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EvoS in a Crystal Ball: Lessons from the EvoS 2012 Summit

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KEYWORDS

EvoS, Evolutionary Studies, Trans-disciplinarity, Education

On October 26, 2012, a one-day conference on the state of evolutionary studies in higher education was held at the State University of New York at New Paltz. Most of the participants had connections to the Evolutionary Studies (EvoS) Consortium that was created with the help of NSF funding during 2008-10, using programs previously established at Binghamton University and SUNY New Paltz as models (<http://evostudies.org>).

The purpose of the EvoS Consortium is to expand evolutionary training beyond the biological sciences to include traditional human-related subjects that have not been confined to biology departments. Historically, evolutionary thought developed more or less continuously in the biological sciences but experienced a case of arrested development in relation to human affairs. A renewed effort to rethink human-related disciplines from an evolutionary perspective didn't gather steam until the late 20th century. It is currently in full swing at the level of research and scholarship, but it is not yet reflected in the curriculum of most colleges and universities, where evolution is still taught primarily as a biological subject.

An EvoS program attempts to solve this problem by creating a curriculum that can be taken by any student in parallel with his or her traditional major. In the process, faculty who are approaching their respective disciplines from an evolutionary perspective become organized into a single intellectual community, which provides a resource for faculty, especially in the human-related disciplines, who did not receive evolutionary training during their own higher education.

The need for a campus-wide evolutionary studies program that reaches both students and faculty is documented by a survey of scientists who are the forefront of the human behavioral and brain sciences from an evolutionary perspective (Glass, Wilson, & Geher, 2012). Most received little formal evolutionary training and were forced to train themselves, often after they received their PhDs. They evaluated the

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situation at their current institutions as little better than when they were students. Given the conservative nature of most academic institutions, decades might be required for faculty training and the undergraduate curriculum to catch up with current research and scholarship. An EvoS program catalyzes the process.

The basic purpose of an EvoS program can be accomplished in various ways. For example, at Binghamton it took the form of a certificate program, while at New Paltz it took the form of a minor. However, most EvoS programs are well advised to include three core features: 1) An introductory course that teaches the relevance of evolution to the human-related disciplines in addition to the biological sciences from the beginning; 2) a menu of courses that teach evolution across the curriculum with appropriate distribution requirements; and 3) a campus-wide seminar series that provides a flow of external speakers, so that faculty and students alike can witness how evolution is providing a unifying theoretical framework across disciplines at the level of cutting-edge research and scholarship.

NSF funding during 2008-10 enabled the EvoS concept to be developed at Binghamton and New Paltz and to be publicized through seminars, symposia at society meetings, the EvoS Consortium Website, and numerous publications, including a special issue of *Evolution: Education and Outreach* (2011, v4, no 1) in addition to our own online *EvoS Journal* (<http://evostudies.org/evos-journal/about-the-journal/>). Most important, groups of faculty at over fifty colleges and universities were motivated to begin EvoS programs of their own. The EvoS 2012 Summit provided an opportunity to take stock of their progress and to learn from both successes and failures. This special edition of *EvoS Journal* makes this experience available to a broader audience.

We would like to offer a few general observations, based on our experience with our own EvoS programs and the presentations at the Summit. First, EvoS courses tend to be highly popular among undergraduate students, who report that evolution provides a unifying theoretical framework, in contrast to non-EvoS courses that do not offer a comparable framework. This is true at the single-course level and even more for a multi-course curriculum program. Few EvoS courses or programs fail for lack of student interest.

Second, when an incipient EvoS program experiences difficulty getting established, it is sometimes for reasons that make *any* academic program difficult to establish—the faculty are too busy, too much Administrative red tape, all trans-disciplinary programs have special challenges, and so on.

Third, other challenges are more specific to an evolutionary studies program per se. The stigma attached to evolution in relation to human affairs during the first half of the 20th century still lingers, especially in cultural anthropology and humanities departments. Some incipient EvoS programs have even encountered resistance from faculty in the biological sciences, who feel proprietorial about the teaching of evolution!

Despite these challenges, a number of full-fledged EvoS programs have developed and have proven highly rewarding to their participants. In addition, the EvoS consortium provides resources to faculty and students who do not yet have EvoS programs at their institutions. We look forward to expanding evolutionary training across the curriculum in higher education, both at the single-course and

programmatic levels. There is no doubt that higher education will catch up with current research and scholarship. The only question is when.

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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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Evolutionary Studies from the Student Perspective

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ABSTRACT

The Evolutionary Studies (EvoS) minor at SUNY New Paltz is an incredibly diverse academic program that attracts majors from nearly all disciplines. EvoS students are provided with unique educational opportunities beyond their standard curricula, such as the opportunity to engage and collaborate with researchers and distinguished guest speakers from a variety of fields, many outside their major. Students also learn the broad applicability of evolutionary theory and are given numerous opportunities to become involved in projects and publish papers, all of which have the potential to make them more well-rounded as well as give them advantages when applying for graduate programs and future career opportunities.

KEYWORDS

EvoS, Evolution Education, Interdisciplinary Minors, Higher Education

The Evolutionary Studies (EvoS) minor at SUNY New Paltz is an incredibly diverse academic program that attracts majors from nearly all disciplines. EvoS students are provided with educational opportunities that are unique among interdisciplinary minor programs. First, students have the opportunity to engage with prominent researchers in the field through the EvoS Seminar Series. Second, the multidisciplinary nature of the EvoS program exposes students to ideas and fields that they might not have otherwise encountered and results in a broadened perspective. Third, these eye-opening perspectives and collaborative opportunities often lead to students wanting to publish their work, an achievement which is made more accessible through the *EvoS Journal*. Finally, students have the opportunity to move beyond their standard required curricula to make connections with students and researchers at other institutions through academic conferences and other special projects and initiatives. What follows is a description of what makes EvoS so uniquely valuable for students, from the perspective of several alumni of SUNY New Paltz's EvoS program.

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EVOS SEMINAR SEMIANNR SERIES

Perhaps one of the best examples of the diversity that EvoS offers is the structure of the talk series that takes place each spring semester. Each EvoS talk itself is open to the public (i.e., one does not need to be an EvoS student to attend), but prior to the talk, students who are enrolled in the EvoS Seminar Series course attend a small session (usually 40-50 students) in which the guest gives an informal, shorter talk that is more intimate and interactive. The pre-talks are intentionally less structured than the main talk and thus the format tends to differ from guest to guest. Some speakers talk about their personal history and background in their field of study and how they came to appreciate the explanatory power of evolutionary theory, while others choose to focus in-depth on topics that will only be cursorily mentioned in their main talk; yet other speakers opt to discuss other research areas which may be completely unrelated to the subject of their main talk. These small pre-talks allow students to ask questions or engage in discussions that they may not be able to at the main talk, where the audience is often much bigger. The sessions also allow students to get to know the guests on a more personal level than would be possible otherwise.

Students and speakers move directly from the pre-talk session to the main talk, which is open to all SUNY New Paltz faculty, staff, and students, as well as interested members of the community. After the main talk, the entire audience is invited to a post-talk reception with refreshments (traditionally consisting of pizza, salad, and a sheet cake custom-designed for each speaker), which provides students the opportunity to talk directly with the guest speaker and other attendees of the talk, potentially leading to collaborations with one another and/or even the guest speaker(s).

It is one thing to attend a large talk by a distinguished researcher, and quite another to have the chance to actually get to know him or her on a personal level and speak face-to-face about research, academics, and life. The EvoS program, by design, facilitates this type of interaction between students who are new to the field and speakers who are established, thus fostering the discourse that passes information from one generation of researcher to the next and keeps the discipline moving forward and, well, evolving!

BROADENING PERSPECTIVES

Given the interdisciplinary nature of the EvoS program, it is no surprise that one of the greatest advantages that EvoS students enjoy is having their eyes opened to a vast array of different topics and ideas, and how seemingly disparate fields such as literature and biology can be united with a powerful meta-theory like evolution. In the case of the seminar series, speakers come from a wide variety of backgrounds and have often surprised students with the topics they covered. Dr. Victoria Ingalls discussed how the content of fantasy literature such as the *Harry Potter* series could be analyzed from an evolutionary angle, while James Prosek discussed the fascinating lives of freshwater eels. Prosek made these eels engaging not only by providing a wealth of factual information on them, but also by incorporating his own art and displaying pictures of the eels and aquatic life he had

studied. Students also had the opportunity to see the renowned Robb Wolf give a talk on the *Paleo diet* (a set of approaches to food choice which are informed by our evolutionary past) and evolutionarily informed fitness and exercise. His talk inspired many attendees to rethink how our ancestral past can inform our modern day lifestyle choices by critically evaluating the evidence for the medical benefits of adhering to the Paleo lifestyle in its various forms. His talk was so inspiring, in fact, that an entire section of EvoS students decided to try out the Paleo lifestyle for the remainder of the semester (and, for some, beyond).

We have been honored to have some guest speakers return for multiple talks. Dr. Gordon Gallup has spoken on the science of sex appeal and introduced us to a new hypothesis on the demise of the dinosaurs. Dr. Lee Dugatkin described how Thomas Jefferson spent a good portion of his life collecting naturalistic evidence to combat a theory known as *New World degeneracy*, which posited that all North American species of flora and fauna were small and weak due to the local climate (Dugatkin, 2009). The following year, Dugatkin returned to discuss his new book on the life of Peter Kropotkin, who was born a Russian aristocrat and is famous for his anarchist writings, but was also an early theorist on evolution, especially on the subject of cooperation (Dugatkin, 2011).

The EvoS Seminar Series also takes full advantage of local talent. SUNY New Paltz's own Dr. Jeff Reinking gave a seemingly complicated talk on molecular biology, but made it very accessible, which the students appreciated and enjoyed. Lastly, Laura Johnsen, an alumna from Dr. Glenn Geher's evolutionary psychology research lab, was able to cap off her undergraduate thesis project with an EvoS Seminar Series talk, a terrific opportunity for herself as well as the audience. Along with her advisor Dr. Andrea Varga, from the Department of Theatre Arts, Johnsen provided an evolutionary perspective on analysis of the themes in the costume design for the campus production of *Cabaret*, on which they both worked. Overall, one can see that EvoS offers students a wealth of information regarding the ubiquitous applications of evolutionary theory, as well as the opportunity to get personally involved at quite a sophisticated level.

PUBLICATION OPPORTUNITIES

One aspect of the EvoS program that makes it stand out among other minors is that it offers students a number of opportunities to author academic publications, one of the most valuable experiences that aspiring researchers can have under their belt when applying to graduate schools and academic careers. EvoS instructors encourage motivated students to polish and submit outstanding assigned papers for publication. In addition, collaboration in the form of publication opportunities is fostered at the aforementioned post-talk receptions, where enthusiastic swapping of ideas can take place. Finally, advanced EvoS students are often offered the opportunity to write reviews of evolution-themed books for publication in various journals, a great way to become exposed to both the literature and the writing process in the field of evolution research.

Once an idea for a manuscript is born, students have an outlet to publish in the EvoS Consortium-created *EvoS Journal*. The *EvoS Journal* is an open-access, peer-reviewed journal that encourages undergraduate students not only to submit

for publication but also to participate in the peer-review process—both of which benefit any student looking to apply to graduate programs in the future. Students who are enrolled in the EvoS Seminar Series course (which is mandatory to earn the EvoS minor) are required to write a substantial final paper that covers some area or application of evolutionary theory. Providing students with the incentive that a strong paper can be submitted for publication has resulted in students devoting a great deal of effort to the assignment, and a number of undergraduates from SUNY New Paltz and other institutions have been successful in having their work published (e.g., Geher & Gambacorta, 2010; Johnson & Pratarelli, 2011). Additionally, graduate students have found a great deal of success publishing in this journal. Published papers range from theoretical work (e.g., Carmen et al., 2013; Geher & Gambacorta, 2010; Glass, Wilson, & Geher, 2012) to reviews of books (e.g., Carmen, Dillon, & Geher, 2010; Glass, 2011a, Trouton, 2012) and movies (e.g., Glass, 2011b) that were inspired by the talks given by EvoS guest speakers.

COLLABORATIONS AND SPECIAL PROJECTS

In addition to publication opportunities, the EvoS program has created a wealth of other collaborations, special projects, and opportunities for students to further delve into the research community. SUNY New Paltz's close ties to the other EvoS communities in the region (especially at Binghamton University and the University at Albany, SUNY) have resulted in a number of collaborative efforts and lab trips between the schools designed to foster inter-institutional support and cooperation, such as the combined effort to help build a full-fledged EvoS program at Albany.

Another extremely valuable experience for students in the EvoS program is the opportunity to become involved in the research community by attending events such as the Northeastern Evolutionary Psychology Society's annual conferences. The ability to meet other students and researchers in the field and to present a poster or talk at an academic conference gives students interested in pursuing research careers a huge jump start toward this goal. A number of EvoS students, some of whom were undergraduates, were able to become founding members of new professional organizations such as the Feminist Evolutionary Psychology Society (FEPS) and the Applied Evolutionary Psychology Society (AEPS).

One exceptional project that came out of the collaborative nature of the EvoS program was the special issue of the journal *Evolution: Education and Outreach (EEO)* which was entirely devoted to the EvoS Consortium and guest edited by EvoS pioneers Rose Sokol Chang, Glenn Geher, Jennifer Waldo, and David Sloan Wilson. The journal's editor-in-chief Dr. Niles Eldredge, after honoring SUNY New Paltz by giving a talk in the EvoS Seminar Series, appreciated the mission of EvoS enough to collaborate on this special issue, in which a number of students scored publications (e.g., Geher, Crosier, Dillon, & Sokol Chang, 2011; Waldo & Greagor, 2011). The special issue of *EEO* was only one of the many remarkable endeavors that have come out of EvoS's curriculum-bridging efforts and the connections that it creates.

CONCLUSION

Being an EvoS student is a great opportunity to hear directly from prominent researchers in various fields (and interact with them), broaden one's perspective, collaborate with individuals that students may not have the opportunity to meet otherwise, and get an early start on publications. EvoS provides individuals with a novel view of the natural world – life is interdisciplinary, yet unified by a set of basic scientific principles – and the EvoS program at SUNY New Paltz reflects this idea perfectly. It provides its students and alumni (including us, the authors) with mentors, collaborators, publication opportunities, and (most importantly) prospects for the future. In more ways than one, the Evolutionary Studies program has the potential to change lives; EvoS offers students a wealth of interconnected information that spills over the confines of academia and saturates the way in which we understand the world around us.

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Evolutionary Studies' Reproductive Successes and Failures: Knowing the Institutional Ecology

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ABSTRACT

The Evolutionary Studies (EvoS) Consortium has a number of resources available to help new EvoS programs get established, but there is not yet a clear formula that guarantees the success or failure of an effort. From the inside, it seems clear that any institution dedicated to liberal arts and science education should embrace a program that exposes students to the one theory with the power to explain all life and transform how students view the world. However, evolution education is no more the pinnacle of a Socratic “Great Chain of *Learning*” than humans are one of “*Being*.” To illustrate this, we discuss two initiatives where success may have seemed like a foregone conclusion because of previous successes in establishing EvoS programs at schools in the same state system but where, despite this, those efforts stumbled. On the other hand, a program initiated in the Deep South, thought inimical to evolution education, has taken off quickly. Comparing these endeavors highlights the variables in play within given institutions that must be accommodated. Those include the importance of tenured or tenure-track leadership, positively disposed administrators in departments and colleges, manageable teaching loads, as well as idiosyncratic institutional concerns. We consider how to overcome barriers for programs that are not initially successful and to ensure sustainability for those that are. The EvoS Program, writ large, must be general enough in body to adapt to an array of environmental conditions but specialized in focus to uniquely adapt and thrive.

KEYWORDS

Evolutionary Studies, Institutional Ecology, Interdisciplinarity, Administrative Support, Program Leadership

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INTRODUCTION

The success of several Evolutionary Studies (EvoS) programs over the past decade has been well documented (see www.evostudies.org). These programs incorporate psychology, biology, anthropology, the arts (theater, costuming, and fine arts), communication studies, and other seemingly unconnected disciplines. These disciplines are not simply a smorgasbord of fields that employ evolutionary principles but are obviously interdependent and nested within each other when viewed in an evolutionary frame (Carroll, 2011). For instance, as illustrated in Figure 1, evolutionary applications to the humanities rely on evolutionary interpretations of human social behavior as developed in anthropology, psychology, sociology, and other social sciences. These in turn draw on research in evolutionary biology and genetics, which are based on principles of biochemistry and physics. Even with this natural complementarity of the disciplines involved in an EvoS program and the success of such programs throughout the Northeastern United States and down the Eastern Seaboard, there are various pitfalls and obstacles in developing them. The following case studies outline efforts to overcome these issues—even those that end in failure—and to increase the probability of successfully establishing future EvoS programs. One describes a successful effort at setting up a program in the Deep South, while two of the cases involve unsuccessful attempts at State University of New York (SUNY) schools. In fact, while every process is different, even in statewide agencies like SUNY, there are common difficulties, which can be summarized as chiefly relating to funding, leadership and staffing, interdisciplinary cooperation, and university approval.

Examination of the following cases suggests that a formula for overcoming these challenges and starting an EvoS minor includes several factors. First, faculty across an institution with the requisite expertise and interest to offer courses that bind the program together are essential, as is a “spark plug” willing to commit to pushing the effort through, a tenured or tenure-track faculty member to direct the program, and supportive administrators. These are self-evident factors in retrospect, but they are difficult to recognize from the outset and vary from campus to campus. The importance of sharing these narratives is to provide examples that might guide future spark plugs in navigating potential obstacles to starting their own programs and enhancing the EvoS initiative worldwide.

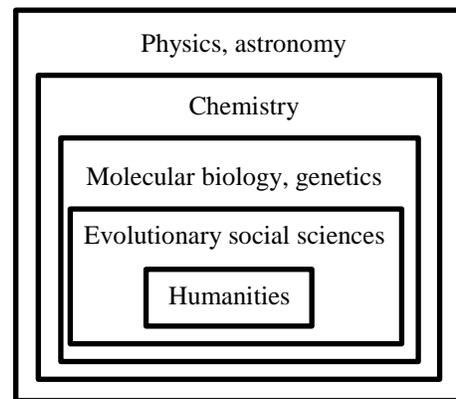


Figure 1. The evolutionary disciplines are nested in causal constraint. Evolutionary interpretations and applications in the humanities are derived from the evolutionary social sciences. Those principles are based on work in molecular biology and genetics, which rely on knowledge of biochemistry, and chemistry is beholden to laws of physics and principles of astronomy (Redrawn from Carroll 2010, www.umsl.edu/~carrolljc/).

Table 1. EvoS program status at University at Albany (SUNY), SUNY Oswego, and University of Alabama.

