BIOGRAPHICAL SKETCH

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NAME: Trenton D. Wirth

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

POSITION TITLE: PhD Candidate

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)*	Start Date MM/YYYY	Completion Date MM/YYYY	FIELD OF STUDY
University of Cincinnati, Cincinnati, Ohio	B.A.	08/2011	04/2014	Philosophy
University of Cincinnati, Cincinnati, Ohio	B.S.	08/2011	04/2014	Psychology
Brown University, Providence, Rhode Island	Ph.D.	08/2014	Expected 09/2020	Cognitive Science

A. Personal Statement

It is my long term career goal to develop expertise exploring the nuanced connections of human perception and action, providing basic science insights that have real world impact. My interest in perception and action systems stems back to my training as an undergraduate at the University of Cincinnati, where I conducted a senior thesis under Dr. Michael Riley studying the connection between auditory localization tasks and postural control. My passion for the study of perception and action led me to Brown University, where I began my investigation into the complex interpersonal system of human crowds. With the guidance of my advisor, Dr. William Warren, I have spent the past six years becoming an expert in the study of complex systems that manifest within human perception and action problems. My dissertation work has focused on applying theories and methods from behavioral dynamics, synergetics, psychophysics, and animal collective behavior to establish an understanding of how coordination in human crowds manifests by a process of self-organization; where the local perceptual interactions between individuals and their neighbors gives rise to complex behavior. In my time at Brown University, I have taken coursework in visual perception, perception and action, cognitive science, spatial navigation, experimental design, and regression analysis. My experimental training has made me an expert in implementing a data-driven three-pronged approach to study complex systems: experimentation in Virtual Reality, model development and simulation of behavior, and real-world behavioral observation. It is my belief that this same system, regularly applied to understanding collective motion, can also be applied to developing a holistic understanding of the visuo-locomotor system.

My scientific background has prepared me to conduct the proposed research that I will be pursuing as an incoming post-doctoral associate in Dr. Jonathan Matthis' Human Movement Neuroscience Lab. In this space, I will establish a foundation for my long term career goals directly by developing the skills and knowledge required to study the visuo-locomotor system, combining methods and insights from visual and motor neuroscience. As a recipient of the NRSA Fellowship, I would be empowered to continue my passion for mentorship and my history of grantsmanship, establishing a foundation from which to build my career that will reflect the values I hold as an emerging scientist. What is presented in this application is a proposal that both pushes the boundaries of our understanding of how perception and action influence one another, but also provides me with the resources and training from Dr. Matthis and my co-sponsors at Northeastern University necessary to achieve my ambitious career goals.

B. Positions and Honors

Positions and Employment

2020- (Incoming) Postdoctoral Research Associate, Biology Department, Northeastern University

Other Experience and Training

2012-2014 Research Assistant, Psychology Department, University of Cincinnati
2014-2020 Graduate Student, Department of Cognitive, Linguistic and Psychological Sciences, Brown University

Awards and Honors

2014 Research Assistant of the Year, Psychology Department, University of Cincinnati
2014 B.A. Philosophy, *Summa Cum Laude*, College of Arts and Sciences, University of Cincinnati
2014 B.S. Psychology, *Cum Laude*, College of Arts and Sciences, University of Cincinnati
2018 Hyundai Visionary Challenge, Brown University, Award Recipient-
Pedestrians to Pilots: using virtual reality as a tool for 3D human navigation
2019-2020 Link Foundation: Modeling, Simulation & Training Fellowship

Memberships

2011-2014 Psi Chi, International Honor Society in Psychology
2015- Vision Sciences Society
2016- International Society of Ecological Psychology

