Context-Based Methodology for Decision Making: Application to Car Driving

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ABSTRACT

Our objective is to support decision makers for improving their behavior by combining bottom-up and top-down approaches. The context-based methodology establishes a conceptual description of behaviors that addresses the initial objective of behavior management. Decision makers’ behaviors are represented in two spaces, namely a behavior space and a situation space. The identification of an “expected behavior” determines the class where the decision maker is and the types of errors associated with this initial class. Validation is realized by the comparison of the “expected” and “effective” behaviors, and the use of scenarios with the same errors but in different contexts allows a second validation. This work, initiated in road safety, is now applicable in other domains where it is more important to work on behaviors of decision makers rather than decision makers themselves. [Article copies are available for purchase from InfoSci-on-Demand.com]

Keywords: Context; Contextual Graphs; Decision Making; Pre-Critical Situation; Training

INTRODUCTION

In most real-world applications, a decision maker faces ill-defined situations where the form of the argumentation rather than the explicit decision proposal is crucial (Forslund, 1995). As a consequence, it looks better to store advantages and disadvantages rather than the complete decision only. Decision makers make their decision (and adapt consequently their behavior) in real time rather than relying on procedures. A first reason is that a procedure never matches exactly the situation at hand and may lead to improper actions or sub-optimal solution strategies. A second reason is that the deci-
sion maker can miss some important facts and notice them too late to adequately solve the problem. Such know-how is generally built up case by case and is complemented by “makeshift repairs” (or non-written rules, “magic book”, etc.) that allow decision makers to reach the required efficiency. This is a way of getting the result whatever the path followed.

A decision maker does not consider the world from an objective viewpoint, but based on a mental representation in which the decision maker interpret the decision-making process at hand (including procedures) and the conditions in which this process is realized. This mental representation is a « circumstantial representation » built in a working memory from permanent knowledge, such as procedures, stored in the long-term memory and from perceptive information extracted in a scene (such as environmental cues). The mental representation provides the contextual framework of the decision maker for a meaningful and self-oriented interpretation of the situation, including anticipation of potential developments in the current situation. Endsley (1995) defines it as Situation Awareness: “The perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.”

Mental representation is “action-oriented,” that is, the decision maker’s behavior must be considered from his viewpoint, not from an observer’s viewpoint. Once built, such mental models generate perceptive expectations, guide the environment exploration and the new information processing, orientate decision making and, lastly, determine all behaviors carried out by the decision maker. Thus, mental representations are key elements of the decision maker’s cognition, and an erroneous mental representation means potentially errors and unsafe actions in the decision-making process.

The application of a procedure depends on the operational environment, the situation in which occurs the activity, the type of people who operate it, the culture of the society in which they live, etc. Consequently, decision makers adapt procedures to reality in order to deal with the richness and complexity of the situation and decision-making is associated with a process of contextualization. Such practices are a kind of compilation, or contextualization, of the procedure in which knowledge pieces and contextual cues are assembled, organized, structured together in comprehensive knowledge about actions (a chunk of contextual knowledge a la Schank, 1982). Conversely to procedures, practices are highly contextualized, and may introduce new sub-strategies not foreseen in the corresponding procedure. This is a general way to reach the efficiency that decision makers intended when designing the task (Pomerol, 2001). A practical reasoning is not logical and theoretical reasoning for which the sequence of actions to do leads to a conclusion (suboptimal or not). Practical reasoning has more a status of inductive probabilistic reasoning: the conclusion cannot be detached (i.e. take a meaning) from the premises. Modeling decision makers’ reasoning is a difficult task because a number of contextual elements are used. These knowledge pieces, which are not necessarily expressed explicitly, result in more or less proceduralized actions that are compiled in comprehensive knowledge about actions.

The lack of explicit representation of context is one of the main reasons for the failures of many knowledge-based systems in artificial intelligence (Brézillon and Pomerol, 1997). We have developed
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