Type of institution	Institution		
	University at Albany	SUNY Oswego	University of Alabama
	State research institution; graduate, undergraduate and professional programs	Four-year teaching college; some Master's level programs	State research institution; graduate, undergraduate and professional programs
Number of students	~17,000	~6,500	~33,000
Students interested or involved in program	~20		~23 enrolled 4 graduated 4 dropped ~24 in Club*
Number of faculty	>1,000	~400	1,731
Faculty involved in EvoS program	9 (steering committee) ~18 (expressed interest)	7	~30
Departments involved in EvoS program	6	6	7
Existing interdisciplinary programs	2	9	5**

*Reflects only additional EvoS Club members not enrolled in minor

**Includes EvoS program

These narratives regard initiatives at the University at Albany (UAlbany), SUNY Oswego, and the University of Alabama. Table 1 summarizes some of the key similarities and differences in these institutions regarding factors necessary for the establishment of an EvoS program. The UAlbany is a large state university with a number of interdisciplinary programs and faculty familiar with and supportive of EvoS. The effort there stumbled initially, which we discuss as follows, while highlighting the necessary factors for this program to take hold. SUNY Oswego is a small state school that suffered in its initial effort due to factionalism among the involved departments. However, as the environment there has changed, there is renewed hope for the successful institution of an EvoS program. The University of Alabama is the flagship research institution for the state of Alabama. Despite a statewide paucity of support for evolution education, the program at Alabama was immediately successful due to preexisting factors, but long-term sustainability is less certain.

UNIVERSITY AT ALBANY (UAlbany)

The University at Albany (UAlbany) is a large research institution in the state capitol of New York with about 17,000 students. It offers undergraduate and graduate degrees in over 100 programs. All three authors received their graduate training in evolution at this institution. The effort at UAlbany was initiated by a

doctoral student in Psychology (Spaulding). Despite substantial interest in and support for the program on campus, the effort was ultimately unsuccessful. Unlike the experiences at SUNY Oswego and the University at Alabama discussed below, the UAlbany effort terminated in the early stages, though a number of factors produced initial optimism. In the long-run, however, those elements were not enough to overcome the obstacles.

Current level of involvement

UAlbany has a precedent for the establishment of interdisciplinary majors/minors. An interdisciplinary Neuroscience minor (Biology and Psychology) had recently been established, setting precedent for coordination between at least two of the major players in an EvoS program. In addition, the University has offered an interdepartmental major in Human Biology for some time, which combines classes from both Anthropology and Biology.

Despite this, at the time the EvoS program was proposed, UAlbany was not participating in EvoS membership (<http://evostudies.org/members/membership-criteria/>) on any level. This meant that a lot of groundwork would need to be done before the launch of any kind of EvoS program.

Interest and support

Undergraduate and graduate students in Psychology and Biology were enthusiastic about starting an EvoS program and helped with planning in a number of ways. The undergraduates established an EvoS club to demonstrate their interest and secure funding for expenses related to establishing the new program. Several students also attended the general interest meeting. This was important because the enthusiasm of the undergraduate students suggested that if an EvoS program was established, there would be a contingent of students interested in completing the minor.

Once the faculty members predicted to be most interested in a program were identified, they were contacted by e-mail. The list included members of the “big three” on the UAlbany campus—Psychology, Biology, and Anthropology—as well as members from Geology, Economics, Nanoscience, and Biomedical Sciences. Responses were very consistent—enthusiastic but cautious and limited to those in fields directly informed by evolutionary theory (Psychology, Biology, Anthropology, and Biomedical Sciences). They all agreed it would be a valuable program and something that would fill an important need. However, with few exceptions, most responses included reservations, citing concerns of time investment, funding or both. Despite the caution, all respondents expressed support for moving forward.

At the general interest meeting, faculty members from a few additional departments indicated their interest in an EvoS program. The complete list included faculty from Anthropology, Biology, Information Technology Management, Psychology, and the School of Public Health; but when a steering committee was established, it was composed exclusively of faculty members and graduate students from Anthropology, Biology, and Psychology.

Finally, there was quite a bit of support from established EvoS programs in the SUNY system. Both Glenn Geher (SUNY New Paltz) and David Sloan Wilson (SUNY Binghamton) offered advice via e-mail. The author had the opportunity to attend an EvoS board meeting at New Paltz, which provided valuable insight into the structure of a successful EvoS program. Geher also spoke about the EvoS initiative in general and the success of the program at SUNY New Paltz during the UAlbany general interest meeting. Having the director of a thriving program at another SUNY school was an excellent way of illustrating how successful such a program can be as well as providing an excellent resource for any questions or concerns attendees had.

Logistical factors

The first substantial obstacle involved the development of a list of classes and a method for addressing the prerequisites. Many evolution-related courses in UAlbany's Biology department require so many prerequisites that it would be prohibitive for a non-Biology major to complete them. This was true to a lesser extent in other departments as well. Over the course of 2-3 meetings, a list of classes was compiled that could fulfill EvoS program requirements, and the development of EvoS-specific classes was discussed (such as an Evolutionary Studies seminar/speaker series and an Evolution for Everyone class like those offered at Binghamton and New Paltz [Wilson, 2005]). Although progress was made, a final solution to the prerequisite issue was not reached before the initiative was tabled for other reasons as outlined below. It was also unclear who would teach EvoS-specific classes, but this most likely would have fallen to doctoral students in one of the three programs, at least in the beginning. Again, while all faculty members were supportive of the idea and willing to help in planning and implementation, they were already busy with research, teaching, committee work, and projects of their own.

It seems unlikely that the prerequisite issue alone would have been enough to prevent the establishment of an EvoS program. The question of instructors may have provided more of an impediment but also seemed to be surmountable. However, these issues certainly slowed things down and need to be addressed if the effort is revived.

Funding

Lack of funding turned out to be a much larger obstacle. Members from all the departments stated that their department had neither funding nor additional teaching lines. However, many other sources of funding, such as the Dean of Arts and Sciences and Honors College, were mentioned. In particular, it seemed likely that funding for bringing in speakers for a seminar series could be obtained, but it was not clear if enough funding to run a successful long-term EvoS program could be raised. At the last meeting, it was decided that Spaulding should approach potential sources for funding, and this is where the process finally broke down.

Lack of leadership figure in faculty or administration

Given that this effort was initiated by a graduate student, there was a concern about submitting grant requests to fund a program without assurance of program continuity upon her graduation. Unfortunately, none of the faculty members who had expressed interest in the program were willing or able to take a leadership position. For this reason, no funding requests were submitted, and the initiative was tabled. Obviously, even if a leader had stepped forward, success of the program would not have been assured, but lack of leadership ended the initiative before definitive progress was made.

An EvoS program is not out of the question at UAlbany. However, it requires a faculty member with the motivation and availability to lead and move the project forward. The initial groundwork has been laid, and receptive students await.

SUNY OSWEGO

Where the UAlbany effort had a groundswell of initial support but lacked someone to follow through, an effort at SUNY Oswego was spearheaded by an assistant professor of psychology (Burch) in the institutional position to coordinate and direct an EvoS effort. The State University of New York at Oswego is a relatively small (6,000-7,000 students), four-year teaching college on the shores of Lake Ontario. Oswego also offers some Master's level programs in business, education, mental health counseling, and others. While Oswego prides itself on interdisciplinary programs and collaborations between departments, an effort to establish an EvoS minor failed for a number of reasons.

Funding

With the recession of 2008 to present, the willingness of the administration to invest financially in new programs dropped drastically. Although the administration was technically supportive of innovative programs, particularly those that were interdisciplinary and part of a larger consortium, this was to be done without creating a strain on resources. There would be no funding given for additional staff or materials. This is not the death blow many would expect, as new academic programs can be created through the recombination of existing resources, but these new programs need to be nearly complete within the existing structure (little additional resources should be needed).

Time and space

Both Psychology and Biological Sciences identified as "impacted" majors, having a huge number of students assigned to a relatively small number of faculty. This created inflexibility in developing a new program, opening up new courses, or diversifying the roles and workloads of faculty. The primary departments for an EvoS minor could not afford to dedicate any staff to the new core courses that would be needed. Additionally, due to new construction beginning in 2007, classroom

space was also at a premium. This restriction had obvious ramifications—even if faculty were willing to take on extra courses for the new program, there was no place to put them.

One would expect these obstacles in the development of any academic program on any campus. There is little variation in the effects of the recession on educational institutions, flexibility of departments, or scheduling difficulties. Therefore, the expectation was that, despite these obstacles, Oswego could create an interdisciplinary minor with little difficulty. The original outline for the EvoS program at Oswego was put together by an Evolutionary Psychologist (Burch). The program was to be housed in the Interdisciplinary Programs and Curricula (IPAC) Office at SUNY Oswego rather than a particular department. Meetings with administration promised a great deal of support, with the proviso that the minor be truly interdisciplinary with other departments on board. This support excluded financial support, but included space (the IPAC office), secretarial support, assistance with preparation for the program for curriculum approval, and potentially the approval of hiring lines if the program expanded or new faculty hires were justified.

Prior to presentation to the chairs of the departments involved, the program outline included courses in Anthropology, Biology, Geology, Psychology, and Cognitive Sciences and also included options for courses in any other department that examined an evolutionary perspective. The EvoS program would culminate with an interdisciplinary capstone course wherein students would integrate their previous coursework and work with other students of differing perspectives to create final projects illustrating the depth and breadth of evolutionary theory. The program in this incarnation was approved by the Chair of the Psychology Department, the Director of IPAC, and the Associate Provost.

Difficulties in the approval process

When the program was presented to the Chairs of the various departments, suggestions were made to alter the program in ways that decreased its viability and eliminated its interdisciplinarity—the linchpin that ensured administrative support. Departments demanded that the content areas be expanded to include all the electives in their major. This would have several outcomes; in essence, the individual departments would have their own EvoS programs, students would not have to explore outside their majors to take courses, and all students in said majors would automatically graduate with a certificate in the EvoS program. This suggestion eliminated all interdisciplinarity from the program and made singular leadership of the program unwieldy. Furthermore, outside disciplines that would want to add courses to the EvoS curriculum (but not house their own) would not be accepted by the departments or enrolled in by the students.

With the suggestion that all students in these majors could take courses in their major and automatically graduate with a certificate, the required capstone was seen as an unnecessary burden and not compatible with the students' differing backgrounds—i.e., an interdisciplinary capstone would not work given that the program was no longer interdisciplinary. With the removal of all of the interdisciplinary requirements of the program, including the capstone course, there

was no longer the need for the involvement of the IPAC Office, which meant the program no longer had a home.

Competition

Given the current state of funding and staffing, the inevitable conclusion was made: these departments could only develop their own EvoS programs if they were given additional funding by the administration for course additions, course releases, hiring lines, adjunct professors, and lab spaces. These were demands that the administration could not and was not willing to fulfill given the departments' refusal of interdisciplinarity. If administrative support was to be received, there would have to be a singular program that involved all departments.

This administrative imperative set off a series of arguments as to which department would house the program and, therefore, receive support. Several departments argued for ownership of the program, either because of the need for more lines (even if these lines were not for the EvoS program) or because their department was the most focused or based upon evolutionary theory. When a department was finally chosen, it was announced that the EvoS program could not be implemented until funding was given.

In summary, support from the administration was dependent on interdisciplinarity. The departments that were to provide it were not willing to participate in interdisciplinarity and could not support the program without additional funding. In the creation of an EvoS program at SUNY Oswego, a lack of funding, staffing, and space led to intense competition over ownership of a new, potentially funded, program. This competition led to a breakdown in cooperation, eliminating the very interdisciplinarity that might have led to more staff and support.

However, since 2008 major changes have taken place on campus. Several new enthusiastic, collaborative faculty members have been hired across disciplines. New hiring lines and funding have been made available, particularly for interdisciplinary endeavors. There have been large-scale changes in the college curriculum as well. Students now have more flexibility and fewer credit requirements, which will create a demand for more minors and interdisciplinary programs.

In conclusion, there is hope for an EvoS program at SUNY Oswego, one that is interdisciplinary and reliant on younger faculty who are interested in collaboration. The new curriculum provides obvious niches where evolutionary perspectives can be placed, and the increased academic flexibility of the students ensures that these courses will be filled. While developing an EvoS program in 2008 proved to be impossible, these changes indicate that one can be developed in the future.

UNIVERSITY OF ALABAMA

The University of Alabama (UA) EvoS program encountered similar cross-disciplinary interest and impediments as the UAlbany and Oswego initiatives. Unlike those cases, the EvoS effort at UA ultimately succeeded because it had the motivated tenure-track faculty leadership that UAlbany lacked and the administrative

support and departmental leverage to overcome disciplinary issues not initially available at Oswego. UA, located in Tuscaloosa, AL, is the flagship public research institution for the state of Alabama with over 33,000 undergraduate, professional, and graduate. It is unclear if the larger size or status of UA in its respective state had anything to do with the EvoS success, but one unique factor that definitely and ironically played a role was Alabama's poor record of evolution education.

The UA EvoS program development was initiated by a newly arrived assistant professor of anthropology (Lynn) in the fall of 2009, coincident with the publication of Mead and Mates' (2009) state-by-state evaluation of K-12 evolution education. It was no surprise to anyone who has grown up in Alabama that their state ranked 50th and received a grade of "F," and it made the argument for a college-level EvoS program obvious. It was agreed that basic liberal arts and science education should expose students to fundamental theories for explaining life and behavior, which an EvoS program could provide, as well as influence positive change by training students who contribute to improvements in their respective communities and through outreach programs. Another advantage UA had in making this happen was that many of the pieces were already in place.

Faculty interest, leadership, and administrative support

Given the four EvoS membership levels of participation (<http://evostudies.org/members/membership-criteria/>), UA was almost a level 3—a program with a campus-wide seminar series—but had not formalized it, developed an introductory course, or affiliated with the EvoS Consortium. The Evolution Working Group (EVOWOG) at UA was started 7 years ago by faculty with shared interest in researching and teaching evolution to host the Alabama Lectures on Life's Evolution (ALLELE) speaker series. This series has hosted numerous eminent speakers over those years, and the EvoS initiative merely had to build upon this scaffold.

Funding for the EvoS program has largely been directed toward maintaining the ALLELE series. After exhausting outside sources obtained in the first few years, EVOWOG members began approaching internal departments and programs. The College of Arts & Sciences provides the bulk of the funding for the series but requires EVOWOG to match this contribution. EVOWOG members do this by annually requesting sponsorship from any UA department or program for which evolution is relevant in exchange for input in speaker selection and promotion through all advertising. While this approach works, it is difficult each year for faculty to engage in fundraising and event-hosting, as well as to obtain consistent pledges from the same sponsors, as budgetary constraints shift.

Because of these factors, it was essential that tenure-track faculty members be willing and able to take on the extra work to follow things through, which Lynn and EVOWOG chairperson Leslie Rissler committed to do. Of equal importance, departmental and college administrators supported the effort. The Anthropology Department, in which the UA EvoS program is housed, does not require new professors to "pay dues" by taking on onerous introductory courses and encourages new professors—which were being added to an expanding department until recent budget restriction—to develop courses they would enjoy teaching and,

consequently, that students would enjoy taking. Thus, the UA EvoS program was proposed during a relatively unique window of support for the development of new courses and coordination of curricula across disciplines.

Logistics of starting interdisciplinary minors

Curricular flexibility was important because there is no formal process for starting a minor at UA. Relevant courses already on the books at UA were culled from the course catalog, and instructors were contacted to verify that they were appropriate for inclusion in the minor. An introductory team-taught course was developed and a formal proposal to teach this new course submitted. Hypothetical requirements of the minor were outlined and the proposal sent to EVOWOG members and department chairpersons for feedback and support.

At this point, impediments that have stalled programs at other institutions were encountered. The development committee was challenged to demonstrate the utility of an EvoS program and student interest if it were approved. The proposal needed to emphasize that an EvoS program would inculcate critical interdisciplinary thinking through the guiding focus on evolutionary principles. Additionally, student interest was assessed using a simple internet survey, and these data were circulated with the proposal.

Distributing the responsibilities of interdisciplinarity

The proposal was placed on the agenda for the next full faculty meeting for the College of Arts and Sciences, but, because of poor communication, several people who had not been informed were taken aback that the initiative had proceeded so far without their knowledge, consultation, or inclusion. This was handled by postponing a vote. There was additional concern over housing the leadership in Anthropology, since evolution is based on biological principles; but the Biological Sciences Department did not have the available resources to assume leadership, and Anthropology was the only department willing and able to do so. Nevertheless, it was considered pragmatic to share the directorship across multiple departments, beginning with Anthropology and Biological Sciences. This partnership reached out directly to all parties who had not previously been included and negotiated accommodations.

Another stumbling block was the integration of an upper-level Biology course called "Evolution" because of its numerous prerequisites. It was agreed that this would be too advanced for EvoS minors who were not also Biology majors, which was a problem, since (1) it was hoped the EvoS minor would have broad appeal and (2) because Biology majors are not required to declare minors. Furthermore, the enrollments in the Biology major and service demands on faculty were so high that the creation of a new course for this minor wasn't practical. A compromise was negotiated with Biological Sciences to forego teaching a low enrollment course and develop a lower-level course in biological evolution with no prerequisites.

Finally, it was decided that a concluding capstone course should also be developed akin to the team-taught introductory course but that it be offered in Biology, though it later fell back to Anthropology due to these same resource

constraints. To manage this, the introductory and concluding courses are concurrent and meet together, which works because of the team-approach taken and variation of the team from semester to semester (see Appendix B for the full, current list of EvoS requirements at UA).

Sustaining the program

Since approval, the UA EvoS minor has enrolled over 20 students. However, education scholar Karri Holley (2009) points out that interdisciplinary programs tend to lack a sense of being “real” to students unless they have a tangible location and organization, a consistent and interactive cohort of students, or synergistic extracurricular opportunities for students to get involved with each other. In a partial effort to meet these standards, students were encouraged to start an EvoS club and host an annual Darwin Day colloquium, which required several months of synergistic interaction. One-credit research and reading courses were also inserted between the capstone courses to keep students involved through an evolution-oriented project they develop in the introductory course and through the ALLELE series, which puts them in direct contact with visiting lecturers.

In summary, the key to the current status of the UA EvoS program was having a person willing and able to be persistent but patient with bureaucratic processes, the assistance of someone in the university with enough leverage to push through roadblocks, and the support of administrators. The embarrassment of being worse than arch-rivals Mississippi in K-12 evolution education didn't hurt. Yet the future is still uncertain, as it may prove even harder to sustain a program once the initial excitement is over.

CONCLUSION

Much like evolutionary processes, each of the aforementioned institutions has tried to create a program by tinkering with existing materials, and that program has attempted to survive against various selection pressures. Many of these pressures are the same—resource strains, curricular inflexibility, competition, and territoriality. The evolutionary allusions are quite obvious. With proper preparation—and therefore knowledge of one's respective academic ecosystem—many of these obstacles can be surmounted.

However, just as in evolutionary processes, variation is critical. There is no tried and true path to curricular approval, even in strikingly similar institutions. Evolutionary programs can be created through any number of collaborations and interdisciplinary efforts. For SUNY Oswego, this path now appears to be through Human Development, Global Studies, and World Awareness requirements. Just as in evolutionary processes, environmental change is inevitable. Failure in the past does not mean a niche will not change and become hospitable in the future. For example, the addition of one key "spark plug" figure at UAlbany could be enough to overcome other obstacles there and successfully establish a program. The same is true in maintaining a program, which is now Alabama's biggest obstacle. The path to establishing a program may not be the one that sustains it. Without the essential but variable ingredients to maintain the fecundity of an EvoS program, it can easily

go extinct. The key to creating an enduring Evolutionary Studies program is to be flexible, seek out new niches, and take advantage of hospitable environments, even if they appear in unexpected places.

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APPENDIX A

SUNY OSWEGO MINOR REQUIREMENTS

Evolutionary Studies Minor Form

When filing for graduation, bring a signed copy of this document to the Registrar with a copy of your degree application. To obtain a certificate in the Evolutionary Studies minor, you must take at least 18 credits within the following framework. Only 6 of these 18 credits can be earned within your major.

