CONTEXT-BASED INTELLIGENT EDUCATIONAL SYSTEM FOR CAR DRIVERS

Juliette Brezillon, Patrick Brezillon, Thierry Artieres
LIP6, University Paris 6, 104 avenue du President Kennedy, 75016, Paris, France

Charles Tijus
Cognition et Usages, University Paris 8, 2 rue de Liberte, 93526 SaintDenis Cedex 02, France

Keywords: Driver modeling, Cognitive Sciences, Machine Learning, Context, Situation Awareness.

Abstract: Although a driving licence concludes training, such an initial is insufficient because new drivers do not know how to contextualize the learned procedures into effective practices. Our goal is to improve the drivers' situation awareness, in which the drivers perceive the environment's events and the projection of their status in a close future. To achieve this goal, we design an educational system for the drivers, which help them to become aware of their driving errors. This educational system aims to identify and correct drivers' drawbacks. In this paper, we discuss the reasons for associating two approaches: a local approach (resulting from cognitive sciences) and a global approach (resulting from machine learning), and we show the key role that context plays in the driving activity.

1 INTRODUCTION

Car driving is a complex activity that needs practical experiments to be safe. Initial training required a driving license that appears insufficient because young drivers do not know how to contextualize the learned procedures in effective practices. A reason is that learners are always with a car instructor that monitors (and corrects) their actions. Thus learners rely on this support and do not develop an efficient awareness on the driving task.

As a consequence, novice drivers are proportionally more involved in accident than experienced drivers. Inexperience concerns several aspects of drivers' cognition, but the main factor of novice drivers' errors is an inadequate mental representation of the driving situation. The learner does not consider the relevant contextual cues related to his driving task. Indeed, driver's decision making is not based on the objective state of the world, but on a mental model of the driving task and the conditions to accomplish this task. This mental model is a circumstantial representation of (Richard, 1990) built in a working memory from perceptive information extracted in the road scene, and form permanent knowledge stored in the long-term memory.

This representation provides a meaningful and self-oriented interpretation of the reality, including anticipation of potential evolutions in the current driving situation. From this point of view, this corresponds to the driver's Situation Awareness, (Endsley, 1995): ”The perception of the 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”. Moreover, this mental representation is ”action-oriented” (i.e. the driver is an actor not a witness). Mental representations are a key element of the driver's cognition. An erroneous representation means, potentially, decision-making errors and unsafe driving actions. Hereafter, the paper is organized as follow: the first part aims to explain the previous works our project is based on. The following part describes the global and local methods that are used in this project. The third part gives our viewpoint about the context. The last section presents the first results of our project, which are an errors-based drivers' typology and the choice of a case study.

Brezillon J., Brezillon P., Artieres T. and Tijus C. (2007).
CONTEXT-BASED INTELLIGENT EDUCATIONAL SYSTEM FOR CAR DRIVERS.
In *Proceedings of the Ninth International Conference on Enterprise Information Systems - AIDSS*, pages 403-406
DOI: 10.5220/0002366204030406
Copyright © SciTePress

2 PREVIOUS WORKS

2.1 Gadget Project

The GADGET, acronym for ”Guarding Automobile Drivers through Guidance Education and Technology”), project (Siegrist, 1999) was a European project about safety road. It aims to assess traffic safety measures on driver behavior; analyze the influence of in-car safety devices, various road environments, education and training programmes, safety campaigns, and legal measures (including enforcement) on driver behavior. This project stars from the work of (Van der Molen, Btticher, 1988) who split driving tasks and driving behavior into three hierarchic levels: Strategic level, Maneuvering level or Tactical level and Control or operational level. In the GADGET matrix, later also referred to as the GDE matrix, a fourth level was, however, added above the other three, the Political level. We make the assumption in our work that GADGET methodology can be revisited at the light of the notion of context. We make the assumption that all the variables in the GAGDET matrix can be used to describe the context of the driving activity.

2.2 Other Study

Another work on which we based ourselves on is the work of (Young, 2006) which shows that it's better to learn from errors than from successes. The study examines whether error exposure training can enhance adaptive performance. Fifty-nine experienced firefighters undergoing training for incident command participated in the study. War stories were developed based on real events to illustrate successful and unsuccessful incident command decisions. Two training methodologies were compared and evaluated. One group was trained using case studies that depicted incidents containing errors of management with severe consequences in fire-fighting outcomes (error-story training) while a second group was exposed to the same set of case studies except that the case studies depicted the incidents being managed without errors and their consequences (errorless-story training). The results provide some support for the hypothesis that it is better to learn from other people's errors than from their successes. That's why we based our driver's typology on driving's errors.

