# Automotive Habitat Laboratory: overview of insights
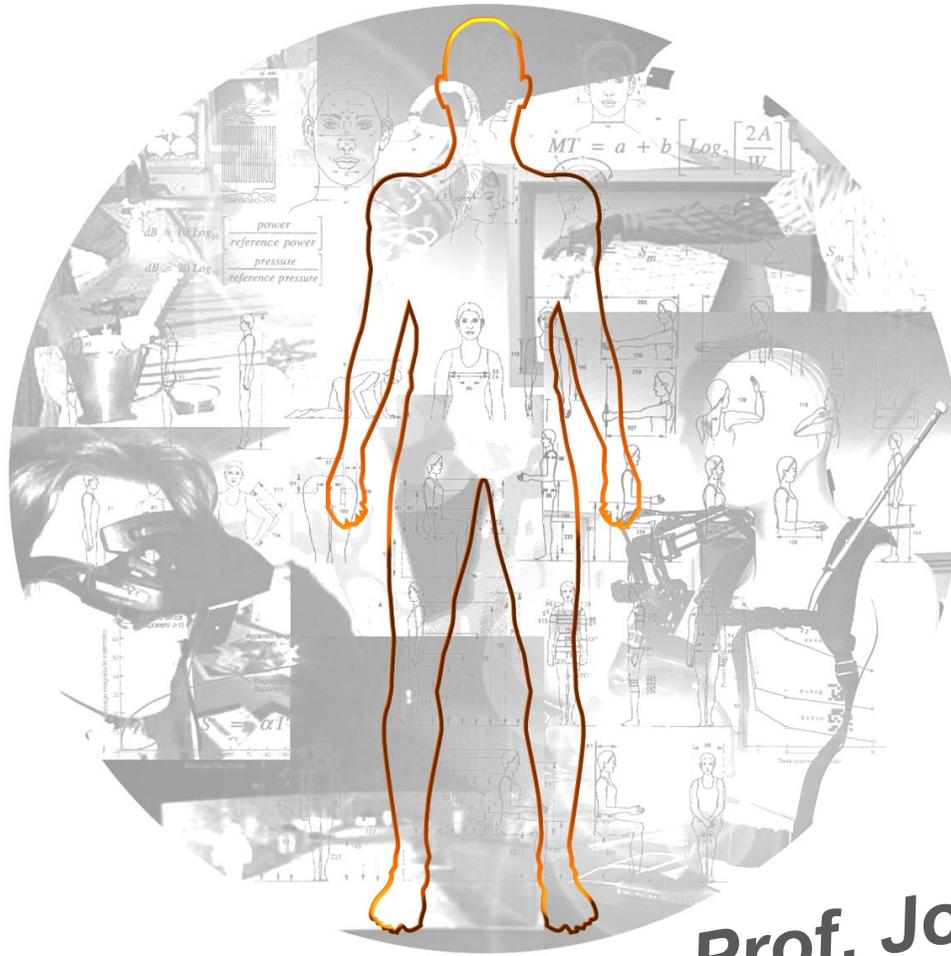
Prof. Joseph Giacomin

CREATING EXPERIENCES CUSTOMERS LOVE, FOR LIFE

Human Centred Design Challenges

Challenges Arising From The Context

Response (*n=20 participants*) to the question "what would you like now ?"

DRIVING IN THE COUNTRYSIDE

DRIVING IN THE HIGHWAY

DRIVING IN THE CITY TRAFFIC

4618 words

5333 words

5704 words

Giuliano, L, Germak, C. and Giacomin, J. 2017, Effect of Driving Context On Design Dialogue, 8th Int. Conf. on Applied Human factors and Ergonomics (AHFE),17 to 21 July, Los Angeles, California, USA.

Challenges Arising From The Person

- attention narrowing under intense emotion
  (Easterbrook effect)

- gaps caused by the event horizon
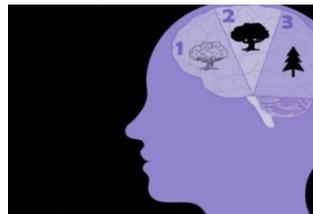
- errors from long term memory encoding

- fading affect bias

Challenges Arising From Driving Simulators

Study (*n=25*) investigated if emotions were triggered reliably in simulated driving:

- behaviours often appeared to be unrealistic;

- some emotions such as anger and fear were rarely triggered;

- some emotions such as joy were obviously incorrect with respect to driving an actual vehicle.

Simulated driving was judged to not be suitable when accurate assessments of emotion are required.

Challenges Arising From Contextual Interviews

A contextual interview, or contextual inquiry, is a user research method specifically designed to provide insight into the environment or context in which a design will be used. A session typically consists of a mix between a traditional user interview and observations of how the research participants use a product or service in the relevant context.

