Talking Traffic

HMI Use Case TRS information

Human-machine interfaces for presenting TRS information regarding “time to red/green” to traffic participants with a focus on car drivers.

Hogeschool Arnhem en Nijmegen UNIVERSITEIT TWENTE. GreenDino Mijksenaar

Introduction: Research team

HAN AUTOMOTIVE RESEARCH

Chris Huijboom
Saskia Monsma

UNIVERSITEIT TWENTE.

Arie Paul van den Beukel

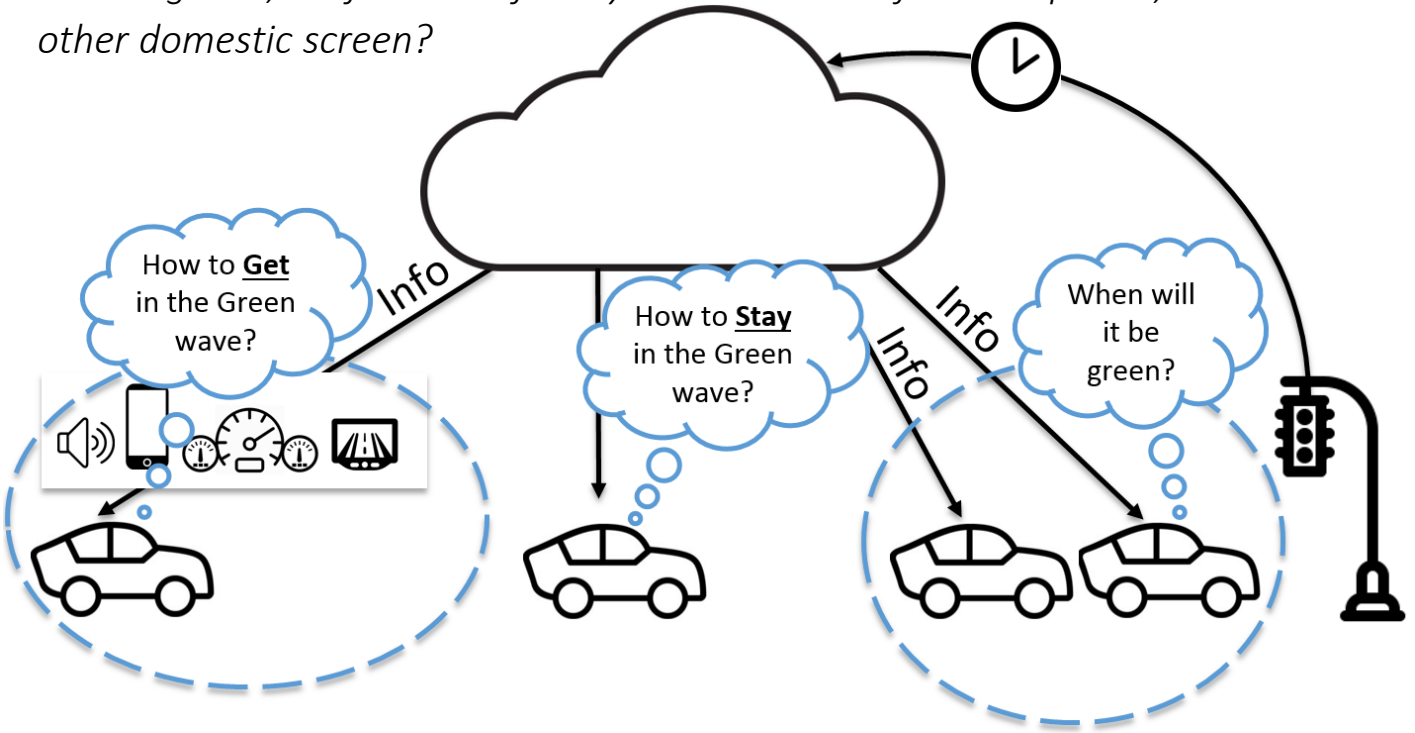
Jorrit Kuijpers

Mijksenaar

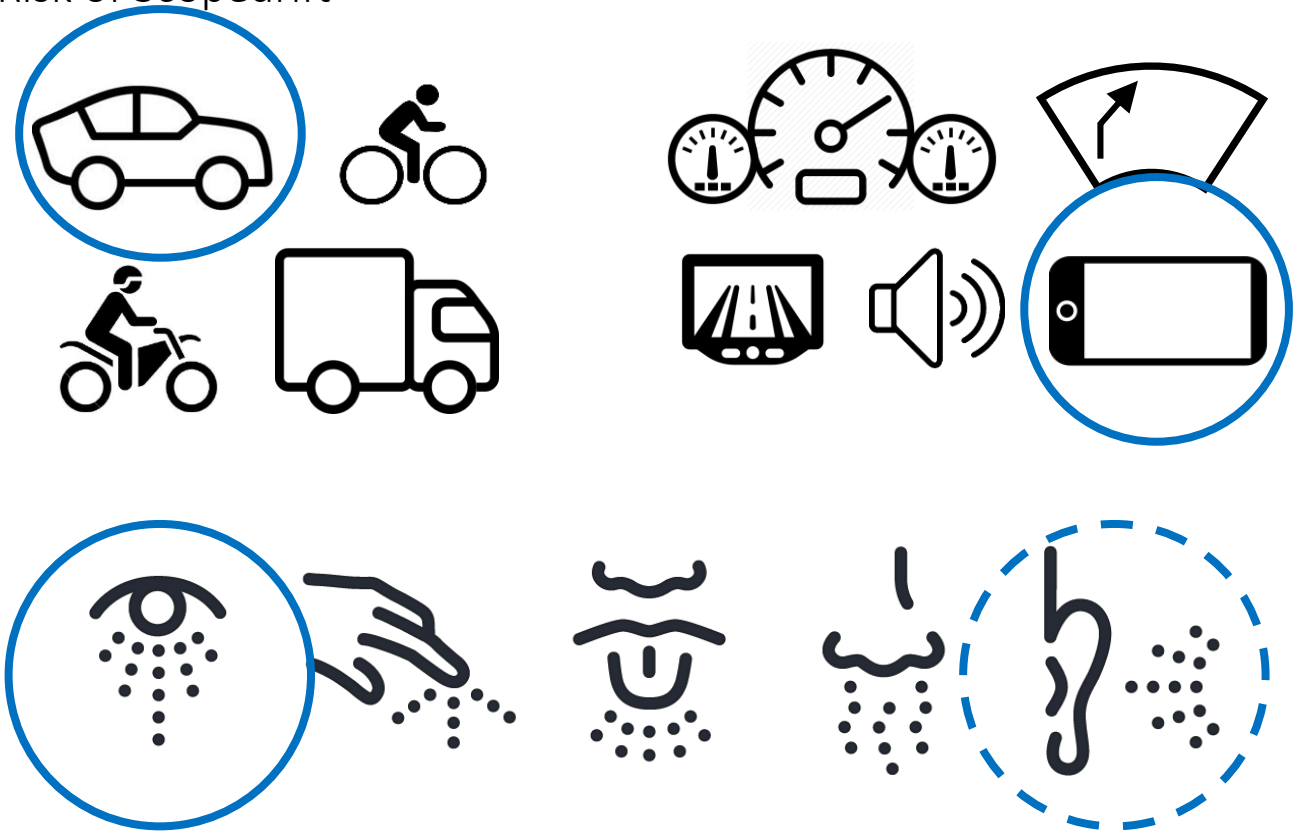
Aad Kalkman
Jaap Knevel

Main Question in words and images

What are the options to provide the TRS information in one glance in a clear, unambiguous, useful and safe way on the screen of a smartphone, satnav or other domestic screen?