I. Foundation Courses (6 or more credits)

Note that other courses not included in the subsequent list may also count toward this category (students may petition their advisors to have other courses count and, in such cases, will need to provide evidence to support their petition (e.g., the syllabus and/or textbook of a particular course). Only one course within your major may be taken towards the minor.

_____	ANT 111	Archaeology and Human Evolution ^{GE}
_____	BIO 207	Understanding Evolution ^{GE}
_____	GEO 100	Physical Geology ^{GE} <u>or</u> _____ OCE 100 Oceanography
_____	PSY 270	Evolution and the Behavioral Sciences (NEW COURSE) ^{GE}
_____	COG 266	Brains, Minds and Consciousness

II. CONTENT AREAS (9 or more credits from at least two different departments)

A: Courses that necessarily count toward the content-areas category. Six credits must be upper division.

_____	ANT 280	Biological Anthropology
_____	ANT/BIO 303	Ethical Treatment of Nonhuman Primates ^{GE}
_____	ANT 369	Human Sexuality: Cross-Cultural Studies ^{GE}
_____	ANT 383	Disease and Human Behavior. Prerequisites: 9 hours of Social and Behavioral Sciences including Ant 111 or 112
_____	ANT 480	Human Sociobiology. Prerequisites: junior standing/15 Social and Behavioral Sciences hours or Bio major, and Ant 280
_____	AST 360	Human Futures ^{GE}
_____	BIO 120	Molecular and Cellular Foundations ^{GE}
_____	BIO 315	Genetics. Prerequisites: Biology 120.
_____	BIO 200	Environmental and Population Biology ^{GE}
_____	BIO 320	Introductory Ecology
_____	BIO 325	Behavioral Biology

Knowing the Institutional Ecology

_____	BIO 340	The Plant Kingdom
_____	BIO 370	The Animal Kingdom
_____	BIO 400	Current Issues in Environmental and Population Biology ^{GE}
_____	BIO 425	Evolution. Prerequisites: Bio 315
_____	COG 166	Introduction to Cognitive Thinking
_____	GEO 200	Historical Geology: Prerequisites: Geo 100 or Oce 100
_____	GEO 440	Paleontology
_____	PSY 301/401	Perception 301 (Prerequisites: PSY 100) Perception 401 (Prerequisites: PSY 290)
_____	PSY 302/402	Psychology of Learning 302 (Prerequisites: PSY 100) Psychology of Learning 402 (Prerequisites: PSY 290)
_____	PSY 303/403	Biopsychology 303 (Prerequisites: PSY 100) Biopsychology 403 (Prerequisites PSY 290)
_____	PSY 322	Child Development*
_____	PSY 340	Social Psychology*
_____	PSY 363	Cognitive Neuroscience*
_____	PSY 370	Evolutionary Psychology*
_____	PSY 377	Human Sexuality*

^{GE} Fulfills General Education Requirement

* PSY 100 prerequisite for all 300 level psychology courses.

B: Courses that *may* count toward the content-areas category; such courses need to be considered under advising with an EvoS advisor. Note that other courses not included in the subsequent list may also count toward this category (students may petition their advisors to have other courses count and, in such cases, will need to provide evidence to support their petition (e.g., the syllabus and/or textbook of a particular course)). ANT 399 Independent Study

ANT 499	Independent Study
BIO 492	Research
BIO 497	Senior Honors Thesis
BIO 499	Independent Study
GEO 399	Independent Study
GEO 499	Independent Study
PSY 490	Research Seminar
PSY 499	Independent Study
PSY 441	Theories of Personality
OTHER _____	(course title)

III. Evolutionary Studies Seminar (3 or more credits (may be taken twice; up to 6 credits))

_____ XXX Evolutionary Studies Seminar (NEW COURSE). This course will consist of: on and off campus speakers on various evolutionary topics, papers and discussions of speakers and their research, student projects and lectures (students teaching other students outside their discipline) and peer review of student projects and lectures. Teaching of course can rotate through departments or be co-taught.

Note: Additional offerings such as ‘special topics’ courses and special seminars within departments may be able to count toward this component of the curriculum (consult with EvoS advisor if you feel that such a course should be included)

APPENDIX B

UNIVERSITY OF ALABAMA MINOR REQUIREMENTS

Courses in the minor (20 credits total)

The minor is designed to be taken over the course of your time at UA, beginning with “Evolution for Everyone.” In this course, you will be introduced to evolutionary principles and a cross-section of applications of these principles. You will also outline an evolutionary project you can do while a UA undergraduate. In subsequent semesters, while taking other minor requirements and electives, you will take a 1-credit “Readings in ALLELE” course to stay involved with other students in the minor and a 1-credit “Independent Research” in conjunction with a faculty mentor in your primary discipline. In conjunction with this mentor, you will conduct the project you outlined during the first semester. In your final EvoS semester, you will take “Advanced Evolutionary Studies and Big Questions,” which will again expose you to the principles and applications but which you will be able to integrate more deeply. Additionally, you will write-up your project results for submission to a student-level peer-reviewed publication. It is hoped that this course of study, while not as rigorous as a major, will enable you to be constructive critics of cultural use of evolutionary principles and prepare you for further studies.

Introduction

- **FLC 101, Evolutionary Attitudes, 1cr**
This optional 1-credit course is a part of the Freshman Learning Community program. It is offered occasionally in the fall. Students take this in conjunction with an introductory course in anthropology or psychology. The focus is on viewing and discussing pop cultural depictions of evolution. The forum is informal and evaluated based on attendance and participation.

Required “Foundation” Courses (12 credits)

- **ANT 150, Introduction to Evolutionary Studies** (*no prerequisites*), 3cr
This team-taught course is the introduction to the minor. The objective is to expose students to the array of applications for evolutionary theory across the natural, social, and applied sciences and humanities. It features an array of guest lectures from across the university that changes each semester, as well as visits by ALLELE lecturers. Students design a project (based in the discipline of their major) that will be completed over the course of the minor and review a trade book for possible publication. It is offered every spring semester.
- **BSC 220, Principles of Biological Evolution** (*no prerequisites*), 3cr
This course is an introduction to the process and patterns of biological evolution. It is geared for non-biology majors. It is offered approximately every two of three semesters.

- **ANT 450, Advanced Evolutionary Studies and Big Questions** (*prereqs: ANT 150, BSC 220*), 3cr
This is the concluding course of the minor and should be taken in one's final spring semester. It meets concurrently with ANT 150 and features the same format. It's intention is to review basic mechanisms with the purpose of a deeper integration of principles and provide students exposure to a different set of instructors and ALLELE guests. Students present results from their minor project and, if relevant, submit it to a peer-reviewed journal for publication consideration. It is offered every spring.

One of the following:

- **ANT 270, Physical Anthropology**, 3cr
- **GEO 102, Earth Thru Time**, 4cr
- **PHL 387, Philosophy & Evolution** ("W"), 3cr

Integrative Courses (2 credits)

- **ANT 431, Readings in ALLELE**, 1cr
This 1-credit course involves meetings to discuss readings of ALLELE guests scheduled for the semester. Students attend ALLELE lectures and meetings as a group with ALLELE speakers for direct opportunity for in-depth discussion. The course is designed to ensure that students stay integrated in the EvoS program since, as an interdisciplinary minor, students are not taking evolution courses as part of a specific department or with a cohort. Can be arranged any semester between ANT 150 and ANT 450.
- **Independent Research**, 1 cr
This -credit course is designed to provide an opportunity for students to collect data or complete their minor project. Students are mentored by a faculty member in their major. Arrangements should be made to take this between ANT 150 and ANT 450 and register for credit in their mentor's discipline. Credit will be manually assigned to the EvoS minor.

Elective "Context" Areas (6 or more credits from at least TWO DIFFERENT departments that are not your major)

Anthropology electives:

- **ANT 270, Physical Anthropology***, 3cr
- **ANT 208, Anthropology of Sex**, 3cr
- **ANT 275, Race, Ethnicity, & Variation**, 3cr
- **ANT 311, Population, Health, & Origins** (*prereqs: ANT 100 or 270 or permission*), 3cr
- **ANT 312, Non-Human Primates** (*prereq: ANT 101 or 270 or permission*), 3cr
- **ANT 471, Fossil Humans and Evolution** (*prereq: ANT 270 or perm*), 3cr
- **ANT 473, Human Osteology** (*prereq: ANT 270 or permission*), 3cr

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2014, Volume 6(1), pp. 18-38.

- **ANT 475, Biology, Culture, & Evolution** (*prereq: ANT 100, 270 or permission*), 3cr
- **ANT 479, Human Paleopathology** (*prereq: ANT 270 or permission*), 3cr

Astronomy electives:

- **AY 155, Life in the Universe**, 3cr

Biological Sciences electives:

- **BSC 315, Genetics** (*prereq: BSC 114:115 or BSC 118, & CH 101:102 or 117 and 118*), 3cr
- **BSC 373, Vertebrate Zoology** (*prereq: BSC 114:115 or 118 & 116:117 or 120*), 4cr
- **BSC 400, Vertebrate Functional Morphology** (*prereq: BSC 114:115 or 118 & 116:117 or 120; 300*), 4cr
- **BSC 420, Principles of Systematics** (*prereq: BSC 483 & 360, 373 or 376*), 3cr
- **BSC 428, Biology of Fishes** (*prereq: BSC 373 & 385*), 3cr
- **BSC 441, Developmental Biology** (*prereq: BSC 300 & 315*), 3cr
- **BSC 448, Animal Behavior** (*prereq: BSC 385 or permission*), 3cr
- **BSC 434, Plant Systematics** (*BSC 114:115 or 118 & 116:117 or 120*), 4cr
- **BSC 464, Biology of Algae** (*prereq: BSC 114:115 or 118 and 116:117 or 120*), 4cr
- **BSC 482, Conservation Biology** (*prereq: BSC 114:115 or 118, 116:117 or 120*), 3cr
- **BSC 483, Evolution** (*prereq: BSC 220*), 3cr

Geology electives:

- **GEO 102, Earth Thru Time***, 4cr
- **GEO 355, Invertebrate Paleontology** (*prereqs: GEO 102 or BSC 376 or permission*), 3cr
- **GEO 367, Sedimentology & Stratigraphy** (*prereq: GEO 102 & 210 or permission*), 3cr
- **GEO 401, Paleoclimatology** (*prereq: GEO 101 or 102 or permission*), 3cr
- **GEO 462, Quaternary Climates & Environments** (*prereq: GEO 401 or permission*), 3cr

History electives:

- **HY 400, Darwin, Evolution & Revolutions**, 3cr

Philosophy electives:

- **PHL 387, Philosophy & Evolution*** (*prereq: 6cr in PHL or permission*), 3cr
- **PHL 367, Philosophy of Cognitive Science** (*prereq: 6cr in PHL or permission*), 3cr

- **PHL 390, Art & Human Nature** (*prereq: 6 credits in PHL or permission*), 3cr

Psychology electives:

- **PY 313, Sensation & Perception** (*prereq: PY 101 or permission*), 3cr
- **PY 352, Developmental Psychology** (*prereq: PY 101 or 105 or permission*), 3cr
- **PY 372, Social Psychology** (*prereq: PY 101 or 105 or permission*), 3cr
- **PY 413, Physiological Psychology** (*prereq: PY 355 or permission*), 3cr

University Honors:

- **UH 300, Topics in Vertebrate Paleontology**, 3cr
- **UH 300, Primate Religion & Human Consciousness**, 3cr

* if not taken as Foundation course

APPENDIX C

UNIVERSITY AT ALBANY PRELIMINARY LIST OF PROPOSED COURSES FOR MINOR

Below is a list of the proposed courses for the Evolutionary Studies Minor. This list was never finalized and likely would have included courses from other departments if the minor had been established. Any prerequisites listed represent current prerequisites for the listed course. Again, if a minor was established, some of these may have been changed to allow for easier access by Evolutionary Studies minors.

Evolutionary Studies Courses:

- Introduction to Evolutionary Studies, 3 cr
- Evolutionary Studies Seminar Series, 3 cr

Anthropology Courses:

- **AANT 100, Culture, Society, and Biology**, 3cr
- **AANT 110, Introduction to Human Evolution**, 3cr
- **AANT 211, Human Population Biology** (*prereqs: AANT or ABIO 110 or ABIO 120 recc*), 3cr
- **AANT 310, Human Paleontology** (*prereq: AANT 110*), 3cr
- **AANT 409, Primate Evolutionary Biology** (*prereq: AANT 110*), 3cr
- **AANT 414, Demographic anthropology** (*prereqs: AANT 110 and 211*), 3cr
- **AANT 416, Topics in human biology** (*prereqs: AANT 110 and 211*), 3cr
- **AANT 419, Human Evolutionary and Environmental Physiology** (*prereqs: ABIO 110 or 120 and 122; and 111 or 121 and 123*), 3cr

Biology Courses

- **ABIO 120 General Biology 1**, 3cr
- **ABIO 121 General Biology 2** (*prereq: ABIO 110 or 120*), 3cr
- **ABIO 199 Contemporary Issues in Biological Sciences**, 1cr to 3cr
- **ABIO 205 Human Genetics** (*prereqs: ABIO 110 or 120, and 111 or 121*), 3cr
- **ABIO 209 The Human Organism**, 3cr
- **ABIO 212Y Introductory Genetics** (*prereqs: ABIO 110 or 120 and a grade of C or better in ABIO 111 or 121*), 4cr
- **ABIO 316 Biogeography** (*prereq: AMAT 106 or APHY 140*), 3cr
- **ABIO 317 Comparative Animal Physiology** (*prereqs: ABIO 110 or 120 and ABIO 111 or 121 and jr. status*), 3cr
- **ABIO 318 Human Population Genetics** (*prereq: AANT 211 or ABIO 205 or 212Y*), 3cr
- **ABIO 320 Ecology** (*prereqs: AMAT 106 or APHY 140, ABIO 212Y*), 3cr

- **ABIO 325 Comparative Anatomy of Chordates** (*prereqs: 12 credits of biology or permission of instructor*), 4cr
- **ABIO 329 Genetics of Human Disease** (*prereq: ABIO 212Y*), 3cr
- **ABIO 335 Immunology** (*prereq: ABIO 365*), 3cr
- **ABIO 343 Evolutionary Biology and Human Health** (*prereq: a course in genetics*), 3cr
- **ABIO 397 Topics in Biology** (*prereq: jr. or sr. status*), 1cr to 3cr
- **ABIO 402 Evolution** (*prereq: ABIO 212Y*), 3cr
- **ABIO 432 Animal Behavior** (*prereqs: 15 credit hours in bio and AMAT 106*), 3cr

Psychology courses

- **APSY 385 Evolutionary Psychology** (*prereq: APSY 101*), 3cr

The Moral Brain as Content and Context for Educational Innovation in Southwestern Madagascar

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KEYWORDS

Service-Learning, Moral Psychology, Contextual Behavioral Sciences, Program Development, Madagascar, Africa

INTRODUCTION

Madagascar is a country rife with challenges not only to human flourishing, but to basic levels of human development (UNDP 2013). This article reports on an emerging model of educational innovation at the University of Toliara, in the atsimo andrefana (southwestern) region of the country. Based on the EvoS Program (www.EvoStudies.org); this experimental programming utilizes evolutionary sciences to explore positive and moral psychology at individual, group, and socio-cultural scales for the first time in an African nation. What is described here is a synthesis of both established best practices along with emerging theoretical advancements that show promise in this challenging environment.

Madagascar is an Indian Ocean island located to the east of Mozambique and to the west of the Mascarin islands, Mauritius and Reunion. The UNDP Human Development Report (2013) ranks Madagascar at 151/186 in terms of Human Development Potential, with the atsimo andrefana region considered among the most challenging on the island nation. Despite these harsh socio-economic and ecological conditions, the capital city of Toliara is home to the oldest academic institution in the south: the University of Toliara (UoT). With a student population of ~ 3000, UoT offers undergraduate through doctoral degrees in both life sciences and social sciences. The national Universities of Madagascar follow the French academic tradition; including a decentralized “Ecole Normal Superior” or Secondary Teacher Training program; at UoT, this is the home of the nation’s first university-level psychology department – focusing on educational psychology.

In October 2012, UoT become the first African nation member of the international EvoS Consortium for Evolutionary Studies (requiring a minimum of one interested faculty member). Originating at the University of Binghamton by Biologist

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and Anthropologist, David Sloan Wilson, EvoS seeks to bring the leading edge of evolutionary sciences to our understanding of the human condition in Higher Education. This initiative offers significant resources for course and programming development in the human sciences (see www.EvoStudies.org). Yet, these resources were developed for institutions with vastly different resources, cultures, and even language than is available at UoT. During the winter of 2013, a new core-course was adapted from the *Evolution for Everyone* course as documented in O'Brien, Wilson, and Hawley (2009). While significant challenges remain, this course was officially adopted and run for a second time in the spring of 2013. Additionally, interest sparked during the EvoS class led to the development of a new applied research group at UoT; the *Positive Education Action-Research (PEAR) Laboratory*. Reported here is a brief overview of the emerging research agenda within the PEAR Lab; followed by examples from our actual programming for both Social Sciences and Life Sciences students. Directions for future research and conclusions are offered.

SERVICE AS EVOLUTION; EVOLUTION AS SERVICE

The on-line resources developed by the EvoS consortium are vast, easy to use, and provide a clear plan for programming development that greatly eased adoption at UoT. Despite these impressive resources, exactly *how* EvoS programming connects with myriad other institutional objectives is not always clear to many academics. Is EvoS another dreaded “add-on” to already overloaded Professorial duties? Or, is it actually a better way of accomplishing what Higher Education already may see as its mandate?

Benson and colleagues (2007) make a compelling case for the moral imperative of achieving “Dewey’s Dream”: the vision of John Dewey of the University as an applied community-learning center. A place that engages the whole community in finding workable direction for the pressing challenges at the local, regional, or global scales. As well, EvoS founder David Sloan Wilson (2011) echoes and adds to this sentiment in his “Whole University – Whole Community” approach within the Binghamton Neighborhood Project. In making workable adaptations to the EvoS model for the unique environment of UoT, what is beginning to emerge is a new synthesis that connects the established pedagogy of *Service-Learning* to modern evolutionary theory; both in terms of course content and educational context. The section that follows offers a brief preview of theoretical advances that may constitute claiming Service-Learning as “evolution’s lost pedagogy.” Examples from PEAR Lab coursework are then discussed.

Evolution’s lost pedagogy

Service-Learning (SL) is a method of teaching that tightly integrates community service as a context for authentic learning. The *KIDS Consortium* for SL emphasizes a three-component model for effective program development:

- Academic Integrity
- Student Ownership

- Apprentice Citizenship

Research into the benefits of this pedagogy clearly represents these broad categories, yet no research has been found interpreting SL practices from a modern evolutionary perspective. What is offered here is an argument for reinterpreting both the historical development and current practices of SL in light of the current state of evolutionary theory as applied to human affairs.

First, the theoretical development of SL is reviewed in light of recent claims regarding the Darwinian influence of educational psychologist and philosopher, John Dewey (Popp 2009). Viewing SL as '*evolution's lost pedagogy*,' it is then argued that SL practices and the integration of evolutionary sciences (e.g. Big History) can function as a curricular engine. A formula of "Big Content" plus "Applied Context" is offered as a general framework integrating theories of the moral brain as both content and context in educational settings.

