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Genesis, development and actuality of the Social Representation theory in more than fifty years (1961-2011 and beyond): the main paradigms and the "modelling approach"

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Comprehension and acceptability of on-board traffic information: Beliefs and driving behaviour

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ABSTRACT

Co-Drive on-board traffic information system is a complementary tool providing a dynamic management of transportation infrastructure and traffic as well as the diffusion of accurate real-time information about the road environment and motorists' driving behaviour. The aim of this study was to examine drivers' acceptability of Co-Drive by investigating the impact of traffic information provided via on-board display devices on motorists' beliefs and behaviour.

116 drivers (Men = 46.6%), between 22 and 62 years, participated to a driving simulator experiment. They were randomly divided into two experimental groups according to the type of display device (Blackberry vs. iPhone) and a control group. The experimental groups were exposed to fourteen on-board traffic messages: warning (e.g., road crash), recommendation (e.g., the use of seat-belt) and comfort messages (e.g., the location of a gas station). They had to validate each message by pushing the headlight flashing button as soon as they understood it. At the end, all participants had to fill in a questionnaire.

Drivers evaluated positively the on-board messages, expressed a high level of confidence in the on-board information and estimated having received it sufficiently in advance for them to adjust their behaviour. Regardless of the type of display device, they took more time to read warning and recommendation messages as compared to comfort messages and complied with them. Finally, those exposed to the messages adapted their behaviour easier to the road events than those who did not receive them. Practical implications of the results are discussed.

1. Introduction

Advanced on-board systems provide accurate real-time traffic information which improves road safety by facilitating drivers' opportunity to anticipate traffic events and adapt their behaviour, ameliorates the traffic flow and encourages sustainable mobility (Jamson et al., 2013).

Co-Drive project represents a recent French initiative to validate a cooperative driving system between the driver, the vehicle, and the infrastructure, in order to obtain an intelligent and safe route in the service of sustainable mobility. More specifically, Co-Drive system represents a complementary tool providing a dynamic management of transportation infrastructure and traffic as well as the diffusion of real-time traffic information. The information should be presented via on-board display devices (e.g., mobile phones) and notify drivers' about legal speed limits, time headway, warnings on local events (e.g., slippery road, traffic jams, the location of a gas station, etc.) and be updated in a regular manner.

In order for drivers to develop safer interactions with the road environment and adopt smart mobility, any information provided via on-board traffic information systems (Bierlaire et al., 2006; Caird et al., 2006, 2008; Hanowski and Kantowitz, 1997; Lee et al., 1999; Staplin and Fisk, 1991; Regan, 2004) or variable message signs (VMS) (Dudek et al., 2006) would have to be quickly read and understood. In this regard, numerous studies examined drivers' reading and comprehension of messages provided via VMS (Dutta et al., 2005) or road-safety campaigns (Delhomme et al., 2009, 2010; Haddad and Delhomme, 2006).

Thus, some studies explored the factors with potential influence on reading and comprehension such as *length of the message* (Arditi, 2011), *colour use* (Lai, 2010; Shaver and Braun, 2000), *the presence* vs. *absence of pictograms* (Collins and Lerner, 1983; D'Onghia et al., 2008; Dowse and Ehlers, 2005), *type of display device* (Delhomme et al., 2013), *type of message* (Wang et al., 2009), and *motorists' characteristics* such as *driving experience* (Tijus et al., 2005), *age* (Allen et al., 1980), *gender* (Al-Madani and Al-Janahi, 2002), and *fatigue* (Lum et al., 1983). Thereby, motorists require approximately

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one second per word presented on VMS or 4-units information (1-unit information = one word) to accurately process and understand the information and still pay attention to the driving activity (Dudek and Huchingson, 1986; Ullman et al., 2005). Red is associated with warnings and increases compliance behaviour (Braun et al., 1994, 1995; Rudin-Brown et al., 2004). Drivers prefer pictograms over text messages and their reading time is shorter for messages accompanied by pictograms as compared to text-only (Houts et al., 2006; Jaynes and Boles, 1990; Monteiro et al., 2013; Shinar and Vogelzang, 2013; Tijus et al., 2005; Wang et al., 2007). Furthermore, drivers spend more time reading warning messages as compared to other types of message (Delhomme et al., 2013). Young (<19 years) and elderly drivers (>54 years) have difficulties in understanding and recognizing warning traffic signs (Otani et al., 1992; Richards and Heathington, 1988). Female drivers between 40 and 60 years recognize faster "speed limits" warning signs as compared to male drivers between 25 and 40 years (Schmidt, 1982). Finally, fatigue was associated with difficulties to focussing attention on stimuli provided via advanced on-board traffic systems (Hancock and Verwey, 1997).

Other empirical studies examined the impact of traffic messages on drivers' behaviour (Ullman et al., 2005). For example, Rämä and Kulmala (2000) investigated the effects of the presence vs. absence of the message "slippery road" provided via VMS on motorists' speed behaviour. A reduction of approximately 2 km/h in the average speed was registered among those exposed to the message. Similarly, Luoma et al. (2000) observed that drivers refocused their attention on seeking cues of potential danger and drove more carefully on the slippery road segments when exposed to a "slippery road" message via VMS. Erke et al. (2007) investigated the effects of the presence vs. absence of a "closed road segment" message recommending an alternative route displayed on two VMS in Oslo on drivers' route choice and speed behaviour. Larger speed reductions and higher compliance with taking alternative routes were found among the drivers who had seen the message as compared to those who had not been exposed to it.

The aim of our study was to investigate motorists' comprehension of on-board traffic messages provided on two types of display devices (Blackberry vs. iPhone) and their acceptability of Co-Drive. More specifically, we tested the effects of these messages on motorists' beliefs and driving behaviour during a simulator driving task, according to the type of message (warning, recommendation, and comfort messages), gender, and age. In this regard, we formulated the following hypotheses in accordance with the previous literature review:

H1. Warning messages inform motorists about imminent dangers therefore, we assumed that motorists will take less time comprehending warning messages as compared to recommendation and comfort messages.

