

Preliminary Results of the Effects of Progressive Lenses on Gait Performance among Different Age Groups

Autumn Milanowski, BS, Kurt Beschoner, PhD, Dennis Tomashek, MS, Roger O. Smith, PhD

Abstract

Background: Multifocal lenses (MfL) are designed for both near and distance viewing, distort vision in the lower part of the visual field at ground level while walking. Safe ambulation relies on the lower visual field to detect obstacles (Marigold et al, 2008). The need for investigating the connection between MfL glasses and falls is important for healthcare providers and fall preventative measures (Lord et al, 2002). Observing the effects of MfLs on age can determine MfLs as a moderating variable between vision and gait impairment.

Objective: This study will show that when wearing MfLs both young and middle-aged individuals will experience a significant decrease in functional gait performance compared to when wearing single lenses.

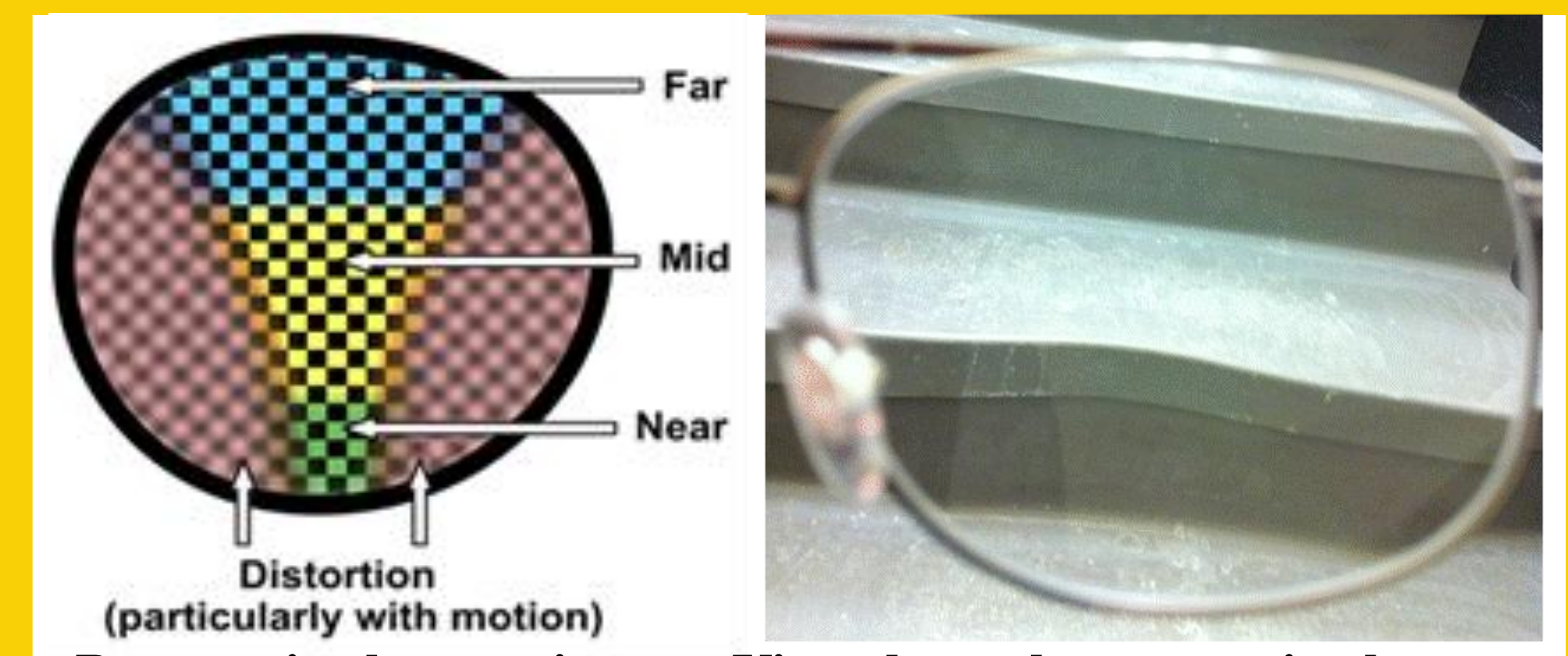
Participants: Twenty 18-35 year olds and fifteen 45-60 year olds who do not currently wear multifocal lens glasses and have no history of balance or gait impairments. Preliminary analysis of 5 young adults.

