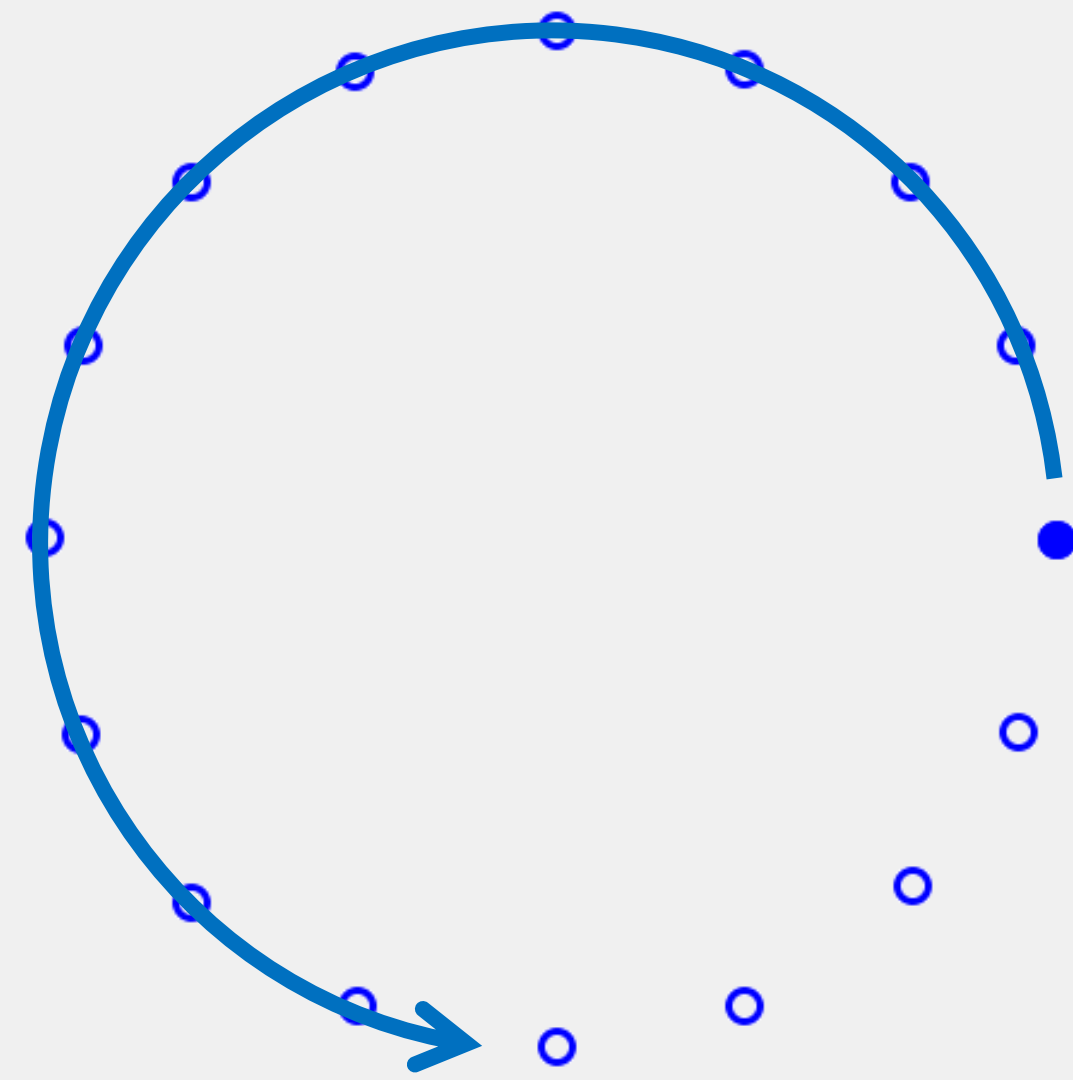