H2. Motorists' from the experimental groups will express high acceptability of on-board traffic information systems, positive attitude towards on-board traffic messages and pictograms, and confidence in on-board traffic information, will report changing their behaviour after being exposed to on-board information, and will declare themselves satisfied with on-board traffic information and Co-Drive.

H3. Motorists will adjust their driving behaviour according to the type of message by reducing speed when confronted to warning or recommendation messages and maintain it when confronted to comfort messages which do not require any particular behavioural change.

H4. Motorists from the experimental groups will adapt their driving behaviour easier to the road events as compared to those from the control group.

2. Method

2.1. Apparatus

In order to achieve the aims of this study, we used the driving simulator with a fixed platform belonging to the Mobility and Behaviour Psychology Lab (IFSTTAR). The equipment is composed of ten parallelepiped-shaped panels and visual channels (2.44 m × 1.83 m) as well as an instrumented vehicle (Peugeot 308). Seven of these panels are equipped with a classic video projector (F22 Projection Design) while the other three with a Titan stereoscopical video projector (Digital Projection, 3D). The instrumented vehicle is positioned in the centre of seven panels with a triptych facing the driver while the other three panels are fixed in the back of the vehicle. The retro lateral vision is ensured by external fixed visual panels and the refresh rate of these panels is 60 Hz. The driver has a 360° field of view. Different driving parameters (e.g. speed, acceleration, braking, wheel movements, etc.) are registered in accordance with the virtual traffic situation to which the driver is exposed (see Fig. 1).

2.2. Experimental design

Two designs were used

(1) Without the control group. To test the effects of the type of message (warning, recommendation vs. comfort messages) according to type of display device (Blackberry vs. iPhone), gender (men vs. women) and age category: young (22–34 years), middle-aged (35–44 years) vs. older (45–62 years) on drivers' comprehension, acceptability of Co-Drive, and speed behaviour (Hypotheses 1, 2, and 3).
(2) Including the control group. To the effect of the presence vs. absence of the messages according to the experimental condition (Blackberry, iPhone vs. control group) gender (men vs. women), and age category (young, middle-aged vs. older) on motorists' driving behaviour (Hypothesis 4).

2.3. Participants

The sample consisted of 116 drivers (Men = 46.6%) between 22 and 62 years (M = 38.73, SD = 10.65). Participants had their driving license for 17.63 years (SD = 10.74) and had driven over 16,537 km/year (SD = 12,314). They declared driving at a general average speed of 128.33 km/h on highway (SD = 13.37) and a maximal average speed of 135.04 km/h (SD = 10.00, Min = 100; Max = 160). We divided them by median split into three categories according to their age: young (42.2%), middle-aged (27.6%), and older drivers (30.2%).

2.4. Procedure

Participants were selected by a recruitment agency according to the criteria provided by the experimenter (i.e., gender, age, and driving experience) and received financial incentives for their participation. They were randomly divided in three groups: two experimental groups which received on-board traffic information via Co-Drive and displayed on a Blackberry (N = 43 drivers) vs. iPhone (N = 37 drivers) situated on the dashboard of the vehicle and a control group (N = 36 drivers) (see Table 1).

They were equally distributed among the three groups according to gender (χ^2 = .594, p =.74), age (χ^2 = 3.446, p = .17), and driving experience (χ^2 = 3.570, p = .16).

We have chosen two types of display device used by drivers to communicate or receive information on a daily-basis: an iPhone 4S (screen sizes: 8.89 cm × 7.39 cm × 4.93 cm; screen resolution:

Fig. 1. The Driving Simulator of the Mobility and Behaviour Psychology Lab (IFSTTAR).

Table 1
Means and standard deviation for age category and driving experience according to the type of display device and gender.

N = 118	Blackberry (N = 43)				iPhone (N = 37)				Control (N = 36)			
	Men		Women		Men		Women		Men		Women	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Age category	43.59	12.17	38.76	9.94	36.25	9.35	38.66	10.55	37.31	10.71	36.55	10.12
Driving experience	23.04	12.68	17.19	8.65	14.93	9.47	16.52	10.23	17.81	9.64	15.35	11.82

960 × 640 pixels) and a Samsung Galaxy Pro Y blackberry (screen sizes: 6.60 cm × 5.28 cm × 3.96 cm; screen resolution: 320 × 240 pixels) in order to check any possible influence of the screens' dimensions. The experiment lasted approximately 1 h 30 and was divided in four stages as follows.

2.4.1. Welcoming stage

On the arrival at the driving simulator, all participants were briefed on the requirements of the study, their ethical rights, the risks of simulator operation, and the safety measures employed to mitigate these risks and invited to sign an informed consent.

2.4.2. Familiarization with the simulator

The researcher explained them functionality of the driving simulator and assisted them in the simulator while they drove for approximately 10 min in order to familiarize themselves with the simulation system.

2.4.3. Experimental task

Participants were invited to drive on the simulator for approximately 40 min. The experimental itinerary simulated a 50 km ring highway (2×2 lanes) with 3 intersections. During the driving task, the two experimental groups were exposed to fourteen messages selected out of a list of 45 messages regularly provided on VMS by the highway operator APRR ("Autoroutes Paris Rhin Rhône"). These messages are presented in Table 2.

Participants in the experimental groups were informed that several messages would appear on the Blackberry vs. iPhone via Co-Drive providing *warning* (e.g., road crash), *recommendation* (e.g., the use of seat-belt), and *comfort messages* (e.g., the location of a gas station) (see Table 1). The messages contained between 4 and 9 words (Min = 17 characters; Max = 48 characters). All text messages were written in black on a white background, were centred and distributed on 1 to 3 lines. In order to obtain comparable data, graphical characteristics were controlled in accordance to the vertical (Calibri, 60, 1.0 spacing, 22.8 mm) or horizontal position (Calibri, 60, 1.0 spacing, 16.5 mm) of the display device. Three of the warning messages were meant to appear only if the participant had transgressed speed limits or time headway. In order to increase the salience of the messages, each message was accompanied by a pictogram located at the top of the text. Two types of pictogram corresponding to warning vs. recommendation messages were used. Their colour characteristics were consistent with the colour codes as suggested by Brockman (1991) (see Fig. 2).

