

Second International Conference on
**Driver Distraction
and Inattention**

September 5-7, 2011

**IMPACT OF SIMULATED
FORWARD COLLISION WARNING SYSTEM
WHILE DRIVING:
AN EVENT RELATED POTENTIAL STUDY**

Mercedes Bueno^{1,2}, Alexandra Fort¹,
Boris Collette¹, Philippe Deleurence¹,
Arnaud Bonnard¹ & Colette Fabrigoule²



Rear-end collision ~ 30% of all crashes

Forward Collision Warning Systems



Contributing factors

**DRIVER
INATTENTION**

**Following
too close**

**Poor
Visibility
Conditions**

Others

Redirecting
attention



&

Faster RT



Benefit **distracted**
drivers in particular



BUT...

How does the system benefit **distracted** drivers?



Literature shows different results depending on kind of warning; secondary tasks...)

How does the drivers' trust change according to the **reliability** of the system?



Malfunctioning system → irritating, rejection
Perfect system → overreliance

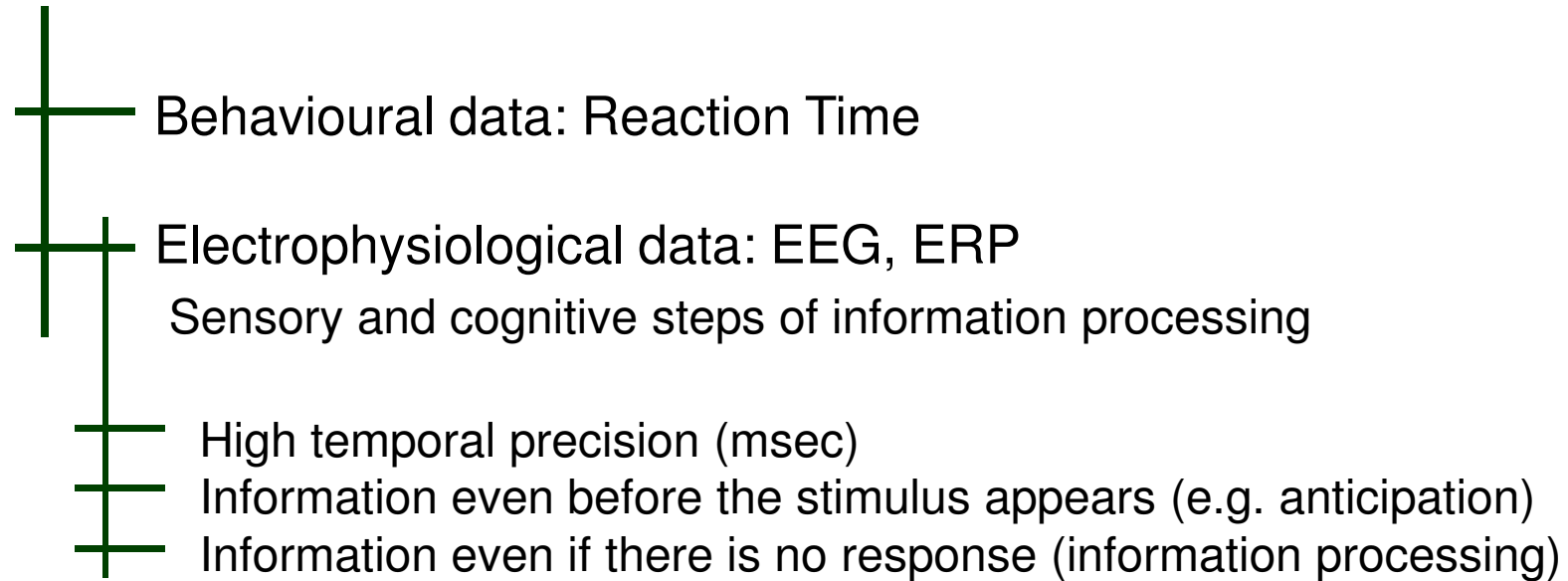


Objectives

To evaluate the impact of a warning system on driver's behaviour according to:

1. The **distraction level** of the driver
2. The **reliability** of the warning system

HOW do we reach these objectives?



WHAT is electroencephalography?

Study of the continuous electrical activity of the brain

WHAT is an Event Related Potential?

