

The Impact of Typeface Design in a Text-Rich Automotive User Interface on Driver Distraction

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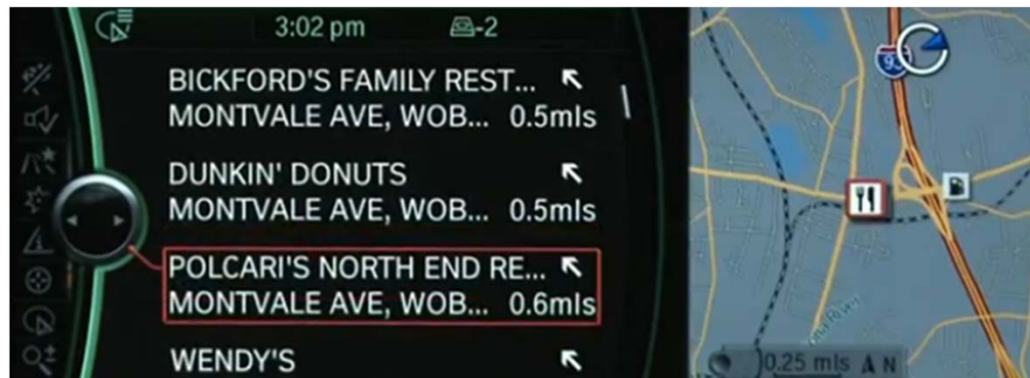
Driver Distraction & Inattention
Gothenburg, Sweden
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Background – Text in Vehicles

Historically

- Limited Text
- Fixed Positions – easy memorized



Now

- Growing Text
- Display Screens present changing text context
- Navigation Screens & Point of Interest Listings

Research Question

- Embedded reading
- Electronic screens
- Previous research
 - Clearview® typeface
 - Standards ISO 15008:2009
 - O'Day, S., & Tijerina, L. (2011). Legibility: Back to the Basics. SAE

Can the right
TYPEFACE
reduce
driver
distraction?



What makes a typeface legible?

Size: Capitals vs. Larger x-heights

Hf foxg Hf foxg

What makes text legible?

SHAPE

shape

What makes a typeface legible?

What typeface attributes aid legibility?

a c

dnco

g9

00

a c

dnco

g9

00

Open shapes

Ample
intercharacter
spacing

Unambiguous
forms

Varying
proportions

Top – Square Grotesque design | Bottom – Humanist design

Typeface Choices

Sq. Grotesque (“Eurostile”)

- Very popular and widely used in many existing UIs
- Highly-assimilated forms challenge “at a glance” legibility

acegos
BCDGORS
036589

Humanist (“Frutiger”)

- Open letterforms and loose spacing enhance legibility

acegos
BCDGORS
036589

Apples to Apples

Equivalent letter heights based on the capital letter “H” in line with ISO5008 standards for defining automotive font sizes:

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz

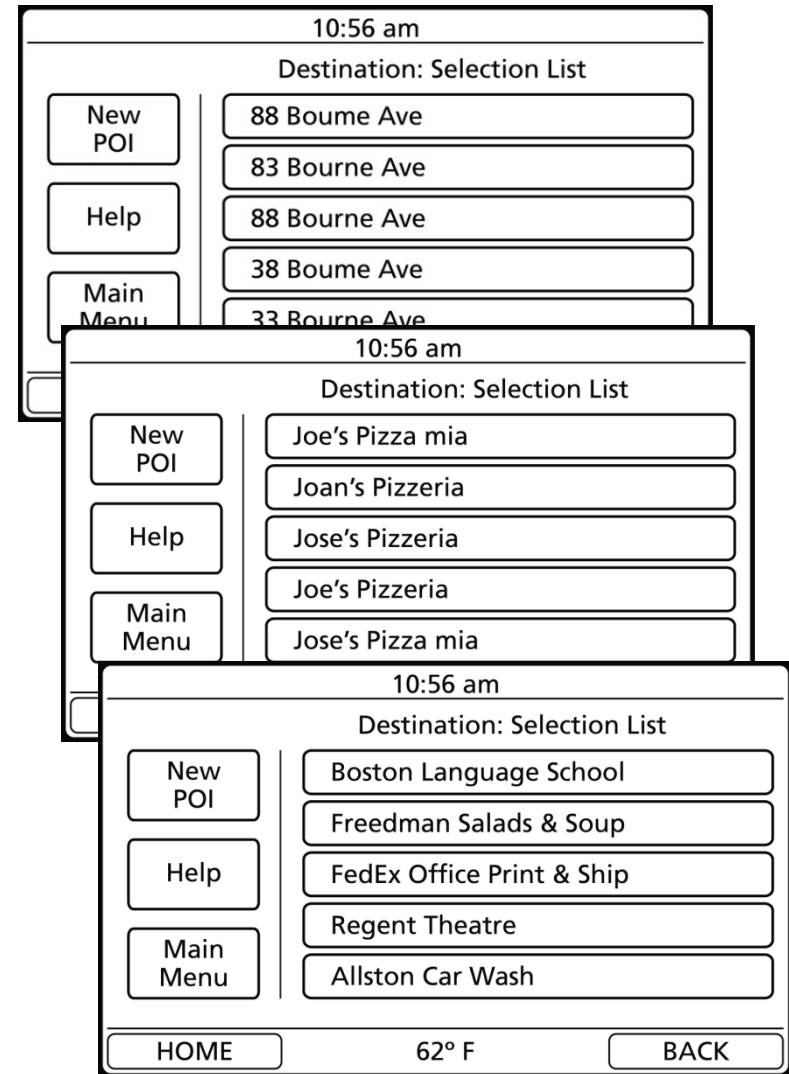
Square Grotesque

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz

Humanist

Experiment Setup

- List-based search task with three menu types (5 each)
 - Address selections
 - Restaurant selections
 - Content search
- Each menu type is presented in random order using either a “humanist” or “square grotesque” typeface genre
- Physical text size was 4 mm at the screen surface (19.6 arch minutes at driver’s distance from screen)



Task Structure

- Task was initiated with instructions
 - Instructions are presented in all uppercase to prevent word shape carryover
- Ends with response
 - Task responses are designed to minimize word shapes differences to prevent simple visual search responses and increase cognitive demand
- The self-paced experiment
 - Driver controls the start and end times of the responses

Please Select:

88 BOURNE AVE

START



10:56 am

Destination: Selection List

New POI	88 Boume Ave
	83 Bourne Ave
Help	88 Bourne Ave
	38 Boume Ave
Main Menu	33 Bourne Ave

HOME 62° F BACK

Simulator Setup



Driver Sample Statistics

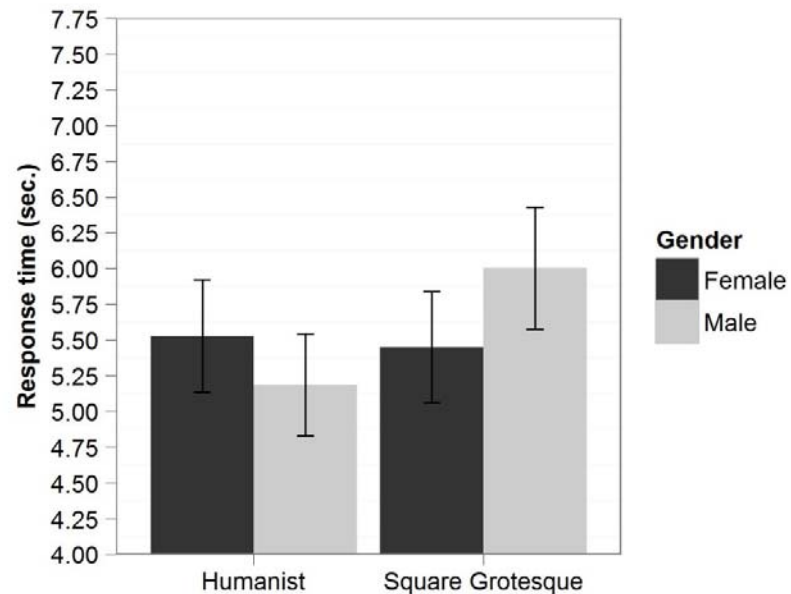
- Active, experienced drivers (3+ years), in self-reported good health
- 36 to 75 years old, 50/50 males and females, fluent English speakers (mean age approx. 55; SD approx. 11.5)
- No statistical differences in age or visual acuity (Snellen Eye Chart) by gender
 - » Study 1: 42 participants
 - » Study 2: 40 participants
- In addition to base compensation , a incentive was offered for secondary task performance, with monetary penalties for unsafe driving.

