Detection Radius Modulates Systematic Strategies in Unstructured Haptic Search

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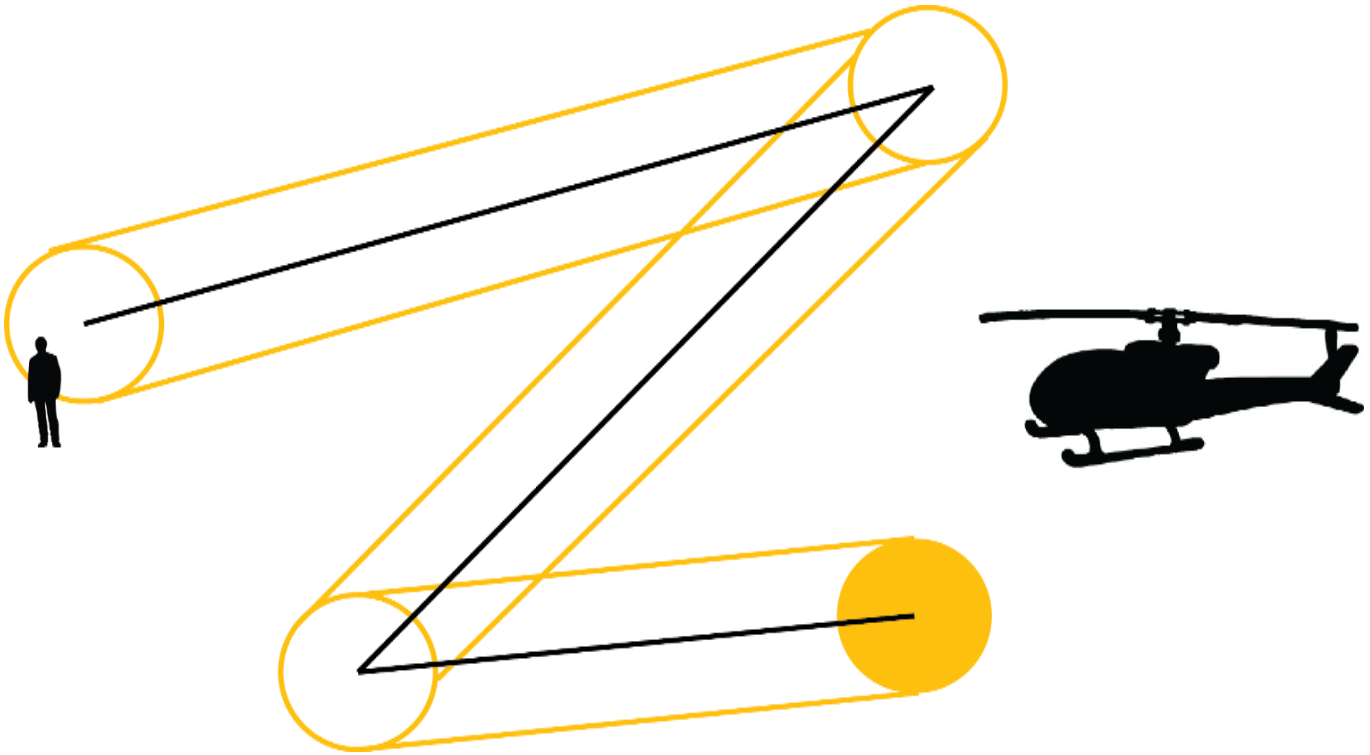
Spoken Notes:
Humans sometimes use systematic movement patterns (such as spirals) when searching for targets on a tactile display without vision.
What I will present in this talk is a framework for thinking about these movements – which is a framework that motivates these movements as optimal.

I will then show you research results that show that hand movements during haptic search are consistent with this framework.

The framework I will be using is search theory, which has been developed in operations research and animal ecology.

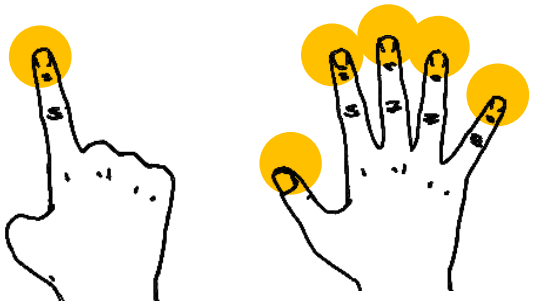
I'm going to start first by talking about search theory: what is a detection radius and what is a systematic strategy, and how they interact. Then, I'm going to talk about the perceptual study.