Interaction Design Foundation 2021, What Are Contextual Interviews?
https://www.interaction-design.org/literature/topics/contextual-interviews

- limited number of people can interact at any one time;

- a form of ethnography rather than a form of co-design.

Automotive Habitat Laboratory

Virtual Workshops: a new tool for automotive HCD
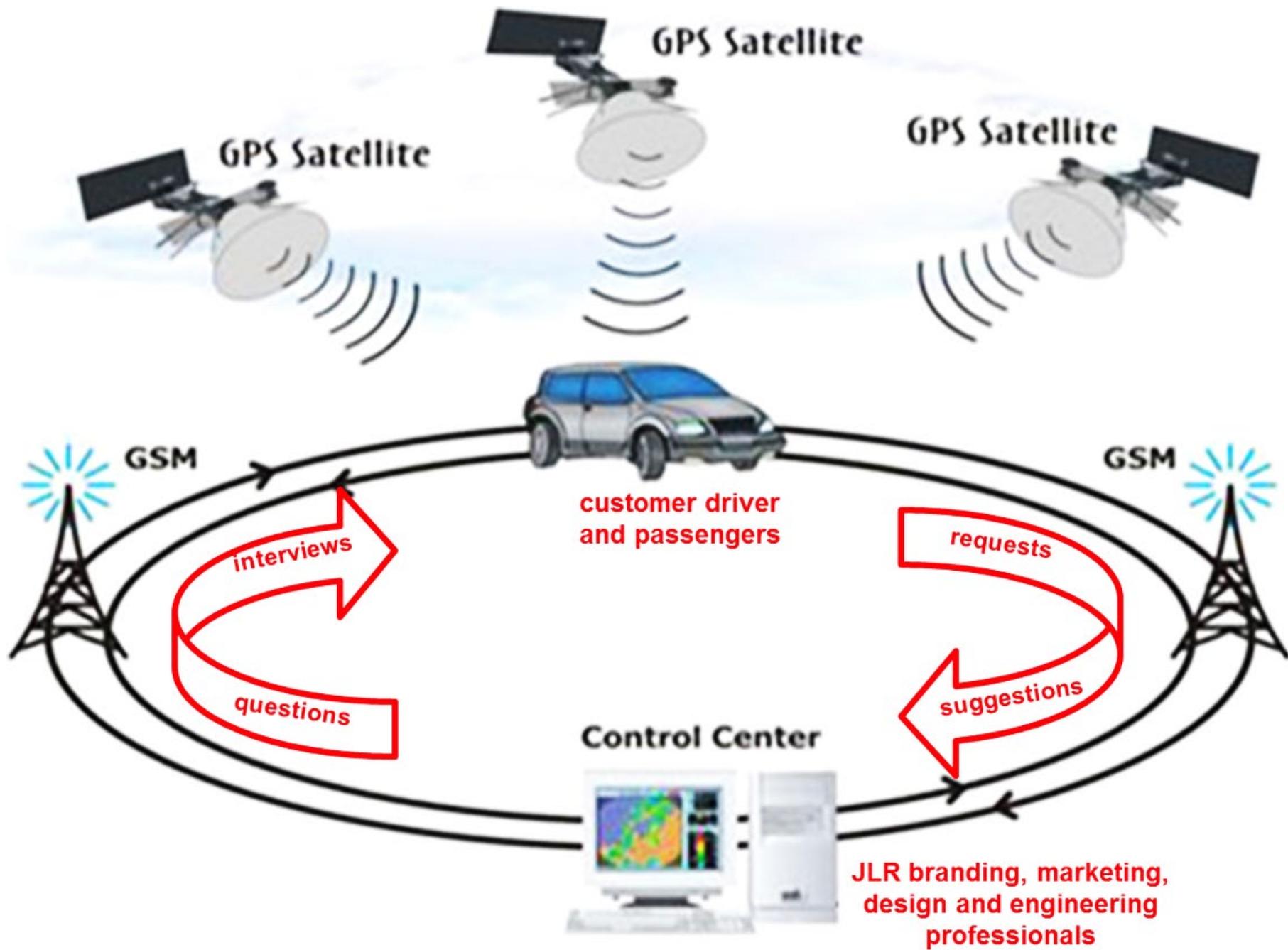
CHARTS

