CONSUMERS' ONLINE COGNITIVE SCRIPTS: A NEUROPHYSIOLOGICAL APPROACH

Research-in-Progress

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Abstract

A cognitive script is a predetermined sequence of actions that define a well-known situation. Building on neuroscience literature, the objectives of this research-in-progress are to verify and validate that consumers activate cognitive scripts when shopping online, understand how cognitive scripts are formed by consumers over multiple online shopping trips, and investigate how consumers activating different cognitive scripts respond when facing a novel shopping environment. Twenty-one novice participants (i.e., no digital music purchase experience) were assigned to either an "intrascript" condition (multiple visits to a single website) or an "interscript" condition (single visits to multiple websites). Using psychometric and neurophysiological measures, our results suggest that intrascript consumers appear to use more automatic processing, while interscript consumers use more controlled processing. In addition, when visiting a new website, interscript consumers perceive this website as easier to use than intrascript consumers. Theoretical and practical implications of these results are discussed.

Keywords: Brain, Cognitive Workload, Electroencephalography (EEG), NeuroIS, Online Cognitive Script, Neurophysiology.

Introduction

Shank and Abelson (1977) define a cognitive script as a “predetermined, stereotyped sequence of actions that define a well-known situation.” For instance, a consumer going to a fast-food restaurant may activate his or her “fast-food restaurant” script which consists of a series of steps such as placing his or her order, waiting, receiving the order, eating, paying, etc. The main function of a script is to facilitate cognitive processing (Smith and Houston 1985). Basically, it allows people to understand and behave appropriately in a particular situation (Abelson 1981).

Although consumer researchers have used script theory to investigate consumer behaviors in offline settings, to the best of our knowledge, no published research has yet investigated how consumers form and activate scripts in online settings.

From a theoretical viewpoint, investigating online scripts is important because online interactions usually do not involve employees. Hence, instead of a human-human relationship, interactions are computer-mediated online, thereby possibly influencing scripts. Hence, a significant contribution of this paper is to validate whether consumers use scripts when using self-service Internet technologies.

From a practical viewpoint, investigating online scripts is also important. A better understanding of how consumers form and activate scripts when visiting a website could help managers propose more satisfying online experiences. Also, it can contribute to better locking-in consumers with navigation designs that can be learned rapidly, and this, in turn, may positively affect purchases (Johnson et al. 2003).

The proposed research study has three main objectives: 1) validate if consumers activate cognitive scripts when shopping online, 2) understand how cognitive scripts are formed by consumers over multiple online shopping trips, and 3) investigate how consumers activating different cognitive scripts respond when facing a novel shopping environment (e.g., a new Internet store).

In this contribution, we first review the literature on cognitive scripts in marketing and neuroscience, and present hypotheses addressing important gaps in the corresponding literature. Then, we present a pilot study that is currently executed, to test the proposed hypotheses. Preliminary results will be presented at the conference.

Literature Review

Cognitive Scripts in the Marketing Literature

Cognitive scripts are one type of broad classification of memory referred to as schemata. In cognitive psychology, schemata are defined as stored cognitive structures of knowledge about specific objects or topics and are represented by nodes in semantic memory (Brown 1992). Hence, cognitive scripts play a dual role: they help organize comprehension and they also guide behavior (Lord and Kernan, 1987). Schemata are not static, they evolve with experience. According to Taylor et al. (1991), there are four types of schemata: 1) self-schemata, 2) person schemata, 3) role schemata, and 4) event schemata/scripts. Scripts differ from other types of schemata on two aspects: they contain a set of component actions and those actions are associated in a temporal and causal sequence (Smith and Houston 1985). Cognitive scripts have been used as a conceptual foundation in cognitive, social, and clinical psychology (Bless et al. 1996; Leigh and Rethans 1983). Finally, it is important to note that personal routines (Feldman and Pentland 2003) are similar to scripts. However, scripts encompass a broader spectrum of possibilities. For instance, they can include non-regular events, or could be less detailed than routines.

