

COHA Translational Fellowship Opportunity
for Residency-Trained Veterinary Specialists

Altering Diet to Reduce Seizures in Canines

Area of Research: This project addresses two critical needs in the canine epilepsy field, identification of effective treatments and development of validated outcome measures. Specifically, the proposed prospective, placebo-controlled, pilot clinical trial will identify associations between diet and seizures in canines and test FitBark actigraphy as a potential outcome measure to correlate seizure activity with diet.

University/Department:
University of Wisconsin-Madison
Department of Neurology

Primary Mentor:
Cara Westmark, PhD
Assistant Professor
Department of Neurology
School of Medicine & Public Health
University of Wisconsin-Madison
Ph: (608) 262-9730
E: westmark@wisc.edu

Mentor Team:
Starr Cameron, BVetMed, DACVIM (Neurology)
Clinical Assistant Professor-Small Animal Neurology
Department of Medical Sciences
School of Veterinary Medicine

Elizabeth Felton, MD, PhD
Assistant Professor
Department of Neurology
School of Medicine & Public Health

Description of Potential Research Project(s): Companion animals are typically fed single-source chows that are soy-based. These diets are expected to increase seizures, particularly in genetically susceptible patients. A third of canines with epilepsy are refractory to current anti-seizure medications. Altering the diet to treat epilepsy dates back to c. 400 BC when starvation was used to reduce seizures. The classic ketogenic diet (high fat, low carbohydrate, moderate protein) is employed to replace starvation. We plan to test the efficacy of soy-free and ketogenic diets in reducing seizure incidence in client-owned canines. Our research goal is to translate our preclinical findings that demonstrate anti-seizure effects in response to diet into the clinic to benefit companion animals and humans. Specifically, our preliminary data demonstrate that soy-based vivarium chow exacerbates seizures in mouse models of neurological disease. Retrospective analysis of human medical record data demonstrates a strong association between consumption of soy-based infant formula and seizures in children with autism. These data strongly suggest that consumption of single-source, soy-based diets increases seizures. In addition, we recently found a drastic sex-specific (males only) reduction in seizures and altered circadian activity levels in an autism mouse model in response to ketogenic diet. Despite the long-time use and success of the ketogenic diet in treating refractory epilepsy in humans and promising studies in rodents, there are only a handful of published reports testing effects on seizure reduction in canines. The fellow will conduct a prospective, placebo-controlled, pilot clinical trial employing client-owned canines with epilepsy to examine effects of diet on seizures.

Additional Training Opportunities: The fellow may choose from multiple training opportunities to accomplish their career development goals. Examples include: (1) ICTR KL2 career development seminars, (2) weekly T32 seminars for Molecular Environmental Toxicology (MET), Neuroscience, Nutritional Sciences and Comparative Biosciences training programs, (3) weekly seminars (Neurology Grand Rounds, Morgridge

Metabolism Seminars), (4) UW ICTR Fundamentals of Clinical Research Certificate courses (audit: Intro Biostatistics, Intro to Epidemiology, Intro to Clinical Trials I, Intro to Clinical Trials II, Responsible Conduct of Research), and (5) UW ICTR workshops and non-credit courses (Basics of Conducting Clinical Research at UW Madison, Data Monitoring Committee Training, Fundamentals of Clinical Trials, Intro to Principles and Practices of Clinical Research). Mentor training is crucial to assume a faculty position. There will be ample opportunities for the fellow to co-mentor students such as veterinary students in the Summer Scholars Program and undergraduates working in the laboratory. Dr. Westmark regularly hosts undergraduate researchers in MET, BioSignals (Neuroscience), and Bio152 programs. Dr. Cameron mentors veterinary students in their preclinical and clinical years, as well as veterinary interns and neurology residents. Dr. Felton hosts undergraduate students in Bio152, Neurology 699, and the SURE (Engineering) program. Presentations at conferences are crucial to career development. Dr. Westmark's laboratory presents at local (Neurology Research Day, Morgridge Metabolism Symposium, Alzheimer's Disease Research Day) and national conferences (Society for Neuroscience, Gordon Conference on FXS and Autism). Additional national and international conferences that Dr. Felton's laboratory present at include American Epilepsy Society and the Global Symposium on Ketogenic Therapies.

Fellowships are for 2 years and provide stipend and employee benefits at the NIH post-doctoral pay scale. Fellows may supplement their stipend with up to 25% effort towards clinical work, if such work is in alignment with the research and career development plan.

All fellowships will have a start date of fall 2021.

Biosketches of primary mentor and mentor team attached.

BIOGRAPHICAL SKETCH

NAME: Westmark, Cara J., Ph.D.

POSITION TITLE: Assistant Professor

eRA COMMONS USER NAME (credential, e.g., agency login): WESTMARK

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
Clarke University, Dubuque, IA	B.S.	05/1989	Chemistry, Biology
University of Notre Dame, Notre Dame, IN	Ph.D.	08/1995	Biochemistry
University of Wisconsin, Madison, WI	Postdoctoral	07/2000	Molecular Biology, Neuroscience
University of Wisconsin, Madison, WI	Capstone Certificate	12/2015	Clinical Nutrition