MAP

VIDEO

INSTRUMENT CLUSTER

DATA VIEW

EMOTION VIEW

ALERT VIEW

ALERTS GRID

TEST VIEW

FusionClient

Row	Timestamp	Duration (ms)	Trigger Name	Average	No. Samples
22	2017-09-25T10:03:32	1499	LipPucker	50.900103...	8
23	2017-09-25T10:08:58	416	Sadness	54.517728...	7
24	2017-09-25T10:09:13	2923	BrowRaise	51.320195...	31
25	2017-09-25T10:09:13	1007	Joy	53.347473...	11
26	2017-09-25T10:09:34	822	Sadness	50.897202...	12
27	2017-09-25T10:09:37	184	LipPucker	51.124779...	6
28	2017-09-25T10:09:38	921	LipPucker	52.862390...	15
29	2017-09-25T10:09:38	234	LipCornerDepressor	53.276030...	5
30	2017-09-25T10:09:40	1253	LipPucker	50.659461...	21
31	2017-09-25T10:09:40	654	Sadness	52.318121...	10
32	2017-09-25T10:10:35	346	Joy	51.14378	8
33	2017-09-25T10:10:55	339	Sadness	52.196336...	6
34	2017-09-25T10:10:58	1715	Sadness	52.876589...	17
35	2017-09-25T10:11:09	616	Sadness	52.573788...	11
36	2017-09-25T10:11:10	2460	Sadness	50.331736...	33
37	2017-09-25T10:11:14	195	Joy	52.6463325	4
38	2017-09-25T10:11:15	237	Sadness	53.47585	7
39	2017-09-25T10:11:19	46	Sadness	58.513842	4

FusionClient

☑ Auto Rescale... ☐ Auto Rescale... ☑ Auto Follow Ti... Anger ▼

Legend: Sadness, Disgust, Joy, Surprise, Fear, Anger

Sensor Value axis: 80, 60, 40, 20

Timestamp: 10:11:00:000, 10:11:02:500, 10:11:05:000, 10:11:07:500, 10:11:10:000, 10:11:12:500

FusionClient (Map)

Wyatt's Road, Wyatt's Close, Briery Road, London Orbital Motorway, Trout Rise Farm, Little Lady's Wood, Tansworth Road, M25, E30, A404

FusionClient (Instrument Cluster)

Speed (kph): 87.66

Throttle (%): 34

Brake Pressure (%): 0

5.7

Video (×4)

2017 0925 10:11:10.521
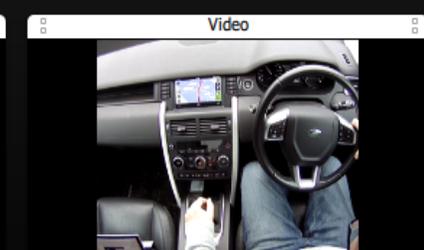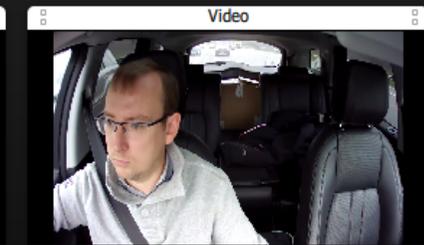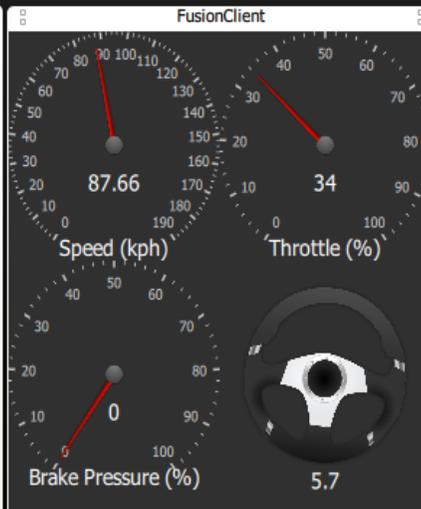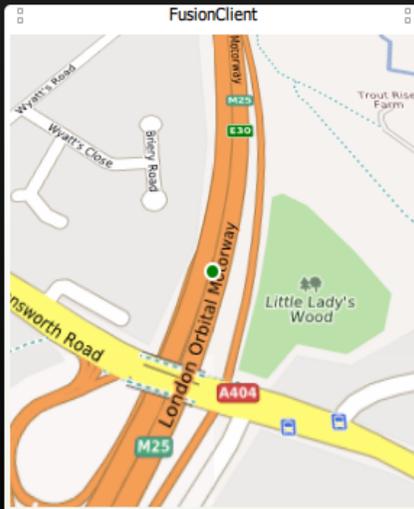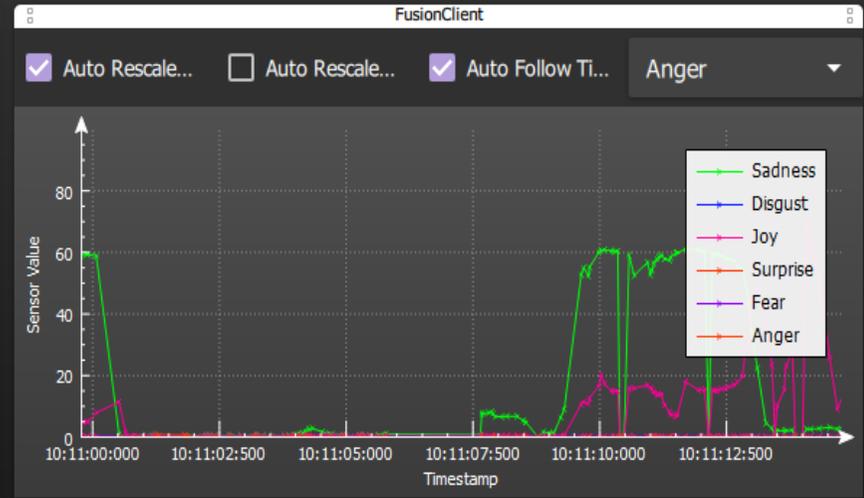
REVIEW 🔊 |←   <5S   �   ▶   ▶1   >5S   →| --:--   10:11:09

