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DETERMINANTS OF E-CONSUMER PRODUCTIVITY ON A COMMERCIAL WEBSITE: AN EXPERIMENTAL APPROACH

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Abstract:

The purpose of this paper was to investigate the determinants of e-consumer productivity on a virtual store. This study drew on research dealing with consumer productivity, information retrieving and website design. A 2x2x2 online experiment with a sample of 350 participants was conducted. Results showed that e-consumer productivity depended on individual characteristics (e.g., Internet experience, cognitive absorption, and product category familiarity) and on interactions between the type of strategy used, the nature of the task and the website design.

Key words: *e-consumer productivity, site design, online experimentation, cognitive absorption, site complexity.*

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1. Introduction

When consumers visit Internet shops with the intention to make a purchase, many of them don't complete the transaction and abandon their intent prematurely (Cho, 2004; Hausman and Siekpe, 2009; Kukar-Kinney and Close, 2010). Ranganathan and Grandon (2005) state that 43% of attempted online purchases fail because the consumer had trouble finding the product on the website. Ng (2003) noted that although the consumer is freed from moving and physical efforts are reduced to mouse clicks, online shopping does not mean that a consumer cannot get lost. When shopping on a website, consumers must be able to understand the organisation and information structure of the site, predict the links to follow, and easily read the presented content to successfully complete a purchase (Sicilia and Ruiz; 2009).

Indeed, problems connected to navigation and product retrieval within a website seem to be one significant obstacle to online purchasing (Markellou et al., 2005; Kalczynski et al., 2006). Difficulties related to product identification and appraisal seem more and more intense given the diversity of the offer (product or service), the impossibility of touching or feeling the product, and the inability for interaction with a salesperson (Pan and Zinkhan, 2005; Punj and Moore 2009). On the one hand, these difficulties and problems prevent the consumer from finding the product that fits his (her) needs. On the other hand, they make the online shopping process longer and harder, reducing considerably consumer productivity (Igene, 1984)[1]. Thus, identifying driving forces and inhibitors of online consumer productivity will help online

[1] Ingene (1984) considered that productivity from a consumer perspective is measured by the ratio of outputs divided by inputs. More details on the consumer productivity concept are given in section 2.1.

retailers better understand e-shoppers' behaviour and create more consumer-friendly and effective websites.

Previous studies from different research fields have addressed various aspects of shopping online related to consumer productivity and laid a theoretical groundwork that guided us in determining which factors affected consumer productivity in the online buying process. However, to our knowledge, none of them were designed specifically to examine determinants (drivers and inhibitors) of e-consumer productivity.

Hence, the purpose of the present research is to fill this gap in the literature. More specifically, this study investigated factors affecting consumer productivity on a commercial website. Considering that when individuals engaged in online shopping are simultaneously consumers shopping for products as well as users of an IT (i.e. Information Technology) artefact (Xiao and Benbasat, 2007) and that designing web-based stores involves the application of knowledge from different fields including marketing, information systems and human-computer interaction (Tractinsky and Lowengart, 2007), we integrated research findings from different areas to propose and test a conceptual model of "e-consumer productivity".

Adopting the point of view of previous researches on information retrieving on the web (Chen et Rada, 1996; Topi et al., 2005; Schaik and Ling 2006), shopping productivity (Ingene, 1984; Xue, et al.2007; Anitsal and Schumann 2007), website atmospherics (Eroglu et al., 2003; Richard, 2005) and website complexity (Bruner and Kumar, 2000; Geissler et al., 2001; Gupta et al., 2005), we considered "e-consumer productivity" to depend on situational, individual and website characteristics, and interactions between these elements. The potential effects on e-consumer productivity are then presented and experimentally tested. This paper contributes to the academic literature by examining the antecedents of e-consumer productivity in a single model. The research offers implications for online retailers with respect to increasing conversion rates from online shopping to buying.

In the subsequent sections, we begin by introducing the concept of "e-consumer productivity". We then present the effects of situational, individual and site characteristics on online consumer productivity. A six-hypothesis conceptual model is then developed and tested using experimental data. We conclude with a discussion of our results, their contributions and limits, and the implications for future research.

2. E-consumer productivity

To retrieve the desired product in a brick-and-mortar context, the consumer must identify the space-time point where this product is available by identifying and selecting a commercial interface acceptable for distributing the product and by decoding the specific product category organisation proposed by the commercial interface. However, failure in identifying the category within the global assortment offered by the store or orientation problems within the store can lead the consumer to abort the purchasing process (Moles and Rohmer, 1977; Chebat et al., 2005).

As for brick-and-mortar shopping, the consumer visiting an e-commerce site is not immune to failure. When online, the shopper must be able to execute several tasks: understanding the site interface, reflecting on information needs, and progressing in resolution of the problem that led to the site visit (Sicilia and Ruiz, 2009). So even if the virtual setting of the Web frees the consumer from time and space constraints, finding what one is looking for can difficult or impossible if the classification system presented on the site's interface is not understood (Ingwersen, 1996). A less usable website inhibits the retrieval of the most important information (Nielsen, 1993) and thus reduces e-consumer productivity. Among various concepts dealing with consumer-interface interactions such as expertise or search skills, the concept of e-consumer productivity is then related to the ability of the individual to retrieve information that is necessary for product purchase from the website. This information includes, but is not limited to, product description, price, image, payment type, delivery methods, and after sale support.

Taking into account that on the Internet, the consumer is at the same time “a customer on a (virtual) store” and “a user of an information system” (Xiao and Benbasat 2007), two approaches can be adopted to study e-consumer productivity. The first one comes from the service marketing literature and is related to the concept of consumer productivity; the second one is IS (i.e. Information Systems) driven and refers to online search performance.

2.1 Consumer productivity

Drawing on the work of Cox (1948) and Anitsal and Schumann (2007) indicated that the definition of productivity is context-dependent and that there is no single meaning attached to this term. Classical productivity analysis in economics is related to manufacturing and uses the relationship (e.g., the ratio) between outputs generated from a system (goods, services) and inputs (labour, capital, equipment, facilities) used to create those outputs (Xue and Harker, 2002; Anitsal and Schumann, 2007). Marketing literature dealing with productivity from a consumer perspective is abundant and a plethora of terms have been used for this purpose: shopping productivity (Ingene, 1984), client productivity (Martin, Horne and Chan, 2001), customer efficiency (Xue and Harker, 2002; Xue, Hitt and Harker, 2007) and customer productivity (Johnston and Jones, 2004 ; Anitsal and Schumann 2007).

Ingene (1984) was the first to introduce productivity from a consumer perspective with the concept of “shopping productivity”. Ingene (1984) considered that in manufacturing, productivity in shopping is measured by the ratio of outputs divided by inputs. Outputs of shopping are products purchased, information acquired, and the pleasure obtained from shopping. Inputs are time, money, and cognitive and emotional effort (Ingene, 1984). Considering the customer as a service co-producer, Xue and Harker (2002) proposed the customer efficiency concept. They established a parallel between customer efficiency and the more classical concept of employee productivity, and defined customer efficiency as follows: "Customer A is evaluated as more efficient than Customer B if Customer A consumes fewer inputs to produce at least the same amount of certain outputs as Customer B, or if Customer A produces more outputs using at most the same amount of certain inputs as Customer B" (p. 256). Xue and Harker (2002) further indicated that in an online service coproduction context, time is the major customer input.

Criticising at the same time the manufacturing approach toward productivity and Xue and Harker's (2002) work on consumer efficiency, Anitsal and Schumann (2007) developed the concept of consumer productivity. They considered that regardless of some interesting aspects in their work, Xue and Harker (2002) used the concepts of efficiency and productivity in an interchangeable way, creating confusion between the two concepts. In their own research, Anitsal and Schumann (2007) opted for the use of consumer productivity rather than consumer efficiency. They presented an approach to productivity that associated both the manufacturing and the service orientations with productivity. They further indicated that manufacturing oriented toward productivity is more related to "efficiency" and the "input side of the system". In contrast, service oriented toward productivity is more focused on "effectiveness" and "the output side of the system".

Anitsal and Schumann (2007) also presented effectiveness and efficiency as two complementary and multiplicative dimensions of consumer productivity: "neither is enough by itself". They considered that during shopping episodes, customers pay attention to their individualistic productivity and are generally conscious of how they spend and save their inputs (time, money, and effort). Anitsal and Schumann (2007) continued to define effort as "the amount of energy put into behaviour or a series of behaviours", and differentiated between three types of customer efforts: physical effort, cognitive effort, and emotional effort. Effort and time represented the major component of customer labour, and consumers were expected to limit their labour by increasing their savings of time and effort (Anitsal and Schumann, 2007).

