
A conceptual framework for the use of Fitts' Law to detect Intentional Misrepresentation of Skills and/or Abilities (IM) in Paralympic athletics

Rebecca L Deuble, Mark J Connick, Emma M Beckman, Bruce Abernethy, Sean M Tweedy

The University of Queensland, School of Human Movement Studies,
QLD 4072, Australia

Introduction

“In athletics there's always been a willingness to cheat if it looks like you're not cheating. I think that's just a quirk of human nature”

Kareem Abdul-
Jabbar



Introduction – Classification and IM in Paralympic Sport

- Purpose of classification in Paralympic sport is to minimise the impact of impairment on the outcome of competition
 - **Paralympic Athletics and focused on 5 impairment types**
 - Impaired Strength
 - Impaired Range of Movement
 - Ataxia
 - Hypertonia
 - Athetosis
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Introduction - subjective vs. objective tests of Impairment

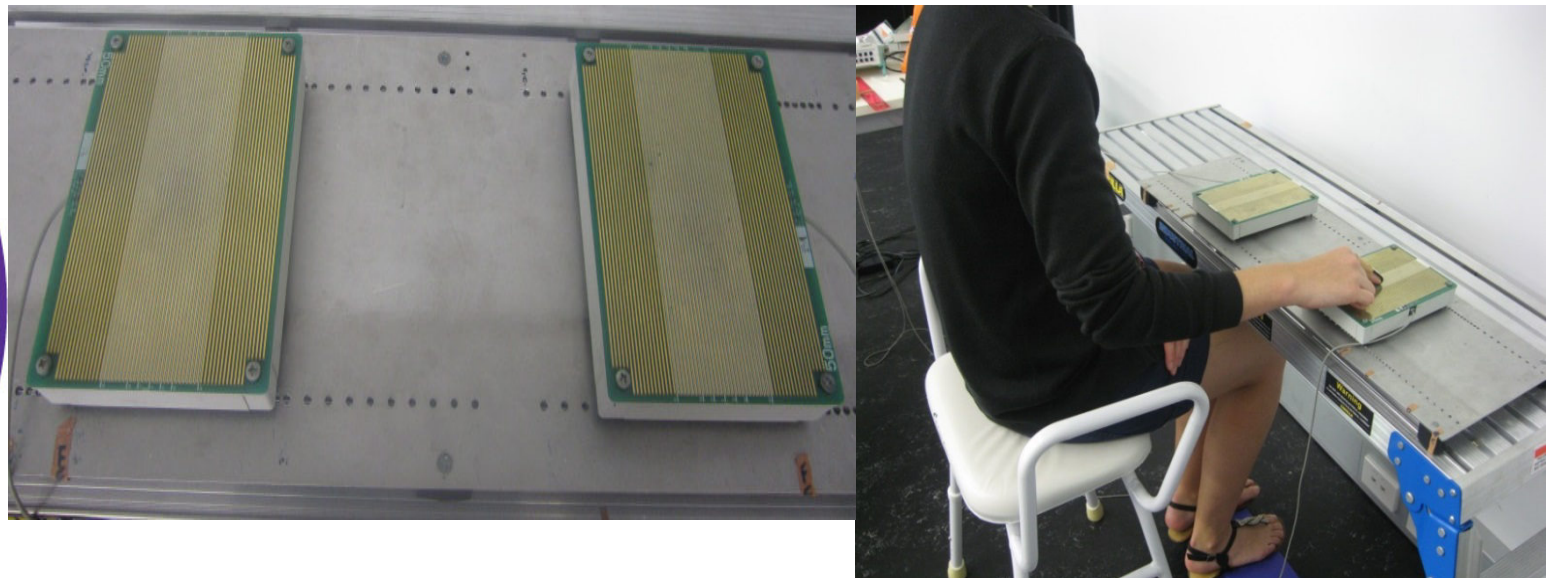
- Currently use subjective tests rely on clinical judgement
- Measure of impaired coordination: Finger to Nose Test
- IPC mandated development of evidence-based methods of classification
- Objective tests are required which are valid and reliable, so we can look at the relationship between impairment and performance



The finger-to-nose test.