Lip... Fear above threshold for 8781ms 6387ms

Emotion Road Circuit

Drive time of 40 minutes

Distance of 15.2 miles

City of 4.5 miles (23%)

Country of 4 miles (26%)

Highway of 6.7 miles (44%)
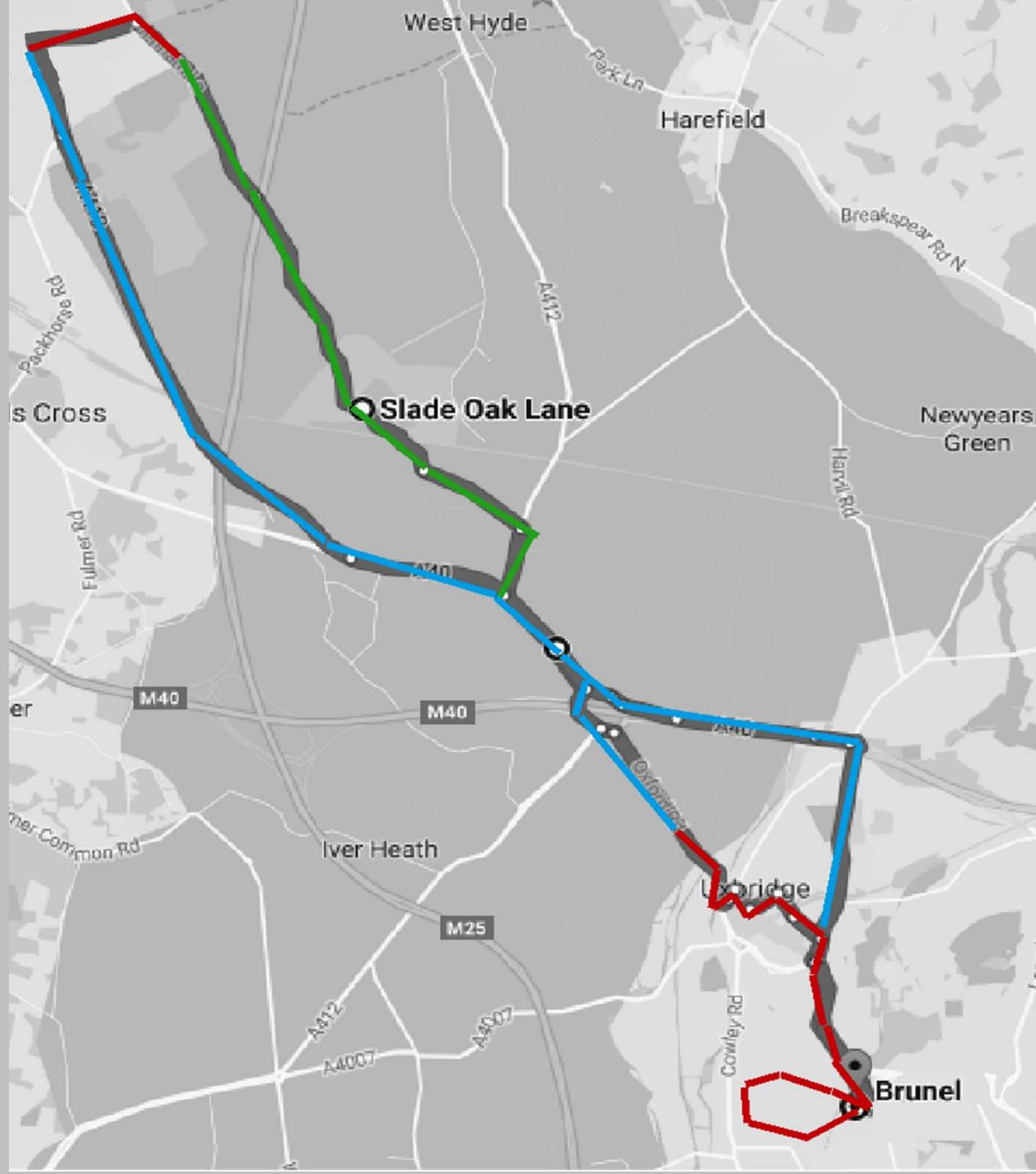
Co-Design Communications

Communication Requirements

For people in automobiles the real-time communication is effected by the screen size, screen resolution and sound volume of the in-car interface.