Thus, we could conclude from the first approach used to study e-consumer productivity that independently of the terms used (i.e., shopping productivity, client productivity, customer efficiency, and customer productivity), effectiveness and efficiency seem to be the best representative dimensions of productivity from an e-consumer point of view.

2.2 Online earch performance

The second approach for studying e-consumer productivity on a commercial website considered the consumer as an IS user and, more specifically, an information searcher. From this perspective, it was clear that literature on online search behaviour could be very helpful. In accordance with works on consumer productivity, online searching behaviour literature presents two generic categories of variables used to measure online search performance: search outputs and search outcomes (Ondrusek, 2004). Other authors, such as Topi et al. (2005), highlighted that prior studies evaluated two aspects of performance: correctness and time. In the same line of reasoning, Schaik and Ling (2006) assessed task performance in terms of speed (time-on-task) and efficiency (number of pages loaded), while Turetken and Sharda (2001) considered online end-user success to have two dimensions: effectiveness and efficiency. They explained that effectiveness is a measure of how desirable the user's outcomes are, whereas efficiency refers to how well one uses the available inputs in producing those outcomes.

These findings were in perfect harmony with those presented by Anitsal and Schumann (2007) on consumer productivity, discussed above. They are also in accordance with website usability investigations presenting effectiveness, efficiency and satisfaction as the main formal indicators of site usability. Villey-Migraine (2004) defined effectiveness as the capacity of a device or an individual to reach a given objective, and defined online task efficiency as the ability to realise a task with a minimum of effort. In general, therefore, a decrease in effort leads to an increase in efficiency.

However, Xia and Sudharshan (2002) and Kumar et al. (2005) considered that effectiveness and efficiency were insufficient as indicators and proposed to integrate time into performance measures. In the same vein, Limayem et al. (2000) indicated that time saving was a major perceived outcome of online shopping. Moreover, Hostler, Yoon and Guimaraes (2005) presented time as an IS user performance and Xiao and Benbasat (2007) highlighted the importance of time in measuring consumer effort in online shopping context

3. Towards a model of e-consumer productivity

Drawing on both consumer productivity and online search performance literature, the present study used three variables to measure e-consumer productivity: effectiveness, efficiency and time. The effects on these variables will then be examined against three categories of determining variables that affect online consumer behaviour and information searching: (1) site design, (2) user characteristics and (3) situational characteristics (Chen and Rada, 1996; Hsieh-Yee, 2001; Eroglu et al., 2003; Richard, 2005; Gehrt and Yan, 2004; Kumar et al. 2005; Xiao and Benbasat, 2007).

3.1 Situational characteristics

Consumer situations are all those factors that are specific to a certain time and place of observation, and can change consumer decisions once they are inside the store (Rads and Anic, 2007). As such, Gehrt and Yan (2004) claimed that situational factors have a significant influence on online purchasing success. One prominent situational factor shown to impact online shopping behaviour, and consequently performance, is the interaction between task strategy (or behavioural strategy) and task nature (Hsieh-Yee, 2001, Nadkarni and Gupta, 2007).

Considering the first element of this interaction, Wood (1986) identified four distinct theoretical frameworks used in the study of tasks: task qua task[2], task as behaviour requirements, task as behaviour description and task as ability requirements. Wood (1986) indicated that to study task, individual and task effects must be separated and tasks described independently of individuals who perform the task. In this sense, Wood (1986) pointed out that only "task qua task" and "behaviour as requirements" frameworks clearly satisfy this requirement. Wood (1986) further specified that using a combination of both frameworks leads to the assumption that tasks contain three essential components: products, acts, and information cues. Products are the output of the task, and acts and information cues are the two types of task input components.

In the online context, some researches classify tasks into two distinct categories: goal-directed and experiential (Nadkarni and Gupta, 2007; Hoffman and Novak 1996; Novak et al. 2003). Rosenfeld and Morville (1998) considered that most search tasks performed by Internet users fell into three categories: specific search task, non-specific search task and general browsing. Additionally, Marchionini (1989) classified tasks as closed or opened. While closed tasks entail specific purposes, opened tasks have more general purposes. Furthermore, Shneiderman

[2] In the "task qua task" framework, "*the task is described as a class of phenomena that are totally independent of individual phenomena*" (Wood, 1986).

(1997) specified that in a controlled experiment, it is very difficult to measure the outcomes of a loosely defined objective (such as general or experiential browsing). For this reason, the majority of experiments in the area use only opened and closed tasks (Hsieh-Yee, 2001). Considering the second element of the interaction, task strategy can be defined as "the process that individuals use to accomplish a task" (Verner, 2001). Research suggests that differences in task nature induce users to adopt separate mechanisms as they interact with the online environment (Hoffman and Novak 1996; Schlosser 2003, Nadkarni and Gupta, 2007). With respect to task strategy, Nielsen's (1997) work distinguished between three information-seeking strategies: the search-dominant strategy, the link-dominant strategy and the mixed strategy. He explained that a consumer using a search-dominant strategy goes straight for the search button of the browser. That is, the consumer's site behaviour is dominated by search engine use. In contrast, in the link-dominant strategy, consumers use hyperlinks on the site almost exclusively.

As noticed previously, interaction between strategy and task nature has been identified as fundamental. Nadkarni and Gupta (2007) specified that when goal-directed users face complexity, they might employ a strategy relying on search functions available on the site. In contrast, users executing less closed tasks may use more link-based strategies to face complexity. In addition, Tabatabai and Shoreb (2005) demonstrated that the kind of strategy used, together with the nature of the task, influenced the performance of a closed search, while Tung et al. (2003) found that when an opened task was performed, the use of a search engine had a negative impact on search effectiveness (i.e., the capacity to reach a given objective). On the other hand, a site with no search engine capability will hamper closed task executions. Kim and Allen (2002) specified that search efficiency was strongly dependent on how well the adopted (information seeking) strategy fit with the specific task.

More recently, the exploratory results of Authors (2006) indicated that for a closed search task, the adoption of a dominant search strategy (based on the use of search functions) leads to better efficiency than the use of a links based strategy. In other words, the type of strategy used affects effectiveness and efficiency level (Tabatabai and Shoreb, 2005; Authors, 2006), and consequently the e-consumer productivity, but this effect depends on the nature of the executed task (Kim and Allen, 2002, Nadkarni and Gupta, 2007). Specifically, we could conclude that search (engine) dominant strategies fit better than link dominant strategies with closed tasks, but less so with opened tasks (Tung and al, 2003). Therefore, we formulated the following hypothesis:

H1: The impact of the adopted strategy type on e-consumer productivity depends on task nature;

H1.a: When a closed task is performed, the use of a "search dominant strategy" leads to better productivity and the use of a "links dominant strategy" leads to weaker productivity.

H1.b: When an opened task is performed, the use of a "links dominant strategy" leads to better productivity and the use of a "search dominant strategy" leads to weaker productivity.

3.2 Individual characteristics

Scholars in psychology and sociology, and recently management and marketing, have demonstrated that an individual's characteristics are a major source of factors affecting the formation of the individual's shopping behaviour. As we underlined previously, the present work is meant to be a collaborative work, considering the variety of approaches and disciplines that can help in the study of e-consumer productivity. Considering the multitude and diversity of individual variables affecting consumer behaviour on the Web, we take into account only variables benefiting from a certain consensus in the literature independently of the adopted approach (e.g., Internet experience, product category familiarity and cognitive absorption).

Experience is recognised in IS literature as an important contingent factor affecting user performance (Wood, 1986; Khalifa and Liu, 2007). In a large literature review, Ondrusek (2004) found that Internet experience is one of the most cited determinants of online user behaviour. Similarly, O'Cass and Fenech (2003) presented network familiarity as a main factor that influenced Internet consumer behaviour. More precisely, and specifically concerning the effect of Internet experience on information searching, Khan and Locatis (1998) examined the search performance of novices and experts and found that experts exhibited better ability to prioritise search tasks. Furthermore, Hsieh-Yee (1993) concluded that in online searching, experience positively affects search performance. Specifically, Chang (2008) indicated that experience allowed individuals to better understand interrelationships between elements of the task stimulus and helped them distinguishing relevant from irrelevant information, leading to better efficiency. In addition, experience with the Internet makes information searching much less time and effort consuming (Laroche and al., 2005).

