Intelligent User Interfaces

Xiaojun Bi
Stony Brook University
Xiaojun@cs.stonybrook.edu

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Definition:

- Intelligent user interfaces are human-machine interfaces that aim to improve the efficiency, effectiveness, and naturalness of human-machine interaction by representing, reasoning, and acting on models of the user, domain, task, discourse, and media.

IUI range of approaches:

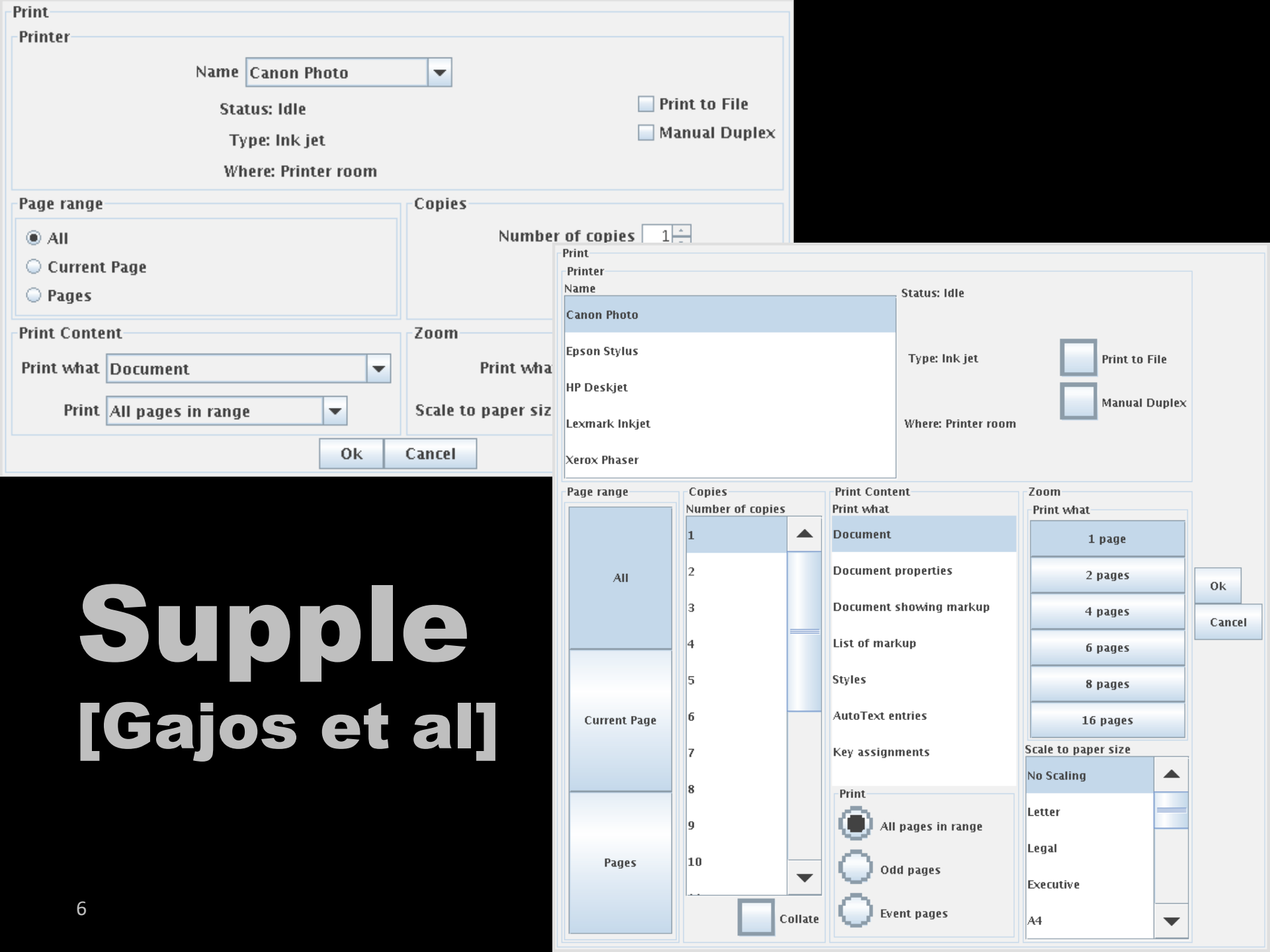
- Personalized, proactive interfaces
  - Personalization
  - User modeling/user profiling
  - Adaptive interfaces (machine learning)
  - Recommender systems
  - Software agents
  - …
- Interfaces to mimic human-to-human interaction
  - Conversational interfaces, natural language techniques in interfaces
  - Interface that plan and reason

Main conference: annual IUI conference

Intelligence in commercial applications

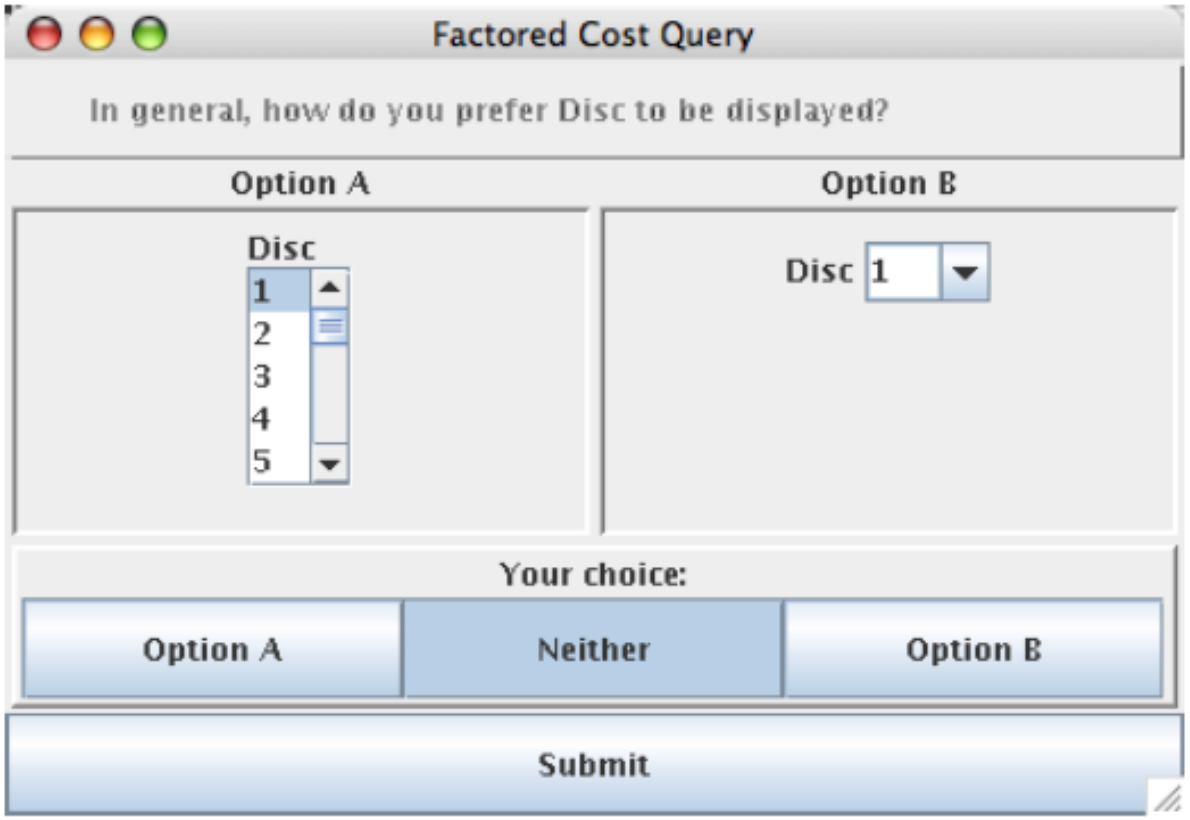
- Recommendation systems are ubiquitous
- Typo & grammar correction
- Spam filters
- More, better speech interfaces
- …

Intelligent User Interfaces



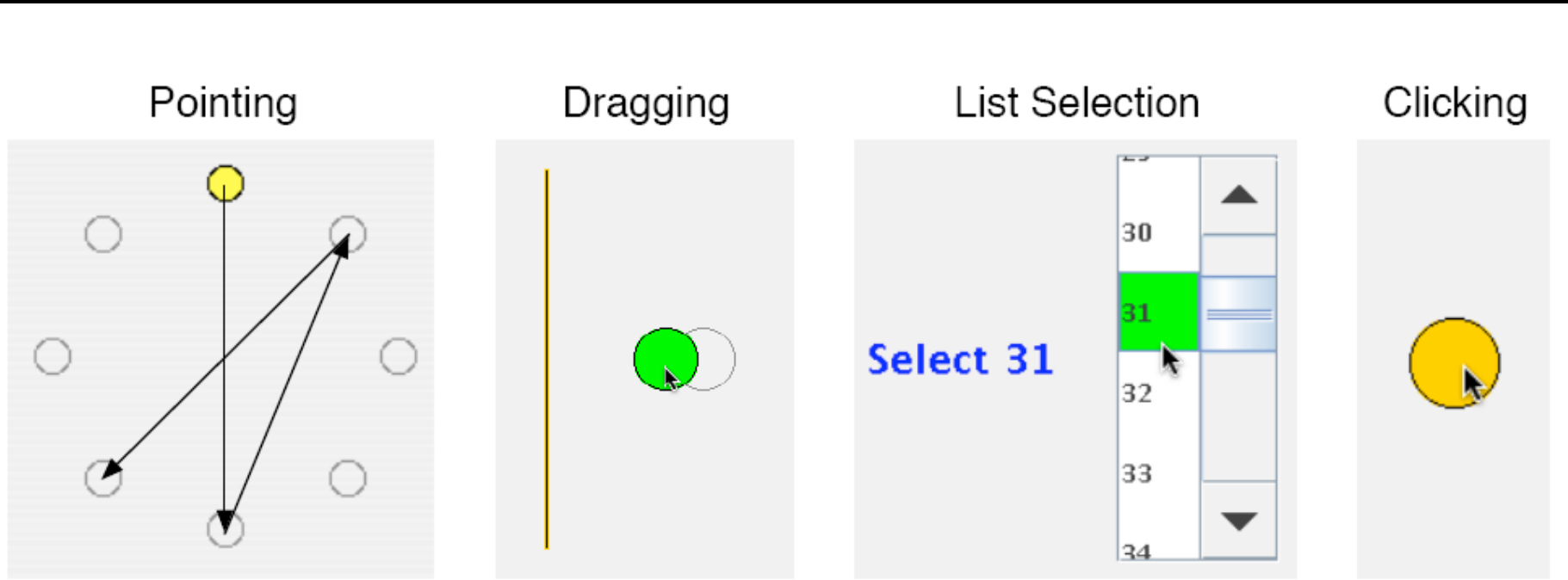
Supple
[Gajos et al]

User Preference Elicitation

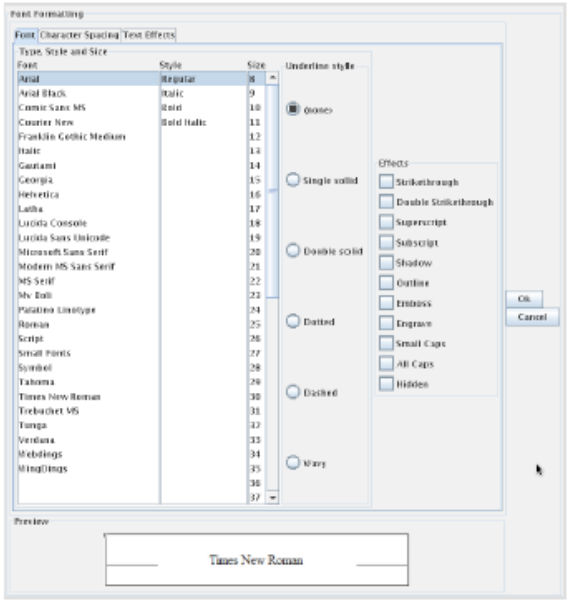


(a) An example of a query used during the active elicitation part of the preference elicitation.