Participants had to validate each message by pushing the headlight flashing button as soon as possible after having read and understood it. Participants in the control group undertook the same driving task except no messages were provided.

2.4.4. Post-experimental questionnaire

At the end, all participants were asked to fill in a 10 min questionnaire.

Table 2
The fourteen messages provided during the experimental driving task according to the order of appearance.

Type of message	No.	Message
Warning messages	8	02 – Stationary damaged vehicle in 2 km on the right lane 05 – Caution. Pedestrian in 3 km 07 – You are driving too fast. Slow down! 09 – Slippery road 10 – You are driving too close. Adopt safe time headway 11 – Peak pollution 110 km/h mandatory 12 – Work zone in 3 km. Speed limited at 90 km/h 13 – You are driving too fast. Slow down!
Recommendation messages	4	01 – Smooth driving. I protect the environment 03 – Too fast. Too close = Danger 06 – Fasten seat-belt = Protected life 14 – Road crash in 3 km. Exit 12 recommended
Comfort messages	2	04 – Closed gas station in 10 km 08 – Rest area. Take the next exit.

Fig. 2. Example of warning and recommendation messages and the corresponding pictograms.

2.5. Measures and instruments

2.5.1. Comprehension

Comprehension time was registered with DR2 and ARCHISIM software (Espié, 1999). Once every 33 ms, DR2 and ARCHISIM registered all parameters indicating the drivers' behaviour while travelling (e.g., instant speed, time headway, acceleration, deceleration, lane change, flashing lights, etc.). Later on, this information was processed in order to extract variables such as reaction time, average speed, etc. In our case, an overall comprehension time was created as well as comprehension time indexes according to the type of message: *warning, recommendation*, and *comfort messages.*

2.5.2. Acceptability of Co-Drive

2.5.2.1. Attitude towards on-board traffic messages. This was registered using 6 adjectives (i.e., useful, comprehensible, efficient, important, distracting, and pertinent; scored 1 to 5, not at all/very much). The mean of the six adjectives produced an overall scale (Cronbach's α = .84).

2.5.2.2. Attitude towards pictograms. This was registered by 4 items (e.g., "Have the pictograms accompanying the text help you better understand the messages?", scored 1 to 5, not at all/very much). The mean of the 4 items produced an overall scale (Cronbach's α = .72).

2.5.2.3. Confidence in on-board traffic information provided by Co-Drive. This was registered by 4 items (e.g., "Did you have confidence in the on-board information provided by Co-Drive?", scored 1 to 5, not at all/very much). The mean of the 4 items produced an overall scale (Cronbach's α = .76).

2.5.2.4. Self-reported behavioural change after the exposure to the messages. This was registered by 3 general items (e.g., "Have you changed your behaviour after being exposed to the on-board traffic information provided via Co-Drive?) and 3 items concerning specific dangers (i.e., the presence of a stationary damaged vehicle, wandering pedestrian, and work zone; scored 1 to 5, not at all/very much). The mean of the three general items produced an overall scale (Cronbach's α = .87).

2.5.2.5. Perceptions about receiving in advance on-board traffic information. This was registered by 3 items (e.g., According to you, the road traffic information was presented sufficiently in advance for you to adjust your behaviour?, scored 1 to 5, not at all/very much). The mean of the 3 items produced an overall scale (Cronbach's α = .75).

2.5.2.6. Self-perceived efficacy of the on-board information provided by Co-Drive. This was registered by 11 items (e.g., "Have the on-board information provided by Co-Drive allowed you to gain time while driving?, scored 1 to 5, not at all/very much). The mean of the 11 items produced an overall scale (Cronbach's α = .84).

Table 3
Number of messages validated during the experimental task.

N = 80 drivers		Number of validated messages			
		14	13	12	11
Type of display device	Blackberry	5	23	14	1
	iPhone	7	20	9	1
Total		12	43	23	2

2.5.2.7. Self-perceived satisfaction towards Co-Drive. This was registered by 6 items (e.g., "Do you feel satisfied with the Co-Drive providing you on-board traffic information? ", scored 1 to 5, not at all/very much). The mean of the 6 items produced an overall scale (Cronbach's α = .80).

2.5.3. Driving behaviour

Driving behaviour included several indicators: (a) average speed adopted during the experimental task, (b) (c) speed registered at the moment of the exposure to the message and at its validation, (d) speed registered at the moment an event occurred on the highway (e.g., a road crash), and (e) the change in speed after the validation of the message. This change corresponds to the difference between the speed adopted at the moment of message exposure and 20 s after the validation of the message. Once again, the data was registered in m/s with DR2 and ARCHISIM.

Furthermore, we created speed indicators according to the type of message: a) average speed at the moment of the exposure to *warning, recommendation*, and *comfort messages* and b) average speed at the moment of the validation of *warning, recommendation*, and *comfort messages.* In addition, we calculated the change in speed after the validation of the messages according to each type of message.

2.5.4. Socio-demographic variables

The following socio-demographic variables were registered: gender, age category, driving experience, mileage in the last 12 months, weekly mileage on highway, speed behaviour on highway, and number of accidents in the last 3 years.

3. Results

3.1. Effects of the type of message

Results confirmed the hypotheses regarding the effects of the type of message, type of display device, gender, and age category on motorists' comprehension of on-board traffic messages, acceptability of Co-Drive, and driving behaviour.

3.1.1. Comprehension

3.1.1.1. Messages' comprehension. Table 3 presents the number of messages validated by participants during the experimental task according to the type of display device.

Drivers validated a different number of messages (14, 13, 12 or 11 messages). Three warning messages appeared only if drivers had transgressed speed limits (messages 7 and 13) and time headway (message 10). Thus, 55 drivers (69%) received the speed limits warning just one time (M = 114.44, SD = 5.24) and only 18 drivers (22.5%) received the same warning the second time. As for time headway, 72 drivers (90%) received a time headway transgression warning during the experimental task.

3.1.1.2. Comprehension time. We conducted an ANOVA repeated measures analysis with one within-subjects factor: *type of message* (warning, recommendation vs. comfort messages) and three between-subjects variables: *type of display device* (Blackberry vs.

iPhone), *gender* (men vs. women), and *age category* (young, middle-aged vs. older drivers).