3 GLOBAL AND LOCAL METHODS

The main idea of the project is to associate global method resulting from machine learning and local methods resulting from cognitive sciences. The idea to associate global and local methods comes from the limitations of each method. Indeed, the local method performed very well to describe a driver's behavior at the highest levels (in the most general way) but can not describe a driver's behavior on the lower levels since it must take into account too much variables. We have the opposite problem in the global methods. They analyse very poor data (from the lower levels) and infer some more general information. But they are limited and can't describe drivers' behavior at the upper levels. The global methods can only give general information on the driver's behavior in their driving task, whereas there is a high individual variability in this kind of study since each driver is a particular case who acts with a set of contextual cues highly personal that differ one from all other. Moreover, one driver can present very different behaviors for the same driving task since the contexts in which he is doing this task can be very different. Thus, a global method constructed from every day life's data allows establishing a driver classification in reality, which has to be completed by a local method. In this way, we hope to be able to describe a driver at all the levels in the same time. The association of the two approaches allows modeling the driver at all the levels of the matrix proposed in the GADGET methodology. Thus we solve some problem found in literature which are the facts that some studies analyze the driver at one level at the time; for example they studies at the tactical level. But each level depends on highest levels, what is a limit of the other studies.

4 FIRST RESULTS

4.1 Driver's Risky Behaviors Typology

Our driver's typology, based on driver's risky behavior, is resulting from a questionnaire. This questionnaire has been made by taking all the variables in the GADGET matrix, completing by others we thought was missing, and by organizing them not by layers as it was usual to do, but by type. The questionnaire was then done to implements 61 variables (issues from GADGET and complete by ourselves). It has 162 questions, there are thus some reformulations in the questions to stage the skew of the morality of the driver and to determine if it lies or not. To stage this skew, we also guided the questions about the facts while trying to ask for the least most often possible the opinion of the driver about his own behavior. The results show here are issues from the first 214 participants to that questionnaire. From this data, we extract 16 classes, by doing a principal composant analysis to reduce the 61 variables to 3, and we classify these new data thanks to the agglomerative methods in 16 classes. We then identify for each class variables which describe the class; they are variable which has a specific value in that class and another value in the others classes. We after determine for each class the specific variables which are relative to risky features and behaviors. Here are these variables for each class:

1: driver does not think of managing the unforeseen situations and do not plan its way

2: driver feels to develop by his driving

3: driver already was under the effect of tiredness and alcohol in his driving

4: driver already was under the effect of alcohol

5: driver thinks of having basic competences to drive, missing automatism, driving in bad mood, feels to develop by his driving, and drive to decompress

6: driver has tendency to risks and is accustomed to taking risks

7: driver has tendency to risks and is accustomed to taking risks, does not always control the trajectory of its vehicle, does not always put its indicators, miss automatism, drive in bad mood, does not always make good prediction in the evolution of the driving situation and feels to develop by his driving

8: driver doesn't thinks to have basic competences to drive, does not always put its indicators and does not always control the trajectory of its vehicle

9: driver already was under the effect of alcohol and drugs, and has already have an aggressive behavior in his driving

10: driver does not always make good prediction in the evolution of the driving situation

11: driver thinks he has a driving style and feels to develop by his driving

12: driver does not think of managing the unforeseen situations and does not always make good prediction in the evolution of the driving situation

13: driver does not consider his car like a purely functional instrument

14: driver is an amateur of races of cars, at search of strong feelings, and already has an aggressive behavior in his driving

15: driver doesn't thinks to have basic competences to drive; he thinks he misses automatisms and does not always make good prediction in the evolution of the driving situation

16: the driver do not think of managing the unforeseen situations, doesn't thinks to have basic competences to drive, doesn't drive if there is fog, or snow, or glaze, if the traffic is dense, already was under the effect of alcohol and drugs, does not always make good prediction in the evolution of the driving situation, thinks he has a driving style, has already have an aggressive behavior in his driving, does not see the road as a social space and is not sensitive to social pressure.

This typology of drivers' errors is the first step of our work. We aim further to identify a driver's behavior in this typology to analyses his drawbacks and to help him to improve his situation awareness by correcting this drawbacks thanks to adapted scenarios on simulation.