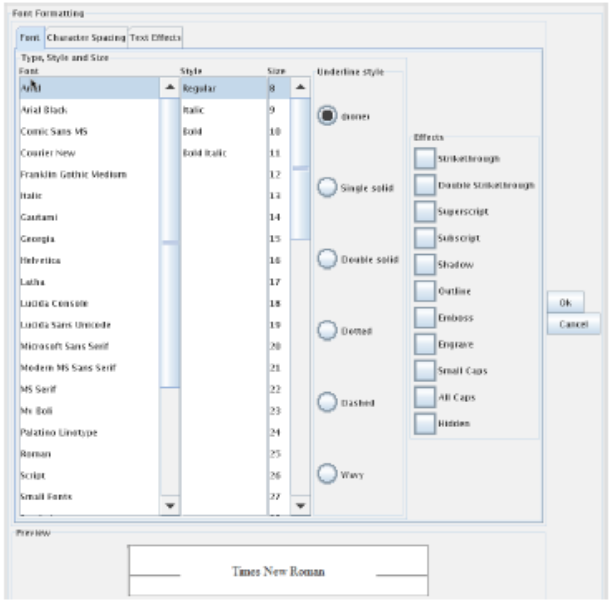
Model Motor Abilities



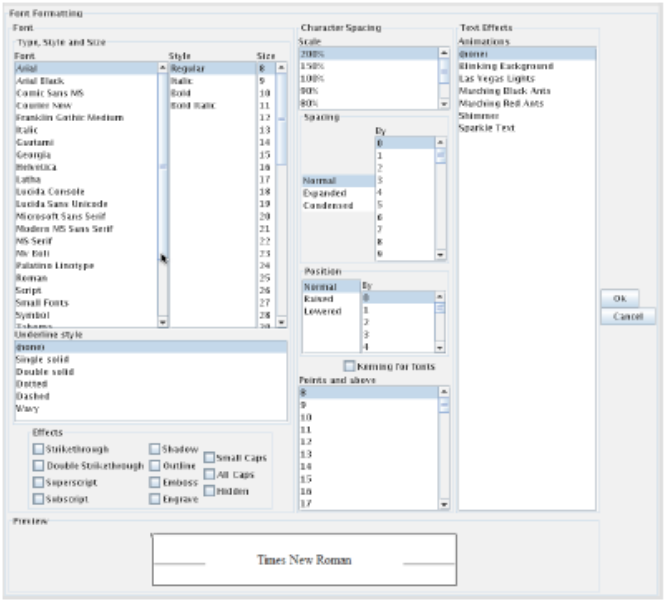
(b) Four task types used to measure participants' motor capabilities



