

## Evolutionary Studies in Higher Education: Interdisciplinarity and Student Success

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### ABSTRACT

The field of Evolutionary Studies (EvoS) stands at a significant junction. On one hand, the field has demonstrated the ability to serve as a model for a truly interdisciplinary approach to higher education (see Garcia, Geher, Crosier, Saad, Gambacorta, Johnsen, Pranckitas, 2011, for an example). This said, evolutionary approaches outside certain areas of biology proper have, in fact, been met with a great deal of skepticism and academic mistrust. In three discrete sections, the current work seeks to demonstrate that EvoS comprises a powerful academic framework that effectively integrates the ideas of so many academic areas – enhancing educational outcomes in many areas within biology and beyond. Further, this work seeks to demonstrate the broad reach of EvoS in terms of student success, partly by summarizing outcomes of a recent NSF grant designed to expand EvoS' reach. As part of the work of this grant, approximately a dozen student research teams conducted research across several disciplines, leading to many presentable (and, in some cases, publishable) papers that reflected very high levels of quality. A final section of this work addresses controversies in the field of evolutionary studies, such as the controversies that surround evolutionary psychology (which focuses on applying evolutionary principles to issues of human behavior), and how such controversies are frequently presented in straw-man ways. This final section seeks to show how developing a sophisticated understanding of the different facets of these issues may serve a conciliatory and progressive role in the future – to allow the powerful ideas related to evolution positively affect all academic areas across the ivory archipelago (Wilson, 2007).

### KEYWORDS

Evolution Education, Educational Philosophy, Teaching Evolution, Evolution in Higher Education, Evolutionary Psychology

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The Evolutionary Consortium Summit of 2012 at New Paltz brought together students and scholars from various places to share experiences and thoughts regarding evolution in the higher education curriculum – largely with an eye toward (a) taking stock of the current state of evolution's place in higher education and (b) trying to forecast and shape the future of evolution within academia.

As three of the primary scholars who worked on an NSF-funded grant to expand evolutionary studies within higher education, we have unique perspectives on these issues which we shared in a presentation at the 2012 meeting – which we summarize in this paper. This paper, in particular, addresses (a) the highly interdisciplinary nature of EvoS, (b) the unique kinds of student success stories that EvoS programs have cultivated, and (c) the role that EvoS can play in helping bring together traditionally distinct academic areas and perspectives.

### **EVOS: A TRULY INTERDISCIPLINARY APPROACH**

Academia is clearly moving toward interdisciplinary forms of education (see Garcia et al., 2011). As a result, we see the growth of such large-scale interdisciplinary academic programs as women's studies, black studies, American studies, and other interdisciplinary approaches that now represent curricula at many colleges and universities. Started at Binghamton University in 2003, EvoS is something of a newcomer on the scene of interdisciplinary studies. This said, largely based on our prior work related to the NSF grant we'd received to expand EvoS, there are now more than 50 colleges and universities around the world that are explicitly connected to the EvoS Consortium – and many of these institutions, such as Albright College, the University of Alabama, and the University of Missouri, have full-blown curricula in EvoS. EvoS is growing.

Further, EvoS differs from traditional interdisciplinary programs in a significant way. Specifically, most interdisciplinary programs revolve around shared content. For instance, a program in American Studies includes courses from such fields as English, History, and Political Science – all addressing the content of the American experience from the angle of a particular academic approach. EvoS is different. EvoS is an interdisciplinary program based on a shared set of intellectual ideas – the basic ideas of evolutionary theory (such as natural selection) and then connects content from there. As such, students in an EvoS program receive a strong background in evolutionary principles and then they can apply these principles to such diverse content areas as biological anthropology, literary studies, social psychology, and more. Once a student has a strong background in EvoS, he or she becomes able to apply and integrate the ideas of evolutionary theory widely across his or her academic experience.

In two recent papers that speak to the interdisciplinary nature of EvoS, we've focused particularly on the behavioral sciences, and have documented that the evolutionary perspective truly cultivates an approach that is significantly more interdisciplinary in scope relative to other perspectives that are not explicitly rooted in evolutionary ideas. This work, summarized in the following paragraphs, provides evidence that an evolutionarily informed approach to an academic area has strong

potential to truly connect students and scholars with work that spans many different areas of academia.

