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Mobile Eyetracking for Decision Analysis at the Point-of-Sale: Requirements from the Perspectives of Marketing Research and Human-Computer Interaction

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1 Introduction

In a typical grocery-shopping trip consumers are overwhelmed not only by the number of products and brands in the store, but also by other possible distractions like advertisements, other consumers or smartphones. In this environment, attention is the key source for investigating the decision processes of customers. Recent mobile eyetracking systems have opened the gate to a better understanding of in-store attention. We present perspectives from the two disciplines marketing research and human-computer interaction and refine methodical and technological requirements for attention analysis at the point-of-sale (POS).

2 The Marketing-Research Perspective

For those who want to sell their products to the potential customers, knowledge about the customers' decision processes is crucial. Most of the research findings cited below come from experiments which have been set up in lab-like situations. For marketing researchers, however, experiments in more realistic decision environments are important to solve the following central research questions.

How can we bring more attention to our product in the store? A couple of studies have been conducted to determine whether attention to products in a store is top-down (endogenous), which means that consumers direct their attention to products according to their preferences, or rather bottom-up (exogenous), which means that preferences are being formed based on attention (Theeuwes, 2010; Orquin and Mueller Loose, 2013). Identifying in which decision contexts attention is driven by endogenous and exogenous factors has been recognized as an important research topic (see, e.g. Atalay et al., 2012). Research has shown that visual saliency is an exogenous factor that makes products more likely to be chosen (Milosavljevic et al., 2012). That makes tools which assess the saliency of products in competitive settings a valuable resource for marketing practitioners. Centrality is a second important exogenous factor. Recent findings suggest that central options in

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a supermarket shelf receive an increased amount of attention which also increases the likelihood that a central-positioned product is being chosen (Atalay et al., 2012).

What can we learn from the attentional processes of consumers about their decision processes? Research has shown that the finally chosen product receives more attention than the non-chosen products (Pieters and Warlop, 1999). Building on these findings, Shimojo et al. (2003) gave evidence that the increased attention on the finally chosen product results from the fact that attention shifts to this option in the very last seconds of the decision process. This effect has been called a gaze cascade effect and has been replicated in a couple of different decision environments (see, e.g., Shi et al., 2013), but not at the POS.

Researchers have also developed metrics to divide the attentional process into different stages. Russo and Leclerc (1994), for example, suggest using refixations to define three stages of the decision process which they named the orientation, evaluation and verification stage. An important aim of research in this field therefore is to develop ways to define decision stages and associated information needs.

How do previous attentional processes influence later attentional processes in POS-decisions? Most of the previously described studies have been tested in single decisions. Grocery-shopping trips, however, most of the times include dozens of purchase decisions which may influence one another. The influence of attentional processes in earlier decisions on later ones has been investigated in only a small number of studies (see, e.g., Janiszewski et al., 2013).

3 The Human-Computer-Interaction Perspective

Imagine consumers wearing an attentive mobile interactive cognitive assistant (AMICA), e.g. realized as “intelligent goggles”, at the point-of-sale that gives advice based on the context-sensitive data collected by an integrated eyetracking device. The AMICA will detect the interaction context by localization and computer vision techniques and activate apps tailored to the specific situation, here a shopping decision. Instead of a command-based interface, the attentive system monitors the ongoing cognitive processes of the wearer in particular by observing eye movements and establishing a semantic link between the fixations and the objects of the environment. Just as an observant sales-person, the AMICA will stay in the background, monitoring the ongoing decision process and only provide help when it detects uncertainty in the user’s gaze patterns, or if it is directly asked to do so.

Regarding general behavior models of such decision processes, HCI perspective and Marketing Research meet in their interest in mobile eyetracking systems. For example, findings on decision stages or the gaze cascade effect (see Section 2) allow predicting the stage of the information acquisition process. In each of the stages, consumers have different information needs. Early in the decision process, explanation-facilities about the use of the recommender system help building trust

and lead to a higher chance of adoption (Wang and Benbasat, 2005; Wang and Benbasat, 2007). Furthermore, consumers might need additional information about the product attributes being relevant in the purchase decision depending on the consumers' product knowledge. In the next stage, promising products must be identified by the system which the consumer will compare in more detail along several product attributes in the later stages (Häubl and Trifts, 2000).

However, an AMICA needs to identify the context and the objects of interest in real-time, to detect products and attributes of interest. The detection needs to be highly robust and be able to cope with dynamic environments, because errors will not average out with an increased number of trials. It also requires a high level of personalization, both to adapt to the peculiarities of the individual user's cognitive processes and to the user's preferences to provide sound recommendations.

