

# ENGAGING UNDERGRADUATES IN PUBLISHABLE RESEARCH: BEST PRACTICES

EDITED BY: Traci A. Giuliano, Jeanine L. M. Skorinko and Marianne Fallon  
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# ENGAGING UNDERGRADUATES IN PUBLISHABLE RESEARCH: BEST PRACTICES

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Worcester Polytechnic students collaborating on research.  
Image: Worcester Polytechnic Institute.

Although many articles and books have been written about conducting research with undergraduates, there is a dearth of research on the process of publishing with undergraduates. Thus, in this research topic, we assembled a collection of 43 articles from 98 researchers worldwide who are passionate about—and have had success in—publishing high quality peer-reviewed journal articles with undergraduates. The diverse articles represent a wide range of practices to help researchers publish with undergraduates, including structuring the curriculum to promote undergraduate research and publication, optimizing research experiences for undergraduates, training students in implementing advanced techniques, accessing special populations, or conducting research in off-campus settings, addressing institutional and career challenges for faculty, and increasing inclusion and diversity. Each article provides a unique and diverse perspective that nevertheless resonates across contexts and situations. We hope that the ideas, models, techniques, and practices in these articles will motivate and inspire readers to begin, continue, or rethink how they engage undergraduates in publishable research; we also hope to stimulate empirical and quantitative research on the effectiveness of these ideas, models, techniques, and practices.

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# Editorial: Engaging Undergraduates in Publishable Research: Best Practices

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**Keywords:** undergraduate students, research, psychology, publication, mentoring

## Editorial on the Research Topic

### Engaging Undergraduates in Publishable Research: Best Practices

## INTRODUCTION

As faculty members who are passionate about engaging undergraduates in publishable research, our goal for this Research Topic was to provide a forum for the dissemination of effective practices toward reaching this goal. We learned that we are not alone: Many faculty members throughout the world share our passion for collaborating with undergraduates on high-quality research. Although there is no shortage of books, articles, and resources<sup>1</sup> on the topic of conducting research with undergraduates in psychology (see, for example, *Developing, Promoting, and Sustaining the Undergraduate Research Experience in Psychology*, Miller et al., 2008), far fewer articles have specifically addressed the process of publishing with undergraduates<sup>2</sup>. To address this gap, we assembled a large collection of articles that present effective models, innovative ideas, and solutions to the challenges of conducting publishable research with undergraduates. In doing so, we hope to increase the quantity and quality of such experiences worldwide. This Research Topic of *Frontiers in Psychology* contains 43 articles featuring 98 authors from the United States, Canada, Australia, and the United Kingdom who successfully engage undergraduates in publishable research. The diverse range of articles represented here (and summarized below) can be broadly grouped into five categories<sup>3</sup>: (1) structuring the curriculum to promote undergraduate research and publication, (2) optimizing research experiences for undergraduates, (3) training students in implementing advanced techniques, accessing special populations, or conducting research in off-campus settings, (4) addressing institutional and career challenges for faculty, and (5) increasing inclusion and diversity.

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<sup>1</sup>The Council on Undergraduate Research has an up-to-date, online compendium of excellent publications and resources on topics ranging from broadening participation in undergraduate research to models of undergraduate research in the arts and humanities to the impact of undergraduate research on student learning to excellence in mentoring student research (see <https://myaccount.cur.org/bookstore/>).

<sup>2</sup>For notable exceptions in psychology, see Wendt (2006), Cramblet Alvarez (2013), Hughes (2014), Hartley (2014), and Griffiths (2015); for other fields, see Burks and Chumchal (2009; biology), Bliss (2002; nursing), and Jalbert (2008 accounting).

<sup>3</sup>Some articles are mentioned more than once because they make significant contributions in more than one category.



## STRUCTURING THE CURRICULUM TO PROMOTE UNDERGRADUATE RESEARCH AND PUBLICATION

As nearly a dozen of the articles in the Research Topic illustrate, two of the best ways to facilitate publication with undergraduates are: (1) to structure the curriculum with multiple and often scaffolded opportunities for both skills training (e.g., in methodology, statistics, and writing) and faculty-student collaboration, and (2) to incorporate high-quality research projects with publication potential into specific courses.