We could therefore conclude from both marketing and IS literature (Khan and Locatis, 1998; Laroche and all. 2005; and Chang, 2008) that Internet experience positively affects e-consumer productivity. More precisely, it is expected that higher Internet experience will lead to better efficiency and less time in executing tasks on a commercial website. We thus formulated the following hypothesis:

H2: Internet experience positively affects "e-consumer productivity";

H2.a: Higher Internet experience leads to better efficiency in executing tasks on a commercial website.

H2.b: Higher Internet experience leads to less time duration in executing tasks on a commercial website.

In addition to Internet experience, other researches concluded that another factor necessary to improve information-seeking performance was domain familiarity, which is related to the topic area of a specific Web search (Holscher and Strube, 2000; Nysveen and Pedersen, 2005). In an online shopping context, domain familiarity can be viewed as product category familiarity.

In general, persons with high product familiarity are more capable of acquiring relevant information on a site. They are also more likely to know where they can find suitable information and will then be more effective in their search (Brucks, 1985).

In the precise situation of an online search task, Nadkarni and Gupta (2007) indicated that individuals who were familiar with a task domain limited their attention to task-related information, thus minimising their efforts and improving their efficiency. Meanwhile, Mazursky and Vinitzky (2005) stipulated that product category familiarity would cause a decrease in online shopping duration. Finally, Swaminathan (2003) stated that consumers with a higher level of category knowledge were more efficient in searching online information than consumers with lower levels of knowledge. According to the same line of reasoning, we expected that online shopping familiarity would improve effectiveness (Brucks, 1985), efficiency (Nadkarni and Gupta 2007; Swaminathan (2003) and reduce shopping duration (Mazursky and Vinitzky, 2005). Therefore, we hypothesised that:

H.3: Product category familiarity has a positive impact on e-consumer productivity;

H3.a: A higher level of product category familiarity leads to better effectiveness in executing tasks on a commercial website.

H3.b: A higher level of product category familiarity leads to better efficiency in executing tasks on a commercial website.

H3.c: A higher level of product category familiarity leads to less time executing tasks on a commercial website.

Recently, researchers have noted the importance of intrinsic motivations in understanding online consumer behaviour (Moon and Kim, 2001; Chang and Wang 2008; Chang, 2009), and a number of them have presented flow as a major determinant of e-consumer behaviour (Csikszentmihalyi, 1990; Hoffman and Novak, 1996; Hoffman et al., 2003; Siekpe, 2005; Hoffman and Novak 2009). Flow refers to "the state in which people are so involved in an activity that nothing else seems to matter" (Csikszentmihalyi 1990). Although being a valuable construct, Koufaris (2002) indicated that flow was too broad and ill defined, and argued that this deficiency was the result of the numerous ways used to operationalise and test flow.

Conscious of problems related to flow conceptualisations, and motivated by a need to further examine and incorporate holistic experiences with the Web in an understanding of Web users, Agarwal and Karahanna (2000) defined cognitive absorption as ''a state of deep involvement with software'' (p. 665). According to Agarwal and Karahanna (2000), cognitive absorption can affect online consumer behaviour through its five dimensions of temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity. They indicated that while experiencing temporal dissociation, the individual loses track of time and perceives that there is ample time to complete a task. Focused immersion suggests that all of the attention resources of an individual are focused on the particular task, thereby reducing the level of cognitive burden associated with task performance. Amplified curiosity indicates that the act of interacting with the site invokes excitement about available possibilities (discovering various contents). Such excitement should serve to reduce the perceived cognitive burden associated with the task. A sense of being in charge and exercising control over site interaction also reduces the perceived difficulty in task performance (Agarwal and Karahanna, 2000; Saade and Bahli 2005; Shang et al., 2005). Moreover, Kamis et al. (2010) compared perceived control to the emotional response of dominance in environmental psychology, defined as feeling “unrestricted or free to act in a variety of ways” (Mehrabian and Russell 1974, p. 19).

To summarise, the intrinsically motivating state of cognitive absorption will lower the perceived cognitive burden associated with a task. That is, the individual experiencing pleasure is willing to expend more effort on it (Shang et al., 2005), which can thus improve the offer retrieving effectiveness on a commercial website. In addition, cognitive absorption can affect the time duration of task execution through amplified curiosity and temporal dissociation dimensions. As a consequence, we propose that:

H.4.a: A higher level of cognitive absorption leads to better effectiveness in executing tasks on commercial website offer retrieving.

H.4.b: A higher level of cognitive absorption leads to more time executing tasks on a commercial website.

3.3 Website characteristics

As for situational and individual characteristics, site design elements have been found to have important impacts on web information searching, as they can facilitate or hinder access to important information (Turetken and Sharda, 2001; Robbins and Stylianou, 2003; Resnick and Lergier, 2003; Topi and al., 2005; Zhang and Myers, 2005; Tan and We, 2006). Palmer (2002), Madeja and Schoder (2003) and Ranganathan and Grandon (2005) studied the relationships between website design elements and website performance, and they revealed that website success is closely associated with website design.

Eroglu, et al. (2000; 2001; 2003) specified that website navigation tools play an important role by creating or preventing a pleasant consumer experience. Indeed, Eroglu, et al. (2000; 2001; 2003) developed a model considering that as in the case of their offline counterparts, online stores can also create a shopping environment affecting consumer behaviour. They classified environmental characteristics of a virtual store into two general categories: "high task-relevant cues" and "low task-relevant cues". On one hand, high task-relevant cues refer to "all the site descriptors (verbal or pictorial) that appear on the screen which facilitate and enable the consumer's shopping goal attainment" (Eroglu, et al., 2001). On the other hand, low task-relevant cues represent "all site information that is relatively inconsequential to completion of the shopping task" (Eroglu, et al., 2001). Product description, price, terms of sale, delivery policies, products pictures, product reviews and navigation aids constitute examples of high task-relevant cues. The purpose of these high task-relevant cues is to help the customer in achieving his (or her) shopping goals (i.e., utilitarian aspects). Background patterns, colours, music and animations are examples of low task-relevant cues irrelevant for task completion, but which have a positive effect on the hedonic and experiential aspect of the shopping activity (Eroglu and al., 2000; 2001; 2003).

Building on the online environment model of Eroglu, and al. (2000), Richard (2005) considered that poor organisation of websites is often due to hyperlinks profusion (high task-relevant cues) and to excessive animation use (low task-relevant cues). Indeed, a profusion of links and excessive use of animations contribute to website complexity (Gupta, et al. 2005). Site complexity is then a fundamental characteristic to take into account when dealing with e-consumer productivity. On one hand, Internet literature considers web page complexity to depend on colour, the number of links, the number of graphics, home page length and the presence of animation (Bruner and Kumar,2000; Geissler, et al.,2001). On the other hand, offline environment literature presents complexity as uncertainty towards the environment (Donovan and Rossiter, on 1982).

Gupta, et al. (2005) specified that most research on complexity had its roots in Berlyne's (1960) stimulus complexity. Geissler, et al. (2001) indicated that complexity of a stimulus is difficult to define. In addition, Berlyne (1960) presents complexity as “the most impalpable of four elusive concepts (the others are novelty, uncertainty, and conflict)” and defines complexity as "the amount of variety or diversity in a stimulus pattern" (Berlyne 1960, p. 38). The complexity of a stimulus pattern depends on several elements: the number of distinguishable elements, the dissimilarity between elements, and the degree to which several elements are responded to as a unit (Berlyne 1960, Geissler, etal., 2001). Furthermore, Berlyne’s (1960) theory identified two dimensions of the complexity: the structural complexity and the interactive complexity. Berlyne (1960) considered that the structural complexity of a stimulus reflects the range of the various structural elements and the irregularity in arrangement. In other words, structural complexity corresponds to distinct information cues that must be perceived and processed in the performance of a task (Gupta, et al.2005). The interactive complexity results from the fact that individuals must frequently adapt to changes in the cause-effect chain during the execution of a task (Wood, 1986). Drawing on Berlyne’s (1960) complexity work, Gupta, et al. (2005) proposed a model of Website complexity distinguishing between the interactive complexity of a website and its structural complexity. Interactive complexity refers to “the degree to which users find the hyperlinks at a website ambiguous and the expectations based on the hyperlink format incongruous with the ensuing web page” (Gupta, et al., 2005), and depends on elements like the capacity of the hyperlinks to allow individuals to form expectations, the uncertainty between pieces of information presented on the website and the presence of banners or pop-up windows that hinder site navigation.