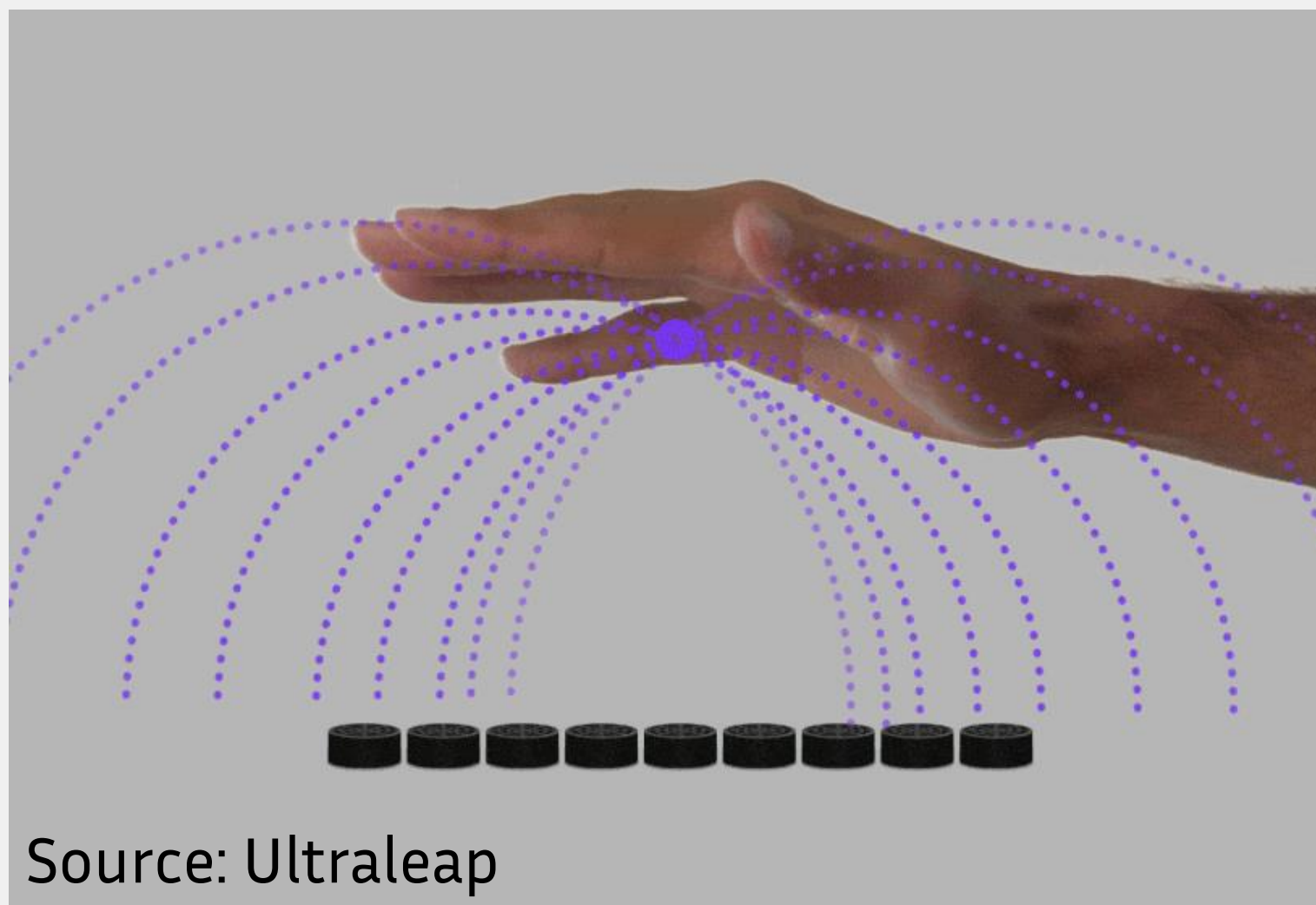


