Analysis of Target Assistance Techniques in Pointing Tasks

1. Goals of the Experiment

This experiment investigates how different target assistance techniques, specifically sticky targets and target gravity, affect pointing performance by analyzing their impact on completion time and error rates. Our goal is to explore how varying strengths of these techniques influence user performance and determine whether sticky targets or gravity improve pointing efficiency compared to normal conditions.

2. Procedure

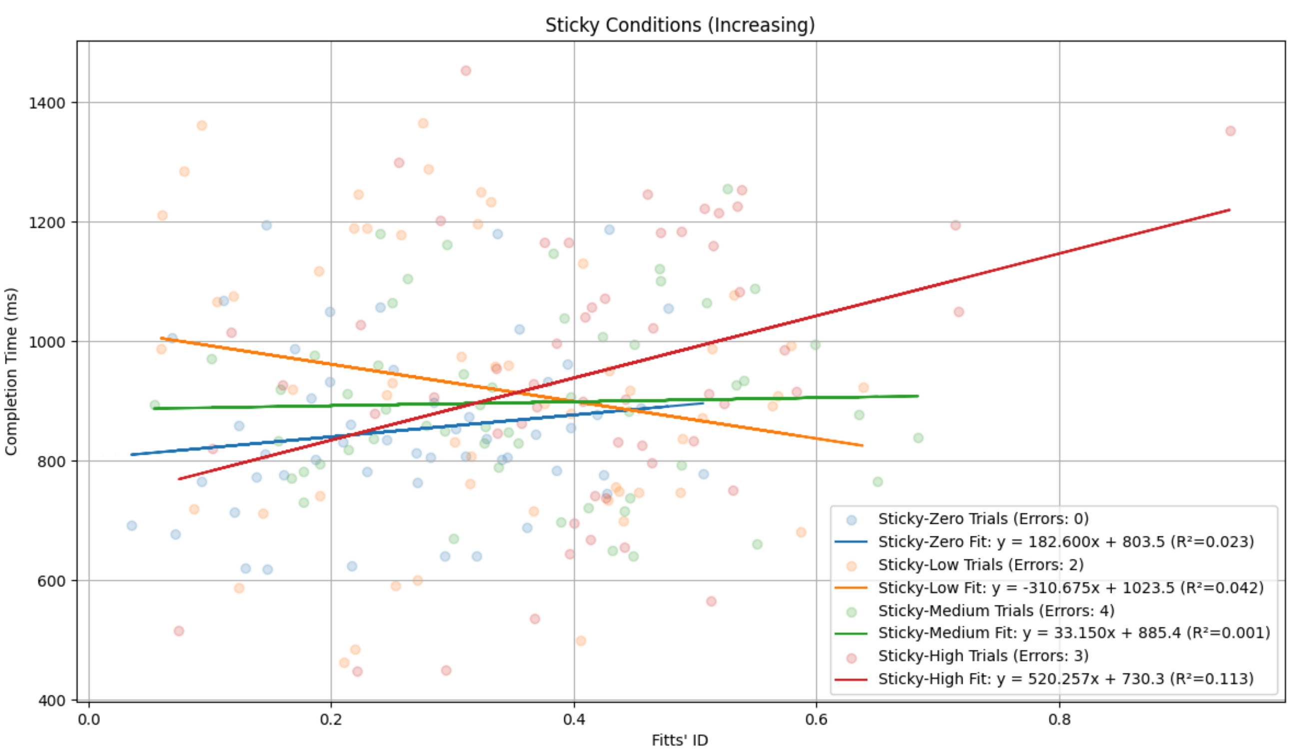
The experiment consists of **16 conditions** as outlined in the table.

