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Purchase behavior analysis through gaze and gesture observation☆

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ABSTRACT

This is a part of behavioral marketing research. Its purpose is to establish a classification of the customers in term of their profiles. Customer profiles are characterized by several attributes such as purchasing behavior. In a selling area, a customer adapts his purchases depending on the stimulus he perceives. This strategy can be precise, can follow a routine, or can be elaborated at the time he enters the selling area, hence the need for marketing managers to be able to determine the indecisiveness class of consumers and their types of purchasing.

The first study is based on the analyzing hand movements of customers. A structural behavioral architecture is built. We show that the path in front of the store shelves can be seen as a sequence of states. Hence we use a HMM algorithm to describe each decision-making situation. It leads to satisfying results, as it correctly predicts 75% of the subjects' indecisiveness classes.

The second part investigates two of the main purchasing scenarios: the routine and the impulse purchasing. To reach this goal, we extract relevant eye-tracking descriptors. We use a supervised learning algorithm (SVM), to build the model and reach performances of 74% of good identification.

1. Introduction

The study described in this paper is part of the ANR[1] project ORIGAMI2 ("Observation du Regard et Interprétation du Geste pour une Analyse Marketing Non Intrusive", or "observation of gaze and interpretation of gesture for a non-intrusive marketing analysis"). The project aims at completing an analysis of the customer's decision-making process by combining various data acquisition tools. This project is funded by the French Ministry of Research.

Understanding person's needs in a selling area, customizing sales offer and stimulating purchases are perpetual concerns of physical distribution networks. Currently, more than seven out of ten purchase decisions are made at the physical point-of-sale. Marketing studies show that most of these purchases are related to customers' habits: trajectories and movements of the customer in the selling area as well as their gaze position in front of store shelves strongly impact the buying act [36,76]. As buying behaviors greatly vary for each customer, studying the customers' habits and their behavior becomes primordial. It is necessary for the managers of distribution networks to possess this information to define their merchandising strategy and their marketing mix.

In the "economical man" approach [27], people are described as fully rational and disinterested, making decisions according to their ability to maximize usefulness while spending the least amount of effort possible. In order to rationally behave, from an economical viewpoint, a customer should be aware of all the possible options that are available. He also should be able to correctly weight each alternative and be able to select the optimal action plan [61]. Nevertheless, he rarely has adequate information, enough motivation or enough time to come to such a perfect decision. He is often guided by less rational influences such as social relationships and social values [4]. Moreover, people are often described as seeking satisfaction, more than making optimal choices, as stated in the Satisfaction Theory of Augier [4], or in the Theory of Perspectives of Kahneman and Tversky [31]. The behaviorist approach explains the subject's behavior with outer events. Everything peoples experience, from their actions to their thoughts, including their feelings, can be considered as behavior. The causality of behavior is related to factors that are external to the individual. Each of these developments relies heavily on logical positivism that argues that empirical and objective methods used in physical sciences can be applied to the study of a customer's behavior [17]. The cognitive approach relates the actions (behaviors) to intra-personal cognition. The individual is seen as an "information processor" [56]. This intra-personal causality questions the

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power of environmental and social variables in the behaviorist approach. Nevertheless, it does not totally neglect them in the way that a customer seeks and receives stimuli from his environment so as to help him in his internal decision-making process [30].

Within these theoretical approaches of customer analysis, there are several variables that influence the actions of a person that enters a selling area [62]. Among these variables, there are those related to the customer himself, such as age and gender, as well as variables related to his personality. Personality refers to single psychological characteristics that lead to coherent responses of an individual to his environment [35]. Among these characteristics, we can name self-confidence, domination, sociability, impulsivity, involvement degree, or indecisiveness degree [1,33,47].

Our work is within the previous theoretical frameworks. Indeed, we consider that individuals can be guided by the quest for satisfaction. We also consider that in a selling area, a customer adapts his behavior according to the stimuli his organism perceives, and that he adopts a strategy of choice according to each situation.

In a selling area, it is important to know if a person is decisive or indecisive. This helps, for instance, the seller to know if the layout of the market shelf can help the customer in making his choice. If this is not the case, an indecisive person can be targeted by advertising or vouchers. Marketing managers are also interested in people who come to buy everyday products. They want quantify the impact of advertising on impulse buying. Hence the need of a predictive model that differentiates a routine purchasing scenario from an impulse purchasing scenario.