Tests of achievable combinations of these three parameters were thus performed in a driving simulator

Screen Options	Size (inches)	Pixels*	Speaker Options	Volume**
1	7.8 x 5.8	854 x 480	1	55 dB
2	5.6 x 4.2	320 x 180	2	67 dB
3	4 x 3		3	77 dB

*images at 25 frames per second   **sound at driver's left ear.

Communication Requirements

The participants *(n=24)* performed three tasks while driving the simulator:
- listening to a speech
- paying attention to a video
- following a driving route displayed on the screen

Standard metrics of workload (WL), perceived media quality (PMQ) and error rate (ER) were measured.

Optimal screen size: 7.8 x 5.8 inches

Optimal frame resolution: 480p

Optimal speaker volume: 77 ± 3 dB

Telepresence Requirements

Does interaction via voice+video create a closer feeling of collaboration between the people than interaction via only voice ?

Voice Interaction

Voice + Video Interaction

Telepresence Requirements

Participants (n=24) were grouped into couples with one person assigned the role of driver and the other the role of collaborator. The driver was located in the driving simulator while the collaborator was located in a control room.

Each couple was connected through either a **voice+video** channel or by a **voice channel** alone, and was asked to perform tasks as a team while driving a city route:

- *co-navigation task where both driver and collaborator had a map (10 minutes);*
- *co-navigation task where only the collaborator had a map (10 minutes);*
- *riddle resolution task where the couple talked their way through a problem of logic (10 minutes)*

Self-reported copresence, reported others copresence and social presence* were measured at the end of each task.

* Nowak, K.L. and Biocca, F. 2003, The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments, Presence: Teleoperators & Virtual Environments, Vol. 12, No. 5, pp.481-494.

Telepresence Requirements
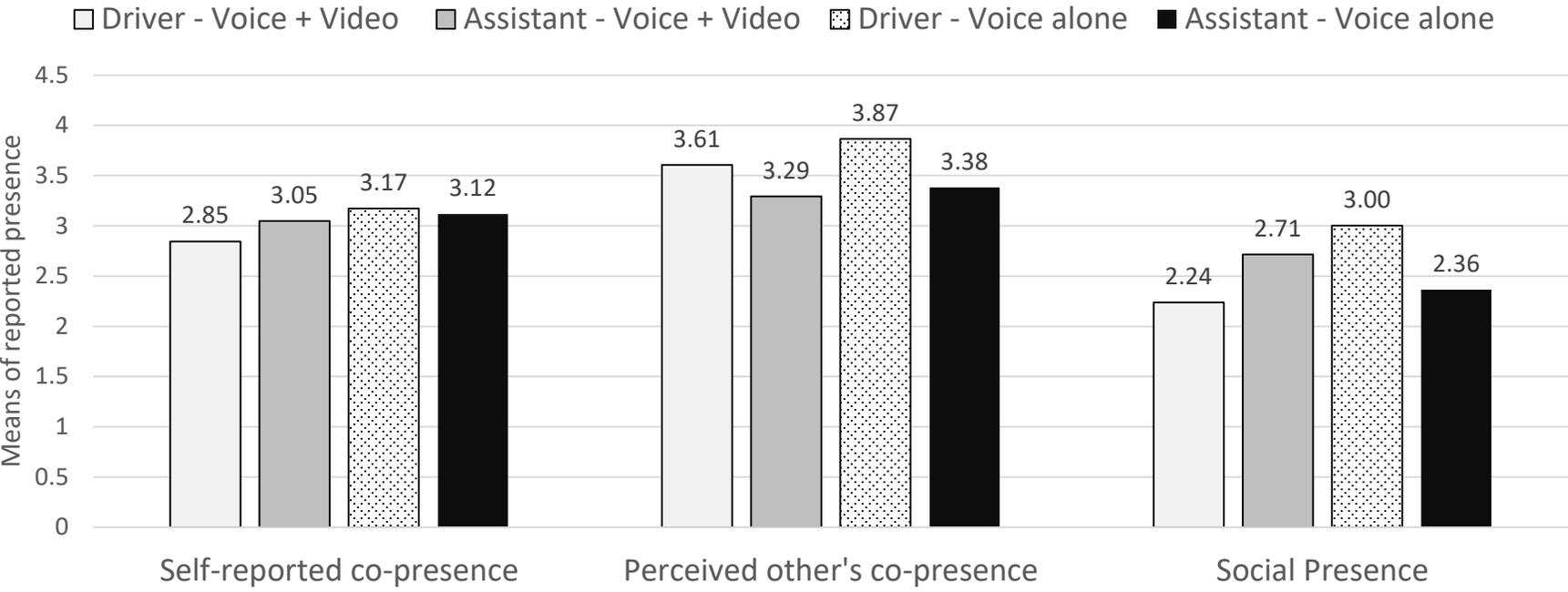
Greater telepresence was reported in the case of the voice channel alone.