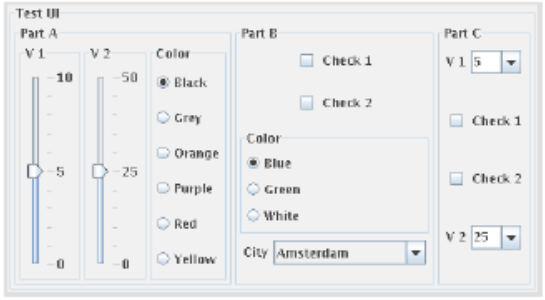
AB02



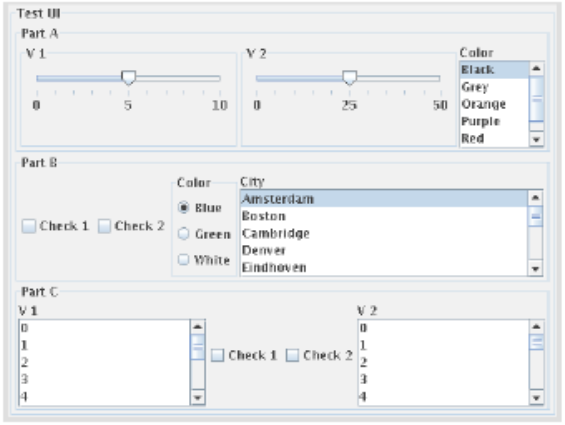
MI02



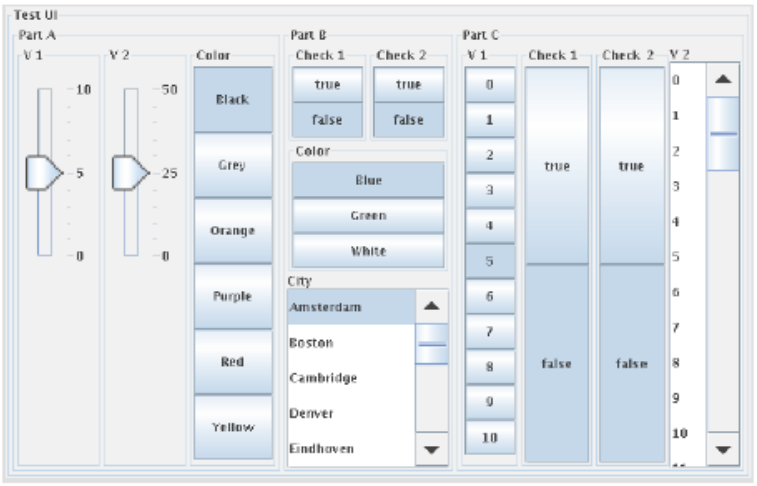
MI04



baseline

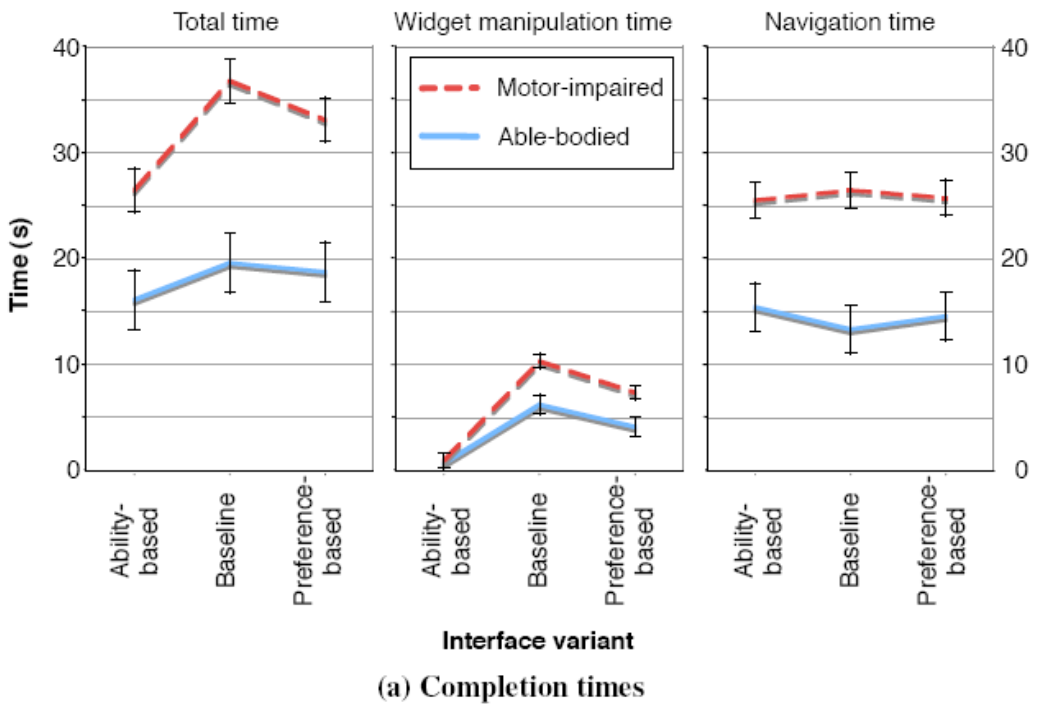


AB03

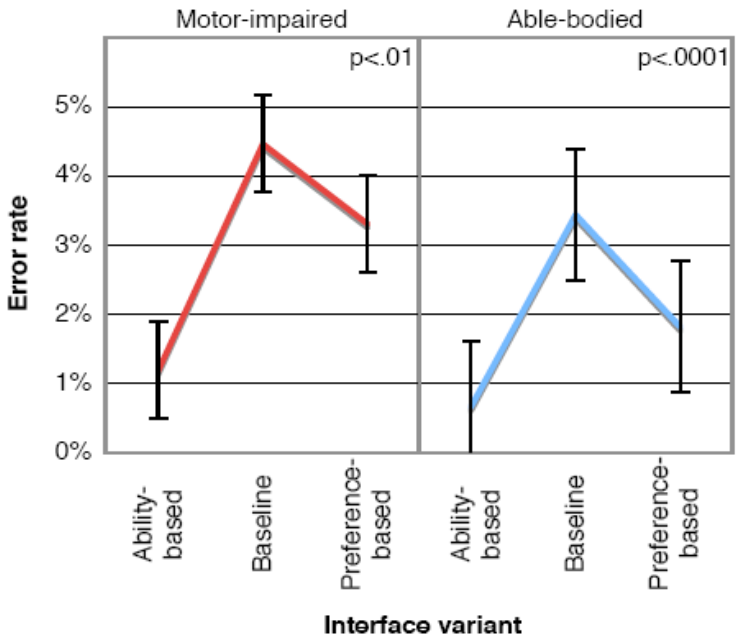


MI09

Evaluation

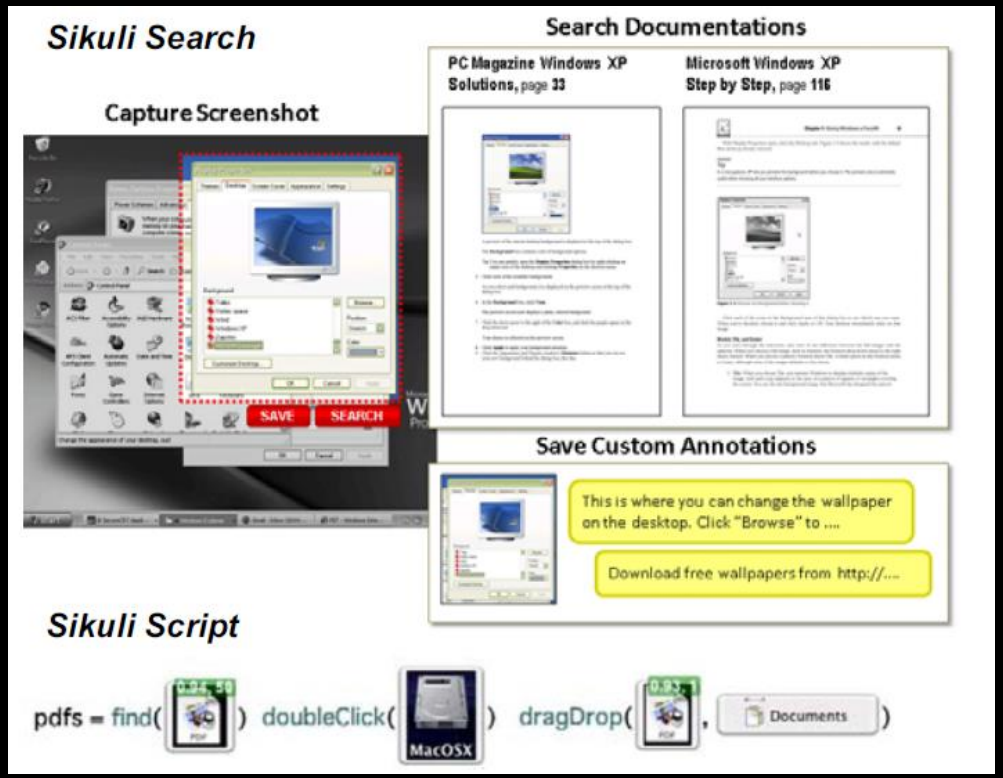


(a) Completion times



(b) Error rates

Sikuli - GUI Screenshots for Search and Automation



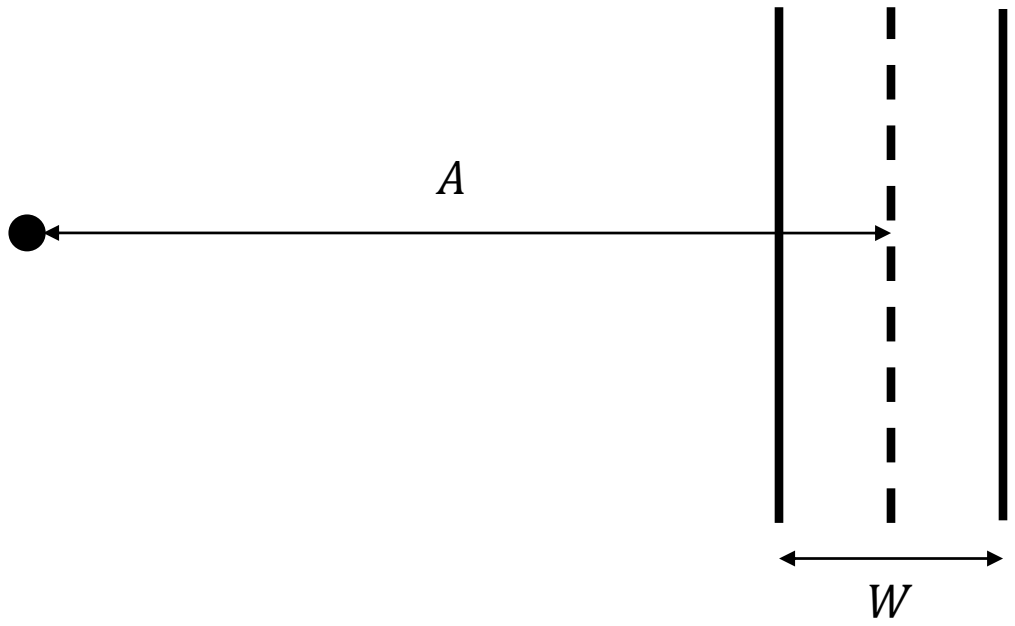

Sikuli Script

Inferring Identity using Accelerometers in Television Remote Controls

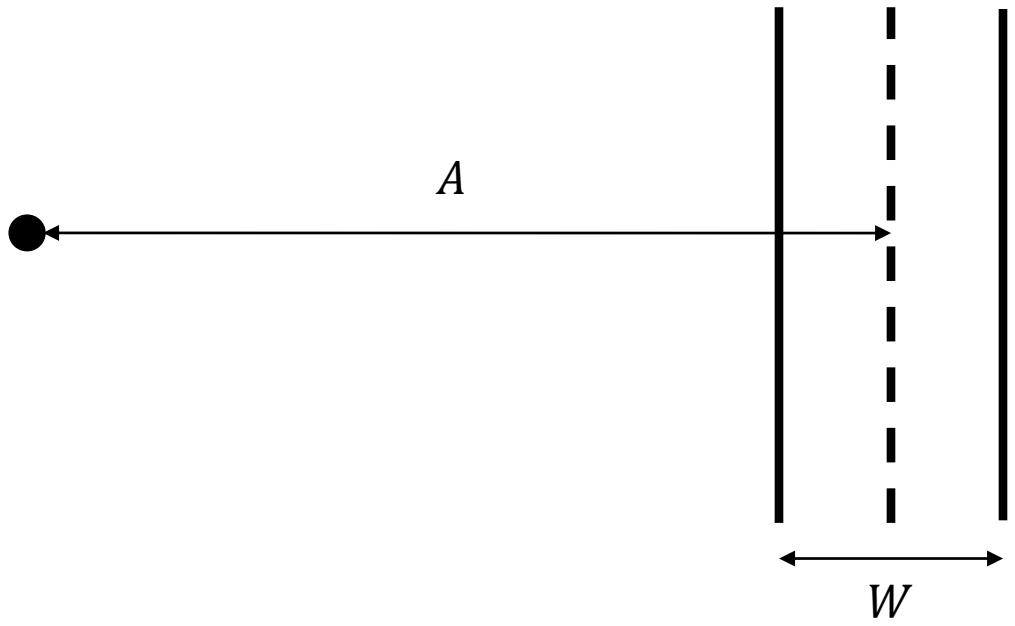
(a) (b) (c)

Fig. 1: Snapshots of different hand motion patterns as captured in our plausibility study. In comparison to (a), the participant in (b) holds the remote with different orientation, and the participant in (c) leans his arm on the sofa, which stabilizes his movements.

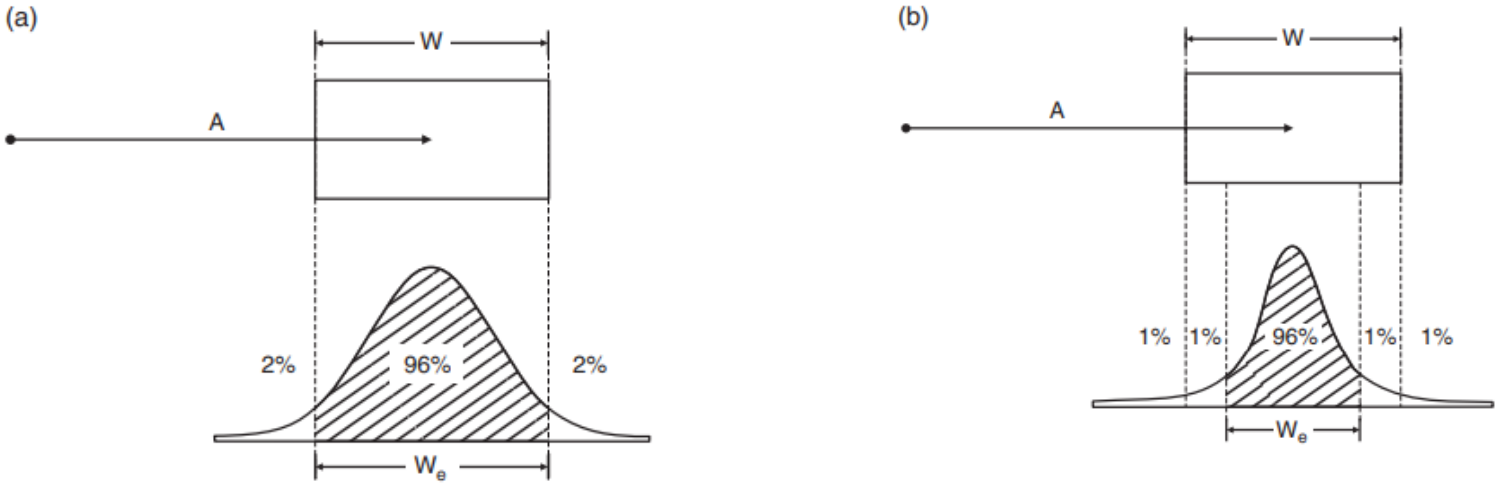
Fitts' Law: $T = a + b \log_2 \left(\frac{A}{W} + 1 \right)$



Fitts' Law: $T = a + b \log_2 \left(\frac{A}{W} + 1 \right)$



Effective Width of Fitts' Law

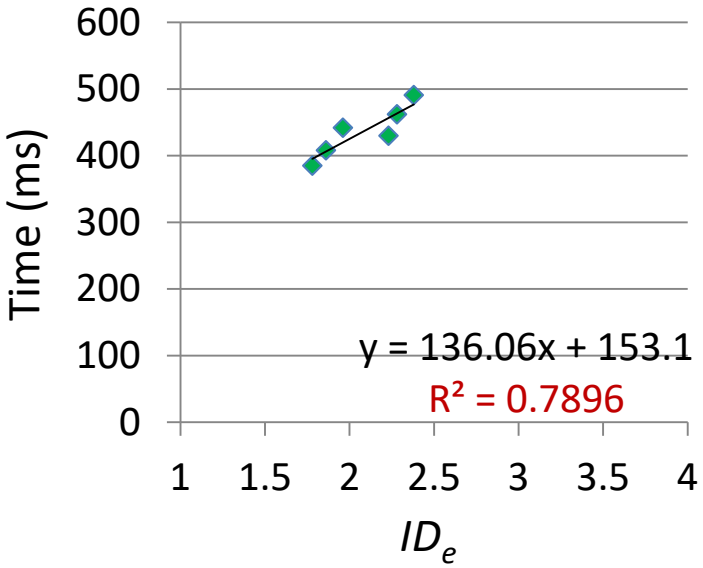


$$T = a + b \log_2 \left(\frac{A}{W_e} + 1 \right)$$

$$W_e = \sqrt{2\pi e}\, \sigma$$

Fitts' Law for Finger Touch

Fitts' Law for Finger Touch



FFitts Law

$$T = a + b \log_2 \left(\frac{A}{\sqrt{2\pi e(\sigma^2 - \sigma_a^2)}} + 1 \right)$$

