Wedge

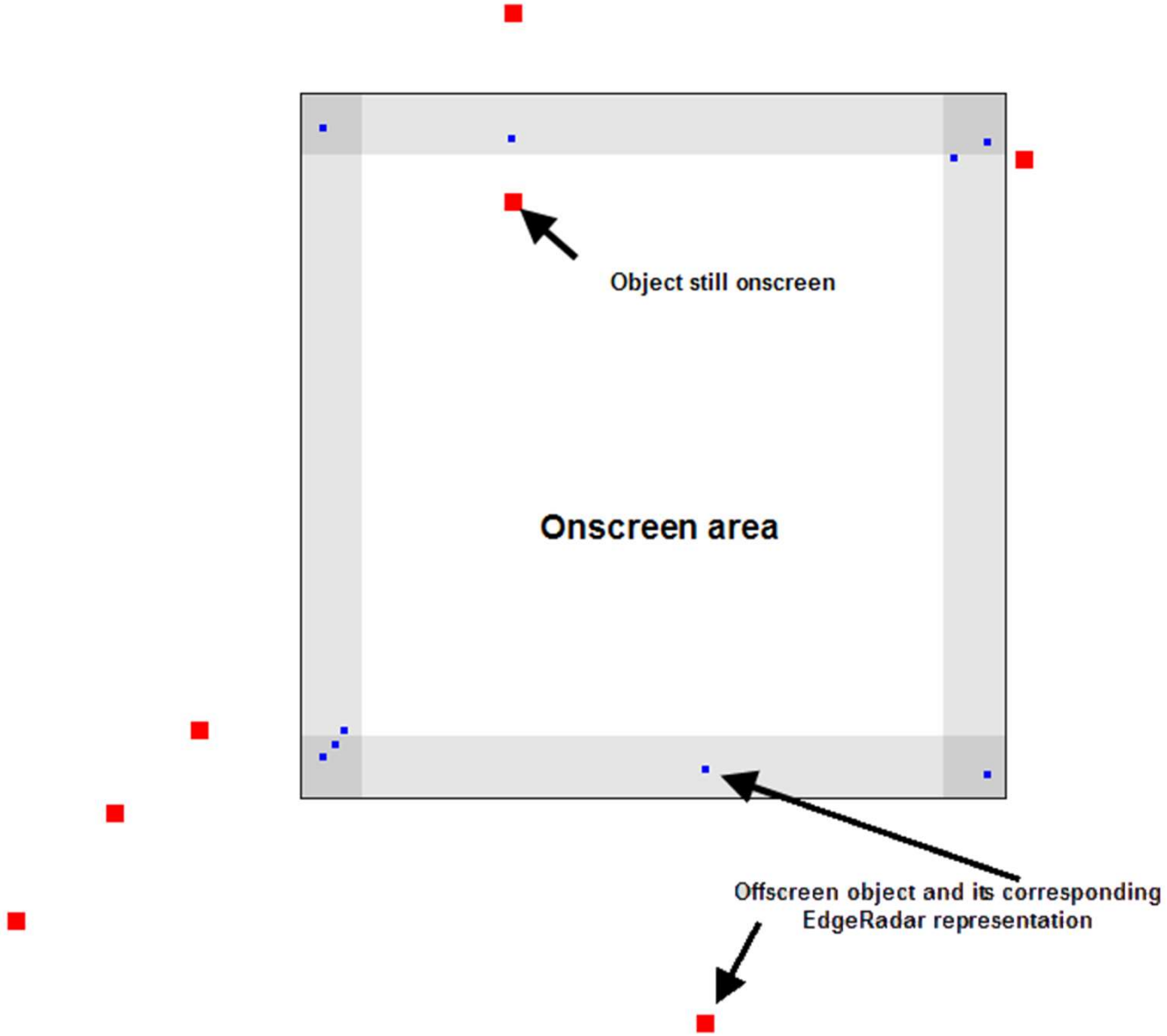
http://patrickbaudisch.com/projects/wedge/

To overcome display limitations of small-screen devices, researchers have proposed techniques that point users to objects located off-screen. Arrow-based techniques such as City Lights convey only direction. Halo conveys direction and distance, but is susceptible to clutter resulting from overlapping halos. We present Wedge, a visualization technique that conveys direction and distance, yet avoids overlap and clutter. Wedge represents each off-screen location using an acute isosceles triangle: the tip coincides with the off-screen locations, and the two corners are located on- screen. A wedge conveys location awareness primarily by means of its two legs pointing towards the target. Wedges avoid overlap programmatically by repelling each other, causing them to rotate until overlap is resolved. As a result, wedges can be applied to numbers and configurations of targets that would lead to clutter if visualized using halos. We report on a user study comparing Wedge and Halo for three off-screen tasks. Participants were significantly more accurate when using Wedge than when using Halo.