Driving Emotions

Driving Emotion Statistics: roads

Average emotion rate for all roads was
2.16 facial expressions per minute.

	Total Time (Sec)	Total FE	FE/Sec	Relative
Highway	16340	465	0.028	0.80
City	19163	687	0.036	1.00
Country	10273	434	0.042	1.19
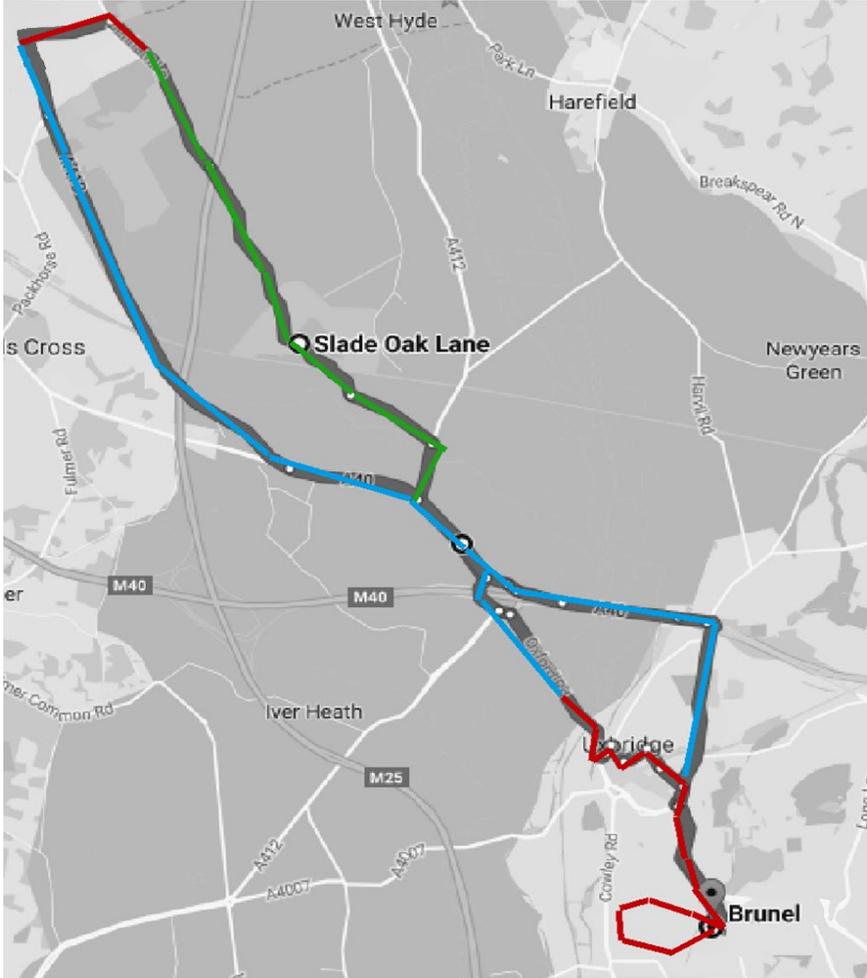
Driving Emotion Statistics: triggers

Joy (n=147)

N	Assigned Cause
64	Enjoying car
28	No cause assigned
22	Interaction with other person
4	High traffic density
3	Poor road conditions
3	Navigation problems
2	Accelerating
21	others

Surprise (n=115)

N	Assigned Cause
22	Poor road conditions
13	Navigation alert
11	Car passing close
9	Scratching face
8	Sun blinding
7	No cause assigned
6	High traffic density
39	others

Sadness (n=53)

N	Assigned Cause
8	Navigation alert
6	Poor road conditions
6	No cause assigned
5	Sun blinding
4	Check navigation
3	High traffic density
2	Road conditions
19	others

Anger (n=112)

N	Assigned Cause
23	Checking navigation
21	Navigation alert
12	High traffic density
9	Navigation recalculating
7	No cause assigned
5	Roundabout
4	Poor road conditions
31	others

Disgust (n=121)