Overall, participants took 5.73 s (SD = 1.16) to comprehend the messages provided via Co-Drive. An effect of the type of message ($F(2,78) = 14.578$, $p < .001$, $\eta^2 = .17$) was obtained for overall comprehension time. Participants took less time to read warning ($M = 5.19$, SD = .32) and recommendation messages ($M = 7.06$, SD = .75) as compared to comfort messages ($M = 8.97$, SD = .52). These results are stable across type of display device, gender, and age category ($F(4,76) = 17.645$, $p < .001$, $\eta^2 = .34$). Similarly, an age category effect ($F(2,78) = 8.575$, $p < .001$, $\eta^2 = .17$) was observed for overall comprehension time. Young drivers ($M = 5.17$, SD = .59) took less time to read and understand the messages as compared to older ones ($M = 8.89$, SD = .68.). No effect of the type of display device and gender was found on overall comprehension time ($F < 1.00$).

Further on, no significant effect of the type of display device, gender, and age category was found on the comprehension times for each of 14 messages provided via Co-Drive ($F < 1.00$). However, type of display device ($F(1,79) = 16.442$, $p < .001$, $\eta^2 = .19$), gender ($F(1,79) = 36.977$, $p < .001$, $\eta^2 = .35$), and age category ($F(2,78) = 43.370$, $p < .001$, $\eta^2 = .56$) effect was obtained for the comprehension time of the "Closed gas station in 10 km". Thus, drivers in the Blackberry condition ($M = 7.69$, SD = 1.08), females ($M = 6.10$, SD = 1.09), young ($M = 5.74$, SD = 1.19) and middle-aged ones ($M = 5.68$, SD = 1.48) took less time to read this message as compared to drivers from the iPhone condition ($M = 14.05$, SD = 1.13), males ($M = 15.64$, SD = 1.12), and older ones ($M = 21.19$, SD = 1.37).

3.1.2. Drivers' acceptability of Co-Drive

We conducted several ANOVA univariate analyses with two between-subjects variables: *gender* (men vs. women) and *age category* (young, middle-aged vs. older drivers).

3.1.2.1. Attitude towards messages. Drivers expressed a positive attitude towards the messages provided via Co-Drive ($M = 4.44$, SD = .61). They considered them useful, comprehensible, efficient, and important for the driving activity. An effect of age category was observed ($F(2,78) = 4.283$, $p = .01$, $\eta^2 = .10$): middle-aged drivers ($M = 4.74$, SD = .12) expressed a more positive attitude as compared to older ones ($M = 4.24$, SD = .11).

3.1.2.2. Attitude towards pictograms. Drivers expressed a positive attitude towards the pictograms accompanying the text ($M = 4.08$, SD = .91) and considered them useful for the comprehension of the messages. An effect of age category was observed ($F(2,78) = 4.659$, $p = .01$, $\eta^2 = .10$): young drivers ($M = 4.32$, SD = .15) expressed a more positive attitude as compared to middle-aged ones ($M = 3.66$, SD = .16).

3.1.2.3. Confidence in the on-board traffic information provided via Co-Drive. Drivers were very confident in the information provided via Co-Drive ($M = 4.39$, SD = 0.69). No significant effect of type of display device, gender, and age category was observed ($F < 1.00$).

3.1.2.4. Self-reported behavioural change after the exposure to the messages. Drivers declared having changed their speed behaviour after being exposed to the overall messages ($M = 4.25$, SD = 0.93). More specifically, drivers declared having changed their behaviour when being exposed to the damaged stationary vehicle ($M = 4.60$, SD = 0.83), wandering pedestrian ($M = 4.06$, SD = 1.20), and work zone ($M = 4.30$, SD = 1.07). These results confirmed the findings on the simulator. Drivers reduced their speed with approximately 4 km/h, 9 km/h, and 2.37 km/h after the validation of the "stationary damaged vehicle", "wandering pedestrian" and, respectively, "work zone" messages during the experimental task. No significant effect of type of display device, gender, and age category was observed ($F < 1.00$).

3.1.2.5. Perceptions about receiving in advance on-board traffic information. Drivers declared having appreciated receiving in advance traffic information ($M = 4.57$, SD = .56). No significant effect of type of display device, gender, and age category was observed ($F < 1.00$).

3.1.2.6. Self-perceived efficacy of the on-board information provided by Co-Drive. Drivers evaluated the on-board traffic information provided by Co-Drive as useful and efficient for the driving activity ($M = 4.09$, SD = .67). No significant effect of type of display device, gender, and age category was observed ($F < 1.00$).

3.1.2.7. Self-perceived satisfaction towards Co-Drive. Drivers declared themselves satisfied by Co-Drive ($M = 4.21$, SD = .67). An effect of age category was observed ($F(2,78) = 4.330$, $p < .01$, $\eta^2 = .10$): young ($M = 4.35$, SD = 0.11) and middle-aged drivers ($M = 4.38$, SD = 0.14) expressed more satisfaction with Co-Drive as compared to the older ones ($M = 3.92$, SD = 0.12).

3.1.3. Driving behaviour

Participants' average speed during the experimental task was of 108.89 km/h (SD = 6.43). No effect of the type of display device and gender on the average speed was observed ($F < 1.00$). However, there was an effect of age category ($F(2,78) = 4.581$, $p < .01$, $\eta^2 = .10$): middle-aged motorists drove faster ($M = 111.36$, SD = 1.34) as compared to older motorists ($M = 106.14$, SD = 1.18).

Furthermore, we conducted several ANOVA repeated measures analysis with one within-subjects factor: *type of message* (warning, recommendation vs. comfort messages) and three between-subjects variables: *type of display device* (Blackberry vs. iPhone), *gender* (men vs. women), and *age category* (young, middle-aged vs. older drivers).

3.1.3.1. Average speed at the moment of the exposure to the message. An effect of the type of message was observed on the overall average speed at the moment of the exposure to the messages ($F(2,78) = 5.019$, $p = .03$, $\eta^2 = .55$): motorists were driving faster when they received warning ($M = 123.10$, SD = 1.97) and recommendation messages ($M = 121.56$, SD = 2.12) as compared to comfort messages ($M = 116.08$, SD = 2.95). No effect of the type of display device, gender, and age category was found on the overall average speed at the moment of the exposure to the messages ($F < 1.00$).