There are several main approaches that are used to extract a customer's actions in a selling area. For example in the SWC approach [9,48], the researcher shares the subject's life so as to give a sense to his shopping activity; during the shopping activity, each action is precisely noted by the researcher. The other approach consists in using sensors to follow a customer's path in physical selling areas. Some authors use videos analysis, with image processing algorithms. Sicre and Nicolas [63] propose a model that describes the customer's behavior through several recurrent states. Video analysis is a non-intrusive method; it gives quantitative and more precise data than the SWC method. Another category of sensors (RFID) is used by Hu et al. [25] and Larson et al. [40]. As video analysis, RFID techniques give quantitative and more precise and data than the SWC technique.

In this paper, we propose a compromise between these techniques, by placing firstly, the targets on the customer's hand that can be easily tracked using infrared cameras. It gives precise and quantitative data for the analysis of the indecisiveness degree. For the second application, we used the SMI eye tracking glasses to capture the gaze position.

2. Gesture analysis for indecisiveness class

2.1. Indecisiveness degree

Indecisiveness is a matter that is studied in several disciplines, from clinical psychology to the choice of a professional calling, passing by marketing and management. There are several conceptual and/or operational definitions of indecisiveness in research works [69,60,54,12]. Each of these definitions involves one or more notions such as the extension of decision making, procrastination, the difficulty to decide, unstable commitments ... Crites [14] describes indecisiveness as the difficulty in making everyday decisions, whether they have a great importance or not, and even when all the conditions of choice are gathered (availability of several options, incitation to choose, freedom of choosing). Other authors reuse this notion of difficulty. Fuqua and Hartman [20] propose a Trait Indecision Scale, and Reed [54] suggests two ways of quantifying indecisiveness; either with the time needed to make a choice, or the number of requests that are made to get more information. In addition to the notions of difficulty and inability, there is the notion of postponing decision making, either because of personal qualities [60], or because of procrastination. This is the case for Ferrari and Dovidio [18], who propose a measurement scale for procrastination. A similar notion of procrastination is fear of commitment [21]. In parallel to procrastination and fear of commitment, there are regret of a decision, unstable commitment and, more generally, chronic indecisiveness. For instance, Frost and Shows [19] propose a behavioral measurement, based on these three notions and previously quoted notions (procrastination, difficulty to choose, latency of choice, negative affects). With regard to unstable commitment, Bacanli [5] evokes two aspects. The first aspect consists in an exploratory indecision, that is to say a long exploratory process, even if all the options have already been previously analyzed. The second aspect consists in an impetuous indecision, that is to say choices that are made quickly but instantly given up.

The behavioral definition of indecisiveness presented in this paper relies on Frost and Shows' definition [19], lately rewritten by Yates et al. [77]. Yates defines "decision" as a commitment toward an action plan whose purpose is to satisfy the subject or the "beneficiary" (see also [45] and [39]). In this definition, a decision involves both commitment toward the action and the success of such a commitment. In other words, "indecision" is reflected by *the state of not (yet) having made, within a specified timeframe, a stable commitment toward an action plan, despite the fact that this commitment is necessary*.

Several works are based on Frost Shows' Indecisiveness Scale (IS). This degree is calculated thanks to a multiple-choice questionnaire with valuated answers. Zeisler [79] uses this scale as an indicator for a tendency to procrastinate. She studies the relationship between stress and procrastination among parents whose children suffer from Down syndrome. Rassin and Muris [53] analyze the relationship between indecisiveness and obsessive-compulsive disorder, among men and women. Di Schiena et al. [15] work on the role of indecisiveness among people with depressive symptoms. In another field of study, Swami et al. [66], and Patalano and Wengrovitz [49], investigate the cultural differences that are related to indecisiveness. Germeijs and De Boeck [22] propose to measure career indecision, based on Frost and Shows' IS. In marketing research, Wellington and Hutchinson [72] analyze the impact of business simulation games on indecisiveness among students, that is to say the ability of participants to become better decision-makers during simulation games. Kyrios et al. [38] explain that customer's compulsive buying is influenced by a range of cognitive domains, including deficits in decision-making. In our previous works [44,43], we study the indecisiveness degree of customers in a selling area, based on gaze analysis, and propose a predictive model.

2.2. Proposed approach to predict a buyer's indecisiveness class

Every purchasing act is preceded by a decision-making process. When the customer stands in front of several sources of data, he first acquires the information, then evaluates it and launches an action sequence (buying or not buying). The decision-making process is reflected by the customer's micro-actions, such as for instance a customer's hesitations and movements back and forth between one product and another. We propose to predict the indecisiveness class during the purchasing act using gesture analysis. Fig. 1 shows the architecture of our approach.

Since the prediction of human behavior is a difficult task, the subjects are analyzed through several scenarios. In each scenario, a HMM classifier is built in each case. We need an algorithm that combines the results of each scenario. Several methods have been developed in order to combine complementary classifiers.

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