*Electrical activity of the brain specifically **related** to a particular **event***

SENSORY COMPONENTS

- Sensory analysis
- Between S and ≈ 200 ms
- P1, **N1**, P2

Physical properties of the S

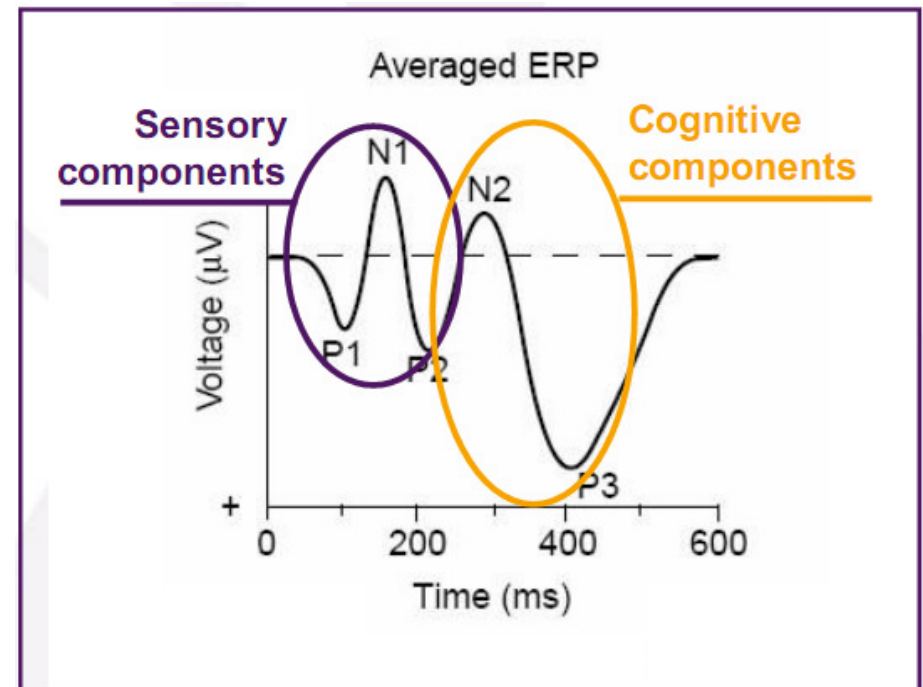
COGNITIVE COMPONENTS



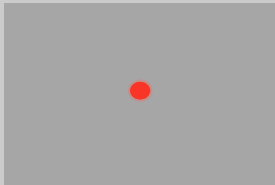





- Higher level processing
- ≈ 200 ms after S
- **N2, P3**

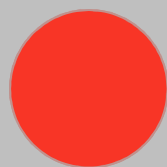
Elicited by infrequent and relevant S
Measure of the mental workload

CONSTRAINTS

- High number of repetitions
- High sensitivity to some artifacts



Introduction	Exp. 1 Simple Visual		Exp. 2 Driving	
	Objectives	Effect of an auditory alert on the perception of a simple visual target	Effect of warning on the perception of a potential obstacle in driving	
Method	Participants	12 (25.4)	12 (30.3)	
	Material			
Results	1ry Task <i>Undistracted</i>	To detect a visual target		
	Stimuli & Target	 Bright red disc 	 Brake light	
Conclusion	Response	To remove the foot from a pedal		
	Warning	 Perfect	 Imperfect (70%)	 No Alert
	2ry Task <i>Distracted</i>	Cognitive distraction task: Mystery Word Set of 3 words: « cat – computer – Mickey » Response: «mouse»		



DESIGN – Exp 1 & 2

Independent Variables

Distraction Level

SIMPLE TASK


DUAL TASK

Warning

No Alert

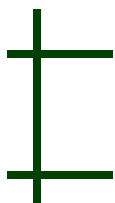
Imperfect Alert

Perfect Alert

No Alert -
Simple TaskImperfect Alert-
Simple TaskPerfect Alert-
Simple TaskNo Alert -
Dual TaskImperfect Alert-
Dual TaskPerfect Alert-
Dual Task
 6 counterbalanced conditions