Cognitive scripts are particularly appealing to conduct consumer research since they can help explain how individuals interpret and behave in commercial settings. Hence, the cognitive script theory has been used to investigate many consumption situations over the years (for a review, see Erasmus et al. 2002). For instance, it has been used to investigate how consumers shop for groceries, over-the-counter medicine, washers, automobiles, and restaurants (Bower et al. 1979, John and Whitney 1982, Rethans and Taylor

1982, Stoltman et al. 1989).

Research suggests that for a given situation, individuals' scripts can be different (Lord and Kernan, 1987). Leong et al. (1989) and Martin (1991) suggest that experts form more elaborate, distinctive, contingent, and hypothetical scripts than novices. This gives experts the flexibility to deal with many different obstacles that could be encountered. Martin (1991) also suggests that experts have the ability to abstract to new situations, whereas novices are more restricted in their ability to generalize. These findings are consistent with Abelson's (1976) proposition that scripts evolve from a more concrete nature to more abstract nature as individuals gain experience with a situation over time.

Cognitive Scripts and Neuroscience

Recent advances in neuroscience suggest that the human brain is proactive (Bar 2009), "it is continuously generating predictions that approximate the relevant future based on memories of past experiences and associative activation" (Bar and Neta 2008, p. 328). When encountering a situation, the brain tries to match the input information (e.g., music website) with a similar representation existing in memory (i.e., script) and generates a prediction of what to expect next (Bar 2009, Bar and Neta 2008). Hence, Bar (2009, p. 1239) suggests that cognitive scripts could be at the basis of human brain activity and consequently human behaviors: "Information encoded in our memory guides and sometimes dictates our future behavior. One can look at our experience as stored in memory as scripts."

Specific brain areas have been identified as fundamental for the neural implementation of this principle. It is reported that three interconnected brain regions, namely Medial Temporal Lobe (MTL), Medial Parietal Cortex (MPC), and Medial Prefrontal Cortex (MPFC) play a major role in performing associations between external stimuli and memory (Bar and Neta 2008). Based on Bar's (2009) discussion, it is possible to verify if consumers activate cognitive scripts when exposed to stimuli such as a website.

Moreover, research suggests that experts and novices differ in terms of knowledge, effort, recognition, memory usage, and follow-up capacity (Chi 2007). Recent theorizing in psychology, behavioral economics, and neuroscience (e.g., Camerer et al. 2005, Satpute and Lieberman 2006) suggests a dual-process model underlying human decision making; a more controlled system (conscious, serial, effortful, and slow) and a more automatic system (unconscious, parallel, effortless, and fast). As novices evolve to become experts (thus evolving from a controlled to an automatic system), activations in specific brain regions change (Hill and Schneider 2007). Most changes occur in the frontal region (involved in task control and working memory) and the parietal region (involved in attention). For instance, when an individual has over learned specific skills, stimuli are automatically processed (Alba and Hutchinson 1987). Hence, when processing moves from controlled (e.g., new task) to automatic (e.g., routine task), parietal and frontal cortical brain activities decrease (Schneider and Chen 2003).

The transition from a more controlled to an automatic processing is associated with lower *cognitive workload*; the latter refers to "any demands on working memory storage and processing of information" (Schnotz and Kürschner 2007, p. 471). Self-reported measures of workload are often biased due to the difficulty of individuals to discern between task demand and invested effort (Veltman and Gaillard 1996). Hence, several physiological measures have been suggested to correlate with cognitive workload (Oken et al. 2006; Klimesch 1999), making possible a more objective measurement.

In the following, we briefly describe physiological measures related to cognitive workload (note that several synonyms are used in the scientific literature to denote cognitive workload, such as mental effort, memory load, cognitive demand, and mental workload).

Studies in human-computer interaction suggest that 1) heart rate (HR) increases with mental effort (e.g., Roscoe 1992), heart rate variability (HRV) decreases as memory load increases (e.g., Jorna 1993), and 3) electrodermal response (EDR) increases with increasing cognitive demand (Boucsein 1993). In addition, electroencephalograhy (EEG) indices of mental workload have also been developed to assess the information processing capability of an individual (Berka et al. 2007; Freeman et al. 1999). Specifically, as mental effort decreases, working memory load decreases, and processing of stimuli becomes more automatic, and this, in turn, decreases the power of frontal mid-line theta of EEG frequencies (Jensen and Tesche 2002). Against the background of these findings on the relationships between cognitive workload and various physiological measures, the transition from controlled to automatic processing can be objectively assessed based on biological measurement.

