

Measuring the distraction of alternative list-scrolling techniques when using touchscreen displays in vehicles.

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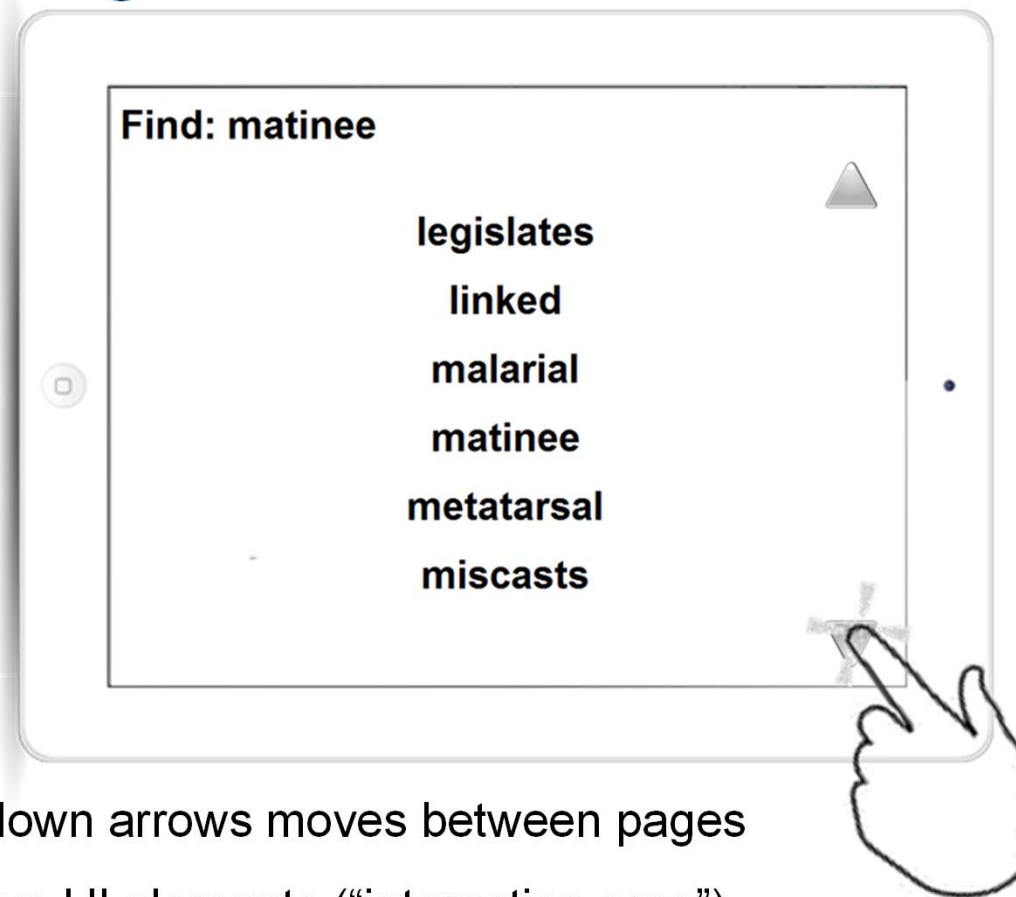
Touchscreens in Vehicles: Pros & Cons

- Pros:
 - Allow presentation of large amount of info.
 - Presentation is dynamic (e.g. traffic updates)
 - Familiar interface
- Cons:
 - No/limited tactile feedback
 - Require high visual demand
 - Features & interaction techniques don't necessarily transfer from non-automotive domain
 - Anthropometric issues (e.g. different location, different hand)
 - Secondary task (divided attention; precise movements)

Aims of Study:

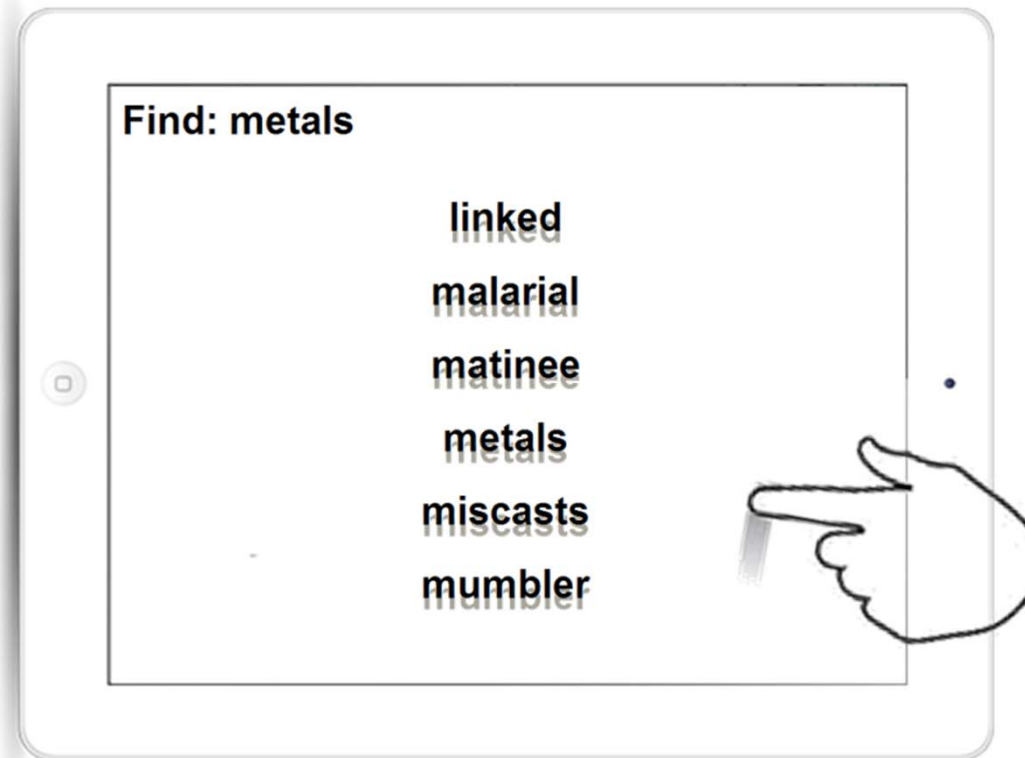
- To investigate relative impact of using 3 existing list-browsing techniques in context of driving:
 - Page-By-Page
 - Flick-Scroll
 - Page-Swipe
- One-dimensional, structured, vertical lists only
- Familiar techniques – extensive training given prior to experiment

