly affect the dependent variable, and the significant relationship between the independent variable and the dependent variable should be weakened after controlling for the mediators (Baron and Kenny 1986) .

According to the above criteria, an ANCOVA test was firstly conducted to test the 2-way and 3-way interactions on the intention to explore without controlling for perceived usefulness and perceived ease of use. Results in Table 15 showed that the 2-way interaction effect of information presentation and task type and the 3-way interaction effect of information presentation, task type and style of processing on the intention to explore were all significant (Sig. $<$ 0.05). This satisfied the first criterion to establish mediation effects. Then a MANCOVA test was performed to examine the interactive effects on perceived ease of use and perceived usefulness. Results in table 16 showed that the 2-way interaction effect of information presentation and task type had significant influence on perceived ease of use and perceived usefulness (Sig. $<$ 0.05), and that the 3-way interaction effect of information presentation, task type and style of processing significantly affected perceived usefulness (Sig. $<$ 0.05). So the second criterion was also satisfied. Additionally, results in table 13 showed that perceived ease of use and perceived usefulness significantly affected the intention to explore BIS functions. Results in table 13 also showed that when perceived ease of use and perceived usefulness were included as control variables, the 2-way interaction effect of information presentation and task type, and the 3-way interaction effect became insignificant. Thus, the third criterion was also satisfied. In short, the above results collectively suggest that (1) perceived usefulness and perceived ease of use fully mediate the 2-way interactive effect of information presentation and task type on the intention to explore BIS functions and that (2) perceived usefulness fully mediates the 3-way interactive effect on the intention to explore BIS functions.

Given the salient direct effect of information presentation on intension to explore shown in Table 13, I also tested whether perceived usefulness and perceived ease of use mediate the relationship between information presentation and intention to explore. Firstly, the information presentation exerted significant effect on intention to explore BIS functions (see table 15) (Sig. $<$ 0.05) without the control of perceived usefulness and perceived ease of use, so the first criterion was satisfied. Secondly, the information presentation significantly influenced perceived usefulness and perceived ease of use (Sig. $<$ 0.05) (see table 16), fulfilling the second criterion. Finally, perceived usefulness and perceived ease of use significantly affected intention to explore (Sig. $<$ 0.05) (see table 13), and the relationship between information presentation and intention to explore was weakened after controlling for perceived usefulness and perceived ease of use, since the F value were reduced from 27.943 to 13.952. Thus, the third criterion was satisfied. These results collectively suggest that perceived usefulness and perceived ease of use partially mediated the relationship between information presentation and intention to explore BIS functions.

Table 15. ANCOVA result of intention to explore BIS functions without controlling for perceived usefulness and perceived ease of use

Source	F (d.f. = 1)	Sig.
Information presentation * Task type	13.630	**0.000**
Information presentation * Style of processing	0.183	0.669
Task type * Style of processing	0.066	0.798
Information presentation * Task Type * Style of Processing	5.797	**0.017**
Information presentation	27.943	**0.000**
Task type	0.415	0.520
Style of processing	0.560	0.455
Perceived innovativeness of IT	9.166	**0.003**
Gender	2.560	0.111
Age	0.000	0.986
Familiarity of spreadsheets	1.267	0.261

Familiarity of statistical software	0.000	0.983
Familiarity of data management systems	0.004	0.950
Data analysis experience	0.565	0.453
Cognitive decision effort	20.213	**0.000**

Table 16. MACOVA result of perceived ease of use (PEOU) and perceived usefulness (PU)

Source	Dependent variable	F (d.f. = 1)	Sig.
Information presentation * Task type	PEOU	41.816	**0.000**
	PU	44.042	**0.000**
Information presentation * Style of processing	PEOU	3.794	0.052
	PU	0.846	0.358
Task type * Style of processing	PEOU	1.075	0.301
	PU	0.103	0.749
Information presentation * Task type * Style of processing	PEOU	0.632	0.427
	PU	4.088	**0.044**
Information presentation	PEOU	6.918	**0.009**
	PU	11.964	**0.001**
Task type	PEOU	6.255	**0.013**
	PU	3.806	0.052
Style of processing	PEOU	1.104	0.294
	PU	0.431	0.512
Gender	PEOU	0.767	0.382
	PU	0.630	0.428
Age	PEOU	0.177	0.674
	PU	0.052	0.820
Familiarity of spreadsheets	PEOU	0.474	0.492
	PU	0.007	0.932

Familiarity of statistical software	PEOU	0.000	0.985
	PU	0.025	0.874
Familiarity of data management systems	PEOU	0.436	0.510
	PU	0.008	0.927
Data analysis experience	PEOU	0.183	0.669
	PU	0.613	0.434
Cognitive decision effort	PEOU	49.710	**0.000**
	PU	74.090	**0.000**

To be conservative, I also adopted the more recent approach by Preacher and Hayes (2008) to further verify the mediation effects identified above. Following Preachers and Hayes (2008), the detailed procedure to test the mediation effect of perceived usefulness and perceived usefulness on the interactive effect of information presentation and task type on intention to explore was as follows:

1) A macro called “Indirect” was installed on SPSS 19.0 so that the “Preacher and Hayes (2008) multiple mediation procedure” could be applied;

2) The interaction of information presentation and task type (IP*TT) was calculated by multiplying information presentation by task type, and the interaction of information presentation and style of processing (IP*SOP), the interaction of task type and style of processing (TT*SOP), and the 3-way interaction of information presentation, task type, and style of processing (IP*TT*SOP) were also computed in the same way;

3) Intention to explore was selected as the dependent variable, perceived usefulness and perceived ease of use were both selected as mediators, the IP*TT was selected as independent variable, and perceived innovativeness of IT, cognitive decision effort, gender, age, familiarity of spreadsheet, familiarity of statistical software, familiarity of data management system, information presentation task type, style of processing, IP*SOP, TT*SOP, and IP*TT*SOP were all selected as covariates;

4) The number of samples for bootstrapping was set as 5000, and the confidence intervals were set as 95%;

5) Click “OK” to run this multiple mediation procedure.

The mediation effect of perceived usefulness and perceived ease of use on the 3-way interactive effect on intention to explore, and the mediation effect of perceived usefulness and perceived ease of use on the influence of information presentation on intention to explore were also tested using the above procedures.

Results of the mediation tests showed that 1) for the indirect effect of the 3-way interaction on the intention to explore, the confidence intervals for perceived usefulness and perceived ease of use ranged from -1.1026 to -0.615 and from -0.3870 to 0.0565, respectively; 2) for the indirect effect of 2-way interaction of information presentation and task type on the intention to explore, the confidence intervals for perceived usefulness and perceived ease of use ranged from 0.9207 to 2.7932 and from 0.0693 to 1.1253, respectively; and 3) for the indirect effect of information presentation on the intention to explore, the confidence intervals for perceived usefulness and perceived ease of use ranged from –3.6579 to -1.0023 and from -1.3396 to -0.0236, respectively. According to Preacher and Hayes (2008), if the 95% confidence interval of a variable does not contain zero, then this variable is a mediator. Therefore, it can be concluded that 1) perceived usefulness served as a mediator for the 3-way interaction effect on the intention to explore; 2) both perceived usefulness and perceived ease of use served as mediators for the 2-way interactive effect of information presentation and task type on the intention to explore; and 3) both perceived usefulness and perceived ease of use served as mediators for the influence of information presentation on the intention to explore. The results of mediation tests prescribed by Hayes' approach were consistent with the results of mediation test prescribed by Baron and Kenny (1986), providing strong evidence of mediating roles played by perceived usefulness and ease of use.

5.4.2 Test for Intention to Explore BIS Functions

I further tested how the 2-way interactive effect of information presentation and task type and the 3-way interactive effect influenced the intention to explore BIS functions. I firstly drew the plot diagram for the 2-way interactive effect of information presentation and task type (see figure 8). The plot diagram suggests the trend that when conducting symbolic tasks, users displayed slightly a higher intention to explore BIS functions for text-based information presentation than for visual information presentation; but when conducting spatial tasks, users displayed a higher intention to explore BIS functions for visual information presentation than for text-based information presentation. Then I statistically compared the intention to explore with regard to different information presentation (text-based vs. visual) for symbolic tasks, and also compared the intention to explore with regard to different information presentations for spatial tasks. Results in table 17 showed that when conducting symbolic tasks, difference of users' intention to explore for the two information presentations was insignificant (Sig. > 0.05), and that when performing spatial tasks, users displayed significantly different levels of intention to explore for the two information presentations (Sig. < 0.05).

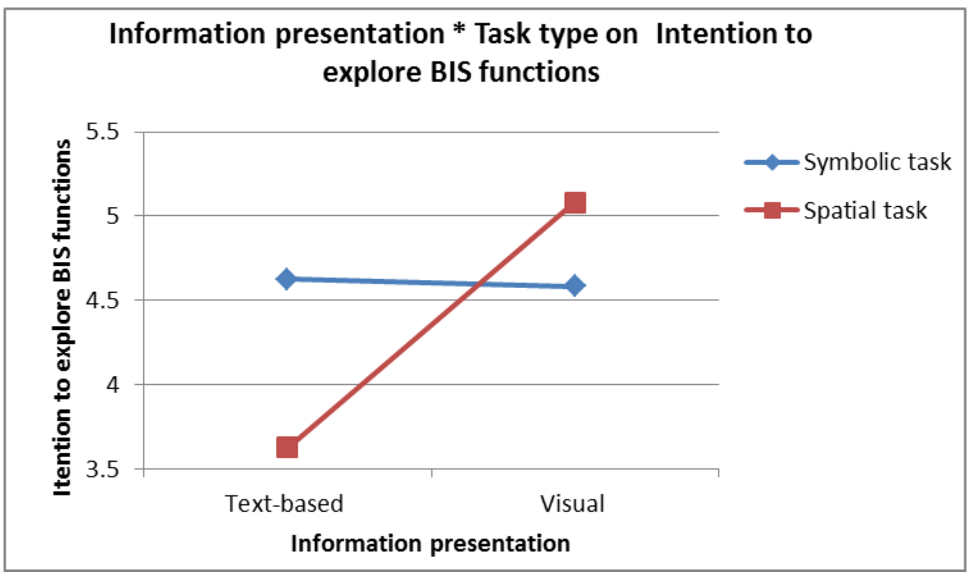


Figure 8. Information presentation * task type on intention to explore BIS functions

Table 17. T-Test for comparisons of intention to explore BIS functions

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound

Text-based information presentation & Symbolic task	Visual information presentation & Symbolic task	0.042	0.188	0.825	-0.329	0.412
Text-based information presentation & Spatial task	Visual information presentation & Spatial task	-1.456	0.208	0.000	-1.867	-1.044

I also drew the plot diagram for the 3-way interaction on the intention to explore, as can be seen in figure 9. The four scenarios introduced in chapter 3 were represented by four lines with different colors (e.g., blue, red, green, and purple). The plot diagram suggests the trend that for text-based information presentation, users in scenario 1 (symbolic task & verbal SOP) exhibited a higher intention to explore than users in other scenarios, and that for visual information presentation, users in scenario 3 (spatial task & verbal SOP) exhibited a higher intention to explore than users in other scenarios.

Next, I statistically compared the mean values of intention to explore of the four scenarios for text-based information presentation. Results shown in table 18 indicated that the users' intention to explore in scenario 1 was significantly higher than that in scenario 3 and 4 (Sig. $<$ 0.05), and intention to explore in scenario 2 was significantly higher than that in scenario 3 (Sig. $<$ 0.05) for text-based information presentation. However, the differences of intention to explore between scenario 1 and scenario 2, between scenario 3 and scenario 4, and between scenario 2 and scenario 4 were insignificant (Sig. $>$ 0.05). I also statistically compared the mean intention to explore of the four scenarios for visual information presentation. Results shown in table 19 indicated that users' intention to explore in scenario 3 was significantly higher than that in scenario 1 and 2 for visual information presentation (Sig. < 0.05). However, the differences of intention to explore among scenario 2, 3, and 4 were insignificant (Sig. > 0.05).