Related Work

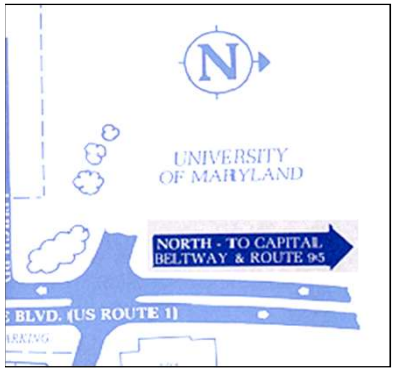
- Edgeradar
- Arrows
- City lights
- Halo

edgeradar



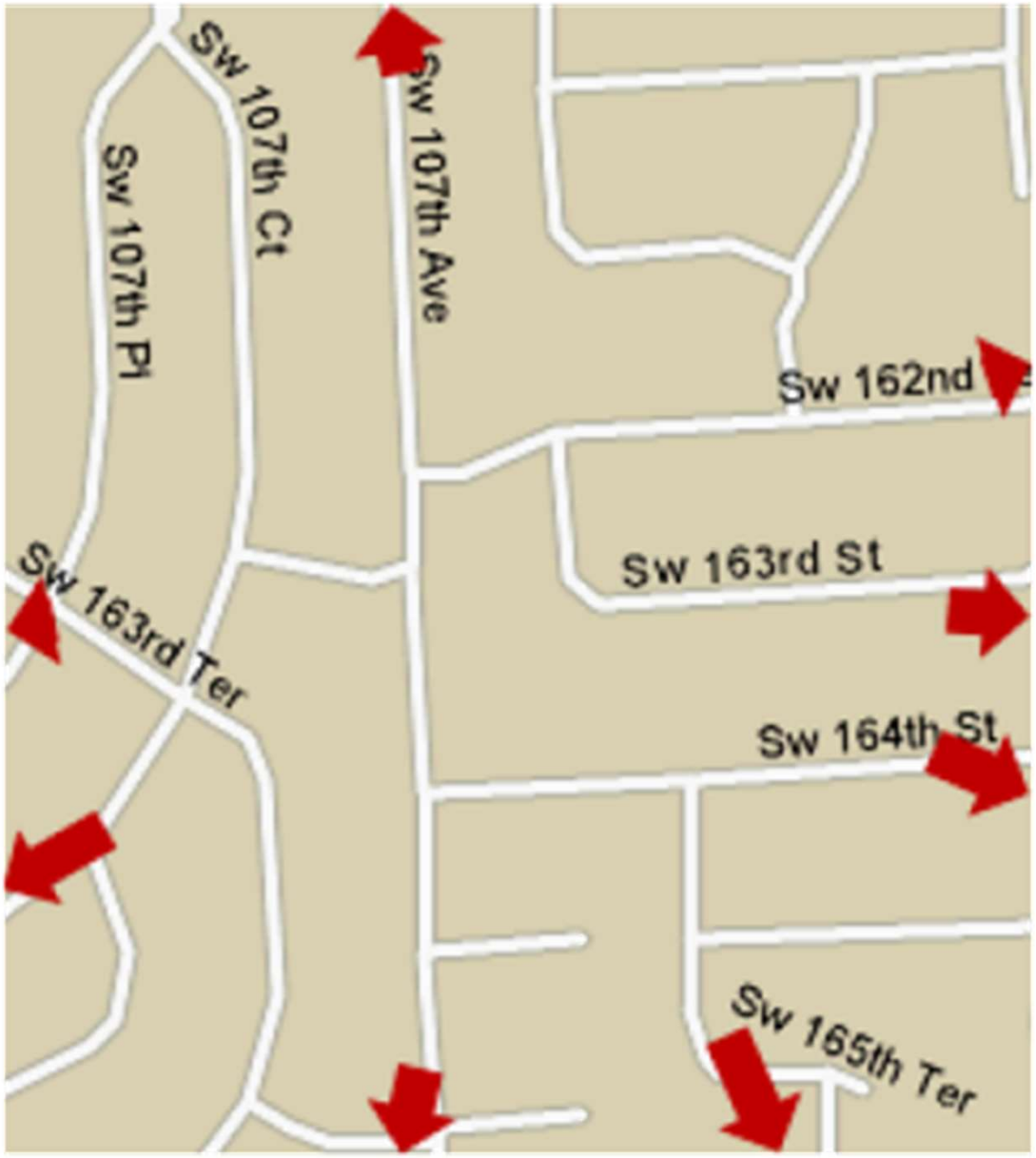
[Gustafson 07]

simple arrows



[Tecmo Bowl 87]