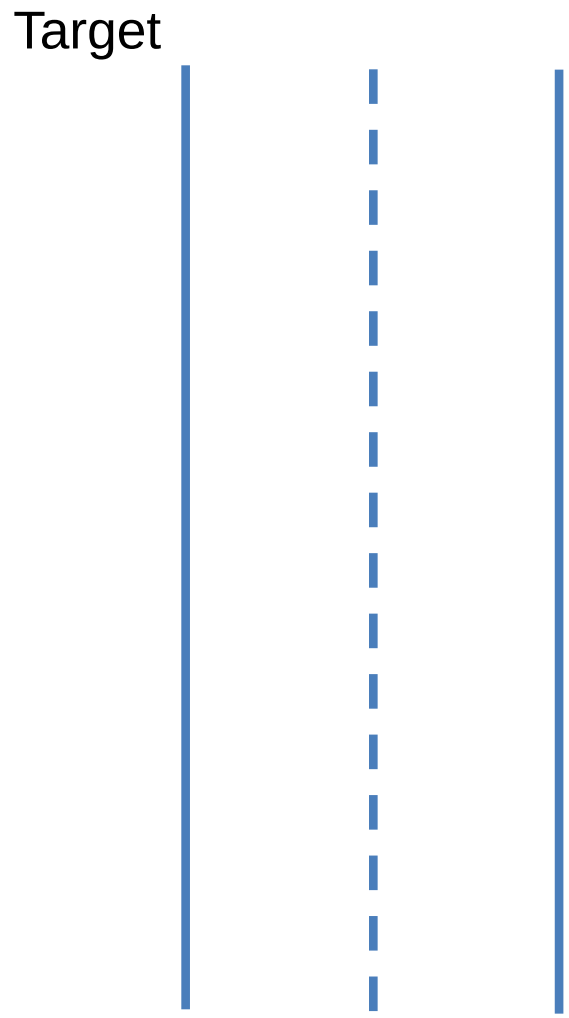
Xiaojun Bi, Yang Li, Shumin Zhai (2013) "FFitts Law: Modeling Finger Touch with Fitts' Law". In *Proceedings of CHI 2013 - the SIGCHI Conference on Human Factors in Computing Systems.* 1363-1372

FFitts Law

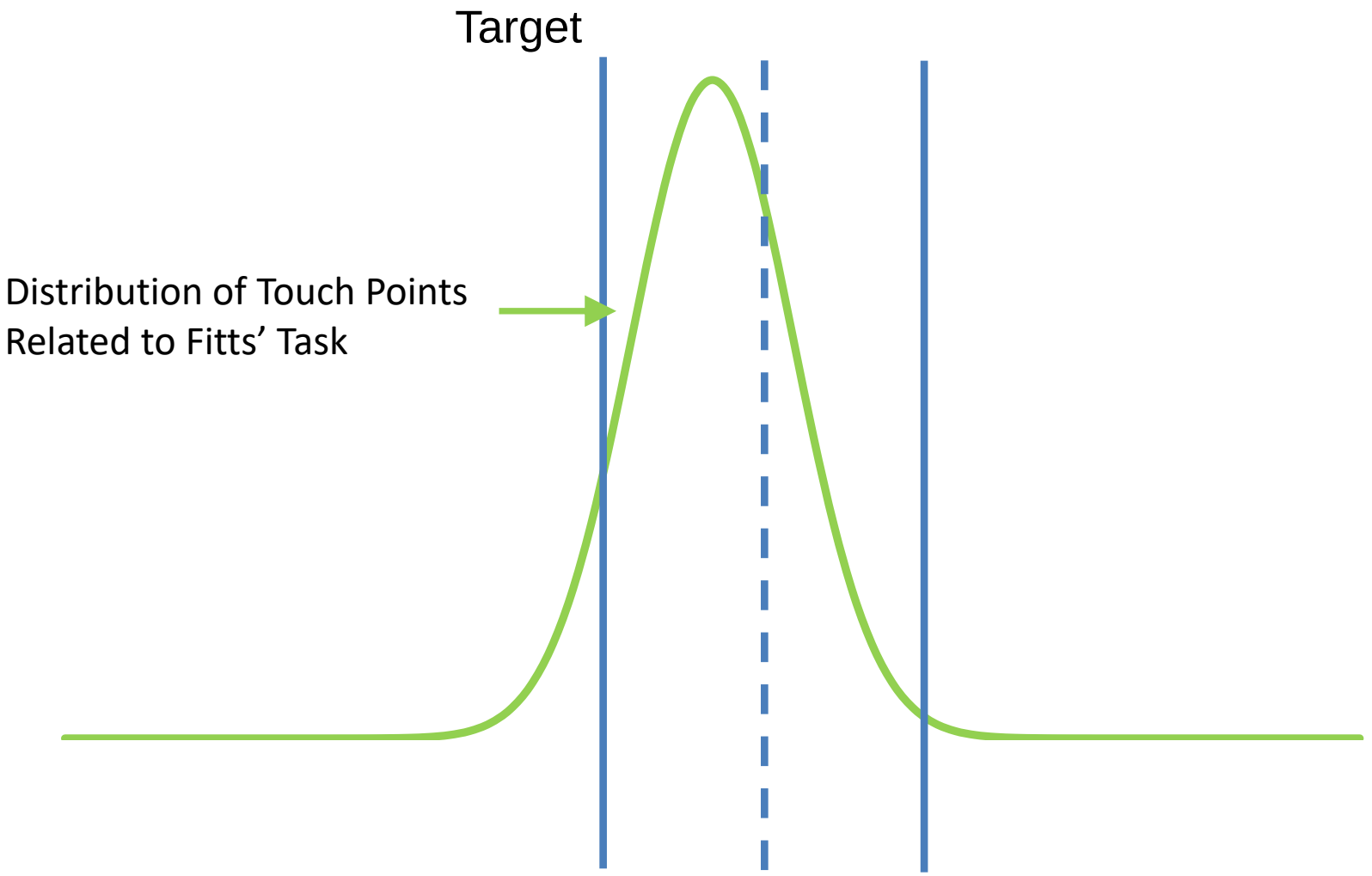
$$T = a + b \log_2 \left(\frac{A}{\sqrt{2\pi e(\sigma^2 - \sigma_a^2)}} + 1 \right)$$