Hypotheses Development

Since online cognitive scripts possess unique characteristics (e.g., self-service technology rather than human-human interaction) research findings on scripts in offline settings may not be applicable in online settings. Also, most studies (e.g., Martin 1991) are focused on inter-individual script differences (expert vs. novice), but not on intra-individual script differences over time (i.e., script formation). A better understanding of script formation should lead to significant insights into consumer learning.

Moreover, the literature does not provide evidence for the influence of different cognitive script activations on consumers' responses (e.g., affect, cognition, attitudes, intentions, behavior) when facing a novel situation (e.g., new store). A better understanding of consumer responses could help managers design more effective websites and promotional offers. Our stated objectives aim to address these gaps in the literature. Against this background, we develop our hypotheses in the following.

First, because a consumer's experience influences his or her cognitive script, it is suggested that different cognitive scripts will be formed if consumers have different experiences during the formation stage of their scripts.

> *H1: Consumers, whose script was formed during repeated visits to a single website (intrascript consumers), will possess a different script than those whose script was formed during single visits to different websites (interscript consumers).*

Second, it is suggested that during the script formation phase, intrascript consumers will tend to move from controlled processing to automatic processing (i.e., reducing their cognitive workload) since they will develop their expertise on the website. However, the cognitive workload of interscript consumers should not vary as much since they are used to always visiting new websites, i.e., continue to activate controlled processing.

> *H2: In the script formation phase, the cognitive workload of intrascript consumers will reduce to a larger extent than the cognitive workload of interscript consumers.*

Third, it is suggested that once formed, different scripts will trigger different responses during consumers' next store visit. As mentioned, if intrascript consumers revisit the same store (e.g., Store A; Figure 1), they will behave like experts (i.e., more automatic processing), however, if they visit a dissimilar website (Store L; Figure 1), they will behave more like novices (i.e., more controlled processing). However, the cognitive workload of interscript consumers should not vary as much since they are used to always visiting new websites, i.e., continue to activate controlled processing.

> *H3: When visiting a new and dissimilar website, the cognitive workload of intrascript consumers will increase to a larger extent than the cognitive engagement of interscript consumers.*

Finally, we suggest that consumers who have experienced various and dissimilar websites while forming their script (i.e., interscript consumers) will find a new and dissimilar website easier to use since they have a wider variety of experience with different websites relative to intrascript consumers.

> *H4: When visiting a new and dissimilar website, interscript consumers will perceive it as easier to use than intrascript consumers.*

Methodology

Experimental Protocol

A lab experiment was performed to test the four hypotheses. The experiment was approved by the IRB of the institution. During the experiment, subjects were asked to perform multiple online music shopping trips. A prepaid credit card was provided to the participant to complete actual online purchases. Based on a between-subjects design, twenty-one novice participants (i.e., no digital music purchase experience) were assigned to either an "intrascript" condition (multiple visits to a single website, $n_{intrascript}=10$) or an "interscript" condition (single visits to multiple websites, $n_{interscript}=11$).