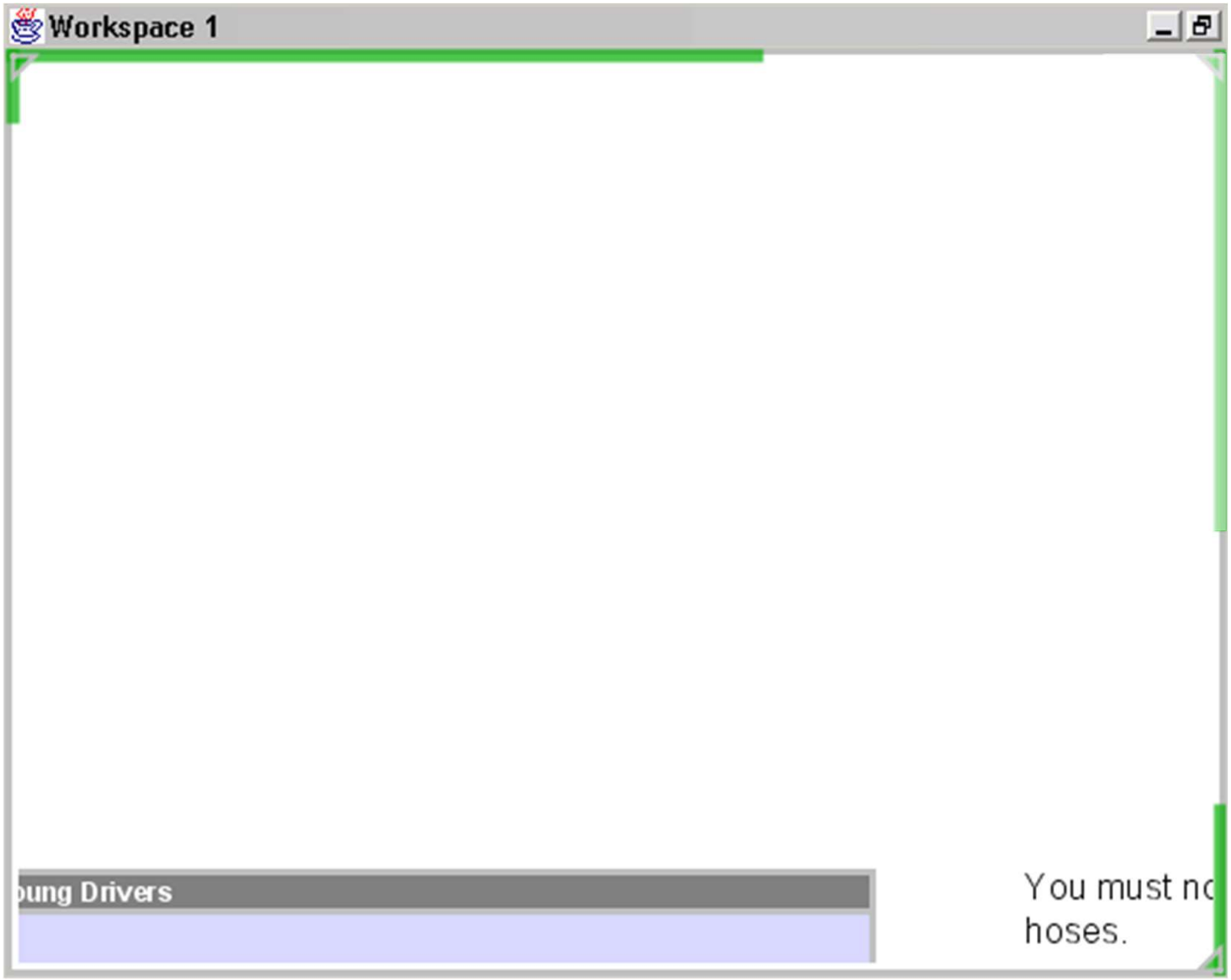
scaled and stretched arrows



[Burigat 06]

city lights

"space-efficient fisheye technique"