Garcia et al. (2011) examined the academic departmental homes of first authors of articles in several top-tier journals within the behavioral sciences. Some of these journals were explicitly evolution-based in scope (e.g., *Evolutionary Psychology*) while others were more traditional (e.g., *Cognitive Psychology*). Two basic findings emerged. First, the evolution-based journals showed a much higher proportion of authors from areas outside psychology compared with the non-evolution based journals. So, someone from Anthropology or Biology, for instance, would be much more likely to be a first author of an article in *Evolutionary Psychology* than in *Cognitive Psychology* (or in several other non-evolution-based journals in the behavioral sciences). Second, the total number of disciplines represented by academic homes of authors was much broader for the evolution-based journals than for the others – evolution-based journals included authors from over a dozen disciplines in the sample – the other journals included only typically about 2-4 disciplines.

In a follow-up study, Geher, Crosier, Dillon, and Chang (2011) examined the literature cited by articles published in evolution-based journals versus a similar set of non-evolution-based journals – also in the behavioral sciences. This was done by examining the academic affiliations of the first authors of a large sample of articles cited as references in articles that were published in evolution-based versus non-evolution-based journals. The bottom line was very parallel to the findings from Garcia et al. (2011) – articles in evolution-based journals were much more likely to draw on literature written by authors from across many different academic areas; articles in non-evolution-based journals were not likely to cite literature from disciplines outside the behavioral sciences. So, at least within the behavioral sciences, the evolutionary approach seems to cultivate, or at least go hand-in-hand with, a truly interdisciplinary approach to academia.

### EVOS AND STUDENT SUCCESS

EvoS exists to provide new and important opportunities to enhance faculty research and student education. Clearly, there are many ways to gauge student success. As we prepared for the EvoS summit, we chose to reflect upon the place that EvoS had in the personal and professional journeys of the students that participated in the NSF-funded EvoS faculty-student research projects over the summers of 2009 and 2010. We asked students to describe where their individual paths led, and how the research conducted for this project influenced their trajectories. In short, this remarkable cohort of students has made the most of the opportunities afforded them—a few of their stories follow.

In 2009, four projects at New Paltz were funded. Zuchra Zakirova worked with Dr. Jeffrey Reinking to investigate the question “When did nuclear receptors evolve the capability to bind heme?” Zuchra graduated from SUNY New Paltz in May of 2010, earning a BS in Cellular and Molecular Biology, and a BA in English Literature. Since graduation, she has earned an MSc degree in Genomics and Pathway Biology from the University of Edinburgh (Scotland, U.K.) and is currently enrolled in a Ph.D. program in Neuroscience from the Open University. When

asked to reflect on the place EvoS held in her journey, she replied, “participating in the EvoS research program helped me grow academically as well as personally, in that it allowed me to dream, make mistakes, and most importantly learn from them. Undergraduate research is a precious gift, it is able to open up a world of possibilities to a young person, and ignite a passion for science, discovery, and the endless pursuit of answering the question, “Hmm, interesting... but ... HOW does that happen?””

Rachel Carmen worked with Dr. Corwin Senko during the summer of 2009 exploring how the ovulatory cycle influences a female's perception of what type of humor style is attractive (self-deprecating vs. other-deprecating). She earned a BA in Psychology with minors in Evolutionary Studies and History in 2009 and an MS in Psychology in 2013. Rachel has been fantastically busy as a scholar during this time, with ten publications completed and four more in preparation. The future is likely to involve further academic work, in the form of a Ph.D. program. On the immediate horizon is the opportunity to teach Evolutionary Psychology at New Paltz in the Spring. When asked about the role EvoS played in her education, Rachel replied, “the EvoS program really helped me create a solid foundation to build my writing and teaching on. Taking classes that were outside of my major was a really enjoyable, eye-opening experience for me--and I've recommended it to all the students I've talked to. Every single publication I've gotten was either explicitly related to EvoS or it included some aspect of evolutionary theory within it. It's more than an academic discipline, it's a way to understand the world around us.”