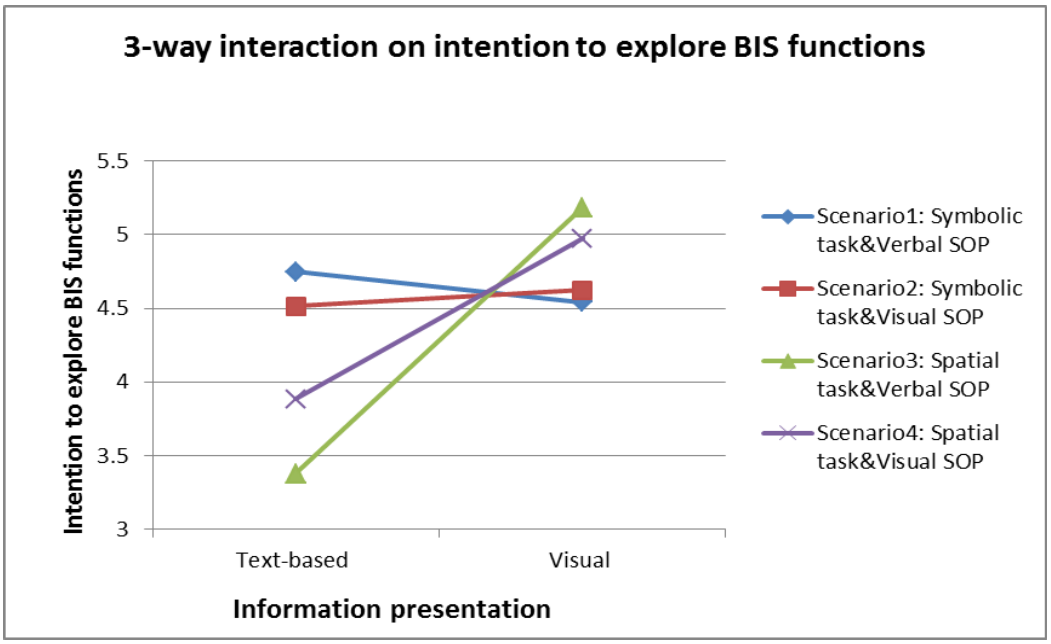


Figure 9. 3-way interaction on intention to explore BIS functions

Table 18. Multiple comparisons of the intention to explore BIS functions for text-based information presentation

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Scenario 1: symbolic task & verbal SOP	Scenario 2	0.23396	0.27972	0.406	-0.32421	0.79213
	Scenario 3	1.37028	0.30561	**0.000**	0.76060	1.97996
	Scenario 4	0.86459	0.31100	**0.007**	0.24400	1.48518

Scenario 2: symbolic task & visual SOP	Scenario 1	-0.23396	0.27972	0.406	-0.79213	0.32421
	Scenario 3	1.13632	0.33467	**0.001**	0.46932	1.80332
	Scenario 4	0.63063	0.34022	0.068	-0.04759	1.30885
Scenario 3: spatial task & verbal SOP	Scenario 1	-1.37028	0.30561	**0.000**	-1.97996	-0.76060
	Scenario 2	-1.13632	0.33467	**0.001**	-1.80332	-0.46932
	Scenario 4	-0.50569	0.35780	0.162	-1.21878	0.20740
Scenario 4: spatial task & visual SOP	Scenario 1	-0.86459	0.31100	**0.007**	-1.48518	-0.24400
	Scenario 2	-0.63063	0.34022	0.068	-1.30885	0.04759
	Scenario 3	0.50569	0.35780	0.162	-0.20740	1.21878

Table 19. Multiple comparisons of the intention to explore BIS functions for visual information presentation

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Scenario 1: symbolic task & verbal SOP	Scenario 2	-0.08227	0.25407	0.747	-0.58862	0.42409
	Scenario 3	-0.64279	0.20526	**0.002**	-1.05169	-0.23390
	Scenario 4	-0.43243	0.22548	0.059	-0.88191	0.01704
Scenario 2: symbolic task & visual SOP	Scenario 1	0.08227	0.25407	0.747	-0.42409	0.58862
	Scenario 3	-0.56053	0.24194	**0.023**	-1.04240	-0.07866
	Scenario 4	-0.35017	0.26163	0.185	-0.87160	0.17127
Scenario 3: spatial task & verbal SOP	Scenario 1	0.64279	0.20526	**0.002**	0.23390	1.05169
	Scenario 2	0.56053	0.24194	**0.023**	0.07866	1.04240
	Scenario 4	0.21036	0.21409	0.329	-0.21613	0.63685

Scenario 4: spatial task & visual SOP	Scenario 1	0.43243	0.22548	0.059	-0.01704	0.88191
	Scenario 2	0.35017	0.26163	0.185	-0.17127	0.87160
	Scenario 3	-0.21036	0.21409	0.329	-0.63685	0.21613

Furthermore, I used structural equation modeling (SEM) to analyze how perceived usefulness of BIS and perceived ease of use influenced intention to explore BIS functions. AMOS 19.0 was used to analyze the structural model. The structural model exhibited good model fit (χ^2/d.f. = 1.52, $p < 0.001$; CFI = 0.984, SRMR = 0.0301, RMSEA = 0.042). Results in figure 10 showed that 1) perceived usefulness of BIS exerted significant positive effect on intention to explore BIS functions ($p < 0.01$, $\beta = 0.539$), 2) perceived ease of use exerted significant positive effects on users' intention to explore BIS functions ($p < 0.05$, $\beta = 0.249$), and 3) familiarity of spreadsheets (e.g., Excel) also exerted significant positive effect on intention to explore BIS functions ($p < 0.05$, $\beta = 0.103$).

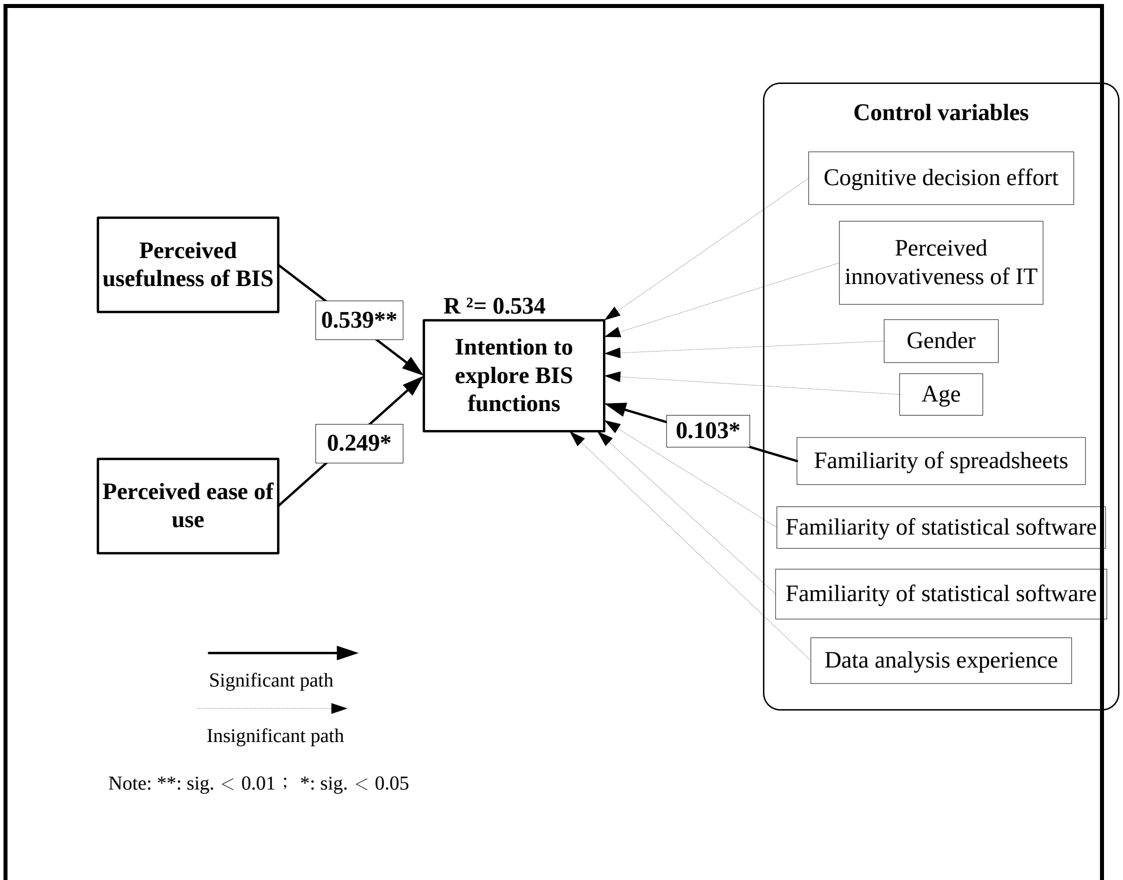


Figure 10. SEM testing results

5.4.3 Test for Perceived Usefulness and Perceived Ease of Use

Since perceived ease of use and perceived usefulness exerted mediation effects on the influence of 2-way interaction of information presentation and task type on intention to explore, I further examined how this 2-way interaction affected the mediators. Firstly, I explored how the 2-way interaction of information presentation and task type affected perceived usefulness. The corresponding plot diagram is shown in figure 11. The plot diagram suggests the trend that when conducting symbolic tasks, users displayed higher perceived usefulness of BIS for text-based information presentation than for visual information presentation, whereas when conducting spatial tasks, users displayed higher perceived usefulness of BIS for visual information presentation than for text-based information presentation.

Next, I statistically compared the perceived usefulness between subjects who viewed text-based information presentation and conducted symbolic tasks and subjects who viewed visual information presentation and conducted symbolic tasks. I also compared the perceived usefulness between subjects who viewed text-based information presentation and conducted spatial tasks and subjects who viewed visual information presentation and conducted spatial tasks. Results of these comparisons are presented in table 20. It was shown that when conducting symbolic tasks, users displayed significantly different levels of perceived usefulness for the two types of information presentations (Sig. $<$ 0.05), and that when performing spatial tasks, users displayed significantly different levels of perceived usefulness of BIS for the two types of information presentations (Sig. $<$ 0.05). In particular, users exhibited higher perceived usefulness when they used text-based information presentation to conduct symbolic tasks and when they used visual information presentation to conduct spatial tasks. Importantly, the pattern of the 2-way interactive effect of information presentation and task type on perceived usefulness (figure 11) was similar with the pattern of this 2-way interactive effect on intention to explore BIS function (figure 8), offering further support that perceived usefulness indeed mediated this 2 way interaction effect on intention to explore BIS functions.