Key Experimental Aspects

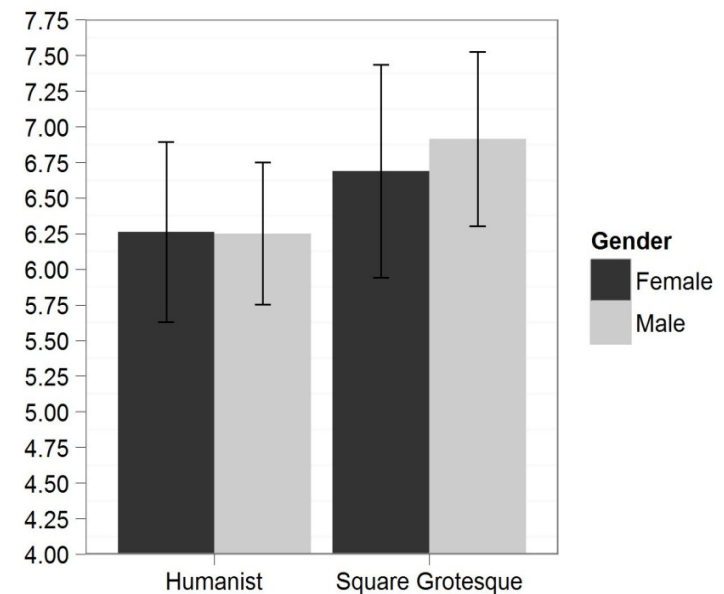
- Driving simulator
- Repeated exposure to menus – 15 each with each typeface
- Constant viewing conditions and text size
- Typeface designs scaled to match capital heights
- Study 1 and Study 2 differed only in display brightness and overall scene contrast
 - Brightness of display in study 2 was adjusted to match the ambient light intensity and projection screen brightness

Task Response Time

Study 1



Study 2

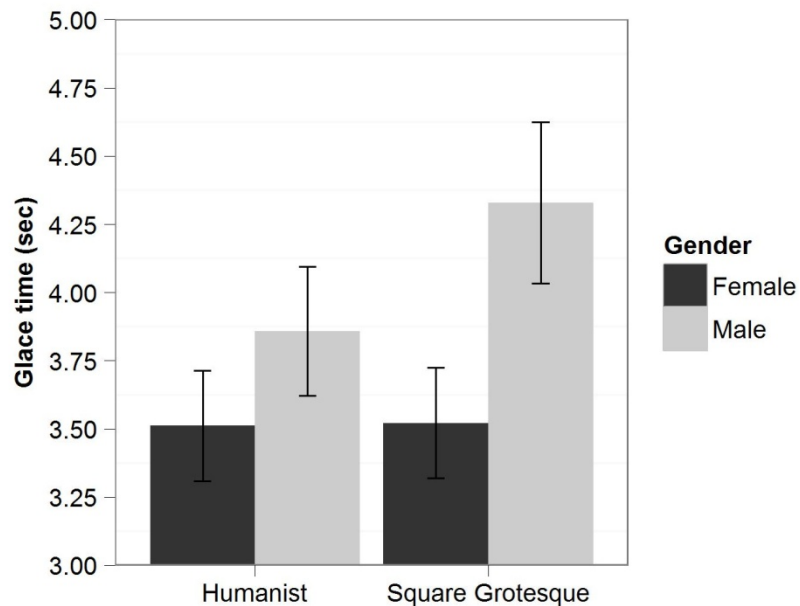


Across both studies:

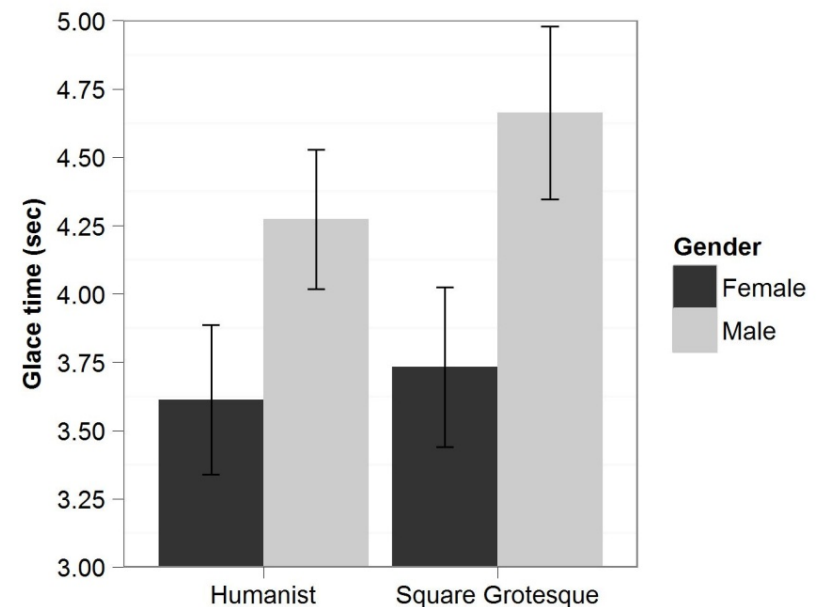
7.8% faster for Humanist than Square Grotesque (men 13.0%; women 2.7%)