A. Personal Statement.

My research interests lie in the area of synaptic function as related to the over-expression of amyloid beta protein precursor (APP) and amyloid beta (A β) in Alzheimer's disease and fragile X syndrome (FXS). I hypothesize that therapeutic and dietary interventions that normalize APP and A β levels will improve seizure, behavioral and cognitive phenotypes associated with these disorders. I have performed basic research in these fields for the past 25 years and am committed to advancing my current studies, which bridge basic and clinical science. As the PI on several university-, pharma- and NIH-funded grants, I successfully administered the projects (e.g. staffing, budgets and regulatory paperwork), collaborated with other scientists, and produced several peer-reviewed publications. Thus, I am cognizant of the importance of frequent communication among project members and the need for a realistic research plan, timeline and budget. I commenced a tenure track Assistant Professor position in the Department of Neurology at the University of Wisconsin-Madison on August 1, 2017. The current application builds upon the strengths of my previous work and that of my collaborators in seeking to understand the role of diet on seizures in canines. There is currently a dearth of potent therapeutics for canine epilepsy and it may be possible to reduce seizures by changing the diet. My expertise lies in the areas of molecular biology and transgenic mouse models, but I have augmented my basic research background by completing short courses in Health Research Dissemination, Clinical Research, and Fundamentals of Clinical Trials sponsored through the University of Wisconsin ICTR program. I have also completed a Capstone Certificate in Clinical Nutrition through the Department of Nutritional Sciences at the University of Wisconsin. I have assembled a team with complementary expertise in companion animal research (Starr Cameron) and the ketogenic diet (Elizabeth Felton) to address this novel hypothesis.

1. Westmark, Cara J. and Malter, James S. FMRP Mediates mGluR₅-Dependent Translation of Amyloid Precursor Protein. *PLOS Biology* **5**, 629-639 (2007). PMID: PMC1808499.
2. Westmark, Cara J., Westmark, Pamela R., O'Riordan, Kenneth J., Ray, Brian C., Hervey, Crystal M., Salamat, M. Shahriar, Abozeid, Sara H., Stein, Kelsey M., Stodola, Levi A., Tranfaglia, Michael, Burger, Corinna, Berry-Kravis, Elizabeth M. and Malter, James. S. Reversal of Fragile X Phenotypes by Manipulation of APP/A β Levels in *Fmr1*^{KO} Mice. *PLoS One* **6**, e26549 (2011). PMID: PMC3202540.
3. Westmark, Cara J., Westmark, Pamela R. and Malter, James. S. Soy-Based Diet Exacerbates Seizures in Mouse Models of Neurological Disease. *J Alz Dis* **33**, 797-805 (2013). PMID: PMC3697030.
4. Westmark, Pamela R., Gutierrez, Alejandra, Gholston, Aaron K., Wilmer, Taralyn M. and Westmark, Cara J. Preclinical Testing of the Ketogenic Diet in Fragile X Mice. *Neurochem Intl*, in press (2020).

B. Positions and Honors.

Positions and Employment

Summer 1988	Undergraduate Research Program, University of Iowa
1989-1995	Graduate Student, University of Notre Dame
1995	Postdoctoral Research Associate, University of Notre Dame
1995-2000	Postdoctoral Research Associate, University of Wisconsin-Madison
1996-1999	NIA Postdoctoral Research Fellow, University of Wisconsin-Madison
2000-2008	Assistant Scientist, University of Wisconsin-Madison
2008-2011	Associate Scientist, University of Wisconsin-Madison
2011-2017	Senior Scientist, University of Wisconsin-Madison
2017-present	Permanent PI Status, University of Wisconsin-Madison
2017-present	Assistant Professor, University of Wisconsin-Madison

Other Experience and Professional Memberships

2006-present	Member, Society for Neuroscience
2007-2010	Committee Member, Institutional Biosafety Committee, University of Wisconsin-Madison
2009-2011	Consultant, SeaSide Therapeutics, LLC
2010	Member, AIBS Scientific Review Panel for DOD PRMRP Clinical Trials Grants
2010	Invited Participant, Banbury Conference on Fragile X Syndrome, Cold Spring Harbor
2011-2013	Associate Editorial Board, Journal of Alzheimer's Disease
2011-2012	Guest Editor, Special Edition of Neural Plasticity
2012-present	Member, Academic Society for Functional Foods and Bioactive Compounds – ASFFBC
2013-present	Member, Molecular and Cellular Cognition Society
2013-present	Member, Wisconsin Prevention of Obesity & Diabetes (WiPOD) Group
2013-present	Member, Scientific Review Panel for R15 NIH AREA grants
2015	Member, Scientific Review Panel for University of Wisconsin-Madison ICTR grants
2016	Member, Scientific Review Panel for DOD CDMRP Gulf War Illness Research Program
2018-present	Member, Faculty Advisory Committee for UW Biomedical Research Model Services
2018	Member, Scientific Review Panel for DOD CDMRP PRMRP
2018-present	Trainer status, UW-Madison, Neuroscience Training Program
2018-present	Trainer status, UW-Madison, Nutritional Sciences Graduate Training Program
2018-present	Trainer status, UW-Madison, Molecular Environmental Toxicology Program
2019-present	Trainer status, UW-Madison, Comparative Biomedical Sciences Graduate Program
2019	Planning Committee, UW-Madison, Morgridge Metabolism Symposium
2019-present	Member, Executive Committee, Molecular Environmental Toxicology Program (METC)
2019	Member, Scientific Review Panel for DOD CDMRP PRARP
2019	Member, Association for Clinical & Translational Science
2019-present	Member, UW-Madison, Department of Neurology, R&D Committee
2019-2020	Guest Editor, Special Edition of Nutrients

Honors

1989	<i>cum laude</i> , Clarke University
1990-1991	Zahm Fellowship, University of Notre Dame
1992-1994	Reilly Fellowship, University of Notre Dame
1995	Rohm & Haas Outstanding Graduate Student Award (honorable mention), University of Notre Dame
1999	New Investigator Award for Excellence in Biomedical Research, Institute on Aging, University of Wisconsin-Madison
2018-2019	Finalist, UW-Madison, Brain Research Foundation Seed Grant Program