 20-30 min each condition

Dependent Variables

**BEHAVIOURAL DATA**

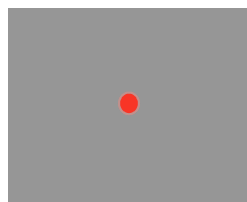
Reaction time

ELECTROPHYSIOLOGICAL DATA

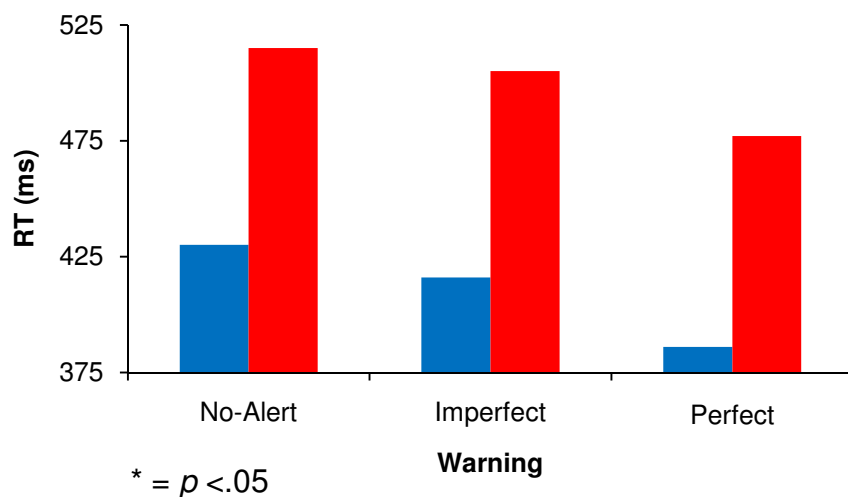
Peak amplitude and latency of the N1, N2 and P3 components

RT RESULTS

Simple Visual Context

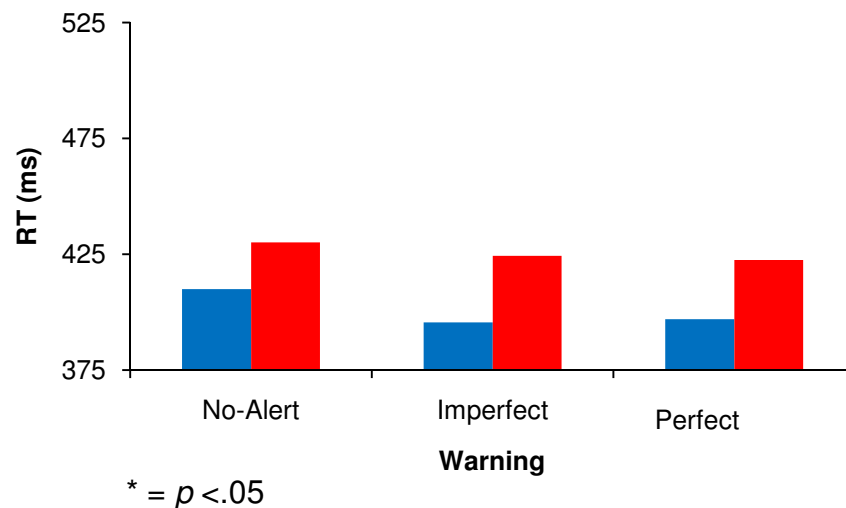
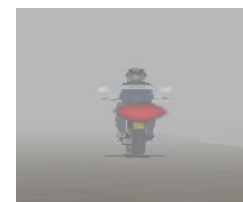


■ Simple Task
■ Dual Task



- ***Faster RTs in Simple Task***
- ***Positive effect of the Perfect Alert in Simple and Dual Task***
- ***...but not of the Imperfect Alert***

Driving Context



- ***Faster RTs in Simple Task***
- ***Positive effect of the Perfect and Imperfect Alert in Simple Task***
- ***...but not in Dual Task***