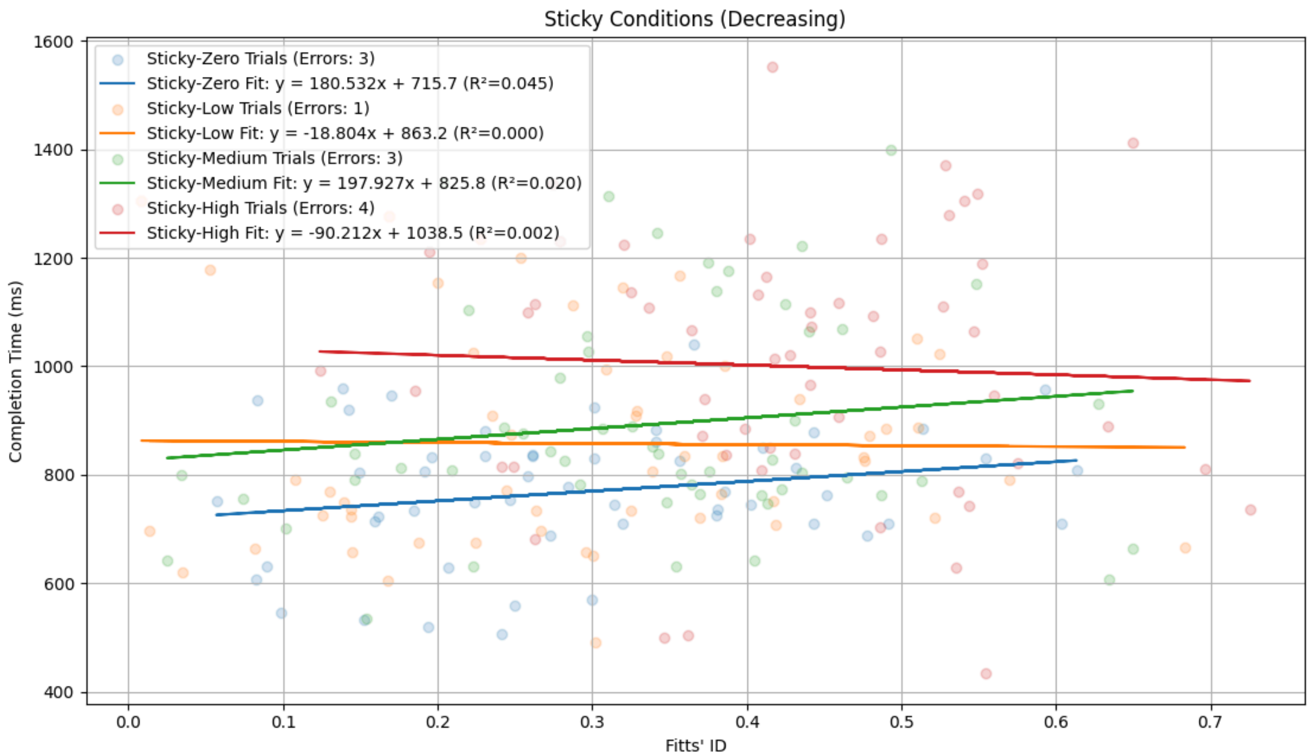
Condition	**Levels**	**Order Tested**
Sticky	Zero, Low, Medium, High	Sticky First, Gravity First
Gravity	Zero, Low, Medium, High	Sticky First, Gravity First

The zero-intensity conditions serve as a baseline for comparison, allowing us to evaluate how each technique affects performance relative to standard pointing. The varying intensity levels help determine the optimal strength for each technique—balancing improved accuracy and speed without introducing unintended difficulties. By testing the conditions in both orders, we minimize potential biases, such as learning effects or fatigue. This ensures that performance differences are due to the techniques themselves rather than the sequence they were presented in.