Gupta, et al. (2005) also identified two-subdimensions of the structural complexity of a website: the range of different structural elements and the dissimilarity of these elements. These dimensions depend on the length of text, the number of animations, the number of hyperlinks and the number of web page. Likewise, Geissler, et al. (2001) indicated that Website complexity resulted from four major factors: the number of hyperlinks, the number of graphs, the length of the pages and the presence of animations.

Building on site complexity research findings (Gupta, et al., 2005, Bruner and Kumar, 2000, Geissler, et al., 2001) and on site atmospheric studies (Eroglu, et al., 2003; Richard, 2005), two design factors were considered in the present study: the level of hyperlink abstraction and the presence of animation. In one hand, referring to the work of Eroglu, et al. (2000; 2003), the level of hyperlink abstraction represents a typical example of "high task-relevant cues", while the presence of animation is a perfect example of "low task-relevant cues". On the other hand, by focusing on Gupta, et al. (2005) and Geissler, et al. (2001), it is noticeable that both the level of hyperlink abstraction and the presence of animation affect the structural complexity as well as the interactive complexity.

Considering the interactive complexity, an increase in labels abstraction increases the probabilistic nature of the hyperlinks' results, while the presence of animations increases the navigation duration.

For structural complexity, however, the level of hyperlink abstraction is related to a range of different structural elements, while the presence of animation is connected to the dissimilarity of structural elements (Gupta, et al., 2005).
We therefore present, in what follows, their potential impacts on e-consumer productivity.

One of the most important features of a usable online catalogue is that product classification should be useful to customers, helping locate products without moving forward and backward in the hierarchy (Nielsen, 1993; Markellou, et al., 2005). Additionally, hyperlink abstraction and discrepancy between the navigation expectations of individuals may contribute to website complexity (Topi, et al., 2005; Gupta, et al., 2005). Indeed, hyperlinks tell users what to expect on a website and allow them to orientate themselves and predict the content underlying each hyperlink (Tan and We, on 2006). For example, Bensadoun-Medioni and Gonzalez (1999) investigated the label abstraction concept and identified two types of labels (hyperlinks) with different levels of label abstraction: generic labels and concrete, or content oriented, labels. Generic labels describe in an abstract way contents of pages to which they give access and accordingly present a higher level of abstraction then concrete or content oriented labels. Bensadoun-Medioni and Gonzalez (1999) further specified that less abstract labels contribute to reducing site complexity and improve important information retrieving and site navigation effectiveness.
In the same way, Nadkarni and Gupta (2007) and Eroglu, et al. (2001) considered that clear and unambiguous hyperlinks facilitate the efficient scanning of goal-relevant information and help shoppers move through a site quickly and efficiently. Pace (2004) presented label ambiguity as a source of distraction for website users, negatively affecting their information search performance. Likewise, Tung, et al. (2003) provided evidence that navigation tools impact user confusion and capacity to retrieve information, as well as search efficiency.

Furthermore, Khan and Locatis (1998) indicated that the correspondence between the terminology in search tasks and hyperlinks increased search efficiency.

According to Tung, et al. (2003), Nadkarni and Gupta (2007), Eroglu, et al. (2001), and Bensadoun-Medioni and Gonzalez (1999), we could therefore infer that an increase in label (hyperlink) abstraction level leads to a loss of time and a reduction in information search effectiveness and efficiency, which in turn reduces e-consumer productivity. Therefore:

H.5: An increase in the level of label (hyperlink) abstraction negatively affects e-consumer productivity.

H5.a: An increase in the level of label (hyperlink) abstraction negatively affects e-consumer effectiveness.

H5.b: An increase in the level of label (hyperlink) abstraction negatively affects e-consumer efficiency.

H5.c: An increase in the level of label (hyperlink) abstraction positively affects task performance duration.

The second web design element that may affect offer retrieving is the use of animation. Zhang (1999) found that when the task is difficult, the presence of animation (on the website) has a negative effect on user performance and hinders access to task-relevant information. Schaik and Ling (2006) investigated the effect of irrelevant screen material on human–computer interaction in web-based systems, and their results indicated a higher level of perceived distraction with animated logos than static logos. Similarly, Pace (2004) and Eroglu, et al. (2001) indicated that the presence of animation on a website constituted a potential source of distraction harmful for executing tasks effectively. In addition, there is some empirical evidence suggesting that the inclusion of animation distracts the user from important details or stable information, which can negatively affect information retrieving efficiency and increases task performance duration (Dehn and Vanmulken, 2000; Lowe, 2003). This discussion leads to the following hypotheses:

H6: The presence of animation negatively impacts e-consumer productivity;

H6.a: The presence of animation negatively impacts e-consumer efficiency.

H6.b: The presence of animation positively affects task performance duration.

As seen in this section, past research reveals a plethora of potential sites, users, and situational characteristics believed to impact e-consumer productivity. However, the integration of all these factors into a single testable model was deemed unwieldy and thought less prudent than starting with a more parsimonious model (see Figure 1). As a result, this study examined the direct and interaction effects on effectiveness, efficiency and time duration of seven variables: task nature and task strategy type (situational characteristics); presence of animations and level of label abstraction (site characteristics); and Internet experience, product category knowledge and cognitive absorption (individual characteristics). These variables are supported by a consensus in IS and marketing literature, and are presented as the most important determinants of e-consumer productivity by both research fields. Figure 1 summarises the hypotheses in an integrative model.

Figure 1. Determinants of the e-consumer productivity research model.

4. Methodology

4.1 Experimental design

A laboratory 2x2x2 experiment was conducted to test the proposed model and associated hypotheses. Three factors were experimentally manipulated: the nature of the task, the presence of animation and the level of label abstraction. Two different task presentations and four sites were developed to test the effect of controlled variables. A total of 350 participants were randomly assigned to one of the task presentations and one of the four sites.

4.1.1. Design of the interface

HTML, PHP, and Javascript were used to develop the experimental website. The home page presented Musicbox, a fictitious website which supposedly specialised in selling music CDs.

4.1.2. Task nature

Two task types were used in the experiment: closed tasks and open tasks. Participants assigned to closed tasks were asked to successively retrieve four specific CDs on the Musicbox site (e.g., April in Paris by Charlie Parker), whereas participants assigned to opened tasks were asked to choose four CDs in four different subcategories (i.e., R&B, Acid House, Disco pop and Detroit Techno) with one CD per subcategory. Individuals were randomly assigned to only one of the two task types.

4.1.3. Level of label abstraction

The idea of this study was to present two types of sites with two different levels of label abstraction. To achieve such an aim, we constructed four versions of the same site. The first two versions presented hyperlinks (labels) with no indications about subcategories (high abstraction level), the second two versions presented links followed by indications of the category content and subcategories (low abstraction level) (Figure 2).

4.1.4. Presence of animation

The presence of animation was operationalised by introducing animated gif formats in only two of the four site versions. As a consequence, manipulation of both the presence of animation and label abstraction led to four different versions of the site (Figure 2). Individuals were then randomly assigned to only one version.

Figure 2. Experimental website versions.

4.2. Measurements

Two categories of variables were measured: four independent covariables (Internet experience, product category familiarity, cognitive absorption, adopted information seeking strategy type) and three dependent variables (time, effectiveness, efficiency).

4.2.1. Internet experience

We used an adapted version of Kleiser and Mantel's (1994) scale to measure Internet experience. The exploratory factor analysis indicated that 68.09% of the total variance was explained, and supported unidimensionality and reliability and scale of the construct with an alpha of 0.76.

4.2.2. Product category familiarity

Smith and Park's (1992) scale was used to measure product category familiarity. Our results supported the unidimensionality of the scale with 86.71% of variance explained and an alpha of 0.92.

4.2.3. Cognitive absorption

In assessing cognitive absorption during Web navigation, we used the scale of Shang, et al. (2005). Our data indicated that 69.67% of the total variance was explained and that the construct was multidimensional with four dimensions (in comparison to the original scale, which had five dimensions): immersion (alpha: 0.83), enjoyment (alpha: 0.75), control (alpha: 0.68) and curiosity (alpha: 0.85).