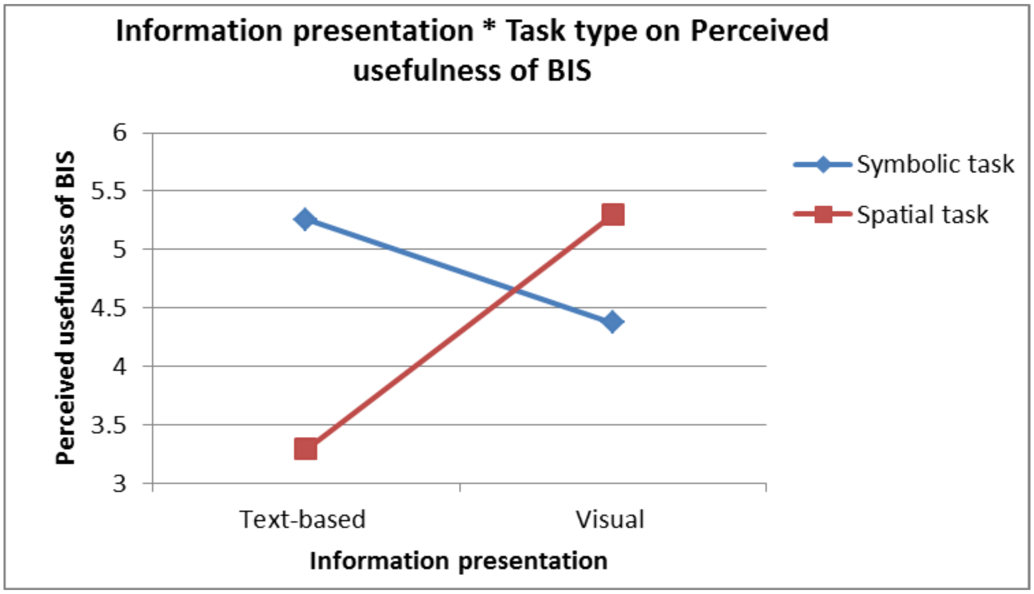


Figure 11. Information presentation * task type on perceived usefulness of BIS

Table 20. T-Test for comparisons of perceived usefulness

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Text-based information presentation & Symbolic task	Visual information presentation & Symbolic task	0.884	0.187	0.000	0.514	1.254
Text-based information presentation & Spatial task	Visual information presentation & Spatial task	-2.001	0.231	0.000	-2.457	-1.545

I also investigated how the 2-way interaction of information presentation and task type affected perceived ease of use. The corresponding plot diagram is shown in figure 12. The plot diagram suggests the trend that when conducting symbolic tasks, users displayed higher perceived ease of use for text-based information presentation than for visual information presentation, whereas when conducting spatial tasks, users displayed higher perceived ease of use for visual information presentation than for text-based information presentation.

Next, I statistically compared the perceived ease of use between subjects who viewed text-based information presentation and conducted symbolic tasks and subjects who viewed visual information presentation and conducted symbolic tasks. I also compared the perceived ease of use between subjects who viewed text-based information presentation and conducted spatial tasks and subjects who viewed visual information presentation and conducted spatial tasks. Results of these comparisons are presented in table 21. It showed that when conducting symbolic tasks, users displayed significantly different levels of perceived ease of use for the two types of information presentations (Sig. < 0.05), and that when performing spatial tasks, users displayed significantly different levels of perceived ease of use for the two types of information presentations (Sig. < 0.05). In particular, users exhibited higher perceived ease of use when they use text-based information presentation to conduct symbolic tasks and when they use visual information presentation to conduct spatial tasks. Importantly, the pattern of the 2-way interactive effect of information presentation and task type on perceived ease of use (Figure 12) was similar with the pattern of this 2-way interactive effect on intention to explore (Figure 8), providing further support that perceived ease of use indeed mediated this 2 way interaction effect on intention to explore BIS function.

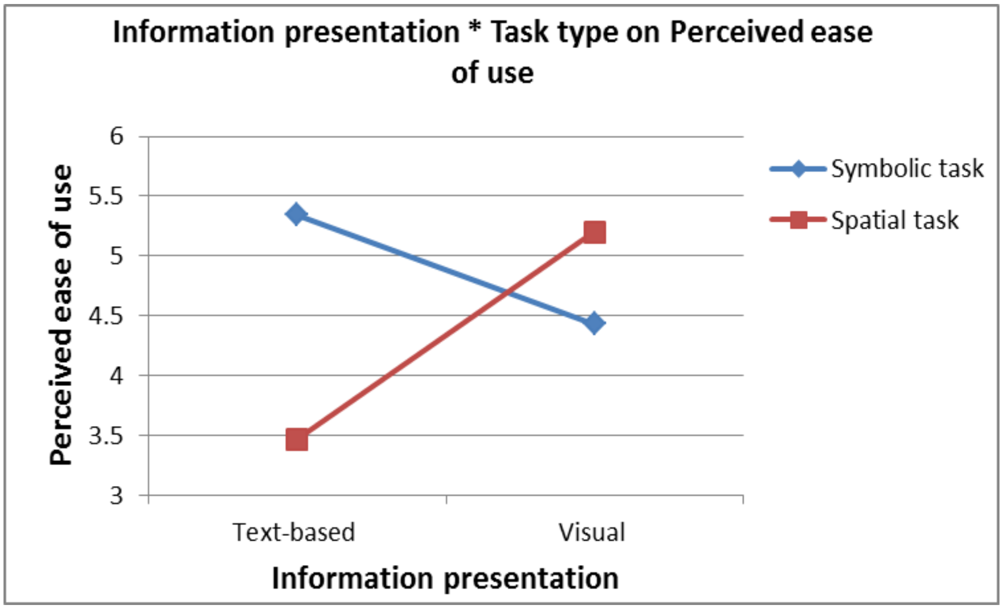


Figure 12. Information presentation * Task type on Perceived ease of use

Table 21. T-Test for comparisons of perceived ease of use						
Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Text-based information presentation & Symbolic tasks	Visual information presentation & Symbolic tasks	0.912	0.177	0.000	0.562	1.261
Text-based information presentation & Spatial tasks	Visual information presentation & Spatial tasks	-1.732	0.229	0.000	1.280	2.185

In addition, as perceived usefulness mediated the relationship between the intention to explore BIS functions and the 3-way interaction, I further investigated how this 3-way interaction influenced perceived usefulness of BIS. The plot diagram for this 3-way interaction is presented in figure 13. The four scenarios introduced in chapter 3 were represented by four lines with different colors (e.g., blue, red, green, and purple). The plot diagram suggests the trend that for text-based information presentation, users in scenario 1 (symbolic tasks & verbal SOP) displayed higher perceived usefulness, as compared to users in other scenarios; and that for visual information presentation, users in scenario 3 (spatial tasks & verbal SOP) displayed higher perceived usefulness, as compared to users in other scenarios.

Next, I statistically compared the mean values of perceived usefulness of the four scenarios for text-based information presentation. Results shown in table 22 indicated that users' perceived usefulness in scenario 1 and 2 was significantly higher than that in scenario 3 and 4 when text-based information presentation was used (Sig. $<$ 0.05). For text-based information presentation, the difference of perceived usefulness between scenario 1 and scenario 2 was insignificant (Sig. $>$ 0.05), and the difference between scenario 3 and scenario 4 was insignificant (Sig. $>$ 0.05) as well.

Furthermore, I statistically compared the mean values of perceived usefulness of the four scenarios for visual information presentation. Results in table 23 showed that users' perceived usefulness of BIS in scenario 3 and 4 was significantly higher than that in scenarios 1 and 2 for visual information presentation (Sig. $<$ 0.05). For visual information presentation, the difference of perceived usefulness between scenario 1 and scenario 2 was insignificant (Sig. $>$ 0.05), and the difference between scenario 3 and scenario 4 was insignificant (Sig.

> 0.05) as well. These results showed that the pattern of the 3-way interactive effect on perceived usefulness (figure 13) was similar with the pattern of this interactive effect on intention to explore (figure 9).

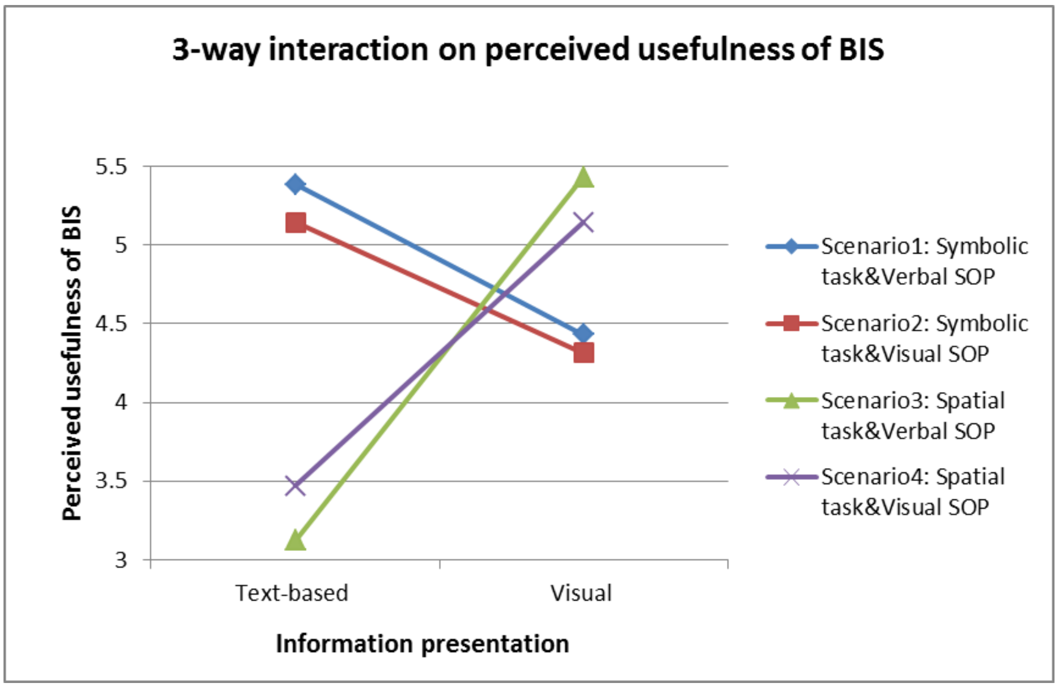


Figure 13. 3-way interaction on perceived usefulness of BIS

Table 22. Multiple comparisons of perceived usefulness of BIS for text-based information presentation

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Scenario 1: symbolic task & verbal SOP	Scenario 2	0.23969	0.24048	0.322	-0.24017	0.71956
	Scenario 3	2.26103	0.28343	**0.000**	1.69561	2.82646
	Scenario 4	1.91537	0.35233	**0.000**	1.21231	2.61843

Scenario 2: symbolic task & visual SOP	Scenario 1	-0.23969	0.24048	0.322	-0.71956	0.24017
	Scenario 3	2.02134	0.31239	**0.000**	1.39875	2.64392
	Scenario 4	1.67568	0.37055	**0.000**	0.93701	2.41434
Scenario 3: spatial task & verbal SOP	Scenario 1	-2.26103	0.28343	**0.000**	-2.82646	-1.69561
	Scenario 2	-2.02134	0.31239	**0.000**	-2.64392	-1.39875
	Scenario 4	-0.34566	0.39377	0.383	-1.13045	0.43912
Scenario 4: spatial task & visual SOP	Scenario 1	-1.91537	0.35233	**0.000**	-2.61843	-1.21231
	Scenario 2	-1.67568	0.37055	**0.000**	-2.41434	-0.93701
	Scenario 3	0.34566	0.39377	0.383	-0.43912	1.13045

Table 23. Multiple comparisons of perceived usefulness of BIS for visual information presentation

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Scenario 1: symbolic task & verbal SOP	Scenario 2	0.11664	0.28546	0.684	-0.45227	0.68556
	Scenario 3	-1.00090	0.24077	**0.000**	-1.48055	-0.52126
	Scenario 4	-0.71171	0.25814	**0.007**	-1.22630	-0.19713
Scenario 2: symbolic task & visual SOP	Scenario 1	-0.11664	0.28546	0.684	-0.68556	0.45227
	Scenario 3	-1.11754	0.27285	**0.000**	-1.66096	-0.57412
	Scenario 4	-0.82835	0.29044	**0.006**	-1.40720	-0.24951
Scenario 3: spatial task & verbal SOP	Scenario 1	1.00090	0.24077	**0.000**	0.52126	1.48055
	Scenario 2	1.11754	0.27285	**0.000**	0.57412	1.66096
	Scenario 4	0.28919	0.24637	0.244	-0.20160	0.77998

Scenario 4: spatial task & visual SOP	Scenario 1	0.71171	0.25814	**0.007**	0.19713	1.22630
	Scenario 2	0.82835	0.29044	**0.006**	0.24951	1.40720
	Scenario 3	-0.28919	0.24637	0.244	-0.77998	0.20160

Since I found that perceived usefulness and perceived ease of use fully mediated the effect of information presentation on intention to explore, I further tested how information presentation influenced perceived usefulness and perceived ease of use. Table 24 showed that the means of perceived usefulness were significantly higher for users with visual information presentation than users with text-based information presentation (Sig. < 0.05). Table 25 showed that the means of perceived ease of use were significantly higher for users with visual information presentation than for users with text-based information presentation (Sig. < 0.05). This pattern regarding the effect of information presentation on perceived usefulness and perceived ease of use was similar with the pattern of this effect on intention to explore, providing additional evidence to the mediation role of perceived usefulness and perceived ease of use for effect of information presentation on intentions to explore.