Further on, no significant effect of the type of display device, gender, and age category was found on the average speed registered by drivers at the moment of the exposure to each of 14 messages provided via Co-Drive ($F < 1.00$). However, gender ($F(1,79) = 4.833$, $p = .05$, $\eta^2 = .32$), and age category effects ($F(2,78) = 4.772$, $p = .03$, $\eta^2 = .51$) were obtained for the average speed registered at the moment when drivers received the message "You are driving too close. Adopt safe time headway". Thus, females ($M = 126.61$, SD = 2.64), young ($M = 126.85$, SD = 2.59) and middle-aged motorists ($M = 122.39$, SD = 2.59) were driving faster than males ($M = 118.37$, SD = 2.64) and older motorists ($M = 111.86$, SD = 4.10).

3.1.3.2. Average speed at the moment of the validation of each message. No effect of the type of message, type of display device, and age category was found on the overall average speed at the moment of the validation of the messages ($F < 1.00$). However, there was an effect of the gender ($F(1,79) = 11.315$, $p = .02$, $\eta^2 = .73$): women were driving faster when they validated the messages ($M = 123.82$, SD = 1.45) as compared to men ($M = 116.74$, SD = 1.37).

No significant effect of the type of display device, gender, and age category was found on the average speed registered by

Table 4
Means, standard deviations, difference in means and *t*-tests for the average speed at messages' validation and at the encounter of the stationary damaged vehicle, wandering pedestrian, and work zone on the highway.

Message	Speed validation[1]		Speed event[2]			
	M	SD	*M*	SD	$M_{dif.}$	*T*
Stationary damaged vehicle in 2 km on the right lane	124.55	6.39	120.38	8.53	4.17 km/h	126.093***
Caution. Pedestrian in 3 km	120.37	11.92	110.45	8.36	9.92 km/h	111.102***
Work zone in 3 km. Speed limited at 90 km/h	106.44	13.40	104.07	11.95	2.37 km/h	77.888***

Note: 1 – average speed at the validation of the message; 2 – average speed drivers encountered the event on the highway; ***$p<.001$.

drivers at the moment of the validation of each of 14 messages provided via Co-Drive ($F<1.00$). However, gender ($F(1,79)=5.487$, $p=.04$, $\eta^2=.35$), and age category ($F(2,78)=4.306$, $p=.04$, $\eta^2=.48$) effects were obtained for the speed registered when drivers validated the message "You are driving too close. Adopt safe time headway". Thus, females ($M=124.67$, SD = 4.53), young ($M=123.05$, SD = 3.88) and middle-aged motorists ($M=120.25$, SD = 3.88) were driving faster than males ($M=112.13$, SD = 3.78) and older motorists ($M=102.19$, SD = 6.14).

3.1.3.3. Speed change. An effect of the type of message on the overall speed change was found ($F(2,78)=21.908$, $p<.001$, $\eta^2=.84$): motorists reduced significantly their speed after receiving warning ($M=3.56$, SD = .90) and recommendation messages ($M=2.72$, SD = .30) and rather maintained or slightly increased their speed after receiving comfort messages ($M=-1.68$, SD = .52). No effect of the type of display device, gender, and age category was found on the overall speed change ($F<1.00$).

No significant effect of the type of display device, gender, and age category was found on the speed change corresponding to the 14 messages ($F<1.00$). However, motorists reduced significantly their speed after having being warned that they were transgressing speed limits ($M_{dif.}=3.87$ km/h) and time headway ($M_{dif.}=7.76$ km/h).

3.1.3.4. Speed registered at the moment an event occurred on the highway. Three warning messages informed drivers of specific dangers on the highway (i.e., the presence of a stationary damaged vehicle, wandering pedestrian, and work zone): a significant reduction in speed was observed from the validation of these three messages until they encountered the stationary damaged vehicle, the wandering pedestrian, and the work zone on the highway (see Table 4).

3.2. Effects of the presence vs. absence of the messages

Results confirmed the hypothesis concerning the effects of the presence vs. absence of the on-board traffic messages on motorists' driving behaviour.

3.2.1. Driving behaviour

We conducted several ANOVA univariate analyses with three between-subjects variables: *experimental condition* (Blackberry, iPhone vs. control group), *gender* (men vs. women), and *age category* (young, middle-aged vs. older drivers).

The experimental itinerary lasted approximately 27.90 min (Min = 24.99; Max = 34.74; SD = 1.73) and the average speed adopted by the three groups was 111.37 km/h (SD = 6.85). Significant differences between the three groups were observed on the duration of the itinerary ($F(2,114)=20.266$, $p<.001$, $\eta^2=.26$) and average speed ($F(2,114)=24.868$, $p<.001$, $\eta^2=.30$). The itinerary lasted less for the control group ($M=25.98$, SD = 0.92) as compared to Blackberry ($M=28.09$, SD = 1.95) and iPhone groups ($M=27.68$, SD = 1.42) underlining that the motorists from the control group drove faster ($M=116.89$ km/h, SD = 3.95) than the ones exposed to the on-board messages on Blackberry ($M=108.05$ km/h, SD = 7.00) and iPhone ($M=109.89$ km/h, SD = 5.64) during the experimental task. Furthermore, an age category effect was observed ($F(2,114)=4.926$, $p<.001$, $\eta^2=.08$): middle-aged motorists ($M=113.84$, SD = 1.20) drove faster than older one ($M=108.74$, SD = 1.13). No gender effect was found ($F<1.00$). In addition, no effect of experimental condition, gender, and age category was found ($F>1.00$) for average speed at the moment of the exposure and validation of the message.

3.2.1.1. Speed change. Data registered on the simulator have allowed us to extract the values corresponding to the speed at which drivers from the control group were travelling at the same moments when experimental group drivers (Blackberry and iPhone) had received and validated each of the 14 messages and, thus compare the three groups.