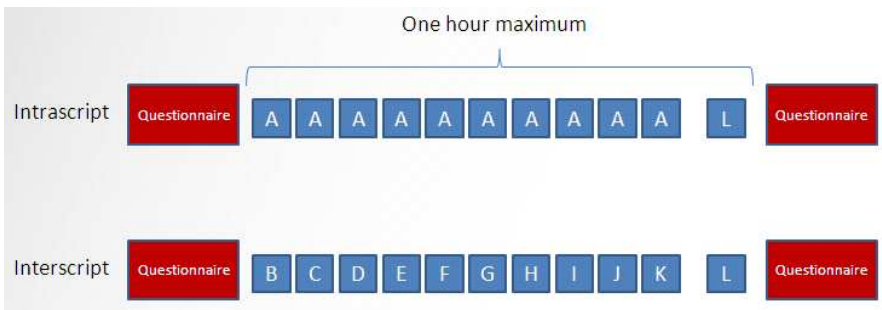

Figure 1. Experimental Design

A set of twelve music websites were selected for the experiment. Three criteria were used to select these websites: 1) they had to give the possibility to purchase and download single music tracks, 2) they had to be available to Canadian consumers (some websites restrict their activities to certain geographical regions), and 3) they had to differ from each other in terms of electronic service quality (Bressolles and Nantel 2008). To ensure this diversity, an expert was asked to complete a purchase on each website and afterwards evaluate the website using an adapted version of the NetQual scale developed by Bressolles and Nantel (2008) in order to evaluate each website on ease-of-use, aesthetics, information quality, and interactivity dimensions. Results indicate that the selected websites represented a spectrum of electronic service quality. Selected websites varied from large music retailers (HMVdigital.ca) to small and new music retailers (fairsharemusic.com).

Participants were first asked to read and sign the research consent form. Then, participants had to complete a questionnaire eliciting their online cognitive script for the product category (Martin 1991). Participants were asked the following question: "To your knowledge, what are the steps needed to purchase a song on a website from your arrival on the website to the song download?" Then, they were asked to perform the experimental task. Intrascript participants were asked to buy a song every time they visit their assigned website, while interscript participants were asked to buy a song on each website they were assigned to. To avoid any fatigue related biases, the experiment sessions were limited to one hour. No time limitations were given to participants for each purchase and they were not aware of the length of the experiment.

After one hour, participants in both experimental conditions were asked to visit the same final online store to perform a purchase. They were all asked to perform a purchase on the *fairsharemusic.com* website (see L in Figure 1). Hence, both groups were exposed to the same new website. Following their last purchase, participants were asked to complete a questionnaire eliciting their online cognitive script and website evaluation using an adapted version of the NetQual measurement scale, a Likert-type measurement instrument ranging from 1 to 7 (Bressolles and Nantel 2008).

Neurophysiological Acquisition and Measurement

Prior research on cognitive scripts mostly used self-reported measures (e.g., Martin 1991). The current research uses self-reported and neurophysiological measures for the following reasons: 1) to precisely assess the cognitive workload in the script formation phase and the final script activation within and between groups, and 2) to compare neurophysiological measures with self-reported measures.

EEG data was acquired using the B-Alert® X10 device from Advance Brain Monitoring (ABM, 2010). The data was acquired from 9 sensors pre-determined by the manufacturer (F3, F4, FZ, C3, C4, Cz, P3, P4 and POz). The B-Alert device calculates an EEG cognitive index developed by Berka (2007). At every second, the measurement instruments estimated the probability that the subject was in each of the following 4 cognitive states (four-class quadratic discriminant functional analysis using absolute and relative power spectra from channels FZPOz and CzPOz): sleep onset, distraction, low engagement, and high engagement. Since, sleep onset was not a relevant indicator for the current research, further analyses focus on the remaining three states.

Building upon the work of Freeman et al. (1999), a cognitive workload (CW) odds was calculated using the average probability estimated for the first 15 seconds of interaction with each website using Equation 1. A greater CW odds indicates more controlled processing.

Equation 1: $$\textit{Cognitive workload odds} = \frac{\textit{probability of high engagement} + \textit{probability of low engagement}}{\textit{probability of distraction}}$$

In addition, all sessions were video recorded to collect information about web pages visited during the experimental task. The experiment was conducted at HEC Montreal's Tech3Lab.

Preliminary Results

Hypothesis 1

The first hypothesis suggested that intrascript and interscript consumers will develop different scripts. In order to test this hypothesis the number of actions contained in participants' scripts was analyzed (e.g., "use the website search engine" or "complete an order form"). Two independent judges coded each participant's initial and final scripts. The inter-coder reliability coefficient was excellent (0.97), thus an average number of actions per script was calculated for each participant.

The results show that the average number of actions between the initial and final script in the intrascript condition slightly decreased (from 5.70 to 5.65 actions), and it slightly increased in the interscript condition (from 7.18 to 7.55 actions). However, the difference in variation (-0.05 vs. 0.37) was not statistically significant based on a Mann-Whitney test ($n_{intrascript}$=10 and $n_{interscript}$=11). Thus, H1 was not supported.