4.2 The Case Study of Our Experimentation

We take a real traffic situation -a simple crossroad- and try to analyze all the driving situations that can happen. We assume only two cars arriving to the crossroad. We select the viewpoint of the driver of

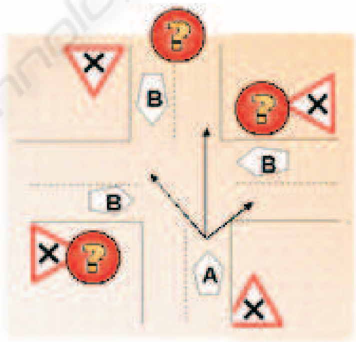

Figure 1: Real situation driving.

car A (coming from the bottom), and analyze all the options, first, according from where is coming the car B (from the left, the right or in front of car A), and second, according to the movement of the two cars (turn left, straight ahead, or turn right) at the crossroad. We model all the behaviors by contextual graphs. In the retained traffic situation, each road has a "Yield" sign. This means that no priority has been defined and the rule is "priority to the car on the right side". This crossroad can leads to 27 initial traffic situations, according from where is coming car B and where are going the two cars. After defining our real driving situation, we model with contextual graphs: topology of the crossroad, road sign position, theoretical behavior of the drivers, possible behaviors of the drivers.

The topology of the road show how the law decides that a crossroad needs a yield road sign. This takes into account the specificity of a crossroad, and the visibility to evaluate that needs. The road sign position means that once we have established that a crossroad has the need of a yield sign, we have to determine the position where it would be. This model shows that the position will be not the same in a city or in countryside. Since the chosen crossroad has no special priority, the law defines the 'theoretical" behavior as "to yield the emerging passage to the vehicles of right-hand side, by having a special vigilance and a deceleration adapted to the announced danger." There are some restrictions with this panel: the trams have right of way and if the topology of the crossroads obliges it, a special panel added to the first definite the priority. The theoretical behavior established from the law texts is to check that the roadway to cross is free, to circulate with a moderate speed especially if the conditions of visibility are worse, in the event of need, to announce our approach, must engage in an intersection only if our vehicle does not risk to be immobilized in the crossroad area and to anticipate the passage of the vehicles circulating on the other ways. There are two successive parts: the analysis of the situation and the process of the decision making itself. Possible behaviors have been analyzed start from what can happen concretely in that crossroad that is not planned by the law. First, the car's driver, which has not the priority, does not stop and enters the crossroad, because for instance, the car's driver thinks that he has time to pass before the other car, or he didn't see it. Then, he can realize that he's making a mistake and decides to stop in the middle of the crossroad. The other car attempts to avoid him. Moreover, the two car's drivers can break down. If a car's driver breakdown, the other car's driver will have to wait until the other starts again and leave the crossroad, or decides to overtake it. If the driver overtakes, the first car can start again and realize the other car is in front of him and try to avoid him. Or maybe, the other car's driver was not attentive and didn't see that the car driver breaks down, thus he will has to react at the time he will realize the problem, and he has still some. We determine, thanks to this case study, the drawbacks of the driver behavior. We have several possible scenarios on this situation and each is linked to class of our errors-based driver's typology. For example, the driver who is not attentive (and who belongs to the class 12 on our typology) would make the scenario in which he would not see the other car on the crossroad. With the correlation, we are able by making pass this specific driving situation to any driver to identify his drawbacks and his errors in his driving thanks to our typology and we would be able to help any driver to improve his situation awareness.

5 CONCLUSION

Driver modeling is an important domain that interests a number of administrations (for a uniform road security in European countries, for the police for interpreting correctly drivers' behaviors, for associations wishing introducing some changes. etc.). This is also an interesting field of investigation for AI researchers. Our contribution brings at least three new insights on this hot topic. First, we propose "driver's based" classification of drivers and not an arbitrary classification. Second, we propose an open modeling in the sense that it is possible to incrementally acquire new behaviors of drivers. Third, we use good and bad practices for driver's self-learning, bad practices being mainly used by the system for identifying what is doing a given driver, and how to help him to correct his behavior.

REFERENCES

Brezillon, P. (2003), Context dynamic and explanation in contextual graphs. In: Modeling and Using Context (CONTEXT-03), P. Blackburn, C. Ghidini, R.M. Turner and F. Giunchiglia (Eds.). LNAI 2680, Springer Verlag Verlag, , pp. 94-106.

Endsley, M. R. (1995), Toward a Theory of Situation awareness in Complex Systems. Human Factors.

Richard J. F. (1990), Les activits mentales. Comprendre, raisonner, trouver des solutions. Paris.

Schank, R. C. (2003), Dynamic memory, a theory of learning in computers and people Cambridge University Press.

Siegrist, (1999), Rapport GADGET, Formation et valuation du conducteur, obtention du permis de conduire. Vers une gestion thoriquement fonde du risque routier des jeunes conducteurs. Rsultats du projet europen GADGET - Groupe de travail N3, Stefan SIEGRIST (ed.) Berne 1999.

Van der Molen, H. H. Botticher, A. M. T. (1988) A hierarchical risk model for traffic participants. Ergonomics.

Young, W., Hesketh, B., Neal, A. (2006), Using "War Stories" to Train for Adaptive Performance: Is it Better to Learn from Error or Success?, Applied Psychology.