### Curriculum

- Reavis and Thomas detail how their small liberal arts college's scaffolded psychology curriculum (which includes hands-on research in introductory courses, a combined statistics/methods course, a research-focused upper-level course, and a senior research course in which 2 faculty supervise 6–10 individual projects) provides multiple opportunities for faculty-student collaboration at every level and leads to presentations and publications.
- Canadian researchers McKelvie and Standing describe their department's 8-course methodology curriculum (which includes three semesters of statistics, a regular and an advanced methods course, a psychometrics/testing course, and a two-semester honors course) and two helpful practices (i.e., class discussion of published articles and replication projects) that have led to numerous undergraduate publications.
- In the first half of Mendoza and Martone, Mendoza highlights how the stepwise progression of his department's curriculum-oriented research experiences (i.e., CORE) helps turn their undergraduates into both critical consumers and producers of published research. CORE emphasizes developing critical thinking and writing skills, conducting original research in courses, and applying a graduate-school mentorship model to undergraduate research labs.
- Mickley Steinmetz and Reid describe how their psychology department incorporates research into most courses early and often to prepare students to produce publishable research. Upper-level core courses require original experiments designed for publication and a required apprentice-based senior thesis provides a capstone opportunity.
- Wieth et al. discuss their department's creativity-centered cooperative problem-solving (CPS) approach to undergraduate research and publication. The CPS approach exposes students to individual and group brainstorming, provides diverse feedback from students and faculty, and culminates in a senior thesis for the majority of students.
- Golding et al. describe the benefits (e.g., work readiness, networking, teamwork, publication) and challenges (e.g., mismatched expectations, equity in access) associated with the summer Undergraduate Research Experience at their Australian university.
- Because the United Kingdom has far fewer opportunities for undergraduates to present their research at conferences compared to the United States, Kent et al. suggest strategies

to strengthen the pathway from undergraduate presentation to publication in the UK, including creating pre- and post-event community-building activities and incorporating conference presentation into the dissertation supervision process.

### Course Projects

- LoSchiavo describes seven helpful guidelines for incorporating a professional-grade, full-class project into a research methods course, which maximizes the probability of producing publishable undergraduate research.
- In her research methods course, Giuliano provides students with a "Writing Spiral" containing 10 handouts on grammar, citation, scientific writing, and APA style that has facilitated undergraduate publications in both research methods and capstone courses.
- Skorinko argues that project-based learning in courses can successfully lead to multiple forms of publishable scholarship, including the scholarship of discovery (e.g., research that advances knowledge), the scholarship of teaching (e.g., pedagogical articles), and the scholarship of engagement (e.g., applied and/or community service projects).
- Lineweaver and Bergeson outline eight steps for establishing a general education research course that turns non-science majors into civically-engaged student scientists who conduct a project in the community. They also discuss potential pathways to publication from this approach.

## OPTIMIZING RESEARCH EXPERIENCES FOR UNDERGRADUATES

Over a dozen articles in the Research Topic are devoted to tailoring research experiences to undergraduate publication. These include articles that (a) describe effective practices (e.g., tips for recruiting and training students, the use of contracts and agreements, authorship discussions, writing weekends, open science practices), (b) recommend a variety of mentoring strategies, and (c) focus on the perspective of the undergraduate researcher.

### Effective Practices

- Scisco et al. provide a multi-site perspective based on their experiences at small liberal arts colleges, mid-sized regional universities, and a large research university; they offer strategies for selecting (e.g., targeting underrepresented groups and students with a growth mindset), managing (e.g., setting clear expectations and teaching collaborative writing skills), and engaging (e.g., by providing positive, instructive feedback and plenty of encouragement and support) undergraduate co-authors.
- Adams outlines four learner-centered practices that she has found effective in guiding undergraduates to produce publishable research, including building rapport, providing structure and clear expectations, teaching writing skills, and engaging in self-reflection.
- Bloomfield et al. present the content of their faculty-student co-authored "research agreements," which they argue promote the ideal atmosphere for producing publishable research

because such agreements foster discussions about scientific professionalism, ownership, and ethics and also allow faculty and students to reflect on shared project goals.

