What Happens When 3D Gestures Don't Get Recognized?

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Living with Errors

Introduction

- Device-based 3D gestures are becoming more widely adopted as an alternative to mobile touchscreen/keyboard input
- But errors are an inevitable part of interaction with technology
- Many gesture classes are available (e.g., iconic, symbolic, deictic) for use in smartphones, but which have minimum user frustration when recognition errors occur?
- We investigate user error tolerance for two iconic gesture sets used in HCI: mimetic and alphabet gestures

Question

- What are the effects of unrecognized gestures on user experience, and what are the differences between mimetic and alphabet gestures (under varying error rates: 0-20%, 20-40%, 40-60%)?

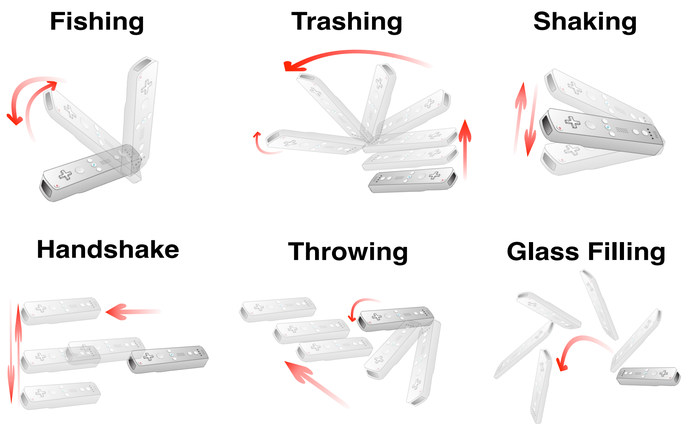
Hypotheses

- Mimetic gestures → users less familiar with ideal shape → *more gesture variation* under high error rates → but *lower subjective workload* due to higher degrees of freedom
- Alphabet gestures → users more familiar with ideal shape → *more rigid gestures* under increasing error rates → but *higher subjective workload* due to lower degrees of freedom

Methods

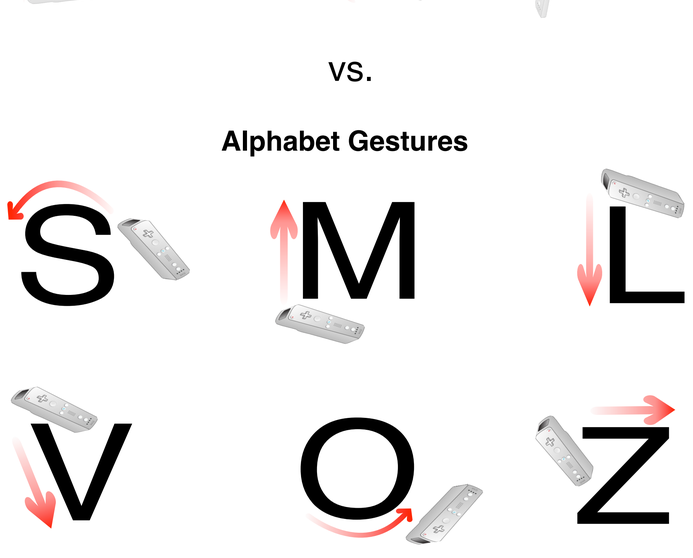
Gesture Design

Mimetic Gestures



vs.