Detection Radius



Detection Radius

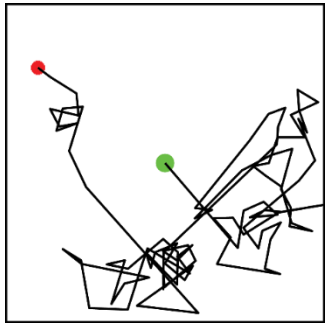
- Light (vision)
- Sound (hearing or sonar)
- Chemical presence (smell)
- Heat
- Pressure and Touch



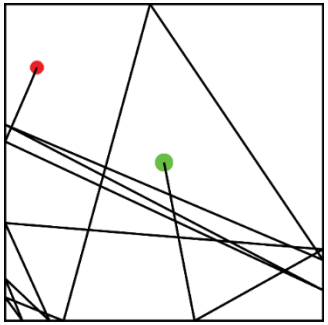
Types of Movement

Random

Brownian

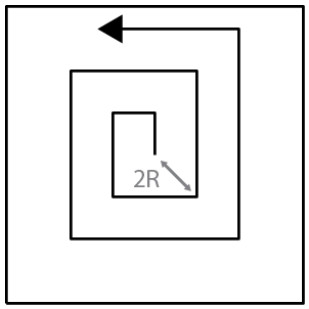


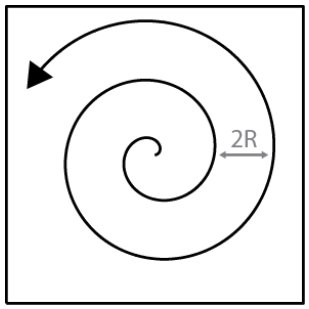
Levy

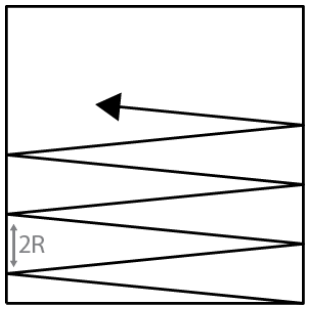


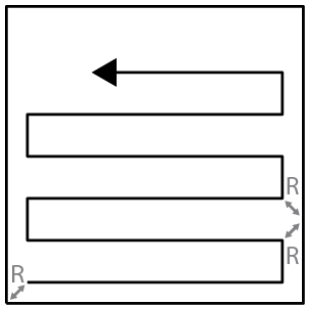
Ballistic

Systematic

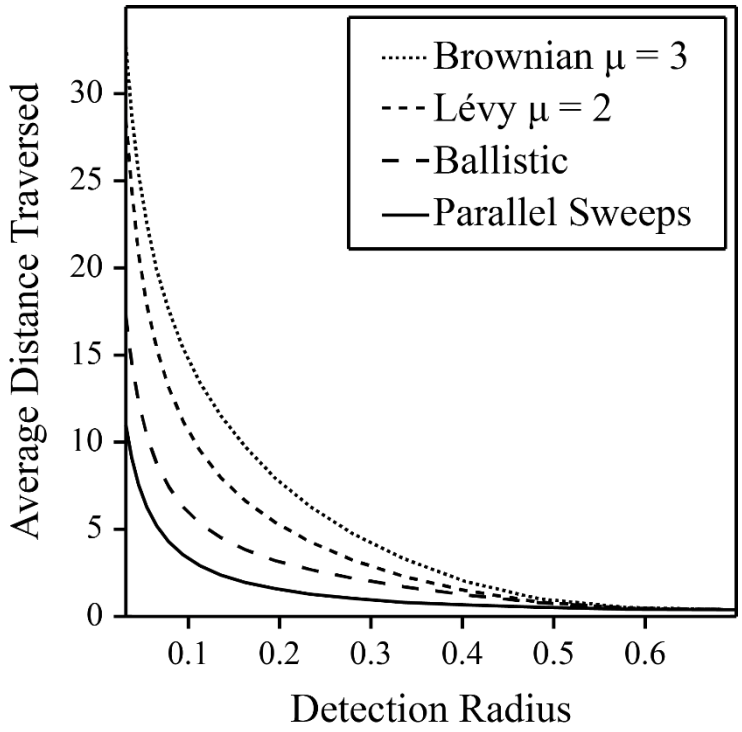


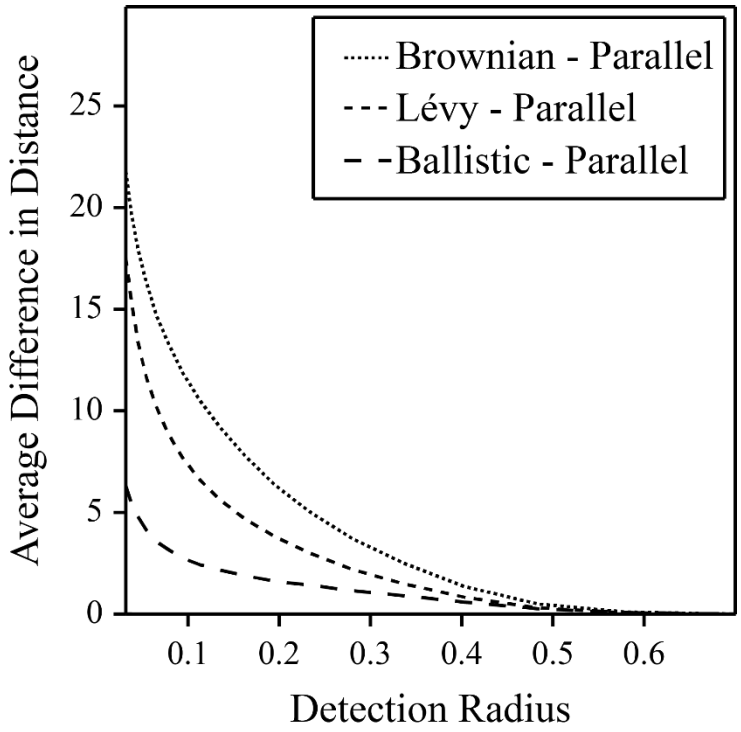




