# User Adaptability to System Delay

**Brian D. Hall**
University of Wisconsin-Stevens Point

## Introduction

- This experiment analyzed the effects of *system delay* on a graphical browser-based computer interface
- System delay is the gap between "user gives input" and "user receives response"
- What effect does delay have on work speed and accuracy?
- This experiment focuses on system delay in interfaces used to perform work-like tasks

## Background

- System delay is a classic topic in HCI, studied for over 60 years by dozens of groups around the world
- Past results on the effects of delay have been mixed
- Studies have indicated delay should be lower, higher, or are irrelevant within a reasonable range
- Many studies have few participants, no blindness, or only look at very few aspects of task performance
- Most studies are not about modern GUIs, browser-based apps, or work-related tasks

## Tasks

- Participants completed small 5x5 training grids with 100% accuracy before being given the full tasks
- Full tasks were 10x10 grids of English letters
- Participants clicked to highlight cells with matching neighboring letters (horizontally or vertically only)
- After clicking on a cell, the system would not respond to further action or highlight the cell until the designated system delay time had passed

| | | | |
|---|---|---|---|
| A | H | F | B |
| C | K | J | F |
| C | C | U | D |
| V | P | R | D |

*Instructional grid*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| D | G | A | H | C | A | A | K | M | O |
| E | F | H | H | K | L | K | J | K | J |
| L | I | C | D | K | G | L | O | L | C |
| B | F | I | G | J | C | H | K | M | H |
| C | B | C | D | I | D | G | J | K | L |
| C | B | D | E | G | F | I | N | J | L |
| A | J | L | L | F | C | I | L | K | L |
| B | K | M | E | D | E | G | J | K | G |
| G | F | J | F | C | A | L | H | O | L |
| K | A | A | A | B | H | K | O | C | O |

*Full task grid*

## Limitations

- Study was conducted in a quiet room with minimal distractions
- Tasks were simple and objective, not requiring high cognitive load
- Delay was "locking" – unavoidable and couldn't be ignored
- Lowest delay was 0.5s between clicks, highest was 2s

## Discussion

- System performance needs to be "good enough"
- Micro-optimizations can be extremely costly, yet may not result in increased operator speed or accuracy
- Users are cautious, intelligent, and resourceful - but imperfect, prone to overlooking important data
- There is no need to throw out an otherwise promising system just because it is a little too slow
- Users can adapt to a system that is not perfect, within reason, if they are motivated to do so

## Experiment

- 61 undergraduate students participated
- Research application was custom designed for this experiment
- 8 tasks were given to each participant in counterbalanced order
- Every task was randomly assigned a delay level
- There were four delay levels: 0.5s, 1.0s, 1.5s, 2.0s
- Performance was analyzed for 7 key dimensions
- Double-blind procedures were implemented

## Results

- Users proved to be resilient against the effects of delay
- User accuracy was unaffected by system delay
- Time to perform tasks seemed to increase with system delay, but performance was slowed by only as much time as was introduced by system delay
- Regardless of system delay, users did make a lot of one kind of error: omission

## Future Work

- Experiment with more demanding tasks that require high cognitive load, or more distracted users
- Use additional lab instrumentation to analyze how users coped so effectively with delay, such as eye/gaze tracking and recording of screen and mouse movements
- Outside the lab: use crowdsourcing to establish generalizability to other people and environments
- Analyze some of the 25,000+ other collected data points
  - Predictors of individual user speed and accuracy
  - Task completion strategies
  - Reasons for common errors

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