

# UNDERGRADUATE RESEARCH Highlights

**Jumper PH, Fisher RT.** Shaping the Brown Dwarf Desert: Constraints from Turbulent Fragmentation. *Astrophysical Journal*. 2013; 769:9-42. (University of Massachusetts Dartmouth)

This research suggested that several observed properties of brown dwarfs (a class of substellar objects) in binary systems could be accounted for as a consequence of a single mechanism, the fragmentation of a turbulent, star-forming region. These properties include the “brown dwarf desert” (a dearth of brown dwarfs in nearby orbits around Sun-like stars) and the narrow separations for pairs of brown dwarfs. Robert Fisher is an assistant professor of physics. Peter Jumper, a Commonwealth scholar, physics major, and mathematics minor, participated in this research from the summer of 2010 to the spring of 2013. Jumper has now graduated with a BS in physics with honors and will be a Connaught PhD Fellow in the fall of 2013 in the University of Toronto’s Department of Astronomy and Astrophysics. Fisher’s work was funded through NSF Grant CNS-0959382 and AFOSR DURIP Grant FA9550-10-1-0354. Jumper was funded by NSF Grant DMS-0802974.

**Chandler S, Castillo A, Kadash M, Kenner MD, Ramirez L, Valdez RJ.** *New Literacy Narratives from an Urban University: Analyzing Stories about Reading, Writing, and Changing Technologies*. New York: Hampton Press, 2013. (Kean University)

Our book presents literacy narratives—reflective stories about experiences with reading and writing—by five undergraduate co-authors. It begins with an overview of theory and methods used to create and analyze life stories. Because we analyze both what participants say and how they said it, we review research from new literacy studies, narrative/discourse analysis, and oral history. Co-authored chapters explore correlations between storytelling and literate learners’ agency (Ramirez); suggest relationships between identity stories and patterns for connecting to (or not) online literacies (Kenner); present storytelling patterns as evidence of how literate learners change and grow (Kadash); identify patterns for negotiating (or not) multiple discourses (Valdez); and describe how online spaces

sponsor new patterns for identity development (Castillo). Sally Chandler is an associate professor in the English Department at Kean University. The project began back in 2006, when all co-authors were students in courses where Chandler talked about my research on literacy narratives. Each co-author volunteered to participate in an interview and then continued on as a collaborative researcher. All co-authors read drafts and reviewed data as they graduated, found jobs, completed graduate degrees, and continued on with their lives. Castillo and Valdez earned MAs in Writing Studies from Kean University and currently work as adjunct professors. Kadash is the mother of three children and is a manager at a bank. Kenner earned an MFA from Western Connecticut State University, and writes for *J’Adore* magazine. Ramirez is enrolled in the MA in Public Administration program at Kean University. Our work was funded by a Kean University UFRI grant, and by a University-sponsored Students Partnering with Faculty Summer Research Grant.

**Odio C, Holzman SA, Denison MS, Fraccalvieri D, Bonati L, Franks DG, Hahn ME, Powell WH.** Specific Ligand Binding Domain Residues Confer Low Dioxin Responsiveness to AHR1 $\beta$  of *Xenopus laevis*. *Biochemistry*. 2013; DOI:10.1021/bi301722k. (Kenyon College)

Toxicity of dioxin-like chemicals is mediated by the aryl hydrocarbon receptor (AHR). Frogs are remarkably insensitive to the toxicity of dioxin-like chemicals, and frog AHRs bind dioxins with low affinity. In this study, we constructed a homology model suggesting that low affinity dioxin binding was due to two variant amino acids in the putative ligand binding cavity. Binding and activity assays with mutated AHRs confirmed the suppositions of the model. Wade Powell is a professor of biology. Cami Odio and Sarah Holzman performed much of the work as their senior thesis projects. Odio is a medical student at the Cleveland Clinic. Holzman was a post-bac Intramural Research Training Award (IRTA) at NIH before moving on to medical school at Emory. NIH AREA Grant: R15 ES011130. Odio received a Pfizer Undergraduate Travel Award to present portions of this work at the 2012 Annual Meeting of the Society of Toxicology.