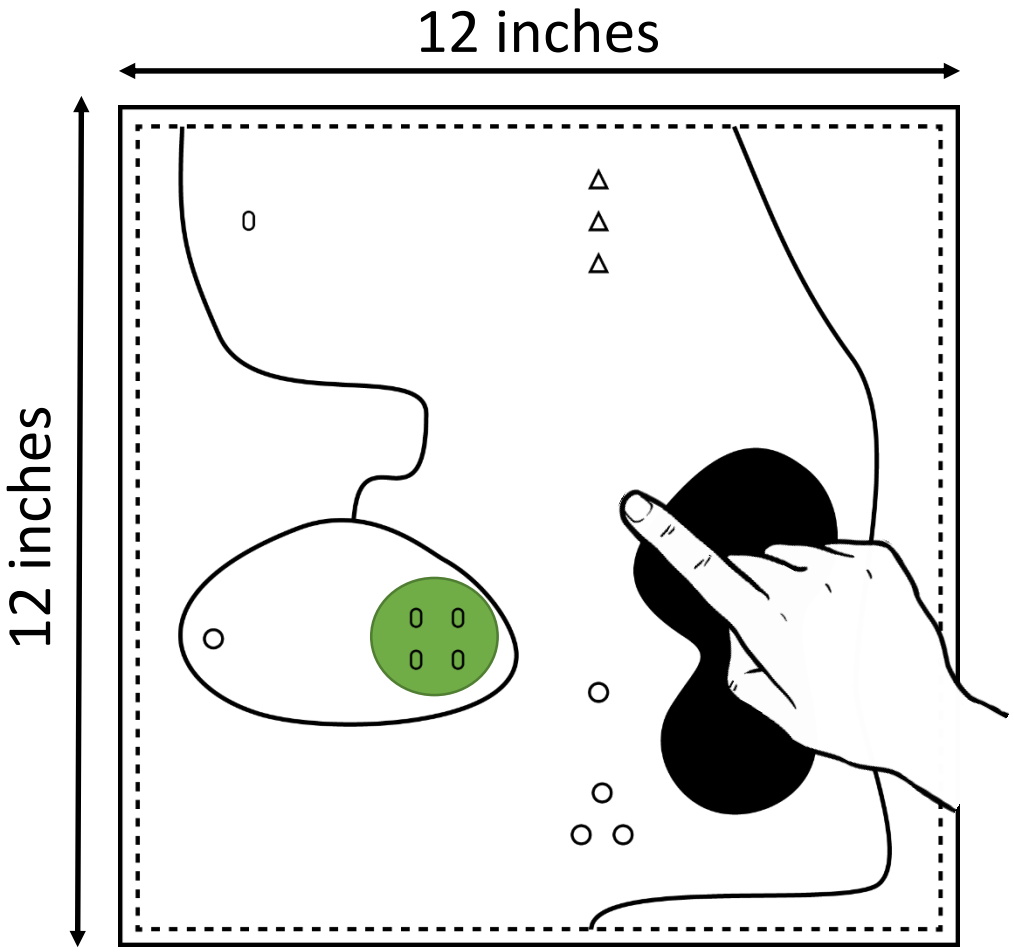


Types of Movement





Research Study



Stimuli:

- Unstructured tactile maps (clear)

Task:

- Find landmark using 1 or 5 fingers

Participants:

- 9 Blindfolded sighted

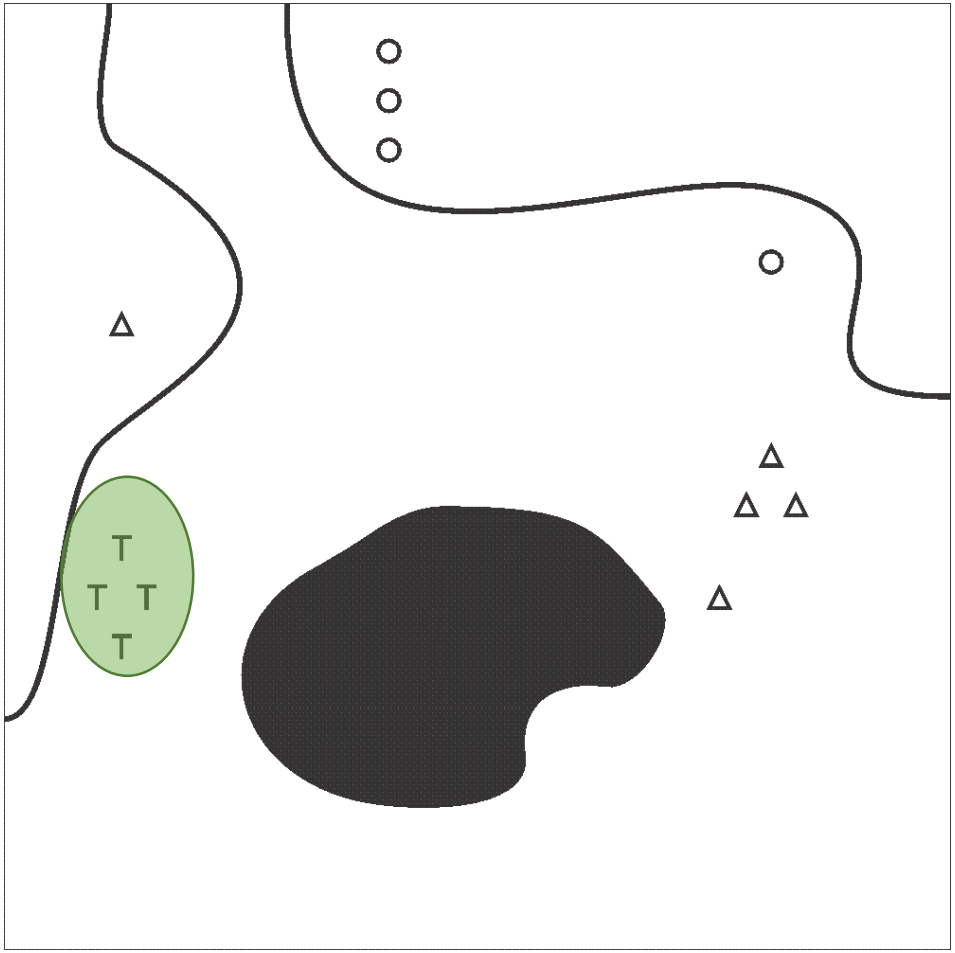
Data:

- Track Index Finger

Research Study

Research Study

Example 1-Finger Search



Example 1-Finger Search

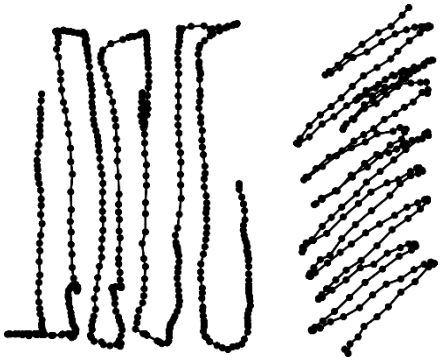
Example Index-Finger Movements

One-Finger

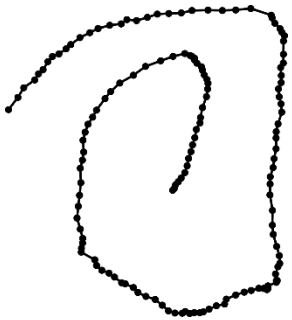
Five-Finger

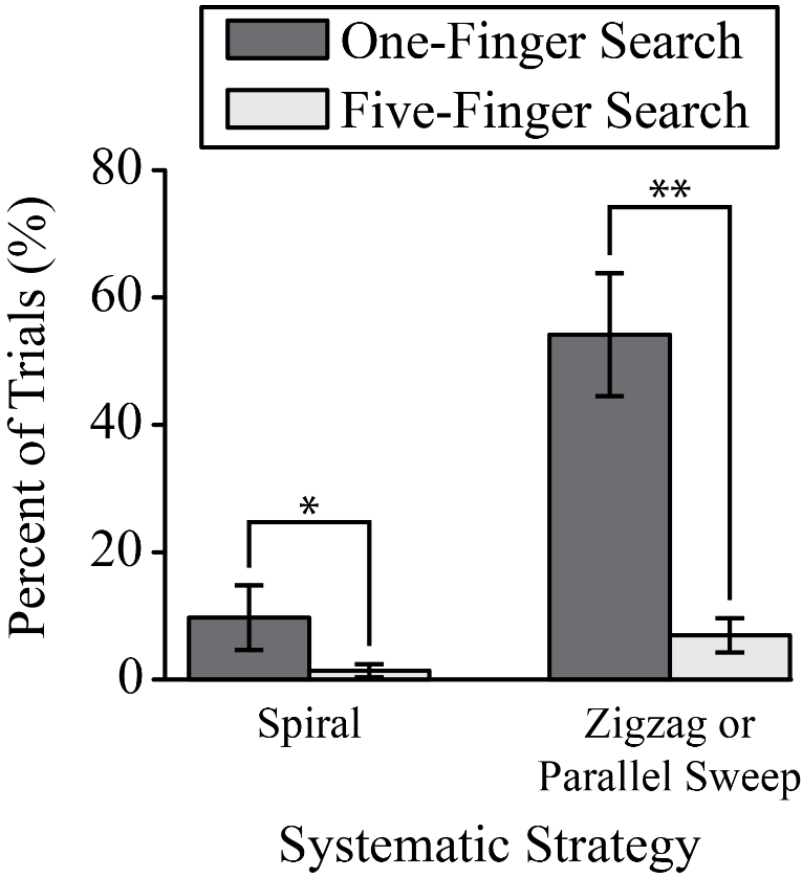
Systematic Index-Finger Movements

zigzags or parallel sweeps
98.6%
kappa = 0.97



Spirals
99.3%
kappa = 0.93





Conclusions

- There are systematic movements in haptic search of an unstructured display.
- The use of systematic movements is consistent with optimal search theory.
- Framework for thinking about and modeling finger movements:

  systematic patterns and random walks

Thank You!