C. Contributions to Science

1. To develop an accurate model of human crowd behavior is self-organized, one must understand the local interaction rules of an individual pedestrian. The first step in this process, is characterizing the zone of influence of an individual pedestrian within a crowd. The first steps of my graduate career were to compare two potential neighborhood models which are common in the collective motion literature: 1. A metric model, where neighborhood influence decays with distance, and 2. A topological model, where neighbor influence is independent of distance. By manipulating density in three different experiments (two in virtual reality, and within a real human "swarm), we were able to determine with whether a human crowd model should use a metric or a topological neighborhood, where metric neighborhoods are sensitive to density manipulations, but topological ones are not. Our results reveal that participants were sensitive to density across all three experiments, consistent with the metric hypothesis. However, the data are better explained by a visual model based on optical velocity and visual occlusion, both of which depend on metric distance. We conclude that the neighborhood of interaction in human crowds is metric, not topological, a natural consequence of the laws of optics.
    a. Wirth, T.D., Warren, W.H., (2016). The visual neighborhood in human crowds: Metric vs. topological hypothesis. Poster presented at Vision Sciences Society, St. Pete's Beach Florida.
    b. Wirth, T.D., Dachner, G.C., & Warren, W.H., (2018). Metric vs. topological models of collective motion in human crowds. Poster presented at Vision Sciences Society, St. Pete's Beach Florida.
    c. Wirth T.D., Dachner G.C., Rio, KR. & Warren, W.H., (in preparation). The neighborhood of interaction in human crowds is metric, not topological, due to the laws of optics.

2. The self-organization of human crowds relies on the coordination of neighbors within the crowd. How is a pedestrian recruited into coordinative motion? To answer this question, I conducted two experiments. The first was to determine if participants would average over "noisy neighbors", i.e. neighbors that were walking in random directions. The second experiment determined if neighbor alignment (pocketed within noisy crowds) would serve as the positive feedback loop necessary for recruitment into coordinative motion. The "noisy neighbors" experiment demonstrated that participant do indeed average over neighbors walking in disparate directions, as long as the neighbors are within the "neighborhood". The second recruitment study confirmed that as subsets of a crowd become more

aligned, they become more attractive to a pedestrian, establishing the framework for self-organized recruitment into collective motion for human crowds.

a. Wirth, T.D. & Warren, W.H., (2017). Recruitment of pedestrians into collective crowd motion. Poster presented at Vision Sciences Society, St. Pete's Beach Florida.
b. Wirth, T.D. & Warren, W.H., (in preparation). Self-organization in human crowds: Recruitment into collective motion.

3. Studies have shown that humans demonstrate the robust ability to average over "noisy neighbors" when walking with a crowd, but that they are also attracted to coherent subsets within large crowds. At what point does a pedestrian's tendency to average over their neighbors transition into decision making between subgroups of neighbors? Through a series of four virtual reality experiments, I was able to determine that participants tend to average over two groups of completely aligned neighbors out to an angular difference in heading of around 60° - without spatial separation, meaning that the two turn groups are always spatially present. At this point, competing goal dynamics emerge. With competing goals (the goals being two turn groups), pedestrians are likely to follow the larger group, but once crowds start to turn too far (>100°), pedestrians will follow the smaller of the two groups, preferring to walk closer to their initial heading. The findings have resulted in notable model improvements, where we have implemented competing goal dynamics into our crowd model.
   a. Wirth, T.D. & Warren, W.H., (2019). Collective Decision Making in Human Crowds: Majority Rule Emerges from Local Averaging. Talk presented at Vision Sciences Society, St. Pete's Beach Florida.
   b. Wirth, T.D. & Warren, W.H., (in preparation). Self-organization in human crowds: transition from averaging to decision making behavior for individual pedestrians.
   c. Wirth, T.D., Free, B. & Warren, W.H., (in preparation). Self-organization in human crowds: Competing goal dynamics in human crowds.

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

YEAR	COURSE TITLE	GRADE
	GRADUATE COURSES: BROWN UNIVERSITY	
2014	Ecological Approach to Perception & Action	A
2014	Graduate Proseminar	A
2014	Experimental Design	B
2015	Visualizing Vision	B
2015	Core Topics in Perception	A
2015	Spatial Cognition	A
2016	Core Topics in Cognition	B
2016	Applied Regression Analysis	B
2016	Perceiving and Acting in 3D	A
2016	Core Topics in Language	A

Brown University courses can either be taken for a letter grade (A/B/C/No Credit) or for a grade of Satisfactory (S) or Unsatisfactory (U).