No effect of experimental condition, gender, and age category was found on overall speed change ($F>1.00$). However, an effect of the experimental condition was observed for the speed change regarding several warning messages about speed limits, slippery road or work zone. Thus, motorists from the control group were driving faster as compared to those who had been exposed to these specific warning messages (see Table 4). No effect of gender and age category was found ($F<1.00$) (Table 5).

Moreover, an effect of presence vs. absence of the message was observed for drivers' speed when they encountered the stationary damaged vehicle ($F(2,114)=5.634$, $p<.001$, $\eta^2=.09$) and the work zone on the highway ($F(2,114)=32.780$, $p<.001$, $\eta^2=.36$). Motorists from the control group were driving faster when they encountered the stationary damaged vehicle on the highway ($M=120.85$, SD = 1.21) as compared to those who received the message about the stationary damaged vehicle on the iPhone ($M=117.62$ km/h, SD = 1.21). Similarly, motorists from the control group were driving faster when they encountered the work zone on the highway ($M=120.68$ km/h, SD = 1.83) as compared to those who received the message about a work zone on the Blackberry ($M=100.75$ km/h, SD = 1.61) or iPhone ($M=107.94$ km/h, SD = 1.78).

4. Discussion

The objective of this study was to investigate motorists' comprehension of on-board traffic messages and their acceptability of Co-Drive by investigating the effects of these messages on motorists' beliefs and driving behaviour during a simulator task according to the type of message, gender, and age.

Table 5
Means, standards deviations, and ANOVA for speed change concerning the messages 7, 9, 12, and 13.

Message	Blackberry		iPhone		Control			
	M	SD	M	SD	M	SD	*F*	η^2
M7	6.95	4.61	0.50	5.95	-1.16	4.00	6.113***	.31
M9	0.83	1.71	3.07	7.06	-1.49	2.55	3.510**	.20
M12	1.98	2.50	2.59	3.65	-0.33	2.05	3.999**	.22
M13	4.61	4.92	5.52	4.48	-2.33	5.21	8.055***	.37

According to our results, participants took approximately 6 s to read and comprehend the messages provided via Co-Drive. These results are in line with findings of Dudek and Huchingson (1986) which showed that motorists required approximately one second per word presented on VMS to accurately process and understand the information and still pay attention to the driving activity. Richards, McDonald et al. (2005) also found that 4 to 6 seconds is the maximum safe viewing time of a message on a VMS for a driver travelling at 112 km/h to accurately comprehend the information without any interference with the driving activity. Ullman et al. (2005) also observed that the shortest information message (4-units: 1-unit = one word) would be the most appropriate for keeping drivers' attention on the forward roadway. However, when information is provided on VMS, there are other specific factors that might interfere with drivers' reading and comprehension of the message such as distance from the VMS, visibility, time of exposure, etc.

Participants also took less time to read warning and recommendation messages as compared to comfort messages which confirmed our first hypothesis and were consistent with previous results (Delhomme et al., 2013; Wang et al., 2009). However, the comprehension of messages depends not only on the type of information provided but also on their length or the presence vs. absence of pictograms. For example, the warning "Caution. Pedestrian in 3 km" contained 27 characters and was accompanied by a "danger" pictogram while the comfort message "Closed gas station in 10 km" contained 25 characters and was a text-only message. These results may raise questions on whether the difference in comprehension time resides in the type of information provided, the presence vs. absence of the pictograms, the interaction between these factors or others.

In addition, young drivers took less time to read the messages as compared to elderly drivers. Richards and Heathington (1988) found that very young (<19 years) and elderly drivers (>54 years) encounter more problems in the comprehension of rail road grade-crossing traffic control devices. Similarly, Otani et al. (1992) showed that older drivers' (>60 years) have difficulties in recognizing and comprehending warnings traffic signs.

Further on, participants expressed a positive attitude towards the messages provided via Co-Drive and the pictograms accompanying the text. They found the messages comprehensible, efficient, and important for the driving activity and the pictograms useful for the comprehension of the messages which is consistent with previous findings (Katz et al., 2006; Mansoor and Dowse, 2004; Paivio, 1975). They were also confident in the information provided via Co-Drive and declared having changed their speed behaviour after being exposed to the messages which was consistent with their behavioural reactions registered during the driving task. Furthermore, they estimated having received the information about road traffic or their behaviour sufficiently in advance for them to adapt their driving behaviour and declared themselves satisfied by Co-Drive. These results confirmed our second hypothesis.

In addition, young and middle-aged drivers expressed a more positive attitude towards the messages and the pictograms and declared being more satisfied by Co-Drive as compared to the older ones. In everyday life, elder people express more resistance to change (Kasteler et al., 1968; Pollman and Johnson, 1974). Moreover, older people are known to express more negative attitudes towards the adoption of new technologies (Czaja et al., 2006; Tacken et al., 2005).

Regardless of the type of display device, participants reduced their speed after having received warning and recommendation messages, and, as expected, maintained it after having received to comfort messages which did not require any particular behavioural change. Moreover, they validated a different number of messages depending on their transgressive behaviour, Thus, approximately 70% of the drivers received only one time speed limits warning while only 23% of them received it the second time underlining the potential benefits of Co-Drive in terms of adjusting speed behaviour. These results confirmed our third hypothesis and were consistent with previous findings (Levinson, 2003; Erke and Sagberg, 2006).

Moreover, middle-aged motorists drove faster as compared to older ones which is congruent with previous findings (Cavallo and Triggs, 1996; Palamara and Stevenson, 2003) suggesting that younger drivers have more crashes and violations than older drivers due to speeding (Clarke et al., 2002; Engström et al., 2003).

Furthermore, participants from the control group travelled at approximately 117 km/h while those who received on-board traffic messages provided on the Blackberry or iPhone travelled at 108 km/h respectively, 110 km/h. Moreover, those in the experimental groups adapted their driving behaviour easier to the road environment because they could anticipate traffic difficulties through the on-board traffic information provided via Co-Drive as compared to the control group. For example, a reduction of approximately 9 km/h was observed in the average speed of those who received the message about the wandering pedestrian as compared to those who hadn't been exposed to the message and who maintained their speed. These results confirmed our fourth hypothesis and were consistent with previous findings (Chatterjee et al., 2002; Luoma et al., 2000; Wardman et al., 1997).