Objective Test of Impaired Coordination

- Upper Limb Reciprocal Tapping Task
- Objective – measures movement time
- Maximal speed = a valid classification system



Overview of Problem: Intentional Misrepresentation of Skills and/or Abilities (IM)

“Form of cheating in which athletes attempt to exaggerate impairment severity by not fully cooperating on impairment tests” (IPC, 2007)

- Severe punishments are available but not enforced
- Currently no objective tests of impairment to facilitate detection

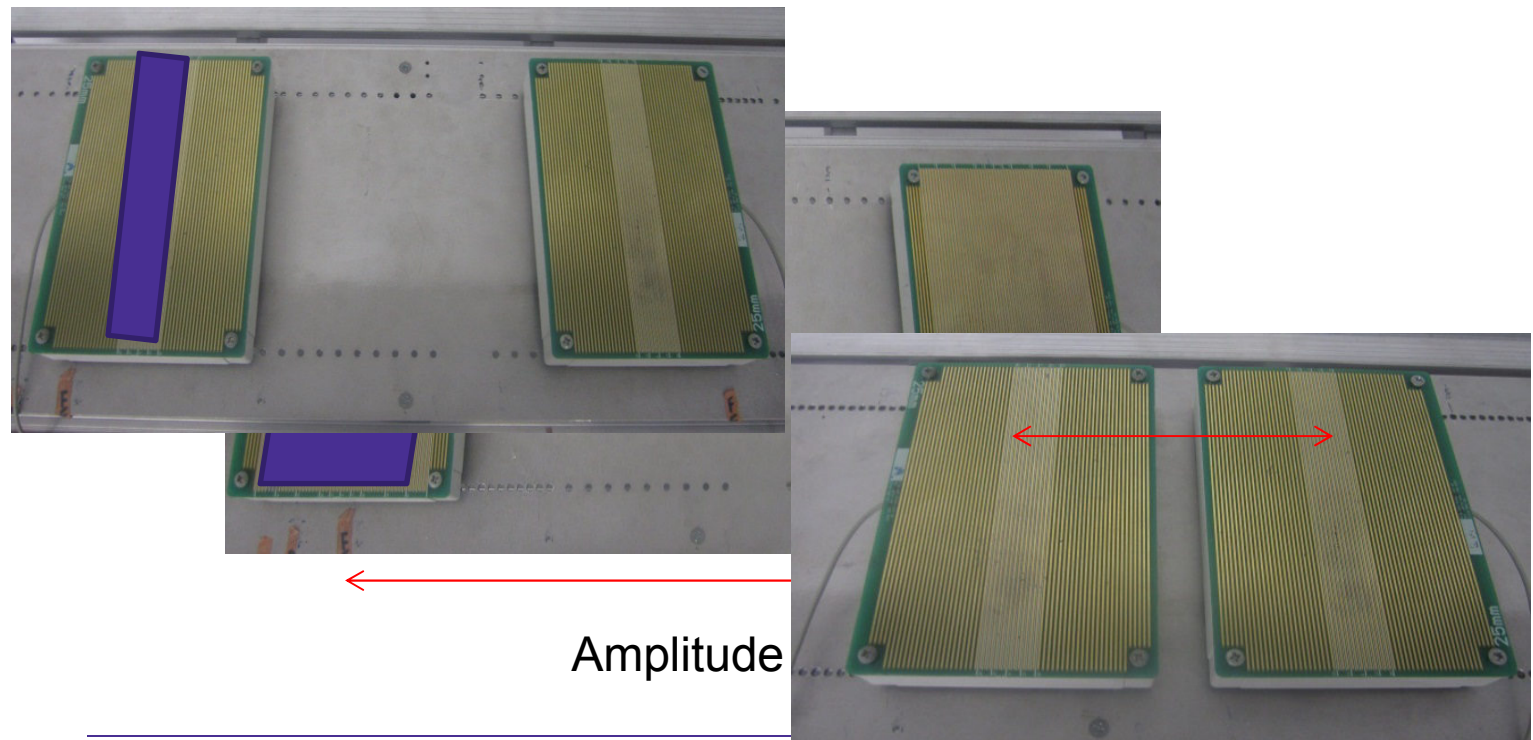
Research Aim: To develop and evaluate objective methods which can distinguish maximal test results from submaximal

- Closely linked with developed tests of impairment
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Fitts' Law