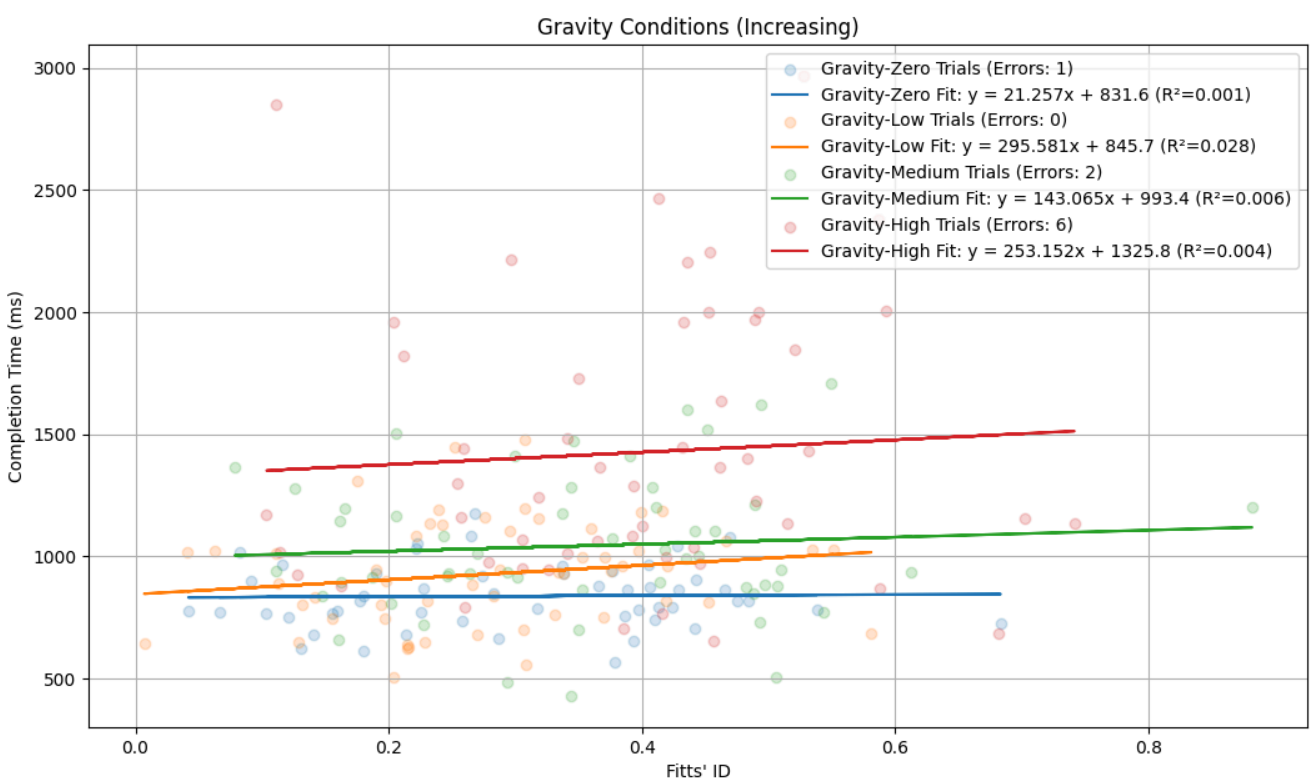
3. Results

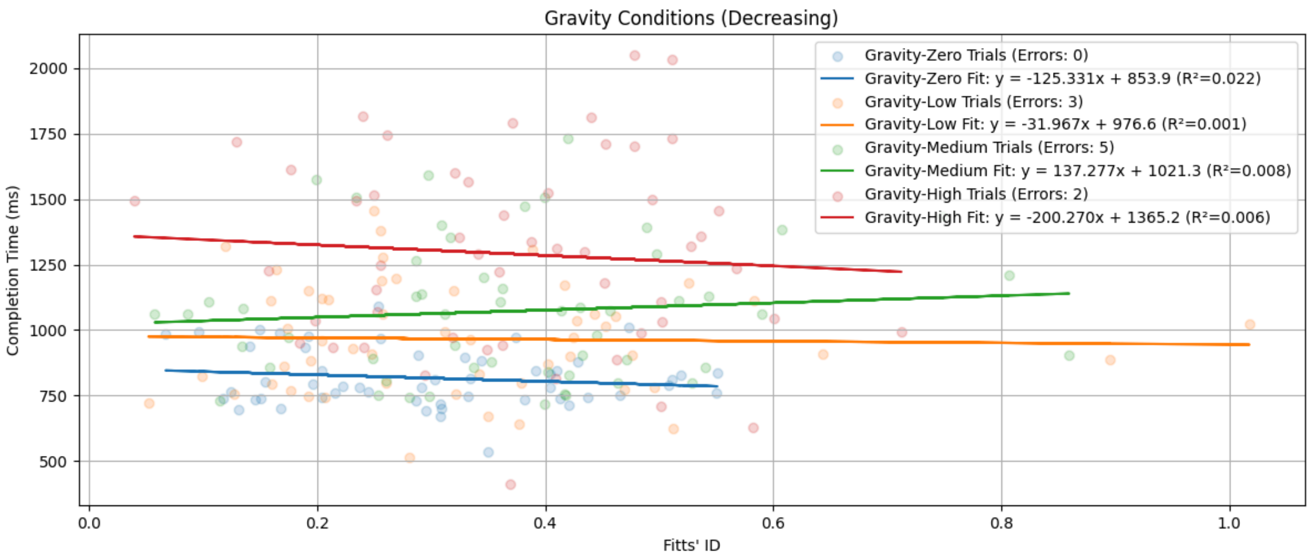
Each condition was tested with 60 trials, of which 55 were recorded. The following charts illustrate the relationship between Fitts' ID and completion time, with best-fit lines and R^2 values for each condition.