Finally, educator resources and experimental course designs are briefly reviewed from the efforts of the PEAR Laboratory at University of Toliara. Educator resources include two non-profits actively advancing evolutionary perspectives within a moral psychology context for the advancement of human (and non-human) flourishing. Examples are drawn from courses designed to utilize the resources of these non-profits as launching pads for SL course development.

A Mindful Commitment to Action: Service-Learning in an Evolutionary Paradigm

Various incarnations of the *community school movement* have risen and fallen throughout most of the century since John Dewey's influential career; most strikingly and enduringly – in the set of practices known as Service-Learning (SL). In folk terms – it might be said that SL challenges students and communities to "evolve" their preferred future; and while the literal truth of this statement should not be underestimated – without proper theoretical backing, such a "soft" usage of *evolution* may hinder rather than help efforts to develop a serious applied field of evolutionary studies. What is needed is a more precise understanding of exactly what kinds of evolutionary processes are being impacted by this pedagogy. It is argued here that just such an understanding is well underway from diverse and often disparate disciplines. As well, the implications of this emerging understanding are significant and may serve to more strongly validate SL from its current formulations all the way back to its theoretical roots in John Dewey. We will begin with Dewey.

"Since in reality there is nothing to which growth is relative save more growth, there is nothing to which education is subordinate save more education." - *John Dewey (1916)*

In Popp's (2007) *Evolution's First Philosopher*, the work of John Dewey is reinterpreted as having a deceptively strong Darwinian influence. Dewey was born the year *On the Origin of Species* (Darwin 1859) was published, and he died the year before Watson and Crick discovered DNA (1952). Popp provides an in-depth and provocative re-analysis of Dewey's conception of "growth" and "education" as a

“naturalized theory of meaning” - in light of his clearly under-emphasized evolutionary perspective. Critical to understanding the above quote is an understanding of Dewey's (1916) definition of education as “that reconstruction or reorganization of experience, which adds to the meaning of experience and increases the ability to control subsequent experience.” Dewey saw the function of education as fundamentally empowering a meaningful and directed life through the repeated reorganization of experience. This perspective is clearly central to basic SL practices (Eyler & Giles 1994); yet it is as well, a foundational (if unrecognized) concept of the growing branch of cognitive behavioral sciences known as *functional contextualism* (itself a form of *pragmatism*). Among the major advances coming from this field is *Acceptance and Commitment Therapy* (ACT); an approach to *Mindfulness* training that emphasizes *acceptance* of emotion and cognition; as well as *commitment* to acting on identified values (Luoma et al., 1999; Kashdan & Ciarrochi, 2013). This idea is encapsulated in a concept Dewey would surely endorse: *psychological flexibility*.

It is from this *functional contextualism* that we are now seeing the rise of a strong evolutionary theoretical framework for SL practices (Wilson et al., In Press). Because functional contextualism is an expansive approach beyond the scope of this article – emphasis here is limited to ACT. This line of cognitive behavioral interventions has garnered an explosion of empirical support in the past decade (Kashdan & Ciarrochi, 2013), and may be on the verge of resolving longstanding tensions between Skinnerian behaviorists and evolutionary psychologists (Wilson et.al in press). Core to the functioning of ACT is the conception of human cognition as a “Darwin Machine”: a process of evolution that itself uses evolutionary processes to produce a combinatorial explosion of diversity (e.g. an explosion of cognitive capacities - in the case of the brain). While this cursory summary requisitely simplifies the work, ACT views behaviors, emotions, and cognition all as processes of selection and inheritance across multiple adaptive systems (*Sensu*, Jablonka, & Lamb, 2006). The actual interventions that make up ACT can thusly be understood as linguistic tools to elevate states of *Mindfulness*; an intentional alteration of these selection pressures toward the aim of advancing the values of the individual, institution, or culture (Wilson et al., In Press). *Mindfulness* is a form of consciousness in which, that which is out of one's control is more easily *accepted*, and in which we more ably commit to acting on our reflected values. This practice of mindfulness applied towards selecting for the values of an apparently unending adaptive peak of human flourishing can easily be argued as empirical validation of Dewey's conception of “education.” While much work is needed to expand this idea; it is becoming clear the SL offers educational researchers an incredible opportunity to study the applied management of evolutionary processes from a previously unimaginable theoretical foundation. Classrooms employing SL can be seen as the logical curricular location for deploying interventions from the intertwined fields of Positive Psychology and ACT (Kashdan & Ciarrochi, 2013). Yet, far more broadly, many common SL projects revolve around processes of reflective moral reasoning. Viewed from the insights of ACT and contextual functionalism, these classrooms can be seen as managing multi-level selection processes of emotion, cognition, and behavior relating to an almost infinite domain of locally relevant community needs. The *context* of the SL classroom has the clear potential to lay claim as “evolution's

lost pedagogy.” But what about content? In the section that follows, past and in-progress reports from PEAR Lab classrooms are offered that specifically integrate EvoS *content* as a launching pad for the development of engaging and meaningful SL projects.

• *Curricular Examples from the PEAR Laboratory*

The PEAR Lab is housed within the UoT Department of Educational Psychology and the Faculty of Life Sciences. As such, the current educational objectives are well established within traditional boundaries. Despite such set objectives, the work of turning EvoS into a set of on-going SL projects has been well received in terms of outcomes and program acceptance. Two projects are described. First, the EvoS core-course as adapted for this community which focuses largely on the teaching of *Positive Psychology*. Second, an in-progress course for Biology and Agriculture students connecting *Moral Psychology* and *Public Policy* in ways that are both relevant and repertoire expanding for students in these disciplines.

The EvoS Core-course at University of Toliara

While the PEAR Lab places high emphasis on *student ownership* of the research agenda, there is no pretense that EvoS comes from anywhere but “outsiders.” Specifically, strong majority of EvoS members could be classified as coming from WEIRD (Western, Educated, Industrialized, Rich, Developed) nations as described by Heinrich et al. (2010). This presents both obvious cross-cultural communication challenges, as well as significant research opportunities. Within this cultural context, ENS-Psychology students reported being (n>80%) “very religious,” primarily Catholic and Evangelical. Great sensitivity was taken to be respectful of local beliefs, while ensuring the clear communication of a modern scientific perspective. Indeed, what at first seemed like a challenge, became a curricular focal point that added a strong element of authentic learning.

Rather than presenting EvoS in terms of essentialist, “truth” claims (*Sensu “The New Atheists,” e.g. Dawkins 2008*) science, more generally, was presented in purely anthropological terms. A definition was crafted based on the psycho-social *functioning* of science as a cultural adaptation. That is, the claim was made that:

“Science functions as the mythology of those cultures that, in part,
sacralize convergent naturalistic evidence”
- The PEAR Lab functional definition of *Science*

This definition was adapted from Wilson's (2011) description of science as “a religion that worships truth as it's god,” re-worked in two important ways. First, “religion” was replaced with “mythology” - not as a token olive branch for religious students, but rather for practical reasons of specificity. Students were presented with Joseph Campbell's (1976) four functions of mythology, which outlines the psychosocial functions that effective cultural story telling serves. Second, the term “sacralize” replaced Wilson's “worship,” again for reasons of specificity. This term is used in the sense of Jonathan Haidt's (2012) moral psychology claim that the

sacred ideas of a group or culture “bind” them into cohesive groups and “blind them” to the potential truths of others (moral out-groups). Armed with this definition, PEAR Lab students could now begin the first ever SL project at UoT. Importantly, every SL project must start by investigating a community need.

The community need that this first class was to investigate logically became was: “Is the EvoS program valuable for UoT and the Toliara Community?” Informal hypotheses were made as students embarked on the “literature review” phase of this course (O'Brien, Wilson, and Hawley, 2009). Students were introduced to the Universities limited (n<10) computer resources, and a variety sampling of EvoS concepts were reviewed. Critical to this review was the mapping of *moral diversity* on the question at hand. In the United States, UoT Students learned, “evolution in education” is often divisive and controversial – especially at the secondary school level. Yet, Haidt and colleague’s *Moral Foundations Theory* (Haidt & Graham, 2007) allowed students to accurately predict that we should see complex moral diversity rather than a clear-cut dichotomy on this issue. To delve into this diversity; one class was devoted to looking at some “species typical” specimen from across the moralistic ecosystem. Noted scientists, science activists, scientific theologians, and religious fundamentalists were studied in light of our functional definition of *science* (notably: *Richard Dawkins, Zack Kopplin, David Sloan Wilson, Jonathan Haidt, Michael Dowd, Connie Barlow, Ken Hamm, and Kent Hovind*). Discussion ensued; “In what ways is this individual functioning as a scientist when he/she makes this claim?”; “Is it possible other sacred values are distorting how observable evidence is

Figure 1

	Proximate Explanations [Explications Proche]		Ultimate Explanations [Explications Ultime]	
	Mechanism [Mécanisme]	Development [Développement]	Function [Fonction]	History [Histoire]
Molecular [Molécule]				
Cellular [Cellule]				
Organ / Brain [D'organes / Cerveau]				
Individual [Individuel]				
Group [Groupe]				
Socio-Cultural [Socio-Culturel]				

Figure 1. A Unified Human Sciences Framework. This basic, bilingual framework is offered to all students in PEAR lab courses or projects. Adapted from Medicus (2005) and based on Tinbergen's (1963) four questions, it serves as a map to looking at *the moral brain* from across any and all human science disciplines. Importantly, the continuity of nature is emphasized, both explicitly in classroom content, and theoretically through an evolutionarily informed *service-learning* design.

interpreted?"; and lastly - "Is there a fundamental distinction in the disagreements between those who sacralize convergent naturalistic evidence" (i.e. function, in part, as scientists) – and those who don't?" Various controversial disagreements were contrasted with disagreements between religious fundamentalist Ken Hamm and scientific theologian Michael Dowd – the former believing biblical authority trumps fossil evidence; the later believing that "truth seeking" from an evidential basis is among the highest of Christian virtues. Over the course of this work, students were exposed to an impressive array of cutting edge evolutionary science in a non-threatening way – and even more importantly – they were given a practical and sophisticated understanding of the scientific process from a psychosocial perspective that many western students are not yet afforded. Rather than forcing "western truths" into their belief systems, they were offered a clear and compelling understanding of global scientific culture, and given a road map to entering that culture should they so choose. Students unanimously recommended to UoT Administrators that the EvoS program and PEAR Lab should be integrated and expanded. Numerous (n=47) students are now working under the PEAR Lab to develop Positive Psychology and Evolutionary Education classroom interventions as Action-Research projects in local Public and Catholic High Schools.

Upon the recommendation to expand the program, a course titled *The Moral Sociology of Biopolitics* was developed during the spring of 2013, and is currently in progress for (n=75) Biology and Agricultural Sciences undergraduates. Similar to the work in the core-course, these students are beginning to explore the moral diversity pertaining to Genetically Modified Organisms (GMOs) in Malagasy agricultural and food systems. Madagascar has a strict ban on such biotech crops for agricultural production, experimentation, as well as import. Hailed by Anti-GMO activists as an intelligent "precautionary" approach, and decried by others as "anti-science" - and potentially immoral given the human development challenges faced in the country (Paarlberg 2001, 2009). Students will use modern and emerging tools of moral psychology; namely Moral Foundations Theory (Haidt & Graham 2007), and Moral Vocabularies Analysis (Lowe 2006, 2010); each of which, respectively, evoke evolutionary processes as central to both ultimate and proximate explanations of moralistic behaviors. Rather than a standard "debate" format, students are encouraged to "slow down" their judgment. Students study both the biology of biotechnology, but also are presented with modern conceptions of "the moral brain," as an evolved emotional agent dealing with problems at a geographic scale (global) and rate of change (exponential) that our biology simply wasn't designed to perfectly manage. Borrowing on concepts from ACT, Students are invited to experience their moral intuitions as "context" rather than "reality" (what ACT practioners call *self-as-context*). In small groups students are mapping out the moral diversity (and specific moral vocabularies) of this heated debate. By viewing *self-as-context* and cultivating the development of perspective taking skills with-in student groups, it is hoped that a multi-level selection process may emerge that more fully reflects action towards values. The final project aims to result in a guide for policy makers on creating a healthy and evidentially-informed, on-going public policy discourse for biotechnology in Madagascar.

•*Big Content; Applied Context*

Human knowledge and technological capacity is growing at exponential rates, yet our wisdom in applying this knowledge for universal flourishing does not clearly track such a steep curve. For education to become proactively adaptive, it must meet the needs of both students and society in meaningful ways. Developments from the PEAR Lab suggest an approach (at the Secondary and Higher Education levels) that integrates *Big Content* within an *Applied Context*.

The term *Big Content* here refers to an emerging educational concept of *Big History* as well as to a more general conception of *Future Studies*. *Big History* (Christian, 2011; Smail, 2012) is an interdisciplinary effort to bring continuity to the story of Humanity. *Big History* emphasizes the deep time (~13.7 billion years) continuity of change; and places Humans squarely within an expansive evolutionary framework. *Big Historians* also frequently glance into the future (Spier, 2011); and indeed; creating a preferred future is a core aim of SL classrooms. In this context, the role of emerging technologies and the existential threats to humanity (global warming, cultural conflict, pandemic disease, etc.) are placed within the continuity of evolution in cosmic, genetic, epi-genetic, behavioral, and symbolic systems. The PEAR Lab has placed specific emphasis on “the *Big History of the Moral Brain*” - telling the story of the deep-time evolutionary emergence of human morality in continuity with the historical and proximate stories of the *moral sciences*.

Applied Context simply means that, as *Big Content* is woven through the curriculum, Students should also have opportunities to apply their knowledge at the local, regional, or global scales. SL is clearly the most established and empirically researched pedagogy to accomplish such an applied context. Where SL combined with advancements in the practice of ACT can constitute an emerging methodology for promoting the conscious selection of emotions, cognitions, and behaviors toward shared values, this applied context itself is now being explicitly taught to undergraduate Educational Psychology students at UoT as a new twist in “the big history of the moral brain”.

While this article documents only two cases in which such *Big Content* and *Applied Context* are being tightly woven together (to varying degrees), there is no shortage on the topical diversity this approach can take. Indeed, the PEAR Lab utilizes resources from two innovative NGO's that excel in mapping the leading edge of an applied evolutionary perspective.

The Evolution Institute is a non-profit organization dedicated to using modern evolutionary sciences to improve the human condition. Their work in networking *evolutionary educational psychologists* has been pivotal in advancing much of the science described in this article and employed by the PEAR Lab; yet this is far from the full scope of their work. With projects spanning: *Quality of Life, Play, Evolutionary Mismatch, and Evolutionary Medicine*, the Evolution Institute offers a treasure trove of applied topics where evolutionary studies are rapidly making valuable contributions. The work of the PEAR Lab suggests a role for local Universities globally to digest and further explore the work of the Evolution Institute through innovative SL Projects (perhaps SL projects that also build bridges with local secondary schools).

The Institute for Ethics and Emerging Technologies (IEET) is the fiscal agent for the PEAR Lab, but also serves as a source of limitless social media content

regarding emerging technologies and ethical issues, often from multidisciplinary and evolutionary perspectives. As the pace of technological growth expands exponentially, many educators are able to stay on top of current ethical issues resulting from emerging technologies. IEET provides numerous resources to support classroom discussion around both specific technologies as well as *biopolitical orientations* (Hughes 2004). In the PEAR Lab, these biopolitical orientations are then mapped onto Moral Foundations Theory, Moral Vocabularies Analysis, and ACT. Thus – students are able to examine both ultimate and proximate explanations for diverse biopolitical orientations; and given tools to more intentionally align their emotions, cognitions, and behaviors with their values.

CONCLUSIONS

The moral brain has served as both content and context for educational innovation at the University of Toliara in southwestern Madagascar, yet there exists no logical reason the same could not be accomplished in any academic setting globally. Using service-learning as a foundational pedagogy and infusing this practice with the leading edge in evolutionary sciences from multiple disciplines holds virtually unlimited promise to develop a richly applied evolutionary psychology of *education* in the truest sense that Dewey imbued to the term. A “Big History of the Moral Brain” can encompass a broad range of curricular content objectives; and provides a logical keystone to bridging content with context as a multi-faceted strategy for educational innovation. As Wilson et al. claim, “we are closer to a theory of intentional change than it may appear” (In Press). We can use this science of positive intentional change to *design* our classrooms, yet there remains an untapped efficiency gain if we do not concurrently update and *explicitly teach* this science as the newest chapter in the unfolding big history of our moral brains. Both “evolution” and “moral issues” are challenging yet critically important topics for secondary schools and even for many higher education institutions. The work of the PEAR Lab suggests a bold approach that engages Higher Education in partnership with regional High Schools to strongly integrate these topics under a strongly supported theoretical framework previously thought impossible.

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APPENDIX A

Abbreviations & Vocabulary

ACT: Acceptance and Commitment Therapy

Evo-Edu: Evolutionary educational psychology

EvoS: The Evolutionary Studies Consortium

SL: Service-Learning

UoT: University of Toliara, Madagascar

Disciplinary Unification of the Natural Sciences, the Humanities, and the Social Sciences: Adapted Minds and Strategic Approaches to Consilience in the Academy

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ABSTRACT

The purpose of this paper is to consolidate and extend the arguments we made at the EvoS symposium on Oct. 26, 2012. Most fundamentally, we argue that we are entering an exciting and potentially productive era in the history of the human knowledge enterprise. We are at the inception of a “unification revolution” in which all the areas of our understanding (the natural sciences, the social sciences and the humanities) have the potential to be joined in a single coherent endeavor through shared insights and practices. Earlier, more local cases of such disciplinary unification produced spectacular advances (the unification of quantum mechanics and classical chemistry to produce modern chemistry and the subsequent unification of these with biology to produce the molecular revolution, for example). Thus, we can expect even more dramatic advances from the unification of all disciplines, including insights that can serve global human welfare in very specific and powerful ways. We argue that evolutionary psychology has an important contribution to make to this unfolding knowledge revolution. From this vantage, we outline what we believe the crucial challenges are and the institutional and social responses we can make to facilitate this vital unification.

KEYWORDS

Human Evolution, Evolutionary Psychology, Disciplinary Unification, Knowledge Revolution, Unification Revolution, Human Welfare, History, Archeology, Power, Hierarchy, Global Democratization, Competitive Parsimony

“An unexamined life is not worth living.”
“Education is the kindling of a flame, not the filling of a vessel.”
Attributed to Socrates

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INTRODUCTION

Professional evolutionary psychologists have long recognized that human minds are primarily designed to see and understand the world, not as it “really” is, but in ways that serve individual self-interests. In developing what has come to be called social coercion theory, the authors have argued that all the human properties considered unique to us emerge as adaptations to a single adaptive novelty, our unprecedented vast expansion of kinship-independent social cooperation. Moreover, this novel social adaptation, in turn, has a single, simple cause: The ancient evolution in our lineage (for the first time on Earth) of the capacity to cost-effectively manage individual conflicts of interest through access to inexpensive coercion (Bingham & Souza, 2009; Bingham & Souza, 2012; Bingham, Souza & Blitz, 2013; and references therein). It follows that the human knowledge enterprise lives at the interface between our conflicting individual interests and the management of those conflicts allowing our social groups to form and function.