Standard deviation of touch points

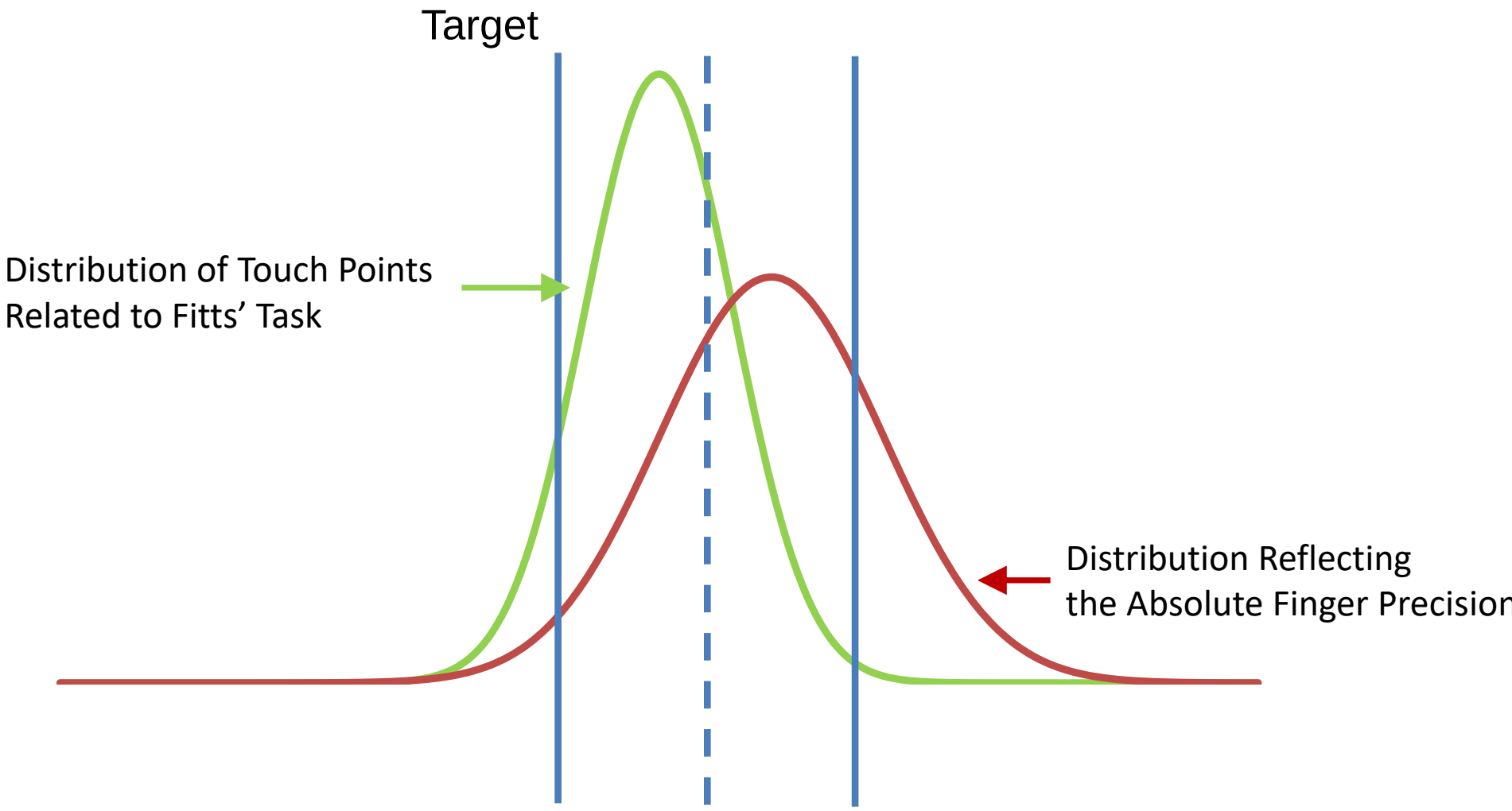
Absolute precision of input finger


Target

$X_r \sim N(\mu_r,\ \sigma_r^2)$



$X_r \sim N(\mu_r,\ \sigma_r^2)$ $X_a \sim N(\mu_a,\ \sigma_a^2)$



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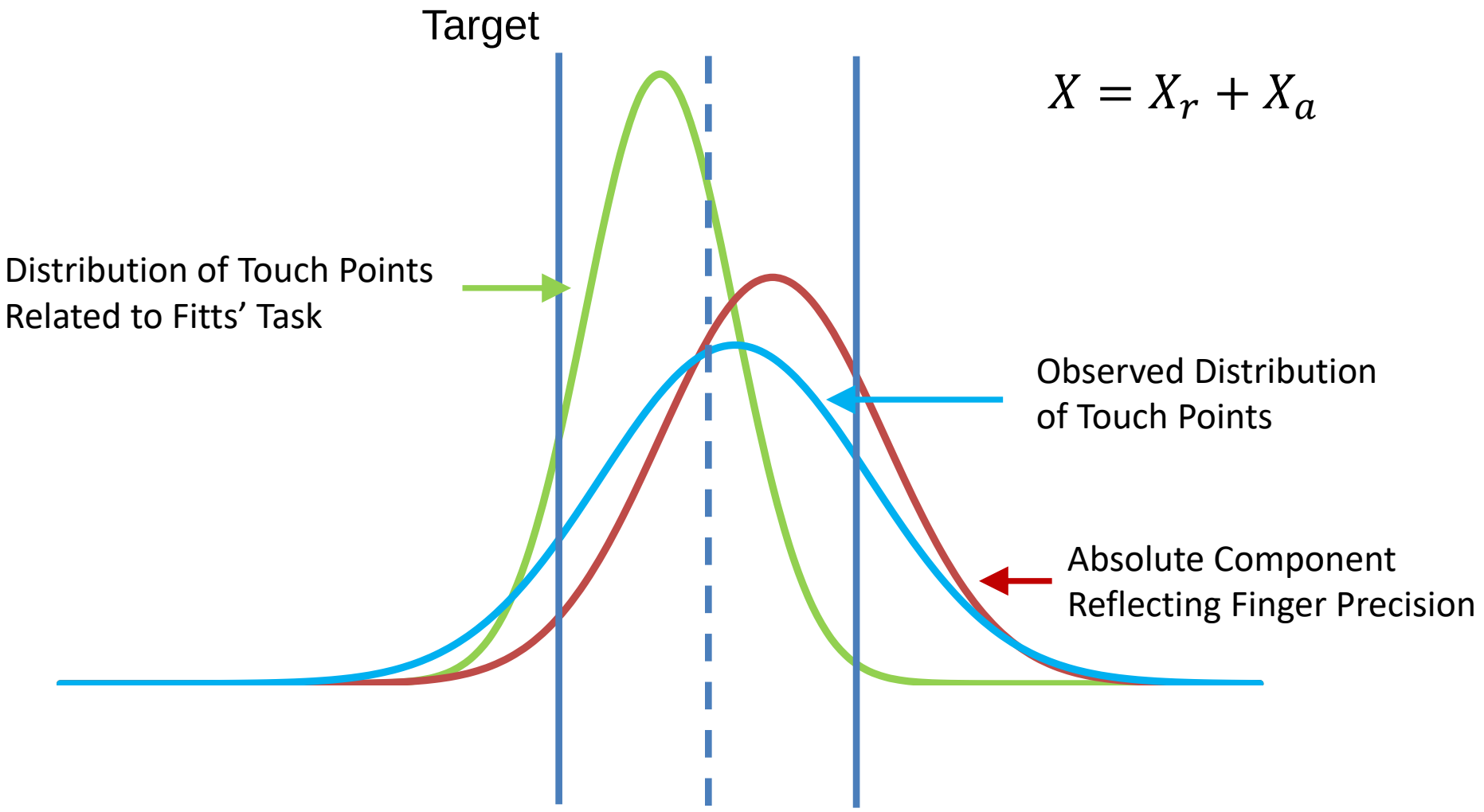

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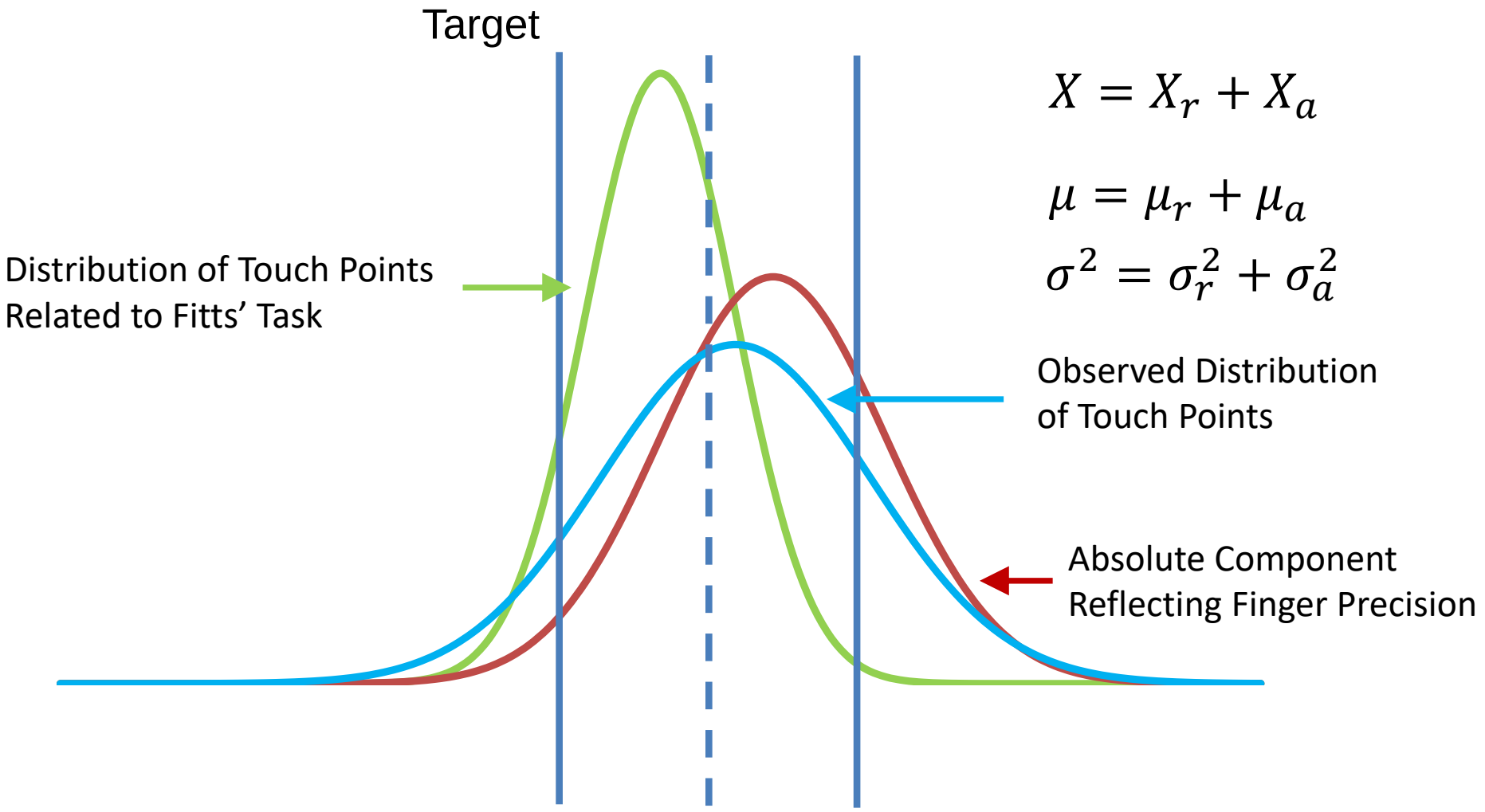
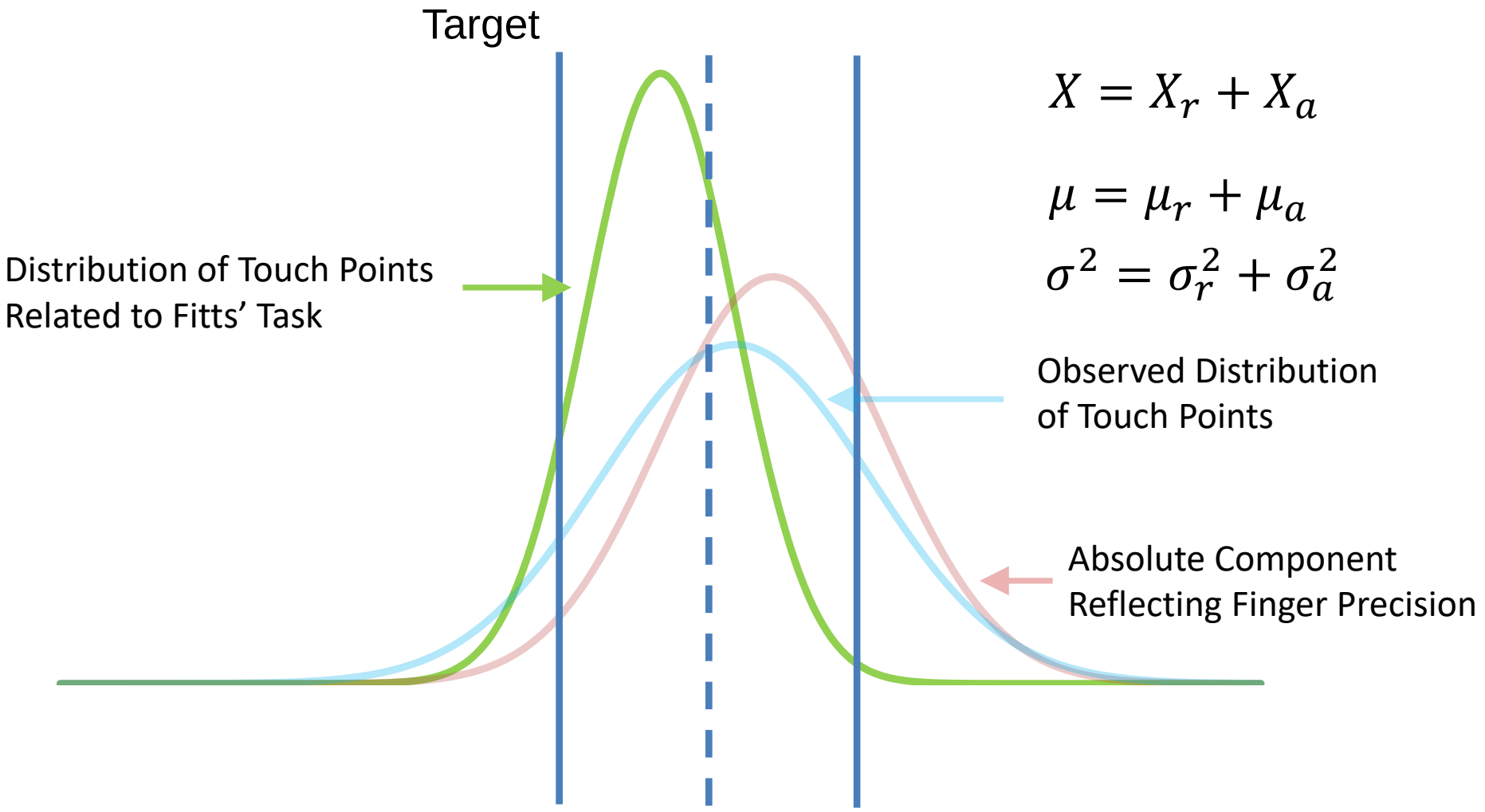


$$X = X_r + X_a$$

$$\mu = \mu_r + \mu_a$$

$$\sigma^2 = \sigma_r^2 + \sigma_a^2$$

$X_r \sim N(\mu_r,\ \sigma_r^2)$ $X_a \sim N(\mu_a,\ \sigma_a^2)$ $X \sim N(\mu,\ \sigma^2)$



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Deriving FFitts Law

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$$T = a + b \log_2 \left(\frac{A}{\sqrt{2\pi e}\sigma_r} + 1 \right)$$ Eq. 1

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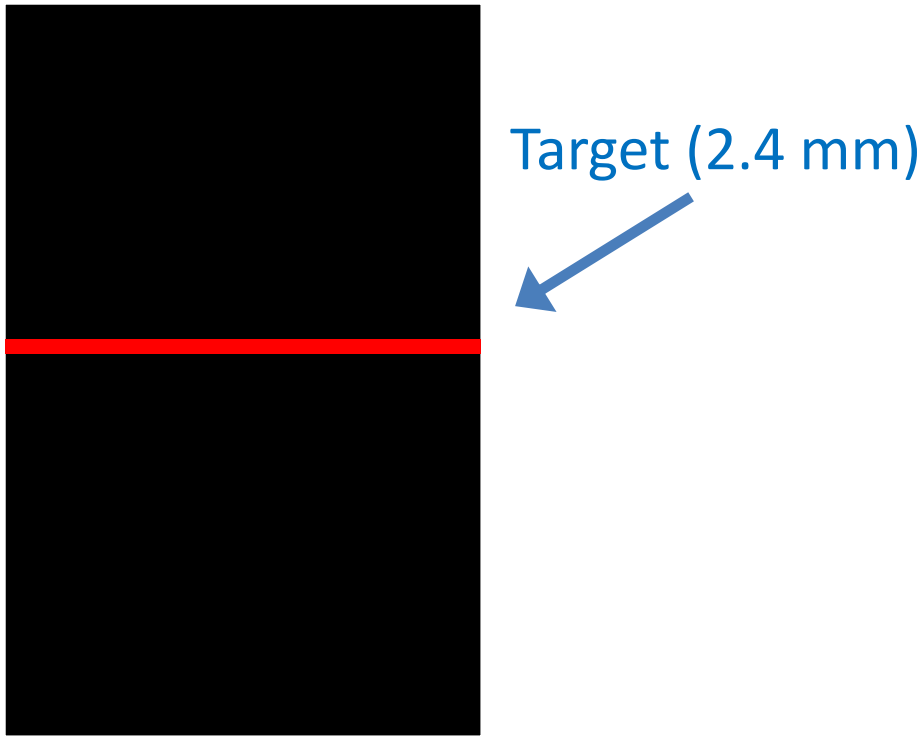
$$T = a + b \log_2 \left(\frac{A}{\sqrt{2\pi e(\sigma^2 - \sigma_a^2)}} + 1 \right)$$

Computing σ_a via Calibration Expt.