Risk of Scopedrift

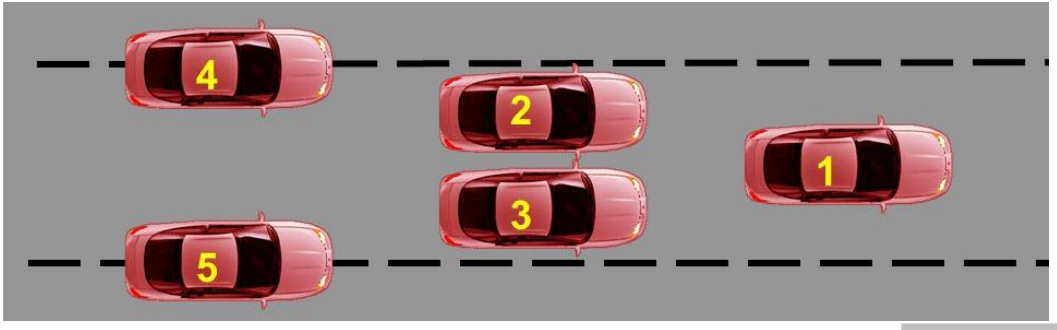


Translation of Traffic Regulation System (TRS) Information

Visually provide waiting time and Green wave information to car drivers on a smartphone

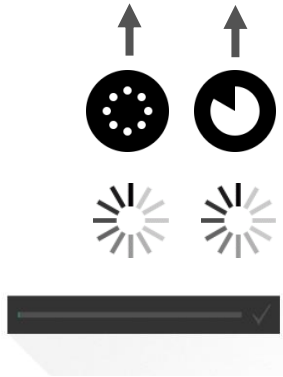
- Safe
- Clear
- Unambiguous
- Usefull and
- Visible with one glance

Elaboration on generic interface options



Elaboration on generic interface options

- The only **exact** information is indication by seconds.
- Exact display provides **pretence certainty**:
  Disturbances can occur (Emergency vehicles)
- Interpretation of meaning exact information hard:
  Is 6 seconds a long time?
- Absolute display provides limited information value.