ERPs RESULTS

Simple Visual Context



— ST --- DT

Driving Context

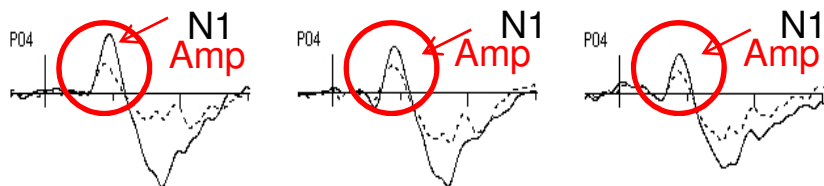


No Alert

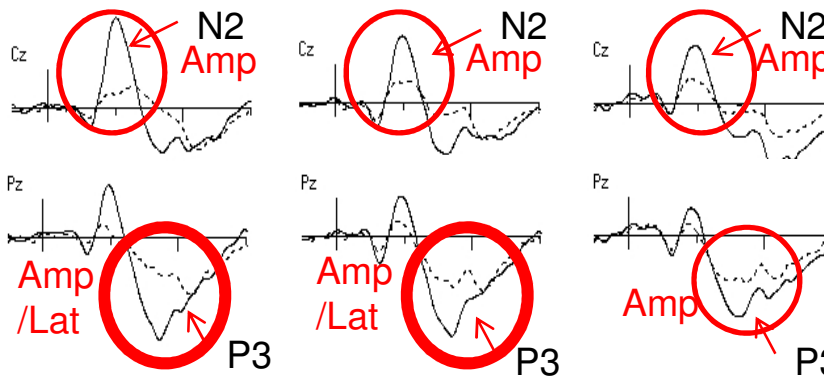
Imperfect

Perfect

Sensory Components (N1)



Cognitive Components (N2/P3)



► **Disrupting effect of the Dual Task at sensory and cognitive level (less resources and slower processing)**

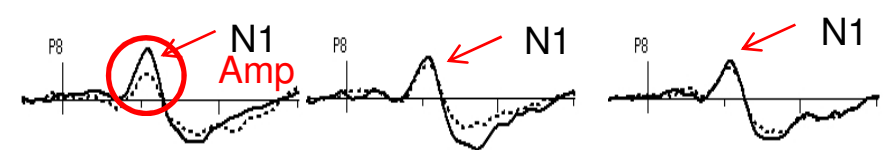
► **...but less marked with Perfect Alert**

No Alert

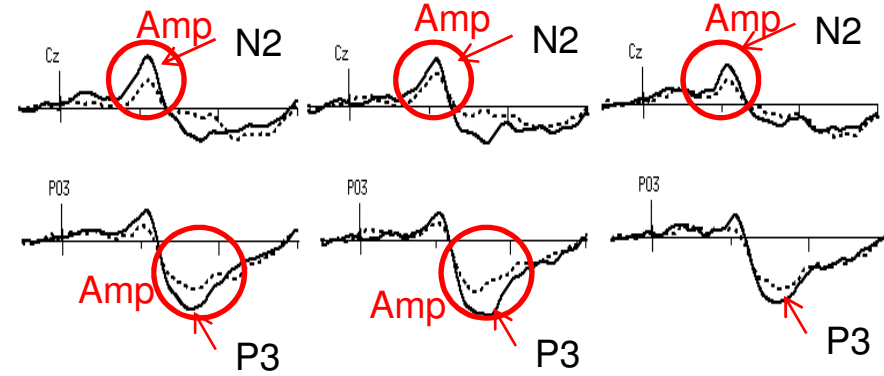
Imperfect

Perfect

Sensory Components (N1)



Cognitive Components (N2/P3)

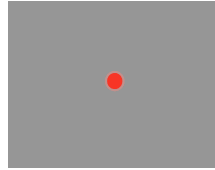


► **Disrupting effect of the Dual Task at sensory and cognitive level (less resources)**

► **...but less marked with Perfect Alert**

IMPACT of the DISTRACTION LEVEL

Simple
Visual
Context



Driving
Context



RT RESULTS

- ▶ Performing a **dual task deteriorates** performance whatever the system
- ▶ ...but effect less marked with Perfect Alert in Simple Task and Dual Task
- ▶ Performing a **dual task deteriorates** performance whatever the system
- ▶ ... effect less marked with Perfect and Imperfect Alert but only in Simple Task

ERPs RESULTS

- ▶ Performing a **dual task deteriorates** performance at sensory and cognitive level whatever the system
- ▶ ...but effect less marked with Perfect Alert
- ▶ Performing a **dual task deteriorates** performance at sensory and cognitive level whatever the system
- ▶ ...but effect less marked with Perfect and Imperfect Alert

Limits

Both experiments differ:

- ▶ Faster RT in case of the driving experiment



Differences between both exp. might be explained by:

- ▶ Contextualization effect
- ▶ Differences in protocol
 - Exp. 1: only the alert was an indicator of the target
 - Exp. 2: the alert but also the motorbike decelerating were indicators



Anticipation was easier in the driving experiment

Perspectives

- ▶ New experiment in which only the alert will be a predictor of the target in a driving context

**THANK YOU
FOR YOUR ATTENTION**

and remember...
if you think (a lot),
don't drive!

mercedes.bueno-garcia@ifsttar.fr
alexandra.fort@ifsttar.fr