# Can We Increase the Perceived Intensity of Mid-Air Haptic Shapes Rendered With Dynamic Tactile Pointers?

## CONTEXT

**Ultrasound mid-air haptics:** generating successive points of pressure using focalized ultrasounds, to create a tactile sensation.



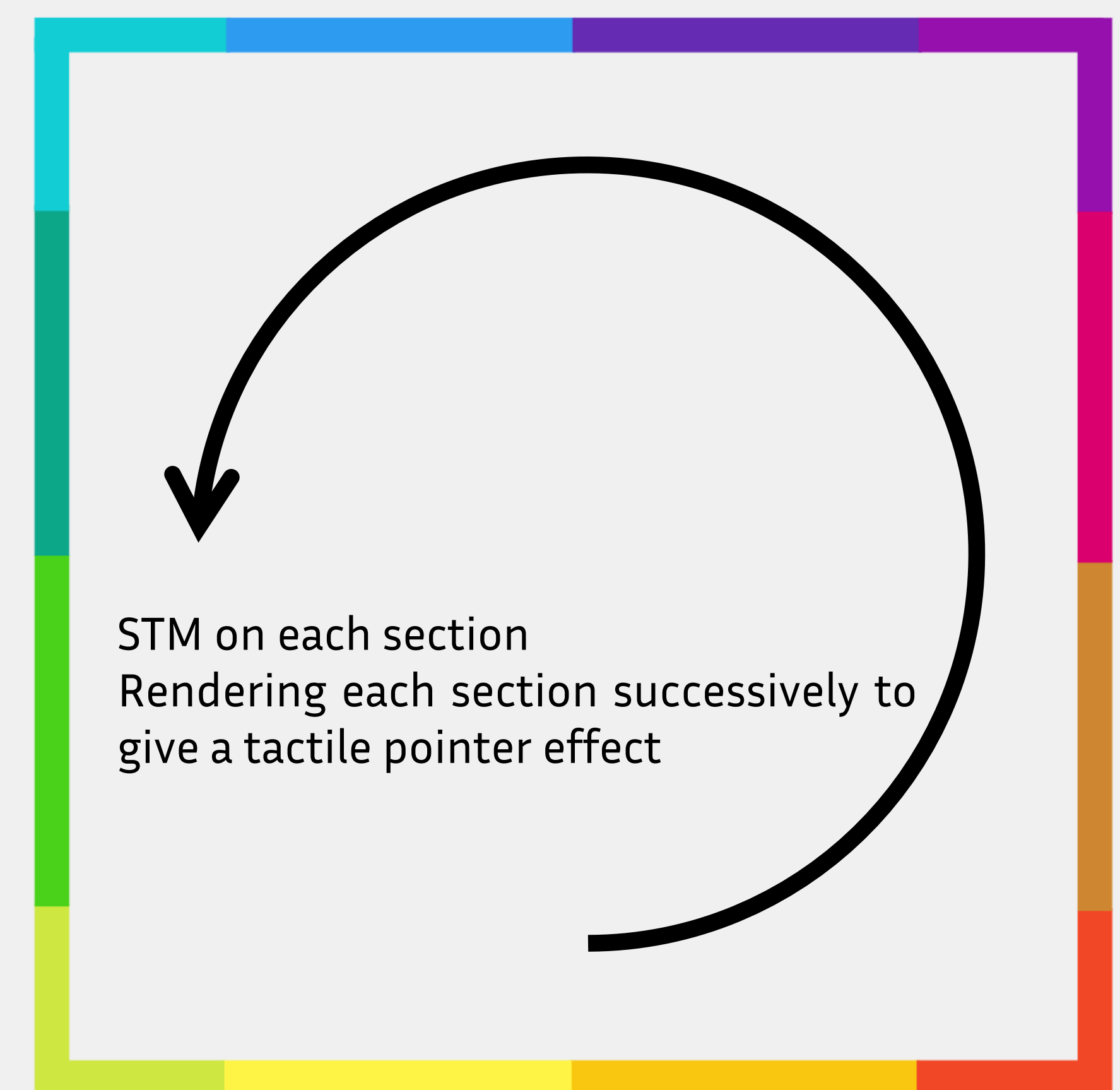
### Shape rendering:

Since a focal point cannot be perceived as is, several techniques have been designed to render a 2D shape:

- SpatioTemporal Modulation (STM): quick continuous motion of the point  
→ **high intensity**, **blurry feeling**
- Dynamic Tactile Pointers (DTP): slow motion of an amplitude-modulated point, with pauses on vertices  
→ **low intensity**, **sharp feedback**

## DESIGNED TECHNIQUE

**Spatio-temporally-modulated Tactile pointers (STP)** leverage the benefits of STM and DTP.



STP rendering of a square

- The shape is divided into small sections.
- Each section is rendered using STM (**high intensity**).
- Sections are rendered successively, with longer pauses around the vertices (**high sharpness**).

## USER STUDY AND RESULTS

### Goal:

Increase the perceived intensity of dynamically rendered 2D shapes, without any loss in shape identification performances.