Page-By-Page



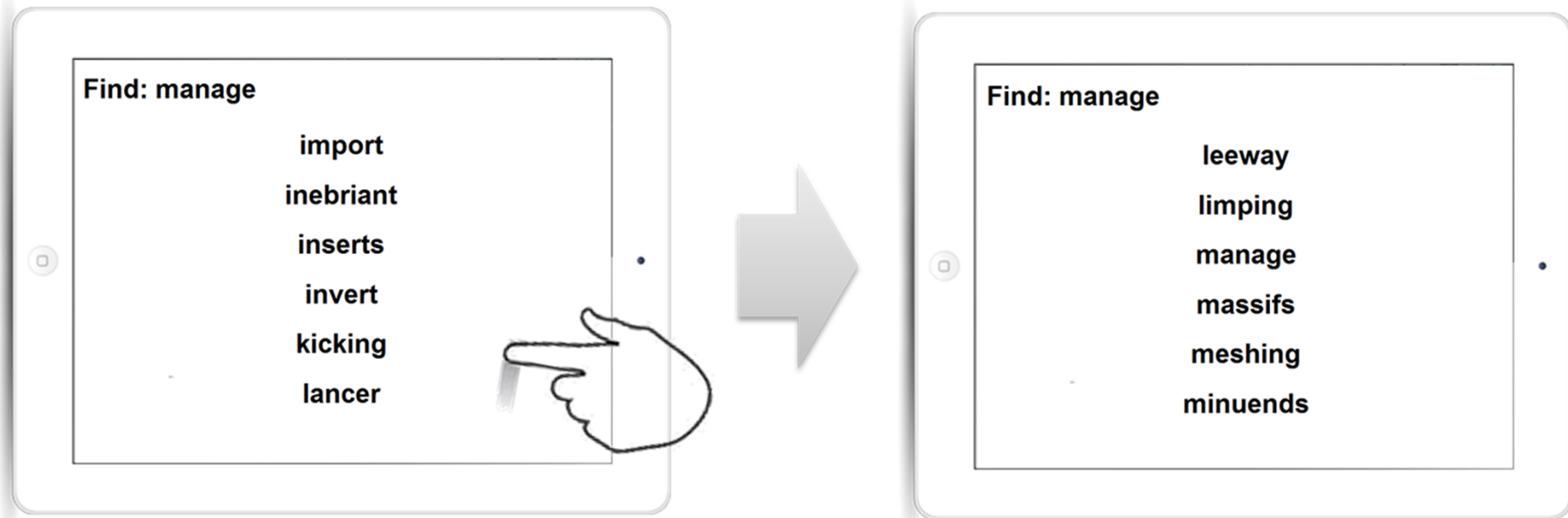
- Touching up and down arrows moves between pages
- Small, distinct active UI elements (“interaction area”)
- Information presented in discreet ‘chunks’

Flick-Scroll



- Flicking finger scrolls through list
- Large, general active UI element (entire screen)
- Information presented dependent on size and speed of finger movement

Page-Swipe



- Sliding or flicking finger moves through list page by page
- Large, general active UI element (entire screen)
- Information presented in discreet 'chunks'

Experimental Set-up



- Medium fidelity, fixed base simulator
- STISIM Drive software
- Primary Task: Follow lead vehicle
- SMI Eye Tracking Glasses (ETG)
- iPad 2

