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# Users' performance with a riding simulator: The role of the social setting

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## ABSTRACT

The present work considers the training in risk perception carried out with a motorcycle simulator, the Honda Rider Trainer (henceforth HRT), and investigates the effect of the social setting on the trainees' performance. Through preliminary pilot studies a general procedure and three different social settings are defined: (a) a standard one (one trainee, one instructor); (b) standard with an audience of two schoolmates; and (c) two trainees and one instructor. The results show that in a school environment and with a careful procedure, the users'actions are aligned with the training purpose, and no gender difference emerges in the performance; also, the addition of a small audience, or a parallel training does not modify the trainees' ability to cope with risks.

## Categories and Subject Descriptors

K.3.1 Computer Uses in Education; J.4 Social And Behavioral Sciences

## General Terms

Experimentation, Human Factors.

## Keywords

social environment, risk perception training, qualitative analysis.

## 1. INTRODUCTION

Hazard perception is the ability to identify potentially dangerous situations in the traffic and to react to them; it has usually been measured as the perceived degree of danger associated to a traffic scene and/or as the reaction time to a danger [1]. Drive simulators are able to train both aspects: acknowledging a danger and properly reacting to it [2]. For this reason, they provide a valuable alternative to safety training based on multimedia material, frontal lectures and leaflets [3,4].

However, as in a real traffic experience, the driver's behavior is influenced by the surrounding situation. First, the meaning of the whole experience might differ from the intended one; for instance, trainees might seek risks instead of avoiding them [5]. Second, other people co-present in the room with the trainees might exert an influence on them: they might inhibit performance [6, 7], or trigger competitiveness and law violations [8] or –on a positive note – facilitate obedience to traffics laws [9] and decrease arousal accompanying violent behaviors [10]. Therefore we decided to select an optimal setting through some pilot observations, and then to compare the selected settings through a study with a controlled design. The next paragraphs will describe the HRT used in this work, the study procedure, the data analysis and the results.

## 2. HRT

The HRT is the refined version of a prototype started in 1989, and aimed at offering an experience of a motorcycle ride in different traffic and environmental conditions. Dangerous situations are generated by the system and the users' reactions to them are rated and commented. The purpose of the system is to increase the users' perception of some situations as risky and to do so in an interactive environment. Users can learn to behave so as to avoid or successfully cope with dangers. The ultimate objective of the HRT is to improve real-world safety of novice motorcycle riders.

**Figure 1. The model of HRT used in the study**

The whole machine is composed of a frame, a handlebar, pedal controls for clutch and braking, a seat, and a board holding a LCD 19" video monitor (Figure 1). The handlebar faithfully reproduces that of a motorbike. Realistic sound effects, accompanying operations such as engine acceleration or wheels jamming are included. The value of the HRT resides in its inexpensiveness and transportability, in allowing an

interactive training experience, and in the accuracy of the software developed after an analysis of about 1000 accidents involving motorbikes in Europe (MAIDS – Motorcycle Accident In-Depth Study of the ACEM association).

The system offers 16 different tracks located in urban, suburban and countryside scenarios and visible in three modalities, daylight, dark and fog. At pre-defined points along each track, the system automatically starts up to 8 hazardous situations. Once the track is completed, the system proposes a fast replay of the whole session, pausing after each hazardous situation and showing rates, comments and suggestions. The system can simulate different classes of motorbike; for this study with schools we selected the moped.

# 3. METHOD

At the beginning of the study, preliminary observations of 26 participants were made. These pilots considered several social settings in which the HRT is likely to be used, in order to identify those that resulted more able to endorse a proper approach to the training. In addition, they allowed to define the arrangement of the video-recording equipment; to get familiar with the basic aspects of the training procedure defined by another module within the same project; and to introduce some modifications to avoid boredom and to make sure that participants learnt all functions needed. The instructor's conduct (emotional, or neutral) and presence, the audience's presence, and the setting (school versus exhibition) varied.

The pilots allowed to discard 2 potential settings. The first one was the exhibition, which was too chaotic to allow a proper approach to the ride. The second one was the user left alone, since s/he did not pay attention to the replay and related advices after the session, and got bored. Therefore, the setting with the instructor and one trainee at school was considered as the default one (setting A); the variants consisted of a small audience of two classmates involved in the same training program (setting B), or of another schoolmate involved in a simultaneous training with another HRT (setting C) in the same room.

## 3.1 Design

The study design includes two between subjects variables (sex and social setting) and a within subjects variable (track number). In each social setting (A, B and C), 18 observations were planned, 9 with female participants and 9 with male participants. This allowed to observe 54 participants in total. Since it was not possible to study the effects of the students', audience's and instructors' gender as separate variables with 54 observations only, then gender was balanced in the different participants and conditions. In other words:

- the instructor was the same sex as the trainees, to make them feel at ease;
- the audience was composed by one boy and one girl;
- in setting C, trainees and instructor were all the same sex.