Design: A within-between subjects repeated measures MANOVA, with three biomechanical variables and a functional gait assessment (the Dynamic Gait Index) as the dependent variables. Lens condition (with or without progressives) and age group will be the independent variables.

Preliminary Results: Results from motion capture analysis of five young participants show an increase in toe clearance ($p < 0.05$) DGI-m results indicate a significant decrease in functional gait performance.

Background

It is estimated that over 85% of all adults over the age of 45 will develop presbyopia (Holden, 2008). This condition develops with age and causes loss of near distance viewing. Because of this dilemma, multifocal lenses, which include lined bifocals, trifocals, and progressive lenses, are often prescribed. Multifocal lenses (MfL) are designed for both near and distance viewing and result in distorted vision in the lower part of the visual field at ground level while walking. Safe ambulation relies on the lower visual field to detect obstacles (Marigold et al, 2008).



Progressive lens regions View through progressive lens
MfLs have been shown to cause a decrease in depth perception, contrast edge sensitivity, and functional mobility in different age groups (Smith et al; Lord, 2006; 2002). Falls risk increases as visual impairments become more severe (Hardwood, 2001). Falls increase with age due to a decrease in balance (Lord et al, 2005). Additionally, vision impairments increase with age, thus, vision acts as a moderating factor for increased fall rates as individuals age (Heasley et al, 2005).

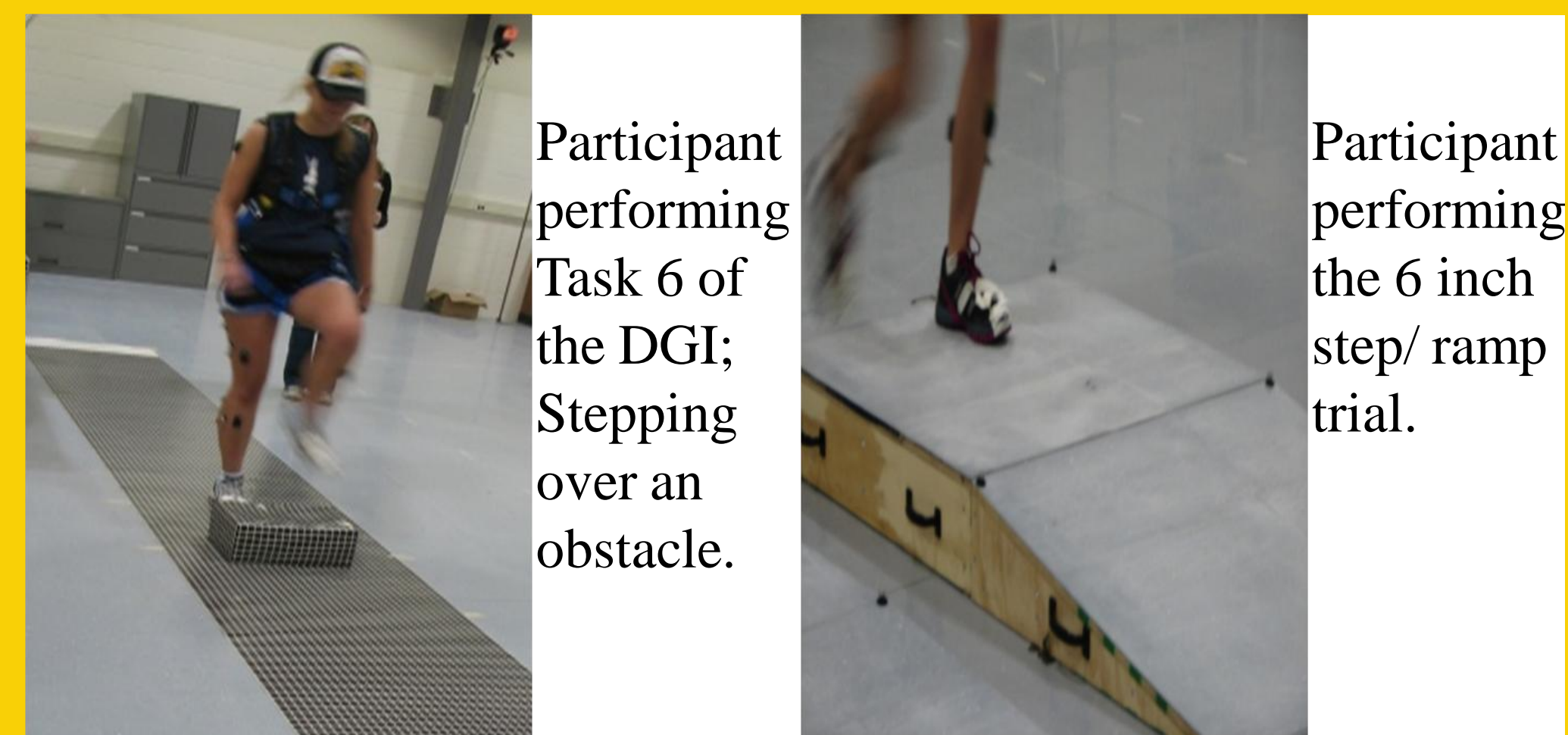
Hypotheses:

1. Young non-experienced MfL wearers will show a decreased functional gait performance when using MfL glasses compared to single lenses.
2. Middle-aged non-experienced MfL wearers will show a decreased functional gait performance when using MfL glasses compared to single lenses.
3. Given groups of individuals (young non-experienced MfL wearers and middle-aged non-experienced MfL wearers) will both show the same within group gait performance difference when using MfL glasses compared to single lenses when using three biomechanical instruments and the gait index.

Methods

This study examined performance of 5 healthy young adults while wearing +2.75 progressive lens and non-corrective single lens glasses for a 1.5 hour testing session. Dependent variables used in trials include: Dynamic Gait Index-modified (DGI-m) and biomechanical measurements. Participants performed 36 trials of a loop course. The loop course includes 15 meters of walking straight while encountering a ramp/step or step/ramp followed by a DGI-m task. Single and progressive lens glasses were switched every 18 trials.

DGI-m consists of 9 functional gait tasks that are scored by a trained rater. A perfect score is 45.



Biomechanical variables include: maximum normal force, toe clearance, and heel to step edge. Measurements were collected by applying 36 motion capture markers on participant's joint landmarks. Biomechanical variables were used while walking up the ramp/step or step/ramp.

Results

Preliminary analysis consists of the DGI-m and toe clearance of five young, healthy adults (hypothesis one). Future analysis will include previously mentioned variables for all 30 participants using within and between group analyses.