C. Contributions to Science

1. Discovery that the fragile X mental retardation protein (FMRP) binds to and regulates the translation of *App* mRNA through metabotropic glutamate receptor 5 (mGluR₅) signaling. *App* mRNA codes for APP, which is cleaved by β - and γ -secretases to generate A β , the predominant protein found in senile plaques. I demonstrated that APP and A β are increased in *Fmr1*^{KO} mice, which lack expression of FMRP. I hypothesized that the over-expression of APP and A β in FXS contributes to disease phenotypes. Seizures

and hyperexcitability are prevalent phenotypes in FXS that are manifested as audiogenic-induced seizures in *Fmr1^{KO}* mice. Subsequently, I demonstrated that both Alzheimer's and Down syndrome mice, which over-express APP and A β , are also highly susceptible to audiogenic-induced seizures, which can be attenuated by treatment with mGluR₅ inhibitors or passive immunization directed against A β . Genetic reduction of APP and A β to WT levels by creation of *Fmr1^{KO}/App^{HET}* mice rescues audiogenic-induced seizures, anxiety behavior, the ratio immature/mature dendritic spine, mGluR-LTD, neocortical hyperexcitability and ictal discharge phenotypes. The electrophysiology studies were performed in collaboration with the laboratories of Drs. Corinna Burger (University of Wisconsin-Madison), Kim Huber & Jay Gibson (University of Texas-Southwestern), and Bob Wong (SUNY Downstate Medical Center). Thus, APP and A β play a pivotal role in FXS pathogenesis. Four relevant publications, which were not cited in the previous section, are listed below. I served as the primary investigator for these studies, and they were primarily funded through grants from FRAXA Research Foundation and the University of Wisconsin Madison ICTR program for which I was the P.I.

- a. Westmark, Cara J., Westmark, Pamela R. and Malter, James S. Alzheimer's Disease and Down Syndrome Rodent Models Exhibit Audiogenic Seizures. *J Alz Dis* 20, 1009-1013 (2010). PMID: PMC2915889.
- b. Westmark, Cara J. What's hAPPening at Synapses? The Role of Amyloid- β -Protein Precursor and β -Amyloid in Neurological Disorders. *Mol Psych* 18, 425-434 (2013). DOI:10.1038/mp.2012.122.
- c. Westmark, Cara J, Chuang, Shih-Chieh, Hays, Seth A., Filon, Mikolaj J., Ray, Brian C., Westmark, Pamela R., Gibson, Jay R., Huber, Kimberly M and Wong, Robert K.S. APP Causes Hyperexcitability in Fragile X Mice. *Front Mol Neurosci* 9, 147 (2016). PMID: PMC5156834.
- d. Westmark, Cara J. Fragile X and APP: A Decade in Review, a Vision for the Future. *Mol Neurobiol* 56, 3904-3921 (2019). PMID: PMC6421119.

2. Repurposing Alzheimer's drugs for FXS. The aforementioned work elicits the hypotheses that drugs under study for Alzheimer's disease, such as beta-secretase inhibitors, could be repurposed for the treatment of FXS, and conversely, mGluR₅ inhibitors may rescue Alzheimer's phenotypes. Recently completed funding includes an NIA R21, DOD Discovery Grant and FRAXA Research Foundation Program Grant, which involved preclinical testing of mGluR₅ antagonists and secretase inhibitors in Alzheimer's disease and FXS mouse models, respectively. This funding was augmented by a pilot award from the Alzheimer's Disease Research Center and ICTR at the University of Wisconsin-Madison to assess the effects of mGluR₅ antagonists on novel outcome measures including sleep. In addition to these contributions, I have collaborated extensively with pharmaceutical companies (Lundbeck Research USA, Inc., Merz Pharmaceuticals GmbH, Pierre Fabre and Angelini Pharma) to test the effects of their novel compounds on FXS disease phenotypes in *Fmr1^{KO}* mice.

- a. Westmark, Cara J., Westmark, Pamela R. and Malter, James. MPEP Reduces Seizure Severity in *Fmr1* KO Mice Over Expressing Human Abeta. *Int J Clin Exp Pathol* 3, 56-68 (2009).
- b. Westmark, Cara J., Berry-Kravis, Elizabeth M., Ikonomidou, Chrysanthy, Yin, Jerry C.P. and Puglielli, L. Developing BACE-1 Inhibitors for FXS. *Front Cell Neurosci* 7, 77 (2013). PMID: PMC3664772.
- c. Westmark, Pamela R., Dekundy, Andrzej, Gravius, Andreas, Danysz, Wojciech and Westmark, Cara J. Rescue of *Fmr1^{KO}* Phenotypes with mGluR₅ Inhibitors: MRZ-8456 versus AFQ-056. *Neurobiol Dis* 119, 190-198 (2018).
- d. Filon, Mikolaj J., Wallace, Eli, Wright, Samantha, Douglas, Dylan J., Steinberg, Lauren I., Verkuilen, Carissa L., Westmark, Pamela R., Maganti, Rama K. and Westmark, Cara J. Sleep and Diurnal Rest-Activity Disturbances in a Mouse Model of Alzheimer's Disease. *Sleep In Press* (2020).