To further examine the validity and reliability of the constructs, confirmatory factor analysis (CFA) was performed. In CFA, fit indices ($?^2$/df, GFI, NFI, CFI, RMR, and RMSEA) are often used to assess model fit. Most studies employing the CFA technique have indicated that for models with a good fit, chi-square normalised by degrees of freedom ($?^2$/df) should be less than 5, while GFI, NFI, and CFI should all exceed 0.9 (Hair, et al., 1998; Jöreskog and Sörbom, 1993). For the current CFA model, $?^2$/df was 2.39 ($?^2$ = 115.01; df= 48), GFI was

0.94, NFI was 0.95, and CFI was 0.95. Additional fit indices used to evaluate model fit were the root mean squared residual (RMR) and the root mean-square error of approximation (RMSEA). The RMR index was 0.04, below the recommended 0.05 (Jöreskog and Sörbom, 1993) and the RMSEA value was .06, indicating the parsimony of the model.

4.2.4. Adopted information seeking strategy

Log files were used to measure the dependent variables. Concerning the strategy type used, three kinds of data were taken into account: the total number of clicks, the number of search engine uses and the number of clicks on category links. Based on Nielsen's (1997) and Nachmias and Gilad's (2001) classification of strategy types (i.e., search dominant strategy, links dominant strategy and mixed strategy), the log file data were used to calculate two ratios, R1 and R2, to determine the strategy type (R1 = Total number of uses of the search engine / Total number of clicks, and R2 = Number of clicks on category links / Total number of clicks) If R2 < 25%, the consumer was considered to use a search dominant strategy, and if R < 25%, the consumer was considered to use a links dominant strategy, while a mixed strategy was used when R1 > 25% and R2 > 25%.

4.2.5. Time

Time was measured by the duration of time a participant spent to perform the three simulation tasks of the experiment (the difference between the site access time and end of the session in minutes and seconds for each participant was the time spent on the online shopping tasks used in the data analysis).

4.2.6. Effectiveness

Given the effectiveness definitions presented in section 2 of this paper, we measured effectiveness by the number of successful tasks carried out by each participant in our experiment.

4.2.7. Efficiency

We measured efficiency by the ratio of Level of achievement of the tasks / Total effort. Using log files, the level of achievement of tasks was measured by the number of (exact/chosen) products retrieved, while effort was measured by the total number of clicks.

4.3. Experimental procedure

The experiment took place in a university laboratory. A total of 350 business students participated in the experiment. Only 292 successfully completed the experiment. Computers with experimental websites were all situated within the same LAN connection to minimize the impact of connection speed on task time achievement. First, we asked each participant to type a local address in a Web browser to go on the site where they were presented a brief introduction to the experiment. After reading the introduction, the participant was directed to click on a start link that gave access to the first part of the experiment, which consisted of completing a questionnaire. Then, the participant found an introduction to the second part of the experiment and the presentation of the tasks that must be accomplished on the Musicbox site. After reading the task instructions, the respondent launched the Musicbox site (a random selection of one of the four versions) in a new browser window. Subjects were randomly assigned to the experimental conditions with approximately 40 subjects per cell. Each experimental session involved a single participant.

5. Results

Our hypotheses were tested by General Linear Model (GLM) MANCOVA analysis. Task nature, level of label abstraction, presence of animation and strategy type were integrated in the equation as factors. Product category familiarity, Internet experience and cognitive absorption dimensions (immersion, enjoyment, control and curiosity) were integrated as covariables. Time, effectiveness and efficiency were our dependent variables. We also tested the interaction effect between factors. The MANCOVA results are summarised in Table 1. The data in Table 1 indicated that the effect of product category familiarity on overall offer retrieving performance was not significant; thus we rejected Hypothesis 3. However, the results showed that the effects of Internet experience, level of label abstraction, and strategy type and strategy task interaction on offer retrieving performance were significant.

While MANCOVA results allowed us to show the effects of variables on overall retrieving performance, ANCOVA results also allowed us to see the impact of independent variables on each of the performance indicators.

In addition to main effects, we tested all interaction effects between the factors: level of label abstraction, use of animation, task nature and strategy type (Table 2).

The ANCOVA results indicated no effect of cognitive absorption dimensions on effectiveness, thus hypothesis H4a was also rejected. However, through its curiosity dimension, cognitive absorption has a positive effect on time, which leads to support of Hypothesis H4b. Whereas the MANCOVA showed that Internet experience had a significant impact on overall performance, ANCOVA results indicated that Internet experience clearly had a positive impact on effectiveness efficiency, and reduced time duration. H2, H2.a and H2.b were therefore supported.

Furthermore, ANCOVA results showed that the impact of the use of a strategy type, by itself, was significant only on offer retrieving effectiveness, not on time and efficiency. However, the strategy type showed significant impact on time, effectiveness and efficiency when it interacted with the task nature. In the case of a closed task, use of a links dominant strategy or a mixed strategy had a negative impact on all three performance measures, while the use of a search dominant strategy had a positive impact on these three dependent variables (better effectiveness and efficiency and less time duration) (Figure 3). The opposite effect was observed when the person was performing an opened task. In this case, the search dominant strategy had a negative impact and use of the mixed strategy or link dominant strategy had a positive effect, with better results for the link dominant strategy. Thus, Hypotheses H1.a, H1.b and H1 were supported.

Figure 3. Effect of strategy and task interaction.

Results also indicated that there was an interaction effect between use of animation, label abstraction level and strategy. Further analysis revealed that the use of animation's impact on time duration depended on both level of label abstraction and the type of strategy used, and as a result, H6 was rejected (i.e., there was no pure effect for the presence of animation)

Figure 4. Animation, label and strategy interactions.

Another important outcome was that an increase (a decrease) of label abstraction level had a negative (positive) impact on both effectiveness and efficiency when a closed task was approached with the links dominant strategy, or when the search dominant strategy was used for an open task (Figure 5). Thus, H5 was rejected.

Figure 5. Task, strategy, and label interaction effect.

6. Discussion

The main purpose of our research was to identify the determinants of e-consumer productivity on a commercial website. GLM results on the effect of Internet experience and cognitive absorption's curiosity dimension indicated that e-consumer productivity depends on these individual characteristics. The results further showed that Internet experience had a positive impact on all three indicators of e-consumer productivity (effectiveness, efficiency and time). This finding was in agreement with those of Hsieh-Yee (1993) considering the positive effect of Internet experience on search performance. Because we found no effect of product category familiarity on e-consumer productivity, Internet experience was more important than product category familiarity during online shopping.

Regarding the cognitive absorption effect on e-consumer productivity, our results indicated that the curiosity dimension led to increased time duration for task accomplishment. This suggested that the act of interacting with the site invoked excitement for the available possibilities. Such excitement led to the adoption of an exploratory behaviour, increasing in turn the time duration for task accomplishment (Agarwal and Karahanna, 2000).

These results encouraged us to interrogate the integration of time as an e-consumer productivity indicator. In fact, if task execution time was associated to positive emotion and experience, could we consider time as negatively correlated to e-consumer productivity? Certainly this point of view conformed to the HCI (i.e. Human-Computer Interaction) and IS paradigms, which focus on completing online tasks effectively and efficiently (Tractinsky and Lowengart, 2007). However, it passed over the fact that the shopping activity can be a source of pleasure and a positive experience for the consumer (Holbrook and Hirschman, 1982; Babin and al, 1994).

The GLM results also illustrated that the effect of the type of strategy on e-consumer productivity was task dependent. Figure 3 indicates that the use of a search dominant strategy gives better results (less time, better effectiveness, and better efficiency) than either the link dominant strategy or the mixed strategy in the case of a closed task. It also shows that use of a links dominant strategy or a mixed strategy better fits an open task. These results corroborated earlier findings of Tabatabai and Shore (2005), Tung, et al. (2003) and Kim and Allen (2002) on the interaction between search strategy and task type.

In addition, the ANCOVA results were in accordance with the work of Gupta, et al. (2005) and Geissler, et al. (2001) on site complexity. Figure 4 illustrates that association of animation with the display of subcategory details (low label abstraction level) had a negative impact on e-consumer productivity (more time duration) independent of the type of strategy employed. At first thought, this result seemed to be counterintuitive as it is easy to believe that the inclusion of more categories and subcategories should lead to a decrease in site complexity and thus to better performance. This is true if we take into account only the interactive complexity, which is the degree of uncertainty between potential action activities and desired outcomes (Gupta, et al., 2005). If we consider structural complexity, however, the use of animation together with the display of category content details may lead to an increase in structure complexity, defined as the number of distinct information cues that must be perceived and processed (Berlyne, 1960).

