

**BIOGRAPHICAL SKETCH**

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NAME: Laurie A. King

eRA COMMONS USER NAME (credential, e.g., agency login): LAURIE\_KING

POSITION TITLE: Associate Professor- Neurology; Assistant Scientist- Center for Regenerative Medicine

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Reed College, Portland OR			English
University of Oregon, Eugene, OR	BS	05/1990	Psychology
Mayo Clinic, Rochester, MN	MS	06/1992	Physical Therapy
Medical College of Virginia, Richmond, VA	PhD	06/2001	Anatomy/Neurobiology
Oregon Health & Science University – Portland, OR	Postdoc	07/2010	Movement Disorders

**A. Personal Statement**

The ultimate objective of my research is the clinical implementation of useful emerging practices and technology for improving assessment and rehabilitation in neurologically impaired people. I have spent the past decade characterizing and developing rehabilitation practices for balance disorders in patients with neurologic deficits using sensitive measures such as force plates, kinematic gait and balance analysis, and inertial sensors. In addition to my past and current research training, I have an extensive clinical background in treating neurologic disorders in physical therapy. I am dedicated to the translation of scientific findings to both the community and to clinicians who treat neurologically impaired patients and have made many presentations and taught courses to both patient groups and health care providers who treat mobility deficits. In summary, I have a record of successfully completing projects that are highly relevant to the current proposal, and have the expertise and experience necessary to assist on this exciting and high priority project.

1. **King LA** & Horak FB. (2014). Role of the Vestibular System in Postural Control. Vestibular Rehabilitation; Third edition, editor Susan Herdmann; FA Davis Company Philadelphia.
2. **King LA**, Horak FB, Mancini M, Pierce D, Priest KC, Chesnutt J, Sullivan P, & Chapman JC. (2014). Instrumenting the balance error scoring system for use with patients reporting persistent balance problems after mild traumatic brain injury. Arch PMR, 95(2):353-359.
3. Horak F, **King LA**, & Mancini M. (2015). Role of body-worn movement monitor technology for balance and gait rehabilitation. Physical Therapy, 95(3):461-470.
4. Haran FJ, Slaboda JC, **King LA**, Wright WG, Houlihan D, & Norris JN. (2016). Sensitivity of the Balance Error Scoring System and the Sensory Organization Test in the Combat Environment. Journal of Neurotrauma, 33(7):705-711.

**B. Positions and Honors****Positions and Employment**

1992-1995 University of Minnesota Adult Rehabilitation Center, Minneapolis, MN

- Inpatient and outpatient neurologic rehabilitation (CVA, TBI, SCI),
  - Wheelchair seating and positioning, Gait analysis in diabetic foot clinic (F-Scan system)
  - Program development, Clinical instructor
- 1995-1997 Sargent Rehabilitation Center, Providence, RI
- Adult TBI program/outpatient rehabilitation, Clinical instructor
- 1995-1997 Lasell College, Newton, MA
- Instructor in PTA program
- 1997-1999 Medical College of Virginia, Richmond, VA
- Neuroscience ICU
- 1997-1999 Medical College of Virginia, PhD student and teaching assistant
- Gross anatomy; lecture and lab
  - Neurorehabilitation; lecture and lab
  - Neuroanatomy; lecture and lab
- 2001-2003 Oregon Health & Science University, Portland, OR
- Gross anatomy instructor; Lecture and Lab
- 2003-2004 Portland Providence Physical Therapy, Portland, OR
- Home health physical therapist
- 2005-2010 Oregon Health & Science University, Balance Disorders Laboratory, Portland, OR
- Post-doctoral research fellow
- 2011-Present Oregon Health & Science University; Department of Neurology; Balance Disorders Laboratory
- Assistant Professor (2010-2106); Associate Professor (2016-present)
- 2011-Present Portland Veterans Affairs Medical Center; Appointment without compensation
- Associate Scientist

