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MAVIE-Lab Sports: a mHealth for Injury Prevention and Risk Management in Sport

PhD Student Track

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ABSTRACT

Smart-phones technology and the development of mHealth (*Mobile Health*) applications offer an opportunity to design intervention tools to influence health behavior changes. The MAVIE-Lab is a mHealth application including a DSS (*Decision Support System*) to assist in the personalized evaluation of HLIs (*Home, Leisure and Sport Injuries*) risk and to promote the adoption of prevention measures. *MAVIE-Lab Sports* will be the first module of the mobile application.

The purpose of this PhD project is to improve a particular module of MAVIE-Lab, devoted to sports (MAVIE-Lab Sports), in different aspects: statistical modeling, design and ergonomics. It also aims to evaluate system usability, acceptability, safety and efficacy. The development structure proposed and executed in this thesis will be replicated for the development of future modules for different types of HLIs.

This document develops the argument, objectives and advances in the development of the MAVIE-Lab Sports and the future work.

CCS CONCEPTS

• **Mathematics of computing** → **Bayesian networks**; • **Human-centered computing** → **Personal digital assistants**;

KEYWORDS

App; eHealth; Injury; HLIs; Prediction

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1 INTRODUCTION

Injuries are a main concern in Public Health, leading cause of mortality, leaving further major consequences on the quality of life of the population. Each year in France, HLIs cause more than 11 million victims and 20,000 deaths [5]. In Horizon 2020 call for Research and Innovation actions, the European Commission promoted the development of DSSs to empower individuals to self-management their health condition[4].

This context offers a novel opportunity to develop the MAVIE-Lab, an innovative mHealth for primary prevention of HLIs.

The MAVIE-Lab has been developed under the MAVIE project framework (<http://www.observatoire-mavie.com/>), a large web-based cohort study with the objective of prospectively collecting data related to HLIs in France. Currently, over three years of recruitment, 27 000 volunteers have already been enrolled in the cohort.

A first version of MAVIE-Lab Sport is based on this available MAVIE volunteers information. This prototype is available online, and includes: running, hiking, road cycling, downhill skiing and basketball (<https://ssl3.isped.u-bordeaux2.fr/MAVIE-OBS/Appli/#/>). However, the statistical models currently included in the App are non-optimal model predicting personal risk. Besides, it did not achieve a design, structure and popularity for a potential success as intervention tool.

This thesis aims to maximize the potential of MAVIE-Lab Sports. The first objective is to select and to implement an appropriate methodology to develop a *personalized prediction risk model* using MAVIE cohort data together with experts information. In addition, the thesis also aims to improve the App scientific value, design and ergonomics and to evaluate it among MAVIE volunteers.

DSSs are intended to induce beneficial behavior changes, specifically, the use of a DSS with the possibility of virtually experiencing solutions is hypothesized to enhance perceived susceptibility, perceived vulnerability, perceived behavioral control of self-efficacy [2, 7]. Our assumptions are that good personalized advice will call the attention of the users. The exposition to this DSS could induce change in risk behaviors and the adoption of safety tools.

2 METHODOLOGICAL PROPOSAL

2.1 MAVIE-Lab Sports Development

2.1.1 Data Sources. The MAVIE cohort is composed of approximately 6,000 practitioners over 15 years old who have authorized the use of their data. MAVIE survey includes detailed information: demographic, life-style, health data, environment and sport practice. In addition, there are specific variables about training, coaching, protective clothing, equipment, among others. Moreover, there are HLIs injuries follow-up, together with information about their causes, consequences and severity.

2.1.2 Modeling. We suggest implementing *Bayesian Networks models* (BN) using re-sampling techniques [6]. BN combine quantitative and qualitative modeling, probabilistic conditional dependencies and causal diagrams reasoning DAGs (*Directed acyclic Graph*). It allows us to combine previous qualitative causal relationships between variables (risk and protection injury factors), quantitative previous knowledge and MAVIE data evidence.

2.1.3 Design and software. The BN model relations and risk predictions will be used to build a DSS to produce adequate personal prevention advice. This DSS system will allow the user to virtually experiment the impact of a range of preventive decisions. The functions that have been designed for this objective are:

- (1) A graphical overview of each risk as compared to the average level of risk between different sports.
- (2) An estimation of the personal injury risk.
- (3) Experience potential risk change for a set of proposed behavioral changes, protective devices, equipment or sport practice environments.

Graphic design, software programming and use of technologies for the development of Apps is carried out as an interdisciplinary work in the IETO (*Injury Epidemiology, Transport, Occupation*) team following the practices proposed by HAS (*The French National Authority for Health*) to mHealth development [3].

2.1.4 Evaluation. The evaluation will be carried out among the volunteers of the MAVIE cohort. It will include the following components:

- (1) *Safety.* Experts will evaluate if the advice and recommendations given by the App are suitable for users health.
- (2) *Acceptability.* A questionnaire will be integrated into the application asking about user perception.
- (3) *Usability.* Tracking statistics of *Google Analytics* which are being taken for the current version of MAVIE-Lab.
- (4) *Efficacy.* Change in prevention behaviors and reduction of injury rates will be evaluated comparing MAVIE-Lab users and non-users, before and after MAVIE-Lab implementation.

3 RESULTS AND ONGOING WORK

The most important work done so far relates to the development of the first version of MAVIE-Lab Sports. Nevertheless, the main thesis progress has been the statistical methodological proposal for the improvement of prediction models in the App.

BN elicitation requires a complete review of scientific literature, results of similar studies and expert information to correctly quantify the different degrees of knowledge of risk and protection factors and their relationships in terms of probability. Currently, we are working in DAGs structures using literature information. On the other hand, we are working on an *elicitation protocol* adapted to risk injury evaluation according to recommendations of previous experts elicitation applications [1].

4 CONCLUSION

MAVIE-Lab is a novel idea for safety promotion and HLIs prevention. The key expected result is to achieve a validated and functional version of the MAVIE-Lab Sports that would motivate users to change their behavior regarding injury prevention. The research aims to evaluating whether the exposition to a DSS displaying personalized risk could generate behavioral changes leading to the reduction of the effective number of victims, which remains a major public health problem.

5 COMPETING INTEREST

The authors have declared that no competing interests exist.

6 ETHICAL CONSIDERATIONS

The MAVIE project has already received the approval of the CNIL *Commission Nationale Informatique & Libertés* (France), which will be updated to take into account the specificity of the MAVIE-Lab, in particular on the issue of the provision of personalized advice without the possibility of human intervention. MAVIE volunteers signed online the informed consent to participate in the research.

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