- Giuliano describes her experiences guiding students through the process of first authorship, including perceived barriers, paths to undergraduate first authorship, and best practices, including how to assign authorship order and credit.
- Scherman highlights the factors that promote successful “student writing weekends,” which address many of the barriers to undergraduate publication (e.g., continuous access to mentor instruction and feedback, dedicated space and time to write, freedom from work and family distractions) while providing a fun, bonding, and collegial experience.
- Strand and Brown discuss the benefits of using open science practices in their research labs and outline the steps they use in conducting publishable open science research with undergraduates.
- Wagge et al. also emphasize the advantages of conducting open science research with undergraduates, as illustrated by the high quality, publishable replications (from methods and capstone courses, as well as research labs) that have resulted from the Collaborative Replications and Education Project.

## Mentoring Strategies

- Holmes and Roberts compare the relative merits of four popular faculty mentoring models (*sculptor*, *makeover artist*, *coach*, *CEO*), arguing that the first two are superior for producing publishable undergraduate research characterized by high student interest and equitable faculty-student benefits.
- Overman describes three strategies for group-level mentoring of undergraduates (creating a shared vision, using interlocking projects, and building a lab community with strong relationships) that increase faculty productivity and lead to publications and grant funding.
- Detweiler-Bedell and Detweiler-Bedell advocate for a team-based approach that enhances students’ sense of belonging and leads to student co-authored publications and external funding. In their model, ladder teams consist of an experienced senior lab member, a mid-level sophomore or junior lab member, and a student “assistant” new to the lab.
- Dunbar uses a similar team-based, peer mentoring approach at an R2 university, where graduate students participate in the mentoring teams and conduct parallel projects that, when combined with undergraduate projects, yield stronger multi-experiment papers and increase the number of undergraduate co-authors.

## The Undergraduate Perspective

- Matthews and Rosa, who recently graduated from a liberal arts university with Bachelor’s degrees, reflect back on their research lab experience. They discuss the benefits (e.g., confidence, work ethic, critical thinking, graduate school/career preparation, presentations, and publications) and challenges (e.g., interpersonal dynamics, procrastination, project work continuing after graduation) of their research experience, along with tips for success (e.g., individual brainstorming prior to group brainstorming; meeting notes,

task lists, and weekly progress reports; peer review and section-by-section writing/revising of drafts).

- In the second half of Mendoza and Martone, recent graduate Martone describes the impact that joining a faculty-led research lab had on her self-confidence, research and writing skills, and graduate school preparation, attributing her successful outcomes to the support and role modeling of her faculty mentor.
- Skorinko, a faculty member, outlines nine helpful strategies that are informed by her own experiences as an undergraduate for engaging students at her R2 institution in publishable research.
- In a qualitative interview study examining Australian undergraduates’ perceptions of their dissertation experience, Roberts and Seaman found that helpful supervisors were supportive, directive, and had styles and interests that matched their students, whereas less helpful supervisors failed to provide clear expectations and/or treated students inequitably.

## TRAINING STUDENTS IN ADVANCED TECHNIQUES, SPECIAL POPULATIONS, OR OFF-CAMPUS SETTINGS

Nearly a dozen articles in the Research Topic discuss the challenges of teaching undergraduates technically-advanced research skills (e.g., physiological assays, narrative research, archival research), working with special populations (e.g., children, primates, dolphins, rats), and conducting research in different settings (e.g., off-campus local research sites, community service, international field studies).

- Bukach et al. describe their PURSUE (Preparing Undergraduates for Research in STEM-related fields Using Electrophysiology) initiative, which incorporates cross-institutional collaboration and shared resources to address the challenges of publishing with undergraduates in cognitive neuroscience (e.g., working with complex technologies, such as EEG and ERP, that require time-intensive training).
- Goldey et al. similarly tout the benefits of cross-institutional collaboration for sharing resources, time, and expertise in conducting research on salivary biomarkers (e.g., cortisol, opioids) linked to physical and mental health. They offer step-by-step recommendations for others wanting to conduct such research.
- Because conducting clinical psychiatric research with undergraduates can be challenging (especially at universities without access to clients), Hammersley et al. recommend the use of both cross-disciplinary and cross-institutional collaboration to pool funds, equipment, supplies, and research assistants, as well as the use of publicly-available archival datasets to study clinical topics.
- Dunbar describes how the development of the Faculty for Undergraduate Neuroscience (FUN) organization, along with NSF funding and a partnership with a pharmaceutical company, increased his department’s ability to conduct publishable neuroscience research with undergraduates.