3. Characterization of the role of diet on neurological phenotypes. During the course of my research involving chronic dosing of mice with the mGluR₅ antagonist fenobam to reduce A β , I incorporated the drug into a refined diet. Surprisingly, the refined diet alone with no fenobam added greatly reduced the strong seizure phenotype normally observed in the mice. The refined diet was matched for protein, carbohydrate and fat content with the Purina5015 lab chow that our colony was traditionally maintained on. The major difference in the feeds was soy/grains as the protein source in the Purina5015 versus casein in the refined diet. Pursuit of this serendipitous finding has led to studies in mice suggesting that the phytoestrogen daidzein is a seizure-promoting ingredient in soy and that soy-based diets increase weight gain in *Fmr1^{KO}* mice. These findings have significant implications for the quarter of babies who are fed soy-based infant formulas. I utilized the Simon's Foundation Autism Research Initiative (SFARI) database of medical records to

determine that autistic children fed a soy-based infant formula, as opposed to a non-soy formula, are over 2-fold more likely to exhibit febrile seizures, simple partial seizures or epilepsy comorbidity. I was the recipient of a 2014 RayBiotech Product Grant to pursue the finding that soy-based diets are associated with excessive weight gain. The possible connection between the consumption of soy-based diets during infancy and the development of seizures, autism and/or obesity, particularly in children with developmental disabilities, remains to be determined. My long-term goal is to translate these results into the clinic. Because dietary restriction of soy, like sugar or wheat, is not regulated by the FDA and poses no health hazards in an otherwise balanced diet, this type of medical intervention could be rapidly implemented in the clinic. I served as the primary investigator for these studies, which were funded through grants from FRAXA Research Foundation and the University of Wisconsin Madison ICTR program for which I was the P.I. Relevant publications, which were not cited in the Personal Statement, are listed below:

- a. Westmark, Cara J. Soy Infant Formula and Seizures in Children with Autism: A Retrospective Study. *PLoS One* **9**, e80488 (2014). PMID: PMC3951190.
 - b. Westmark, Cara J. Soy Formula may be Associated with Autistic Behaviors. *Autism* **3**, e1000120 (2013). PMID: PMC4229689.
 - c. Westmark, Cara J. A Hypothesis Regarding the Molecular Mechanism Underlying Dietary Soy-Induced Effects on Seizure Propensity. *Front Neurol* **5**, 169 (2014). PMID: PMC4153031.
 - d. Westmark, Cara J. Soy-Based Therapeutic Baby Formulas: Testable Hypotheses Regarding the Pros and Cons. *Front Nutr* **3**, 59 (2017). PMID: PMC5241282.
4. Testing the ketogenic diet in FXS models. Current work in the lab builds upon the strengths of my research portfolio by seeking to study the effects of the ketogenic diet in a FXS mouse model. There is currently a dearth of potent therapeutics for FXS and it may be possible to repurpose the ketogenic diet, or drugs that mimic the diet, for disease treatment. The ketogenic diet is highly effective at attenuating seizures in refractory epilepsy, and accumulating evidence in the literature suggests that it may be beneficial in treating autism. To our knowledge, no one has studied the ketogenic diet in any FXS model. We tested the effects of chronic ketogenic diet treatment on seizures, body weight, ketone and glucose levels, diurnal activity levels, learning and memory, and anxiety behaviors in *Fmr1^{KO}* and littermate control mice as a function of age. The ketogenic diet selectively attenuates seizures in male but not female *Fmr1^{KO}* mice and differentially affects weight gain and diurnal activity levels dependent on genotype, sex and age. This work was funded by a grant from the University of Wisconsin Madison ICTR program for which I was the P.I.
- a. Westmark, Cara J. A Role for Amino Acid Balance in Dietary Treatments for Epilepsy. *J Nutr* **148**, 307-308 (2018).
 - b. Westmark, Pamela R., Gutierrez, Alejandra, Gholston, Aaron K., Wilmer, Taralyn M. and Westmark, Cara J. Preclinical Testing of the Ketogenic Diet in Fragile X Mice. *Neurochem Intl*, in press (2020).
5. Teaching & Service. In addition to the research contributions described above, I teach a Phase 3 elective course entitled, “*Neurol 914: Diet & Neurological Disorders*”, for 3rd and 4th year medical students in the School of Medicine & Public Health at the University of Wisconsin, Madison. I designed this online course from scratch in response to the need for distance learning elective courses for medical students doing rotations at clinics across the country. I serve on the Executive Committee of the Molecular & Environmental Toxicology Program and on the R&D Committee for the Department of Neurology at the University of Wisconsin, Madison. I am regularly invited to participate in the peer review process. I have reviewed AREA grants for the R15 mechanism for NIH for the past 7 years and frequently review for DOD PRMRP panels. I was a Guest Editor with Drs. Hansen Wang, Emma Frost and Laurie Doering for a 2012 special edition of *Neural Plasticity*. I am currently the guest editor for a special issue in *Nutrients* entitled, “*Diet in the Treatment of Epilepsy: What We Know So Far*” scheduled for publication in late 2020. Relevant publication:
- a. Hansen Wang, Westmark, Cara J., Frost, Emma and Doering, Laurie C. Recent Progress in Understanding Plasticity in Neurogenetic Disorders. *Neural Plasticity* **2012**, 1-3 (2012). PMID: PMC3434408.

Complete List of Published Work

<http://www.ncbi.nlm.nih.gov/sites/myncbi/cara.westmark.1/bibliography/40727872/public/?sort=date&direction=ascending>

BIOGRAPHICAL SKETCH

NAME: Starr Cameron, BVetMed, DACVIM (Neurology)

POSITION TITLE: Clinical Assistant Professor in Neurology and Neurosurgery

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Carroll University, Waukesha, WI	BS	2004	Biology, with honors
Royal Veterinary College, London, England	BVetMed	2009	Veterinary Medicine
Pittsburgh Veterinary Specialty & Emergency Center, Pittsburgh, PA	Internship	2010	Rotating Intern
Cornell University, Ithaca, NY	Residency	2013	Veterinary Neurology & Neurosurgery
University of Wisconsin, Madison, WI	MS	2021	Clinical & Translational Research

A. Personal Statement

I am an assistant professor and board-certified veterinary neurologist and neurosurgeon at the University of Wisconsin – Madison, School of Veterinary Medicine. I am extremely excited about the collaboration with Dr. Cara Westmark and Dr. Elizabeth Felton on this project, “Altering Diet to Reduce Seizures in Canines”. A collaboration between veterinary medicine, human medicine, and basic science aligns perfectly with the mission of the COHA and the idea of one health medicine.