With regard to interactive complexity, Figure 5 shows that reduction of label abstraction level (presence of indications of subcategory content) counterbalanced the negative effect of the use of an inadequate strategy. In fact, when a closed task was performed, the presence of subcategory indications neutralised the negative impact of adopting the links dominant strategy (inadequate strategy for closed task) on effectiveness and efficiency. Whereas in the case of an open task, the negative impact of a search dominant strategy (inadequate strategy for open tasks) was compensated for by the reduction in label abstraction (presence of indications of subcategory content).

Therefore, considering that a higher level of label abstraction led to increased interactive complexity (more uncertainty between potential action activities and desired outcomes), we concluded that websites with less interactive complexity counterbalanced the negative effect of adopting an inappropriate strategy. This result corroborated the results of Chen and Rada (1996) that indicated the effects of task complexity and website complexity were correlated. The presence of appropriate tools on a website can indeed reduce the complexity during the execution of a particular task (specifically when the search strategy is inadequate for the task performed). These findings were also in line with previous research on "Cognitive Fit Theory" (Vessey 1991, 1994), which indicated that technology could be used to reduce complexity when there was a good fit between the task and the information or problem representation. The result is increases in efficiency, effectiveness and speed in problem solving (Kamis, et al.2010; Speier and Morris, 2003).

Our results highlighted the need of not only understanding how consumers behave on a commercial website (i.e., their search strategy), but also understanding the relationship between the consumer, the website and the task. Indeed, the current study found evidence supporting the use-centred design approach introduced by Flach and Dominguez (1995) and Farris (2003).

In opposition to the more classic user-centred design approach focusing on the user and the user's goals (the performed task) when designing a website, the use-centred design approach does not focus on the user or the task as separate entities, but rather on the relationship between these entities. Therefore, the user, the website and the task can be integrated to facilitate a better performance (Flach & Dominguez, 1995; Farris, 2003). More specifically, our results demonstrated that it is not the task type, the strategy type, or the site design that determine the level of e-consumer productivity on a commercial website, but the interaction between these three variables.

7. Concluding Comments

In conclusion, this study sought to contribute to the expanding literature on how consumers behave while shopping online. Specifically, it proposed a conceptual model of e-consumer productivity determinants. A 2×2×2 online experiment was then used to test this model.

Results indicated that individual characteristics affected e-consumer productivity and that site design can improve or worsen this productivity.

More specifically, our results go beyond the classical view that online search performance depends on the “fit” between task nature and behavioural strategy (Tung, et al.2003; Tabatabai and Shore, 2005; Kim and Allen, 2002) by highlighting the importance of considering the combined interaction effects (“Strategy type × Task nature × Site characteristics” rather than considering the simple interaction “Strategy type × Task nature”). For instance, our study showed that the presence of additional content details of categories and subcategories could attenuate the effect of using a strategy that was inappropriate for the performed task.

Another important contribution of our study lies in examining how individual characteristics affect e-consumer productivity. First, our results confirmed previous findings concerning the importance of Internet experience in online behaviour (O’Cass and Fenech, 2003; Ondrusek, 2004). Second, we found that cognitive absorption positively affected time duration of a task, indicating similarity with the flow construct’s effect on online behaviour. This study could therefore be viewed as an extension of previous research that tested only the effect of cognitive absorption on intention to behave (e.g., Agarwal and Karahanna, 2000; Saade and Bahli 2005; Shang, et al., 2005).

More generally, our findings were parallel with those of Flach and Dominguez (1995) and Farris (2003) regarding “use-centred design”. Specifically, it was demonstrated that it is important for web designers to take into account not only the “user-site design” relationship, but also the relationship between the user, the site design, and the task. For example, we can imagine situations where the objective of the user does not match the website objectives, creating serious problems in usability. This could occur when the consumer is looking for a precise product on a website while the website developer wants to encourage impulse buying by favouring browsing behaviour. In this situation, the site design could impede the consumer from adopting an adequate navigation strategy, creating lower productivity and leading to a premature ending of the shopping process (by stopping Web navigation or by moving to a competitor's website).

Several solutions can be employed by web designers to avoid such situations and adapt the site design to the user and the task. Current web technologies, such as dynamic HTML, applets, and cookies, provide the means to acquire not only the individual customer profile but also the nature of the task performed on the site (Nadkarni and Gupta 2007). Therefore, to improve e-consumer productivity, different versions of the site could appear not only according to the user profile, but also according to the task the customer wants to execute. Greater e-consumer productivity will then encourage greater product purchasing and a longer relationship length (Xue and Harker 2002, 2007; Koufaris 2002; Xue and Harker 2007).

Regarding site complexity and use of animation, our findings strengthened the idea that "complexity is the biggest inhibitor of product (site) success" (Vredenburg, et al., 2002). This was demonstrated by showing that the most complex site version (increased animation and additional text) led to the worst e-consumer productivity (regardless of the offer retrieving strategy used). Therefore, our results constitute a warning against the excessive use of useless animations and pop-up windows. However, it is important to specify that the effect of the use of animations on e-consumer productivity depends on the global complexity of the site. Thus, the more complex the site (information overload, abundance of links, variety of colours), the more the use of animations is discouraged.

This study is not without limits. Online experimentation may be questioned on the basis of external validity, even more so because respondents surfed only one site and searched for only one product category. However, the results of our work constitute a starting point for future research. For example, the results indicated that the interaction between the type of strategy used and the nature of the task performed was one of the most important determinants of offer retrieving performance. This observation invites further examination of potential determinants of adoption of a specific strategy. One other issue that was not examined in the current research was the use of time as an e-consumer productivity indicator. Adopting the point of view of previous work on online search behaviour (Ondrusek, 2004; Topi and al., 2005; Schaik and Ling 2006) and customer productivity (Ingene, 1984; Martin, et al. 2001; Xue, et al.2007; Anitsal and Schumann 2007), we could consider the fact that the more time a consumer spends performing a task on a website the lower the productivity. However, is this statement still true if this time is associated with increased fun and pleasure? Further investigation should be done to answer this question.

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Figures

Figure 1. Determinants of the e-consumer productivity research model.

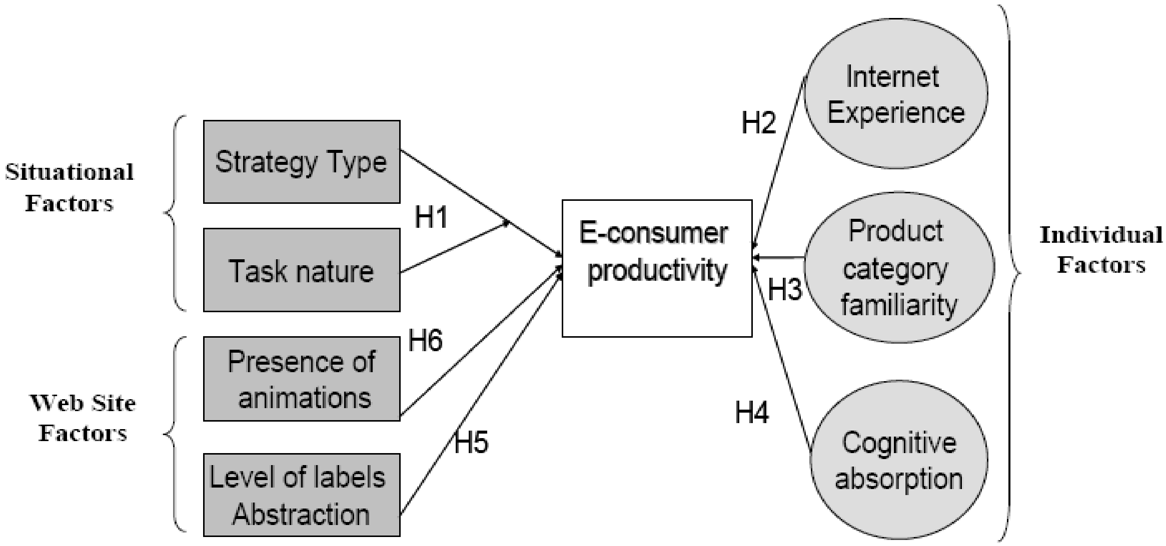


Figure 2. Experimental website versions.