Table 24. T-Test for perceived usefulness of BIS regarding different information presentations

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Text-based information presentation	Visual information presentation	-0.599	0.173	**0.001**	-0.939	-0.258

Table 25. T-Test for perceived ease of use regarding different information presentations						
Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Text-based information presentation	Visual information presentation	-0.448	0.167	**0.008**	-0.777	-0.119

According to the above analysis, although the 2-way interactive effect of information presentation and task type and the 3-way interactive effect cannot influence users' intention to explore BIS directly, they can affect the intention to explore through perceived usefulness of BIS and perceived ease of use, and through perceived usefulness, respectively. At the same time, information presentation can influence intention to explore directly or indirectly through the mediators: perceived usefulness and perceived ease of use.

5.4.4 Revised research model

On the Basis of the results of post-hoc analyses, I revised the research model, as shown in figure 14.

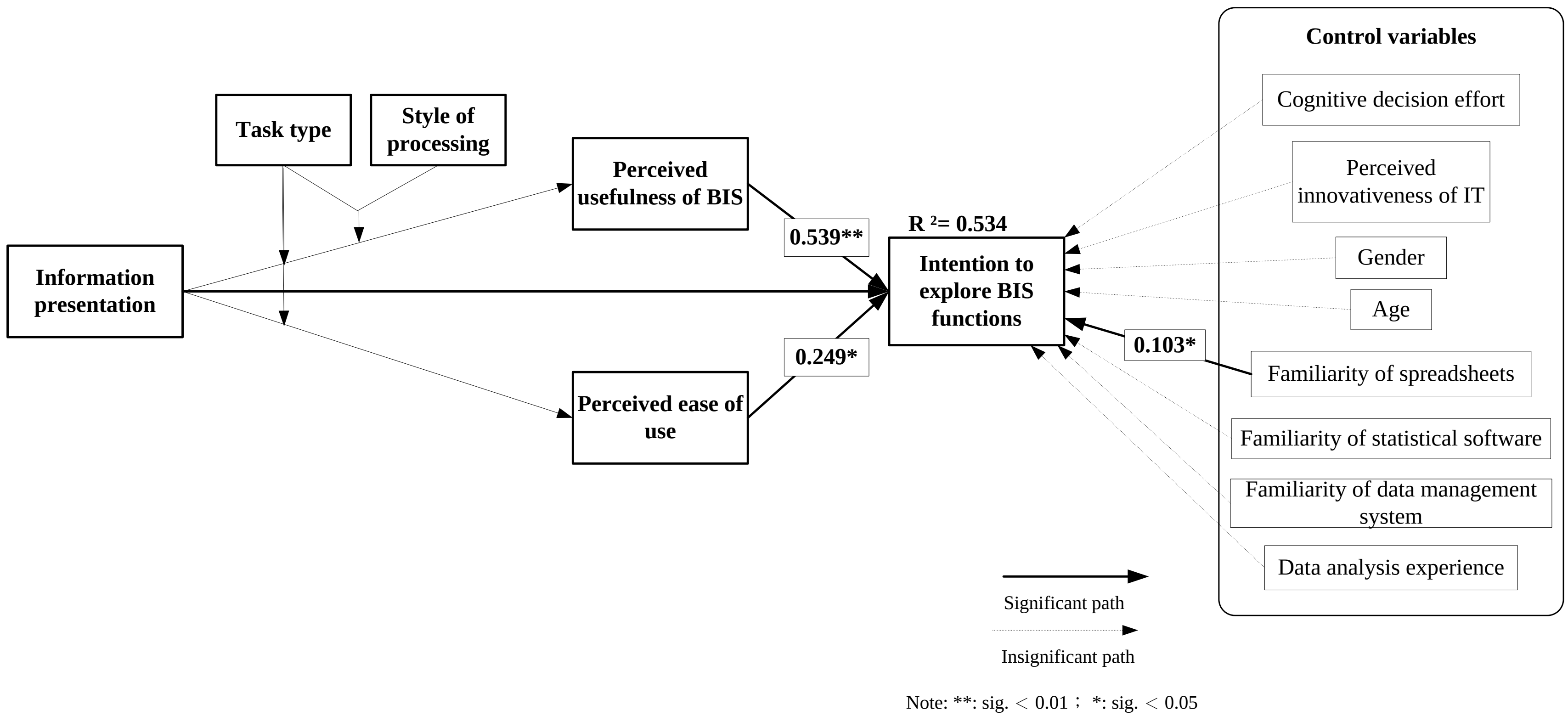


Figure 14 Revised research model

In short, figure 14 shows that

1) The 2-way interactive effect of information presentation and task type influences users' intention to explore BIS functions through perceived usefulness and perceived ease of use, and this 2-way interactive effect is fully mediated by perceived usefulness and perceived ease of use.

2) The 3-way interactive effect of information presentation, task type, and style of processing influences users' intention to explore BIS functions through perceived usefulness, and this 3-way interactive effect is fully mediated by perceived usefulness.

3) The information presentation affects intention to explore BIS functions directly and indirectly through the mediators of perceived usefulness and perceived ease of use. In other words, perceived usefulness and perceived ease of use partially mediate the effect of information presentation on intention to explore BIS functions.

4) Among the control variables, familiarity of spreadsheets affects the users' intention to explore BIS functions.

5.4.5 Test for task performance and task time

This experiment adapted the factorial design (information presentation * task type) from the study of Vessey and Galletta (1991). Given that Vessy and Galletta (1991) have tested the interaction effect of information presentation and task types on task performance and task time, I further tested the 2-way interactive effect of information presentation and task type on task performance and task time to check whether the factorial design in my study was scientific and effective. Results in table 26 indicated that the interactive effect of information presentation and task type had significant effect on task performance (Sig. $<$ 0.05), and the plot diagram is shown in figure 15. The plot diagram suggests the trend that when conducting symbolic tasks, users displayed higher task performance for text-based information presentation than for visual information presentation, whereas when conducting spatial tasks, users displayed higher task performance for visual information presentation than for text-based information presentation. Then I statistically compared the users' performance on symbolic tasks with regard to different information presentations, and their performance on spatial tasks with regard to difference information presentations, as shown in table 27. Results showed that users' difference of performances on symbolic tasks were significant regarding different information presentations (Sig. $<$ 0.05), whereas users' difference of performances on spatial tasks were insignificant regarding different information presentations (Sig. $>$ 0.05)

Table 26. ANCOVA result of task performance

Source	F (d.f. = 1)	Sig.
Information presentation * Task type	18.153	**0.000**
Information presentation * Style of processing	2.529	0.113
Task type * Style of processing	4.630	**0.032**
Information presentation * Task Type * Style of Processing	0.668	0.414
Information presentation	6.989	**0.009**
Task type	27.971	**0.000**

Style of processing	2.851	0.092
Gender	0.705	0.402
Age	0.223	0.637
Familiarity of spreadsheets	4.503	**0.035**
Familiarity of statistical software	3.992	**0.047**
Familiarity of data management systems	0.119	0.731
Data analysis experience	3.876	0.050

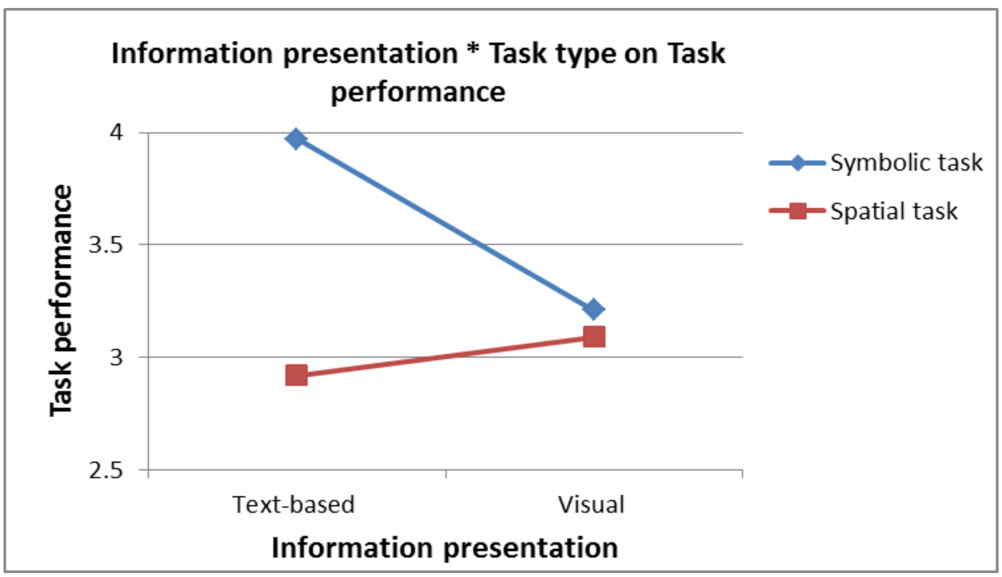


Figure 15. Information presentation * Task type on Task performance

Table 27. T-Test for comparisons of task performance

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound

Text-based information presentation & Symbolic task	Visual information presentation & Symbolic task	0.758	0.154	0.000	0.454	1.062
Text-based information presentation & Spatial task	Visual information presentation & Spatial task	-0.171	0.178	0.338	-0.552	-0.180

In addition, ANOVA test was conducted on task time. Results in table 28 showed that the 2-way interaction of information presentation and task type exerted significant influence on task time (Sig. $<$ 0.05). The plot diagram of this interaction effect is presented in figure 16. Then I statistically compared the users' task time on symbolic tasks with regard to different information presentations, and their task time on spatial tasks with regard to different information presentations, as can be seen in table 29. Results indicated that the task time for symbolic tasks or spatial tasks was significantly different regarding different information presentations (Sig. $<$ 0.05). In particular, users accomplished symbolic tasks faster using text-based information presentation, while users accomplish spatial tasks faster using visual information presentation. In a sum, these findings were consistent with the those implication derived from the lens of cognitive fit by Vessey and Galletta (1991), suggesting that when there was a fit between information presentation and task type, users could arrive at the better decision outcome (i.e., task performance) with shorter time.