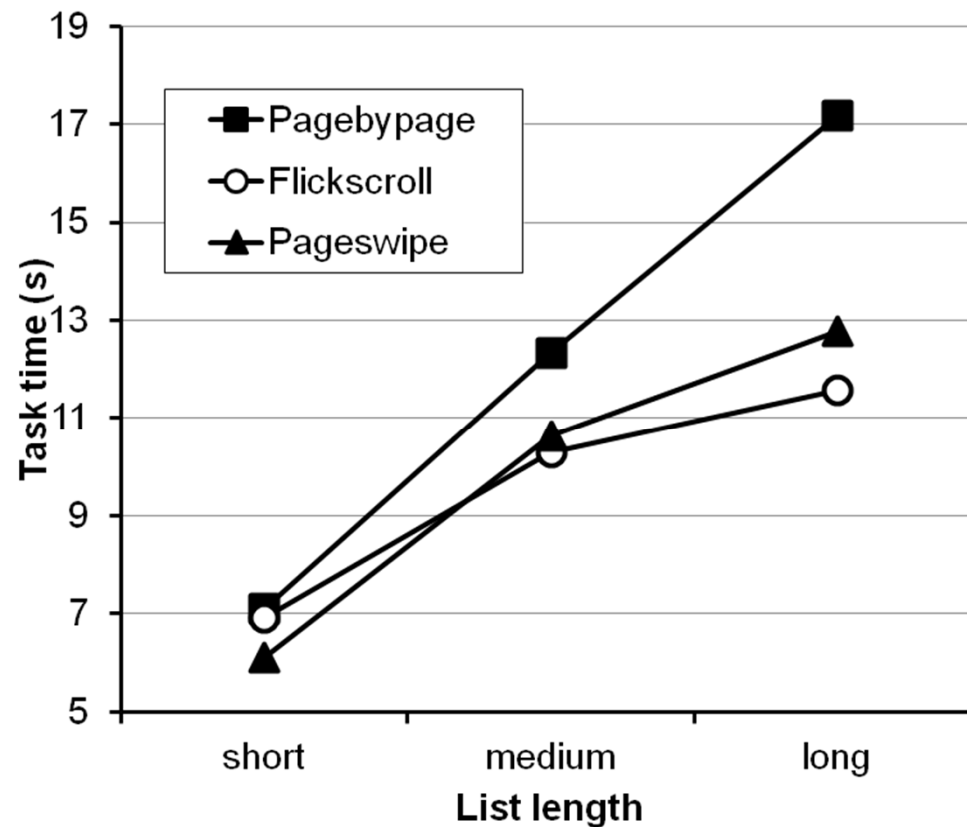
Design

- IVs:
 - Technique (page-by-page; flick-scroll; page-swipe)
 - List Length (short, medium, long)
- DVs:
 - Task Completion Time
 - Eye-tracking measures (mean off-road glance duration; number of off-road glances)
 - Driving measures (mean and s.d. speed, lateral position, headway to lead vehicle)
 - Preference measures before & after driving

Hypothesis

- Page-swipe technique requires less precise interaction, and provides predictable delivery of information, which should reduce demands on visual attention. So, compared with the other techniques, PS will lead to:
 - Shorter task completion times
 - Shorter, fewer off-road glances
 - Lower speed, less variation in speed, lateral position & headway
- Benefits of page-swipe over other techniques will be greater for longer lists.

Results: Task Completion Time

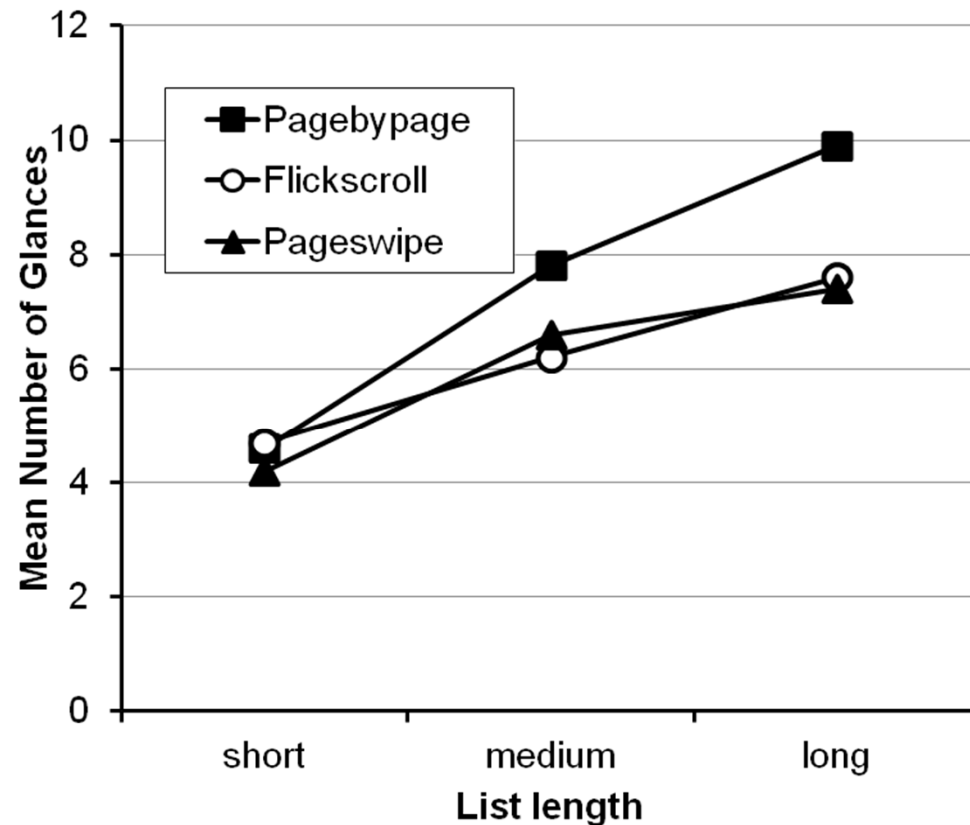


- Slower with page-by-page than other techniques ($F_{(2,30)} = 10.03$; $p < 0.001$).

