Map Design: A Simulator Evaluation of the Factors Affecting the Time to Read Electronic Navigation Displays

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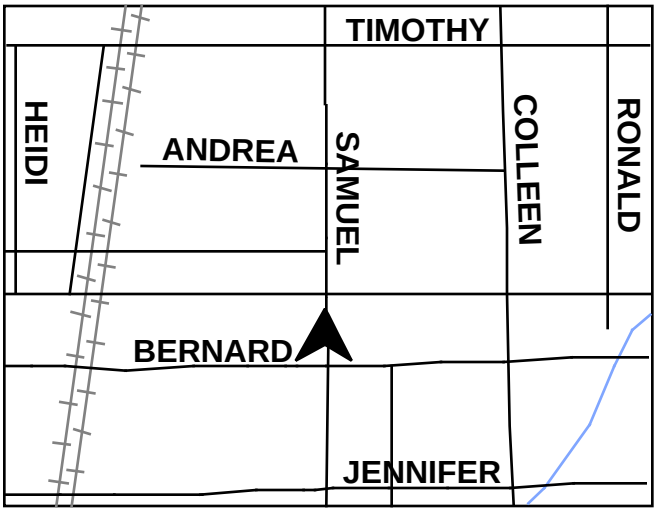
1 ISSUES

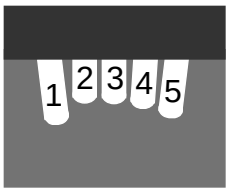
1. How many streets should appear on an in-vehicle navigation system?
2. How many streets should be labeled on an in-vehicle navigation system?
3. What size text should be used for the street labels?
4. What is the effect of display location on map-reading time?

2 MAP TASKS

Sample Map



Keypad Responses



Note: only necessary response keys were visible during each task

Task 1 - On-Street
2 = male
3 = female

Task 2 - Cross Street
1 = not there
2 = male
3 = female
4 = not labeled

Task 3 - Where is?
1 = not there
2 = ahead
3 = behind
4 = left
5 = right

Task 1 - On Street

What street are you on?
Subject Finds: Samuel
Subject Responds: male (**2** key)

Task 2 - Cross Street

What is the 3rd Cross Street?
Subject Finds: Andrea
Responds: female (**3** key)

What is the 6th Cross Street?
Subject Finds: only 4 streets
Responds: not there (**1** key)

What is the 1st Cross Street?
Subject Finds: no name
Responds: not labeled (**4** key)

Task 3 - Where is?

Where is Timothy?
Response: ahead (**2** key)

Where is Jennifer?
Response: behind (**3** key)

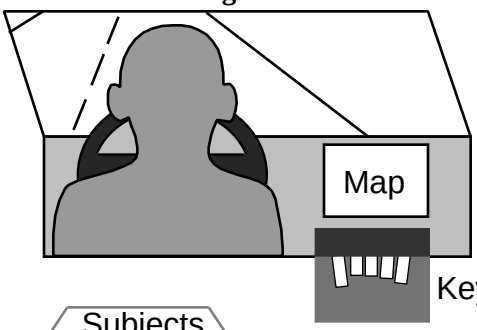
Where is Heidi?
Response: left (**4** key)

Where is Ronald?
Response: right (**5** key)

Where is Douglas?
Response: not there (**1** key)