**Cogan E, Parker S, Zellner DA.** Beauty Beyond Compare: Effects of Context Extremity and Categorization on Hedonic Contrast. *Journal of Experimental Psychology: Human Perception and Performance*. 2013; 39(1): 16-22. (Montclair State University)

Hedonic contrast occurs in ratings of the attractiveness of faces (i.e., attractive females are rated as more attractive if rated after unattractive ones and unattractive females are rated as less attractive if rated after attractive ones). This contrast effect can be eliminated if extremely attractive females are rated with unattractive females unless subjects are told that these two sets of females are all members of the same category (a choir). These results parallel findings in intensity judgments in which stimuli that are too different on the dimension being judged are not compared and contrast does not occur. However, thinking of them as belonging together results in a contrast even in these extremely different stimuli. Scott Parker is a professor of psychology at American University. Debra Zellner is a professor of psychology at Montclair State University. Elizabeth Cogan, a senior psychology major, conducted this research as her psychology honors thesis. Cogan is currently in a doctoral program in psychology at the University of Michigan.

**Pyper KJ, Jung JY, Newton BS, Nesterov VN, Powell GL.** Reactions of  $\text{Os}_3(\text{CO})_{12}$  with Carboxylic Acids in a Microwave Reactor; Synthesis of  $\text{Os}_2(\text{benzoate})_2(\text{CO})_6$ , a Dinuclear Osmium(I) Compound with Aromatic Carboxylate Ligands. *Journal of Organometallic Chemistry*. 2013; 723: 103-107. (Abilene Christian University, University of North Texas)

This was the first report of the use of microwave heating to synthesize dinuclear osmium(I) carbonyl complexes with carboxylate ligands, including the first example with an aromatic ligand. Compounds of this type are relatively rare since only four had been previously prepared. We obtained the X-ray crystal structures of two new compounds and reported the first successful direct reaction of  $\text{Os}_3(\text{CO})_{12}$  with benzoic acid. Gregory Powell is a professor of chemistry at ACU. Vladimir Nesterov is the staff crystallographer at UNT. Kayla Pyper, Jade Jung, and Brittney Newton worked

on this project at ACU for one summer and two semesters each during 2009-2011. Pyper is currently in a doctoral program in chemistry at the University of Michigan. Jung is employed by American Airlines as a water-quality analyst. Newton is employed as a teacher and is in the process of applying to graduate programs. The research was supported by a departmental grant to ACU from the Welch Foundation.

**Rusinko J, Swan H.** Agent-Based Fabric Modeling Using Differential Equations. *Community of Ordinary Differential Equations Educators*. 2012; 9. <http://www.codee.org/library/articles/agent-based-fabric-modeling-using-differential-equations>. (Winthrop University)

We use an agent-based modeling software, NetLogo, to simulate fabric drape by applying a modified mass spring system. This model provides an application of harmonic motion to textiles and fashion, fields not typically discussed in the undergraduate differential equations classroom. Euler's method is coded into the model to solve a system of ordinary differential equations describing the fabric's position over time. Our interactive NetLogo model allows students to visualize the behavior of the system and to experiment with parameters and other numerical methods. We show an example of the success of our program. Joseph Rusinko is an associate professor of mathematics. Swan is a senior mathematics major. The research was supported by the Winthrop McNair Scholars Program.

**Lane G, Wagner TP.** Examining Recycling Container Attributes and Household Recycling Practices. *Resources, Conservation and Recycling*. 2013; 75: 32-40. (University of Southern Maine)

This paper examined the influence of the attributes of recycling containers on recycling rates, participation rates, and set-out rates. As communities spend considerable sums on containers, and likely have only one opportunity, it is crucial to know what attributes (e.g., size, shape, color, mobility, convenience, etc.) can maximize the amount of recyclables collected. The study found that the major positive attributes were larger containers and wheeled containers. Travis Wagner is an associate professor of environmental

science and policy. Gordon Lane was an undergraduate student majoring in environmental science. He began work on this project in 2011 as a work-study student. Wagner was able to use some funds from a professional develop award to support Lane as a research assistant. In recognition of his amazing work, Lane was made first author on this paper. Lane is currently employed full time in the field and has expressed interest in going to graduate school in the future. There was no dedicated funding for this research.

**Daubner SC, Avila AM, Bailey JO, Barrera D, Bermudez JY, Giles D, Khan CA, Shaheen N, Thompson J, Vasquez J, Oxley S, Fitzpatrick PF.** Mutagenesis of a Specificity-Determining Residue in Tyrosine Hydroxylase Establishes that the Enzyme is a Robust Phenylalanine Hydroxylase but a Fragile Tyrosine Hydroxylase. *Biochemistry*. 2013; 52(8):1446-1455. (Texas A&M University - TAMU and University of Texas Health Science Center San Antonio - UTHSCSA)