[Mackinlay 03]

halo

[Baudisch 03]

Related Work

- Edgeradar
- Arrows
- City lights
- Halo
- Problem with halo:
  - Clutter and corners


COMPAQ
iPAQ
pocket pc
Virginia St
Walnut St
Shattuck Ave
Grant St
Delaware St
University Ave
Berkeley
Addison St
Martin Luther King Jr Memorial Park
McGee Ave
Roosevelt Ave
Jefferson Ave
Bancroft Way
Harold Way
Milvia St
Haste St
Durant Ave

Evaluation

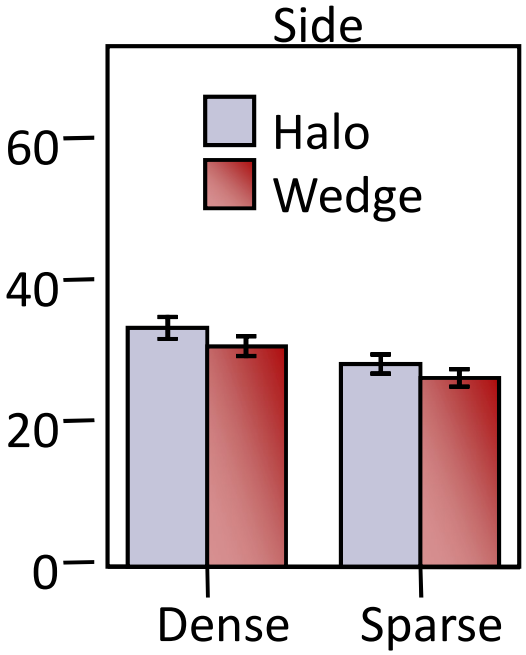
- 18 subjects, with 2 removed because of high error rate
  - Note: This is OK …
- Three tasks:
  - Locate: Click off-screen where you think the target is
  - Avoid: Traffic jams are indicated and you need to click the hospital furthest from traffic jams
  - Closest: Click on halo/wedge corresponding to closest off-screen location

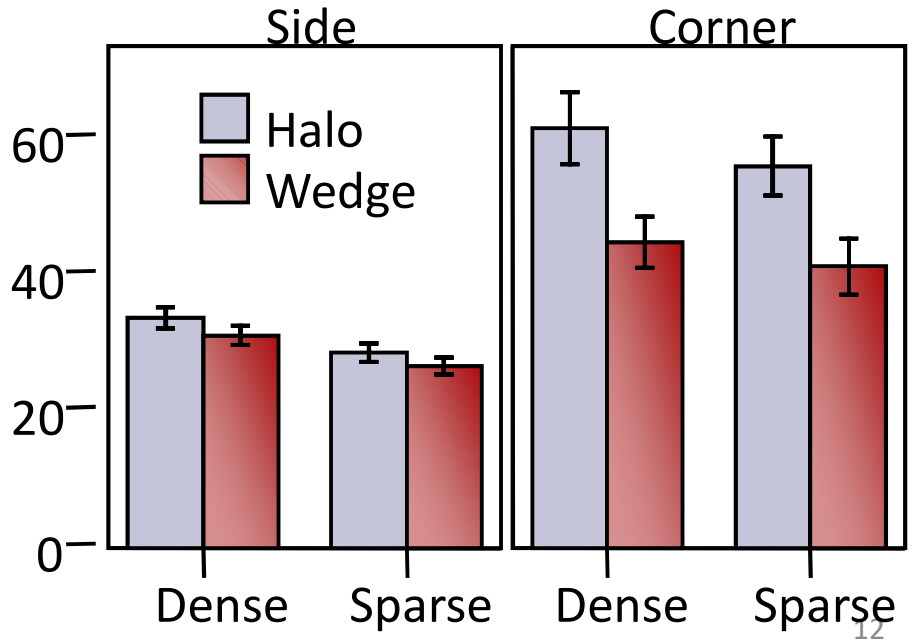
Hypotheses

- **Wedge is more accurate**
- Larger improvement in dense condition
- **Larger improvement in corners**
  - (no hypothesis about task time)

