2011

# Learning from Mistakes: Improving Initial Fingertip Force Scaling by Observing Lifting Errors

Gavin Buckingham
*The University of Western Ontario*, gbucking@uwo.ca

Minnie Tang
*The University of Western Ontario*, mtang54@uwo.ca

Paul Gribble
*The University of Western Ontario*, paul@gribblelab.org

Melvyn A. Goodale
*The University of Western Ontario*, mgoodale@uwo.ca

# Learning from mistakes:
# Improving initial fingertip force scaling by observing lifting errors

Gavin Buckingham, Minnie Tang, Paul Gribble & Melvyn A. Goodale
Centre for Brain and Mind, University of Western Ontario, Canada;
**Email:** gbucking@uwo.ca; **Web:** http://publish.uwo.ca/~gbucking

## Introduction

• When lifting objects that are lighter or heaver than we expect them to be, individuals typically misapply forces in a way that reflects their prior expectations of heaviness.

• Because we lift in this predictive way, large and small cubes elicit these characteristic errors even when they are adjusted to have equal mass. Lifters will apply too much force to a large cube and substantially less force to a small cube – errors that are rapidly corrected with repeated lifts (Flanagan & Beltzner, 2000).

• When watching others lift objects, an observer's motor system automatically reacts in a way that reflects the object's weight (Alaerts et al., 2010). It is, however, unclear how the motor system reacts to observing lifting **errors**.

• To examine how observing an action improves motor learning in the context of fingertip force scaling, participants watched a video of an object lifting task before lifting equally-weighted large and small cubes themselves.

• To determine what style of kinematic information is more valuable to observe, participants watched either **error filled, first-time lifts** or **error free, expert lifts** before lifting these equally-weighted small and large cubes themselves.

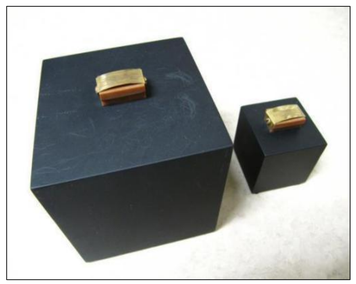
## Materials & methods

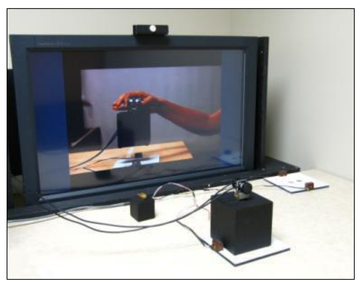
• Forty participants in were randomly divided into two groups: Error video (**EV**) or No error video (**NEV**).

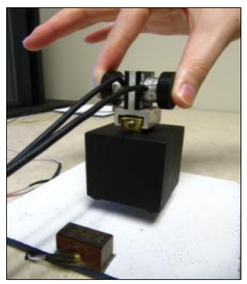
• Participants in the **EV group** watched a short video montage of 6 naïve actors lifting large and small 700 g cubes for the first time, **making visually-subtle lifting errors**.

• Participants in the **NEV group** watched a video montage of the same 6 actors performing well-practiced lifts, **making minimal errors** and applying similar forces to the same small and large cubes.