- Other forms like an hourglass, counting back clocks or circles are **always relative**
- Animation of the relative waiting time relates speed of animation to waiting time. The length or fill is less relevant. This can be confusing.
- Slow speeds indicate long waiting time
  > Speed is harder to interpret.

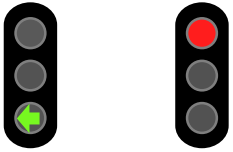
Elaboration on generic interface options

Make sure indication has **meaning** for the user

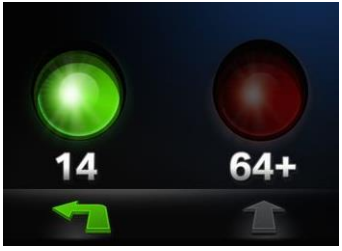
Example: temperature gauge of car

- Exact depiction is an illusion (it would move to much).
- Reality: depiction of 3 situations based on algorithm:
  - "Cold";
  - "Operating Temperature" and
  - "Too Hot".
    (often accompanied by acoustic warning and indicator light)
- Meaningfull information = Meaningfull situation.
  Exact values often hard to interpret for users
  (What is a 'proper' operating temperature??.)

Elaboration on generic interface options

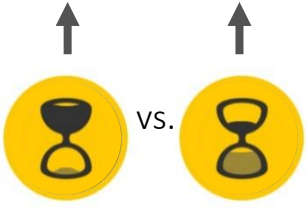


- The more realistic the depiction, the more credibility users grant the information
- ➢ Danger of adverse effects: unrealistic expectations



Bron: Enlighten app

- **True depiction of TRS must be decisive for user (No starts on “Almost Green)**
- Abstract depiction can help stipulating it is an estimation



- Consideration: use icons to indicate waiting time category: “Very long”, “Long”, “Moderate”, “Short”
- **Emphasise estimation** of waiting time
- Assign categories based on local experience

Reflection interface ideas

Relevance: Can the user follow provided advice adequately?

Necessary elements for unambiguous indication of waiting time:

- Clear relation with the subject
- Binary depiction of current status
- Depiction of time to change of status (relative of absolute)
- Remove waiting time 5s before status change.
  (prevents adverse behavior, motivates attention on road, latency less noticable)

Necessary elements for unambiguous indication of green wave position

- Clear relation between vehicle and green wave
- Binary depiction of current status
  (in or out of green wave)
- Explicit input w.r.t. driver actions
  (Speed up or slow down (relative of absolute)

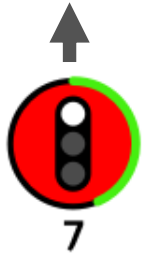
Proposal HMI for simulation

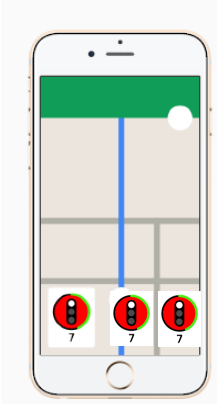
- Taking previous ideas, considerations, wishes and exclusions in consideration, 2 variants will be tested :

absolute depiction (in *sec.*)

Pre-sorting direction
(no destination known)

Wait
symbol





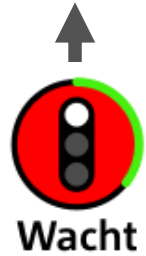
Depiction of waiting time in seconds: Circle diminishes.

Optional: Acoustic signal 5 sec. before green

relative depiction

Pre-sorting direction
(destination known

Wait
symbol



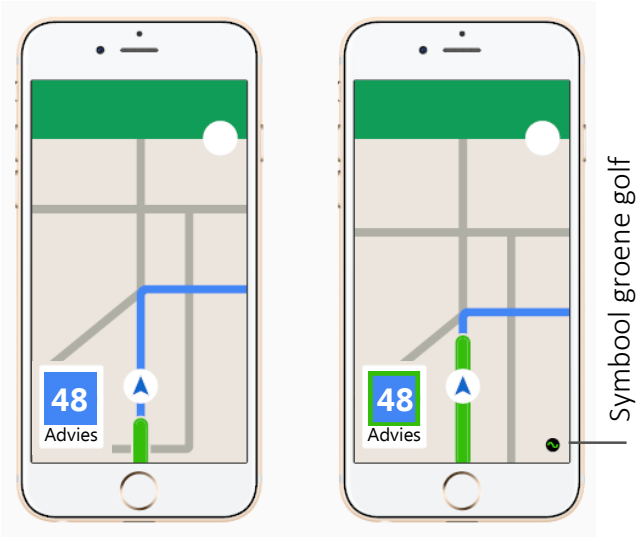
Depiction of waiting time :
Circle diminishes or halts due to interruption + “wait”