Table 28. ANCOVA result of task time		
Source	**F (d.f. = 1)**	**Sig.**
Information presentation *	117.009	**0.000**

Task type		
Information presentation * Style of processing	4.592	**0.033**
Task type * Style of processing	0.060	0.807
Information presentation * Task Type * Style of Processing	4.772	**0.030**
Information presentation	0.262	0.609
Task type	230.612	**0.000**
Style of processing	0.080	0.777
Gender	3.295	0.071
Age	8.022	**0.005**
Familiarity of spreadsheets	0.857	0.355
Familiarity of statistical software	0.204	0.652
Familiarity of data management systems	0.629	0.428
Data analysis experience	0.630	0.428

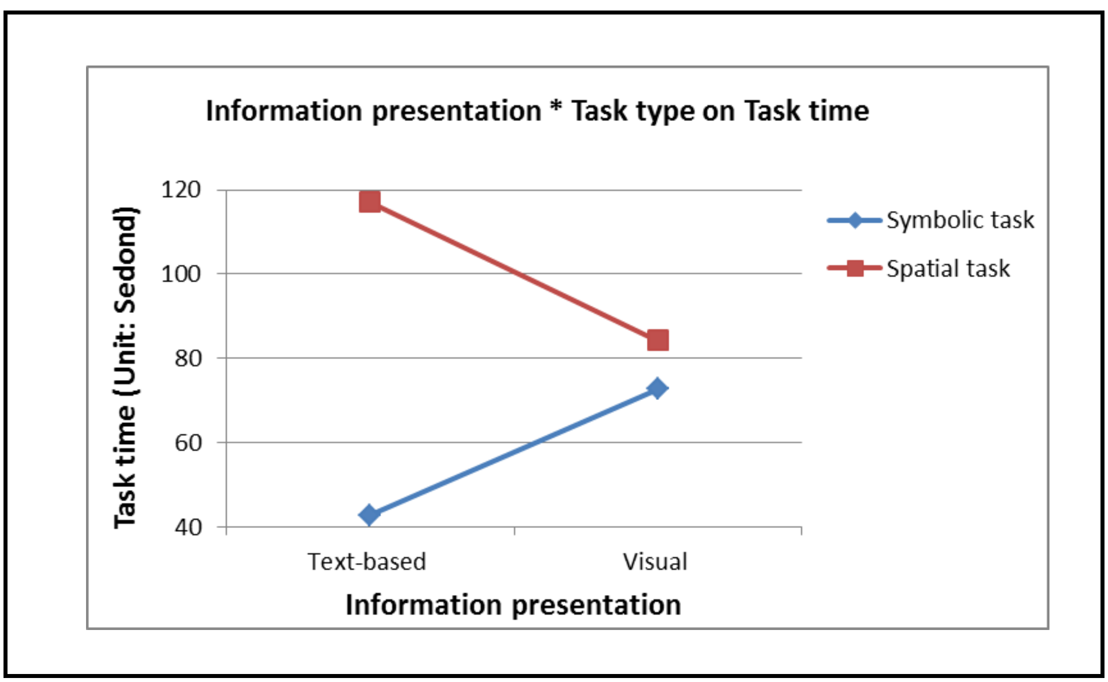


Figure 16. Information presentation * task type on task time

Table 29. T-Test for comparisons of task time						
Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Text-based information presentation & Symbolic task	Visual information presentation & Symbolic task	-29.958	2.884	0.000	-35.659	-24.257
Text-based information presentation & Spatial task	Visual information presentation & Spatial task	32. 892	4.892	0.000	23.226	42.557

I also drew the plot diagram for the interactive effect of information presentation and style of processing on task time (see figure 16). Next, I statistically compared the task time of users who preferred verbal SOP with different information presentations, and the task time of users who preferred visual SOP with difference information presentations (see table 30). Results showed that for users who preferred verbal SOP, the difference of task time between text-based information presentation and visual information presentation was insignificant (Sig. > 0.05). At the same time, for users who preferred visual SOP, the difference of task time between text-based information presentation and visual information presentation was also insignificant (Sig. > 0.05).

However, this 2-way interactive effect was significant, since the two lines in figure 17 intersects with each other. The plot diagram suggests the trend that for users who preferred verbal SOP, their task time for text-based information was longer than that for visual information presentation, and that for users who preferred visual SOP, their task time for visual information presentation was longer than that for text-based information presentation.

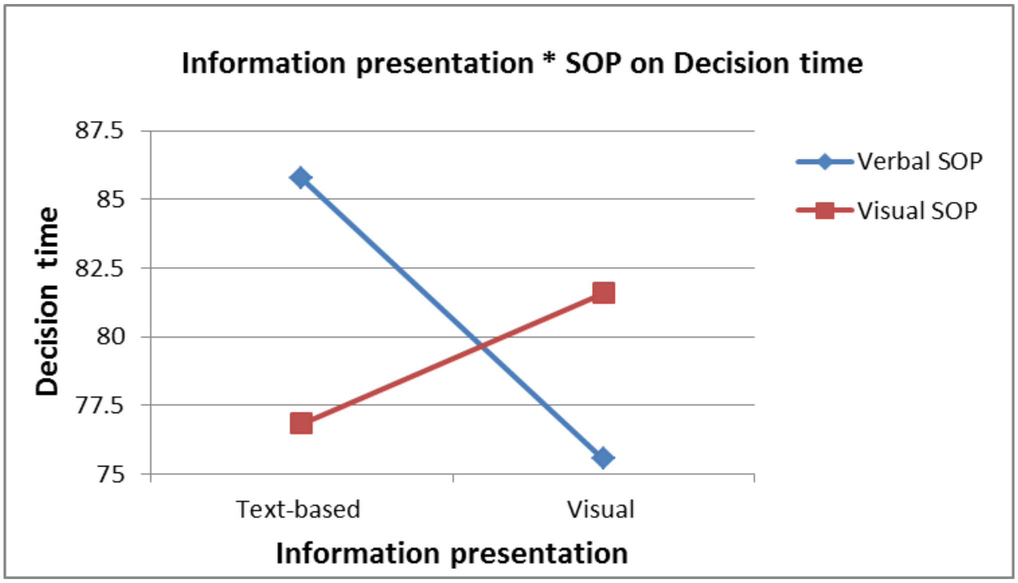


Figure 17. Information presentation * SOP on task time

Table 30. T-Test for comparisons of task time

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Text-based information presentation & Verbal SOP	Visual information presentation & Verbal SOP	10.197	6.282	0.107	-2.219	22.612
Text-based information presentation	Visual information presentation	-4.746	5.526	0.392	-15.668	6.175

& Visual SOP	& Visual SOP					

In addition, I tested how the 3-way interaction effect of information presentation, task type, and style of processing influenced task time. The plot diagram of this 3-way interactive effect is presented in figure 18. This interaction effect was significant, since the line for scenario 3 and the line for scenario 4 intersected with each other (see figure 17). The plot diagram suggests the trend that for text-based information presentation, users in scenario 3 (spatial tasks & verbal SOP) consumed longer task time than users in other scenarios; and that for visual information presentation, users in scenario 4 (spatial tasks & visual SOP) consumed longer task time than users in other scenarios.

Next, I statistically compared the task time of the four scenarios for text-based information presentation. Results in table 31 showed that users' task time in scenario 3 and 4 was significantly higher than that in scenario 1 and 2 for text-based information presentation (Sig. $<$ 0.05). However, there was no significant difference of task time between scenario 1 and scenario 2 or between scenario 3 and scenario 4 (Sig. $>$ 0.05). I also statistically compared the task time of the four scenarios for visual information presentations. Results in table 32 showed that the task time in scenario 4 was significantly longer than that in scenario 1 and 2 (Sig. $<$ 0.05). However, there was no significant difference of task between scenario 3 and scenario 4 or among scenario 1, scenario 2 and scenario 3 (Sig. $>$ 0.05).

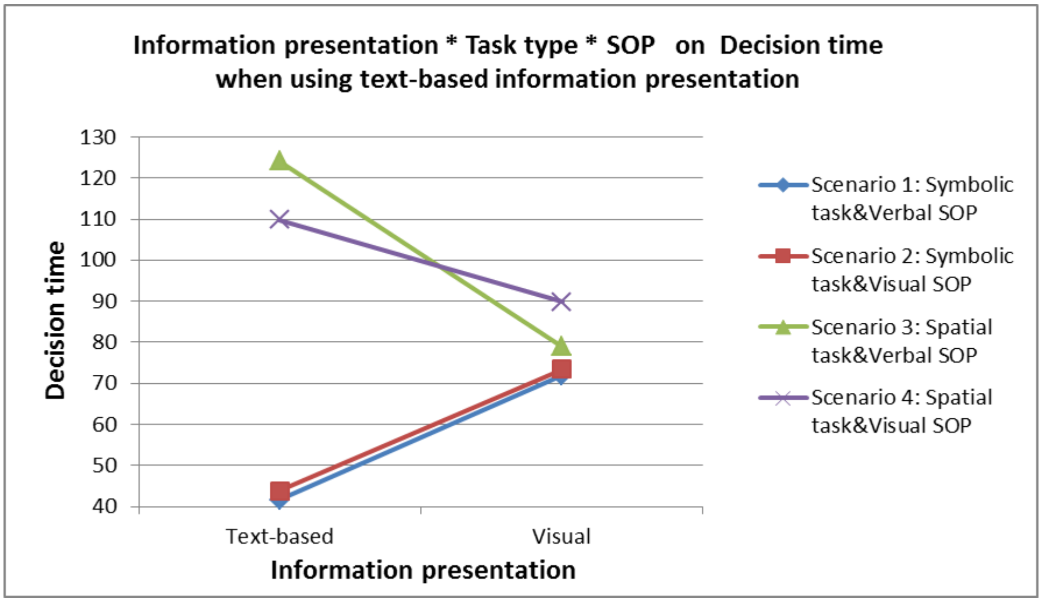


Figure 18. 3-way interaction on Decision time

Table 31. Multiple comparisons of decision time for text-based information presentation

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Scenario 1: symbolic task & verbal SOP	Scenario 2	-2.27727	2.60961	0.386	-7.48467	2.93012
	Scenario 3	-82.56201	6.36172	**0.000**	-95.25330	-69.87072
	Scenario 4	-68.26295	4.79846	**0.000**	-77.82812	-58.68778
Scenario 2: symbolic task & visual SOP	Scenario 1	2.27727	2.60961	0.386	-2.93012	7.48467
	Scenario 3	-80.28474	6.15433	**0.000**	-92.55030	-68.01917
	Scenario 4	-65.98568	4.73170	**0.000**	-75.41815	-56.55320
Scenario 3: spatial task & verbal SOP	Scenario 1	82.56201	6.36172	**0.000**	69.87072	95.25330
	Scenario 2	80.28474	6.15433	**0.000**	68.01917	92.55030

	Scenario 4	14.29906	7.20623	0.051	-0.06294	28.66106
Scenario 4: spatial task & visual SOP	Scenario 1	68.26295	4.79846	**0.000**	58.68778	77.82812
	Scenario 2	65.98568	4.73170	**0.000**	56.55320	75.41815
	Scenario 3	-14.29906	7.20623	0.051	-28.66106	0.06294

Table 32. Multiple comparisons of decision time of BIS for visual information presentation

Group (A)	Group (B)	Mean difference (A-B)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Scenario 1: symbolic task & verbal SOP	Scenario 2	-1.54309	5.04686	0.716	-11.60147	8.51530
	Scenario 3	-6.95230	5.41002	0.203	-17.72962	3.82502
	Scenario 4	-17.94811	6.50429	**0.007**	-30.91418	-4.98204
Scenario 2: symbolic task & visual SOP	Scenario 1	1.54309	5.04686	0.716	-8.51530	11.60147
	Scenario 3	-5.40921	5.04195	0.287	-15.45112	4.63270
	Scenario 4	-16.40502	6.15288	**0.009**	-28.66769	-4.14235
Scenario 3: spatial task & verbal SOP	Scenario 1	6.95230	5.41002	0.203	-3.82502	17.72962
	Scenario 2	5.40921	5.04195	0.287	-4.63270	15.45112
	Scenario 4	-10.99581	6.40529	0.090	-23.75580	1.76418
Scenario 4: spatial task & visual SOP	Scenario 1	17.94811	6.50429	**0.007**	4.98204	30.91418
	Scenario 2	16.40502	6.15288	**0.009**	4.14235	28.66769
	Scenario 3	10.99581	6.40529	0.090	-1.76418	23.75580

Chapter 6 Discussion

6.1 Results Interpretation

The results reveal important insights on the antecedents of users' intention to explore BIS functions, as well as how and the mechanism through which, the antecedents exerted their influences on users intentions to explore BIS functions.