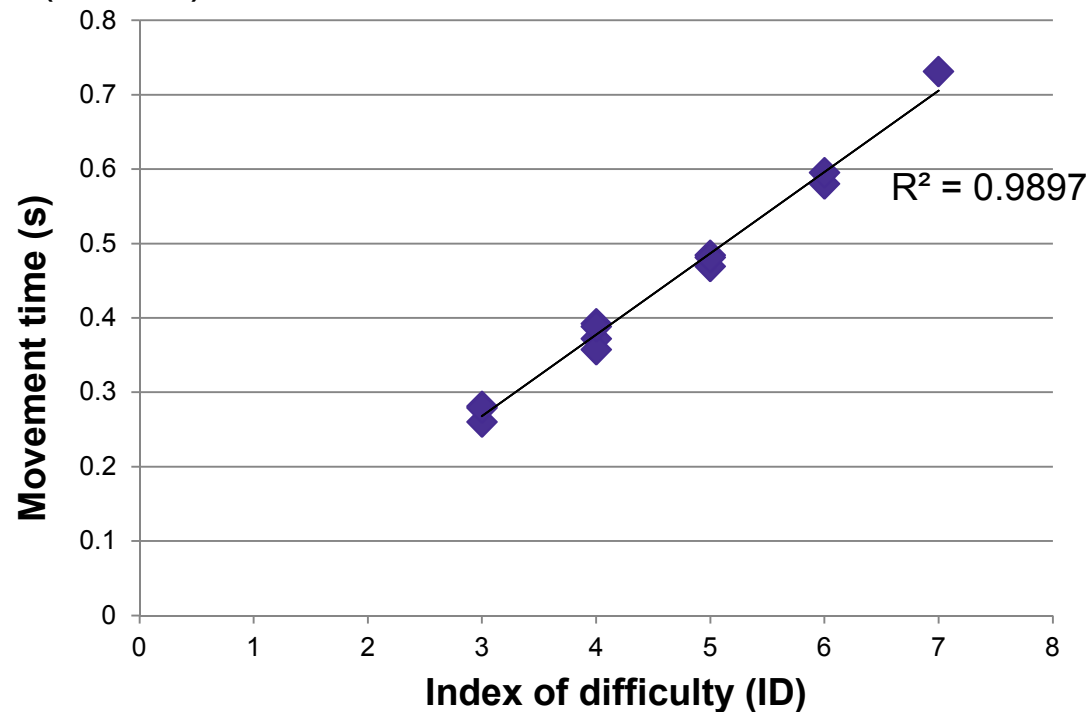
- Describes established log-linear relationship between movement time and index of difficulty: $ID = \log_2 (2A/W)$

Where A = amplitude and W = target width (Fitts, 1954)



Fitts' Law Relationship

Fitts Original Study (1954) – Results from Reciprocal Tapping Task
(n = 16)



Under maximal effort conditions – “as fast and as accurately as possible”)

Fitts Law Literature – Submaximal Effort

Maruff and Velakoulis (2000)

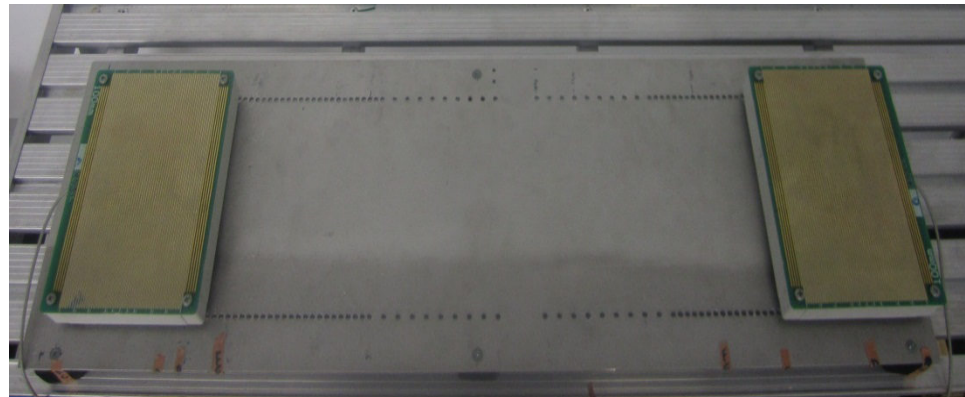
Individuals who feigned an arm injury during visually guided pointing task were unable to conform to Fitts law.

	Feigning an injury (n =10)	Controls (n =10)
Linear Regression	0.10	0.67**

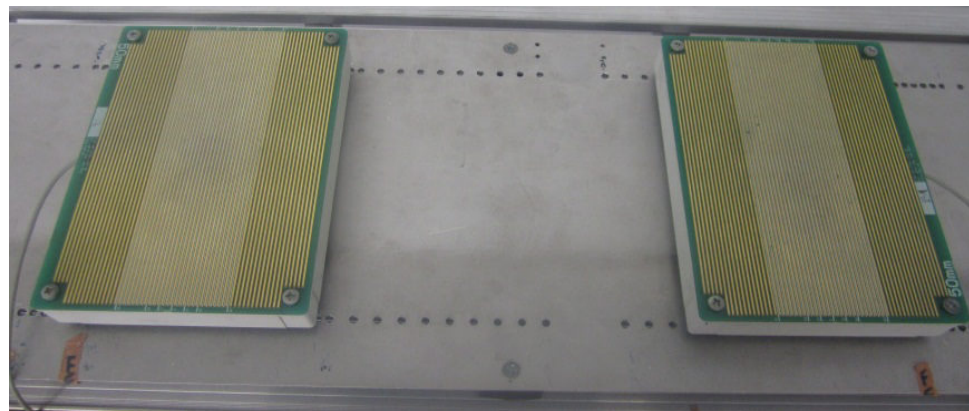
(*p < 0.01)

Note: individuals in this study were completely naive to purpose of study and had not completed task previously