- TCT increased with list length ($F_{(2,30)} = 100.58$; $p < 0.001$).

- Interaction ($F_{(4,60)} = 2.93$; $p < 0.05$): Cost of using page-by-page greater for longer lists.

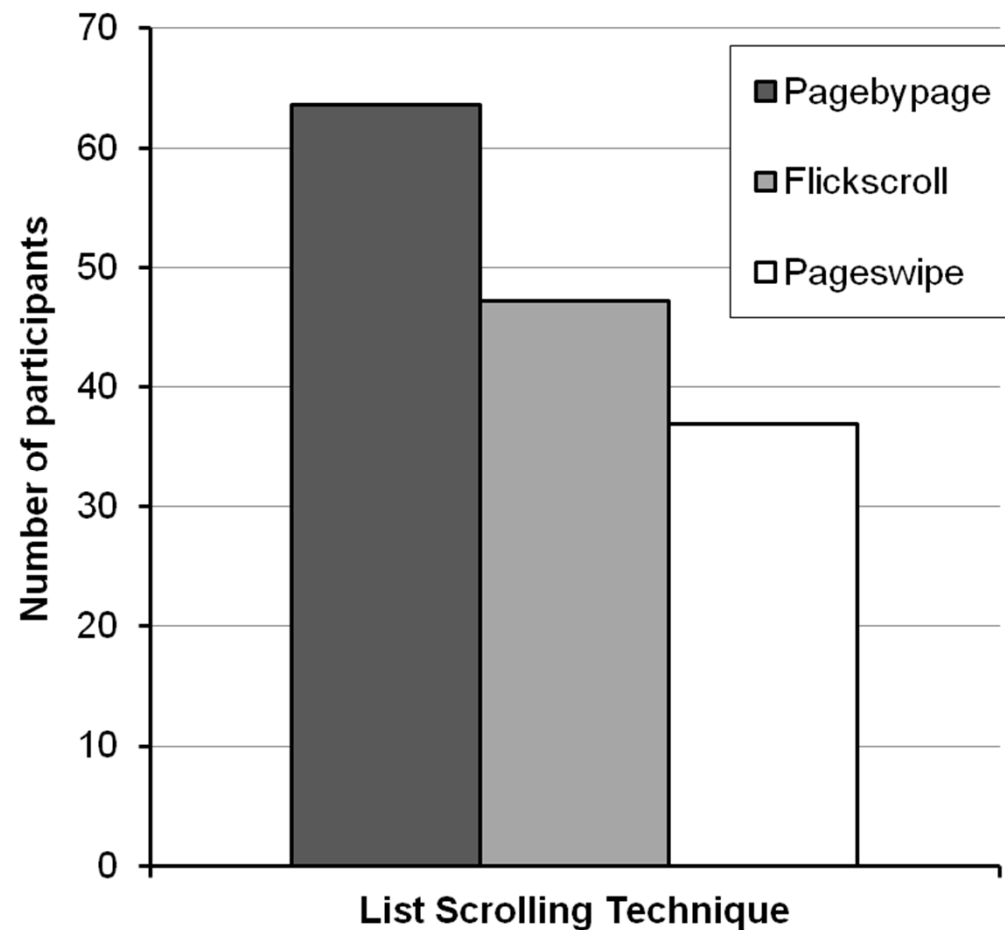
Off-Road Glances



- Mean off-road glance duration greater for short lists (1.4s) than medium (1.1s) or long lists (1.1s) – longer glances at beginning/end of task?
- Number of glances: Significant interaction ($F_{(4,60)} = 2.65$; $p < 0.05$). Page-by-page produced more off-road glances, but only for long lists.