First, the results of the experiment reveal that the significant 2-way interaction of information presentation and task type affects the users' intention to explore BIS functions through perceived usefulness (PU) and perceived ease of use (PEOU), and this 2-way interactive effect is fully mediated by PU and PEOU. The information presentation and task type can interactively influence users' PU and PEOU. Particularly, when there is a cognitive fit between information presentation and task type, users exhibit higher PU and PEOU, whereas when there is a mismatch between information presentation and task type, users exhibit lower PU and PEOU. A plausible explanation is that when users experience cognitive fit, they only need to make little cognitive effort to accomplish the tasks, whereas when users experience cognitive mismatch, they need to make more effort in order to complete the tasks (Vessey 1990; Dennis and Carte 1998). Therefore, users who experience a cognitive fit display higher PU and PEOU, both of which can positively affect the users' intention to explore BIS functions. Additionally, the 2-way interactive effect of information presentation and task type on intention to explore became insignificant after controlling for PU and PEOU, inferring that PU and PEOU fully mediate the 2-way interactive effect on the intention to explore.

This is consistent with the technology acceptance model (e.g., Davis 1985), which suggests PU and PEOU can channel the influence of external factors (e.g., information presentation and task types) on individuals' usage intentions toward the focal technology.

Secondly, the 3-way interactive effect of information presentation, task type, and style of processing can influence users' intention to explore BIS functions through PU, and this 3-way interactive effect is fully mediated by PU. Specifically, for text-based information presentation, users in scenario 1 (symbolic tasks & verbal SOP) display higher PU, as compared with users in the other 3 scenarios. To illustrate, users in scenario 1 experience cognitive fit, and thus make less cognitive effort to solve the tasks (Vessey 1991; Vessey and Galletta 1991; Dennis and Carte 1998). Users in scenario 1 also experience a state of regulatory compatibility, thus displaying deeper involvement toward and better enjoy this process (Bless and Keller 2008). Considering the experience of both cognitive fit and regulatory compatibility, users in scenario 1 exhibit higher PU than users in other scenarios.

Interestingly, for visual information presentation, users in scenario 3 (spatial tasks & verbal style of processing) display higher PU, as compared to users in other scenarios. Possible explanations are as follows. In scenarios 3(spatial tasks & verbal SOP), the spatial tasks are presented in text format (e.g., "in which year was the difference between the sales growth rate of product A and the sales growth rate of product B greatest"), and the visual interface contains many numeric values in the vertical axis. Users may receive the verbal information from the task presentation and the visual interface, and thus experience a regulatory compatibility between the verbal information they receive and their verbal style of processing (Keller and Bless 2008). In scenarios 4 (spatial tasks & visual SOP), users may perceive that the visual interface is not visualized enough due to the verbal information they receive. Hence, they may experience a lower level of regulatory compatibility and display lower PU than users in scenario 3. In scenarios 1 and 2, users experience cognitive misfit between the visual interface and the symbolic tasks, and thus display lower PU than users in scenario 3. Therefore, users in scenarios 3 display highest PU among these four scenarios.

Thirdly, information presentation affects the intention to explore BIS functions directly or through the mediators of PU and PEOU. One explanation for the direct effect is that the visual information presentation is considered as richer than the text-based information presentation (Jiang and Benbasat 2007), so the visual information presentation is likely to be more attractive to users. Thus, users display higher intention to explore BIS functions with visual information presentation than with text-based information presentation. A possible explanation for the mediation effect is that visual information presentation may involve data manipulation (e.g., depicting the data trend) and more visual cues (e.g., color, graph) than text-based information presentation (Shneiderman 1998; Vessey and Galletta, 1991). Users may believe that these characteristics of visual information presentation facilitate their analysis and problem-solving (Zhu and Watts 2010). Therefore, users display higher PU and PEOU toward visual information presentation.

Fourthly, among the control variables, familiarity of spreadsheets affects users' intention to explore BIS functions. In particular, the familiarity of spreadsheets positively influences the users' intention to explore BIS functions. This is probably because users' experience and skills in spreadsheets are compatible with the skills needed for the BIS, so this experience is efficacious in the exploration of BIS functions (Agarwal and Prasad 1999). So users' familiarity of spreadsheets is positively related to the intention to explore BIS functions.

Fifthly, the 2-way interactive effect of information presentation and task type affects users' task performance and task time. Specifically, users exhibit better performance on symbolic tasks with text-based information presentation than with visual information presentation, whereas users exhibit better performance on spatial tasks with visual information presentation than with text-based information presentation. Additionally, the task time for symbolic tasks is shorter with text-based information presentation than with visual information presentation, whereas the task time for spatial tasks is shorter with visual information presentation than with text-based information presentation. These findings are consistent with the cognitive fit theory which suggests that the decision outcome (e.g., task performance, decision time) can be improved if there is a fit between information presentation and task type (Vessey 1991; Vessey and Galletta 1991). This also suggests that the treatments on subjects are scientific and effective.

Furthermore, the 2-way interactive effect of information presentation and style of processing significantly affects users' task time. For users who prefer verbal style of processing, their mean task time for text-based information presentation is longer than that for visual information presentation. At the same time, for users who prefer visual style of processing, the mean task time for visual information presentation is longer than that for text-based information presentation. A possible explanation is that when users experience a fit between the information presentation (e.g., text-based) and their style of processing (e.g., verbal), they feel a state of regulatory compatibility. Thus, they are intrinsically motivated to engage in such tasks, and are willing to spend additional time experiencing a state of regulatory compatibility (Keller and Bless 2008).

Finally, the 3-way interactive effect of information presentation, task type, and style of processing affects users' task time. For text-based information presentation, users in scenario 3 (spatial tasks & verbal style of processing) spend longest task time. This may result from the fact that the spatial tasks involve comparisons, thus are more time-consuming than symbolic tasks which mainly involves data extraction, and the fact that users who experience a compatibility between information presentation (e.g., text-based) and style of processing (e.g., verbal) are willing to spend additional time to engage in the tasks (Csikszentmihalyi 2000, Keller and Bless 2008). For visual information presentation, users in scenario 4 (spatial tasks & visual style of processing) spend the longest decision time, This may result from the fact that the spatial tasks are more time-consuming than symbolic tasks, and that users who experience a compatibility between information presentation (e.g., visual) and style of processing (e.g., visual) are willing to spend additional time to engage in the tasks (Csikszentmihalyi 2000, Keller and Bless 2008).

6.2 Theoretical Implications

This study investigates the effect of information presentation, task type, and style of processing on users' intention to explore BIS functions. It theorized and compared four scenarios of BIS users (e.g., visual style of processing & spatial tasks, visual style of processing & symbolic tasks, verbal style of processing & spatial tasks, verbal style of processing &symbolic tasks) for different information presentations (i.e., text-based, visual). To the best of our knowledge, this is the first study in information systems research that investigates the combined effect of information presentation, task type, and style of processing on users' intention to explore BIS functions. In general, this research offers several major theoretical contributions.

Firstly, prior research has examined the interactive influence of information presentation and task characteristics on task performance or user perception (e.g., , Jiang and Benbasat 2007; Speier and Morris 2003; Vessey 1991; Zhu and Watts 2010). This study will contribute to this stream of research by studying the interactive effect of information presentations and task types on the users' intention to explore BIS, which extends the studies on information presentations into the IS usage research. IS usage is one of the most critical elements to IS implementation, individual performance, and organizational success (DeLone and McLean 1992, Li et al. 2013, Seddon 1997). In particular, users' intention to explore BIS functions is a crucial predictor for BIS exploration behavior which can lead to successful system implementation and realization of organizational business value (Maruping and Magni forthcoming, Nambison et al. 1999). The findings suggest that the interactive effect of information presentation and task type can influence users' intention to explore BIS functions through two mediators: PU and PEOU. When users experience a cognitive fit between information presentation and task type, they exhibit higher PU and PEOU, and thus are more willing to explore BIS functions. This insight is consistent with the technology acceptance model which argues that the effects of external variables (e.g., the interactive effect of information presentation and task type) on behavioral intention are mediated by the individual's cognitive beliefs (e.g., perceived usefulness, perceived ease of use) (Davis 1989).

Next, this study examines the interactive effect of information presentation and style of processing on the intention to explore BIS functions. Although the hypothesized 2-way interaction effect was not observed in the result, I found that the 3-way interaction of information presentation, task type, and style of processing significantly influenced users' intention to explore BIS functions through PU. This finding implies that the interactive effect of information presentation and style of processing may exist but it may be too weak to observe. This also suggests the necessity for future IS research to further examine the moderating effect of information presentation and style of processing on system exploration behaviors.

The present study goes one step further by investigating the 3-way interactive effect on users' intention to explore BIS functions through the mediator of PU. This is one of a few studies that examines information systems usage phenomena from the lens of regulatory compatibility (Bless and Keller 2008). This study applies the regulatory compatibility to examine the effect of personal characteristic as style of processing. The findings suggest that users display higher perceived usefulness of BIS when experiencing cognitive fit of information presentation and task type and regulatory compatibility of information presentation and style of processing, and that users with higher perceived usefulness are more willing to explore BIS functions.

Furthermore, this study applies the cognitive fit theory to evaluate the 2-way interactive effect of information presentation and style of processing and 3-way interactive effect of information presentation, task types, and style of processing on task time. Interestingly, I found that users who experienced a state of regulatory compatibility between information presentation (e.g., text-based) and style of processing (e.g., verbal) actually spend more time on the tasks. One explanation is that users who enjoy a state of regulatory compatibility are willing to spend additional time on the tasks or activities (Csikszentmihalyi 2000, Keller and Bless 2008). Moreover, the 3-way interaction effect also exerts significant influence on users' task time. In particular, for text-based information presentation, users in scenario 3 (spatial tasks & verbal style of processing) spend longer task time than users in other scenarios, whereas for visual information presentation, users in scenario 4 (spatial tasks & visual style of processing) spend longer task time than users in other scenarios. In other words, users who experience regulatory compatibility are willing to spend more time engaging in the activities (Keller and

Bless 2008). Meanwhile, spatial tasks that involve comparison between data values which may demand more cognitive efforts (Dennis and Carte 1998), making users spend more time on performing spatial tasks. In this regard, this study advances our knowledge on the predictors of task time spent on BIS-related tasks.

Finally, this study responds to the call for investigating BIS related issues (e.g., Chen et al. 2012). The empirical studies on BIS usage and its interface design have received limited attention (e.g., Chen et al. 2012). With a particular focus on the interactive effect of information presentation and task type, interactive effect of information presentation and style of processing, and the 3-way interactive effect of information presentation, task type, and style of processing, this study has critical implications concerning the direction of BIS implementation and BIS interface design. The findings suggest that BIS users show stronger intentions to explore BIS functions when they experience cognitive fit and regulatory compatibility.

6.3 Managerial Implications

Apart from the theoretical contributions, this study also provides guidance for the interface design and organizational BIS implementation.

Firstly, when organizational users experience a cognitive fit between information presentation and task type, they can make less cognitive effort to solve the tasks at hand (Dennis and Carte 1998; Vessey 1990; Vessey and Galletta 1991). To help solve organizational users' difficulty with the usage of BIS functions, managers are advised to pay attention to the congruency of the interface design of

BIS and the task. When a cognitive fit occurs, users may display higher perceived usefulness of BIS and perceived ease of use, and thus are more willing to explore the BIS functions (Maruping and Magni forthcoming; Nambisan et al. 1999). Hence, users are more likely to explore and employ a broader set of BIS functions in their work, resulting in extensive and in-depth utilization (Jasperson et al. 2005). Actually, the full benefits of a system can be achieved when users explore and take advantage of a broader range of system features to support their work (Schwarz 2003). Users with higher intention to explore are willing to incorporate more IS features, and they are motivated to leverage the value potential of the implemented IS to an advanced level (Maruping and Magni forthcoming, Nambisan et al. 1999).