- Grysman and Lodi-Smith discuss the challenges and best practices for conducting publishable narrative research (a mixed-method approach that involves qualitative coding of typed or spoken words prior to quantitative analysis) with undergraduates.
  - Childers and Phillips describe strategies for conducting publishable research with undergraduates using advanced technical skills at off-campus research sites. Childers, a developmental psychologist, uses eye-tracking technology to study pre-school-aged children at local childcare centers; Phillips, a behavioral neuroscientist, uses neuroimaging to study non-human primates at the National Primate Research Center.
  - In Mickley Steinmetz and Reid, Reid describes how her students produce publishable research in a single semester (with projects that involve training on a computer program and using rats as subjects) as part of her Learning and Adaptive Behavior course.
  - Ashdown suggests five strategies for conducting publishable research with undergraduates abroad based on his past experiences in Guatemala: establish local connections, avoid superficial cultural understanding, secure institutional support for students, understand students' research and cultural skills, and model good international research ethics.
  - Hill and Karlin share their best practices for stimulating publication-quality projects by underrepresented undergraduates enrolled in their research immersion program. This program consists of a two-semester course supplemented by a week-long international field experience involving research in comparative psychology or conservation biology using dolphins or other marine species.
  - Burns-Cusato and Cusato, who conduct field research on green monkeys in Barbados, describe the benefits and challenges of collaborating with undergraduates abroad, and outline two models that can lead to high quality, publishable projects: faculty securing funding for a stand-alone research project or faculty teaching a study abroad research-based course.
  - Mello-Goldner describes the lessons learned from her very small college's decade-long experience collaborating with community partners on research that benefits both the local community (in terms of understanding local issues) and her students (who gain access to larger datasets than they would have otherwise, obtain real world/applied experience, network for future internship and job opportunities, and cultivate a sense of civic engagement).
- ADDRESSING INSTITUTIONAL AND CAREER CHALLENGES**
- Although a majority of the articles in the Research Topic are written by faculty at primarily undergraduate institutions that provide at least some support and reinforcement for publishing with students, a number of articles provide helpful suggestions for publishing with undergraduates at different types of institutions (including large research universities, regional universities, and community colleges) and for coping with other challenges related to resources, position, or career stage that could impact faculty wherever they teach.
- Lundwall et al. offer guidelines for balancing undergraduate- and graduate-student needs in publishing at an R1 university, including tips for recruitment, preparation, writing, and a modified peer-mentoring structure.
  - Dunbar's article relates two strategies to maximize the involvement of undergraduates in publishable research at an R2 university, including the development of a cross-institutional faculty networking group in neuroscience and the use of both graduate and undergraduate student peer mentoring.
  - Skorinko, whose institution recently moved from an R3 to an R2 classification, outlines nine helpful strategies for engaging undergraduates in publishable research in this environment.
  - Dutta et al. describe three phases (cultivate and motivate, identify and select, polish and enhance) in the research journey with undergraduates at a regional university that can transform them from consumers to producers of publishable research.
  - Frohardt, an administrator and neuroscience researcher at a community college, examines several ways to successfully engage community college students in publishable research, including seeking funding opportunities, prioritizing experiential learning, scaffolding students toward publishable research, and encouraging and recognizing strong mentorship.
  - Wood, a faculty member in a teaching-focused position at a large Canadian research university, describes how "teaching stream" faculty (whose labs may consist of only undergraduate students) can produce rigorous, high quality research by relying on undergraduate research leadership.
  - Mendoza and Golden, a pre-tenure faculty member at a primarily teaching institution and a tenured faculty member at a large research university, respectively, share their unique perspectives on how to overcome obstacles to publishing with undergraduates faced by faculty at different career stages and institution types.
  - Stefanucci describes two strategies for preserving faculty time in a way that maximizes efficiency, ensures productivity, and is rewarding for both faculty and students: mentoring and delegating research tasks, and seeking credit (including course credit) from one's institution for mentoring and publishing with undergraduates.
  - In their discussion of how their department's curriculum prepares undergraduates to publish, Mickley Steinmetz and Reid also note that a key feature of their success in publishing with students is that faculty-student research is incorporated into their standard faculty course load.
- INCREASING INCLUSION AND DIVERSITY**