### **Other Experience and Professional Memberships**

- 2000-Present Member, American Physical Therapy Association, Neurology Section
- 2000-2015 Member Society for Neuroscience
- 2009 Participant in 'Enhancing Rehabilitation Research in the South (ERRIS), Charlottesville, VA.
- 2012-Present Member, International Society for Posture and Gait
- 2012-Present Member, American Congress of Rehabilitative Medicine
- 2014-Present Co- chair of research committee of neurology section APTA
- 2013-present Scientific Reviewers for VA RR&D Spire and career development awards
- 2015-present Invited member of Am. Congress of Rehabilitative Medicine; outcome measures task force

### **Honors**

- 1990 Cum Laude; Psychology Department, University of Oregon, Eugene, OR.
- 1990 Recipient of Phi Beta Kappa honorary academic award; Psychology Department, University of Oregon, Eugene, OR.
- 1997-2000 Recipient of AD Williams Graduate School Scholarship; Medical College of Virginia, Richmond, VA.
- 1998 Scholarship for coursework in viral vectors in gene therapy; National Autonomous University of Mexico, Mexico City, Mexico.
- 1999 Recipient of "student award for outstanding abstract"; Virginia Chapter Society for Neuroscience.
- 1999-2000 Recipient of Walter Riese Award in Neuroanatomy; for outstanding graduate student work in Neuroscience.
- 2005 Recipient of NIA/NIH re-entry grant for post-doctoral work with Fay Horak PT, PhD, OHSU Portland, OR

### **C. Contribution to Science**

1. *Components of balance control:* My work over the past decade has deepened our understanding of balance control and my work has reached many audiences from scientists to clinicians to patients. The concept of balance has traditionally been oversimplified and is often thought of as a one-dimensional,

simple stimulus response to instability. My work and others has demonstrated that balance can depend on context and cognition, and importantly, various aspects of balance control including areas of sensorimotor integration, anticipatory preparation and stepping strategies, all of which may be impaired differently in different patient populations. For example, I studied balance reactions in response to a lateral perturbation in people with Parkinson's disease (PD) and showed that while people with PD had similar compensatory stepping strategies as age matched control subjects, those who chose one strategy over another fell in most trials (unlike controls). This research demonstrated the need to focus rehabilitation on safe strategies to compensate for instability. Further, I showed that people with PD were unable to suppress the preparatory phase before stepping to regain stability in the same way that healthy subjects could. This work suggests an inability to adapt and maximize energy and efficiency for balance recovery in this patient population. My work in further defining subcomponents of balance and in balance deficits that are patient specific has furthered our understanding of balance control and the impact disease states may have on balance control.

**King LA**, St George RJ, Carlson-Kuhta P, Nutt JG, & Horak FB. (2010). Preparation for compensatory stepping in Parkinson's disease. *Archives of Physical Medicine & Rehabilitation*, 91(9):1332-1338.

Wright WG, Gurfinkel VS, **King LA**, Nutt JG, Cordo PJ, & Horak FB. (2010). Axial kinesthesia impaired in Parkinson's disease: effects of levodopa. *Experimental Neurology*, 225(1):202-209.

**King LA** & Horak FB. (2008). Lateral stepping strategies and postural control in Parkinson's disease. *Archives of Physical Medicine and Rehabilitation*, 89(3):492-499.

Wright WG, Gurfinkel VS, **King LA**, Horak F, & Cordo PJ. (2007). Motor asymmetry in Parkinson's disease contributes to spatial perceptual asymmetry. *Neuroscience Letters*, 417(1):10-15.

2. *Assessment of balance control:* My work has advanced how we assess balance and gait in neurologic patients. The commonly used measurement tools for assessment of balance in this group are primarily subjective and rely on stopwatch measures of gait or balance. Much of my work has focused on identifying and quantifying problems with this subjective approach to measurement, particularly in people with subtle, yet still troubling, signs of imbalance. I have shown that one of our most commonly used tool for measuring balance has a ceiling effect and could not detect balance deficits in people with mild PD while more comprehensive tools could. Such identification is critical since early intervention is important in people with PD. I also showed that our most common test for balance after concussion was improved significantly when using an inertial sensor to measure postural sway during balance tasks rather than the clinician subjectively counting errors of instability during the task. I have suggested other tools for measuring balance to include assessing multiple domains of balance (relating to number 1 above and multiple subcomponents of balance that may be uniquely impaired in different disease states) and using available state of the art technology, such as inertial sensors, to better quantify balance.