As a result of the decisive power of cooperating coalitions (arising from their mutually coercive membership), our central, uniquely human evolved social strategy is *not* to pursue isolated individual self-interest (contra classical economic theory; Smith, 1776), but rather to collude with individuals with whom we share some confluent interests (minimizing the costs of policing residual conflicting interests). Thus, our capacity to understand the “real” world (rather than proselytizing for some artificial, self-serving picture) is utterly dependent on the capacity of the coalition of the whole to monitor and police the functioning of its constituent self-interested, colluding sub-coalitions.

The striking association of the Scientific Revolution, the Industrial Revolution, and the Modern Economic Miracle (North & Thomas, 1973; Bernstein, 2004; Clark, 2007; Appleby, 2010) with coercive democratization of the modern state demonstrates how adaptively powerful this broad, democratized policing can be (Bingham & Souza, 2009). The essential prediction of this picture is that the modern democratized state reflects the ancient, original human social adaptation, dramatically increased in scale, thereby permitting enormous gains in knowledge, adaptive sophistication and productive power (op.cit.). We argue here that this insight, in turn, emphasizes the enormous stakes implicit in unification of the academy, and the potential for yet another revolution of even greater scale. Moreover, the molecular revolution in biology (resulting from the unification of physics, chemistry and classical biology over the last ca. 60 years) provides freshly recent, compelling additional empirical verification of the intellectual power of disciplinary unification.

In other words, we can anticipate an intellectual revolution of immense proportions with the unification of the entire knowledge enterprise, with its attendant sharing of information between the natural sciences, humanities, and social sciences. The implication of this intellectual revolution for the expanding human global population (and the enormous opportunities and huge threats it faces) cannot be overstated. We will argue that viewing the special problems presented by the adaptively novel contemporary scale of human kinship-independent social cooperation from the perspective of social coercion theory allows us to begin to

specify the specific steps we should take as members of the academy if we are to bring this potential revolution to its promising fruition.

THE LIMITS AND POTENTIAL OF HUMAN KNOWLEDGE

Emergence of edifices of insight like the scientific advances associated with Newtonian mechanics, atomic theory, Darwinism, or molecular biology (with empirical verifications like footprints on the Moon, thermonuclear detonations, and predictable genome sequences) demonstrates that the management of collusive, short-term interests can be sufficiently successful to achieve authentic knowledge of the universe. However, as the cutting edge of the scientific enterprise has reached the very details of the human condition itself, our problem in managing narrow interests in support of an authentic knowledge enterprise has grown explosively. Specifically, our proximate minds evolved to adaptively navigate the expanded human social scale, not to understand its ultimate causal origins. Moreover, most of us enjoy various de facto individual “privileges” within our local social coalitions that are potentially threatened by full description of the logic of our social cooperation.

We have argued elsewhere that pursuit of full global democratization (majority global policing of individual interests) is the ultimate solution to this problem in the public economic/political sphere (Bingham & Souza, 2009; Bingham & Souza, 2012). Our focus here is how failure to solve this problem within the academy continues to obstruct the human knowledge enterprise.

As evolutionary psychologists, all of us occupy a unique position in the quest for unification of the knowledge enterprise. On the one hand, we are individually self-interested, collusive actors (as all psychologically normal humans always are). On the other hand, we also possess tools and insights that allow us to understand how to approach this problem of conflicting interests as it determines how the academy functions, for better and for worse, day in, day out.

In other words, we can intuitively grasp the central problem we face with a depth that no other discipline currently possesses. Our challenge is to translate this scientific insight into practical action. The path forward will require not merely mapping out specific tactical steps. It will also require translating our knowledge from specialized, unconsciously exclusionary jargon into a shared common language.

In this article, we begin with several translations that we consider essential. We then finish with several suggestions for practical action to help drive the crucial unification of the human knowledge enterprise.

TRANSLATING WHAT WE BELIEVE WE KNOW INTO THE COMMON PUBLIC DIALECT

Power, ethical correctness, and hierarchy

Social coercion theory predicts that our uniquely human social cooperation (independently of close genetic kinship) is the central feature of the human adaptation (Bingham & Souza, 2009). Kinship-independent social cooperation (KISC) is something non-human animals do only in rare cases and on very limited scales, whereas KISC on a large scale is the central feature of the “public” domain

of all known human societies, ancient and contemporary. Moreover, this theoretical assertion leads directly to strong, testable theories of the human fossil record, of the evolution of language and human cognitive virtuosity, and of the details of human history – all emerging as adaptations to or implications of uniquely human KISC (op.cit.).

The central claim of social coercion theory is that uniquely human KISC is a direct consequence of a single ultimate cause, the evolution of access to inexpensive conjoint coercive threat. This development allows cost-effective ostracism of potential cheaters on cooperative endeavors. This use of credible threat then makes non-kin cooperation an adaptive opportunity. As far as we can determine, the only pathway to this novel access to individually cost-effective coercive threat is through the evolution of the capacity to project threat from a substantial distance (many body diameters away). Consistent with this theoretical prediction, the origin of uniquely human KISC in the fossil record follows rapidly after the evolution of elite human throwing, the first biological capacity for projection of threat from a distance (remotely) in any animal in Earth's history, as far as we can determine (Okada & Bingham, 2009; Bingham & Souza, 2009; Roche, Venkadesan, Rainbow & Lieberman, 2013).

Further empirical support for this theoretical assertion emerges from the observation that the scale of human social cooperation over our entire 2 million year history into the present correlates with the properties (especially range) of the coercive technologies we possess for projection of coercive threat. Finally, the everyday function of our societies, through the present moment, appears to be absolutely dependent on the projection of coercive threat remotely (Bingham & Souza, 2009). Think of the handguns of contemporary law enforcement, for example.

On the basis of social coercion theory we can make the following predictions, specifically useful in this context.

First, coercive threat would have been relatively democratically distributed among individuals from the inception of the human lineage until very recently in our history (below). This expectation is based on the inherent properties of the original coercive technologies (throwing stones, atlatls, bows) and ethnographic observation of pre-state societies (reviewed in Bingham & Souza, 2009 and Bingham, et al., 2013). Thus, self-interested projection of threat would have enforced relatively mutually beneficial cooperative practices. Indeed, the “right” (ethically “correct”) would have been defined as pursuing self-interest in those specific ways that were confluent with the self-interests of surrounding (highly mutually powerfully coercive) non-kin others. Self-interested behaviors that did *not* have this property would have provoked pre-emptive ostracism (and have been perceived subjectively as “selfish”) (Okada & Bingham, 2008; Bingham & Souza, 2009).

Second, an important second-order implication emerges from the preceding paragraph's considerations. We are highly adapted to perceive the views (on any subject) supported by coercive power as the “right” (ethically correct). Moreover, our optimal self-interested strategy is to behave as if (and to subjectively believe that) social “might makes right.”

Third, these considerations lead to the origins of the fundamental problem we face. When coercive power becomes systematically monopolized by small

subgroups (as first became possible with technologically advanced weaponry, especially beginning with the rise of the first states; Bingham & Souza, 2009) we expect ancestral human social cooperation to become distorted. In particular, we expect economies policed by those powerful subgroups to serve their interests disproportionately and for the majority of “commoners” to be treated essentially as domesticated animals. This prediction is remarkably well fulfilled by the records of archaic and modern authoritarian states (Bingham & Souza, 2009, 2012).

Fourth, our concern here is the implication of this well-supported picture for the internal workings of the contemporary human knowledge enterprise including our scientific and educational institutions. The central prediction is straightforward. Powerful small subgroups are expected to police the knowledge enterprise in support of their economic and military needs (various branches of engineering and finance, for example), as they apparently do. However, these very same subgroups will act to suppress knowledge generation that would potentially support the interests of coercively weak commoners, especially as this knowledge lays bare the internal logic of human social coalitions. Ostensibly religious suppression of knowledge generation provides excellent empirical support for this prediction. For example, recall the well-known persecution of Galileo by the Roman Church (intimately affiliated with “royal” state power). Also most illuminating is the constant threat posed by religious authorities to early developers of increasingly materialist world views like Spinoza (see Stewart, 2006, for a rich discussion).

Thus, our evolved behavior/psychology makes us extremely vulnerable to distorting our knowledge-pursuing activities in response to perceived concentrations of coercive power. This propensity is crucial to understanding our behavior in the contemporary academy, as we will argue below.

Social scale and adaptive novelty

To fully understand the impact of our evolved behavioral strategies/psychologies it is also crucial to consider the scale of contemporary human institutions, including those of the academy.

For roughly the first 1.7 million years of human evolution, we apparently lived in relatively small, democratized kinship-independent social coalitions. We would each have had a clear view of the locus of coercive power (democratized consensus). As our coalitions have recently grown enormously in size (to hundreds of millions in the case of contemporary states), we have lost the capacity to perceive and monitor directly the locus of coercive power and to conveniently, fully assess the interests being enforced by that coercive power.

This feature puts us in the position of having to make the central adaptive assessments of human cooperation under conditions of severely incomplete information. Moreover, mis-assessment of who holds coercive power and what their interests are creates enormous danger for each individual. This condition of great, but obscure danger engenders an environment in which some level of secrecy and dissembling are crucial strategic tools – pretending to hold power and/or to be aligned with power through various signaling strategies, for example.

While we predict that the actual distribution of access to coercive threat should ultimately determine the structure of human societies (op.cit), we also expect

the massive, adaptively novel societies and institutions of contemporary human cooperation to chronically function at partial (even extensive) disequilibrium. Self-interested acts covered by some level of implicit secrecy allow the chronic creation of the (mis)impressions of holding power and of serving the common good (see Moldoveanu & Baum, 2011; James, 2012, for two recent empirical discussions of this well-known phenomenon).

While it will be of great value to develop this perspective further as a theory of all (contemporary) human institutions, our goal here is more narrow: to understand how these properties of human behavior/psychology play out within the academy.

A brief summary of the nature of the knowledge enterprise

To understand the challenges we face we must always keep in mind the nature of knowledge. While engineering is an enormously creative human activity, it is a fundamentally deductive enterprise, based on the skillful use of knowledge we already possess.

The knowledge enterprise, *sensu stricto*, does not include engineering, but rather consists of the pursuit of new knowledge we do not yet possess. It follows that the knowledge enterprise is a fundamentally inductive process, as has long been recognized (Popper, 1972; 1978). It is the social and institutional context for this inductive process that concerns us here.

The illusion of social power within the academy

Because of the tendency to collude and the capacity for substantial secrecy (often unconsciously pursued), the disciplinary groupings and institutions that make up the knowledge enterprise are continuously at risk of the “social capture” of financial, attentional and institutional resources for the benefit of a collusive community rather than the benefit of the coalition of the whole they claim to serve. Such social capture encompasses not only the assets of the academy, *sensu stricto*; but tributary institutions, like the scientific press and funding agencies, are also extremely vulnerable. Moreover, the secrecy and exclusivity implicit in this social capture creates opportunities for construction of artificial, self-serving hierarchies *within* disciplines.

The challenge presented by social capture is particularly severe as the evolved human mind is highly adapted to unconsciously self-serving ethical self-justification. In other words, each of us runs the constant risk of participating in debilitating social capture, while nurturing the strong subjective illusion that we are purely ethical, pro-social actors.

A specific example will add substance and clarity to these general statements. We choose the human genome project and its connection to human evolution for several inter-related reasons. This example is clear and well-documented. Moreover, it is accessible to evolutionary psychologists and has been impactful on our discipline.

First, the genome projects were launched with great enthusiasm on the parts of the large, well-endowed institutions ideally positioned to benefit from the resulting

multi-billion dollar investment. As this undertaking was fundamentally an engineering project (its scientific foundation had been fully established previously), progress and data return were highly predictable. Massive structures within the academy and its tributary institutions grew up as a result and the desired engineering outcome was efficiently delivered.

Second, however, as an engineering (rather than scientific) endeavor, the genome projects have, thus far, delivered relatively little new knowledge – though, of course, we all expect this massive store of data to ultimately be put to strong scientific uses.

Third, against this background, we can now perceive the distorting effects of this massive social capture of resources on our own discipline. The old joke goes, “When you have a hammer, everything looks like a nail.” In possession of the massive data trove from the genome projects, *scientific* hypotheses that selectively privilege the importance of these data received highly disproportionate attention. For example, the proposal that evolution is driven by genetic change, rather than new selection (“genetic driver” hypothesis), becomes eminently attractive as something that makes the genome sequence engineering project important even though this hypothesis is inherently dubious.

A specific example is illuminating – and also transitional to our final section below. The genetic driver hypothesis predicts that the evolutionary success of behaviorally modern humans over Neandertals should have an ultimately genetic cause. Thus, exploring the genetic differences between moderns and Neandertals is predicted to reveal the basis of modern ascendancy. With this hypothesis in mind, Paabo and colleagues (Enard, et al., 2002) used sequence analysis of living species (humans and other apes) and sequence divergence data within the human population to infer the recent evolutionary history of speech-related amino acid substitution mutations in the FOXP2 gene. These investigators reached the conclusion they expected to reach – FOXP2 was redesigned for speech very recently, after the modern-Neandertal divergence.

For eight long years this interpretation held ascendancy in many communities as they thought about recent human evolution, in spite of its poor empirical foundation. The truly destructive nature of this event sequence is illustrated by the subsequent discovery that this conclusion is simply wrong (including work from the Paabo group; Green, et al., 2010). The crucial point here is that the hypothesis most beneficial to a large interest group was framed in a way that allowed the hypothesis to survive (and even to be apparently actively supported).

The most fundamental failure here is that the genetic driver hypothesis was formulated in ways that allowed uncertain evidence to support it, *not* in ways that made it powerfully falsifiable (below) as scientific hypotheses should always be constructed. The reviewers chosen by the journals publishing the original 2002 work shared the biases of the authors, leaving the larger academic community without critical input. [Disturbingly, new confusion may still be being created in this domain (Maricic, et al., 2013).]

We chose this particular case for one additional reason. It was ultimately resolved, so that our capacity to interpret its implications is unambiguous. However, it is extremely likely that many other cases of weak hypotheses, supported by strong

collusive sub-groups, survive not merely for eight years, but for 80 or 800. Theories of how our (very powerful) economic institutions work is one arena where we expect this problem to be particularly severe, for example (see de Soto, 2000, for one especially illuminating discussion of this particular case).

Our challenge is to immediately translate any particular hypothesis into a form where the coalition of the whole can reliably evaluate its merits and standing. Discipline-internal implicit secrecy supported by and inherent in hierarchical subgroups impedes this essential effort.

Our goal in the following section is to begin to define some institutional practices that allow us, as the scholarly coalition of the whole, to overcome these severe impediments to our common progress and, ultimately, to the essential unification of all our diverse disciplines.

FALSIFIABILITY, PARSIMONY AND FECUNDITY: CRITERIA FOR THE COALATION OF THE WHOLE

We will argue in this section that there are three fundamental tools that the coalition of the whole can bring to bear to minimize the problem of unconscious social capture by individual disciplines and sub-disciplines.

Just-so stories and the problem of falsification

The first of these tools is illustrated by the genome project case above. We must insist that the members of any academic discipline (i.e., interest group) formulate their hypotheses in forms that allow these hypotheses to be potentially falsified by data from other disciplines.

This requirement has three crucial effects.

First, it allows the coalition of the whole to monitor and impose pro-social discipline on each individual interest group within the academy.

Second, this imposed discipline vastly improves the effectiveness of work within each area of specialization. Members of each discipline are required not just to address fellow members with whom they share short-term collusive interests in social capture of resources; they must also address the concerns of the larger academic community.

Finally, this requirement to address the academic coalition of the whole results in the translation of insights and hypotheses into the common vernacular. This translation dramatically improves the capacity for disciplinary unification; we all understand one another. Equally importantly, this translation allows the entire human community (not just the academy) to monitor and discipline the academic enterprise. The relatively low esteem in which the academy is currently held in some quarters reflects our failures in this area to date.

To fully grasp the importance of theory falsifiability, it is fruitful to consider another example of failure (among many), in this case from the social sciences.

The hypothesis that changes in the details of belief systems drive social change (the “belief driver” hypothesis) is extremely pervasive in several academic disciplines, history and anthropology in particular. However, specific versions of this hypothesis are almost always formulated in ways that allow members of a local discipline to find

evidence supporting them rather than in ways that would allow them to be decisively falsified.

A specific example is illustrative. The hypothesis that religious belief is causal of substantial social change (rather than being a knock-on effect of some other ultimate cause) has long standing (Gibbon, 1777). Moreover, it remains popular into the contemporary era (see, for example, Chavin & Watkins, 2000; Pauketat, 2004). Most of the arguments supporting this claim are extreme versions of “just-so story” telling. Correlation and assumptions of causation are hopelessly intertwined.

Indeed, the empirical evidence for *correlation* between religious belief innovation and large scale human social change is powerful (see Trigger, 2003, for one particularly sober, critical assessment of this evidence in the case of the primary archaic states). Translating this religion variant of the belief driver hypothesis into a form that would allow it to be falsified by evolutionary psychologists (or other disciplines) would be an enormous contribution, for example.

Competitive parsimony and fecundity

When dealing with phenomena of large scale or long duration, it can be difficult to achieve the same level of crisp falsifiability that is possible in, say, a chemistry or cell biology laboratory. While we must continue to insist on maximal falsifiability, it is essential to recognize other criteria that are also useful in shaping hypothesis formation in individual scholarly disciplines.

Two interrelated criteria, winning in competitive parsimony and displaying fecundity, provide these essential additional practices. Moreover, these approaches are abundantly validated in the last four centuries of the history of the natural sciences.

Applying competitive parsimony is central to monitoring and disciplining social capture and facilitating the unification revolution. It is useful to reflect on a very familiar case from the natural sciences. Newtonian mechanics can be thought of as a theoretical description of a particular domain of the universe. However, the development of general relativity demonstrates decisively that Newtonian mechanics is merely an “as if” description of a reality well beyond Newton’s ken. In other words, some pieces of the world behave as if the algorithmic mathematics of Newtonian mechanics were an accurate description of reality, but the superior performance of general relativity demonstrates that, to the contrary, Newtonian mechanics is an artificial approximation, a kind of “work-around.” [By the way, the incompatibility of general relativity and quantum mechanics indicates that one or both of these “great theories” is probably just as “as-ify” as Newtonian mechanics, implying a reality still well beyond our contemporary grasp.] Though such as-if theories can have great usefulness (witness Newton’s contribution to putting footprints on the Moon), their narrow artificiality ultimately limits us (witness the irrelevance of Newton to much of the Manhattan Project).

From the perspective of our individual disciplinary silos, we sometimes develop theories that survive as much falsification as we know how to apply. [The NASA engineers tasked with reaching the Moon would never have discovered that Newton’s Laws were merely as-if work-arounds, for example.] However, if we

impose the additional requirement that our local disciplinary theories generalize to predict the observations of other disciplines, we create the environment in which competitive parsimony can drive disciplinary unification. [Note that Newton's work, though ultimately transcended, had revolutionary importance. Likewise, the local theories our individual disciplines have developed can also have profound importance as portals to more general theory.]

The third criterion for scientific hypothesis/theory that is vital for policing local social capture and facilitating disciplinary unification is the requirement of fecundity. Isolated disciplinary interest groups quickly become jaded, satisfied with the endless round of generating empirical evidence that can be explained on the basis of favored theory, without asking that self-serving theory to make new, even unexpected predictions.

In contrast, strong, unifying theory inevitably spins off previously unexpected predictions promiscuously. For example, the development of quantum mechanics in physics spun off an account of the periodic table in chemistry (see, for example, Pauling, 1939). Likewise, the molecular revolution in biology spun off a vast array of predictions about molecular events associated with biochemical function or evolutionary change (among many other things).