I have a strong epilepsy research interest, with a particular interest in translational epilepsy, which is the focus of my Master’s Thesis, which is expected to be completed in January, 2021. Until three years ago, I was in a private practice setting full-time and was also working at Stanford as a research assistant in the comparative medicine department. Our lab studied comparative (translational) epilepsy, specifically in lab animal models and California sea lions, which are a naturally occurring model of temporal lobe epilepsy. During my time at Stanford, I learned laboratory techniques for studying neuropathology in great detail, including sectioning, staining and analyzing tissue. I have always had a love for research, which ultimately led me to pursue a career in academics, and I started with the University of Wisconsin – Madison in November, 2017. Since being at UW, I am extremely excited to be pursuing research in epilepsy, as it is invaluable for improving the lives of our veterinary patients and furthering our knowledge about epilepsy in all species.

Currently, I am finishing a clinical trial studying the effects of exercise in dogs with idiopathic epilepsy and, through this project, I have recruited over 80 participants, which supports the caseload needed for the proposed research here at the University of Wisconsin – Madison, School of Veterinary Medicine. This project also allowed me the opportunity to study some basic ideas about epilepsy in dogs which, until now, had not been previously considered, including activity levels and sleep patterns compared to dogs without epilepsy. In addition, I have two lab-based projects studying the imaging changes and neuropathology associated with seizures in dogs and cats. With these projects, I have successfully collaborated with a variety of individuals from clinical neurology and radiology – both human and veterinary – as well as basic science. Therefore, I have the skills and experience necessary to support this research study, along with Drs. Westmark and Felton.

B. Positions, Services, and Honors

Employment

2009 – 2010	Rotating Internship in Small Animal Medicine and Surgery, Pittsburgh Veterinary Specialty and Emergency Center (PVSEC), Pittsburgh, PA
2010 – 2013	Residency in Veterinary Neurology, Cornell University, College of Veterinary Medicine, Ithaca, NY
2013 – 2017	Neurologist & Neurosurgeon, SAGE Veterinary Specialty and Emergency Centers, Redwood City, CA
2015 – 2017	Research Assistant, Stanford University, Comparative Medicine Department, Stanford, CA
2017 – Present	Clinical Assistant Professor in Small Animal Neurology and Neurosurgery, University of Wisconsin – Madison, WI
2018 – Present	Affiliate Professor in Neurology, School of Medicine & Public Health, University of Wisconsin – Madison

Honors and Professional Activities

2000 – 2004	Tri-Beta (Biological Honor Society)
2009 – 2011	Veterinary License, Missouri State Veterinary Board
2010 – 2012	Veterinary License, Pennsylvania State Veterinary Board
2011	Tiger & Bentley Grosso Resident Research Abstract Award
2012	Resident Research Award, American College of Veterinary Internal Medicine (ACVIM)
2011 – 2013	Member, Internship Selection Committee, Cornell University
2013	Diplomate, American College of Veterinary Internal Medicine
2013 – 2018	Veterinary License, California State Veterinary Board
2013 – Present	Member, American Veterinary Medical Association
2013 – 2018	Member, California Veterinary Medical Association
2013 – 2018	Member, Peninsula Veterinary Medical Association
2014	Neurosurgery Certificate, ACVIM
2014 – 2017	ACVIM Exam Writing Committee
2014 – 2017	ACVIM Exam Rating Committee
2017 – Present	Veterinary License, Wisconsin State Veterinary Board
2018 – Present	ACVIM Residency Training Program Committee
2018 – Present	Member, Wisconsin Veterinary Medical Association
2018 – Present	University of Wisconsin – Madison, School of Veterinary Medicine Internship Committee
2019 – Present	Member, Dane County Veterinary Medical Association
2019 – Present	University of Wisconsin – Madison, School of Veterinary Medicine, Student Appeals Committee

C. Contributions to Science

1. **Cameron S**, Fletcher DJ, & K Buriko. "The Prognostic Value of Admission Blood Gas Parameters in Dogs & Cats with Traumatic Brain Injuries" Presented as an abstract at 2011 ACVIM forum.
2. **Cameron S**, Rishniw M, Miller AD, Sturges B, & Dewey CW. "Characteristics and survival of 121 cats undergoing excision of intracranial meningiomas (1994-2011)." Presented as an abstract at 2012 ACVIM forum.
3. **Cameron S**, Dewey CW. "Vestibular Disease in Cats and Dogs". In: Bonagura JD (ed): Kirk's Current Veterinary Therapy Volume XV. St. Louis, MO: Elsevier; 2014.
4. "Ask the Vet: Collar vs Harness?" Bay Area Woof (San Francisco) – online & published versions; January 2014.
5. "What do you do if your dog has a seizure?" SAGE Newsletter. Distributed to over 25,000 clients & referring veterinarians. Electronic News Article May 2014.