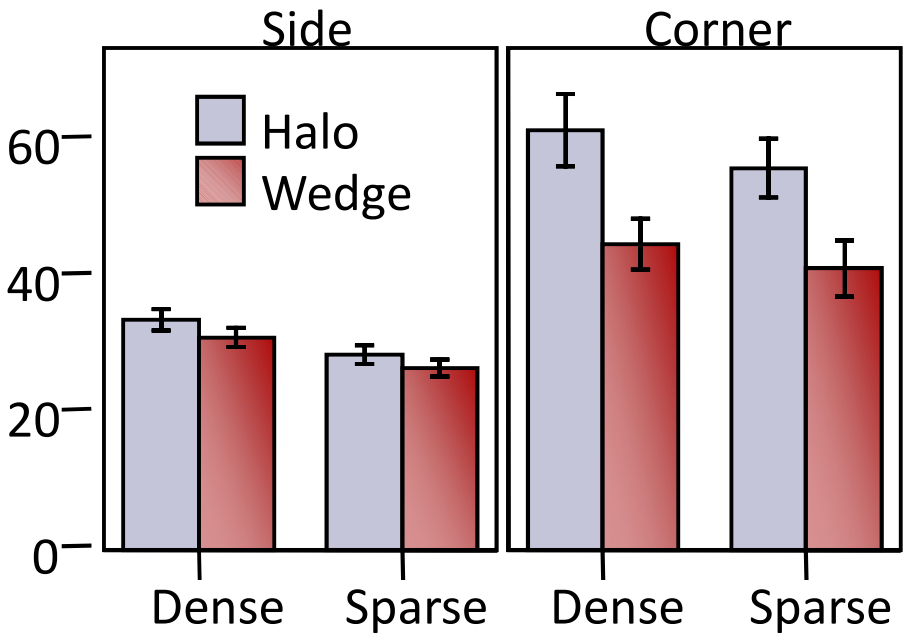
Results

- No significant difference in task time
- Participants were significantly more accurate when using the wedge





Locate Task



As can be seen from Figure 11 larger errors were seen in corner trials (mean 51 pixels) than in side trials (mean 30 pixels). There were also larger errors in dense configurations (mean 43) than sparse configurations (mean 38). The overall difference between visualizations was about 10 pixels (Halo mean 45.3 pixels; Wedge mean 35.6 pixels).

In addition, there was a significant interaction between Visualization and Position ($F_{1,15}=15.36$, $p=0.001$). As shown in Figure 11, the difference between visualization types is considerably larger in corners than on the sides of the screen, which supports our hypothesis that the reduced space in corners causes additional problems for Halo interpretation. There was no interaction between Visualization and Density ($F_{1,15}=0.67$, $p=0.43$).

Additional Results

Avoid:

Figure 13 shows error rates for the different visualizations, densities, and positions. A 2x2x2 ANOVA did not show any effects of Visualization ($F_{1,15}=2.55$, $p=0.13$), Position ($F_{1,15}=2.38$, $p=0.14$), or Density ($F_{1,15}=0.58$, $p=0.46$). In addition, there were no interactions between any factors.

A 2x2x2 ANOVA showed no effects of any of the three factors on task completion time (Visualization $F_{1,15}=0.18$, $p=0.68$; Density $F_{1,15}=2.09$, $p=0.17$; Position $F_{1,15}=1.58$, $p=0.23$), and no interactions between any factors.

Closest

Figure 15 shows error rates for the different visualizations, densities, and positions. A 2x2x2 ANOVA showed significant main effects of Position ($F_{1,15}=76.6$, $p<0.001$)), but not of Visualization ($F_{1,15}=1.24$, $p=0.28$) or Density ($F_{1,15}=0.12$, $p=0.73$). There was a significant interaction between Density and Position ($F_{1,15}=7.33$, $p=0.016$), but no interactions with Visualization.

A 2x2x2 ANOVA showed significant main effects of Position ($F_{1,15}=5.24$, $p=0.037$), but did not show effects of Visualization ($F_{1,15}=0.10$, $p=0.76$) or Density ($F_{1,15}=2.89$, $p=0.11$). There was, however, a significant interaction between Visualization and Density ($F_{1,15}=6.60$, $p=0.021$).

Additional Results

	Wedge	Halo	No Preference
Locate	10	5	1
Avoid	10	5	1
Closest	6	8	2

Table 3: The number of participants who preferred each visualization technique for the three tasks.