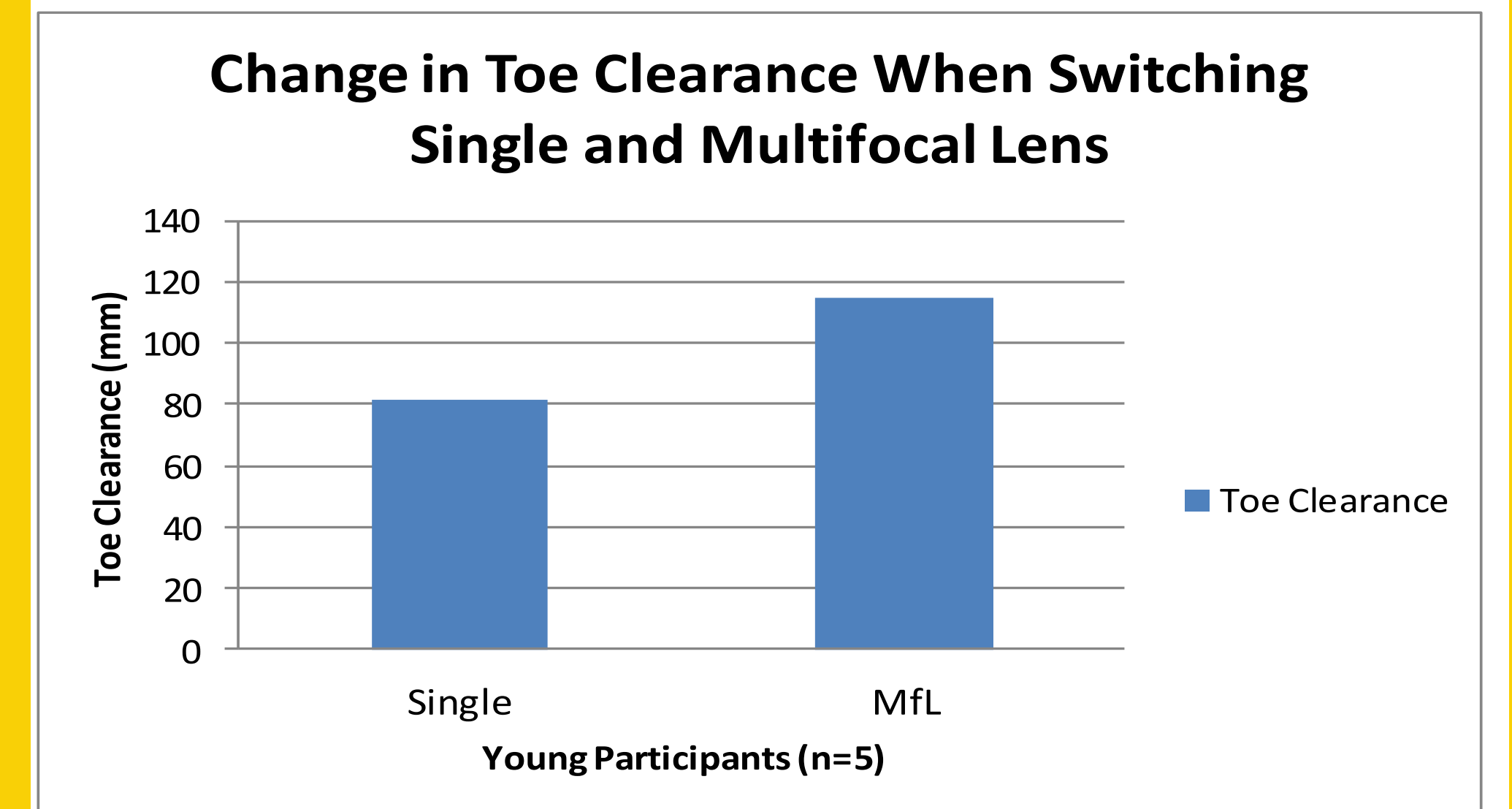


Figure 1
When comparing MfL glasses to single lens glasses, there is a significant increase in toe clearance during the step up trials (Fig 1). Toe clearance was measured by the vertical lifting of the foot. A higher toe clearance measurement indicates a functional gait impairment.