This study was part of an ongoing investigation into the evolution of the aromatic amino acid hydroxylases. An ancient phenylalanine hydroxylase provided the starting gene for the later enzymes, which are critical to neurotransmitter synthesis. This project described the effect of a valine-to-aspartate mutation in a critical position of the active site. Fitzpatrick is a professor in biochemistry at UTHSCSA, Daubner is a professor in biological science at St Mary 's University, and Oxley is an associate professor in chemistry and biochemistry at St Mary 's University (StMU). Avila, (2009-2013), NIH R25 neuroscience program; Bailey (2008), NSF REU student, now in graduate school at TAMU; Barrera (2010); Bermudez (2009), summer undergraduate research fellowship from StMU, now in graduate school at the University of North Texas Health Science Center; Giles (2011), now in graduate school at UT in Austin; Khan (2009-2012), now in graduate school at UTHSCSA; Shaheen, NIH R25 neuroscience program and McNair scholarship recipient; Vasquez (2007), now a medical resident at the UTHSCSA School of Medicine; Thompson (2007), finished a MS in Nutrition at TAMU and now teaching high school science in Waco, TX. NIH R01 GM047291, Welch Foundation AQ-1245, NIH R25 NS080684, NSF Grant DBI-0552822, DOE McNair Scholars program, StMU SURF Program, and Faculty

Development Grant from StMU Vice President for Academic Affairs.

**Huang SH, Clark N, Wedel W.** The Use of an iPad to Promote Kindergartners' Alphabet Recognition and Letter Sound Correspondence. *Practically Primary*. 2013; 18(1):24-26. (Midwestern State University)

This study employed a case study method to investigate the effectiveness of the iPad's applications that foster literacy development and learning for struggling readers. Two kindergarten students, who have been diagnosed as struggling readers and as having ADHD, participated in tutoring sessions over the course of the semester. The researchers worked with each student individually on a weekly basis using the iPad's software applications, such as the ABC Matching game, Alphabet Learn, Alphabet Tracing, and ABC Go Go, etc. By the end of the semester, both students were able to identify the letters of the alphabet, and to distinguish the differences between letters and sounds by hearing, seeing, playing, and writing letters and words in meaningful ways. SuHua Huang is an assistant professor of reading education at Midwestern State University. Nicole Clark and Whitney Wedel participated in this project in spring 2012. Both of them are currently employed as classroom teachers in Wichita Falls, Texas. The research project was supported by the West College of Education of Midwestern State University.

**Zhou M, Rong R, Munro D, Zhu C, Gao X, Zhang Q, Dong Q.** Investigation of the Effect of Type 2 Diabetes Mellitus on Subgingival Plaque Microbiota by High-Throughput 16S rDNA Pyrosequencing. *PLOS ONE*. 2013; 8(4): e61516. <http://www.plosone.org/> (University of North Texas)

We investigated the effects of type 2 diabetes on the subgingival plaque bacterial composition by applying culture-independent 16S rDNA sequencing to periodontal bacteria isolated from four groups of volunteers: non-diabetic subjects without periodontitis, non-diabetic subjects with periodontitis, type 2 diabetic patients without periodontitis, and type 2 diabetic patients with periodontitis. Significant differences in certain bacterial abundances between diabetics

and non-diabetics were observed in patients with healthy periodontium and in patients with periodontitis. Our results show that type 2 diabetes mellitus could alter the bacterial composition in the subgingival plaque. Qunfeng Dong is an assistant professor in the Department of Biological Sciences and the Department of Computer Science and Engineering. Munro, a senior during this research, has graduated and will be attending graduate school at Princeton University in the fall. Funding for this study included the Research Initiation Grant at UNT, and a grant to UNT from the Howard Hughes Medical Institute through the Precollege and Undergraduate Science Education Program.

## **Call for Abstracts Posters on the Hill Spring 2014, Washington, DC**

Nothing more effectively demonstrates the value of undergraduate research than the words and stories of the student participants themselves. In spring 2014, the Council on Undergraduate Research (CUR) will host its annual undergraduate poster session on Capitol Hill. This event will help members of Congress understand the importance of undergraduate research by allowing them to talk directly with the students involved in such studies.

CUR invites undergraduates to submit an abstract of their research that represents any of CUR's divisions (Arts and Humanities, Biology, Chemistry, Geosciences, Health Sciences, Mathematics/Computer Science, Physics/Astronomy, Psychology, and Social Sciences). To ensure proper review of applications, the above are the only disciplines in which students may apply. In the case of research that is interdisciplinary, students should select the division that most closely describes the research.

Directors of undergraduate research, faculty members, and other involved administrators are urged to encourage their students to submit posters. This is a highly competitive program and a very exciting experience for both students and their faculty advisors.

**Call will open September 2, 2013. Applications due November 4, 2013.**