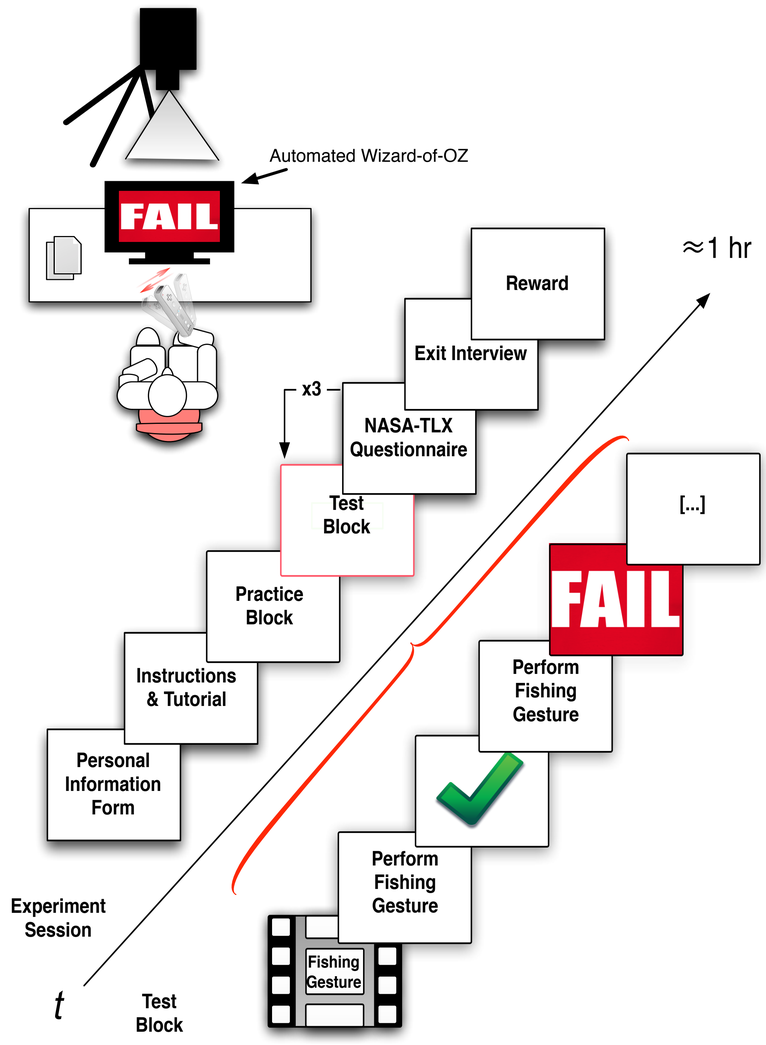
Alphabet Gestures



Study Design

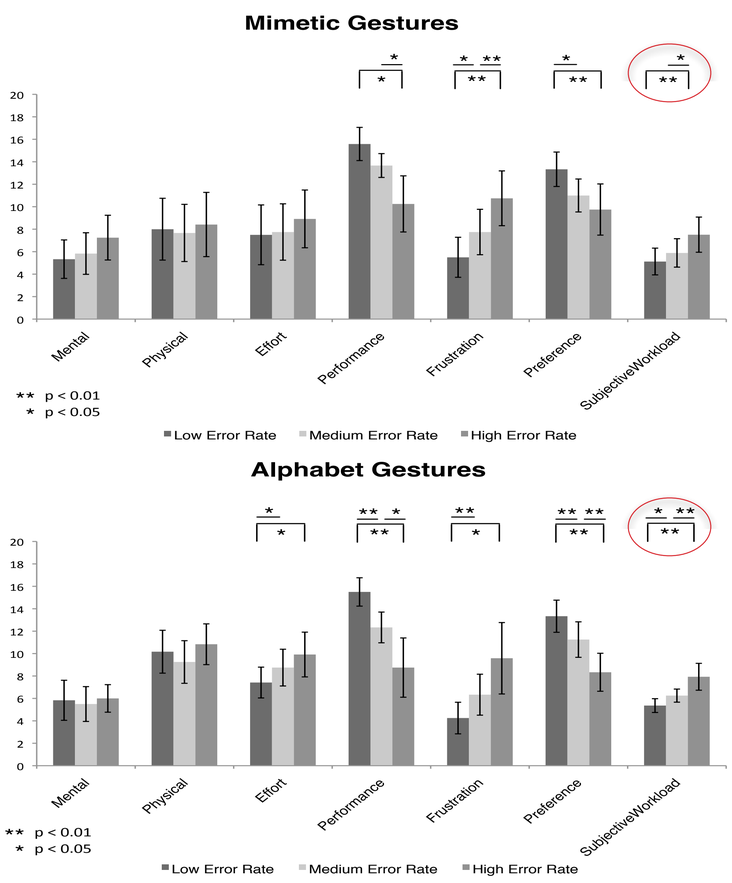
- Qualitative study
- 24 subjects (16 male, 8 female) aged between 22-41 (M= 29.6, SD= 4.5)
- Mixed between- and within subject factorial design: 2 (gesture type: mimetic vs. alphabet) x 3 (error rate: 0-20% (low) vs. 20-40% (med.) vs. 40-60% (high))
- Automated Wizard-of-Oz method
- Tutorial & videos given of how to 'properly' perform each gesture
- Experiment in Presentation®, Wii Remote® interaction using GlovePie™
- Random error distribution across trials
- Data collected:
  - Modified NASA-TLX workload questionnaire data
  - Experiment logs
  - Video recordings of subjects' gesture interaction
  - Post-experiment interviews

Setup & Procedure



Results

Modified NASA-TLX Scores



Observations & User Feedback

- For mimetic gestures, recognition errors were tolerated up to error rates of 40%, while only up to 20% error rates for alphabet gestures
- Mimetic gestures evolve into real-world counterparts under error, symbolic gestures tend to become more rigid and well structured
- "Canonical Variations" via positive reinforcement: Survival of the fittest gesture variations. Variations develop as low as spiral depth of 2 (i.e., min. 2 recognition errors)
- Interesting explanations (e.g., canonical variations) and cause (e.g., fatigue) given why there were more errors in some blocks
- Cultural and individual differences (e.g., shaking someone's hand) in performing error-prone gestures
- Interesting use-cases for mimetic gestures, and more socially acceptable when they fail

Implications

Gesture Recognition

- Mimetic gestures easily vary under error, so one-shot recognition important!
- Transparency in gesture recognition technology may better support users in error-handling strategies

Gesture-based Interaction

- 40% error tolerance in line with previous work [1], which shows usability of gesture-based interaction.
- Mimetic gestures overall have better user experience, and thus more suitable for device-based gesture interaction (even under high recognition error!)

[1] Karam, M., and Schraefel, M. C. Investigating user tolerance for errors in vision-enabled gesture-based interactions. In Proc. AVI '06 (2006), 225–232.

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