Perhaps no issue regarding student research is more important than increasing inclusion and diversity within our labs and providing equal access to publishing opportunities for all students. Psychology's "representation problem" (Peifer) occurs

at every level: Underrepresented populations are less likely to participate in high-impact practices as college students (Stebbleton and Soria, 2012), less likely to be undergraduate co-authors (Grineski et al., 2018), less likely to enter and complete doctoral programs in psychology (Callahan et al., 2018), and much less likely to publish in general (comprising 88% of the world's population but authoring only 20% of published articles; Henrich et al., 2010). A slew of articles in this Research Topic focus wholly or significantly on the goal of increasing diversity in undergraduate research.

- Peifer provides historical context for this issue, examining how three interconnected facets of diversity (racial, socioeconomic, and family educational history) influence undergraduates' engagement with the research and publication process. She also suggests general strategies that faculty mentors can employ to increase the diversity of perspectives not only in undergraduate publication, but in the field of psychology as a whole.
- Ahmad et al. outline several evidence-based strategies for promoting an inclusive research lab, including steps for recruiting (e.g., proactive strategies designed to attract students from all backgrounds), selecting (e.g., making efforts to recognize and minimize the impact of implicit biases), and retaining diverse students through strong mentorship.
- Chan recommends a "systems mapping" approach to create a positive and inclusive climate from the outset that culminates in publishable research for first-generation, historically underrepresented, and low-income undergraduates. This approach involves mapping the current lab or research team climate, monitoring participation and retention rates, and planning strategically throughout the research process.
- In their article describing the benefits of using ladderized peer-mentoring undergraduate teams, Detweiler-Bedell and Detweiler-Bedell make the case that the enhanced sense of belonging created by such teams is especially beneficial for the recruitment, retention, and success of students from underrepresented groups.
- Dutta et al.'s article on transforming undergraduates at a regional university from consumers to producers of research considers the unique challenges faced by a student body that includes many first-generation college students, students who work long hours, and non-residential students.

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- Frohardt's article examines ways that community college faculty, who often deal with heavy teaching loads and a reduced emphasis on scholarship for tenure and promotion, can increase opportunities to engage our most underrepresented students in publishable research.
- Hill and Karlin, faculty members at a Hispanic-Serving Institution in Texas, describe the challenges and best practices for conducting research (including an international field study experience) with underrepresented undergraduates.

## CONCLUSION

In closing, we are amazed by the collective—and in many cases collaborative—excitement, passion, and deep thought that so many colleagues around the world have put into conducting publishable research with undergraduate students. Clearly these efforts pay off, as evidenced by the authors who reflected on the importance of these undergraduate experiences in their educational and professional pathways. We believe that there is something for everyone interested in publishing with undergraduates in this Research Topic, as each article provides a unique and diverse perspective that nevertheless resonates across contexts and situations. We hope that the ideas, models, techniques, and practices in these 43 articles will motivate and inspire readers to begin, continue, or rethink how they engage undergraduates in high quality, publishable research. Finally, we hope to stimulate empirical and quantitative research (which is presently lacking) on the effectiveness of these ideas, models, techniques, and practices. We hope you learn as much from reading this issue as we have from curating it.

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# Building a Scaffolded Research Experience for Undergraduates

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**Keywords:** undergraduates, pedagogy, scaffolding, publication, research laboratory

We teach at a small, teaching-focused liberal arts school on a semester schedule (teaching three courses per semester), with ~1,000 undergraduate students, no psychology graduate programs, and 18–25 psychology graduates per year. Faculty have some research expectations, which are partially confirmed through outside reviewers in the tenure process. However, our institution approaches faculty research as an opportunity to teach students, and we are rewarded for involving undergraduates in our research programs through tenure and internal grants.

Research is fundamental to our major and students regularly engage in research. The scaffolding, or framework, in our curriculum from lower-level courses to a cumulative senior research project, provides students the foundation needed to contribute meaningfully to research. Students have multiple opportunities to work closely with faculty. Increased student-faculty collaboration is associated with higher rates of graduate school attendance (Stoloff et al., 2015) and indeed Earlham is in the 95th percentile of institutions whose graduates complete psychology Ph.D. degrees (HEDS Baccalaureate Origins Report, 2017).