Optional: Acoustic signal 5 sec. before green

Proposal HMI for simulation

- Speed advice on approaching TRS in two HMI variants:

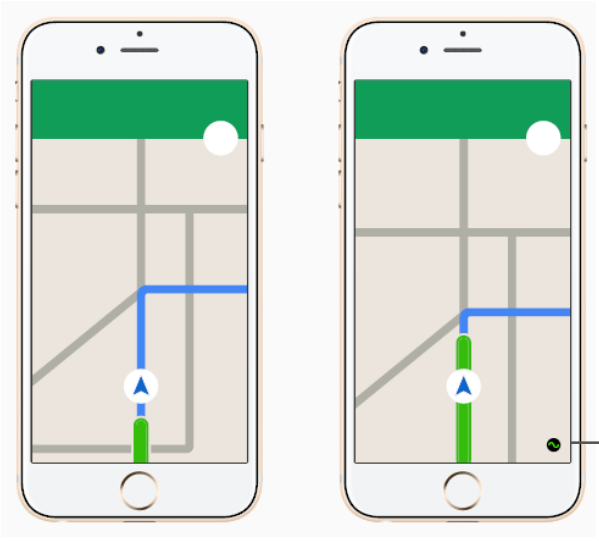
absolute advice (in *sec.*)



Driver reduces speed and enters a green wave

Meaning: advise is 48 km/h

relative advice



Driver reduces speed and enters a green wave

Voice: “drive calm for green wave”

