Screen Scaling

Effect of Screen Scale on Selection Tasks with Moving Targets

Graeme Browning
Robert J. Teather
McMaster University

Problem: It is difficult to design games that run well across multiple platforms because of the large variety of screen sizes and display types.

We examine the effect of screen scaling on selection task throughput to understand the basics of how games can be made to scale easily between screen sizes. We investigate both static and moving targets to understand what additional scale-related issues arise in a more complex game setting.

Approach to studying screen scale:

The ISO 9241-9 standard methodology for evaluating pointing devices.

- Study Fitts' Law target selection tasks
- Use the same set of *ID* values on different screen sizes
- Compare target throughput between screen sizes

Four screen scales were compared

- For each scale, the task window size was reduced within the display
- A black border filled the rest of the display
- Mouse CD gain was constant across scales (based on the display size)

Large (15.6 in.)   Medium (11.7 in.)   Small (7.8 in.)   Extra Small (3.9 in.)
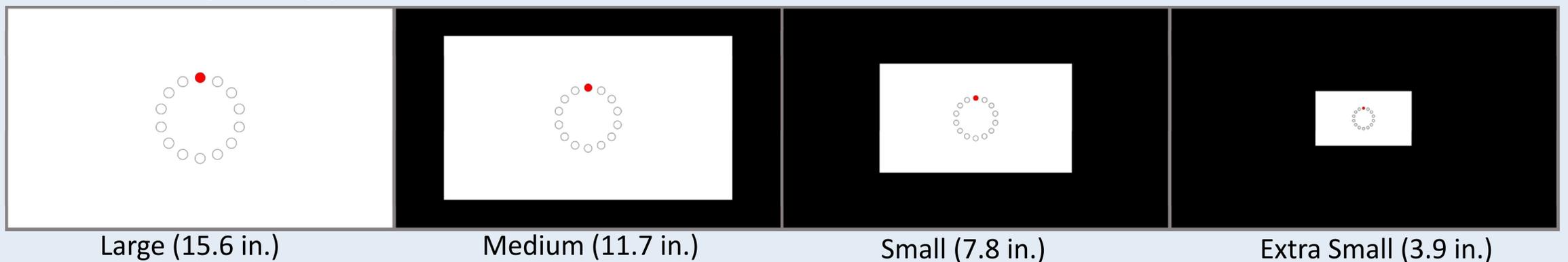
Static and Moving targets: Two selection tasks were tested at each scale level
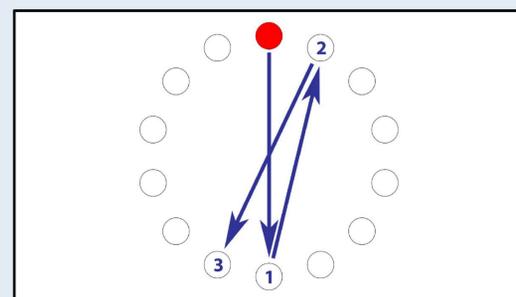

FittsCircle: Multi-direction tapping task. The participant had to select the red highlighted target using the cursor. Upon clicking, the next circle highlighted. Ordering of targets is shown.

MovingTarget: Reciprocal tapping task with moving targets. Targets appear at the bottom of screen, and move upward at constant speed. When selected, the next target would appear offset by a horizontal distance (used to calculate ID)
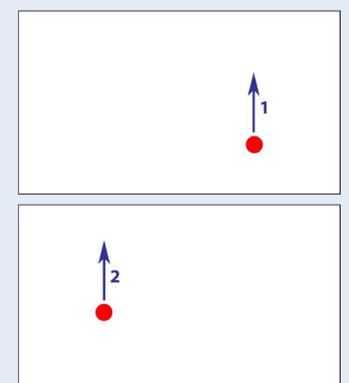
Result: Both small screen size and target movement negatively impacted performance, and the performance difference between static and moving targets was lower on small screen sizes.
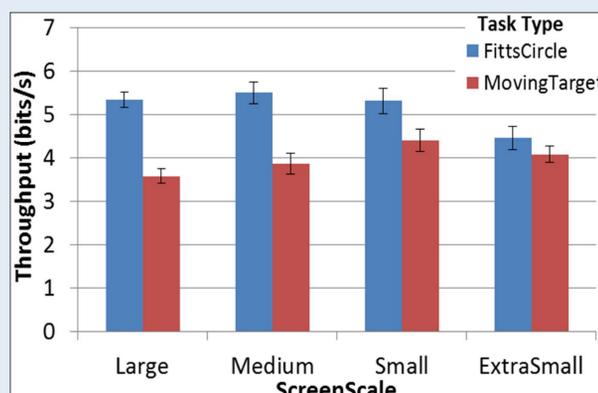
Throughput

- Extra small screen scale has significantly lower throughput than medium
- Throughput is significantly higher with the FittsCircle task than the MovingTarget task
- The difference in throughput between task types is significantly reduced on smaller screen scales. This suggests that target movement hurts performance less on smaller displays

Movement Time

- Regression models were built for each screen scale for the FittsCircle task.
- Only the extra small screen scale has an R^2 lower than 0.9, and a high intercept.

ExtraSmall
$y = 159.05x + 237.34$
$R^2 = 0.8945$

Small
$y = 165.42x + 133.28$
$R^2 = 0.9771$

Medium
$y = 182.55x + 95.551$
$R^2 = 0.9957$

Large
$y = 164x + 162.86$
$R^2 = 0.9759$

McMaster University