In lower-level courses, students do hands-on research, including replication projects and case studies, with 80% of our lower level courses having a research project. The most intensive research engagement comes through a three-course sequence: Statistics and Research Methods, an upper-level research-focused course, and Comprehensive Senior Research. Research suggests that integrated statistics and research methods education results in stronger performance and learning, both in the semester and at the end of the college career (Barron and Apple, 2014). Below, we talk about each of these classes in turn, before discussing the benefits of our curriculum for presenting and publishing with students.

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## SCAFFOLDING RESEARCH OPPORTUNITIES

### Curriculum

Our research sequence begins with a Statistics and Research Methods combination course. Students are introduced to statistical concepts and sound research practices. They conduct small instructor-designed studies, using themselves as participants. The sophistication of the studies and written reports increases across the semester. Upon completion, students can articulate principles of good research design, select appropriate analytical tools, conduct analyses, and write a full-length APA-style report.

Next, students take a research-focused upper-level class, which they enter with the mental scaffolding, terminology, and skills associated with the process of research. We have multiple research courses, including Psychology of Prejudice and Behavioral Neuroscience. Each includes content information and requires students to conduct a research project. Projects vary across courses, but all involve students working in small groups (3–4) to design a content-related study, collect data through the subject pool (maintained by the psychology department), and present the results. These projects give students first-hand experience with a small research project of their choosing.

Group work and design constraints are important parameters for projects at this level. First, students support one another in groups; their skills and strengths are often complementary. Second, project constraints encourage positive experiences by keeping students within the scale of a doable project for novice researchers. Constraints include requiring only one independent variable, limited literature review breadth, and experience-appropriate expectations for independent statistical analysis.

When students reach the one-semester Senior Research course, they are prepared to articulate a research question, review the existing literature, design an appropriate study, analyze their data, and present their results in written and oral presentations. Although students work independently, faculty supervisors still provide scaffolding. Typically, two faculty supervisors lead the course, supervising 6–10 independent projects each. Faculty help students articulate sufficiently narrow research questions (usually quantitative) that can be reasonably addressed in one semester. Students receive detailed and ongoing feedback about their designs and writing and present their results to the department and visitors. Research suggests this type of course improves student learning and is viewed positively by faculty and students (Moore et al., 2018); anecdotally, we find the same. Students show considerable growth over the semester and are often proud of their accomplishments.

## Laboratory

Our structured curriculum supports research education for all students, but also provides strong preparation for high-quality Research Assistants (RAs) to pursue professional presentations and publication. Students receive elective credit as an RA, with the metric that 3 h of work per week during the semester is equivalent to one academic credit. Approximately half of each graduating class serves as an RA for at least one semester. Some RAs will pursue a lab-related topic for their senior project, but most will use the skills they learn in class and lab to pursue a topic in a different area of interest. Applications for RAs open in the mid-semester, which provides opportunities to a broader range of students and increases research participation (Wayment and Dickson, 2008).

The pace of research differs between the curriculum and our labs/research groups. In research courses, students complete an entire project in one semester, from idea to dissemination. In our labs, it is rare to move this quickly, particularly for research with children or non-human animals. The research in our labs is also more sophisticated and time-consuming than what students do in their classes. Specifically, we often have more conditions, more intensive recruitment strategies, longer protocols, and more complex statistical analyses. Given our small size and teaching focus, studies often take multiple semesters to complete.

Below we present two faculty research labs to demonstrate scaffolding, timelines, and support for meaningful undergraduate involvement in research. In the first lab, MT conducts research primarily with college students and adults using MTurk. In the second lab, RR conducts research with college students and children. In both labs each semester, students are given a syllabus-like document that clearly articulates the goals and tasks of

each project, and the expectations for both faculty and students (Shanahan et al., 2015).

## SCAFFOLDING UNDERGRADUATE PUBLICATION

### National Conference Presentations (MT)

The Social Fringe Lab averages four RAs per semester. My research projects involve straightforward protocols, allowing my lab to function well with returning RAs or frequent turnover. RAs build on their understanding of the research process, wherever they are in our curriculum. To start each semester, I have one or two projects ready for data collection and we finish one or two projects each semester. We spend the first 2 weeks of the semester reading background literature supporting the study, discussing the study design/method, and engaging in training on the protocol. Training for RAs involves learning software systems (e.g., Qualtrics, Sona-Systems), being a practice “participant,” leading the study with me as “participant,” and practicing with other RAs as “participants” while I observe. After training, RAs begin collecting data.