Equivalent IDs with different configurations



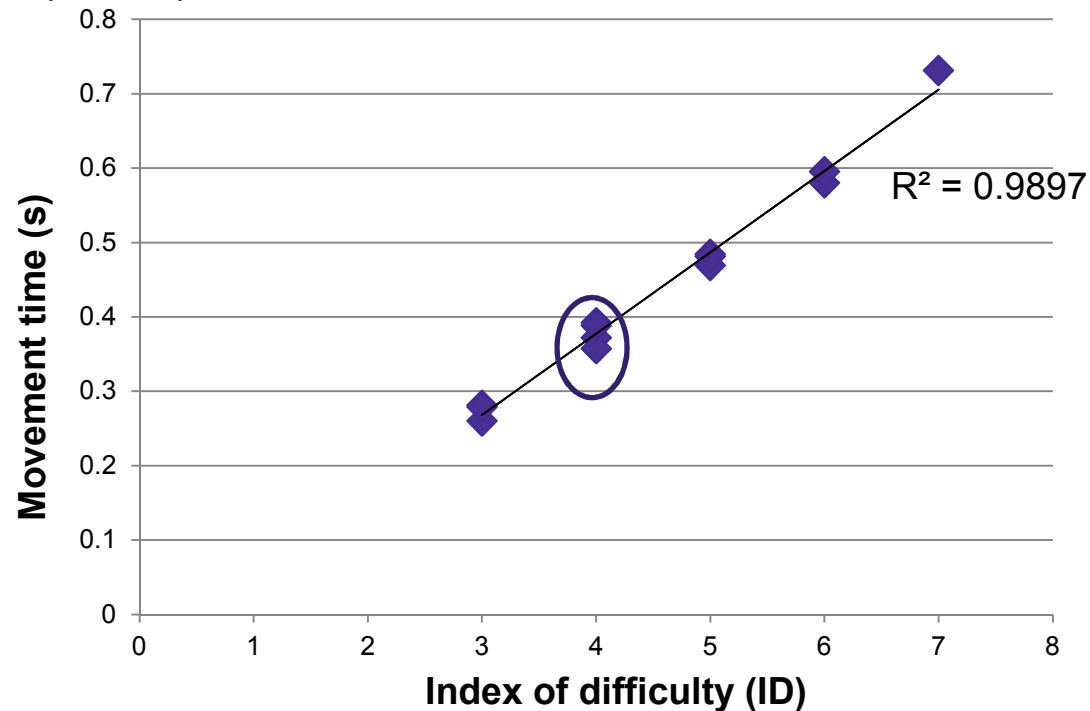
Amplitude = 606mm
Width = 100mm
ID = 3.6



Amplitude = 304mm
Width = 50mm
ID = 3.6

Fitts' Law Relationship

Fitts Original Study (1954) – Results from Reciprocal Tapping Task
(n= 16)