Thus, as members of the academic coalition of the whole, we must insist from one another that our local theories show evidence of continuing to spin off unexpected insight and new falsifiable hypotheses. Indeed, any theoretical claim that has long standing but has never produced a significant new insight beyond appearing to account for the initial evidence on which it was based should be considered, *prima facie*, unlikely to be correct (or even useful). The belief driver hypothesis in history and anthropology that we discussed above is, we argue, an excellent example of a hypothesis that should be regarded as extremely unlikely on the grounds of its lack of fecundity over its centuries of use.

Applying these practices to our own discipline, our theories of human evolved psychology should generalize, perhaps accounting for aspects of history or of contemporary economic or political behaviors, for example, well beyond the specific empirical domains in which they were originally developed.

Applying these criteria to disciplinary unification, a practical example

A crucial practical issue is how we can continue to develop our skills at applying these crucial criteria (falsifiability, competitive parsimony, fecundity) to monitoring for and managing social capture while driving the unification revolution. Our longstanding interest in social coercion theory led us to recently participate in a Symposium and follow-on dedicated journal issue bringing us as evolutionary biologists/psychologists together with archaeologists with an interest in Neolithic revolutions (see Bingham, et al., 2013, and the other papers in this dedicated issue of *Evolutionary Anthropology*).

While a detailed discussion of this project is beyond our scope here, we recommend to young investigators that they explore this work as one source of models for the future. In overview, we combined work in the areas of social complexity theory with work in diverse areas of North American archaeology, asking whether these theories could predict the entire North American record, not just one

local case or another. This required theories to make locally falsifiable predictions. This requirement, in turn, forces theories to demonstrate fecundity and to compete in the parsimony of their explanations and predictions. Incidentally, this approach also contributes to the scientific “dance” between good theory and good empirical evidence – where each feeds and drives the other to deeper knowledge acquisition. We hope this project will prove to have been a small practical step on this long, but crucial and exciting journey toward the disciplinary unification revolution.

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EvoS Online: Deep History Meets the Future

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EvoS, Online Pedagogy, COIL, Disruptive Innovation, Cross-Cultural Research

INTRODUCTION

The exponential growth of both online education and electronic media related to science education and evolution represents both a challenge and an opportunity for the EvoS program. Online education remains in flux in terms of perception of educational efficacy, as well as in technological standards of delivery. It is the goal of the EvoS Online project to create a central hub for the development and regulation of online course offerings operating under the rubric of the EvoS program.

The concept of distance education can be traced at least as far back as the 19th century, with the advent of postal based correspondence courses. The 19th and 20th centuries saw the entrée of various universities into correspondence learning, including the University of London and Columbia University (Moore and Kearsley, 2012). By the mid-20th century, additional media were being incorporated into distance learning programs. For example, the Open University initially relied upon radio and television broadcasts to meet its distance learning objectives (Moore and Kearsley, 2012). This was in furtherance of one of the stated goals of the Open University system, which was to expand the reach of higher education beyond the traditional university population. In this sense, the Open University is a precursor to EvoS in the goal of expanding the reach of evolutionary studies beyond the boundaries of the “Ivory Archipelago” (Wilson 2005).

THE CURRENT STATUS OF ONLINE EDUCATION

Today, online courses and programs have expanded into virtually every type of higher learning institution. In the case of the State University of New York (SUNY) system of state learning institutions, online courses are offered through the majority

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of the systems universities and colleges. However, there is considerable variability in the availability of such online offerings between institutions, as many of the larger universities tend to function as autonomous online course hubs within the SUNY system, while the four-year colleges and community colleges offer online courses interchangeably with each other via the SUNY Learning Network (SLN). One of the reasons for this discontinuity is that SUNY institutions use a diversity of course delivery systems (Blackboard, ANGEL, Sakai) that are not cross compatible.

Perhaps the greatest obstacle to the development of online programs is one of perception. Online education is often associated with poorer quality of education among both educators and the general public. The situation has been exacerbated by the proliferation of online “diploma mills” which offer unaccredited college diplomas for very little actual work (Contreras, 2004). Another poor association with online education comes from the extensive use of the medium by various “for-profit” institutions. Even though such colleges are often accredited institutions, the for-profit education industry has come under increased scrutiny for both poor quality educational outcomes and unethical student recruitment practices (Stimpson, 2012).

Although the development of online education has expanded throughout every field of academia, Moore and Kearsley (2012) point out that the majority of distance-learning programs are not designed with traditional higher education in mind. Rather, the bulk of online learning is still geared toward adult learning and vocational education. This reflects that traditional role of distance learning, which had been geared toward vocational careers and retraining of adult’s already in the workforce.

COLLABORATIVE ONLINE INTERNATIONAL LEARNING (COIL)

SUNY has recently created the SUNY COIL center. The concept is to give students an international experience without the expense of a study abroad. COIL courses can range widely. One extreme is to have an online course where the students are from two different countries. The other extreme is to have two separate traditional classroom courses that are different topics but share a single unit and require students to work together in teams across nations. Either way, it gives students experience working across cultures and helps them realize their own cultural biases.

Currently COIL has primarily been used for courses in the humanities. However it seems that they should play a big part in future course development in the social sciences and seems like a natural fit for much of the work in Evolutionary Studies.

At Binghamton, we are looking into the possibility of a COIL course centered around Evolutionary Religious Studies. Michael Blume, a professor of Evolutionary Religious Studies in Germany, found it interesting that he is able to reach his German students about religion by discussing it in evolutionary terms. David Sloan Wilson, a distinguished professor of Biology and Anthropology in New York, found that he was able to reach many religious students about Evolution. We have also started to put some thought into a new Evolutionary Economics course.

For EvoS at Binghamton, the challenges include not being a department, and there by not having a simple and direct path to teach new courses.

To learn more about COIL go to coil.suny.edu.

ONLINE EDUCATION AS “DISRUPTIVE”

In considering how online education impacts traditional educational processes (and how this will impact the proposed EvoS online learning network) it is useful to consider the observations of Clayton Christensen. Commenting on the impact of online course and degree systems on higher learning, Christensen proposes that online education represents a “disruptive innovation” within the education “industry” (Christensen, Horn and Curtis, 2008). A disruptive innovation begins as a simple innovation to any traditional product or service that is initially unavailable to the majority of consumers due to rarity, high quality and high price. An innovation becomes disruptive when it becomes widely available to the majority of consumers. Disruptive innovations are then managed by either developing a new business model around the innovation or by simply plugging the disruptive innovation into an existing business model. In the latter situation, the existing model simply co-opts the innovation, and the innovation becomes a sustaining innovation. Christensen and Eyring (2011) suggest that the “disruption” of higher education by online education will need to be managed at levels above the individual institution, such as at the state level. The EvoS Online Project serves to manage the potential “disruption” both within the SUNY system as potentially at the higher level of the EvoS Consortium as a whole.

BENEFITS OF EVOS ONLINE

The proposed online EvoS program would serve to expand the reach of EvoS even farther beyond the traditional bounds of evolutionary sciences. By offering EvoS courses in an integrated online system, students would benefit from the diverse course options. This not only serves the goals of EvoS but the traditional goals of liberal arts education.

The EvoS Online program would allow for the development of innovative course structures united by the core EvoS curriculum. Examples of the variety of credit-bearing course offerings include:

- Traditional courses offered within distance learning formats.
- Short courses (6-8 weeks) designed around a specific topic area.
- Video speaker series courses developed on the discussion around a series of recorded talks by prominent academics.
- An online internship course designed to offer EvoS credit for individual internships.

An integrated online EvoS program would draw on a diverse body of potential instructors to serve the educational needs of an equally diverse student body. Although full time faculty would be encouraged to participate in the program, it is likely that a significant proportion of the online classes to be offered through the program would be taught by adjunct instructors. Current trends in higher education suggest that adjunct instructors will make up a significant proportion of teaching faculty in any future higher learning environment (Wilson, 2013). Adjunct instructors

are typically compensated per course, often with limitations on the amount of courses they are allowed to teach. In the case of traditional classroom based courses, this has the effect of severely limiting the earning potential for adjuncts, as well as curtailing any professional development activity (research, publications, etc.).

However, the proliferation of online education opportunities has allowed for technologically conversant individuals to teach for multiple institutions. These “mercenary adjuncts” have the potential for earning a living wage as well as utilizing the online format for conducting research within their individual disciplines (via online surveys and other test protocols). EvoS Online would serve to empower adjunct instructors within the EvoS Consortium to develop their own courses based on their individual subject expertise, as well as their own professional research goals. Courses would be evaluated for content and relevance to EvoS by a peer-review system of participating faculty, and any research programs integrated into these courses would be evaluated based on ethical standards for human subject studies.

Beyond the pedagogical benefits of an expanded online curriculum, the proliferation of online course offerings provides instructors with an expanded potential subject pool for research into cognitive and psychological factors relevant to instructor research interests. Traditionally, behavioral scientists have utilized American undergraduate student populations as a testing pool for various experimental and survey based data collection. This is true of the evolutionary behavioral sciences as well, including evolutionary psychology and (to a lesser extent) human behavioral ecology. However, this research program has recently been called into question by a series of papers critiquing the utility of such subject pools. In particular, the work of Joseph Heinrich, Steven J. Heine and Ara Norenzayan has called into question the applicability of student subject pools as sources of data regarding supposed human universals. Their critique is generally centered on two basic observations. First, the subject pool for the bulk of behavioral science studies consist not only of Western (and more likely, American) individuals, but of undergraduate students derived from particular majors. According to Heinrich et al. (2010), nearly 67% of American test subjects and 80% of test subjects from European countries are derived from psychology undergraduates. Heinrich et al. have coined the acronym “WEIRD” for the societies producing such a subject pool, which stands for “Western,” “Educated,” “Industrialized,” and “Democratic.” And although psychology remains a significant outlier in terms of utilizing undergraduate subject pools, Heinrich et al. note that researchers in economics are also active in developing similar subject pools. The second observation is that data derived from such student subject pools are often used to support hypothesis regarding human behavioral universals. In other words, studies proclaiming to illustrate human universals are based on data derived from entirely WEIRD populations. This assumes that the entire range of human behavioral variation is contained within a very small subset of the human species.

Online courses can serve as data gathering avenues for behavioral research with the above criticisms of survey research in mind. Two suggestions Heinrich et al. make in their analysis regarding data collection are for behavioral scientists to seek out diverse and inconvenient populations and to encourage cross-disciplinary

research. An active and prominent EvoS Online program can address both of these issues. EvoS is a multidisciplinary program by its very nature, and participant instructors (particular those previously engaged as student members) are familiar with at least one subject area distinct from their own. Regarding the diverse student population, the potential reach of online courses beyond the traditional boundaries of college settings addresses the limited range of previous testing protocols. Naturally, this reach is limited to individuals with access to the internet, which cannot completely address the previous critique. However, online courses have the potential to reach so-called non-traditional students who fall outside the standard parameters of traditional college students. This is particularly true for courses taught via community colleges, which often serve the educational needs of non-traditional learners.

Also, in spite of the numerous areas where WEIRD populations cannot be used for assessing human cultural universals, Heinrich et al. (2010) note that several aspect of human behavior appear to be universal. This suggests that student population surveying is useful within certain contexts, provided that appropriate care be given to delineate the limits of what such data can illuminate.

ELECTRONIC MEDIA BEYOND THE CLASSROOM

Beyond the scope of online education, one of the most significant online developments of the past decade has been the emergence of independent online media reflecting developments in the sciences and humanities. One such example is the scientific “blogosphere,” which has been shown to provide a vital, real-time peer-review and commentary on current events relevant to sciences and the academy. For example, the recent debate and controversy over the removal of the term “science” from the Long Range Plan of the American Anthropological Association was driven in large part by anthropology bloggers (Lende, 2010). This demonstrates the efficacy of the variety of electronic media formats available as vehicles for enhancing online education and for promoting research.

An example of an online medium developed within the rubric of EvoS is the Evolution: This View of Life (ETVOL) magazine. ETVOL magazine was founded in 2010 by Robert Kadar who, a graduate student of David Sloan Wilson. The purpose of the magazine is to bring the concept of EvoS to the general public in addition to the students and faculty at college and universities in the EvoS Consortium. ETVOL currently has 10 sections including Education, Economics, Health, Culture, Arts, Paleontology, Biology, Technology, Mind, Religion and soon Morality. Each section is updated with relevant aggregate news and reputable blogs, as well as original content.

The organizational structure of the magazine is volunteer-based. Each section has one to two editors. These editors are responsible for the original content in their section as well as editors notes to put aggregate popular science in context. Original content submissions from outside of the editorial board are forwarded to them. Based on the quality of the submission the editor may choose to publish it outright, work with the submitter, or reject the piece. They are also encouraged to interact with the comments posted on articles in their sections.

ETVOL can be used in several ways regarding the virtual classroom including watching interviews, requesting interviews, submitting original content, getting ideas for projects, and marketing. The website's YouTube channel has a growing collection of interviews with top evolutionists. These short videos can be woven into both online and traditional classroom assignments. If the specific content you are interested in isn't there, you can request interviews and submit specific questions to the managing editor.

ETVOL provides students and faculty following our magazine can see all of the latest research updates. This means that they can be debating and discussing the big discussions that are going on. Students have access to ideas and primary sources for current topics projects. The magazine can also be an effective recruiting tool for both students and instructors. As of November 2012, ETVOL had well over 20,000 twitter followers, nearly 10,000 Facebook likes, and over 80,000 YouTube video views. This illustrates the considerable reach of various social media and the potential for aggregator sites such as ETVOL to facilitate the goals of the EvoS Online Program.

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Evolutionary Medicine: The Impact of Evolutionary Theory on Research, Prevention, and Practice

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ABSTRACT

We review recent evidence for a growing number of discrepancies between our contemporary existence and evolutionary history which have the potential to impair and undermine features of human mental and physical health. Included in this review are health issues related to bottle feeding, caesarian section, infection, cleanliness, fever, exercise, diet, mate choice, contraception, semen sampling, and body odor suppression.

KEYWORDS

Postpartum Depression, Asthma, Autism, Immune Function, Mate Choice, Reproductive Outcomes

INTRODUCTION

Evolution is a gradual, incremental process operating over extended periods of time often measured in thousands or even millions of years. Unlike other life forms, the human species has managed to produce a variety of recent technological changes that have the potential to radically alter our environment and emancipate us from some of the conditions that gave rise to our existence. Although the impetus for some of these changes date back thousands of years (e.g., modifying pieces of stone to produce primitive tools), these technological developments have been increasing at an exponential rate over the past several hundred years. As a consequence, we have reached the point where some of these technological developments have outstripped our evolutionary capacity to keep pace and this is having adverse medical and psychological consequences.

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Evolutionary medicine is an attempt to identify and resolve some of these counterproductive mismatches between our evolved adaptations and different aspects of our contemporary existence. To illustrate the emerging discipline of evolutionary medicine, we selectively focus in this paper on a number of recent technological developments that have begun to undermine and interfere with our physical and/or psychological wellbeing.

BOTTLE FEEDING AND POSTPARTUM DEPRESSION

One of the defining features of the mammalian order, of which we are only one of over 3,000 species, is the capacity to produce milk to feed relatively helpless, parent dependent offspring. For most of human evolutionary history there were no alternatives to breastfeeding, and a decision not to breast feed would have been tantamount to committing infanticide. However, within the last hundred years the technology has emerged that now makes bottle-feeding an alternative to breastfeeding. As a consequence, women who lack the capacity to produce adequate breast milk or have to leave home to return to work often exercise the option of bottle-feeding their babies.

Bottle-feeding is a classic example of a technological development that has put us out of phase with our evolutionary past. Not only is formula a poor substitute for breast milk and may compromise the health of the infant (Heining & Dewey, 1996), but mothers who bottle feed may also be putting themselves at risk. For instance, the risk of becoming overweight (Chapman, 2009) as well as the risk of developing breast cancer (Stuebe, Willert, Xue, & Michels, 2009) is significantly higher among mothers who bottle-feed rather than breastfeed their infants.

For most of human evolutionary history the absence or sudden cessation of breastfeeding would have been occasioned by stillbirth or neonatal death, and therefore bottle feeding may unwittingly simulate child loss (Gallup, Pipitone, Carrone & Leadholm, 2010). Consistent with this hypothesis, the death of a child is a powerful trigger for depression (Suarez & Gallup, 1985), and there is growing evidence that bottle-feeding is a significant risk factor for postpartum depression. To make matters worse, women with postpartum depression who are treated with antidepressants are sometimes advised to discontinue breastfeeding because the medication may get into the mother's milk. Other hospital practices may also unwittingly simulate child loss, such as subjecting mothers to periods of separation from their infants as a result of keeping newborn babies in nurseries.

For mothers who want their babies to benefit from breast milk but have to return to work following the birth of a child, expressing breast milk that can be fed to the child by a caretaker with a bottle is a commonly employed option. In such instances, we would recommend mothers videotape breastfeeding episodes with their baby for playback while expressing milk at work, as a means of simulating breastfeeding and maintaining their bond with the baby to minimizing features of child loss.

BOTTLE FEEDING AND AUTISM

Not only does bottle-feeding create conditions that used to be associated with the death of an infant, bottle-feeding undermines natural birth spacing mechanisms. Breastfeeding produces hormonal changes that serve to promote lactational amenorrhea and anovulation. Both of these conditions evolved to reduce the likelihood of re-impregnation during the postpartum period and function to promote birth spacing. Pregnancy and lactation are very biologically and metabolically expensive, and therefore being re-impregnated while still nursing a young infant could seriously compromise the quality and quantity of milk for the existing child, as well as diminish the nutritional status of the prenatal environment for the developing fetus.

A recent paper in the journal *Pediatrics* (Cheslack-Postava, Liu & Bearman, 2011) reports that children conceived within a year of their next oldest sibling are three times more likely to develop autism, and those conceived within two years of their next oldest sibling are twice as likely to develop autism. We've argued that these peculiar birth order effects on the risk of autism may be a consequence of nutritional deficiencies in the prenatal environment that occur as a result of closely spaced pregnancies due to bottle feeding (Gallup & Hobbs, 2011). In other words, by disrupting natural birth spacing mechanisms the decision to bottle-feed your last child may make re-impregnation more likely during the postpartum period, and increase the risk of autism in your next child.

Research by Ronald et al. (2006), showing a high degree of concordance in the incidence of autism among both identical and fraternal twins, is consistent with this interpretation of birth spacing effects on the risk of autism based on prenatal environment deficiencies.

CAESARIAN SECTIONS AND ASTHMA

In much the same way that bottle feeding puts the mother out of phase with her evolutionary history, caesarian sections also preclude important aspects of the normal birth process. Caesarian sections were not an option during 99% of evolutionary history. Women who were incapable of delivering a child due to constraints on the size of the birth canal or other complications (such as a breech birth), would have died along with their unborn children.

Babies delivered nowadays by caesarian section not only have lower Apgar scores (as a measure of the infant's health and vitality), but they are at a higher risk of neonatal respiratory distress. These respiratory problems appear to be a consequence of the retention of amniotic fluid in the lungs that would otherwise have been purged from the lungs due to the compression that occurs during a normal vaginal delivery.