We created sessions composed of 2 exercise tracks (without traffic) and 4 tracks with traffic and hazard situations. The tracks were combined so as to create a stepwise increase of difficulty from the first to the fourth. On the basis of the Rasch analysis carried out by another module in the project, all tracks were ranked and grouped in 4 categories, from easy to difficult. Then, they were randomly assembled in sequences (permutations) of 4, containing one track from each level of difficulty. 9 different sequences were needed, as many as the number of participants per condition. Each participant within a condition had a different sequence, but all conditions used the same set of 9 sequences. Also, one track was represented the same number of times (6 times) in the 54 observations.

## 3.2 Procedure

The training took place at school. Dedicated rooms were made available to our team, where the equipment was set up for the whole length of the observation period. Nobody else entered during the sessions, apart from the people involved in the study (participants, instructors, audience), and according to the specific characteristics of the setting under investigation (A, B or C).

The procedure started with the collection of the informed consents from participants' parents prior to the training and in the scheduling of the training with each student. The day of the session, participants were collected from their classes, and accompanied to the room devoted to the HRT training. The instructor was sitting slightly behind the trainee, so as to be out of his/her field of view and to make his/her presence less remarkable. The audience in Setting B could sit or stand, as they wished. A session started with the instructions on the functioning of the HRT. Afterwards, participants carried out two exercise tracks with no traffic, to get familiar with the HRT. The instructor encouraged them to try the different commands (accelerator, brakes, direction lights) and especially the lateral view command (letting appear two frames showing a further portion of the scenery on the left and right). Once the exercise tracks were completed, a sequence of 4 regular tracks started, each one including a replay phase where trainees were asked to read the HRT comments aloud. The instructor adopted a natural attitude, refraining from expressing judgments or assessments on the trainee's performance. The whole session took about an hour.

The same procedure was used in settings A, B and C. In the setting C, the one with parallel HRTs, both participants listened to the instructions and started each track simultaneously; during the replay, they were asked to read the comments aloud 'without annoying the other person' and the instructor alternated his/her attention between them every once in a while. In this way, the procedure remained the same as the one adopted in settings A and B, and the instructor was able to attend both trainees.

At the end of the training session, each participant filled in a brief questionnaire, investigating the nature of his/her experience with the HRT. It was self-administered, in the same room of the training, and all questions were mandatory.

## 3.3 Participants

Participants were 54 students attending the first and second year of high school in different institutes in the Padova municipality and aged 13 to 18 (M=14.87, SD=0.75). The dean was always contacted and the teacher responsible for safety issues in the school helped in the organization of the observations.

## 3.4 Data Collection and Analysis

The data collection equipment included: 2 video-cameras, a digital/analogical converter connected with the HRT, a mixer connected with the camera and with the digital/analogical converter to put together the two image sources, a digital

video-recorder to save the output from the mixer, a monitor to check the preview. As the setting became more complex, the number of cameras increased. They were positioned so that the instructor, the participant(s) and the audience could all be seen (Figure 2).

**Figure 2. A screenshot from the videorecordings, where the view of the participant(s) and the screen of the HRT are synchronized and shown simultaneously.**

The data collected included the answers to the questionnaire and the video-recordings of all sessions. The video-recordings (36 hours) represented the core resource for our evaluation of the different settings, and the only one that will be considered here. They were analyzed with the Noldus system called The Observer, which allows to systematically assign a certain label to a frame or a series of frames in the video, and then to extract the frequencies and durations of these event categories. Since we wanted to know what users did and how they performed in the different settings, then we preferred not to focus only on the 8 moments in each track in which an 'official' danger was created by the HRT. We preferred instead to consider any kind of danger or accident occurred to the moped during the use of the HRT. This was the added value of manually observing the video-recordings with a qualitative method.

The events analyzed are listed below.

- *Danger*: any vehicle (bicycle, motorbike, automobile, truck, bus), object, pedestrian, or animal that was in the trajectory of the moped and that, all conditions remaining the same, would have crashed against it.
- *Reaction to dangers*: modifications in the trainee's action after the appearance of the danger and verisimilarly connected to such danger. In a first round of analysis we specified the nature of the reactions (engine start, turning, accelerating, decelerating, lateral view, direction light, horn, trajectory adjustment) and their appropriateness to avoiding the impact. However, in a second round this was simplified and the reactions were analyzed only in their time and order of appearance.

Identifying dangers and reactions allowed to identify accidents and avoided accidents.