4 Requirement Analysis

Based on the research questions outlined above, we identify the following information and technical requirements for mobile eyetracking at the POS:

It is not surprising that knowledge about typical features such as *fixations* and *dwell-times* are a common requirement. *Transitions between fixations* are equally important and thus *saccadic distances* and *saccadic speed between fixations* provide highly supplemental information. In all cases, the *semantic link between* overt *visual attention and the object of interest* is of uttermost importance. Information about visible *product categories* and *individual products in focus* as well as *product features* such as price, brand name and *specific features*, e.g., nutritional information are required. Finally, the *choice of the customer*, as the outcome of a decision process, needs to be detected, too.

Marketing Research is in particular interested in the *topological distribution of attention*, e.g. over a shelf, to answer questions regarding the *saliency of products* in a shelf or shelf set-up and centrality of a product for product placement. These aspects are not so important for HCI, but robustness of the systems could nevertheless benefit if topological information is available. As Marketing Research is interested in *aggregating and visualizing gaze data from many customers*, a relatively *stable topology of the products* and a *large number of respondents* for statistical tests are required.

HCI, in contrast, focusses on the individual and the interaction does not stop at the shelf: Typically customers take products out of the shelf to inspect them, to haptically test them, and to carry them around. Approaches that *support dynamic and noisy scenarios* are thus a must in the envisioned HCI context. *Low latencies* for the classification of gaze data and the fixated objects of interest are important to support a timely reaction of the system. This is challenged by the requirement of a *robust classification process* to allow for a smooth human-computer interaction without many interactive reparations and backtracking operations.

5 Summary

We have approached the analysis of the decision processes at the POS from two perspectives. By tendency, Marketing Research is often associated with the interests of salesperson, but this is not necessarily the case. While Marketing Research has a stronger focus on the description of behavior in general, HCI focusses stronger on individual preferences. In the end, both approaches may cross-fertilize, as one benefits from the methods and results aimed at by the other discipline, e.g. HCI could benefit from an initial general behavior model that can be personalized over time and Marketing Research could benefit from unobtrusive and flexible methods for measuring decision processes as they happen at the POS and not in clean laboratory environments. The technology developed in the HCI part (AMICA) is applicable to other domains, as long as the domain specific aspects of the cognitive models and the computer vision parts are adapted.

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References

1. Atalay AS, Onur Budur H, Rasolofoarison D (2012). Shining in the Center: Central Gaze Cascade Effect on Product Choice. Journal of Consumer Research 39(4):848-866.
2. Häubl G, Trifts V (2000). Consumer Decision Making in Online Shopping Environments: The Effects of Interactive Decision Aids. Marketing Science 19(1):4–21.
3. Janiszewski C, Kuo A, Tavassoli NT (2013). The Influence of Selective Attention and Inattention to Products on Subsequent Choice. Journal of Consumer Research, in print.
4. Milosavljevic M, Navalpakkam V, Koch C, Rangel A (2012). Relative Visual Saliency Differences Induce Sizable Bias in Consumer Choice. Journal of Consumer Psychology 22(1):67-74.
5. Orquin, JL, Mueller Loose S (2013). Attention and Choice: A Review on Eye Movements in Decision Making. Acta Psychologica 144 (1):190-206
6. Pieters, R, Warlop L (1999). Visual Attention during Brand Choice: The Impact of Time Pressure and Task Motivation. International Journal of Research in Marketing 16 (1):1-16
7. Russo, JE, Leclerc F (1994). An Eye-fixation Analysis of Choice Processes for Consumer Nondurables. Journal of Consumer Research 21 (2):274-290
8. Shi W, Wedel M, Pieters R (2013). Information Acquisition during Online Decision-Making: A Model-Based Exploration Using Eye-Tracking Data. Management Science in print.
9. Shimojo S, Simion C, Shimojo E, Scheier C (2003). Gaze Bias Both Reflects and Influences Preference. Nature Neuroscience 6(12):1317-1322.
10. Theeuwes J (2010). Top-down and Bottom-up Control of Visual Selection. Acta Psychologica 135(2):77-99.
11. Wang W, Benbasat I (2005). Trust in and adoption of online recommendation agents. Journal of the Association for Information Systems 6(3):72–101.
12. Wang W, Benbasat I (2007). Recommendation Agents for Electronic Commerce: Effects of Explanation Facilities on Trusting Beliefs. Journal of Management Information Systems 23(4):217–246.