Secondly, managers may give emphasize on the compatibility between the interface design of BIS and the users' style of processing. In particular, managers could gauge the employees' preference of information processing, and then provides the corresponding information presentations to each employee according to their preferences. When users experience a state of regulatory compatibility, they will be more engaged in their tasks at work, and enjoy their tasks more, feel the tasks they conduct rewarding, and are willing to make more effort and spend more time on the tasks (Csikszentmihalyi 2000; Keller and Bless 2008; Nakamura and Csikszentmihalyi 2002). In this case, they may be stimulated to accomplish their tasks better using the BIS. Hence, the economic return of information systems can be better realized (Jasperson et al. 2005).

Finally, users exhibit strongest perceived usefulness and intention to explore BIS when experiencing both cognitive fit and regulatory compatibility.

Toward this end, managers may balance the interface design in order to achieve both the cognitive fit between the information presentation and task and the regulatory compatibility between information presentation and style or processing. Additionally, the findings suggest that users with visual information presentation are more willing to explore BIS functions. To increase users' intention to explore BIS, managers may offer more visualized and entertaining user interfaces of BIS to their employees (Venkatesh 1999).

6.4 Limitations and Future Research

Although this study offers interesting insights into the users' intention to explore BIS functions, a number of limitations must be considered and addressed in future research. Frist, this study uses undergraduate and postgraduate students as subjects, thus the results may not be generalizable to a broader population. Criticisms related to undergraduate or postgraduate student subjects center around their domain expertise (Speier and Morris 2003), since they may not have relevant working experience on BIS usage or data analysis. In this regard, this study uses elementary tasks (e.g., data extraction and data comparison) which would be appropriate to a student population. In addition, the research findings based on the elementary tasks are easy to be generalized. Furthermore, subjects viewed a video clip which introduced BIS functions and their job as data analysts in the beginning of the experiment, which can enhance student subjects' understanding about the BIS and their job context. However, it would be worthwhile in future studies to recruit data analysts who apply BIS to support their work as the subjects for this experiment. This may help ascertain the experimental findings.

Second, the design of BIS is relatively simple compared to BIS used in the organizations. Subjects can only view the function of record which presents the sales growth rates of two companies, but cannot operate with other functions or interact with the BIS. Using only one single function (e.g., records) in BIS may limit the generalizability of results to other functions of BIS. However, the simplified BIS design can enhance the internal validity of the experiment, since other exogenous variables that can interact with variables tested in this study are controlled. The BIS interface presents the main features of business intelligence, such as predictive analysis, competitive analysis, and online analytical analysis. Thus, it is believed that the BIS design in this study displays the essentials of BIS functions and preserve internal validity at the same time. Nonetheless, a more realistic and complex BIS can provide more practical experience to subjects. At such, future studies can design a more complicated BIS interface which can be similar to the BIS in the organizations. At the same time, researchers need to be cautious, since they need to strike a balanced between information given by the visual information presentation and information given by text-based information presentation.

Third, the current study mainly employs self-reported measures, thereby the research findings are likely to be biased by common method variance. Future studies can use the observational techniques, such as eye tracking machines and the functional magnetic resonance imaging to capture subjects' behavioral responses and explorative intentions. Using data from multiple sources (e.g., self-reported, eye tracking data, functional magnetic resonance imaging data) can eliminate the issue introduced by common method variance.

Finally, the current study investigates the text-based and visual interface design of BIS. More extensive studies are needed to examine the design factors such as color, interaction, links, and visual complexity. Additionally, this study concentrates on users' intention to explore BIS functions. Other possible outcomes for future research could include extended use of BIS, innovation with BIS, individual job performance, and team performance. This study may serve as a starting point for developing the effects of BIS information presentation design on intention to explore BIS functions. As BIS has become increasingly pervasive within organizations, this stream of research is of vital importance.

Chapter 7 Conclusion

This study aims to understand the antecedents of users' intention to explore BIS functions. These antecedents include information presentation, task type, and style of processing. Drawing upon the cognitive fit theory and the theory of flow and regulatory compatibility, an interactive moderation model has been proposed to examine the 2-way interactive effect of information presentation and task type, the 2-way interactive effect of information presentation and style of processing, and the 3-way interactive effect of information presentation, task type, and style of processing on users' intention to explore BIS functions.

An experiment has been conducted in a laboratory, and 297 effective data sets have been gathered and used for hypothesis testing. The results show that: 1) The 2-way interactive effect of information presentation and task type can influence the users' intention to explore IBS functions through perceived usefulness of BIS and perceived ease of use; 2) the 3-way interactive effect of information presentation, task type, style of processing can influence the users' intention to explore BIS functions through perceived usefulness of BIS; 3) the information presentation can influence the users' intention to explore BIS functions directly or indirectly through perceived usefulness and perceived ease of use; 4) the 2-way interactive effect of information presentation and task type can influence users' task performance and decision time; 5) the 2-way interactive effect of information presentation and style of processing can influence user' decision time; 6) the 3-way interactive effect of information presentation, task type, and style of processing can influence users' decision time. Based on these findings, a revised research model has been proposed.

Overall, the findings reveal that: 1) when users experience a cognitive fit between information presentation and task type, they display higher perceived usefulness and perceived ease of use, and thus are more willing to explore BIS functions; 2) when users experience a regulatory compatibility between information presentation and style of processing, they are willing to spend additional time engaging in a state of compatibility; 3) when users experience a cognitive fit and regulatory compatibility at the same time, they display the strongest perceived usefulness toward the BIS, and thereby display stronger intention to explore BIS functions.

Appendices

In this section, the online survey for the experiment is presented.

Department of
MANAGEMENT
& MARKETING
管理及市場學系

CONSENT TO PARTICIPATE IN THIS RESEARCH

I understand that information obtained from this research may be used in future research and published. However, my right to privacy will be retained, i.e. my personal details will not be revealed.

My participation in the project is voluntary. I acknowledge that I have the right to question any part of the procedure and can withdraw at any time without penalty of any kind.

If you have read and agreed with the above information, please click the “>>” at the bottom to go to the next page.

Please tell us to what extent you agree with the following statements.

	Always false	Usually false	Usually true	Always true
I enjoy doing work that requires the use of words.	○	○	○	○
I can find the right word when I need it.	○	○	○	○
I do a lot of reading.	○	○	○	○
I think I often use words in the right way.	○	○	○	○
I enjoy learning new words.	○	○	○	○
I often make written notes to myself.	○	○	○	○
I like to think of synonyms for words.	○	○	○	○
I like learning new words.	○	○	○	○
I prefer to read instructions about how to do something rather than have someone show me.	○	○	○	○
I prefer activities that require a lot of reading.	○	○	○	○
I spend much time trying to increase my vocabulary.	○	○	○	○

Please tell us to what extent you agree with the following statements.

	Always false	Usually false	Usually true	Always true
There are some special times in my life that I like to relieve by mentally "picturing" just how everything looked.	○	○	○	○
When I'm trying to learn something new, I'd rather watch a demonstration than read how to do it.	○	○	○	○
I like to picture how I could fix up my apartment or room if I could buy anything I wanted.	○	○	○	○
I like to daydream.	○	○	○	○
I generally prefer to use a diagram rather than a written set of instructions.	○	○	○	○
I like to doodle (unfocused or unconscious drawings).	○	○	○	○
I find it helps to think in terms of mental pictures when doing many things.	○	○	○	○
After I meet someone for the first time, I can usually remember what they look like, but not much about them.	○	○	○	○
When I have forgotten something I frequently try to form a mental "picture" to remember it.	○	○	○	○
I often daydream.	○	○	○	○
My thinking often consists of mental "pictures" or images.	○	○	○	○

Please tell us to what extent you agree with the following statements on <u>your perception about the innovation of information technology</u>.

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
If I heard about a new information technology, I would look for ways to experiment with it.	○	○	○	○	○	○	○
Among my peers, I am usually the first to try out new information technologies.	○	○	○	○	○	○	○
I like to experiment with new information technologies.	○	○	○	○	○	○	○
In general, I am willing to try out new information technologies.	○	○	○	○	○	○	○

Assume that you work as a data analyst in a company. The responsibilities of a data analyst include processing and analyzing data for problem solving and decision making (e.g., analyzing figures of sales growth rate). You may use the functions of business intelligence (BI) system, such as reports, competitive analysis, and predictive analysis to support your work. Now you will watch a short video clip about an interface of the BI system.

Please put on the headphones at your station now.When you are ready, click play to watch the clip.

Treatment 1: text-based information presentation & symblic task

Business Intelligence System

Home Reports Predictive Analysis Comptitive Analysis Online Analytical Processing

Sales growth rate of product A and product B

Year	Sales growth rate of Product A	Sales growth rate of Product B
1990	19%	24%
1991	20%	26%
1992	21%	30%
1993	18%	24%
1994	24%	20%
1995	33%	26%
1996	20%	24%
1997	19%	31%
1998	18%	32%
1999	17%	36%
2000	19%	24%
2001	20%	25%
2002	29%	38%
2003	27%	36%
2004	22%	33%
2005	22%	23%
2006	27%	36%
2007	24%	30%
2008	30%	26%
2009	37%	25%
2010	21%	28%

Please complete the four tasks based on the information given by the business intelligence system (BIS) and **input your answers in the percent format (e.g., 30%)**.

What was the sales growth rate of product A in 1999?

What was the sales growth rate of product B in 2007?

What was the sales growth rate of product A in 2002?

What was the sales growth rate of product B in 1996?

Treatment 2: text-based information presentation & spatial task

Business Intelligence System

Home Reports Predictive Analysis Comptitive Analysis Online Analytical Processing

Sales growth rate of product A and product B

Year	Sales growth rate of Product A	Sales growth rate of Product B
1990	19%	24%
1991	20%	26%
1992	21%	30%
1993	18%	24%
1994	24%	20%
1995	33%	26%
1996	20%	24%
1997	19%	31%
1998	18%	32%
1999	17%	36%
2000	19%	24%
2001	20%	25%
2002	29%	38%
2003	27%	36%
2004	22%	33%
2005	22%	23%
2006	27%	36%
2007	24%	30%
2008	30%	26%
2009	37%	25%
2010	21%	28%

Please complete the four tasks based on the information given by the business intelligence system (BIS) and input your answers (e.g., 1990) accordingly.