Glance Time

Study 1



Study 2

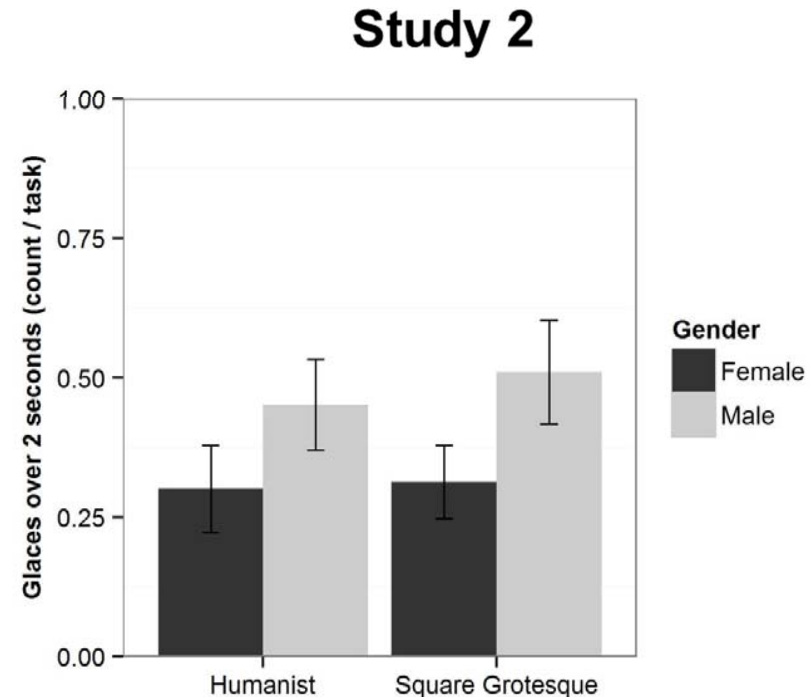
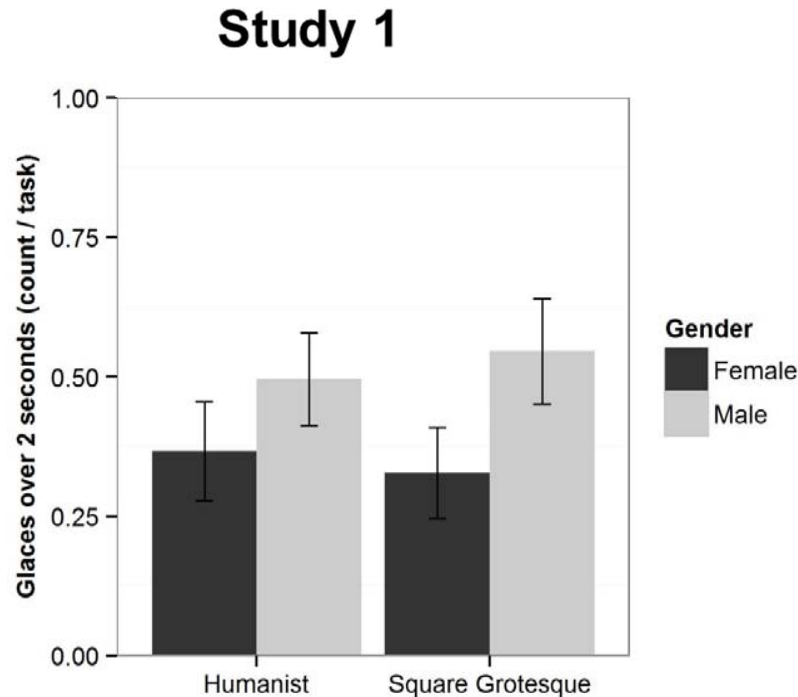


Across both studies:

Glances shorter duration (6.4% lower with Humanist versus Square Grotesque)

Effect is *most evident in men* (**10.6% for men versus 1.7% for women**)

Long Duration Glances (2 sec.)



Across both studies:

Nominal effect of typeface design appears on long duration glances

Key Takeaways

- Typeface design can make a significant difference
 - Reducing glance duration, error rates, total task time
 - Simple and effective way to achieve significant reduction for men
- Results are robust and repeatable
 - Actionable *now* – OEMS, suppliers, government / standards bodies
- Apparent gender differences, to the best of our knowledge, novel and were unexpected
 - Points to complexity of factors involved in interface optimization

A Delicate Balance

Brand

Legibility



For general information on AgeLab: <http://agelab.mit.edu/>

On this presentation: Bruce Mehler – bmehler@mit.edu

On Monotypes' work on typeface in automobiles: www.monotype.com

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