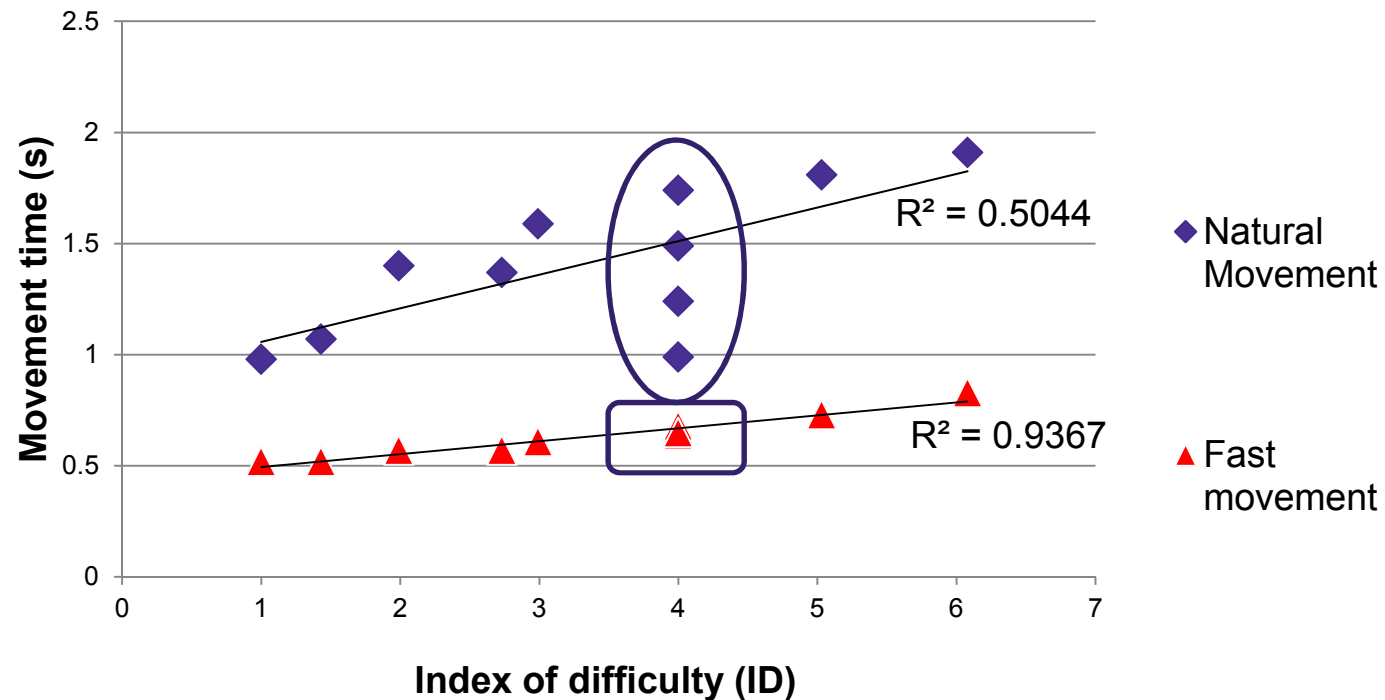


Under maximal effort conditions – “as fast and as accurately as possible”)

Fitts' Law literature – Submaximal Effort

Young et al. 2009

Significant differences in movement times for four different configurations of same ID (equivalent difficulty) were achieved by healthy individuals moving at submaximal speeds (n = 12)



Experiment 1: Using Fitts' law to Detect Intentional Misrepresentation of Skills and/or Abilities in a Reciprocal Tapping Task

The primary aim of this study is to:

- 1) Determine whether participants can intentionally move at submaximal speeds and produce a relationship between movement time and ID which conforms to Fitts' law
 - Strength of association
 - Difference in movement times for IDs that are the same difficulty but differently configured

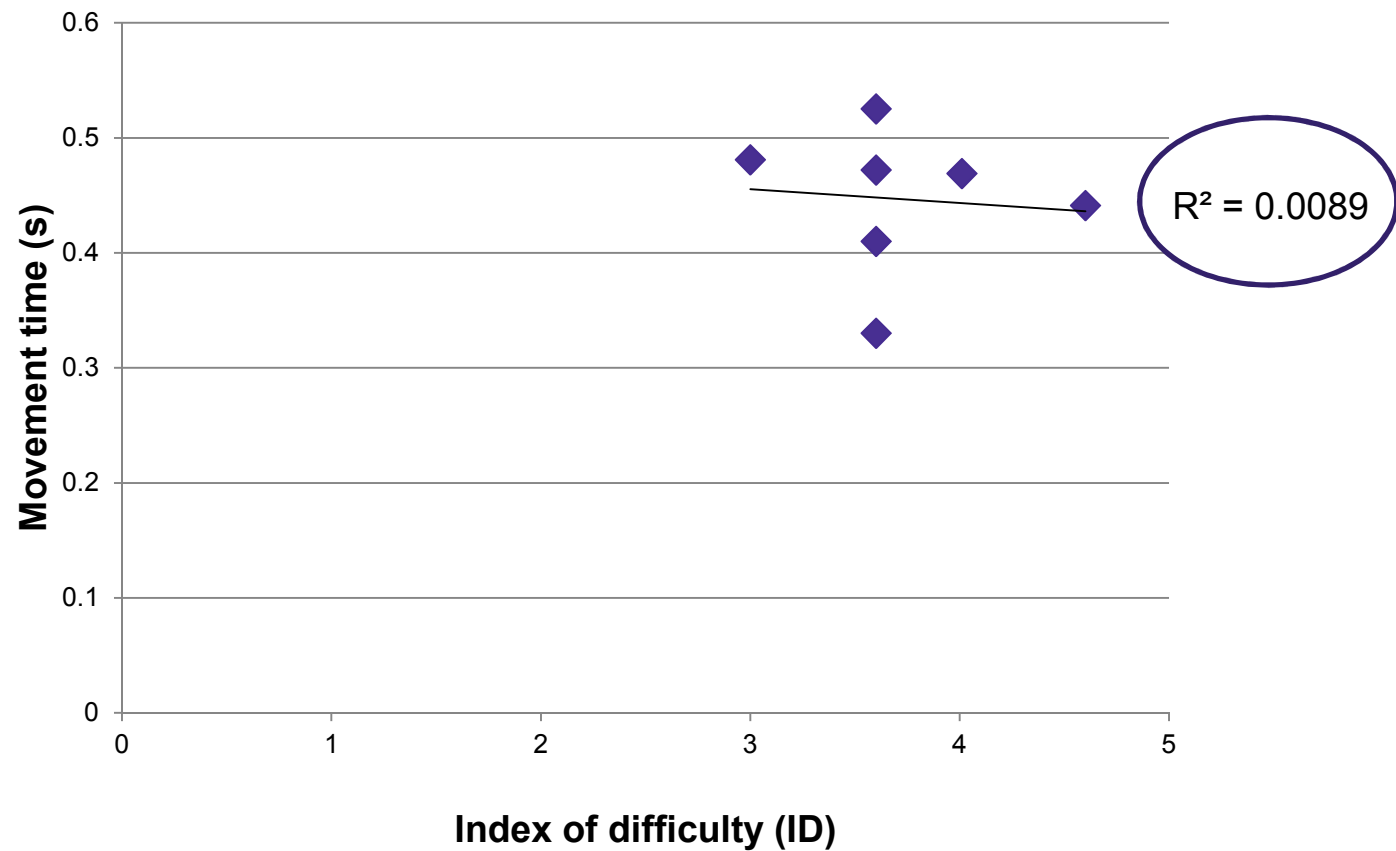
Participants: 30 non-disabled participants aged between 18-35