3 METHOD

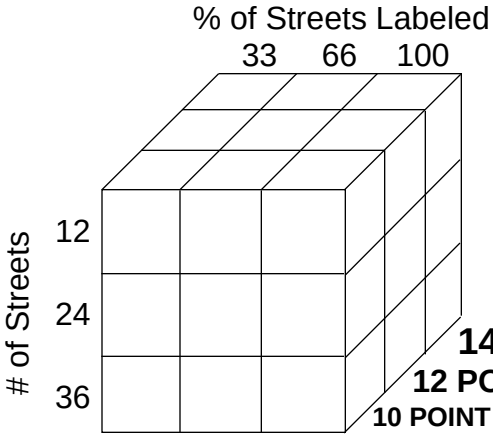
Simulator Driving Scenario



Subjects

	Young	Older
Men	**5**	**5**
Women	**5**	**5**

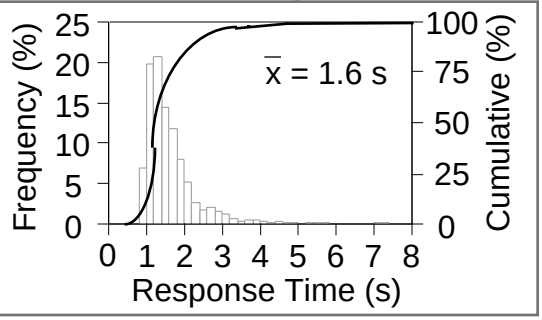
Main Test Conditons



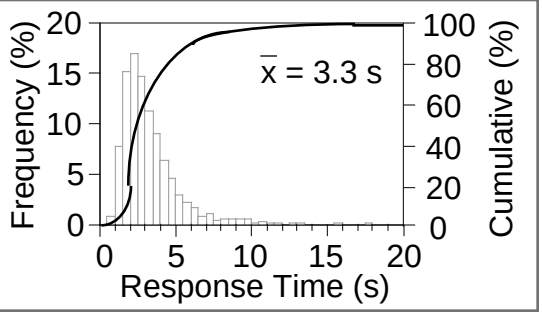
4 RESULTS & CONCLUSIONS

Response Times & Error Rates

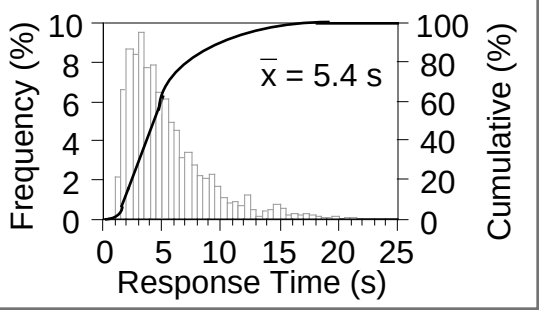
Task 1 - On Street



Task 2 - Cross Street

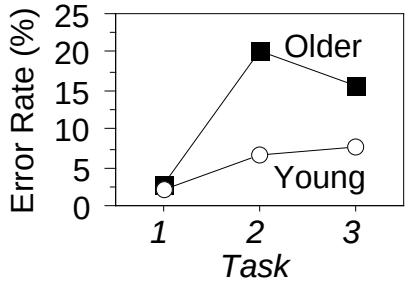


Task 3 - Where is?