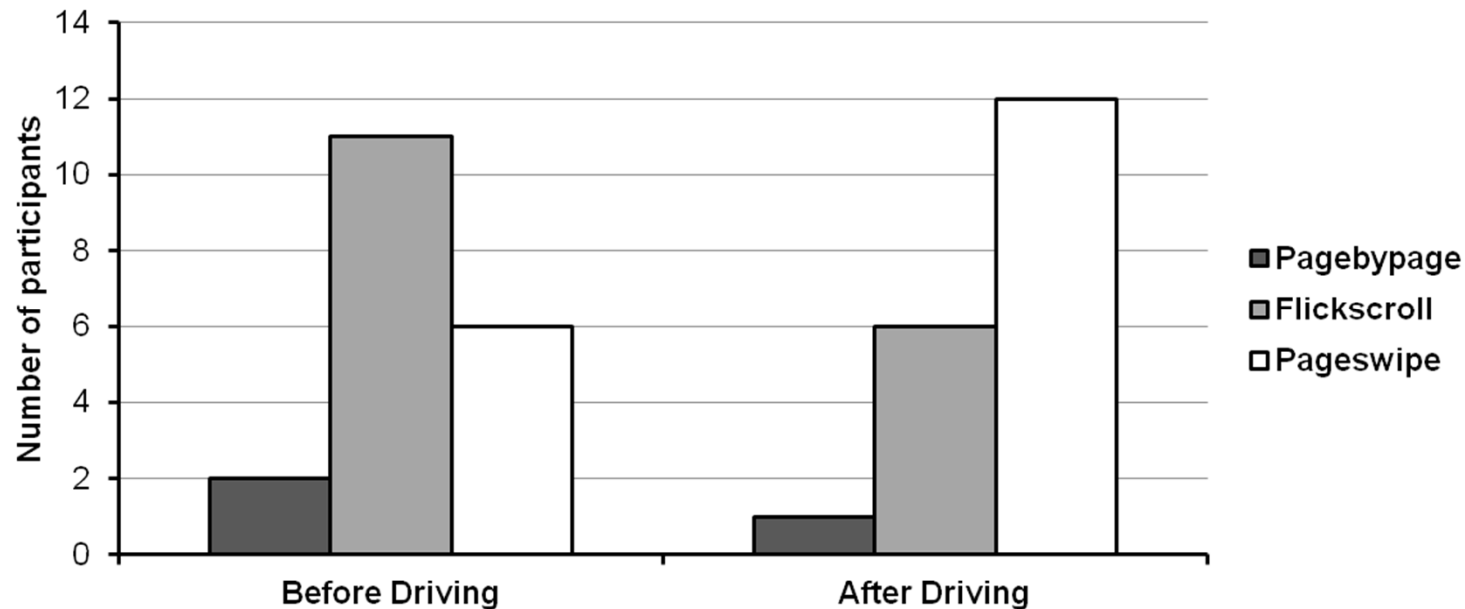
Driving Measures

- Main effect of technique on standard deviation of headway ($F_{(2,30)} = 6.89$; $p < 0.01$): Page-by-page produced greater variation in headway than page-swipe ($p < 0.01$). Other differences approached significance ($p = 0.05$)



Subjective Ratings

- Before driving: Flick-scroll preferred to Page-by-Page ($p < 0.05$).
- After driving: Page-swipe preferred to Page-by-Page ($p < 0.05$).



- After driving, participants preferred the Page-swipe technique as it was “easiest to use” and “distracted them least” while driving.

Conclusions

- Page-by-page least appropriate for driving
 - More off-road glances
 - Greater variability of headway
 - Least preferred
- Negligible differences between flick-scroll and page-swipe, in terms of objective measures.
 - Flick-scroll: Build up momentum (short/no glances?), then fine-tune (long and/or frequent glances?).
 - Page-swipe: Consistent pace
- Participants indicated preference for page-swipe after driving, despite indicating preference for flick-scroll before drive.



- All 3 techniques necessitated glances > 2 seconds (see NHTSA 2006 guidelines).
- Considerable care should be taken regarding the unsolicited transfer of interactive touchscreen technology from a sedentary to an automotive context!