Horak F, **King LA**, & Mancini M. (2015). Role of body-worn movement monitor technology for balance and gait rehabilitation. *Physical Therapy*, 95(3):461-470.

**King LA**, Salarian A, Mancini M, et al. (2013). Exploring outcome measures for exercise intervention in people with Parkinson's disease. *Parkinson's Disease*, (2013):572134.

**King LA**, Mancini M, Priest K, Salarain A, Rodrigues-de-Paula F, & Horak F. (2012). Do clinical scales of balance reflect turning abnormalities in people with Parkinson's disease? *Journal of Neurologic Physical Therapy*, 36(1):25-31.

**King LA**, Priest KC, Salarian A, Pierce D, & Horak FB. (2011). Comparing the Mini-BESTest with the Berg Balance Scale to Evaluate Balance Disorders in Parkinson's Disease. *Parkinson's Disease*, (2012):375419.

3. *Rehabilitation of balance deficits:* My work has had an influence on how people with balance deficits are rehabilitated. I wrote a perspective paper on exercise for PD that has had a significant effect on the field of physical therapy for people with PD. As a result I have been invited to give many talks to rehabilitation groups, internationally and nationally, on this topic and have personally been contacted by patients from around the country asking me to send information to their treating physical therapist. I have also brought attention to the important role that comorbidities play in mobility and rehabilitation of people with chronic neurologic disease. Comorbidities are not often directly measured and considered during rehabilitation and I recently showed a strong relationship between comorbidities and mobility in people with PD, and the

comorbidities had an important effect on the success of their rehabilitation. Whether a person had co-occurring conditions such as depression or mild cognitive impairment significantly effected rehabilitation success only when people were treated with (standard of care) home exercise program. When a PT saw them individually instead, the effects of comorbidities were not as significant. My work in this area has been very translatable to clinical practice for rehabilitation of complex neurologic populations.

- King LA**, Wilhelm J, Chen Y, Blehm R, Nutt J, Chen Z, Serdar A, & Horak FB. (2015). Effects of group, individual and home exercise in persons with Parkinson's disease: a randomized clinical trial. *Journal of Neurologic Physical Therapy*, 39(4):204-212.
- King LA**, Priest KC, Nutt J, Chen Y, Chen Z, Melnick M, & Horak F. (2014). Comorbidity and functional mobility in persons with Parkinson disease. *Archives of Physical Medicine and Rehabilitation*, 95(11):2152-2157.
- Van der Kolk NM & **King LA**. (2013). Effects of exercise on mobility in people with Parkinson's disease. *Movement Disorders*, 28(11):1587-1596.
- King LA** & Horak FB. (2009). Delaying mobility disability in people with Parkinson disease using a sensorimotor agility exercise program. *Physical Therapy*, 89(4):384-393.

4. *Balance control across populations*: Since poor balance can result from many disease states, my works has been important in bringing together findings on postural control from many populations. My skills in using state of the art techniques for assessing important domains of balance control have helped to bridge the gap between often-separate research agendas. While most of my work has been in PD, I work closely with other groups to share information and techniques. For example, I was called into a project on fibromyalgia and asked to comprehensively assess their balance since they reportedly fall more than age-matched peers. This work resulted in a publication that has been cited by others interested in that condition. Similarly, I have brought my skill and furthered techniques in the post-concussion field and that remains an active area of research for me. Finally, I work closely with numerous departments at my University, including orthopedics, otolaryngology and rehabilitation to help cross information into new domains since balance and gait deficits can be pervasive.