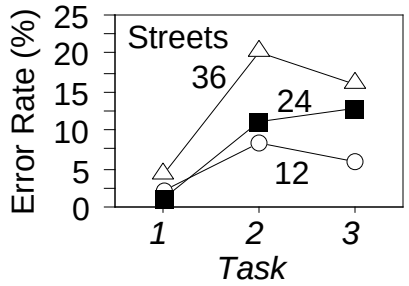
Task Differences

1. Age Effect



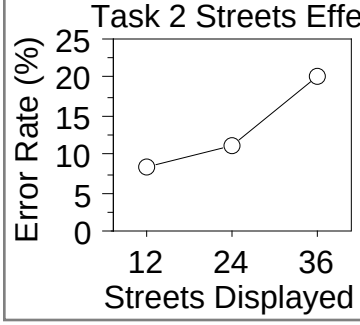
Large age differences

2. Number of Streets Effect



Task changes magnitude of streets effect

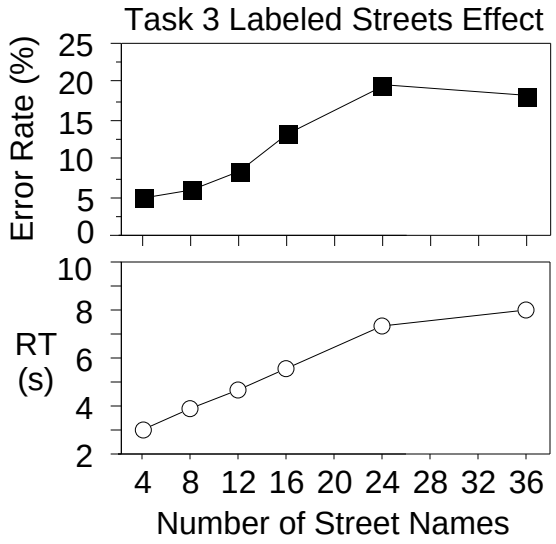
Issue 1 - How many streets to display?



Recommendation:

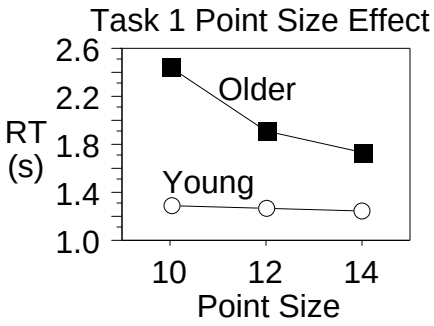
Display ≤ 24 Streets

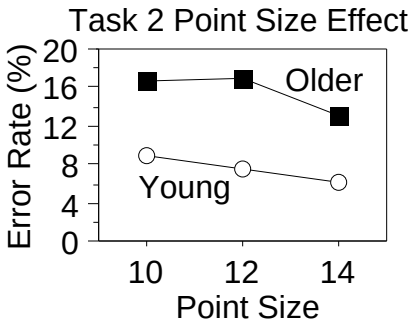
Issue 2 - How many streets to label?



Recommendation: **Display ≤ 12 Labeled Streets**

Issue 3 - What size text to use?

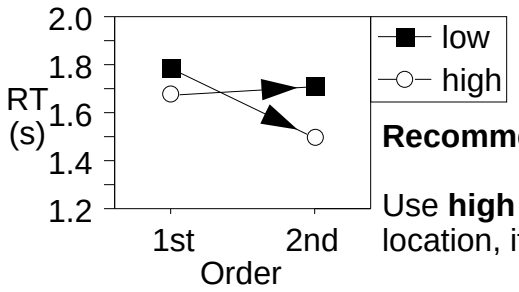




Recommendations:

1. Do **not** use < 12 point.
2. If map is not cluttered, **Use 14 point**

Issue 4 - Display Location effects



Recommendation:

Use **high** display location, if possible

Response Time Regression Equations (ms)

Task 1 - On-Street	RT = 2563 + 381∗(A) + 8∗(S) - 94∗(P) + 88∗(12 - P)∗(A) + 4∗(A + 1)∗(S - 12)∗$\left(\frac{1}{11-P}\right)$
Task 2 - Cross Street	RT = 82 + 582∗(A) + 61∗(S) + 523∗(X) + 19∗(Abs|X - 4|)∗(24 - S)
Task 3 - Where is?	RT = [2305 + 1137∗(A) + 75∗(S) - 81∗(P) + 24∗(PL) + 551∗(L) + (S - 22)∗(PL - 55)] ∗ SR

Terms for Regression Equations

A = Age { -1 if Young; +1 if Older

S = Number of Streets (S ≥ 1)

P = Point Size (10 ≤ P ≤14)

X = Target Cross Street (X ≥ 1)

PL = Percent of Streets Labeled (1≤ PL ≤ 100)

SR = Search Result { 1.0 if found; $\left(\frac{\#\text{names}}{3+0.5*(\#\text{names})}\right)$ if not found

L = Target Location { -1 for ahead; 0 for behind, or not there; +1 for side