Multimodal Graphics for Blind and Visually Impaired Students
 NSF Grant 1644538: Perceptual and Implementation Strategies for Knowledge Acquisition of Digital Tactile Graphics for Blind and Visually Impaired Students
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### Motivation
- **Pressing Challenge for Students with Blindness or Visual Impairments:** Graphical Access
  - Traditional Media
  - Digital Media
  - Growing Problem: Educational Content is rapidly moving to digital formats

### Overarching Goal
- Create accessible digital graphics using multimodal feedback on touchscreens
- Useful in interpreting graphs [1], maps [2], grids [3], and for panning and zooming on touchscreens [4][5].

### Linear Line Following
- **Can users follow straight lines on a flat, smooth, touchscreen surface?**
  - Bordered Lines: Highest Accuracy (90%); Smallest Deviation (11-12 mm)
  - Solid Vibration Lines: 81% Accuracy; 14.5 mm Deviation
  - Solid Auditory Lines: 81% Accuracy; 13.5 mm Deviation

### Non-Linear Line Following
- **How to promote more accurate following of curves and deviations in lines?**
  - Auditory Inflection Points:
    - Improved average deviations - 1 point: 7-8 mm; 3 point: 7-9 mm
  - No difference between the 2 cases – User preference is important!

### Shape Identification
- **Can basic shapes be identified [6]?**
  - Identification Accuracy: >78%
  - Pentagon was poor – 47%.
  - Exploration Strategies: Circling of Vertices or Junctions and Anchoring
  - Necessary to signify vertices

### Effect of Screen Size
- **Impact of Screen Size on Simple Pattern Matching Task**
  - Tablet-sized devices more useful in situations where the accuracy of the interpretation of the graphic is important.
  - Phone-sized screens afford comparable accuracy, but are quicker to explore.

### Guidelines and Framework
- Optimal vibrotactile line width: 4 mm
- Gap width between vibrotactile lines: 4 mm
- Borders around lines encourage finer tracing but solid lines are sufficient
- Inflection Points or Points of Interest (Vertices) should be represented with a different cue (ideally a different modality)
- Physical Reference Markers on the Screen Border promote better navigation and enable kinesthetic referencing
- A Read-Aloud Textual Background Description is helpful at the onset of exploration for context

### Acknowledgements
- We acknowledge the National Science Foundation for supporting this work (Grant #1644538).

### References