In later life, children delivered by caesarian section are also more likely to develop asthma. The connection between asthma and caesarian section appears to be due to the early absence of critical bacterial flora in the child's intestinal tract that promotes healthy immune system development (e.g., Azad et al., 2013). During a normal delivery, the baby is exposed to and ingests bacteria in the mother's vagina that serve to colonize critical parts of the infant's digestive tract,

which in turn stimulate the baby's immune system. The intestinal flora of babies that are bottle-fed also lack certain beneficial bacteria, suggesting that the skin around the mother's nipples contain bacteria that colonize the baby's intestinal tract as well. To make matters worse, women with caesarian sections sometimes delay breastfeeding or opt not to breastfeed at all. Moreover, mothers who undergo caesarian sections may be treated with antibiotics prior to surgery to minimize infections, which can have the unintended consequence of destroying many of these beneficial bacteria and interfering with the colonization process.

An obvious way to reinstate this natural immunization process in caesarian section babies would be to routinely harvest bacteria from the mother's vagina with a sponge, so that the baby could be bathed in the mother's vaginal fluid after delivery as an alternative means of initiating this colonization process.

SITES OF INFECTIONS

The skin is an important line of defense against infection. The easiest entry sites for infection are at the superficial level; cuts, scrapes, and scratches, typical innocuous injuries which create a pathway for microbes to enter the body. It is not surprising therefore that one of the most vital components of the human immune system is embedded immediately beneath the skin.

Recent research has shown that certain vaccinations administered at the subcutaneous level by scratching the skin are more effective than injecting vaccine into deep muscle tissue (Jiang et al., 2012). In fact, both circulating and skin T-cells are generated after skin infection. Having only circulating T-cells is not as effective for viral clearance, thus skin T-cells are superior when it comes to protection. In light of this evidence, novel methods of vaccination could be explored to increase effectiveness.

In the ancestral environment, humans were subjected to a wide variety of circumstances in which cuts and scrapes were common. It can be argued that exposure to viruses and various other microbes through these entry points tended to promote immune system function. Many of us are now removed from conditions where cuts and abrasions are a part of the norm, thus making ourselves more vulnerable to infections that may otherwise be tolerated. Furthermore, it is common practice to apply an antibiotic ointment immediately after such an injury, thus limiting exposure and perhaps doing ourselves a disservice, particularly during development.

CLEANLINESS

It has long been thought, and recent evidence supports the notion that the mammalian host is most sensitive to initial exposure of microbes during neonatal life (Olszak et al., 2012). In modern society, where cleanliness is viewed as next to Godliness, it is common practice to protect children from dirt and germs. Although hand-washing is one of the most important prophylactic measures in medicine, it may be counter-productive to prevent children from getting "down and dirty" and being exposed to many common germs.

A healthy immune system requires challenges, as evidenced by vaccinations. Children who are raised in protected, relatively germ-free environments, have inferior, compromised immune systems and are susceptible to autoimmune diseases (Olszak et al., 2012). The lungs and colon are sites where microbial contact is common. Research shows that asthma and inflammatory bowel disease, both immune mediated conditions, are more common in humans who have not had early-life microbial exposure. Other things being equal, exposing children to germs that will challenge their immune system should lead to greater overall health.

Certainly, the Environment of Evolutionary Adaptedness (EEA) provided the conditions for such challenges. In a time when hypoallergenic pillows, antibiotics, and hand soap didn't exist, germs were still ubiquitous. There were numerous threats that faced a new-born, and it is likely that many did not survive into adulthood. However, the evidence shows that these children may have had a better chance of warding off infection than modern children. Therefore, keeping kids protected in an artificial environment is ironically detrimental to their health. Again, we see that the consequences of removing ourselves from a habitat that gave rise to our existence can be counterproductive. This very simple notion is absent in much of medical practice, where the treatment of symptoms is a primary objective, and prevention is often secondary.

FEVER

A paper in the journal *Surgical Infections* (Schulman et al., 2005), dispels the paradigm of antipyretic therapy (treating fever) commonly employed for critically ill patients with fever, by reporting an increase in morbidity and infection in subjects who underwent aggressive treatment as compared to those who voluntarily did not. In extreme cases, fever can be fatal. However, a low-grade fever is often beneficial and acts as an evolved defense mechanism for fighting infection. With the advent of pharmacological interventions such as acetaminophen and cooling blankets, we are preventing the body from carrying out a natural convalescent function. Furthermore, these interventions can have deleterious side effects such as liver damage and may also lead to adverse interactions with other medications. The upshot of symptom relief is a suppression of anti-body and cytokine production, and the release from inhibition of microbial growth.

The rationale of antipyretic therapy is largely unfounded. The common justification of such measures include: the comfort of the patient, lower cardiovascular stress and an avoidance of increased oxygen consumption (Schulman et al., 2005). There is, however, a lack of evidence to support the use of antipyretic therapy for these indications. Medical practice and research could benefit from seeing this condition through an evolutionary lens. Infections being a mainstay of life, it stands to reason that evolution would select for a biological function that promotes the elimination of such a threat. When it comes to fever, physicians may want to employ a counter-intuitive, but simple philosophy of "don't just do something, stand there."

IMPORTANCE OF EXERCISE AND DIET

For most of human evolution, frequent and intense physical activity was an essential feature of life because of the rigors of survival. Hunting, gathering food, finding water, evading predators, and building shelter was undoubtedly a time consuming and taxing process. Drought, illness, failed hunts, and a variety of other issues would often interfere with the ability to collect food. Individuals were more likely to survive periods without food if they had genes that provided for efficient conservation of glycogen and depositing/storing fat during times when food was plentiful (Chakravarthy & Booth, 2004). Under these conditions, individuals were selected for their ability to effectively cycle between physical activity and rest, as well as between feast and famine. However, aspects of Western society have replaced the need for physical activity and the occurrence and duration of famine is far less frequent. As a result of mechanization and modern agriculture, individuals now have access to large amounts of processed food with little activity or exertion needed to obtain it. On a daily basis, it is estimated that individuals with sedentary lifestyles use 1,200 less calories than hunter-gatherers (Chakravarthy & Booth, 2004). Technology has also brought about greater opportunities for leisure, such as television and artificial lighting, which contribute to inactivity and overeating. Pairing inactivity with diets containing excessive amounts of fat and a variety of foods our bodies haven't evolved to process, has put us out of phase with the lion's share of our evolutionary history and has proven hazardous to our health.

Artificial illumination has made it possible for humans to stay awake long after the sun has set, making sleep deprivation a common phenomenon. Sleep deprivation increases hunger and appetite (Siervo, Wells & Cizza, 2009). Fatigue caused by sleep deprivation may also decrease motivation to exercise. Light plays an important role in the circadian clock that regulates the timing of eating and sleeping. Low levels of light present during the night are enough to disrupt the circadian rhythm. This disrupts metabolism and feeding behaviors and may result in excessive weight gain (Fonken et al., 2010).

Other types of technology driven by an emphasis on leisure and entertainment, such as computers and television, provide people with distractions while they eat. These distractions can also interfere with neural satiety signals and result in increased food intake (Siervo et al., 2009). Many food advertisements alter emotional responses to food and are designed to increase its reward value, exacerbating cravings. Often typical work environments are associated with chronic stress caused by a lack of power and a low reward/effort ratio. Chronic stress has also been shown to increase the reward value of food, which can lead to overeating and obesity (Siervo et al., 2009). Nowadays food is easily accessible and many individuals are able to indulge in their increased desire to eat. Modern technology in the Western World has created the equivalent of a continuous feast. Human digestion and metabolism did not evolve to deal with chronic overeating.

The agricultural revolution has further changed human eating habits by introducing saturated fats, cereal grains, and large amounts of sugar and salt into the modern diet. Our ancestors rarely, if ever, encountered such foods. It is problematic that many individuals today rely on these foods as a main source of nutrition. Not only are they a poor source of fiber and vitamins, many also contain

high concentrations of saturated fat. Meat harvested from domestic animals has about six times more saturated fat than meat from wild game (Chauveau, Fouque, Combe & Aparicio, 2013). Diets high in saturated fat are associated with impairments in episodic memory, attention, and inhibition (Francis & Stevenson, 2013). High saturated fat diets may increase the risk of developing Alzheimer's disease and Parkinson's disease (Francis & Stevenson, 2013). Diets high in cereal grains and simple sugars frequently increase inflammation and insulin sensitivity, which puts individuals at risk for Type 2 Diabetes (Jönsson et al., 2009). Various studies have found that eating lean meat, fish, nuts, eggs, fresh fruits, and vegetables while avoiding grains, dairy, and legumes leads to healthier weight, blood pressure, and cholesterol (Chauveau et al., 2013). It is advisable to eat a diet that's in sync with our evolutionary history.

Advances in industrialization have made it unnecessary for many individuals to engage in hard labor in order to procure food or build shelter. Instead, more and more people have "desk jobs" that involve sitting for long hours at a time. Physical inactivity gives rise to a variety of problems. Inactivity can cause accumulation of abdominal fat and activation of inflammation pathways that result in insulin resistance, thickened artery walls, neurodegeneration, and tumor growth (Pederson, 2009). These health issues can lead to Type 2 diabetes, cardiovascular diseases, colon cancer, breast cancer, dementia, and depression (Pederson, 2009). Hunter-gatherer societies have a much lower prevalence of these types of diseases (Chakravarthy & Booth, 2004). A sedentary lifestyle is associated with dangerous health risks. Just the amount of time spent sitting increases the risk of premature death (Patel et al., 2010), and there is growing evidence that exercise can reduce the effects of age related cognitive impairment and dementia (Heyn, Abreu & Ottenbacher, 2004).

Because the demands of survival put a premium on physical labor during our evolutionary history, it was natural that when such rare opportunities arose people would indulge in rest and relaxation to recuperate and conserve energy for the next exhausting task. However, relaxation should be taken in moderation because the effects of inactivity set in quickly. Healthy humans show prediabetic symptoms within 3 days of bed rest, and athletes show prediabetic symptoms after 10 ten days without exercising (Chakravarthy & Booth, 2004). Reducing food intake and increasing physical activity on a long-term basis can reduce the over activation of inflammation pathways. The inclusion of at least 3 hours of moderate exercise per week leads to a 30% reduction in stroke, Type 2 diabetes, and heart disease (Chakravarthy & Booth, 2004).

MATE CHOICE

Humans have created an environment in which natural mate choice mechanisms may not always operate effectively or appropriately. Hormonal contraceptives (e.g., birth control pills), condoms, and body odor suppression strategies are three contemporary practices that may undermine informed mate choices. By restricting the exchange of biological information, feelings of attraction may not be driven by evolved mechanisms that take into account actual health cues

or compatibility signals, which can in turn lead to less than optimal, imperfect mate choices.

Hormonal Contraceptives

While hormonal contraception is an effective means of reducing the risk of unwanted pregnancy, it also eliminates natural hormonal fluctuations due to the menstrual cycle that function to promote informed mate choices and signal fertility to possible mates. A naturally cycling female experiences heightened olfactory sensitivity when she is ovulating, which activates mechanisms that enable her to unwittingly gauge the MHC compatibility of a potential mate, as well as body odor cues that signal important variation in a male's fluctuating asymmetry. Ovulating females find the body odor of males with compatible MHC and low fluctuating asymmetry to be more attractive than that of an incompatible male (Thornhill & Gangestad, 1999).

Birth control effectively suppresses a female's ability to detect these cues during the ovulatory phase of the menstrual cycle. This poses problems in two ways. First, if she develops a pair bond with a male while on birth control, and later discontinues using hormonal contraceptives, she may find herself no longer attracted to her committed partner (Roberts et al., 2012). Secondly, if she becomes pregnant with that male, it could compromise the health and genetic viability of her offspring.

While a female's choice in mates has important consequences for her reproductive success, she must also present herself as a desirable mate in order to attract a high quality male. Hormonal contraceptives interfere with this aspect of competition for high quality males, as they lower the female's voice, face, body configuration and odor attractiveness, as well as raise her fluctuating asymmetry. They also eliminate the natural fluctuations in attractiveness during the menstrual cycle that make females appear most attractive when they are ovulating. Miller, Tybur, and Jordan (2007), for example, showed that lap dancers who use hormonal contraceptives earn significantly less than naturally cycling females who are not menstruating. Furthermore, hormonal contraceptives have many unintended side effects, such as a lower quality of vaginal lubrication and an increased risk of contracting STDs, due to a change in vaginal acidity. Most of these side effects are not discussed with patients before they decide to use hormonal contraceptives, and it is important to further examine such effects, as well as inform prospective users of the potential costs.

Semen Sampling

The use of condoms may also interfere with a female's assessment of mate compatibility. Much like appearance, body morphology, and odor can be used to index health, fertility, and compatibility, the chemical composition of semen may also contain cues to fitness. A particular male's unique semen signature (Davis & Gallup, 2006) contains information which might allow a female to assess the compatibility of the pairing (Gallup & Atkinson, 2012). Semen sampling was likely an inherent feature of courtship and mate choice during human evolution. A kiss between two

genetically incompatible people may lead to feelings of disengagement and lack of interest (Hughes, Harrison, & Gallup, 2007). It is possible that insemination results in the activation of parallel mechanisms that could lead to feelings of regret the next morning if the pairing was not a good match.

While condoms are effective at reducing unwanted pregnancies and STDs, they mitigate semen exposure, which prevents semen sampling and may impair informed mate choices. The advent of condoms could lead to consequences similar to hormonal contraceptives; e.g., a lack of or change in attraction if the male chooses to stop using condoms, and a higher likelihood of genetically disadvantaged offspring. If true, such information could enable people to make more informed cost-benefit analyses when deciding whether to use condoms.

Odor Suppression

There is a vast array of female cosmetic products and procedures to make women more attractive so that they appear to be more reproductively viable and have better genes. These cosmetics function to mask cues of aging and exaggerate the appearance of being reproductively viable. However, in the name of hygiene and odor suppression, females also often deodorize and remove underarm and pubic hair, which may unwittingly mask, alter, or eliminate important reproductive and mate quality odor cues. The removal of these specialized hair follicles prevents them from collecting and diffusing such cues. We may differentially perceive the attractiveness of a person's scent based on reproductively relevant information, whereas if someone smells appealing based on artificial, superimposed external odor sources, we once again may be impaired in terms of our ability to make informed mate choices. The invention of razors and deodorants is yet another way in which we have put ourselves out of phase with our evolutionary past, which leaves us in a position of having to contend with greater ambiguity when it comes to selecting a proper mate.

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Evolutionarily Informed Research: The Future of Health & Fitness

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ABSTRACT

Looking at our evolutionary past has the potential to inform and improve various facets of human life including areas in health, physical fitness, and nutrition from an evolutionary perspective. We argue that doing so would logically aid the fields of anthropology, biology, kinesiology, holistic sciences, nutrition, psychology, and exercise science, just to name a few. Specifically, we focus on the implications of shifting our paradigm from quantity of food and exercise to quality of such things. Implementing an evolutionarily informed approach, thus reducing the mismatch between our biology and technology, can do this.

KEYWORDS

Mismatch Theory, Evolutionarily Informed, Health, Fitness

INTRODUCTION

Human health, wellness, fitness, and nutrition are popular topics in science and medicine. Although science has devoted a considerable amount of time and resources to these areas of research, there are still widely varying opinions, "facts" and trends that circulate among the academic community, as well as the general lay public. In many ways, just like in other facets of life, history also has a way of repeating itself. A good example of this is the parallel between the physical culture movement of the late 19th/early 20th century and the ancestral health movement currently upon us (Stapell, 2013). During the physical culture movement, the focus turned to healthy eating as fuel for the body, as well as the benefits of plenty of regular physical activity. The physical culture movement also specifically addressed the place that regular weight-bearing exercise had within a well-rounded physical fitness regimen. Since that time, several fitness and diet fads have come and gone.

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Similar trends and parallels to previous eras may be seen among these areas of the academic and scientific community. For example, the ancestral health movement, which takes a holistic approach, encompasses diet as well as concern for modern stressors on hormones, circadian rhythms, and interpersonal relationships. Taken as a complete package, the ancestral health movement attempts to rectify modern ailments of the body and mind by looking to our primal ancestors as a model. Support for some of the claims that are central to this movement can be found by looking at cultures that have been sheltered from many of the modern conveniences that those of us in developed societies enjoy, such as electronic technology and processed foods. We argue that in order to make progress and avoid the constant regurgitation of information among the scientific and academic community, we actually need to look to the past, and incorporate a broader, multi-disciplinary approach to the study of human health and physical fitness. Specifically by incorporating evolutionary theory, may be the answer.

MISMATCH THEORY

Biological evolution happens at a much slower rate than does our agricultural or industrial evolution. As a result, human genes and human lifestyles become incongruent from one another (Eaton & Eaton, 2003). Rapid technological and cultural changes over the past several hundred years have outpaced human genetic adaptations, and thus created a mismatch between our genome and our environment (Platek et al., 2011). This idea is the basis of mismatch theory, which asserts that our external environment has advanced at a much quicker pace than our biological makeup, thus creating a gap (mismatch) between what our bodies are adapted for and how we currently live. In other words, all of these highly convenient, but evolutionarily disruptive, conveniences create a mismatch between the traits that were preserved throughout evolution due to adaptive purposes in the Environment of Evolutionary Adaptedness (EEA), but are no longer matched with how we utilize them in our current environment (O’Keefe & Cordain, 2004).

Oftentimes mismatch theory is applied to reproductive success or genetic fitness, such as in the case of hormonal contraception. However, other mismatches are also important. For example, lack of functional physical movement and a diet rich in whole foods has perhaps had less impact on reproductive maladaptation, as it has on overall human physical and mental health. In response to increased awareness of the mismatch between ancestral living and physical activity as opposed to our modern day health and exercise choices, greater attention has been recently given to factors influencing a healthy lifestyle. Results of this include the emergence of evolutionarily informed dietary plans (such as the “paleo diet” and “primal eating”) and fitness training programs (such as CrossFit and MoveNat) that emphasize a holistic approach to eating “clean” and performing functional, whole-body activities that more closely mimic the movement patterns of our ancestors.

In the Pleistocene, it was necessary for our ancestors to be physically active, in order to obtain food, shelter, and safety, as well as protect mates and offspring. Comparatively, the industrial and agricultural revolution have provided modern, westernized societies with an abundance of processed food choices that don’t need to be hunted down, manually butchered, and protected from predators. Rather than

trekking long distances over varied terrain, lifting, digging, pulling, and pushing as was necessitated by these ancestral times, we now use treadmills, recumbent bikes, and muscle isolation machines if we want to exercise our heart, lungs, and muscles. Many of our modern physical fitness regimens include this machine-based, muscle isolation work and long steady state cardio. This does not parallel those activities of our ancestors, who performed a combination of high-intensity activity (sprinting, throwing) and longer, lower-intensity movements (hiking, carrying). In the EEA, physical effort was necessary, but unwise or inefficient energy expenditure would have compromised the likelihood of survival and reproduction (Platek et al., 2011). Likewise, food was consumed for energy and survival. The myriad of processed convenience foods industrialized societies now enjoy are far removed from the sources of fuel our bodies were made to rely on.

ANCESTRAL ACTIVITY VS. MODERN ACTIVITY

Physical fitness of our ancestors was comprised of a large amount of daily light to moderate activity such as walking and some periods of interval-style, high intensity work, all of which were conducted outside in nature, recruited both the musculature and cardiovascular system, and included weight-bearing, strength and flexibility building movements with plenty of rest periods built in (O’Keefe et al., 2010). A classic example is short bouts of running after prey (cardiovascular endurance), explosively throwing a spear into it (strength, power, accuracy), not getting killed in the process (reaction time), gathering wood/supplies and deep squatting whilst lighting a fire and cooking the meat. These movements are still basic, fundamental parts of our movement pattern and are beneficial for the health of our muscles, joints and ligaments.