Thus, participants processed and evaluated differently the information provided via Co-Drive and adjusted their driving behaviour accordingly. These findings may be explained by the fact that the messages provided via Co-Drive are personalized and directly connected not only to the road environment but also to the drivers' behaviour, creating a system–driver interaction which determines the later to be more self-engaged and thus, react promptly to the feedback provided by the on-board advanced Co-Drive system.

5. Conclusion

The presence of on-board traffic information plays an important role in the driving activity as it allows drivers to promptly react to traffic events and adjust their behaviour according to the road environment, thus, ensuring traffic fluidity and road safety. These results offer support and recommendations for designing the central messages of road safety campaigns' as well as for the ergonomics of the on-board traffic information presentation which might be provided by other on-board advanced systems. Furthermore, they underline the importance of these systems, their effectiveness on drivers' behaviour, and the implications for road safety.

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References

Al-Madani, H., Al-Janahi, A.R., 2002. Assessment of drivers' comprehension of traffic signs based on their traffic, personal and social characteristics. Transportation Research Part F 5, 63–76.

Allen, R.W., Parseghian, Z., Van Valkenburgh, P.G., 1980. Age effects on symbol signs recognition. Federal Highway Administration, Washington DC.

Arditi, R., 2011. Advanced analysis of user's behavior when facing traffic information through Variable Message Signs. In: 39th ASECAP Study and Inform Days 2011, Brussels.

Bierlaire, M., Thémans, M., Axhausen, K., 2006. Analysis of driver's response to real-time information in Switzerland. European Transport 34, 21–41.

Braun, C.C., Kline, P.B., Silver, C.N., 1995. The influence of color on warning label perceptions. International Journal of Industrial Ergonomics 15, 179–187.

Braun, C.C., Sansing, L., Silver, C.N., 1994. The interaction of signal word and colour on warning labels: differences in perceived hazard. In: Paper presented at the Human Factors and Ergonomics Society Annual Meeting Proceedings.

Caird, J.K., Chisholm, S., Lockhart, J., 2008. The effect of in-vehicle advanced signs on older and younger drivers' intersection performance. International Journal of Human-Computer Studies 66, 132–144.

Cavallo, A., Triggs, T.J., 1996. Directions for improving young driver safety within Victoria: a discussion paper. Monash University, Melbourne.

Caird, J.K., Chisholm, S.C., Lockhart, J., Vacha, N., Creaser, J.I., Edwards, C.J., 2006. In-vehicle intelligent transportation system (ITS) countermeasures to improve older driver intersection performance (Rep. No. 14610e). Transportation Development Centre, Transport Canada, Montreal.

Clarke, D.D., Ward, P., Truman, W., 2002. In-depth Accident Causation Study of Young Drivers. Transport Research Laboratory, Berkshire.

Collins, B.L., Lerner, N.D., 1983. An Evaluation of Exit Symbol Visibility. NBSIR 83-2675. April 1983.

Czaja, S.J., Charness, N., Fisk, A.D., Hertzog, C., Nair, S.N., Rogers, W.A., Sharit, J., 2006. Factors predicting the use of technology: findings from the Centre for Research and Education on Aging and Technology Enhancement (CREATE). Psychology and Aging 21 (2), 333–352.

Chatterjee, K., Hounsella, N.B., Firminb, P.E., Bonsall, P.W., 2002. Drivers' response to variable message sign information in London. Transportation Research Part C 10, 149–169.

D'Onghia, F., Delhomme, P., Dubois, N., 2008. Comment persuader les automobilistes à respecter les limitations de vitesse ? Effets du cadrage et de la présence d'une image sur les attitudes à l'égard du respect des limitations de vitesse et l'intention de les respecter. Bulletin de Psychologie 61 (6), 561–576.

Delhomme, P., Chappé, J., Grenier, K., Pinto, M., Martha, C., 2010. Reducing air pollution: a new argument for getting drivers to abide by the speed limit? Accident Analysis and Prevention 42, 327–338.

Delhomme, P., Cristea, M., Imbert, A., Mondet, J.-L., 2013. Rapport intermédiaire N°1 du projet "Co-Drive. Lot n°5: Acceptabilité par les usagers", Ifsttar.

Delhomme, P., Dedobbeleer, W., Forward, S., Simoes, A., 2009. Manual for Designing, Implementing, and Evaluating Road Safety Communication Campaigns. WP3 In Campaigns and Awareness Raising Strategies in Traffic Safety, 6e PCRD, European Commission.

Dowse, R., Ehlers, M., 2005. Medicine labels incorporating pictograms: do they influence understanding and adherence? Patient Education and Counselling 58, 63–70.

Dudek, C.L., Huchingson, R.D., 1986. Manual on Real-Time Motorist Information Displays. Report FHWA-IP-86-16. U.S. Department of Transportation, Washington DC.

Dudek, C.L., Schrock, S.D., Ullman, G.L., Chrysler, S.T., 2006. Flashing message features on changeable message signs. Transportation Research Record 1959, 122–129.

Dutta, A., Fisher, D.L., Noyce, D.A., 2005. Use of a driving simulator to evaluate and optimize factors affecting understandability of variable message signs. Transportation Research Part F 7, 209–227.

Engström, I., Gregersen, N.P., Hernetkoski, K., Keskinen, E., Nyberg, A., 2003. Young novice drivers, driver education, and training: Literature Review. Rapport 491a. VTI, Linköping.

Erke, A., Sagberg, F., 2006. Effects of Variable Message Signs (VMS) on Driver Attention and Behavior. European Association for Transport and Contributors.

Erke, A., Sagberg, F., Hagman, R., 2007. Effects of route Guidance Variable Message Signs (VMS) on Driver Behaviour. Transportation Research Part F 10, 447–457.

Espié, S., 1999. Vehicle-driven simulator versus traffic-driven simulator: the INRETS approach. In: Proceedings of the First Driving Simulation Conference Europe, Paris, pp. 367–376.

Haddad, H., Delhomme, P., 2006. Persuading young car drivers to take part in a driving skills test: the influence of regulatory fit on informational-assessment value and persuasion. Transportation Research Part F 9, 399–411.

