

Attention defaults when driving: A French experience to stimulate research on this road safety issue

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Context

- Recent gains in road safety (speed, alcohol and seat-belt)
- Changes in the driving activity (complexity of the environment, multitasking at the wheel)
- More drivers predisposed to attention defaults (ageing of the population, increase in medicines and drugs consumption)

➔ The proportion of accidents due to attention defaults increases and becomes a major cause to explore

- Sizeable road safety gains can be achieved
- Recent gains = check and punishment policies ➔ ineffective for health and psychological factors
- How should we tackle these residual sources of safety development ?

Research structuring in France

- PREDIT, CNRS, INRETS created the RESAT
- Réseau Eveil Sommeil Attention pour les Transports (RESAT) → Network Awake Sleep Attention for Transports
- Two different research groups dealing with:
 - Sleepiness at the wheel (P. Philip, CHU Bordeaux)
 - Attention defaults when drivers are awake (A. Chapon & C. Gabaude, INRETS Bron)



The DACOTA Project

« *Attention defaults when driving* »

Duration :
42 months

Total cost:
3 640 k€

State aid :
740 K€



Research manpower:
13 research teams
38 researchers

Representative :
French Universities
INSERM
CNRS
INRETS

Disciplines :
Cognitive Psychology
Neurosciences
Neuropsychology
Epidemiology
Linguistic
Psychophysics
Mathematics



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Project organisation

- Five research themes dealing with:
 - Individualization of attention defaults
 - Factors impacting Situation Awareness
 - Elderly drivers' difficulties at intersection
 - Impact of medicines on driver attention
 - Neurophysiology to study drivers attention
- Horizontal management across annual seminars

Main purpose

- A better understanding of task performance (linked to driving activity) under the influence of factors having an impact on cognitive functions
- Agreement obtained on the interest in :
 - Differentiating concepts for attention defaults studies
 - Raising a consensus around their definitions
 - Pursuing two experimental directions
 - Studying how well established routines are altered by cognitive workload
 - Trying to cope with relationships between cognitive, conative and affective factors to be able to individualize their effects
 - Exploring consequences of attention defaults on the driving activity but also on underlying cognitive processes (information processing and decision making)
 - Approaching this issue also through predisposed populations to attention deficits

Useful concepts and definitions

- Attention = the cerebral function controlling and modulating the quality of our cognitive processes relying on representations (perceptive, conceptual or locomotor)
- Regarding driving activity, selective attention is the main process:
 - A slow and sequential process
 - Selecting relevant information and inhibiting distractors
 - ➔ Identify the nature and properties of the various steps in this process
- According to the indices or methods used it is possible to identify various causes leading to an attention default for the driver
- Regarding the cognitive processes implied when driving, the individualization of three concepts appears necessary
- The driver cognitive workload will be studied referring to three concepts: distraction*, inattention* and specific disorders of selectivity

*Lemerancier, C. & Cellier, J-M. (2008). Les défauts de l'attention en conduite automobile: inattention, distraction, et interférence. Le Travail Humain, 71, 3, 271-296.

Definition of distraction

Distraction is a transient redirection of attention from the driving activity to a competitive activity induced by an exogenous factor like an event, an object, an activity or a person being inside or outside the vehicle. It draws the driver's attention away from the driving task.

4 distinct types of driver distraction can be differentiated

- Visual: Eyes off road (reading, looking for a street sign...)
- Auditory: Unable to perceive traffic and vehicle sounds
- Physical: Hand(s) off wheel (dialing/using a phone)
- Cognitive: Engaged in conversation (mobile phone / passenger)

Definition of inattention

Inattention to driving is also a transient redirection of attention from the driving activity arising in the absence of observable triggering event. It is induced by an endogenous factor like thoughts or ruminations. It appears more often with routine driving tasks.

Definition of the Specific Disorders of Selectivity

Regardless of the effects of distraction or inattention, some drivers may have difficulty in effectively guiding their attention to relevant items, they present specific disorders of selectivity. These disorders represent a difficulty to efficiently direct its attention to the relevant factors to the current task.

They may be due to a misrepresentation of the situation or a decline of the driver's attentional abilities due to aging, a health deterioration or the consumption of addictive substances or drugs.

What are the main results of this collaborative project ?