Methods: Reciprocal tapping task performed with dominant hand across 7 IDs (4 of the 7 were identical in difficulty but configured differently)

- Task performed on 3 separate occasions
 - Maximal and Cheating Conditions
 - Monetary reward: \$100, \$50, \$25 awarded to three participants who are best able to conform to Fitts' law while moving at slower speeds
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Results – cheating example

Cheating attempt example



Preliminary Results

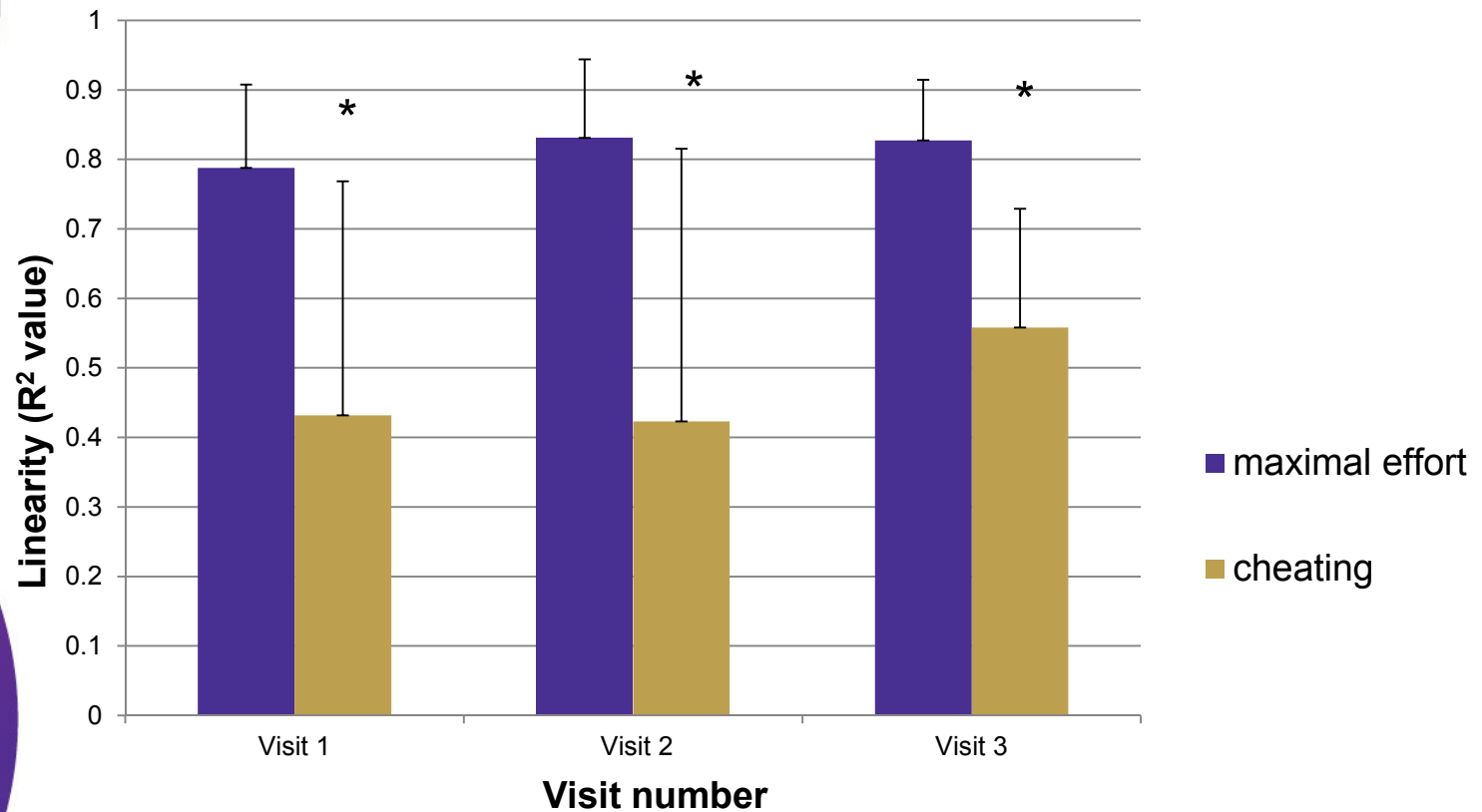
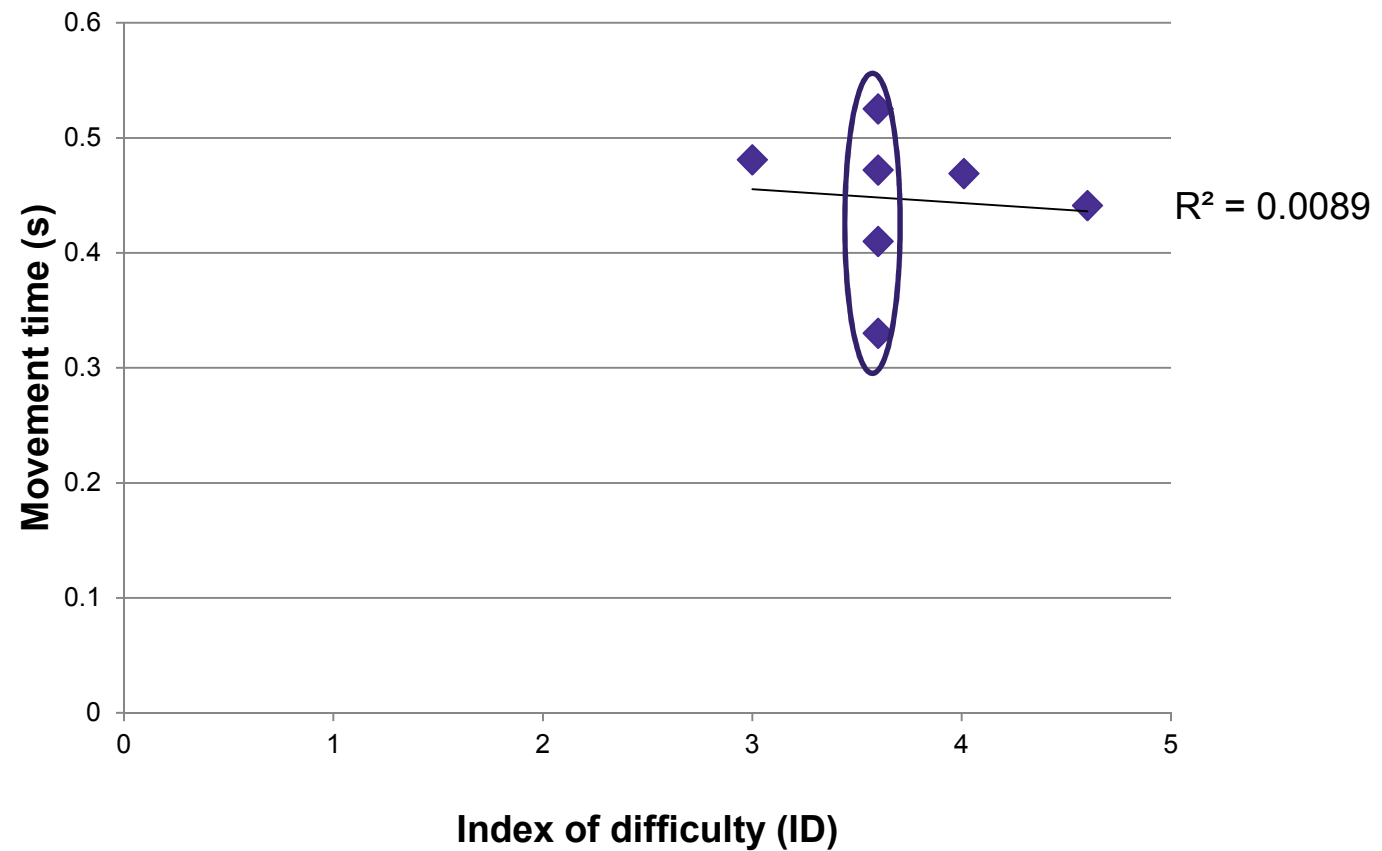


Figure 1: Average R² (+ SD) achieved for both maximal and cheating efforts (n = 10) for each of the three visits. (* indicates p < 0.05)