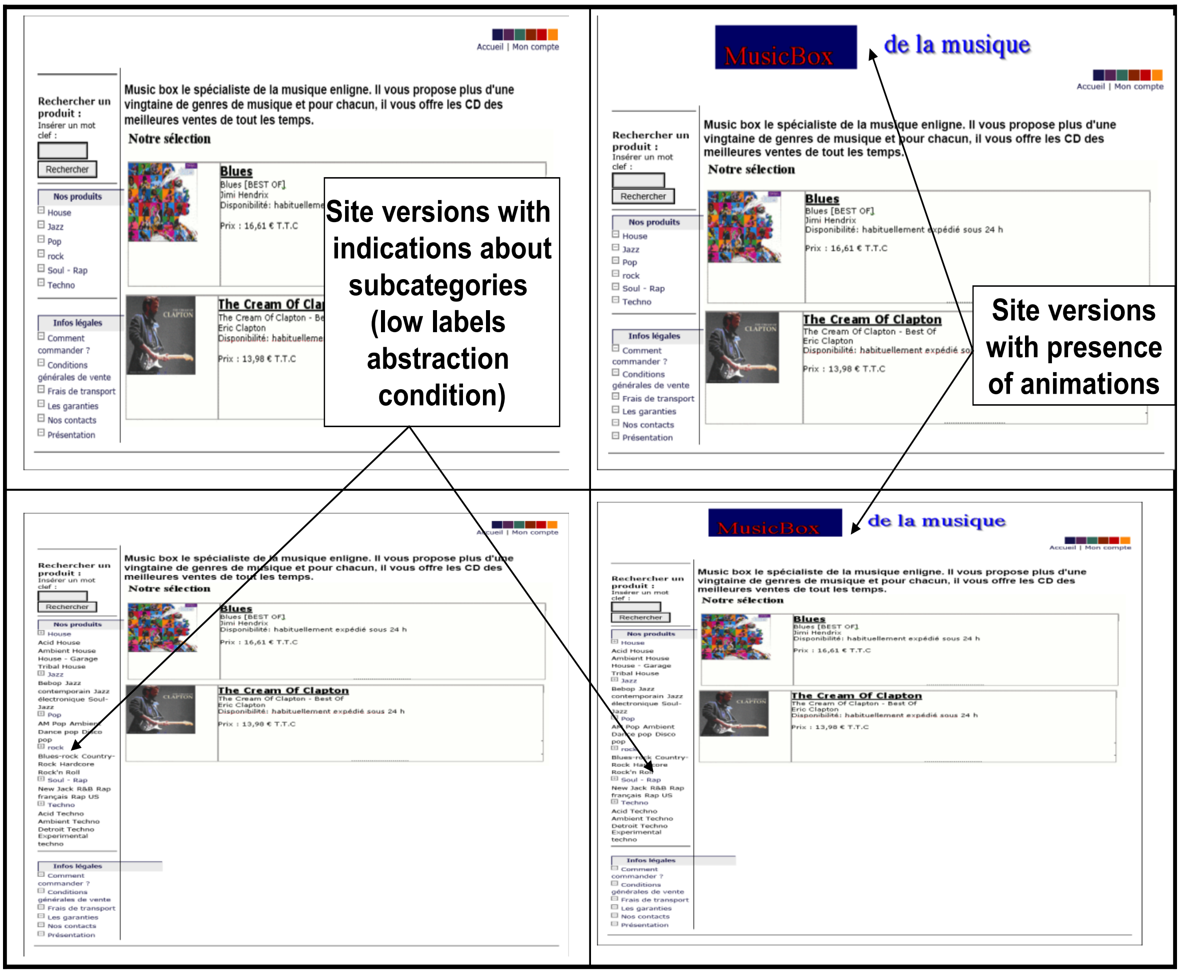


Figure 3. Effect of strategy and task interaction.

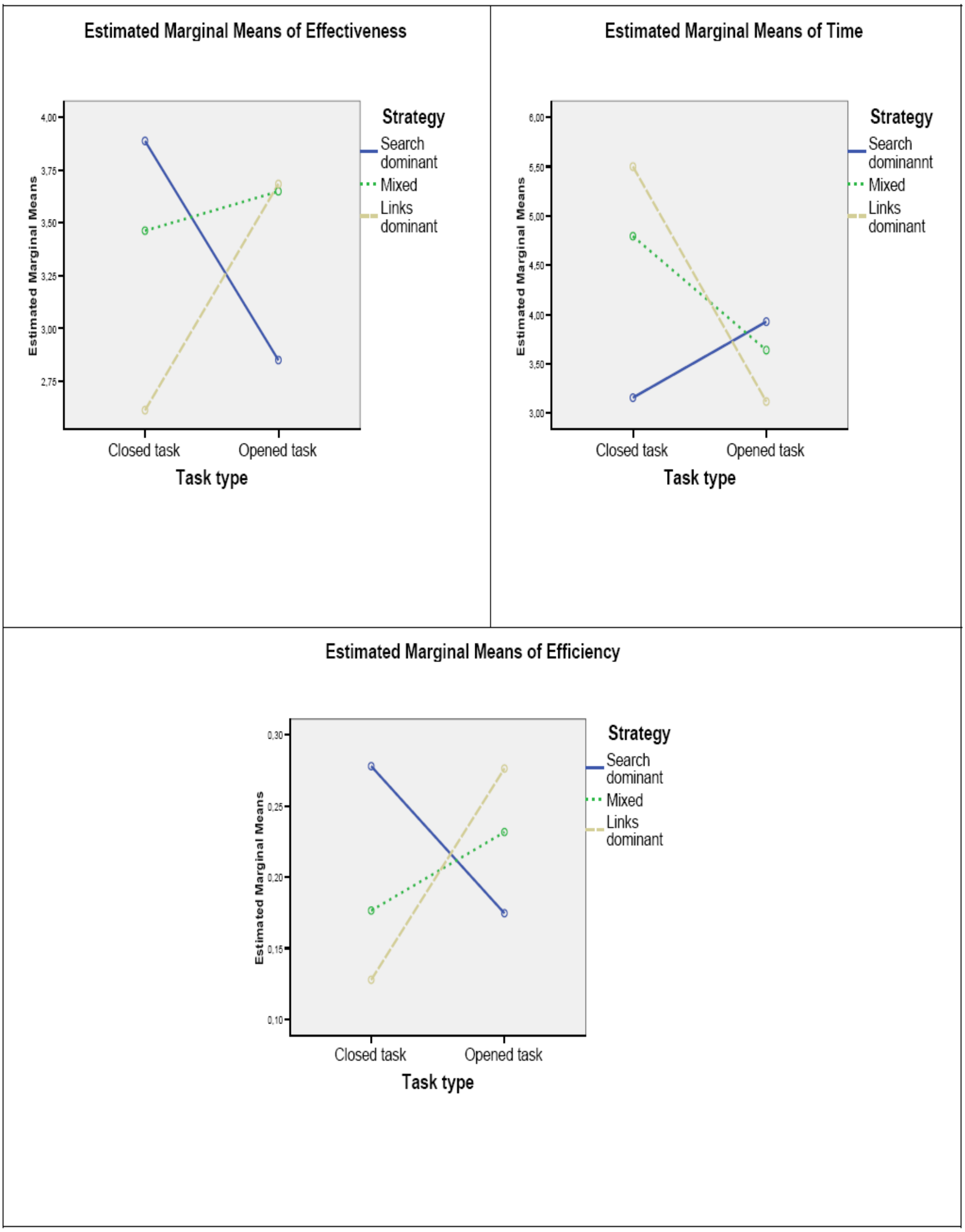


Figure 4. Animation, label and strategy interactions.