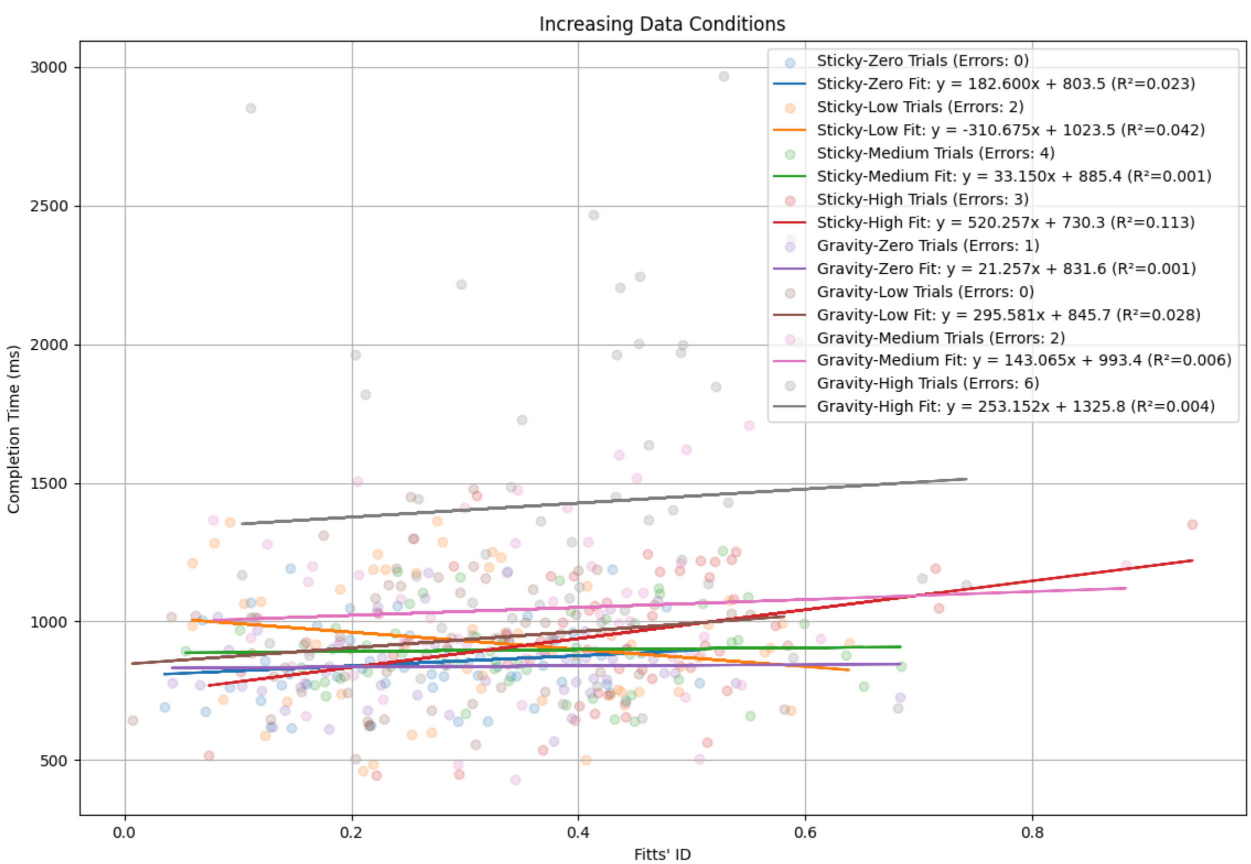
Sticky Target Performance: *Medium stickiness provides the fastest speed, outperforming the regular cursor, while high stickiness slows performance. Both medium and high stickiness resulted in the highest error rates.*