N	Assigned Cause
28	High traffic density
22	Poor road conditions
12	Checking navigation
10	Scratching face
9	Interaction with other person
8	Navigation alert
6	Manoeuvring
26	others

Fear (n=13)

| N	Assigned Cause
5	No cause assigned
3	Navigation alert
2	Scratching face
1	Problems reversing
1	Check navigation
1	High traffic density

Driving Emotion Statistics: familiarity and control

Naturalistic Setting

Average Of One Emotion Event Every 2 Minutes

- SADNESS 2%
- DISGUST 28%
- JOY 39%
- FEAR 0%
- SURPRISE 26%
- ANGER 5%
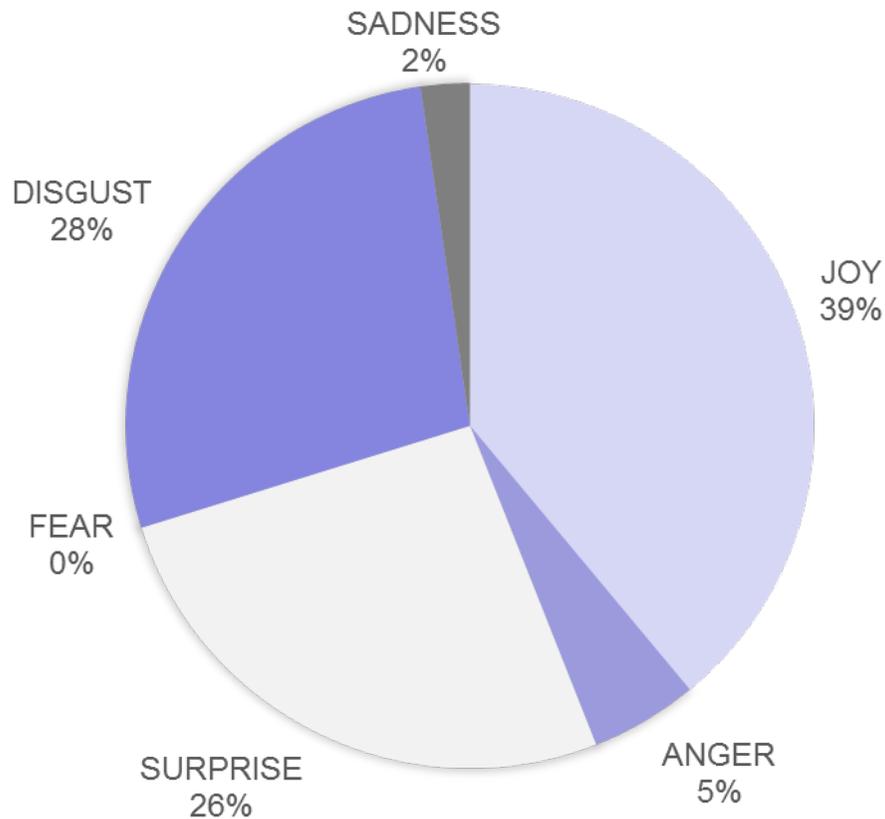
Partially Controlled Setting

Average Of One Emotion Event Every 1.5 Minutes

- SADNESS 9%
- JOY 26%
- DISGUST 22%
- FEAR 2%
- SURPRISE 21%
- ANGER 20%
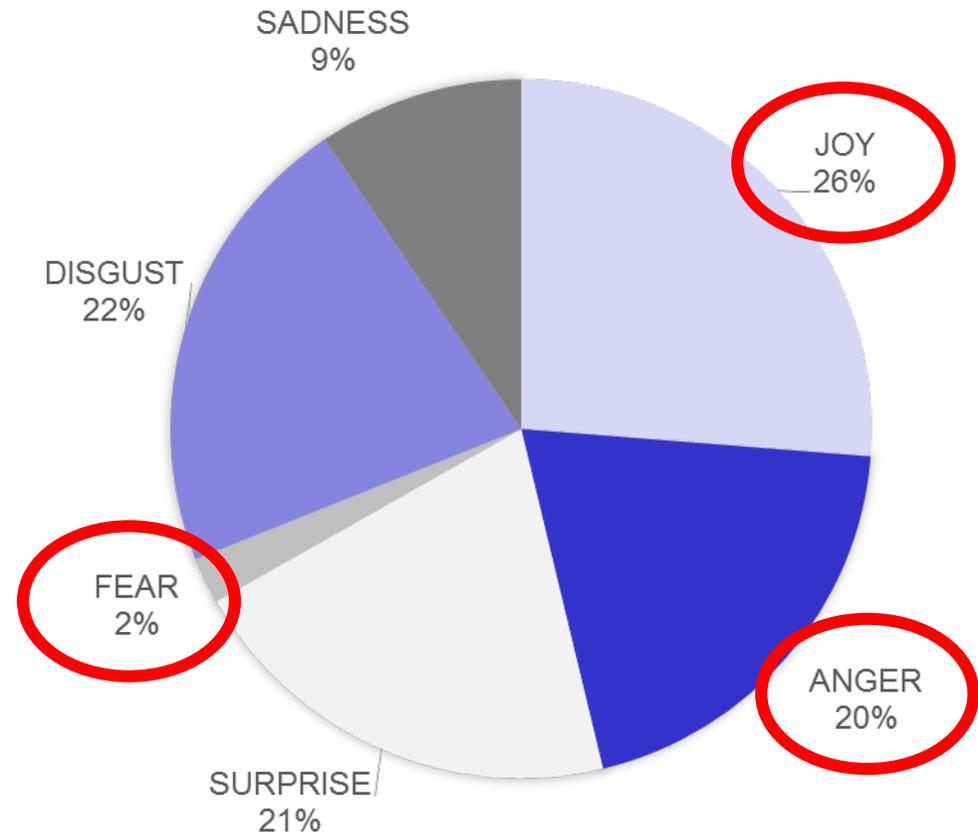
Affective Driving Scenarios