- His added value
 - Collaborative work, numerous exchange on technical and scientific issues
 - Improvement of experimental protocols
 - Additive lever on publications
 - Setup of stronger consortium for future projects
- A lot of results → an attempt to go further having an hindsight analysis on our scientific approach
 - To give overview on the results obtained
 - To clarify the dynamics of the project
 - To Outline future research

An attempt with hindsight

Technic referring to the intermediate theory by Shields & Tajalli (2006)

- Try to draw up a conceptual framework connecting to our more important aspects of empirical inquiry
- Define maps that give coherence to our enterprise

An attempt with hindsight

- Research teams: mono or multi-disciplinary
- Team composition influenced the research purpose
- Main results of the multi-disciplinary teams
 - Their research purposes: exploration, gauging, decision making
 - New methods to analyze the effects of distraction or inattention
 - New results having immediate applications
- Main results of the mono-disciplinary teams (cognitive psychologists)
 - Their research purposes: exploration, description or explanation to broaden fundamental knowledge
 - Need to develop dialectics between artificial and natural situations
 - A first step in the process, no immediate application
 - Final goals
 - To improve the implementation of cognitive models of the driver
 - To develop more specific tools for driving assessment issues
 - To understand the impact of distraction/inattention on the cognitive mechanisms

overview of DACOTA's results through this classification

behavioural modification understanding 1) When using navigation systems

Reference	Research purpose	Research question	research technic	Main Results (technical or scientific)	perspectives
Perreira et al. (2009). IET.	Exploration	How a higher cognitive workload influence elderly driver behaviour at intersection?	On road experiment	Technical: vehicle data analysis according three steps (preparation/turn/exit) and definition of behavioural indicators for each ones; criterias' comparaison between the two conditions Scientific: higher cognitive load => speed reduction; late, rough and jerky braking; higher steering-wheel variance	Behaviour comparison with younger driver to identify elderly drivers specificities
Moessinger , LAB PSA PEUGEOT-CITROEN RENAULT	Exploration ==> Description	How can the LCT method be improved?	Modified version of the LCT	technical: heavy traffic, constant speed instruction and LCTask by overtaking the previous vehicle => more ecological situation avoiding anticipatory strategies	identify adaptive behaviours from performance deterioration
		What are the best indicators to evaluate the influence of distraction with this method?	Modified version of the LCT	Scientific : the ranges of speed ajustement are higer when the task is more complex and drivers kept the vehicle more in the center of the traffic lanes	

overview of DACOTA's results through this classification

medicines and Driving assessment issues: are medicines having the same impact on young and elderly drivers ?					
Reference	Research purpose	Research question	research technic	Main Results (technical or scientific)	perspectives
Bocca (2008)	Gauging	What are the effects of Zolpidem on elderly driver behaviour ?	monotonous driving in simulator	unlike young drivers a residual effect of Zolpidem on monotonous driving performance has been shown for elderly drivers. Awareness campaign for AFSAPS (pictograms).	To develop the driving simulator functionalities to progress in this research theme
Bocca et al.	Gauging	What are the effects of Zopiclone on elderly drivers behaviour ?	monotonous driving in simulator	residual effect of Zopiclone has been confirmed for elderly drivers	
Meskali et al.	Exploration	How can be tested the effects of Zolpidem on driver behaviour in urban environment ?	urban driving in simulator	Technical: implementation of 5 prototypical crash scenarios Scientific: higher collision number with Zolpidem. Drivers kept the vehicle on the left part of the road.	To carry on with the definition of dependant variables in this context

overview of DACOTA's results through this classification

Crash analysis					
Reference	Research purpose	Research question	research technic	Main Results (technical or scientific)	perspectives
Lafont et al. (in press). Le travail Humain.	Description ==> Gauging	How is varying the risk of beeing involved in a fatal crash according to age and to the driving situation just before the crash?	crash database analysis : Odds ratio	Drivers aged 75 years old and more have an increased risk of 16,7 (CI 95%= 15,1-18,5) to be involved in a fatal crash in lane-crossing or left-turn situations, rather than being involved in another crash (ref 25-64 years old drivers)	Use the Rhone Road Trauma Registry to analyse the seriousness of elderly drivers injuries at intersection
Lafont et al. (in press). Le travail Humain.	Description ==> Decision making	What is the best approach to estimate the potential threat of older drivers compared to younger drivers?	crash database analysis : lost-life years	the rate of lost life years for the other crash-involved road users significantly decreases when driver's age increases in all driving situations. Older drivers represent a lesser threat for others compared to younger ones even in complex driving situations (intersections).	The results obtained with this public health approach will be compared with a more traditional method estimating death rate per driven kilometer

overview of DACOTA's results through this classification

2) To broaden fundamental knowledge in cognitive sciences a- effect of different factors on Situation Awareness