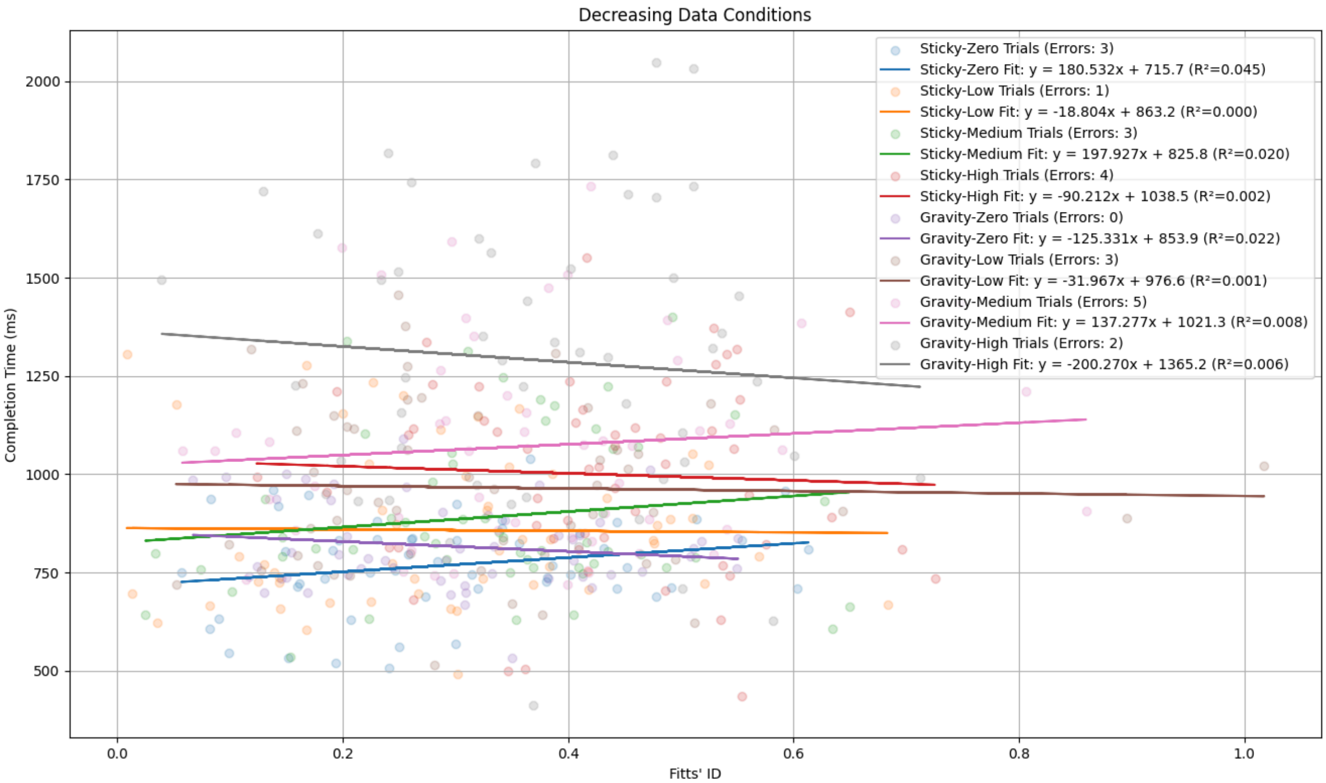




Gravitational Target Performance: *Speed and accuracy decline as gravitational pull increases, consistently underperforming compared to the regular cursor. High gravity resulted in the longest completion times and the most errors.*

Overall Comparison





Overall Comparison: *Sticky targets are faster and more accurate than gravitational targets, but neither technique consistently outperforms regular pointing.*

4. Discussion

Performance Trends for Sticky Targets vs. Gravitational Targets

Sticky targets performed best at medium intensity, offering the fastest speed and outperforming the regular cursor, while higher levels of stickiness reduced efficiency and resulted in the highest error rates. The technique allows users to quickly "flick" the cursor toward a target, with stickiness slowing it down upon arrival. This is particularly beneficial for long-distance movements, where users don't need to be as precise during the ballistic phase, reducing time spent estimating movement distances. However, sticky targets positioned behind obstacles significantly slowed movement, as the cursor stuck to objects along the way. This increased mental load, forcing users to adjust their path or movement strategy, ultimately reducing performance.

The gravitational target technique consistently underperformed compared to regular pointing, with speed and accuracy declining as gravitational pull increased. High gravity resulted in the longest completion times and the most errors. As the cursor moved, surrounding targets pulled on it, causing sudden jolts that disrupted the user's control. This was especially problematic when small targets were surrounded by larger objects, as the pull from surrounding distractors overpowered the target's influence. Users often resorted to cursor adjustments or alternative paths to bypass interference, leading to an extended correction phase. While reaching the general area of a target was relatively fast, the gravitational pull introduced instability when fine adjustments were required.