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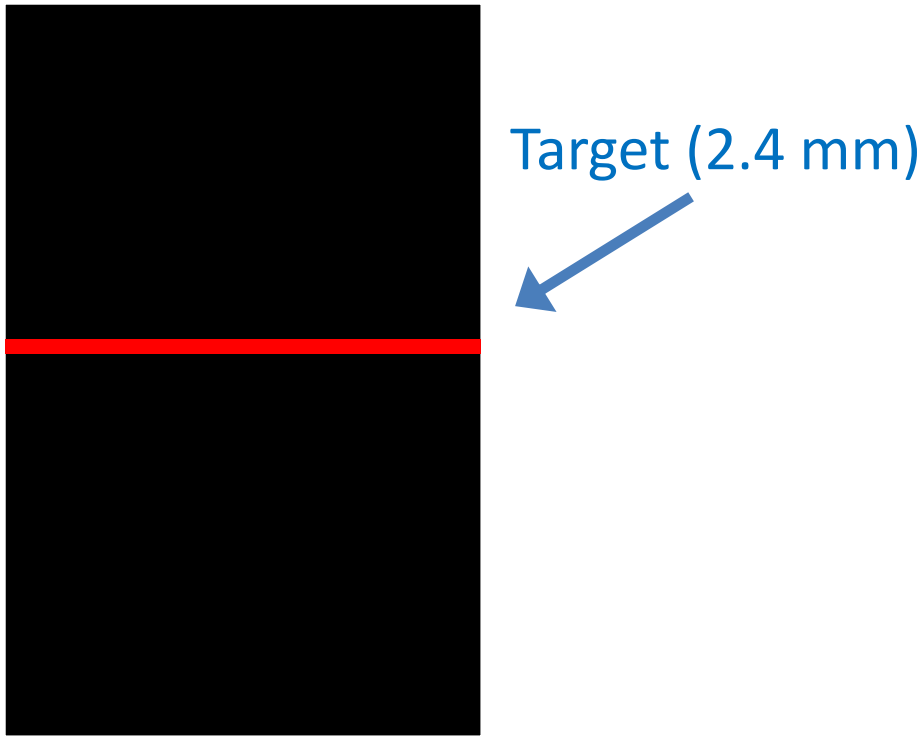
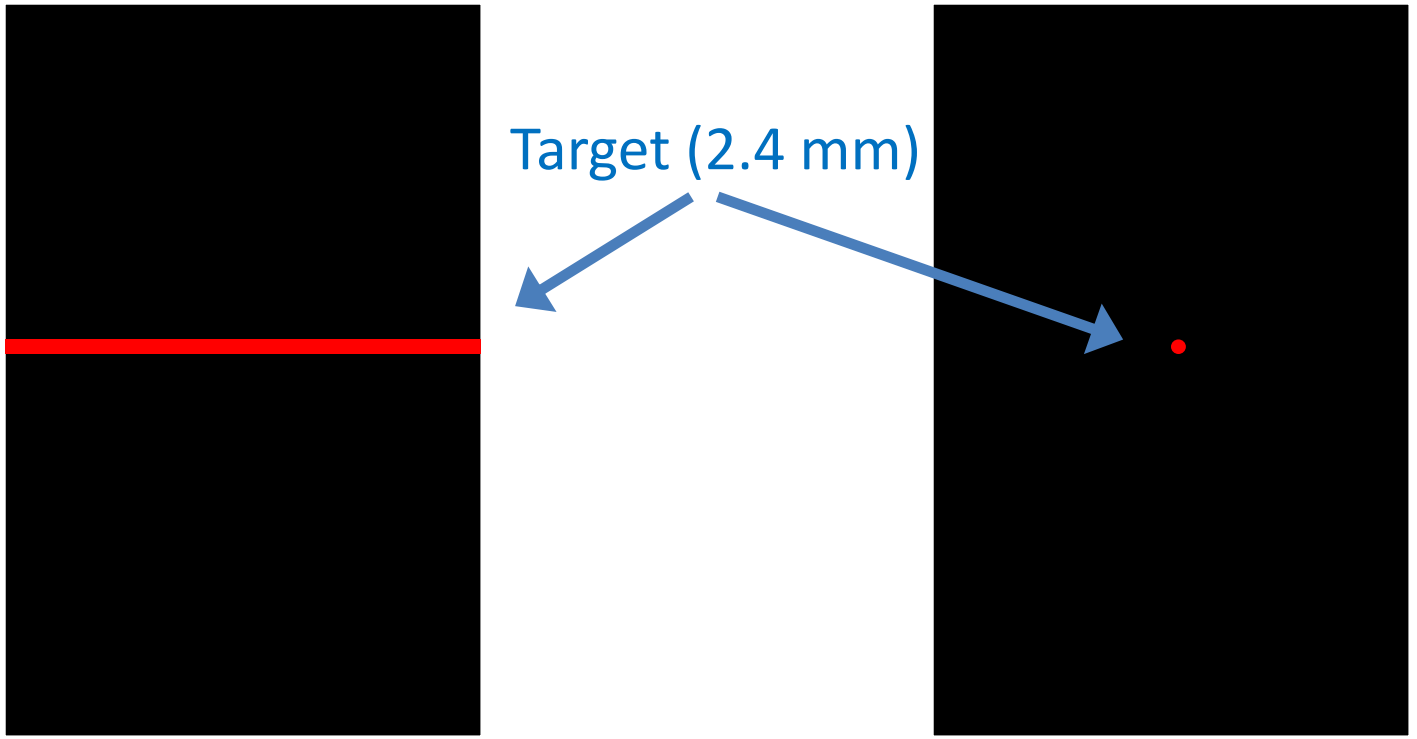


σ_a=0.94 mm (1D)

Computing σ_a via Calibration Expt.



σ_a=0.94 mm (1D)

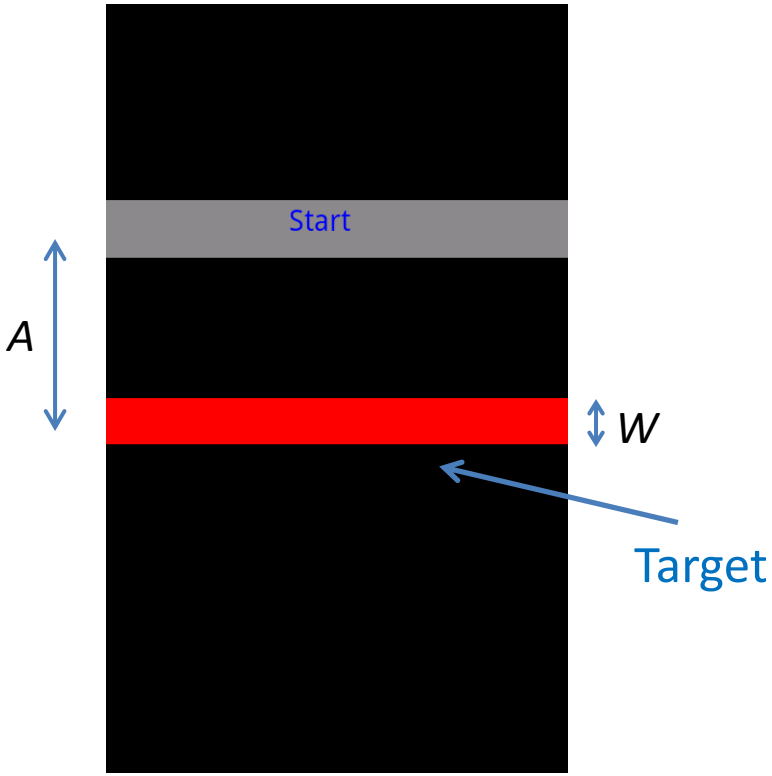
σ_a = 1.5 mm (2D)

FFitts Law

$$T = a + b \log_2 \left(\frac{A}{\sqrt{2\pi e(\sigma^2 - \sigma_a^2)}} + 1 \right)$$

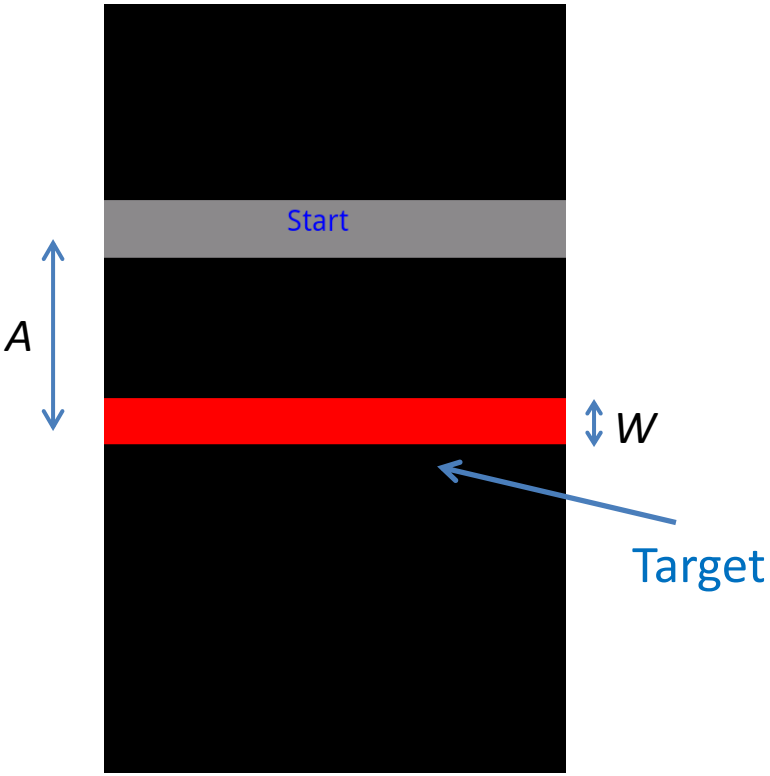
Index Finger: σ_a=0.94 mm (1D) , σ_a = 1.5 mm (2D)