Potential criteria for identifying IM

Cheating attempt example



Preliminary Results

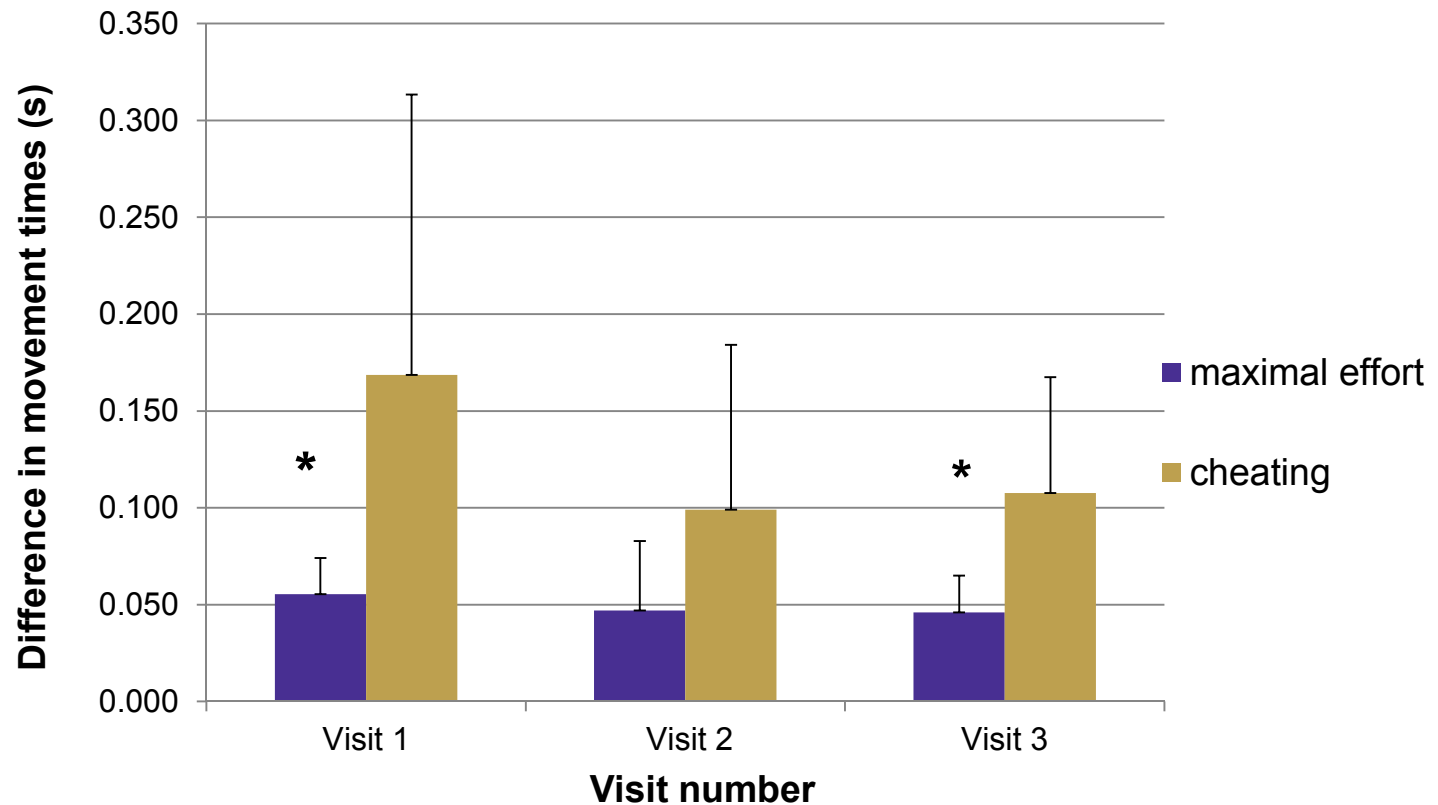


Figure 2: Mean Differences (+ SD) between the fastest and the slowest movement times for IDs 3.6 (a, b, c, d), for both maximal and cheating efforts. (n= 10) (* p<0.05)

Future Analysis

- Results from preliminary **group level analysis** highlight Fitts' law's potential to differentiate between maximal and cheating efforts
 - Receiver Operating Characteristic (ROC) curve analysis will confirm sensitivity and specificity of method – **individual analysis** (if want to differentiate at individual level)
 - Stability of measure over time
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Thanks you!

Questions and comments?

References

- Fitts PM. The information capacity of the human motor system in controlling the amplitude of movement. *J Exp Psychol* 1954 Jun; 47 (6): 381-91
- International Paralympic Committee. International Paralympic Committee Classification Code and International Standards. Bonn International Paralympic Committee 2007
- Maruff P, Velakoulis D. The voluntary control of motor imagery. Imagined movements in individuals with feigned motor impairment and conversion disorder. *Neuropsychologia* 2000; 38 (9): 1251-60
- Tweedy SM, Vanlandewijck YC. International Paralympic Committee position stand--background and scientific principles of classification in Paralympic sport. *Br J Sports Med* 2011 Apr; 45 (4): 259-69
- Young SJ, Pratt J, Chau T. Target-Directed Movements at a Comfortable Pace: Movement Duration and Fitts's Law. *Journal of Motor Behavior* 2009 Jul; 41 (4): 339-46
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