6. **Cameron S**, Rishniw M, Miller AD, Sturges B, & Dewey CW. "Characteristics and survival of 121 cats undergoing excision of intracranial meningiomas (1994-2011)." *Veterinary Surgery*. 2015 August; 44(6): 772 – 6.
7. Bentley RT, Burcham GN, Heng HG, Levine JM, Longshore R, Carrera-Justiz S, **Cameron S**, Kopf K, & Miller MA. "A comparison of clinical, magnetic resonance imaging and pathological findings in dogs with gliomatosis cerebri, focusing on cases with minimal magnetic resonance imaging changes." *Veterinary and Comparative Oncology*. 2016 September; 14(3): 318 – 330. Published electronically 2014 June.
8. **Cameron S**, Glabman R, Abrams E, Johnson S, Gulland F, & Buckmaster P. "Loss of parvalbumin-immunoreactive interneurons in epileptic California sea lions." Presented at the Society for Neuroscience Annual Conference. 2017 November.
9. **Cameron S**, Lopez A, Glabman R, Abrams E, Johnson S, Field C, Gulland FMD, & Buckmaster PS. "Proportional loss of parvalbumin-immunoreactive synaptic boutons and granule cells from the hippocampus of sea lions with temporal lobe epilepsy." *Journal of Comparative Neurology*. Published online 2019 March.
10. Smith T, **Cameron S**, & Trepanier LT. "Incidence of acute and chronic hepatopathy in dogs receiving zonisamide." Presented as abstract at 2019 ACVIM forum. Currently in preparation for publication.
11. **Cameron S**, Hoskinson J, & Alex CE. "Cranial thoracic vertebral stenosis in a cat causing progressive paraparesis." 2020 June. Submitted to the *Journal of Small Animal Practice*, currently awaiting decision.
12. **Cameron S**, Weltman J & Fletcher DJ. "The prognostic value of admission point-of-care testing and Modified Glasgow Coma Scale in dogs and cats with traumatic brain injury (2007 – 2010). Submitted to the *Journal of Veterinary Emergency & Critical Care*. Accepted April, 2020.
13. **Cameron S**, Durand A. "Diffusion tensor imaging in cats using ex vivo perfusion technique." Currently in preparation for publication.
14. Barnard L, Durand A, Blume L, Lee L, & **Cameron S**. "Aventriculi associated with holoprosencephaly in a dog." Submitted to *Veterinary Radiology & Ultrasound*, currently awaiting decision.
15. **Cameron S**, Barry M, & Grady K. "Activity and sleep quality in idiopathic epileptic dogs compared to age- and breed-matched controls." Presented as a research report at 2020 ACVIM forum. Currently in preparation for publication.

D. Research Support

Ongoing Research Support

University of Wisconsin – Madison Cameron (PI) Start-up funds, no overlap	10/2017 – 09/2020
University of Wisconsin – Madison, Companion Animal Grant Cameron (PI) Project: <i>Linking feline and human temporal lobe epilepsy: Clinical signs, magnetic resonance imaging findings, and pathological changes in epileptic cats</i>	06/2018 – 09/2021
University of Wisconsin – Madison, Companion Animal Grant Cameron (PI) Project: <i>Investigating the effects of exercise on seizure frequency in epileptic dogs</i>	05/2019 – 04/2021
American Kennel Club (AKC) – Acorn Grant Cameron (PI) Project: <i>Do Dogs Get Temporal Lobe Epilepsy? Evaluation of Clinical Signs, Magnetic Resonance Imaging and Pathological Findings in Epileptic Dogs with Reference to the Human Disorder.</i>	07/2020 – 06/2021

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Felton, Elizabeth A

eRA COMMONS USER NAME (credential, e.g., agency login): EAFELTON

POSITION TITLE: Assistant Professor of Neurology

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

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Northwestern University, Evanston, IL	BS	06/1998	Chemical Engineering
University of Wisconsin, Madison, WI	MS	05/2002	Biomedical Engineering
University of Wisconsin, Madison, WI	PHD	05/2007	Biomedical Engineering
University of Wisconsin, Madison, WI	MD	05/2009	Medicine
Johns Hopkins Bayview Medical Center, Baltimore, MD	Intern	06/2010	Internal Medicine Internship
Johns Hopkins Hospital, Baltimore, MD	Resident	06/2013	Neurology
Johns Hopkins Hospital, Baltimore, MD	Fellow	06/2015	Epilepsy

A. Personal Statement

I am an assistant professor and board certified neurologist with subspecialty certification in epilepsy in the University of Wisconsin-Madison Department of Neurology. I look forward to working with Dr. Cara Westmark and Dr. Starr Cameron on the "Altering Diet to Reduce Seizures in Canines" project. My areas of clinical and research expertise focus on ketogenic dietary therapy for adults with epilepsy and on women with epilepsy, including hormone related seizure patterns (i.e. catamenial epilepsy). I look forward to working with Drs. Westmark and Cameron evaluating dietary interventions for canine epilepsy.

During neurology residency and epilepsy fellowship I developed a strong clinical research interest in the use of ketogenic diets for adults with epilepsy. I was awarded the NINDS R25 Research Education Program for Residents and Fellows in Neurology grant. My research focused on women starting a ketogenic diet and the relationship between their menstrual cycle, seizures, and ketosis. A sub-project investigated improved treatment for women with catamenial seizure patterns (seizures that correlate with the menstrual cycle and are traditionally difficult to treat) on the modified Atkins diet (a type of ketogenic diet).