$t = -4.421, p = .012, \eta^2 = .830$

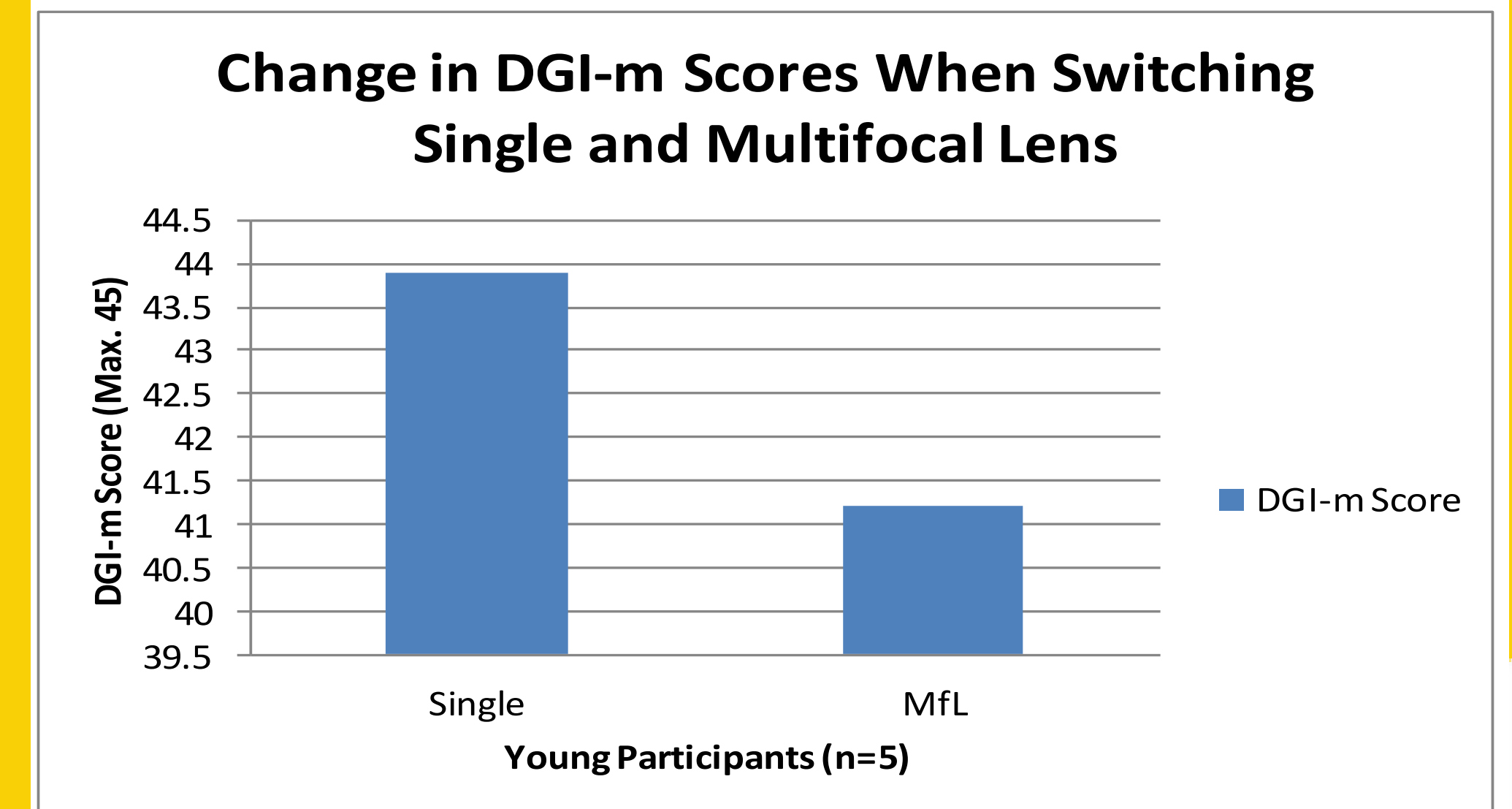


Figure 2

The Figure 2 bar graph shows the DGI-m scores of single lens and MfL trials. The change from single lenses to progressive lenses shows a significant decrease in DGI-m scores. A lower DGI-m score indicates a functional gait impairment.

$t = -3.443, p = .026, \eta^2 = .748$

Conclusion

- Increase in toe clearance indicates a visual impairment and a change in gait. This change in gait increases the amount of time a individual is balancing on one leg and slows movement.
- Decrease in DGI-m scores indicates a functional gait impairment. A functional gait impairment may lead to falls or near falls.
- Overall participants showed a significant involuntary gait adaptation to the new MfLs.
- Involuntary adaptation may be a result of uncertainty caused by visual impairment.

References

Holden, B.A., Fricke, T.R., Ho, M., Wong, R., Schlenther, G., Cronje, S., Burnett, A., Papas, E., Naidoo, K.S., & Frick, K.D. (2008). Global vision impairment due to uncorrected presbyopia. *Archives of Ophthalmology*, 126(12), 1731-1739.

Lord, S.R., Dayhew, J., & Howland, A. (2002). Multifocal glasses impair edge-contrast sensitivity and depth perception and increase the risk of falls in older people. *J Am Geriatr Soc*, 50, 1760-1766.

Marigold, D.S. & Patla, Aa.E. (2008). Visual information from the lower visual field is important for walking across multi-surface terrain. *Journal of Experimental Brain Research*, 188, 23-31.

Smith, R.O., Tomashek, D., Stalberger, K., & Rust, K. BIFOCAL Project Outcomes Paper. 1-24.

Lord, S.R. (2006). Visual risk factors for falls in older people. *Age and Ageing*, 35, 42-45.

Hardwood, R.H. (2001). Visual problems and falls. *Age and Aging*, 30, 13-18.

Heasley, K., Buckley, J.G., Scally, A., Twigg, p., & Elliott, D.B. (2005). Falls in older people: Effects of age and blurring vision on the dynamics of stepping. *Investigative Ophthalmology & Visual Science*, 46(10), 3584-3588.

Acknowledgements

I would like to thank the GABL student workers and all my advisors.

Contact
R₂D₂ Center
UW-Milwaukee
PO Box 413
Milwaukee, WI 53201
Voice (414) 229-6803
Fax (414) 229-6843
TTY (414) 229-5628
www.r2d2.uwm.edu