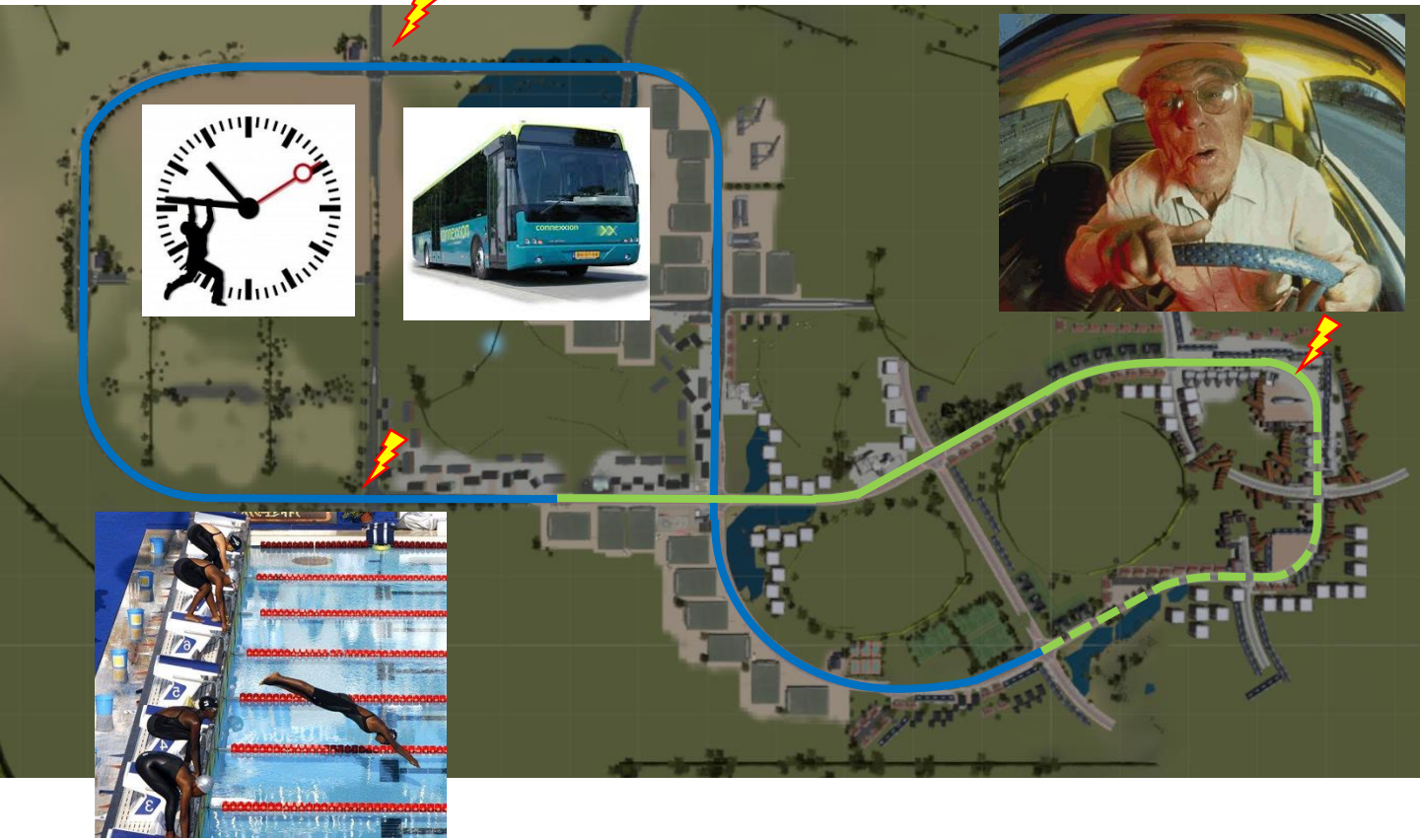
Proposal HMI for simulation

- Knowing a destination effects amount of information, therefore:
- 4 use cases required
  - No map, no destination, Absolute information
  - No map, no destination, Relative information
  - Map, known destination, Absolute information
  - No map, known Destination, Relative information
- Set up simulation measurement
- Design route and environment

Measuring the simulated drives

- Attention behavior (head tracking)
- Speed
- Acceleration
- Braking
- Following Distance
- Open questions
- Scale questions

Scenario design – parcours



Observation i.r.t behavior & green wave information

- Behavioral changes i.r.t. **Staying** in the green wave
  - One wants to stay in the green wave (stay in the flow)
  - Speed advice / suggestion is followed up
  - Feeling of rest/calm when in green wave
  - Crossing intersections without seeing the actual TRS
  - Reduced alertness on corssings (Narrow viewing angle)
- Behavioral changes i.r.t. **Getting** in the green wave
  - Speeding
  - Overtaking in situation with reduced overview and increased risk
  - Increased irritation when not making the green wave
  - Feeling of unrest and rush to stay/get in to the green wave
  - “Searching” for a green wave (even when none present)
- Distraction
  - Wanting to stay in the “green” (keeps checking)

Observation i.r.t behavior & waiting time information

- Right focus in 5 seconds before green: Checking for traffic Left, Righ, then focus on TRS
- With long waiting times:
  - Relaxation: no gazing at the TRS
  - Impatience: “I still have to wait that long??”
  - Acceptance: I still have to wait a bit
- Distraction
  - Gazing at a clock counting down
  - Attention and focus on reality too late
- Triggers
  - Drive off at or even before green light
  - “Pushing” predecessors on green light
- Blind faith in interface
  - Driving of too soon
  - No attention to real TRS
  - Driving up to crossing, unable to see real TRS

Faith / Trust

- Interfacing via a known, personal and trusted medium (Smartphone)
- Confidence grows fast when information is correct
- Readiness to follow advice from app

Remarks

- Correctness of information important
  - Because of and due to trust (Can I use it?)
  - Because of and due to acceptance (Do I want to use it?)

Map and Destination

- Preference for depiction with map.
- Without map understood and applied.
- Know destination necessary

Remarks

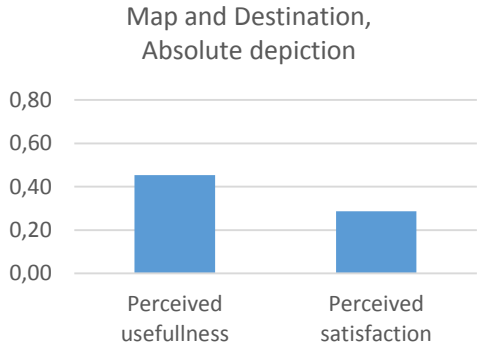
- Applicability and relevance important for users
  - Only show informatin relevant for the specific situation of the user
  - Depiction must relate to the real world situation
  - All additional information is experienced as distracting, irritating and unnessecary