Comments made during the trial suggested reasons for the advantages for Wedge over Halo. One user said, “I found that when the rings overlap it is almost impossible to tell which is the right ring. Wedges just seem natural.” And another stated, “overlapping rings made it very confusing at times. Directional wedges helped a lot, and they also seem to take up less space. More information meant less thinking with the wedges.” Participant’s comments also provided some insight into the reasons why Halo was preferred for the Closest task – that the difference between distant and close off-screen objects was easier to determine with Halo, since there is a large visual difference in this case. One participant stated that, “the sizes of the arcs did not require too much calculation or thinking to spot the smallest ring.”

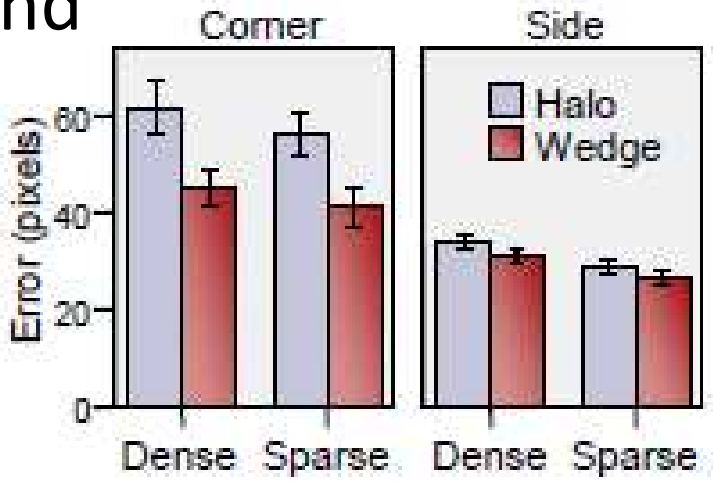
Meta-Level Comments: Experimental Papers

- A lot of techniques + evaluation
- Predictable outline:
  - Problems with existing techniques
  - Rationale for new design
  - Evaluation of new design
    - Usually two or three tasks
  - Discussion and implications

Your thoughts?

My Problem with Wedge

- Read the paper
- For visualization, ONLY LOCATE had significant differences, and ONLY FOR ERROR
- But 2 participants were removed for high error …
- And note that, IMO, visualization is only significant for corners



Second consideration

- Closest completion time was the only other area of significance, and only for interactions
- A 2x2x2 ANOVA showed significant main effects of Position ($F_{1,15}=5.24$, $p=0.037$), but did not show effects of Visualization ($F_{1,15}=0.10$, $p=0.76$) or Density ($F_{1,15}=2.89$, $p=0.11$). There was, however, a significant interaction between Visualization and Density ($F_{1,15}=6.60$, $p=0.021$).

- Problem:
  - Why not explore this interaction as they do for errors in Locate?

Concerning because

Figure 16. Closest task mean completion time. Error bars indicate standard error.

Another problem

- Graphs
  - Kept on showing dense-sparse for Halo-Wedge even when no interactions
  - Particular problem in locate because of interaction between density and position, but not visualization:

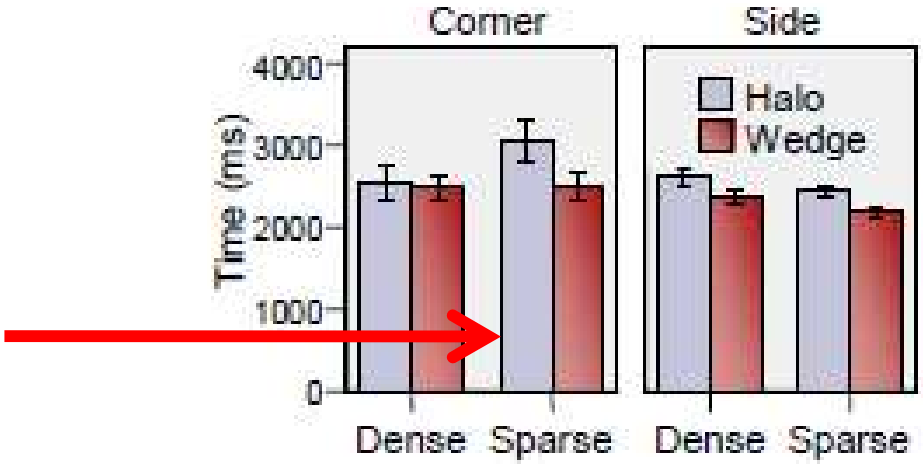


Figure 12. Locate task mean completion time. Error bars indicate standard error.