Overall Comparison

Sticky targets outperformed gravitational targets, but neither consistently surpassed regular pointing. Sticky targets reduced the ballistic phase, helping users reach targets faster, but movement slowed when crossing larger obstacles. Gravitational pull assisted navigation but caused erratic cursor behaviour due to competing forces, which added time to the correction phase. Both techniques' effectiveness depends on target placement and surrounding obstacles, as their influence can either aid or hinder selection.

Key Takeaway

Sticky targets improve speed in structured UI layouts but slow movement in cluttered environments. Gravitational pull helps reach large, isolated targets but reduces precision when targets are small or surrounded.

Insights for Design

Sticky targets can improve UI navigation by reducing the need for precise movements, making them useful for menus, buttons, and accessibility tools. However, excessive stickiness slows interaction and should be carefully tuned. Gravitational pull can help guide cursor movement in drag-and-drop interfaces or assistive navigation, but if too strong, it disrupts fine control. It works best for isolated, large targets rather than dense layouts. Both techniques have potential for accessibility improvements, especially for users with motor impairments, but require careful force calibration to avoid unintended disruptions.

Limitations

Since only one person was tested, the results might not apply to everyone. Performance could also improve with practice, so a longer study would help see if users adapt over time. Different devices like mice, trackpads, or cursor settings might affect the results, so more testing is needed across various setups.