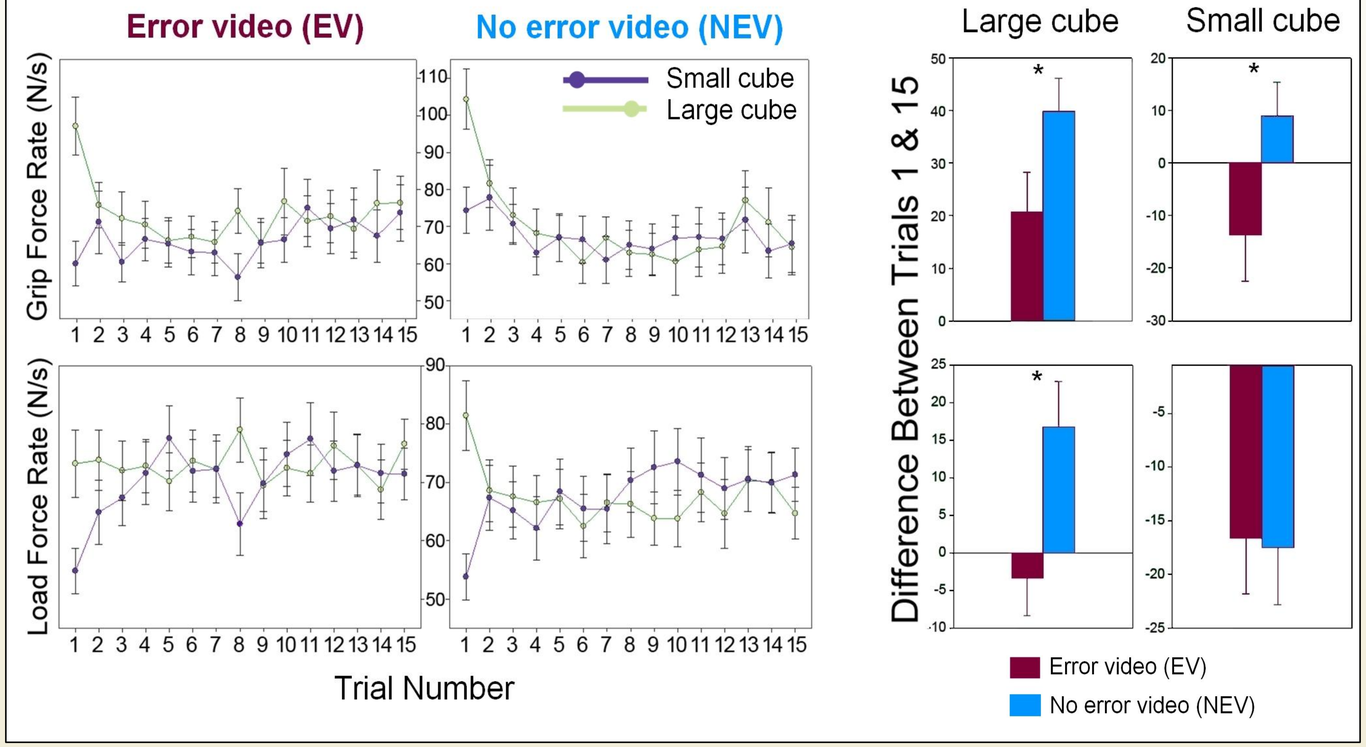
• Participants then lifted the large and small cubes in alternation 15 times, while fingertip forces were recorded by a 6-axis force transducer mounted in a handle. The maximum rates of change of the grip and load force were examined.







## Results




## Discussion

• All participants made expectation-style errors, lifting the identically-weighted small and large cubes with different forces from one another on the first trial. These errors were rapidly corrected with repeated lifts.

• Relative to their well-practiced lifts, however, participants in the EV group made smaller errors on the initial trial than participants in the NEV group.

• When objects are unexpectedly light or heavy, the information contained in the kinematics of expectation-style errors is a better cue to the upcoming force requirements than the kinematics of perfect performance.

• Observation of errors may be crucial to successful motor learning.

## References

Alaerts, K., Senot, P., Swinnen, S.P., Craighero, L., Wenderoth, N., & Fadiga, L. (2010). The force requirements of observed object lifting are encoded by the observer's motor system: a TMS study. *European Journal of Neuroscience*, *31*, 1144-1153.

Flanagan, J.R., & Beltzner, M.A. (2000). Independence of perceptual and sensorimotor predictions in the size–weight illusion. *Nature Neuroscience*, *3*, 737–741.

## Acknowledgements

The authors would like to thank J. Ladich for constructing the cubes, and H. Yang for technical support. We would also like to thank the actors who participated in the videos. The first author's attendance at this conference was supported by a NCM travel scholarship.