Scenario Development Questionnaire

When you were in a car,

Describe a time you were in a car and something happened that made you respond emotionally.

Where specifically did the story happen? (i.e. motorway? country road? car park? etc.)

What did you do? (Tell us what were your actions)

What or who were involved in the story? (i.e. intelligent technology, animals or human?)

At the time of the story, you felt... (Choose as many as you like)

Anger	Fear	Disgust	Happiness	Sadness	Surprise	Other
●	○	●	○	○	○	○
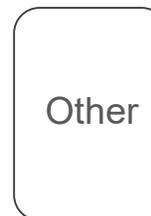
Affective Design Scenario Themes

12 themes derived from the data (*n=211 respondents*) in order of frequency of citation. Each theme had two or more subthemes which will be detailed as mini-scenarios.

Theme 1. Inconsiderate driver behaviour (i.e. Overtaking, Insulting, Forcing to give way)

Theme 2. Car accident (i.e. Bumping into another car or obstacle, Memory of the accident)

Theme 3. Road use circumstances (i.e. Heavy traffic, Road infrastructure, Other road users)

Theme 4. Infotainment (i.e. Music on the radio, News from the radio / calls)

Theme 5. Car hardware system malfunction (i.e. Warning alerts, Broken down, Partial system malfunction)

Theme 6. Unexpected driver behaviour (i.e. Sudden stop, Sudden road entry, Sudden lane changing)

Theme 7. Inexperienced driver behaviour (i.e. Mistakes/confusion, First time driving in conditions)

Theme 8. Driving with a loved one (i.e. Driving with family, Driving with friends)

Theme 9. Kind driver behaviour (i.e. Getting help, Giving way)

Theme 10. Vehicle observations and familiarity (i.e. Experience with car features, Feeling relaxation)

Theme 11. Car software system malfunction (i.e. Navigation/GPS error, Flat phone battery)

Theme 12. Driving landscape (i.e. Seeing incredible scenery, Night driving with stars)

Definition of An Affective Design Scenario

A Design Scenario is a description of a sequence of events and activities which occurs within a specific context, and which can involve other agents such as intelligent technologies, animals and people.

An Affective Design Scenario is a Design Scenario which is expected to produce in the individual a noticeable physiological response which can be described in terms of one or more of the basic emotions of anger, disgust, fear, happiness, sadness and surprise.

Example Affective Design Scenario

Heavy traffic

A driver was sitting in a traffic jam in the middle of a bridge, watching cyclists nimbly passing him, while he could only sit and wait. He wished he could leave his car's autopilot on, but he instead had to start and stop repeatedly by putting on his foot on the brake. He was curious about the incident because a traffic jam at that location was unusual, however he could not see what was happening ahead of him due to the long queue of traffic. He was frustrated because he could not control the traffic on the road and felt that he was wasting his time doing nothing. He started to think about using alternative transportation in the future.

(CAVs)

- A driver wants to get out of traffic.

- What if a car could provide an interactive entertainment service (i.e., game or quiz contest) or socialising service between surrounding cars stuck in traffic?

- What if a driver gets stuck in traffic and is late for an important meeting or is help up in an emergency?

- Possible interaction with other cars and drivers in traffic.
- Possible interaction between drivers and infrastructure

- If any interactive service that requires driver's attention is provided, possible distraction can result while drivers are moving slowly.
- What if a CAV on level 4 automation could fail updating road maps during driving in the middle of a junction/bridge where the occupant is unfamiliar with?
   - Could the car be stopped?
   - Would it be alerted to the occupant for control handover?

Thank you.