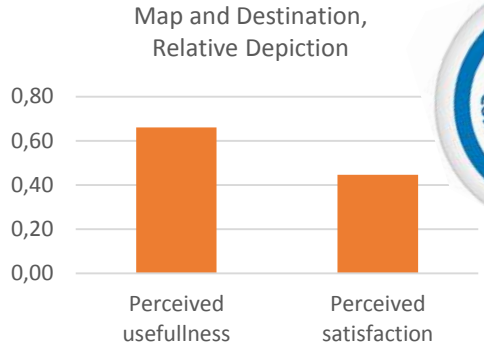
Absolute vs. relative

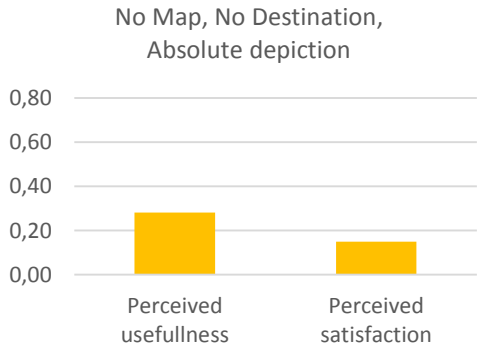
- Absolute depiction
  - Precise information
  - Requires more and longer attention
  - Provides for feelings of rush or impatience in some cases
- Relative depiction
  - Indicative information: short, long, very long
  - Requires relative little attention, can be interpreted from corner of the eye
  - More often results in feeling of rest or acceptance

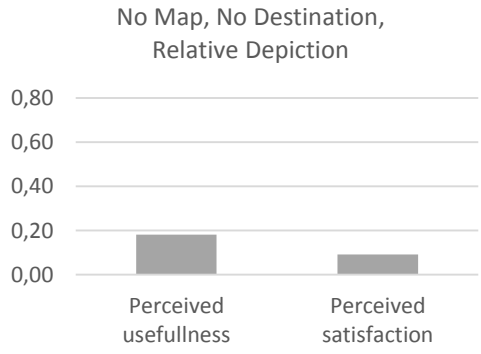
Acceptance of interface concepts

- Perceived Usefullnes, Perceived satisfaction (van de Laan Scale)



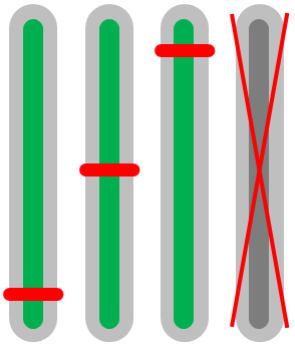


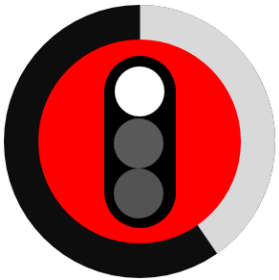




Conclusions

- TRS information is
  - from a corner of the eye / a glance,
  - adequately clear,
  - unambiguous,
  - applicable
  - can be presented with minimal distraction
- Behavior of drivers can be influenced
- It is possible to direct behavior (policy)
- Information can however also motivate adverse effects
  - Therefore provide only
    - under certain conditions,
    - within certain boundaries and
    - in most basic form: <u>less is more</u>





Conclusions

Green wave

- Desire to get/stay in green wave
- Willing to adapt speed to get / stay in green wave
- Directing behavior in favor of policy / traffic flow possible

Waiting time

- Users are aware of remaining waiting time: shot, long, very long
- Directing attention to traffic at the right is possible.

Reduction of negative effects possible

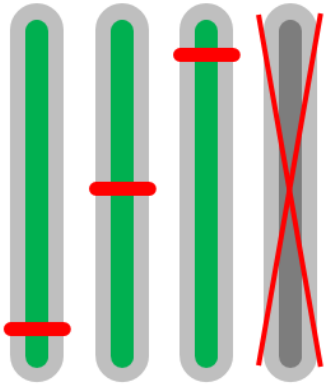
- Take away triggers that require attention or call for action
- Provide notifications in case of speeding
- Minimizing distraction possible by using correct communication channels.

General recommendations

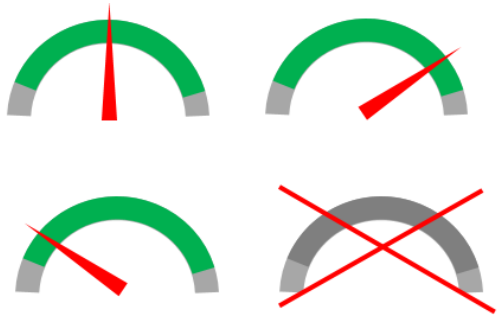
- Ask as littlte attention as possible
  - Only relative, visual information
    - No numbers
    - No earcons
    - No spoken advice
- Before launching applications:
  - Validate effects of design on group of people
  - Roll out to beta testers for first feedback
  - Iteration based on feedback from test panel and beta testers
- Work together on finding the optimal solution

Recommendations green wave

- **Only show indication when:**
  - There truly is a green wave present
  - Destination is known
  - No extreme slow driving is required
  - No speeding is required
    (If the user does: show speeding indication)
  - Else; clearly show that there is no green wave present.
    (Binairy depiction)