- King LA**, Horak FB, Mancini M, Pierce D, Priest KC, Chesnutt J, Sullivan P, & Chapman JC. (2014). Instrumenting the balance error scoring system for use with patients reporting persistent balance problems after mild traumatic brain injury. *Arch PMR*, 95(2):353-359.
- Jones KD, **King LA**, Mist SD, Bennett RM, & Horak FB. (2011). Postural control deficits in people with fibromyalgia: a pilot study. *Arthritis Research & Therapy*, 13(4):R127.
- Mancini M, **King LA**, Salarian A, Holstrom L, McNames J, & Horak FB. (2012). Mobility Lab to Assess Balance and Gait with Synchronized Body-worn Sensors. *Journal of Bioengineering & Biomedical Science*, S1:007.
- Cameron M, Mazumder R, Murchison C, & **King LA**. (2013). Mini Balance Evaluation Systems Test in people with multiple sclerosis: reflects imbalance but may not predict falls. *Gait and Posture*, 39(1):669.

#### **Complete List of Published Work in MyBibliography:**

<https://www.ncbi.nlm.nih.gov/sites/myncbi/laurie.king.1/bibliography/50719848/public/?sort=date&direction=ascending>

#### **D. Additional Information: Research Support and/or Scholastic Performance**

##### **Ongoing Research Support**

W81XWH-15-1-0620 King (PI) 09/30/15-9/29/19  
US Army Department of Defense  
*MR141257: Assessment and Rehabilitation of Central Sensory Impairments for Balance in mTBI*  
The goal is to develop focused rehabilitation strategies based on profiles of chronic balance deficits from mild traumatic brain injury (mTBI).  
Role: Principal Investigator

1 R21 HD080398 01 King (PI) 08/08/14-07/31/17 (NCE)  
NIH NICHD  
*Objective & Portable Balance & Gait Measures to Document Recovery after Concussion*  
The goal of this project is to longitudinally characterize balance recovery in college athletes after concussion.

Role: Principal Investigator

5 R01 AG006457 31 Horak (PI)  
NIH NIA

05/15/14-03/31/19

*Peripheral and Central Postural Disorders in the Elderly*

The goal of this project is to improve our understanding of the role of the frontal cortex in balance and gait and how cognitive impairments relate to postural disorders with the goal of improving mobility rehabilitation in the elderly.

Role: Co-Investigator

W81XWH-15-C-0096 Gregory (PI)

10/01/15-06/30/17

HELIUS Medical Technologies/NeuroHabilitation Subaward (US Army)

*PoNS Device, Study in Safety and Effectiveness in Patients with TBI*

The goals of this project are to demonstrate the clinical utility of Mobility Life to monitor quality of functional of functional mobility and fall risk in people with neurological diseases.

Role: Co-Investigator

### **Completed Research Support**

VA RR&D Merit Review Horak (PI)

01/01/14-12/31/17

Portland Veteran Administration

*Frontal Cortex and Gait Freezing in Parkinson's Disease: Rehabilitation Impact*

The goals of this project are to objectively characterize freezing of gait in PD with body-worn sensors and to explore how objective measures of freezing are associated with abnormal functional connectivity in the brain, by using resting state functional imaging (fMRI).

Role: Co-Investigator

No award number King (PI)

03/01/14-02/28/15

Medical Research Foundation of Oregon

*Objective & Portable Balance & Gait Measures to Document Recovery after Concussion*

The goal of this project is to develop metrics for quantifying balance impairment after concussion to further understand the acute and chronic effects of brain trauma.

Role: Principal Investigator

No award number King (PI)

01/01/11-02/28/14

Foundation for Physical Therapy

*Effectiveness of Physical Therapy in Chronic Neurologic Disease: The Role of Co-Morbidities and Delivery of Physical Therapy Services*

The goal of this project is to improve physical therapy (PT) aimed at reducing mobility disability in elderly people with chronic neurological disease and long-standing co-morbidities.

Role: Principal Investigator

5 KL2 TR000152 08 King (PI)

07/01/12-06/30/14

DHHS NIH National Center for Advancing Translational Sciences

*Quantification of Balance in Acutely Concussed Athletes, Implication for Return to Play Determination*

The goal of this project is the quantification of balance in acutely concussed athletes and implications for return to play determination.

Role: OCTRI Scholar; Principal Investigator on project