Reference	Research purpose	Research question	research technic	Main Results (technical or scientific)	perspectives
Tijus et al. Univ. Paris	exploration	Influence of perceptive and cognitive complexity of the scene on SA	Development of a specific tool ICARE (video + change blindness task)	Technic: development of a categorial complexity metric (Galois Lattice)	Implementation of new modules in COSMODRIVE
				Scientific: the complexity of the scene (number of object and categories) is a good predictor of the performance to detect a modification	
Bellet et al. INRETS		Influence of driver personnality trait (violation) on SA		For driving violators SA is not as good as for the other drivers	
Fabrigoule et al. CHU Bordeaux		How is the SA of ADHD patient compared to normal drivers ?		Technic: too long task for patients	
				Scientific: For ADHD patients SA is not as good as for drivers having no attentional disorder	

➔ Tool sharing, influence of different factors study, implementation in a cognitive model of the driver

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behavioural modification understanding

Influence of a secondary task on attentional mechanisms

Reference	Research purpose	Research question	research technic	Main Results (technical or scientific)	perspectives
Lemerrier et al.	Description	At wich step of the attentional processing we can observe an effect of distraction or inattention ?	Experimental task : Attention Network Test (Fan et Col 2002)	Technical: indentification of a robust procedure for inattention induction (emotional reinforcement)	Use these proto coles to study other forms of distraction; conduct an on road experiment testing the effects of inattention obtained with this induction procedure
		Regarding auditive distraction		A diferentiated impact of distraction and in attention on the alert, orientation and conflict functions of attention	
		Regarding inattention		Auditive distraction is a major source of distraction, the three functions are impacted	
				The atentional orientation is altered when inattention is induced with an emotional reinforcement	
	Exploration	Are these effects similar when driving?	ANT in a driving simulator	Same results = alteration of attentional orientation by distraction and inattention + speed reduction when conflict function is studied = an adaptive strategy?	
Martin et al.	Exploration ==> Description	Objectivation of cognitive and conative functions requested during decision making	decision making in simulated driving, three type of indicators (behaviour, CNS and VNS), MEG	Will be presented in the other talks in this symposium	
		Impact of distraction on cerebral fonctionning			

overview of DACOTA's results through this classification

protocols designed to progress through exploration to description and to explanation effects of a cognitive distraction task on object detection, decision making and links between the two					
Reference	Research purpose	Research question	research technic	Main Results (technical or scientific)	perspectives
Jallais et al. 2009	exploration	Is visual search less efficient with age ?	localisation of object in jumbled pictures	The localisation time is longer for elderly drivers but as younger ones they develop expectations to explore more efficiently the environnement	Use these ecological experimental procedures to identify neuropsychological tests beeing more specific to driving
	Explanation	What about distraction effect on the visual search?	FaceLab +	In dual task the visual search is slower and often disorganised, this effect is increased by aging	
Paire-Ficout et al.	Explanation	Is it possible to explain previous resultats with visuo-spatial and flexibility performances ?	Compastime + Posner	inhibition deficit (visuo-spatial) with age and flexibility deficit (difficulty to alternate between global and local treatments of visual information). Links with previous results not studied yet.	
	Exploration	Are relevant elements always detected during a decision making task?	Two joint experiments: Change blindness experiment and CB with DM	The detection time are significantly longer with aging. The decision making is not influence by age nor by distraction. The matching between the two experiments show that elderly drivers take more often good decision from implicite representation.	
		How distraction influence DM ?			

Conclusion

- A large research community dealing with attention defaults when driving is on the move
- Synergism with a new research community GDR Psycho-Ergo (CNRS)
- First step: focused around the definition of various concepts
- The method indicated in the intermediate theory should be useful for the elaboration of future projects
 - To favour multi-disciplinar exchanges
 - To converge on a research purpose
 - To formulate relevant research questions
 - To facilitate the elaboration of Experimental plans (ex: choice of indendant and dependant variables)

Perspectives

- Hope: First results and method facilitating the exchanges with new partners (automobile industry) to promote an integrated approach to improve the prevention and mitigation of attention defaults when driving
- Partners will continue to exchange around three themes:
 - Expectation and spin-off effects in the health domain
 - Definition and development of technological solutions to palliate attention defaults
 - Development of new methods to analyze attention defaults (especially in driving simulator)
- Starting of a new project:
 - ATLAS (Assesing Traffic Low Attentional Status)
 - Characterization of the impact of distraction and inattention on driving activity with a multidisciplinary approach (epidemiology, mathematics, psychology and neurosciences)

Thank-you for ...
your attention

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