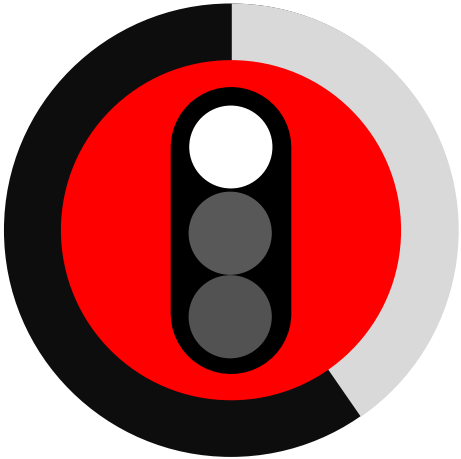


- **Depicting information**
  - Large
  - Relative position or speed (no numbers)
  - Visible at a glance / Corner of the eye
  - Do not show absolut start of green wave
    (Keep margin for real life TRS to confirm
  - Clear relation between vehicle(speed) and green wave



Recommendations waiting time

- Only show information **relevant** for the **specific** situation of the user. Destination known
- Posiibly already show when green wave cannot be met anymore
- Tke away all info 5 seconds before status change
  - Do not trigger a green light in the application (visual or auditive)
- Depicting information
  - Visible and interpretable at a glance / Corner of the eye
  - Large
  - ReRelative (No numbers)
  - Dui Clear relation to subject



Main Question in words and images

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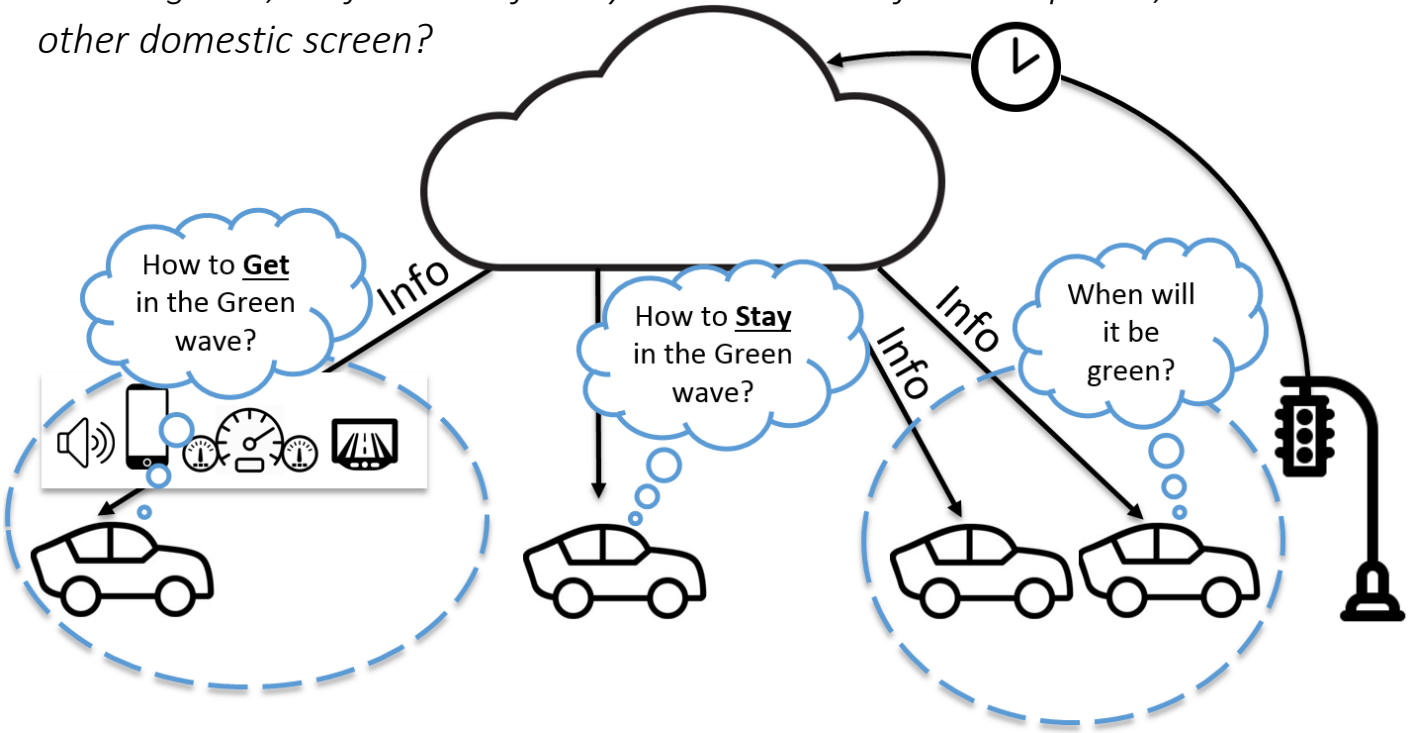