Now as an assistant professor at UW-Madison I am combining the fundamental skills developed during my PhD research with the clinical and research interests I developed during my neurology residency and epilepsy fellowship. I created the UW Health Adult Epilepsy Dietary Therapy Clinic and am concurrently developing a clinical research program investigating the use of the ketogenic diet for adults with epilepsy. This is aimed at addressing the large gap in knowledge regarding the mechanisms, optimal patient selection, and potential beneficial effects (beyond seizure reduction) of ketogenic therapy for epilepsy in adults with a special emphasis on women with epilepsy. There is a paucity of rigorous clinical trials investigating dietary therapy for epilepsy and even less looking at women with epilepsy. I look forward to making contributions in this area and launching a clinical research career with a special focus on ketogenic diets and women with epilepsy. I am well suited to collaborate with Drs. Westmark and Cameron on this study given my clinical and research experience in ketogenic diets for epilepsy, our combined prior research training and expertise, key collaborations, and a supportive research environment.

B. Positions and Honors

Positions and Employment

2013 – 2015 Lumbar Puncture Clinic Attending, Johns Hopkins Hospital, Baltimore, MD, Baltimore, MD
2015 – present Assistant Professor of Neurology, University of Wisconsin, Madison, WI
2015 – present Affiliate Faculty, Department of Biomedical Engineering, University of Wisconsin, Madison, WI

Other Experience and Professional Memberships

2005 – present Member, American Academy of Neurology
2007 – 2010 Member, Committee on Diversity in Neuroscience Society for Neuroscience
2013 – present Member, American Clinical Neurophysiology Society
2013 – present Member, American Epilepsy Society
2015 – present Member, American Neurological Association
2015 – present Member, Wisconsin Neurological Society
2016 – present Member, Fellows/Junior Investigator's Professional Development Committee, American Epilepsy Society
2016 – present Member, Women Veterans with Epilepsy Workgroup, VA Epilepsy Centers of Excellence
2017 – present Member, Epilepsy Benchmark Stewards Committee, American Epilepsy Society / National Institute of Neurological Disorders and Stroke
2019 – present Member, Gender Diversity Taskforce, American Epilepsy Society

Honors

2000 Graduate Engineering Research Scholars Fellowship, University of Wisconsin, Madison, WI
2002 Medical Scientist Training Program Fellowship, University of Wisconsin, Madison, WI (T32 GM008692-10; PI Deane Mosher)
2005 Poster Award, Brain Computer Interface Technology: Third International Meeting
2005 Neuroscience Scholars Program, Society for Neuroscience
2006 Sanofi-aventis Minority Scholars Program, American Academy of Neurology
2006 Clinical Neuroengineering Training Program Fellowship, University of Wisconsin, Madison, WI (T90 DK070079-02 PI, Tom C. T. Yin)
2007 Excellence in Neural Engineering Travel Award, 3rd International IEEE EMBS Conference on Neural Engineering
2008 Gold Humanism Honor Society, University of Wisconsin-Madison
2009 Prize for Excellence in Neurology, American Academy of Neurology
2009 Leonard Tow Humanism in Medicine Award, University of Wisconsin-Madison
2012 Chief Administrative Resident, Johns Hopkins Hospital Neurology Residency
2013 Alpha Omega Alpha Medical Honor Society, Johns Hopkins University
2013 Neurology Board Certified, American Board of Psychiatry and Neurology
2013 Medical License, Maryland Board of Physicians
2014 Poster Award, 4th Global Symposium for Dietary Therapies for Epilepsy and other Neurological Disorders
2014 AES Fellows Program and EpiPORT Program, American Epilepsy Society
2015 Medical License, Wisconsin Medical Examining Board
2016 Epilepsy Board Certified, American Board of Psychiatry and Neurology
2018 Travel Award for the International Society of Neurogastrology Symposium
2018 Travel Bursary Award for the 6th Global Symposium on Ketogenic Therapies for Neurological Disorders
2019 UW Health Patient and Family Experience Provider Champion Award