Also in 2009, Jannett Dinsmore worked with Dr. Aaron Haselton to look at the effect, if any, of diet on sustained flight in *D. melanogaster*. She completed a BS in Biology in 2009 and an MA in Biology in 2012. She is now a lecturer in the Department of Biology at SUNY New Paltz. Jannett describes her involvement with the EvoS research program as such, “participating in the EvoS research program provided me with hands on experience. It gave me the opportunity to take the knowledge that I had gained in the classroom and apply it in a research setting. Instead of just learning about the scientific process, I was able to become an active participant.”

In the Summer of 2010, Aaron Reed followed up on Zuchra's work with Dr. Reinking to study the evolution of nuclear receptors. This work was published in the journal “Nuclear Hormone Signaling.” Aaron finished his BS in Molecular and Cellular Biology in 2010, enrolled in a Ph.D. program in Molecular Medicine, at George Washington University, and hopes to work for the FDA upon completion of his degree. Reflecting upon the role of the EvoS research program, Aaron stated, “academically, this research program exposed me to hands-on, full-time, research at SUNY New Paltz. Many of the molecular biology skills acquired during that period have proven to be useful tools in my independent pursuit of an advanced degree. Personally, it gave me satisfaction when experiments were executed and results were obtained. I also gained an appreciation for the work scientist do.”

Nolan Conaway worked with Professor Alice Andrews and fellow undergrad Leah Manders during the summer of 2010 to conduct an experiment that tested whether scores on a theory of mind assessment would improve in a mating-relevant scenario. Nolan then graduated in the Spring of 2011 with a BA in Psychology and minors in EvoS and Philosophy, and in the fall of 2011 began a Ph.D. program at

Binghamton University in cognitive psychology. Reflecting on his journey, Nolan states, “the project I worked on gave me a sense of how to actually *do* research. I think that’s an important thing for psychology students to learn.”

Working with Dr. Jennifer Waldo on the biophysical and biochemical properties of the Dam1 complex, a 10 protein subunit complex that is a component of the kinetochore, Stacey Greagor feels that “the EvoS research program was the foundation of my academic achievements. My research experience helped to build my confidence in the lab and strongly supplemented my studies in the classroom.” This work led to two publications—one in *Biochemical and Biophysical Research Communications* and another in *Evolution: Education and Outreach*. Following obtaining her BS in Biology and a minor in EvoS, Stacey was able to quickly find temporary employment doing vaccine research at a large pharmaceutical company. In a little over a year since graduating, she has been able to advance her career to a permanent position with a small, but promising pharmaceutical company.

Finally, in 2010, Dr. Glenn Geher mentored three students in an evaluation of New York State public school health education curricula and efforts to incorporate evolutionary theory in hopes of developing a new sample curriculum. One of the participants, Abigail Kurtz, completed her BA in Psychology in 2011 and then moved to Israel to work with African refugees seeking asylum for a year. She is currently back in the States working at the headquarters for a global humanitarian organization. Her future plans include pursuing a Ph.D. in clinical psychology specializing in refugee trauma/PTSD. In considering the role of EvoS, Abbey says, “the research program, and EvoS in general, definitely made me a more well-rounded person both academically and personally. I believe I can understand the world in a greater context and truly understand what drives people to act the way they do. Learning and studying evolutionary theories then observing them play out in animal and human behavior is something I will always be fascinated with. The research program exposed me to a lot of ways to address specific factors of human behavior.”

Another student that worked with Dr. Geher in 2010 is Laura Johnsen. Laura graduated from New Paltz in the Spring of 2012 with degrees in Psychology and Theatre Arts as well as minors in Anthropology and Evolutionary Studies. She also completed the requirements for the honors program, including a presentation of her evolutionarily informed costume choices for the musical “Cabaret” at the EvoS seminar series. She is now pursuing a Ph.D. in Anthropology at Binghamton University exploring the interactions between risk taking and environment. “My participation with the research program was a great experience academically and personally. Academically, it gave me the chance to practice grant-writing skills, learn more about the research process, collaborate with other undergraduate students, and strengthen my presentation skills. It also gave me the chance to learn more about the research interests of students in other departments that I may not have had the opportunity to learn about. Personally, the experience helped me become closer with the two other undergraduate students I worked with, Abbey Kurtz and Stephen Williams. We worked really well together and enjoyed the different challenges that came along with designing a curriculum for high school students.”