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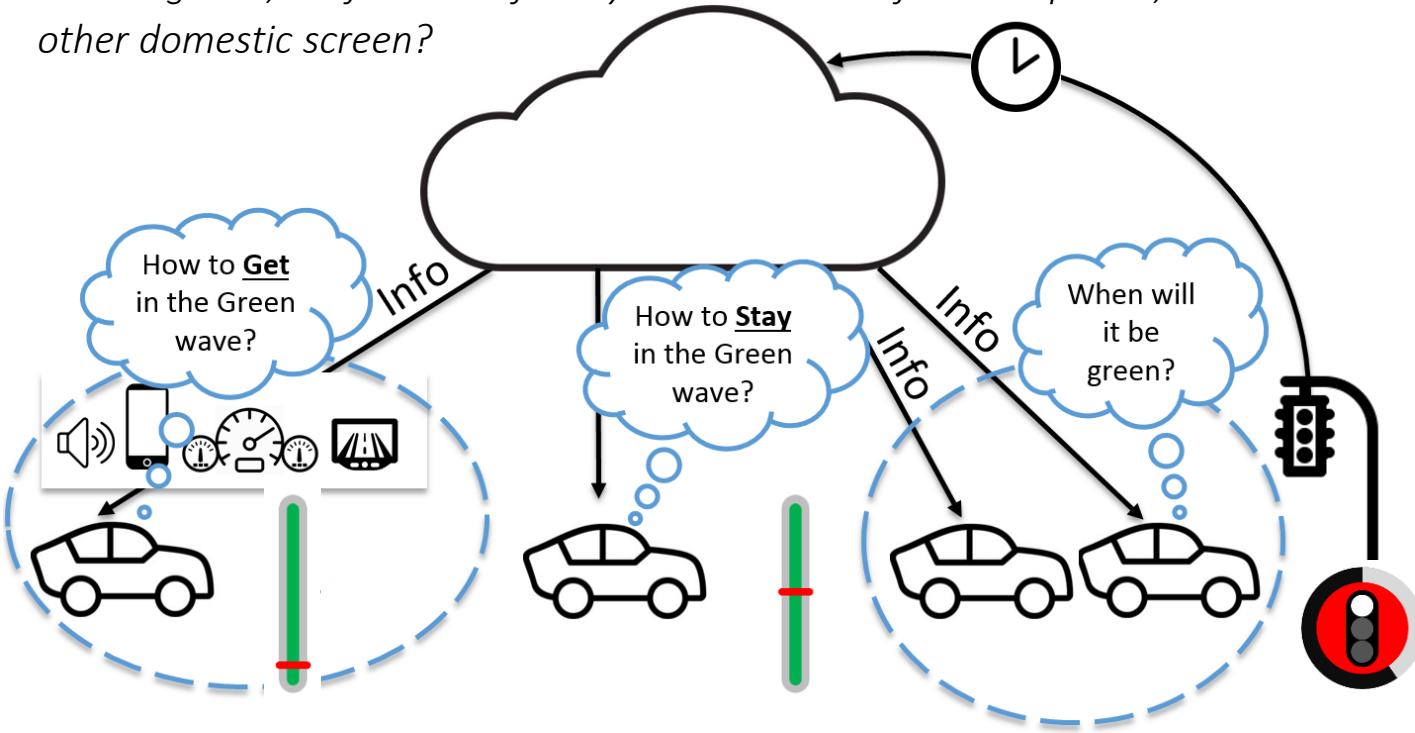

Disclaimer

- Nature of research: Scouting / Initial
  - Results without iteration
  - Limited budget / no large scale research
  - Limited test panel (30)
  - 1e design of HMI
- Simulation
  - Urge for speeding is less suppressed
    - No real danger
    - No G-Forces
    - No tickets

Thank you

Deskresearch: Communication channels

Pros & Cons of channels

Visual 	+ Detailed information transfer possible + “reading” information possible at own pace and with interruption - Can easily be overlooked - Too much and or too busy information distracts + Relatively favourable relation between sense of urgency and irritation
Auditive 	- Detailed information transfer difficult 0 Receiving information not possible at own pace or with interruption + Advantage when used to announce or draw attention + Interrupts attention to other affairs. (positive in case of urgency) 0 Relatively favourable relation between sense of urgency and irritation
Spoken 	- Requires a lot of cognitive attention in case of detailed information - Inconsistent with individual pace, interuption impossible - Required attention has to compete with attention for other affiars 0 Relation between sense of urgency and irritation unknown
Haptic 	- Detailed information transfer difficult + Fast transfer of information due to addressing neuro musculair reflexes 0 Inconsistent with individual pace, interuption impossible + Advantage when used to draw attention - Haptic signals provide risk for startle response or irritation