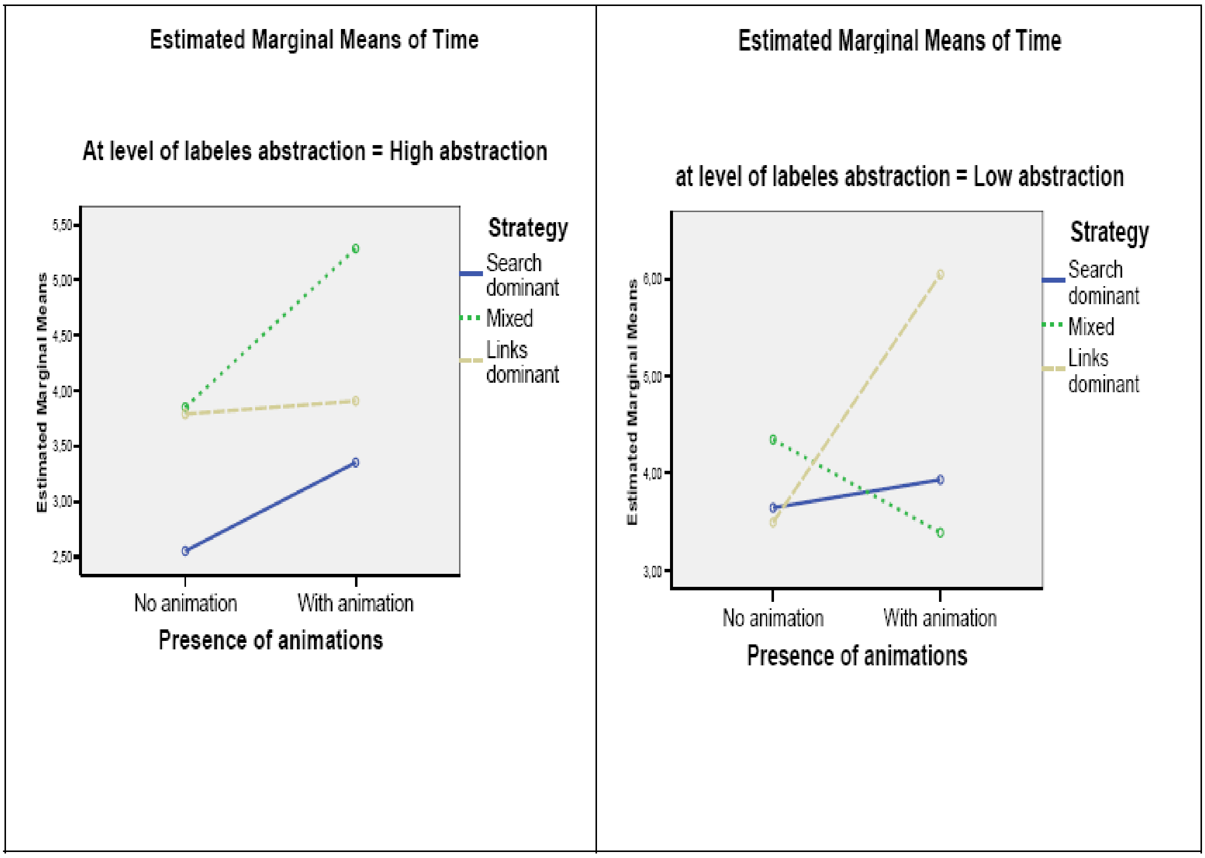
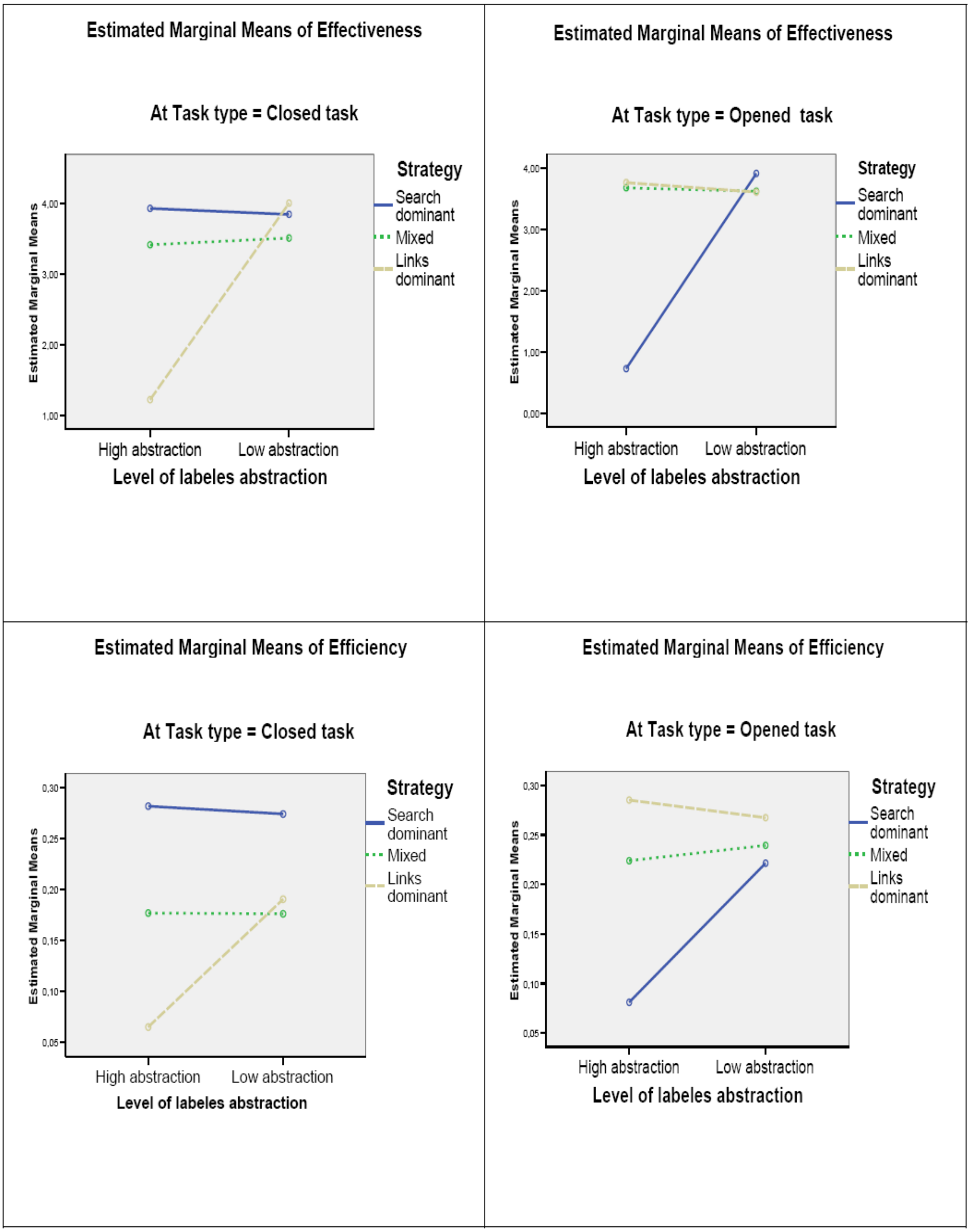


Figure 5. Task, strategy, and label interaction effect.



Tables

Table 1. MANCOVA results

Variables	Wilk's Lambda	*F*	Sig.
Internet experience	0.917	7.831	**0.000****
Product category familiarity	0.981	1.663	0.175
Immersion	0.996	0.389	0.761
enjoyment	0.987	1.190	0.314
Control	0.987	1.183	0.317
Curiosity	0.966	3.019	**0.030****
Label abstraction	0.930	6.564	**0.000****
Strategy	0.928	3.320	**0.003****
Animation	0.991	0.828	0.480
Tasks nature	0.968	2.896	**0.036****
Strategy × Tasks	0.922	3.620	**0.002****

*<0.1; **<0.05

Table 2. ANCOVA results

Variables	Time	Effectiveness	Efficiency
Internet experience	**F=19.922; p=0.000**; B=-.641**	**F=3.770; p=0.053*; B=.116**	**F=5.560; p=0.019**; B=.279**
Curiosity	**F=3.740; p=0.054*; B=.013**	NS	NS
Strategy type	NS	**F=3.211; p=0.042****	NS
Use of animation	NS	NS	NS
Labels abstraction	NS	**F=16.560; p=0.000****	**F=3.411; p=0.066***
Task	**F=4.779; p=0.030****	NS	**F=4.692; p=0.031****
Strategy × task	**F=2.377; p=0.095***	**F=7.216; p=0.001****	**F=10.690; p=0.000****
Strategy × labels	**F=2.524; p=0.082***	**F=8.452; p=0.000****	NS
Strategy × labels × task	NS	**F=13.507; p=0.000****	**F=4.048; p=0.019****
Strategy × labels × animation	**F=5.110; p=0.007****	NS	NS

*<0.1; **<0.05