# Age-related differences in Driver-INFO2000 interaction

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**Abstract**. These pages summarize the user-based evaluation of INFO2000, the prototype of a multifunctional in-car information system. The aim of the study was to investigate the very first impact of INFO2000 on both young and elderly potential users. It emerged that INFO2000 was initially less usable for elderly. Nevertheless, this difference tended to diminish with the practice and the elderly attitude towards the system was positive.

The last years had seen something of a shift in the interest of the automotive industry: an increasing effort is devoted to the production of innovative systems allowing drivers to communicate with the external world. Following this trend, the Fiat Research Centre has developed INFO2000. It is intended to be a telematic, integrated and multifunctional system. It provides several functions concerning communication (i.e. telephone, SMS, e-mail), entertainment (i.e. radio, CD player), travelling (i.e. navigation system, traffic information), and vehicle monitoring (i.e. car check).

One of the primary objectives of the INFO2000 project was the design of an interface that could fit needs and behaviour of potentially all drivers. Because of the natural decreasing of the cognitive abilities normally associated with ageing [Imbeau 93; NHTSA 99], elderly drivers were considered a critical target. Hence, the development of the user-interface was based on an iterative approach. The system life cycle started with the specification of the user requirements. A team of Human Factors experts developed a list of guidelines that according to a literature review and to their own experience should have helped the design of a universal interface. Following them, the designer team developed an extended version of the interface, which was further evaluated and improved. The result of this expert-based approach was a vertical prototype running on a PC: some functions were totally implemented; others were inactive.

The prototype was installed in a vehicle and tested with real users. The study was planned to optimize the ecological validity of the results. The main goal was to investigate the learning phase, when a driver has just bought INFO2000 and started using it. The first part was performed on a stationary car. The experimenter illustrated the basic functions and input modalities of INFO2000. Then, the driver was required to perform some tasks under her supervision. The last part was performed on a circuit: participants were invited to use INFO2000 while driving. The tasks that were proposed in this phase had to guarantee the driver's safety. Hence, they were easier than those proposed during the stationary phase. All the experimental sessions were video-recorded and the prototype produced a log-file. Questionnaires were administered before and after the evaluation, to assess both expectancies and opinions. Thirty male drivers took part in the experiment. They were divided in 3 groups: young driver (24-35 years old) expert in new technologies, young driver non-expert, elderly driver (60-65 years old) non-expert. Three usability dimensions were considered: *effectiveness, efficiency* and *user satisfaction* [ISO 98].

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The number of tasks successfully performed in the stationary phase was very high (91%). No differences concerning age emerged. Nevertheless, 41% of successfully tasks required some suggestions from experimenters to be solved. In particular, elderly were helped during 82% of the tasks, non-expert young during 25% and expert young during 20%. A synthetic EFFECTIVNESS INDEX was computed combining three features of performance: *success* in the execution, *autonomy*, and *awareness* (the result was achieved consciously or by chance). Age appeared to be a good predictor of *effectiveness*: elderly obtained a significantly lower score than young. No differences were found considering expertise. The tasks performed while driving were analysed considering both the interaction with the system and its eventual effects on driving styles. Compared to the stationary phase, the number of failures strongly decreased. Users changed their driving behaviour executing 36% of tasks: some of the participants just slowed down, while most of them spontaneously decided to stop. The age effect on *effectiveness* tended to disappear, as elderly participants performed better than in the stationary session. These results can be attributed both to a learning effect and to easier tasks.

As regards *Efficiency*, a synthetic TIME INDEX and an INPUT INDEX were computed. The first one took into account the average time needed to execute the tasks; the second one was based on the average number of actions performed. The TIME INDEX significantly differed between elderly and young both in the stationary phase and while driving. The effect was always due to the elderly slowness. Concerning INPUT INDEX, in stationary session elderly had the same performance than young. On the other hand, during driving, elderly made a number of actions significantly higher than young, but only in some system functions. The *user satisfaction* was evaluated comparing expectations and opinions in the 3 experimental groups. Generally, expectations were positive and did not modify after interaction. No differences due to age or expertise emerged.

In conclusion, our study demonstrated that INFO2000 is a promising system. The very first impact was positive for all the categories of users, even if it should be further simplified to guarantee an increased autonomy. Initially young drivers performed better than the elderly. They were faster, more autonomous and effective. However, the disadvantage of the elderly tended to disappear with the practice. During the trials we have matured the idea that the elderly just needed a longer time to master the basic concepts behind the interaction, probably because they were generally less familiar with the technology. Note that in our study the level of expertise by itself was not found to be a major determinant of performance (the differences between expert and not expert in the young sample were minimal). Hence, in the elderly sample the lack of direct expertise was exacerbated by other factors. Further studies are needed to understand them. Nevertheless, as a preliminary hypothesis we propose that elderly could have been more disadvantaged since the beginning of the interaction because they expected a more difficult task. Hence, their perception of self-efficacy was lowered and their performance was hampered [Bandura 86].

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