While all of the students took something slightly different from the program, a recurring theme is the impact of the ability to actively participate in research and the exposure to multiple disciplinary lenses through which to view their education.

### EVOS AS A TOOL TO CREATE GREY ACADEMIC BOUNDARIES

Beyond the clear outcomes associated with specific student success stories, the EvoS Summit of 2012 allowed us to step back and think about the potential for EvoS to shed important light on the nature of academia itself. Communication between disciplines, or even within disciplines, has traditionally been oversimplified by such binary issues as nature and nurture (see Galton, 1874), or religious creation and evolution (see Scott, 2008). When either side is presented in a black or white manner, conversations are halted before beginning. There has been a general sense that one must adhere to a more innate **or** experiential philosophy of the human mind; or that human origins can be explained by a greater being **or** scientific explanations.

Scientific disciplines have historically experienced a communicative block over the supposed nature v. nurture debate. Nature generally represents a genetic and inflexible approach to phenotypes, often characterized by critics as genetic determinism. Nurture generally represents the *tabula rasa* (Locke, 1690/1998) approach—the blank slate—that the mind is created by experience. This approach is often attributed to much, if not all, of the social sciences (see the Standard Social Science Model, Tooby & Cosmides, 1992). Such straw creations are often understood simply and only for the goal of tearing down opposing viewpoints. Many emerging fields try to rectify this artificial distinction between nature and nurture, including the fields of epigenetics and evolutionary-developmental biology and psychology. Evolutionary studies programs also show that when these two philosophies begin to grey, they blend together to address complex issues in complex ways.

Evolutionary studies programs have been powerful ways to promote grey boundaries between disciplines. Indeed, the founder of the EvoS movement considers the ways that the Ivory Archipelago can be combined complementarily by each contributing to an understanding of life by incorporating evolutionary theory as a basic building block (Wilson, 2007). Within the initial EvoS programs (i.e. Binghamton University and SUNY New Paltz), there has been a consistent blending between the natural sciences, social sciences, and humanities. The EvoS movement intersects with and inspires courses that incorporate a STEAM (science, technology, engineering, arts, and mathematics) approach (see Walker, 2013); seminars speakers that present complex nature **and** nurture understandings (e.g. Massimo Pigliucci, Frances Champagne); and minors and certificate programs that blend disciplines that traditionally operated as separate islands (e.g. biology and literature; psychology and theatre).

The true power in blending historically black and white, isolated viewpoints through evolutionary studies programs is overcoming misconceptions about and oversimplifications of evolutionary theory that begin in early education (see Nelson, 2007); promoting integration across disciplines that all share a common goal of

understanding how the world and life works; and transforming knowledge into research that can impact the real world.

### DISCUSSION

Overall, this paper, speaks to several facets of the EvoS experience that relate to the beneficial effects of an evolutionary approach academic scholarship and student growth. Specifically, we've documented that (a) EvoS fosters a truly interdisciplinary approach to scholarship that can be empirically documented, (b) EvoS facilitates consistent and strong student outcomes, and (c) EvoS has potential to help academics move beyond traditional debates within academia (e.g., *nature versus nurture*) to help academic areas work collaboratively in creating and achieving goals in regard to building knowledge.

In an analysis of how many modern evolutionists perceive the state of evolution education within modern academia, Glass, Wilson, and Geher (2012) provide strong evidence suggesting that much work needs to be done. In a survey of first authors of evolution-themed articles published in the elite journal *Behavioral and Brain Sciences*, the lion's share of these authors reported (among other things) (a) that their doctoral training institution provided poor opportunities for evolution education, (b) that faculty at their current institution would have a hard time learning about the principles of evolution themselves, and (c) that their current home institution provides little in the way of opportunity for students outside the biological sciences to learn about evolution and its applications.

Based on a large body of convergent work (e.g., Carmen, Geher, Glass, Guitar, Grandis, Johnsen, Philip, Newmark, Trouton, & Tauber, 2013), we see strong evidence of the utility of evolutionary theory as a foundational set of ideas for any academic experience – and working collaboratively within the bounds of the growing EvoS Consortium, we hope to help fulfill Darwin's ultimate vision by better integrating evolution into higher education.

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\*\*Received May 30, 2013; Revision received Aug. 30, 2013; Accepted Dec. 1, 2013\*\*