C. Contribution to Science

1. Graduate School: The limited potential for functionally significant recovery from brain and spinal cord injury or degeneration places an enormous toll on patients, families and society. Ideally, a direct link could be established between the brain and desired action, taking advantage of the natural flexibility of control inherent in the central nervous system. Brain-computer interface (BCI) technology has the potential to make this link and thereby provide increased independence to individuals with severe motor disabilities. My PhD work in Biomedical Engineering focused on BCI research in humans using electroencephalogram (EEG) and electrocorticogram (ECoG) recordings. I determined the human information processing capacity for EEG, ECoG, and manual computer cursor control, which allowed comparisons to be made between tasks and modalities. I also compared task performance and mental effort of participants who were severely motor disabled and able-bodied during BCI training. I performed the research described in these publications under the mentorship of Drs. Robert Radwin and Justin Williams at the University of Wisconsin.
 - a. Felton EA, Williams JC, Vanderheiden GC, Radwin RG. Mental workload during brain-computer interface training. *Ergonomics*. 2012;55(5):526-37. PMID: [PMC3344383](#).
 - b. Felton EA, Radwin RG, Wilson JA, Williams JC. Evaluation of a modified Fitts law brain-computer interface target acquisition task in able and motor disabled individuals. *J Neural Eng*. 2009 Oct;6(5):056002. PMID: [PMC4075430](#).
 - c. Felton EA, Wilson JA, Williams JC, Garell PC. Electrocorticographically controlled brain-computer interfaces using motor and sensory imagery in patients with temporary subdural electrode implants. Report of four cases. *J Neurosurg*. 2007 Mar;106(3):495-500. PMID: [17367076](#).
 - d. Wilson JA, Felton EA, Garell PC, Schalk G, Williams JC. ECoG factors underlying multimodal control of a brain-computer interface. *IEEE Trans Neural Syst Rehabil Eng*. 2006 Jun;14(2):246-50. PMID: [16792305](#).
2. Epilepsy Fellowship: The classic ketogenic diet and the modified Atkins diet (MAD) are both effective nonpharmacologic therapies for adults with epilepsy. Despite the increasing number of women of childbearing age starting ketogenic diets, little has been published about the diet's effect on the menstrual cycle. During my epilepsy fellowship I evaluated the relationship between the menstrual cycle, seizures, and ketosis in women of childbearing age on dietary therapy (specifically MAD) for epilepsy. Data from this work has been presented at three conferences, including one that won a poster award (b below) and one that was selected for podium presentation in 2015 at the American Epilepsy Society Ketogenic Diet Special Interest Group (c below). Data from this research is currently submitted for publication. A sub-project involved methods to better treat women who have a catamenial seizure pattern while on the modified Atkins Diet. Data collection is still ongoing and UW-Madison is now a second data collection site. This research was performed under the mentorship of Drs. Mackenzie Cervenka and Eric Kossoff, internationally recognized experts in dietary therapy for epilepsy at The Johns Hopkins Hospital. These investigations laid the foundation for my current research.
 - a. Felton EA, Cervenka MC, Henry BJ. The Relationship between the Menstrual Cycle, Seizures, and Ketosis. American Epilepsy Society 69th Annual Meeting; 2015 December; Philadelphia, PA.
 - b. Felton EA, Kossoff EH, Henry BJ, Cervenka MC. An Evaluation of Catamenial Seizure Patterns and the Relationship between the Menstrual Cycle, Seizures, and Ketosis in Women on the Modified Atkins Diet for Treatment for Epilepsy. American Epilepsy Society 68th Annual Meeting; 2014 December; Seattle, WA.
 - c. Felton EA, Kossoff EH, Henry BJ, Cervenka MC. An Evaluation of the Catamenial Seizure Pattern in Women on the Modified Atkins Diet for Treatment of Epilepsy. 4th Global Symposium for Dietary Therapies for Epilepsy and other Neurological Disorders; 2014 October; Liverpool, England.
3. Assistant Professor: Since joining the UW-Madison Department of Neurology in 2015 I developed the Adult Epilepsy Dietary Therapy Clinic, which is new offering for the neurology department and one of only ~10 such clinics across the United States. My research is focused on developing a personalized medicine approach for dietary therapy customization and response prediction to reduce seizure burden and

comorbidities in people with epilepsy. My subfocus in investigating hormonal effects in women on ketogenic diet.

- a. Felton EA, Henry-Barron BJ, Kossoff EH, Jan A, Shegelman A, Cervenka MC. "Women on Ketogenic Diets: Perceived Relationships between the Menstrual Cycle, Seizures, and Ketosis" 6th Global Symposium on Ketogenic Therapies; 2018 Oct; Jeju Island, South Korea.
 - b. Felton E & Faltersack K. "Initiation of Ketogenic Therapy – Adult – Inpatient Clinical Practice Guideline." 2018. UW Health, Madison WI.
 - c. Cervenka MC, Henry BJ, Felton EA, Patton K, Kossoff EH. Establishing an Adult Epilepsy Diet Center: Experience, efficacy and challenges. *Epilepsy Behav.* 2016 May;58:61-8. PMID: [27060389](#).
 - d. Felton EA, Cervenka MC. Dietary therapy is the best option for refractory nonsurgical epilepsy. *Epilepsia.* 2015 Sep;56(9):1325-9. PMID: [26198999](#).
4. Assistant Professor: Since joining the UW-Madison Department of Neurology I have also become involved in the NIH U01 Epilepsy Connectome Project (ECP). This is a joint project between UW-Madison and the Medical College of Wisconsin. Imaging, neuropsychological data, and serology is being collected in 200 adult patients with temporal lobe epilepsy (TLE) to investigate brain connectivity changes. I have an interest in women with epilepsy and specifically catamenial (menstrual cycle related) seizure patterns, so am investigating differences in connectivity in women with temporal lobe epilepsy.
- a. Hwang G, Nair VA, Mathis J, Cook CJ, Mohanty R, Zhao G, Tellapragada N, Ustine C, Nwoke O, Rivera-Bonet C, Rozman M, Allen L, Forseth C, Almane DN, Kraegel P, Nencka A, Felton E, Struck A, Birn R, Maganti R, Conant L, Humphries C, Hermann B, Raghavan M, DeYoe E, Binder J, Meyerand ME, Prabhakaran V. "Using low-frequency oscillations to detect temporal lobe epilepsy with machine learning." *Brain Connectivity.* 2019 Mar;9(2):184-193. PMID: [30803273](#).
 - b. Williams L, Hwang G, Zhao G, Hermann B, Struck A, Nair V, Prabhakaran V, Felton E. "Epilepsy Connectome Project (ECP) – Cognitive Gender Differences in Temporal Lobe Epilepsy." American Epilepsy Society 73rd Annual Meeting. 2020. Baltimore, MD.
 - c. Cook CJ, Hwang G, Mathis J, Nair VA, Conant L, Allen L, Almane DN, Birn R, DeYoe E, Felton E, Forseth C, Humphries C, Kraegel P, Nencka A, Nwoke O, Raghavan M, Rivera-Bonet C, Rozman M, Tellapragada N, Ustine C, Ward D, Struck A, Maganti R, Hermann B, Prabhakaran V, Binder J, Meyerand ME. "Effective Connectivity Within the Default Mode Network In Left Temporal Lobe Epilepsy: Findings from the Epilepsy Connectome Project." *Brain Connectivity.* 2019 Mar;9(2):174-183. PMID: [30398367](#).

Complete List of Published Work in MyBibliography:

<https://www.ncbi.nlm.nih.gov/sites/myncbi/elizabeth.felton.1/bibliography/49456630/public/?sort=date&direction=ascending>