Expt 1. 1D Fitts' Tasks



Expt 1. 1D Fitts' Tasks

2 Levels: 20, 30 mm



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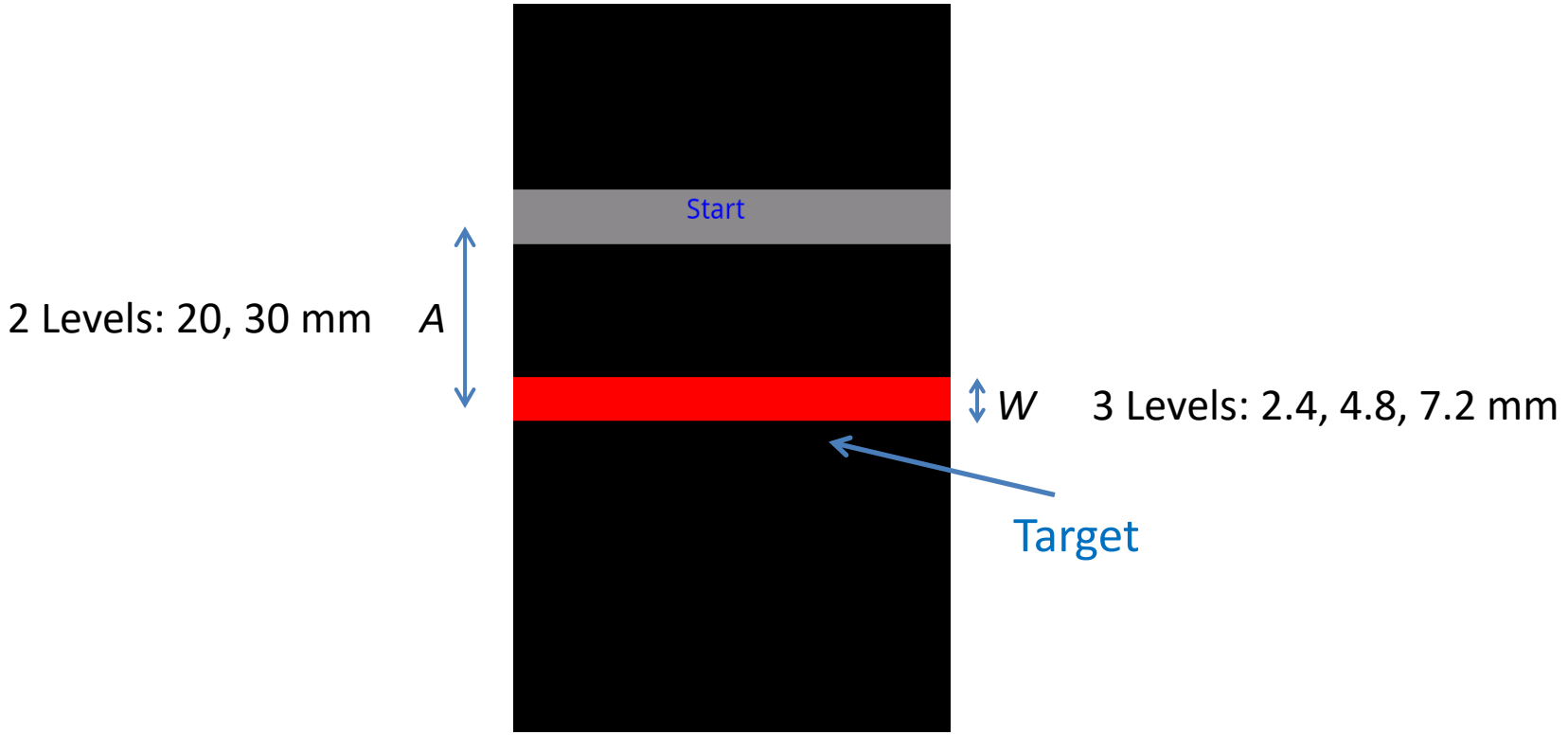

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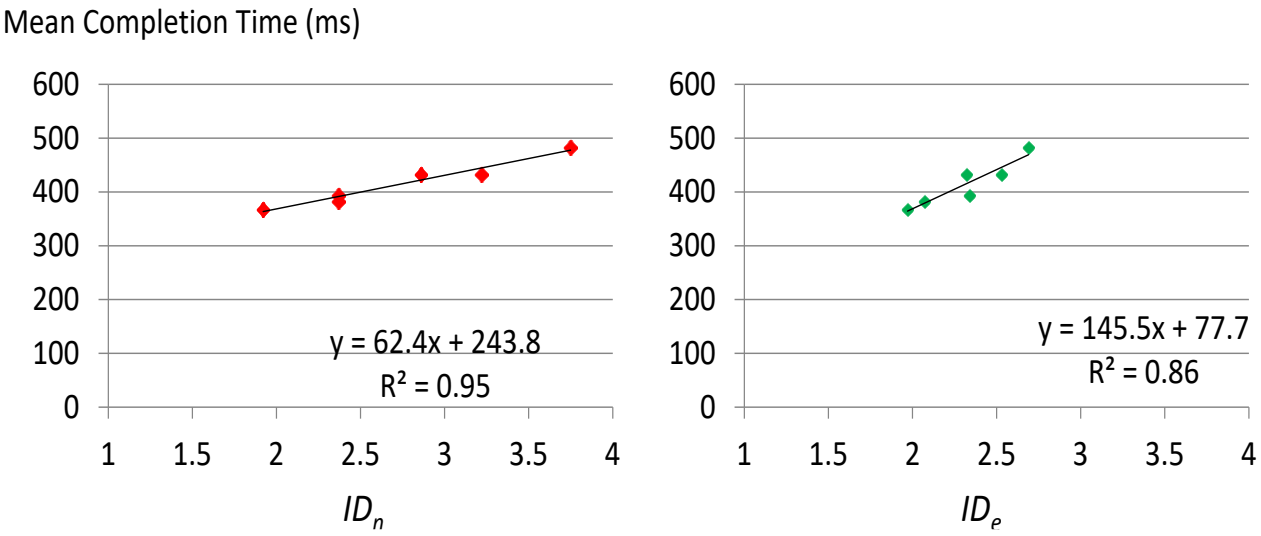
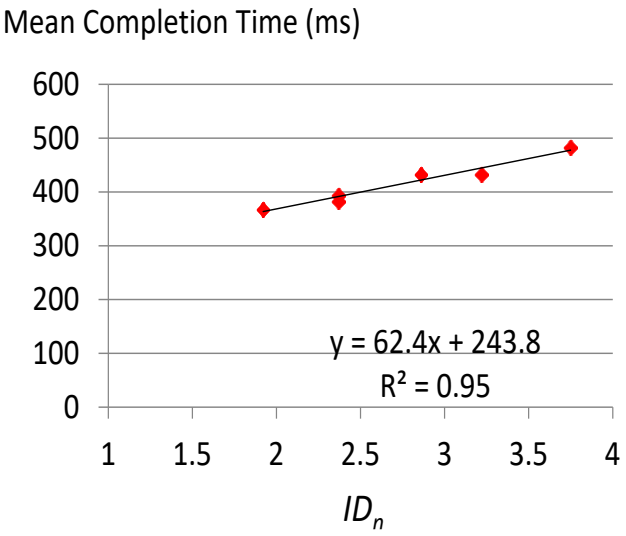


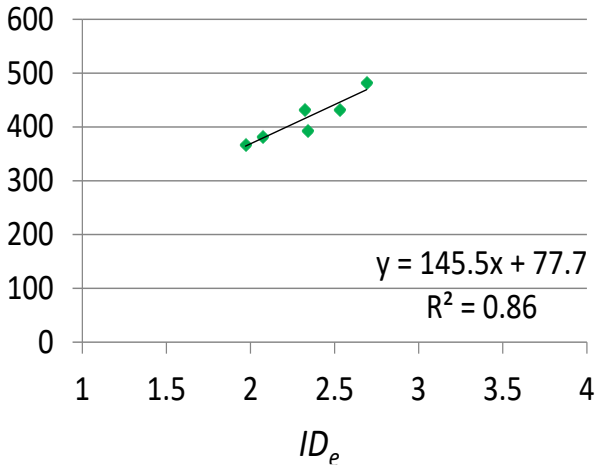
$$ID_{\boldsymbol{n}} = \log_2\left(\frac{A}{W} + 1\right)$$