Hypotheses 2 and 3

Table 1 presents the cognitive workloads (CWs) for consumers' first and last website visit in the script formation phase and for consumers' visit to a new and dissimilar website following the script formation phase.

Table 1. Median Cognitive Workload (CW) Odds

	Script Formation		New and Dissimilar Website
Group	First Website Visit	Last Website Visit	
Intrascript	90.76 [A]	13.38 [A]	258.97 [L]
Interscript	15.15 [B]	28.56 [F-K]	16.27 [L]

Table 1 shows that in the script formation phase, the CW odds of the intrascript group greatly decreased from the first to the last visit to the same website (90.76 → 13.38) and the CW odds of the interscript group slightly increased from the first to the last visit (15.15 → 28.56).

Moreover, Table 1 shows that moving from the script formation to a new and dissimilar website, the CW odds dramatically increased for the intrascript group (to 258.97), and decreased for the interscript group (to 16.27). These observations provide initial support for H2 and H3.

In order to formally test H2 and H3, odds variations were calculated and compared between groups using non-parametric Mann-Whitney tests (Table 2). The results suggest that during the script formation phase, the variations in CW odds were different between the groups. Supporting H2, the variation was greater for the intrascript group than for the interscript group (p=0.047; Table 2). When moving to a new and dissimilar website, the two groups also showed significantly different variations (=0.036; Table 2). Supporting H3, the intrascript group's CW odds varied to a greater extent than the interscript group's CW odds.

Table 2. Cognitive Workload (CW) Odds Variation

	Intrascript (n=8)	Interscript (n=10)	p value
Script Formation (H2)	-0,807	1,729	0,047
Dissimilar Website (H3)	1,701	-0,737	0,036

Hypothesis 4

Using an adapted version of the NetQual scale (Bressolles and Nantel 2008) in order to evaluate each website on ease-of-use, aesthetics, information quality, and interactivity dimensions for the last website visited, we obtained the results below. Even with a limited sample size ($n_{intrascript}$=10 and $n_{interscript}$=11), we were able to show that interscript subjects had a significantly different assessment than the intrascript group regarding how much easier to use was the last website visited (see L in Figure 1).

Table 3. Website Evaluation			
Dimensions	Intrascript	Interscript	p value (Mann-Whitney Test)
Aesthetics	4.70	4.82	37.5%
Ease-of-Use	**3.74**	**5.13**	**2.6%**
Information Quality	4.93	4.70	48.6%
Interactivity/Personalization	3.90	4.32	22.9%

While the average ease-of-use score was 3.74 for the intrascript group, it was 5.13 for the interscript group. Because this difference is statistically significant (see Table 3), this result provides support for H4. Note that we could not find a significant difference between the two groups for the other three dimensions (aesthetics, information quality, interactivity/personalization).

Conclusion

The proposed research study has three main objectives, namely to 1) validate if consumers activate cognitive scripts when shopping online, 2) understand how cognitive scripts are formed by consumers over multiple shopping trips, and 3) investigate how consumers activating different cognitive scripts respond when facing a novel shopping environment (e.g., a new Internet store).

Overall, our preliminary findings suggest that consumers activate cognitive scripts while shopping online (research objective 1). Furthermore, consumers seem to form different online cognitive scripts when exposed to different websites (research objective 2). In addition, consumers exposed to the same website over multiple shopping trips seem to engage in automatic processing, whereas those exposed to different websites over multiple shopping trips seem to engage in controlled processing. Finally, the results suggest that different online cognitive scripts may lead to different perceptions of website ease-of-use (Research objective 3). Consumers exposed to the same website over multiple shopping trips reported lower ease-of-use perceptions of a new and dissimilar website than consumers exposed to different websites over multiple shopping trips.

While further analyses are needed, these preliminary findings suggest important theoretical and managerial implications. First, they extend prior research on cognitive scripts to a self-service and computer-mediated context. Second, they highlight that cognitive scripts have an impact on the way consumers process information by showing how different scripts influence consumers' engagement. Third, for managers, these findings suggest that they should perform marketing actions to make consumers form their script based on their website instead of the competition in order to benefit from lock-in advantages (Johnson et al. 2003).

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