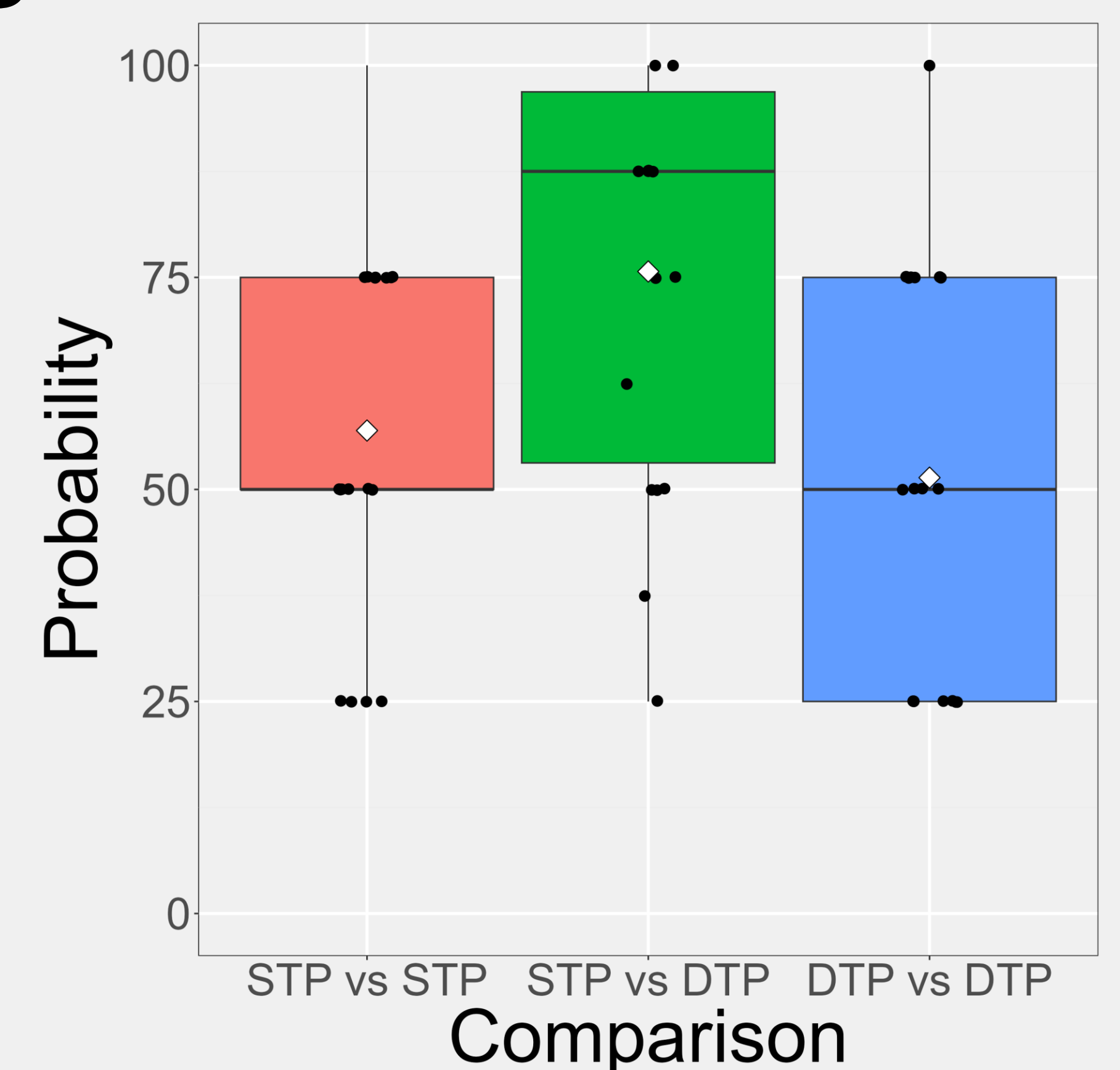
### Protocol – intensity discrimination:

The user was presented with successive pairs of polygon stimuli, rendered with potentially different techniques (DTP or STP), and then asked which one was felt stronger.

- 18 participants
- 16 trials per participant

### Results:

STP is perceived as more intense than DTP 75% of the time.



Proportion of answers saying the first stimulus is stronger

**Future work:** Compare the shape identification performances with STP to that of STM / DTP.