Hancock, P.A., Verwey, W.B., 1997. Fatigue, workload and adaptive driver systems. Accident Analysis and Prevention 29, 495–506.

Hanowski, R.J., Kantowitz, B.H., 1997. Driver memory retention of in-vehicle information system messages. In: TRB Annual Meeting No76, no1573, Washington, DC, pp. 8–16.

Houts, P.S., Doak, C.C., Doak, L.G., Loscalzo, M.J., 2006. The role of pictures in improving health communication: a review of research on attention, comprehension, recall, and adherence. Patient Education and Counselling 61, 173–190.

Jamson, H.A., Merat, N., Carsten, O., Lai, C.H., 2013. Behavioural changes in drivers experiencing highly-automated vehicle control in varying traffic conditions. Transportation Research Part C 30, 116–125.

Jaynes, L.S., Boles, D.B., 1990. The effects of symbols on warning compliance. In: Proceedings of the Human Factors Society 34th Annual Meeting, Human Factors Society, Santa Monica CA, pp. 984–987.

Kasteler, J.M., Gay, R.M., Caruth, M.J., 1968. Involuntary relocation of the Elderly. Gerontologist 8 (4), 276–279.

Katz, M.G., Kripalani, S., Weiss, B.D., 2006. Use of pictorial aids in medication instructions: a review of the literature. American Journal of Health-System Pharmacy 63, 2391–2397.

Lai, C.J., 2010. Effects of color scheme and message lines of variable message signs on driver performance. Accident Analysis and Prevention 42 (4), 1003–1008.

Lee, J.D., Gore, B.F., Campbell, J.L., 1999. Display alternatives for in-vehicle warning and sign information: message style, location and modality. Transportation Human Factors 1 (4), 347–375.

Levinson, D., 2003. The value of advanced traveler information systems for route choice. Transportation Research Part C 11, 75–87.

Lum, H.S., Roberts, K.M., DiMarco, R.J., Allen, R.W., 1983. A Highway Simulator Analyses of Background Colors for Advance Warning Signs. Federal Highway Administration, Washington DC.

Luoma, J., Rämä, P., Penttinen, M., Anttila, V., 2000. Effects of variable message signs for slippery road conditions on reported driver behaviour. Transportation Research Part F 3, 75–84.

Mansoor, L.E., Dowse, R., 2004. Design and evaluation of a new pharmaceutical pictogram sequence to convey medicine usage. Ergonomics 16, 29–41.

Monteiro, S., Huiskes, R., Van Dijk, L., Van Weert, J.C.M., De Gier, J.J., 2013. How effective are pictograms in communicating risk about driving-impairing medicines? Traffic Injury Prevention 14, 299–308.

Otani, H., Leonard, S.D., Ashford, V.L., Bushore, M., 1992. Age difference in perception of risk. Perceptual and Motor Skills. (2), 587–594.

Palamara, P.G., Stevenson, M.R., 2003. A longitudinal investigation of psychosocial risk factors for speeding offences among young motor car drivers (Research Report No. RR128). Injury Research Centre, Crawley.

Pollman, A.W., Johnson, A.C., 1974. Resistance to change, early retirement and managerial decisions. Industrial Gerontology 1 (1), 33–41.

Rämä, P., Kulmala, R., 2000. Effects of variable message signs for slippery road conditions on driving speed and headways. Transportation Research Part F 3, 85–94.

Regan, M.A., 2004. A sign of the future I & II: Intelligent transport systems & human factors. In: Castro, C., Horberry, T. (Eds.), The Human Factors of Transport Signs. CRC Press, Boca Raton, FL, pp. 213–238.

Richards, S.H., Heathington, K.W., 1988. Motorist understanding of railroad-highway grade crossing traffic control devices and associated traffic laws. Transportation Research Record 1160, 52–59.

Rudin-Brown, C.M., Greenley, M.P., Barone, A., Armstrong, J., Salway, A.F., Norris, B.J., 2004. The design of child restraint system (CRS) labels and warnings affects overall CRS usability. Traffic Injury Prevention 5 (1), 8–17.

Schmidt, L., 1982. Observance and transgression of local speed limits. Arbeiten-aus-dam-Verkehrspsychologischen-Institute 19 (6), 107–116.

Shaver, E.F., Braun, C.C., 2000. Effects of warning symbol explicitness and warning color on behavioral compliance. In: Paper presented at the Proceedings of the International Ergonomics Association/Human Factors and Ergonomics Society Congress.

Shinar, D., Vogelzang, M., 2013. Comprehension of traffic signs with symbolic versus text displays. Transportation Research Part F 18, 72–82.

Staplin, L., Fisk, A.D., 1991. A cognitive engineering approach to improving signalized left-turn intersections. Human Factors 33, 559–572.

Tacken, M., Marcellini, F., Mollenkopf, H., Ruoppila, I., Szeman, Z., 2005. Use and acceptance of new technology by older people: findings of the international MOBILATE survey "Enhancing mobility in later life". Gerontechnology 3, 126–137.

Tijus, C., Barcenilla, J., de Lavalette, B., Lambinet, L., Lacaste, A., 2005. Conception, compréhension et usages de l'information iconique véhiculée par les pictogrammes. In: Alamargot, D., Terrier, P., Cellier, J.M. (Eds.), Production, compréhension et usages des écrits techniques au travail. Octarès, Toulouse.

Ullman, G.L., Ullman, B.R., Dudek, C.L., Nelson, A.A., Pesti, G., 2005. Advanced Notification Messages and Use of Sequential Portable Changeable Message Signs in Work Zones. Texas Transportation Institute, College Station.

Wang, J.H., Hesar, S., Collyer, C., 2007. Adding graphics to dynamic message sign messages. Transportation Research Record 2018, 63–71.

Wang, J.H., Keceli, M., Maier-Speredelozzi, V., 2009. Effect of dynamic message sign messages on traffic slowdowns. In: Annual Meeting of Transportation Research Board.

Wardman, M., Bonsall, P.W., Shires, J.D., 1997. Driver response to variable message signs: a stated preference investigation. Transportation Research Part C 5, 389–440.