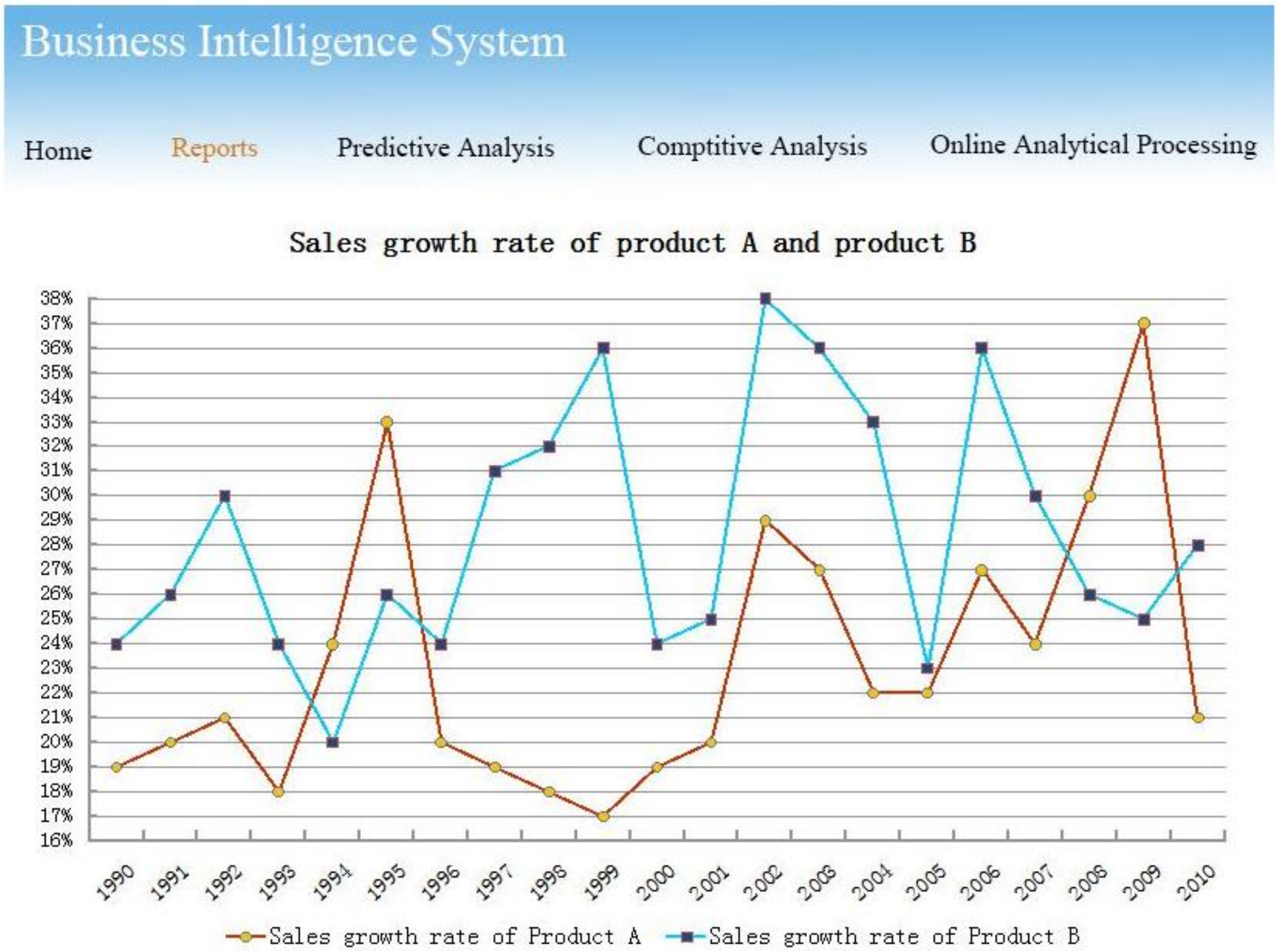
Please compre the sales growth rate of Product A and that of Product B. In which year was their difference the greatest?

Please compare the sales growth rate of Product A and that of Product B. In which year was their difference the smallest?

In which year did product A have the greatest sales growth rate?

In which year did product B have the smallest sales growth rate?

Treatment 3: Visual information presentation & symbolic task



Please complete the four tasks based on the information given by the business intelligence system (BIS) and **input your answers in the percent format (e.g., 30%)**.

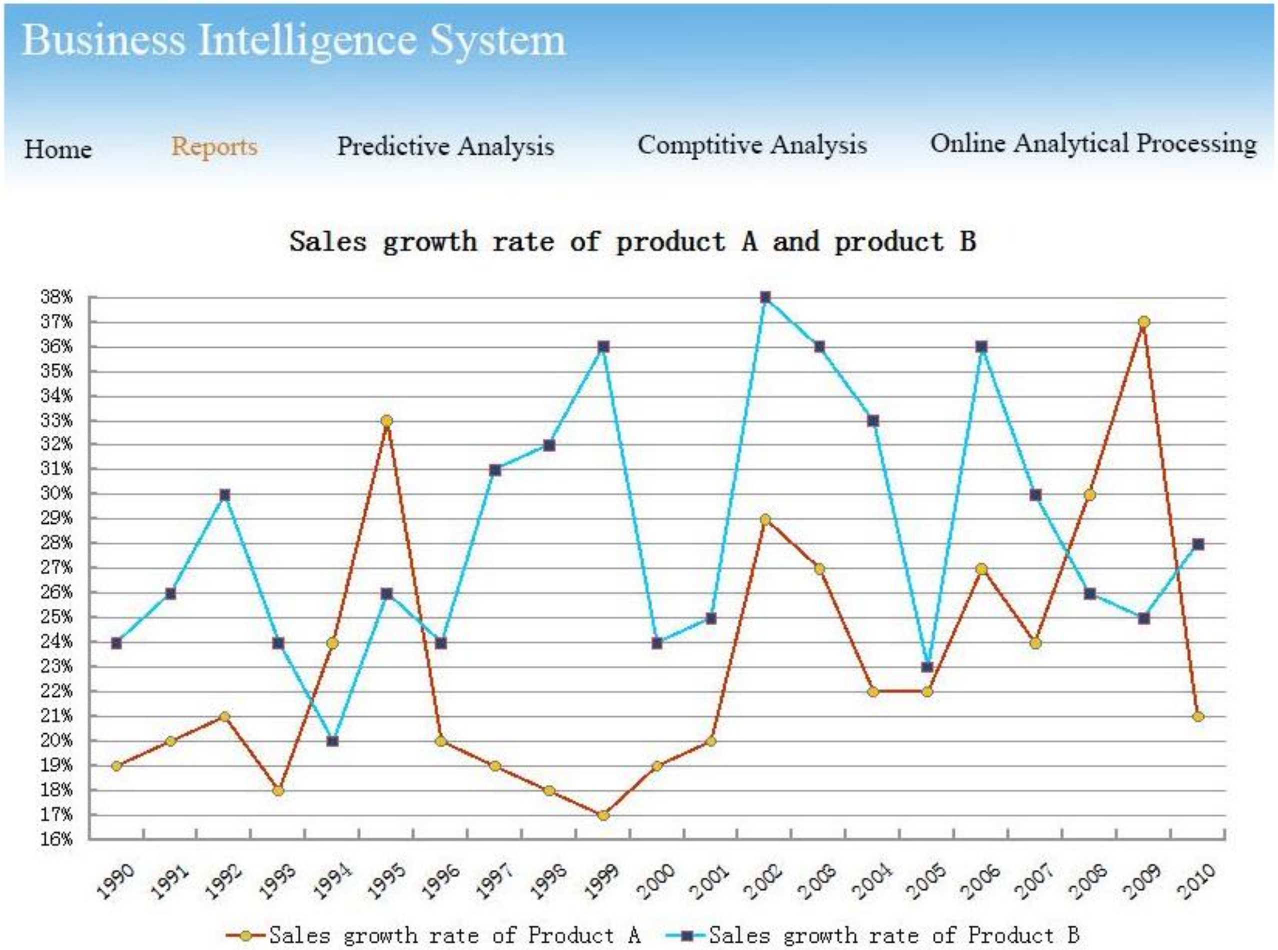
What was the sales growth rate of product A in 1999?

What was the sales growth rate of product B in 2007?

What was the sales growth rate of product A in 2002?

What was the sales growth rate of product B in 1996?

Treatment 4: Visual information presentation & spatial task


Business Intelligence System
Home
Reports
Predictive Analysis
Comptitive Analysis
Online Analytical Processing
Sales growth rate of product A and product B
Sales growth rate of Product A
Sales growth rate of Product B

Please complete the four tasks based on the information given by the business intelligence system (BIS) and input your answers (e.g., 1990) accordingly.

Please compre the sales growth rate of Product A and that of Product B. In which year was their difference the greatest?

Please compare the sales growth rate of Product A and that of Product B. In which year was their difference the smallest?

In which year did product A have the greatest sales growth rate?

In which year did product B have the smallest sales growth rate?

The tasks you just performed involve

- ◯ data extraction (i.e., identify specific values from the BI system).
- ◯ data comparison (i.e. compare the data of product A with that of product B).

The interface of the BI system you just looked at is

- ◯ a text-based interface using a table to present the information.
- ◯ a graphic interface using a figure to present the information.

Please tell us to what extent you agree with the following statements on your perception about the business intelligence (BI) system.

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Using the BI system allows me to accomplish my work quickly.	○	○	○	○	○	○	○
Using the BI system allows me to improve my work performance.	○	○	○	○	○	○	○
Using the BI system allows me to perform my work efficiently.	○	○	○	○	○	○	○
Using the BI system allows me to perform my work productively.	○	○	○	○	○	○	○
Using the BI system makes it easy to complete my work.	○	○	○	○	○	○	○
Overall, I find the BI system useful for accomplishing my work.	○	○	○	○	○	○	○

Please tell us to what extent you agree with the following statements on <u>your interaction with the business intelligence (BI) system.</u>

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
My interaction with the BI system is clear and understandable.	○	○	○	○	○	○	○
Interacting with the BI system does not require a lot of mental efforts.	○	○	○	○	○	○	○
I believe the BI system is easy to use.	○	○	○	○	○	○	○
I believe it is easy to get the BI system to do what I want it to do.	○	○	○	○	○	○	○
It is easy for me to become skillful in using the BI system.	○	○	○	○	○	○	○
Overall, I believe the BI system is easy to use.	○	○	○	○	○	○	○

Please tell us to what extent you agree with the following statements about <u>your decision effort in your work.</u>

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
It is frustrating to use the business intelligence (BI) system to complete my work.	○	○	○	○	○	○	○
It takes much time to use the BI system to complete my work.	○	○	○	○	○	○	○
It takes much effort to use the BI system to complete my work.	○	○	○	○	○	○	○
It is complex to use the BI system to complete my work.	○	○	○	○	○	○	○
I can hardly find the information I look for in the BI system.	○	○	○	○	○	○	○
It is difficult to use the BI system to complete my work.	○	○	○	○	○	○	○

Assume that you will continue working as a data analyst in your company. Please tell us <u>your intention to explore the business intelligence (BI) system,</u> based on your interaction with it.

	Strongly Disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
I intend to explore how the functions in the BI system (e.g., reports, predictive analysis, competitive analysis etc.) can be used in my work.	○	○	○	○	○	○	○
I intend to explore other ways that the functions in the BI system may enhance the effectiveness of my work.	○	○	○	○	○	○	○
I intend to spend time and effort in exploring the functions in the BI system for potential applications in my work.	○	○	○	○	○	○	○

Please answer the following questions about yourself.

Your Gender is

- ◯ Male
- ◯ Female

Your age is

[▾]

How familiar are you with spreadsheets (e.g., Microsoft Excel)?

Not at all 1	2	3	4	5	6	Very familiar 7
◯	◯	◯	◯	◯	◯	◯

How familiar are you with statistical softwares (e.g., IBM SPSS, SAS, R, STATA)?

Not at all 1	2	3	4	5	6	Very familiar 7
◯	◯	◯	◯	◯	◯	◯

How familiar are you with data management systems (e.g., Oracle、 Microsoft SQL Server、 Access、 MySQL)?

Not at all 1	2	3	4	5	6	Very familiar 7
◯	◯	◯	◯	◯	◯	◯

Do you have work experience or project experience on data analysis?

◯ Yes

◯ No

This survey is over. Please press the >> button below to proceed to the last page, otherwise your data will not be recorded.

Your data will be kept completely anonymous and confidential. Presentation of the results of this study will be in aggregate form only (i.e., individual responses will not be reported). Given that this study is ongoing, I would appreciate it if you do not disclose the contents of the study to other students who may be participants in the study.

Once again, thank you for your participation.

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