- *Accidents*: episodes starting with the appearance of a danger (or a cue announcing it) and ending at the replay after the accident.
- *Avoided accidents*: episodes starting with the appearance of a danger (or a cue announcing it), and finishing when the danger was out of sight, not intersecting the trajectory of the moped anymore.

## 4. RESULTS

A first description of the trainees approach towards the experience is represented by the amount of dangers coped with successfully. Figure 3 described this amount (in green) and the amount of dangers concluded with an accident (in red).

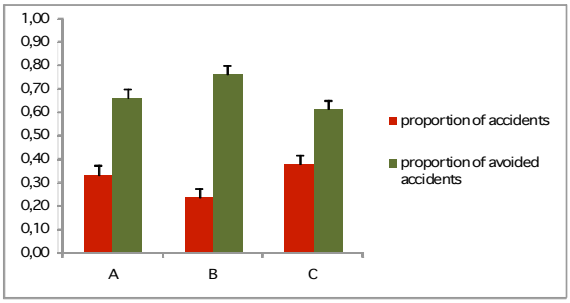


**Figure 3. The proportion of accidents in red, and the proportion of accidents avoided in green, out of the total amount of dangers faced by participants in the three settings: with the instructor (A), with the instructor and the audience (B) and with the instructor and two HRTs (C).**

Clearly from the figure the vast majority of dangers were reacted to properly and did not end up with accidents. This shows that identifying dangers and avoiding accidents was the user's goal, in compliance with the purpose of the training. This is corroborated by the answers to the questionnaire: when asked 'what was your goal during the training', most participants (81.48%) declared that their goal was to avoid dangers and to be cautious. Also, when asked whether the experience of riding the HRT resembled more a game or a way to learn, participants answered "a way to learn" in 79.63% of the cases. Finally, when asked what annoyed them during their training, participants complained abut the audience or the HRT very rarely (3.70%).

Regarding the comparison between the three settings, only the proportion of dangers concluded with an accident was considered. An ANOVA with a three-ways factorial design AxBx(CxS) (A: social setting; B: participants' sex; C: track) was carried out on the mean values; it showed the absence of any interaction among the three factors, and of interactions between each couple of factors. This excludes that any difference in performance was due to a joint effect of the three factors. Regarding main effects, the analysis revealed a non-significant effect for the 'sex' factor, a significant main effect of the 'social setting' ($F(2,48) = 3.37$, $p = .03$, $\_p2 = .14$), and a significant main effect of the 'track' ( $F(3,144) = 5.46$, $p = .001$, $\_p2 = .10$).

For the former, a Tukey test was performed to compare the different levels, showing a significant difference only between settings B and C ($F(1,51) = 7.22$, $p < .05$.), with B having a better performance than C. Setting A did not differ significantly from either B or C.

The performance measures were also broken down by category of danger based on provenance and state of the danger

(moving discontinuously; still; coming from aside; with direction lights on; from the front; from behind; from a secondary street; in the opposite direction). For each category, the proportion of dangers ended up with an accident was calculated. No significant difference between settings was found.

## 5. CONCLUSIONS

This study aimed at analyzing the performance of final users with the Honda Riding Trainer in different social settings, since in the literature they are associated to a great variety of effects, both facilitating and inhibiting a good performance. This goal can be broken down into two sub-goals: the first goal was to make sure that users who were supposed to undergo a training on safe riding and risk perception actually organized their interaction with the simulator in these terms. Therefore we wanted to check whether in a serious setting (school) and with a controlled procedure the attitude was more aligned with the desired one, namely recognizing and coping with dangers. All participants in the study exhibited this attitude. Especially interesting is the non-significance of gender as a factor influencing performance; we would attribute this unusual result to the care with which instructor gender, audience gender and user gender were combined in our procedure and design.

The second goal was to compare three different kinds of setting in order to analyze if there were differences in performance between them. The settings observed were selected because they are very likely to be the ones in which the HRT is actually used: to increase efficiency in time and money, parallel training sessions can be arranged simultaneously in the same room with just one instructor. Also, for organizational and logistic reasons, students waiting to use the HRT would probably watch the session of the person before them in line. The comparison between the different settings shows that -even if the instructor followed two trainees in parallel or other people were attending the session - trainees' performance was not worse than when the 1 instructor followed 1 trainee alone.

The sample was small due to the constraints of an intensive qualitative analysis, which could not be feasible otherwise. The advantage is that a very detailed analysis was carried out, not limited to the number of accidents or to the scores automatically provided by the HRT. Our conclusion is that with a procedure like the one adopted in this study, the presence of other peers does not – under supervision of an instructor – disrupt the training. On the opposite, there are some indications that the presence of a peer audience even improves performance. In addition, the procedure seems to avoid those gender differences that are so common in driving tasks [11].

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