Currently, the majority of individuals in industrialized societies sit for large portions of the day, but not in the deep squat position, our ancestors sat in. We have toilets, chairs, recliners and ergonomic workstations. All of these highly convenient but evolutionarily disruptive characteristics create a mismatch between the traits that were preserved throughout evolution due to adaptive purposes in the EEA, such as eating solely as a fuel for physical activity, but are no longer matched with how they are utilized in our current environment (O’Keefe & Cordain, 2004). Today, we see a much greater prevalence of diseases of modernity, many related to obesity and sedentary lifestyles (O’Keefe et al., 2010). However, the innate physical capabilities and requirements of our ancestors are essentially the same for us in modern times.

Forencich (2012) provides physical evidence to support the assertion that our embodied cognition and kinetic intelligence are slowly being diminished by technology, stress, modern disease, convenience, and general laziness. In fact, our bodies are not well adapted to physical inactivity, which reduces the natural functioning that regular physical activity-induced stress provides. Anthropological data suggest that our male and female ancestors had greater bone density and muscle mass than modern humans. Our ancestors were likely more robust in both muscularity and stamina than modern humans; this pattern holds constant whether the population studied underwent agricultural revolution 10,000 or 1,000 years ago (Eaton, Konner & Shostak, 1988; Forencich, 2012). This suggests that despite the longer hours of labor agriculturist societies have endured, the intermittent intense

physical activity of our primal ancestors actually produced better muscularity and endurance capacity. Although we have gyms and fitness facilities that promote a healthy lifestyle through developing cardiovascular and muscle training activities, our current society is plagued with diseases of modernity such as heart disease, diabetes and obesity (O'Keefe, Vogel, Lavie & Cordain, 2010). Recently, ancestral-inspired fitness programs like CrossFit have begun to bring natural, functional movements to modern humans. These types of workouts, and CrossFit specifically, provide the constantly varied movement patterns and a combination of short, high-intensity and longer, low-intensity training that more closely resembles the types of physical activity of our ancestors. We argue that the quality rather than quantity, of exercise is the important factor when combating modern diseases.

EVOLUTIONARILY INFORMED HEALTH AND REPRODUCTIVE FITNESS

Literature suggests physical wellness and evolutionary fitness go hand in hand (Platek et al., 2011). Evolutionary fitness, or the ability to survive and reproduce with traits recurring into future generations, is thus logically aided by superior physical fitness. Modern medicine has provided advancements that allow almost anyone to have a child, and for the majority of these children, even those with congenital diseases, to make it to reproductive age. However, attracting and selecting mates continues to have some traditional roots, including a preference for physical features that more closely resemble those of the ancestral male/female. Selection favors indicators of reproductive fitness in order to have the best chance of reproduction and gene perpetuation. According to Platek (2010), the movements that were necessary for our ancestors and were adaptive throughout our evolutionary history may also be the ones that help us achieve the physical attributes that attract mates (e.g. optimal waist to hip ratio/shoulder to waist ratio). General Physical Preparedness (GPP) refers to broad programming that increases work capacity and produces the ability to be prepared for any physical task. This is opposed to specific physical preparedness (SPP), which focuses on becoming excellent in one domain. GPP does not focus on becoming excellent at any one aspect/sport/movement but instead being overall conditioned, strong, fast, and flexible. Ancestral-style exercise programming utilizes the motor recruitment patterns to produce both GPP and, possibly optimal mate-worthy bodies (Platek, 2010). Although outside the scope of this paper, we suggest that adopting an ancestral-inspired fitness regimen may not only help produce choice mates but promote healthy pregnancies and offspring as well.

ANCESTRAL HEALTH AND DIET

In terms of food, paleo-style eating is, at its heart, less about emulating the exact foods of our ancestors (saber tooth tiger is hard to come by) and more about emulating the metabolic state and physiological reactions to the food that we consume. Although much of the modern movement toward a paleo-style diet has become simplified as a prescription to eat copious amounts of meat and vegetables, little dairy, sugar, alcohol, and grains, the dietary choices of our Paleolithic ancestors varied greatly by physical location and season. The greatest premise of a

modern primal eating plan should, then, reflect local, seasonal whole foods over those that are mass-produced, processed, or genetically modified. Further, research suggests that ancestral diets consisted of approximately 33% protein, 46% carbohydrates, and 21% fat (Eaton, Konner & Shostak, 1988). Current Western diets typically display higher fat and carbohydrate levels, with much lower protein consumption. Anthropological data leads us to believe that consumption of whole, unprocessed foods also allowed for appropriate and adequate vitamin and mineral consumption/absorption, clearly without the engineered pseudo-vitamins and additives of modern times. In fact, Paleolithic hunter-gatherers typically consumed 1,500-2,000 mg of calcium per day (as compared to the estimated 740 mg consumed by industrialized nations) without having dairy sources as we do today (Eaton et al., 1988). Based on this data, we could deduce that consuming unprocessed, seasonally available foods could also assist in supporting the reduction of modern health complications. Finally, we once again suggest that shifting our focus from quantity to quality will greatly improve the results of dietary choices.

ANCESTRAL HEALTH AND SOCIETAL IMPLICATIONS

Human longevity and survival rate has increased dramatically since Paleolithic times, leading some to believe that we have adapted to this lifestyle. While modern medicine allows for the treatment of injury and disease, this should not be confused with a genetic adaptation to modern times. Improved sanitation, housing, and medical care have provided protection from infection, trauma, and predation, all chief causes of death in the Paleolithic era. While life expectancy is now more than double that of our ancestors, modern humans have plenty to be concerned about. Chronic degenerative and modern diseases such as diabetes/insulin resistance, bone density loss, chronic stress, some cancers, and hypertension appear to be a product of our modern environment (Eaton, et al., 1988). To this end, some researchers may argue that examining ancestral health and wellness is of the utmost importance. To some in this field, "fitness," in the traditional sense of the word, may have little to do with our activity levels or diet and more about reproductive success. However, to others, it is equally relevant as the study of reproductive fitness, which has been possibly the most commonly known evolutionary topic in academia. We argue that these two topics may go hand in hand.

EVOLUTIONARY INFORMED HEALTH ACROSS DISCIPLINES

Overall, health and wellness research may be better supported through incorporating evolutionary theory and practice. In order to reduce the mismatch between our modern lifestyle and ancestral history, we believe that individuals would be better able to tailor exercise programs and dietary choices to decrease the incidence of injury and illness. A general set of guidelines providing a framework by which to evaluate one's own program, or that of clients/patients for those in sports, exercise and medical related fields, can help to reduce this mismatch. For example,

the information gained through evolutionary research may help a long-distance runner evaluate his or her training program by comparing it to a basic set of “primal” criteria, such as incorporating short bursts of high-intensity sprints more often, longer, slow activity more often such as hiking, or functional strength such as pushing, pulling, throwing, and squatting. This is but one example. However, not only physical benefits abound. Aspects of human emotion, cognitive functioning, and overall mental health have been associated with and may benefit from following ancestral principles.

Despite the growing abundance of scholarly information available regarding the benefits of incorporating an evolutionary approach into our daily lives, we have yet to see extensive collaboration between evolutionary scientists and other traditional fields of study. However, this is growing through the work of some cross-discipline researchers such as Robb Wolf, as well as work presented at the Ancestral Health Symposium, Evolutionary Studies (EvoS) Summit, the NorthEastern Evolutionary Psychology Society (NEEPS) and the EvoS Consortium. We argue that by also considering ancestral health and nutrition into the bigger picture of medicine, exercise science, mental health counseling, etc., academia is better able to account and control for modern diseases; ones which also may not only affect individual health, but also extend to public health. Doing so also supports a traditional evolutionary focus of attracting and/or selecting a mate, and successfully (healthfully) reproducing. By approaching this from a multi-disciplinary perspective, rather than simply a medical perspective, reliance on one’s natural awareness may be restored. We argue that studying human health, physical fitness, and nutrition from an evolutionary perspective would logically aid the fields of anthropology, biology, kinesiology, holistic sciences, nutrition, psychology, and exercise science. Collaboration among academics in these fields, allow for a greater breadth and depth of research, knowledge procurement and proliferation. By combining the insight that we gain in the EvoS program, a well-rounded examination of these topics results in, and provides support for healthier ways of living. We believe that a comprehensive approach to health and wellness should be multi-disciplinary, and broad in scope, including science and humanities with range and complexity that supports and promotes the greatest amount of knowledge and collaboration. This may be achieved through channels such as the EvoS Consortium, Ancestral Health Symposium, and EvoS publications such as this.

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Make Peter Kropotkin the Poster Boy for EvoS

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First, a disclaimer. I had the privilege of having David Sloan Wilson as my Ph.D. mentor (1988-1991), so I can hardly claim to be neutral on anything dealing with EvoS. True, there was no EvoS when I studied under David, but the idea was clearly gestating under various different guises in his brain. It would creep out now and again, and sometimes it seemed that David had to fight it back because there were so many other things he was working on at the same time.

Of all the EvoS-to-be-related things that David taught me—and that list is a long one—perhaps the one I cherish most is that everything can be studied from an evolutionary perspective. Everything. The trick is to be unremittingly curious, intellectually brave, know everything about the subject, and then figure out how to ask the question in the proper way.

David is the heart and soul of EvoS. But, everyone who knows EvoS knows that. Here, I am going to make a pitch that EvoS should adopt a less known, but equally brilliant, person as their poster boy. That person is Russian evolutionary biologist, geologist and anarchist agitator, Prince Peter Kropotkin.

Kropotkin's life was the stuff of movies, but space doesn't allow too much on that front here (Dugatkin, 2011; Kropotkin, 1899b; Miller, 1976; Woodcock & Avakumovic, 1950). Born in The Old Equerries Quarter of Moscow on December 21, 1842, into a family of demi-nobles, Kropotkin renounced his title as Prince, and as a teenager became fascinated by the political theory of anarchy. The Czar, however, was not so enamored with anarchist ideas. What makes that rather obvious statement relevant is that teenager Peter Kropotkin happened to be the Chief Page to Czar Alexander II when his burgeoning interest in anarchist ideas became something of an obsession, albeit one that he kept secret from his boss. At the very same time, Kropotkin's brother, Sasha, began telling young Peter about a new idea floating around intellectual circles in Moscow—a theory of change that a Brit named Charles Robert Darwin wrote about in 1859. Peter quickly had two passions – anarchist philosophy and evolutionary biology.

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When he finished his stint as Page to Czar Alexander II, Peter set off on a five-year natural history expedition in the Amur region of Siberia. In what amounted to a colder and more challenging Russian version of *The Voyage of the Beagle*, Kropotkin became immersed in the study of evolutionary biology. He went to Siberia a staunch Darwinist and left there the same way. But when he left he was a new kind of Darwinist. One who would argue that competition was not the only possible outcome of the process of natural selection. Instead, Kropotkin, following in the footsteps of other Russian School evolutionists (such as Karl Fedorovich Kessler) argued that natural selection could, and often did, favor what he called “mutual aid” (Todes, 1989)—what today we would call altruism and cooperation.

During his five years in Siberia, Kropotkin criss-crossed that vast area many times—a rough estimate would log him at about 50,000 miles total—often on dog-sled, and far too often when the temperature was brutally cold. “Lying full length in the sled...wrapped in fur blankets, fur inside and fur outside,” Kropotkin noted in his journal, “... temperature is forty or sixty degrees below zero, Fahrenheit” (1899b, p. 198). Over and over again, wherever he went, what he saw, or at the very least, what he thought he saw, were organisms displaying mutual aid.

Animals formed tightly knit groups, huddling for warmth. They gathered food and shared it, and they took turns on sentinel duty, guarding others from danger. “Wherever I saw animal life in abundance,” he wrote “... on the lakes where scores of species and millions of individuals came together to rear their progeny; in the colonies of rodents; in the migrations of birds which took place at that time on a truly American scale along the Usuri; and especially in a migration of fallow-deer which I witnessed on the Amúr, and during which scores of thousands of these intelligent animals came together from an immense territory...in all these scenes of animal life which passed before my eyes, I saw mutual aid and mutual support carried on” (Kropotkin, 1902, p. xxxiv-xxxv).

And it wasn't only in nonhumans that Kropotkin observed mutual aid. The constructive work of the unknown masses,” Kropotkin noted, “which so seldom finds any mention in books...the importance of that constructive work in the growth of forms of society, fully appeared before my eyes...to see the immense advantages which {these communities} got from their semi-communistic brotherly organization, and to realize what a wonderful success their colonization was, amidst all the failures of state colonization, was learning something which cannot be learned from books” (Kropotkin, 1899b, p. 216).

Kropotkin was clearly obsessed with mutual aid. I know the feeling. And Kropotkin was a brilliant and fascinating character who was instrumental, if overlooked, in the early history of evolutionary biology. But, history is full of such characters. Why make Kropotkin the poster boy for EvoS? I'll devote the remainder of this essay to answering that question, but I'll do so with the caveat that I am only touching here on the tip of the iceberg.

KROPOTKIN WAS THE QUINTESSENTIAL INTERDISCIPLINARY THINKER

As is the case for work in EvoS today, Kropotkin's interdisciplinary approach was rooted in concept: the concept that evolutionary forces explain the diversity of form and function we see around us in everything from microbes to humans.

Kropotkin's mastery of what at first appear to be disparate subjects, but form an integrated whole when viewed through the lens of evolutionary change, was nothing short of mindboggling. He wrote books (or long pamphlets that amounted to books), and was widely considered one of the leading experts on such varied topics as: evolution and behavior, ethics, the geography of Asia, anarchism, socialism and communism, penal systems, the coming industrial revolution in the East, the French Revolution, and the state of Russian literature (Kropotkin, 1898, 1899a, 1903, 1905, 1908, 1909, 1924).

All of these publications, either directly or indirectly, relied on Kropotkin's evolutionarily-derived ideas on mutual aid. In his writings on geography, for example, Peter told his reader that in a world of droughts, freezing temperatures, hurricanes and volcanic eruptions, mutual aid was a must for survival. Geography, he wrote, "teaches us, from our earliest childhood, that we are all brethren, whatever our nationality...that whatever the wars they have fought, mere short-sighted egotism was at the bottom of them all." (Kropotkin, 1885, p. 942). In his book *In Russian and French Prisons*, he used mutual aid theory to defend his claims that prisons were ineffective and eventually would be seen as barbaric relics of the past. Then in his essay *Prisons and their Moral Influences on Prisoners*, he noted, "Antisocial acts, need not be feared in a society of equals...all of whom have acquired a healthy education and the habit of mutually aiding one another."

So enamored was Kropotkin with mutual aid's seemingly unlimited reach, that he eventually spoke of the *scientific* law of mutual aid, which guided the evolution of *all* life on earth. Mutual aid was, he said "of the greatest importance for the maintenance of life, the preservation of each species, and its further evolution" (Kropotkin, 1902, p. xxxv).

KROPOTKIN COULD LOOK FOR ONE THING, BUT FIND ANOTHER

EvoS touches on many broad, conceptually deep topics, and does so in new ways. As with all science, but especially with cutting-edge science like EvoS, initial hypotheses have to be rejected and new ones developed and defined. Kropotkin did so on a regular basis, but never more dramatically than when he first started to study social behavior in the frozen Tundra of Siberia. "I failed to find, although I was eagerly looking for it," Kropotkin noted, "that bitter struggle for the means of existence, among animals belonging to the same species, which was considered by most Darwinists (though not always by Darwin himself) as the dominant characteristic of the struggle for life, and the main factor of evolution." Kropotkin was stunned. Instead, it was "the struggle for existence which most species of animals have to carry on [is] against an inclement Nature" (Kropotkin, 1902). That struggle led directly to mutual aid *among* individuals.

By positing that mutual aid, not competition, was the primary outcome of natural selection, Kropotkin was bucking the strongly held, primarily British, view of the day that competition was the sine qua non when discussing the process of natural selection. From that point on, Kropotkin was always suspect of ideas that reeked of what he perceived as dogma. That skepticism, however, was not without its costs, as much later in his life, Kropotkin rejected Weisman's experiments on the inheritance of acquired traits (he thought these experiments were accepted

dogmatically by British scientists), and clung to Lamarckian inheritance, leading him down a torturous path of misguided predictions. As a case in point: Kropotkin argued that mutual aid evolved much more quickly than might be expected if natural selection was the only driver of the process. But, Lamarckian inheritance provided Kropotkin an evolutionary theory that fit his observations on how quickly he thought mutual aid developed in humans and animals. He was wrong. At least with respect to animals.

KROPOTKIN EMBRACED THE IDEA OF APPLYING THE SAME CONCEPTUAL (EVOLUTIONARY) FRAMEWORK TO BOTH HUMANS AND NONHUMANS

Nothing, I would argue, could be more Darwinian and EvoSian than same conceptual, evolutionary framework to both humans and nonhumans. The easiest way to convey this aspect of Kropotkin's thinking is to list the titles of the chapters in his book *Mutual Aid*: "Mutual Aid in Animals," "Mutual Aid among Savages," "Mutual Aid among Barbarians," "Mutual Aid in the Medieval City," and "Mutual Aid among Ourselves." But the continuity between humans and other organisms ran deeper than just animals: "We must be prepared to learn some day," Kropotkin wrote, "from the students of microscopical [sic] pond-life, facts of unconscious mutual support, even from the life of micro-organisms" (Kropotkin, 1902). It would be fascinating to know what Kropotkin would have thought of all the recent work done on microbial altruism (Cordero et al., 2012; Li & Purugganan, 2011; Raymond, West, Griffin, & Bonsall, 2012; West, Griffin, Gardner, & Diggle, 2006).

KROPOTKIN UNDERSTOOD THE IMPORTANCE OF OUTREACH

Outreach, be it to the undergraduate population, or to the general population at large, plays a role in all EvoS programs. Lip service is not sufficient: a concerted effort to bring ideas to people, and in turn, suggest how those ideas can be put into practice, is fundamental to EvoS. Here again, EvoS could hardly find a better poster boy than Kropotkin. He would talk to *anyone, anywhere* about his ideas on both science and politics. When Kropotkin was young, such conversations tended to take place in coffee shops and the like, but when his ideas on mutual aid (and anarchist politics) made him one of the most well-known intellectuals of his day, the audiences grew, as when Kropotkin went on speaking tours of the United States in 1897 and again in 1901.

Kropotkin gave outreach talks at an astonishing number of places during these tours of the United States. He spoke about his Siberian expedition at the National Geographic Society in Washington, he lectured to thousands at Chickering Hall in New York City and the Odd Fellows Temple in Philadelphia. He dazzled audiences with a series of lectures on mutual aid at the Lowell Institute in Boston. In Chicago, while a guest at Jane Addams' famous Hull House, he poked fun at the "the porkocracy of Chicago," and then settled down and gave a series of talks on mutual aid at The Twentieth Century Club.

If Kropotkin had his way, everyone would come to understand the importance of mutual aid, and he would use every means possible to see to that, be it through pen or podium.

As you might have gathered, I'm an unabashed admirer of both EvoS and Peter Kropotkin, and I savor the opportunity to tie two of my passions together. If EvoS does ever hold a competition for poster boy/poster girl, I implore you, ladies and gentleman, vote Kropotkin.

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