$$ID_{\boldsymbol{e}} = \log_2\left(\frac{A}{\sqrt{2\pi e\sigma}} + 1\right)$$

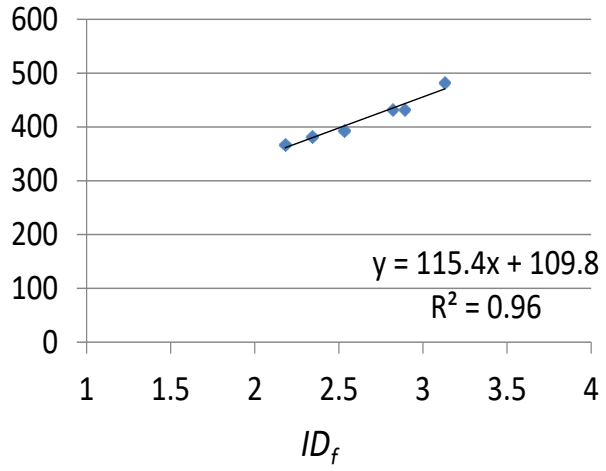
Expt 1. 1D Fitts' Tasks



$$ID_n = \log_2\left(\frac{A}{W} + 1\right)$$

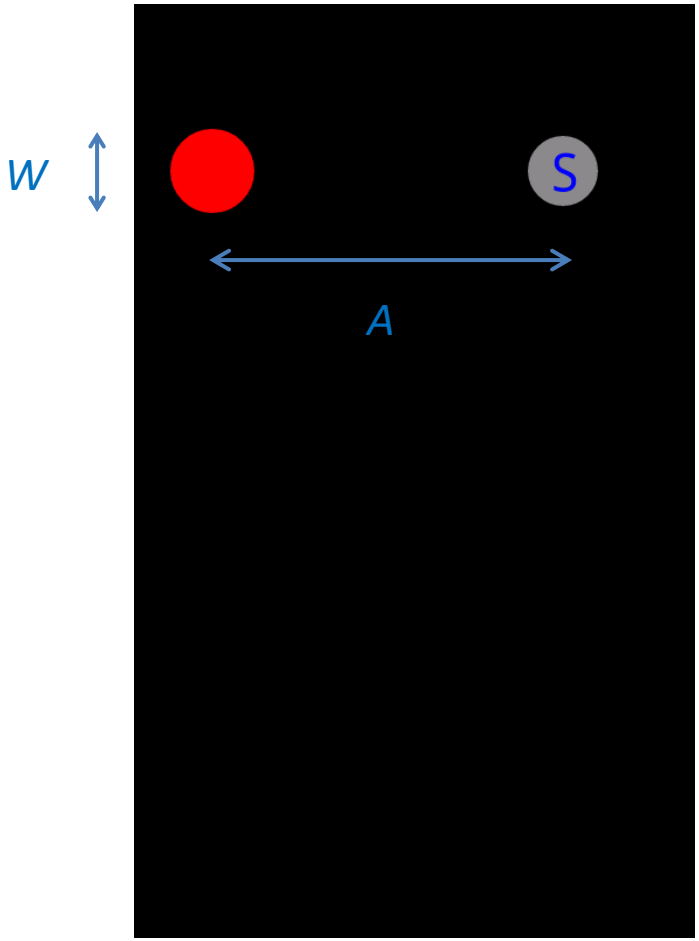


$$ID_e = \log_2\left(\frac{A}{\sqrt{2\pi e}\sigma} + 1\right)$$



$$ID_f = \log_2\left(\frac{A}{\sqrt{2\pi e(\sigma^2 - \sigma_a^2)}} + 1\right)$$

Expt 2. 2D Fitts' Law



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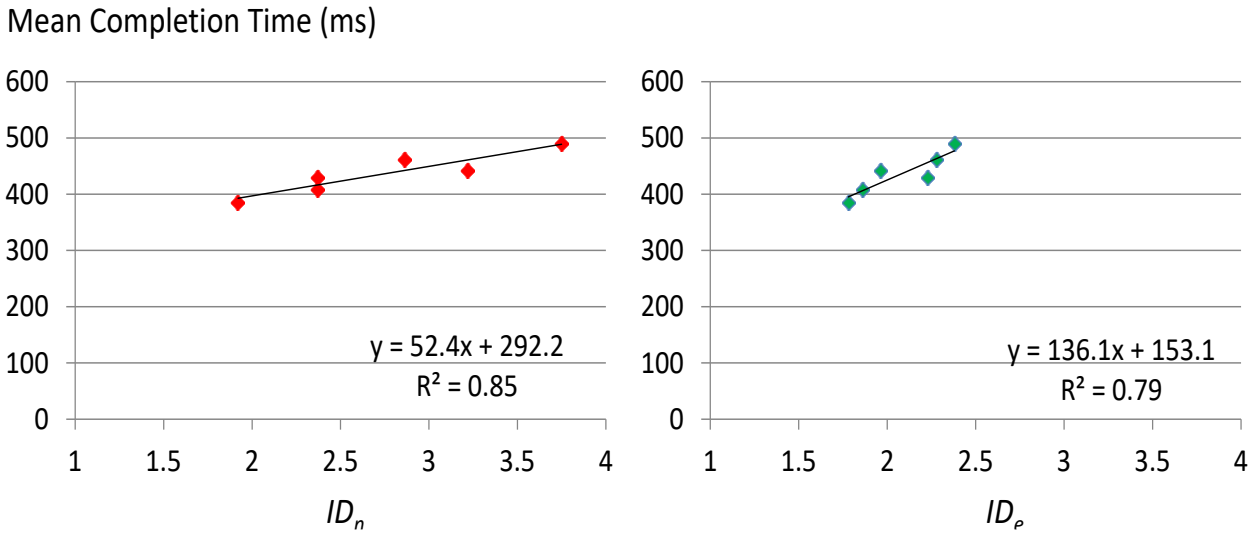

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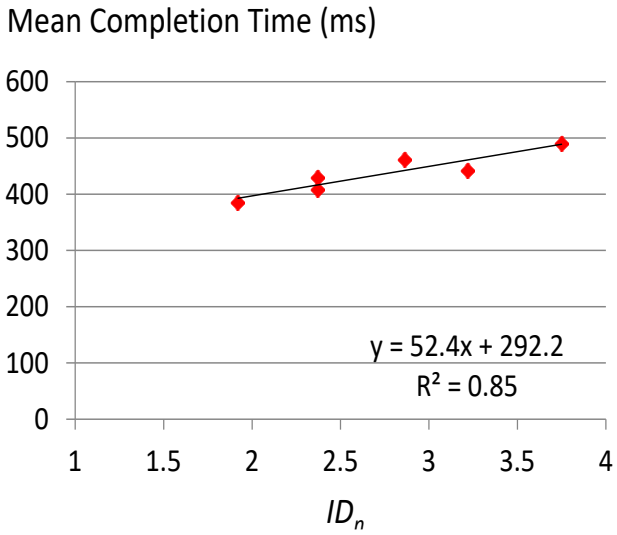
Expt 2. 2D Fitts' Law



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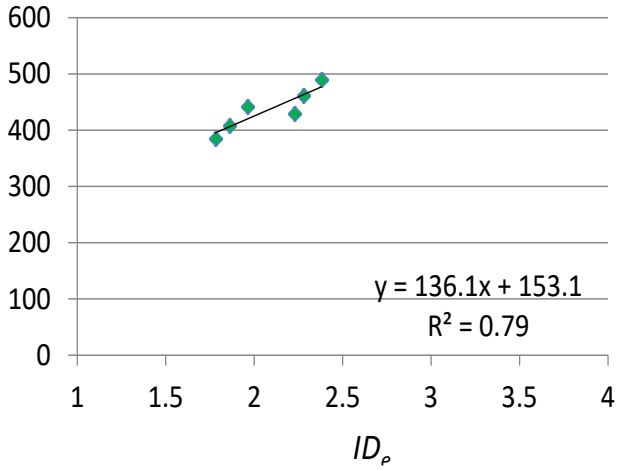

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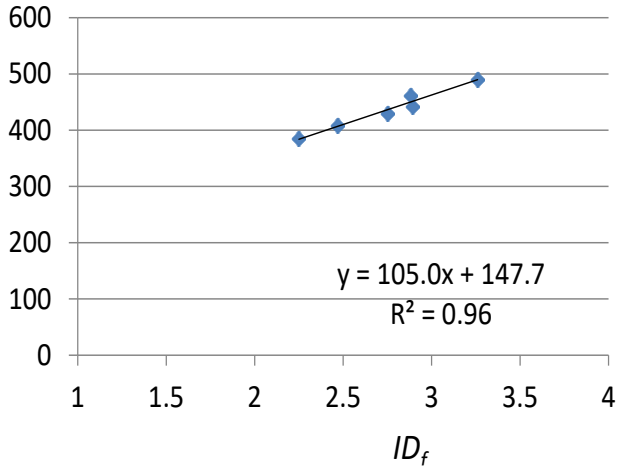
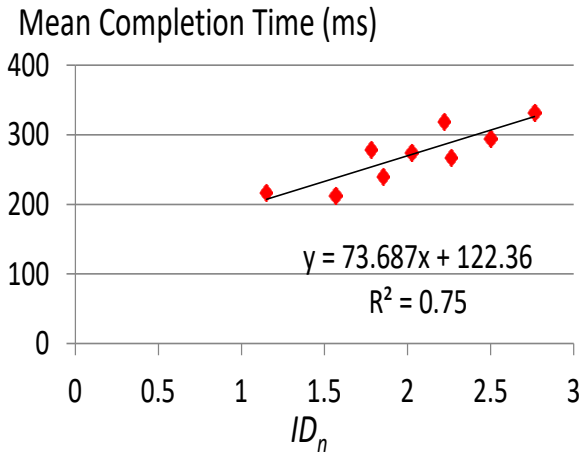


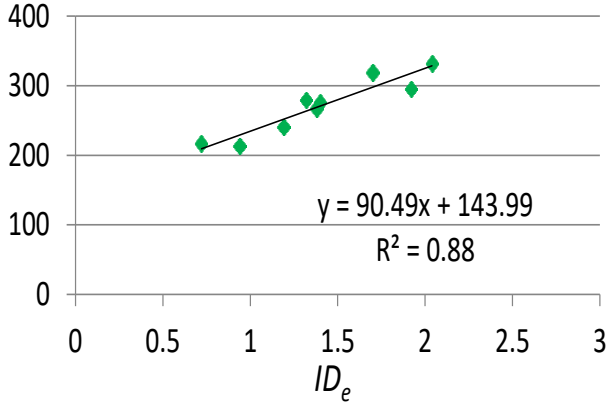
$$ID_f = \log_2\left(\frac{A}{\sqrt{2\pi e(\sigma^2 - \sigma_a^2)}} + 1\right)$$

Expt 3. FFitts Model in Text Input

Expt 3. Text Entry Study

Text Entry Study





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Expt 3. Text Entry Study

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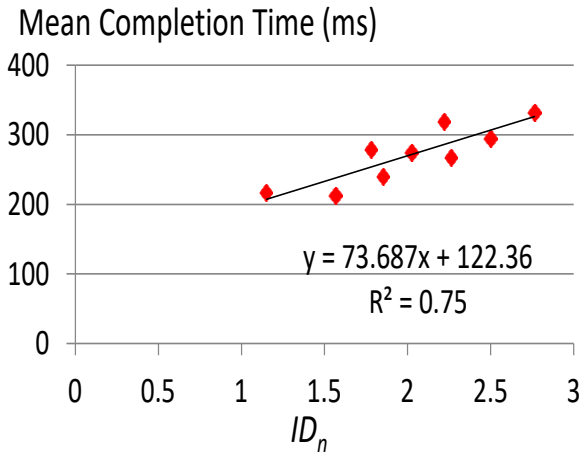

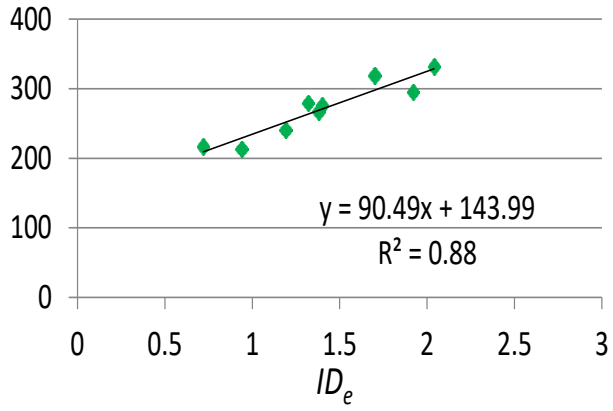

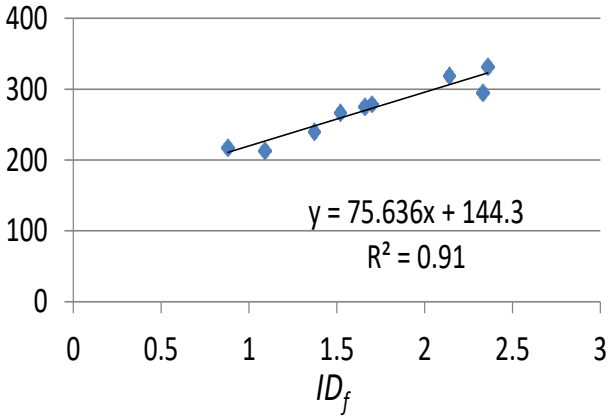

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$$ID_{\boldsymbol{e}} = \log_2\left(\frac{A}{\sqrt{2\pi e}\sigma} + 1\right)$$

$$ID_f = \log_2\left(\frac{A}{\sqrt{2\pi e(\sigma^2 - \sigma_a^2)}} + 1\right)$$

FFitts Law

$$T = a + b \log_2 \left(\frac{A}{\sqrt{2\pi e(\sigma^2 - \sigma_a^2)}} + 1 \right)$$

σ: the standard deviation of touch points

σ_a: the absolute precision of the input finger

Index Finger: σ_a=0.94 mm (1D) , σ_a = 1.5 mm (2D)