Once data collection is complete, we analyze data as a lab. I project my screen and we talk through the design and hypotheses of our study, then discuss which statistical tests are necessary before we analyze our data. At this point, I have RAs begin to work on a poster presentation. I share a template with them, assigning each RA a primary and secondary section. Each RA drafts their primary section, then provides feedback on their secondary section. In a lab meeting, I walk through the entire poster and we discuss edits. As a lab, we create an abstract for submission to a peer-reviewed national conference (which parallels the journal review process), as well as present research at an on-campus conference. Usually, my lab submits two abstracts per year.

After submission, RAs practice presenting the poster, regardless of the place of presentation (on- or off-campus). Practicing includes: a full walk-through of the poster contents, an “elevator speech” of the research, brainstorming questions that may be asked, and answering questions. In future semesters, if the abstract was accepted at a national conference, I coordinate with RAs who are still students to travel to the conference (as well as contact all RAs to update their CVs). At the conference, my RAs present the poster and I stand by to field questions they cannot answer from conference attendees. This poster serves as a draft for a paper, as it covers background literature, method, results, and discussion. Often, questions from conference attendees influence directions for future studies in that line of research, leading to student excitement at developing new studies for the project. Students who have worked on a project a long enough time (meaning over the course of multiple studies; recall my lab works well with high turnover) are invited to work on the manuscript as well.

### Publications (RR)

The Peer Lab is a comparatively larger lab in our department (although small by many standards), with approximately eight RAs each semester. There are typically three projects going on



at any time: one with undergraduate participants and two with children (one conducted in the community and one conducted in the lab). Because the protocols with children are longer and working with children requires extensive training, it is important that most students work in the lab for multiple semesters. Many students join the lab early enough to stay 2–4 semesters (receiving academic credit each semester). Responsibilities in the lab are partially based on seniority in the lab and partially on where RAs are in the statistics/research methods curricular sequence (with most RAs entering the lab after the Statistics course, but usually before the independent senior project).

As in the broader curriculum, student work is scaffolded, with novice students being mentored by more senior students. Novice students generally begin running studies with straightforward protocols. As students progress in the lab and in the curriculum, they take on more responsibility, working on project development, statistical analysis, and writing. This transition to independence is a transformative experience for students (Shanahan et al., 2015). In the Peer Lab, we spend several weeks each year discussing the replication crisis, p-hacking, and appropriate statistical and research practices.

During the fall and spring semesters, students work on conference posters and presentations, but much of the publication writing happens during the summer. One to three students work 40 h per week in the lab each summer for 4–6 weeks. This experience is paid and competitive, supported through endowed funds. Although some writing occurs during the academic year, the focus, and time during the summer allows for more intensive writing and feedback.

During the writing process, we work together on a rough outline. Students then generate search term lists that I approve and are assigned individual sections. They then generate a reading list. Students often need guidance on conducting thorough and appropriate literature reviews. Students will often find work that is decades old and need help discerning what is out of date. They then produce annotated bibliographies followed by integrated summaries. After several drafts and conversations, students begin writing the introduction and discussion, with the goal of a full draft by the end of the summer. Typically, students

are heavily involved in the first submission only. Due to the long review times, students have often graduated by the time reviews come back. My practice has been to forward the reviews and get their approval for any revisions, but I make the revisions myself. Because of the intensive feedback and the students' lack of involvement in rewrites, I take first author position, with students following in order of contribution. My view here is that the scaffolding of the manuscript process continues into graduate school for those pursuing that path. Their experience with me is focused on the first submission. In graduate school and beyond, they will get ample experience with formal revisions. I view my role as a piece in a broader scaffolding process.

## CONCLUSION

Student successes in our labs are dependent on the broader curricular structure in our department. Students' experiences as RAs in our labs are both supported by and contribute to our broader focus on research competence across the major. Although we have had some success in generating publishable work with students during the semester, in our experience, institutional support for focused student research (such as paid opportunities during the summer or travel to conferences) is critical. We encourage departments to examine ways that the broader curriculum can support individual research labs and colleagues to create opportunities for students to build on their experiences in the classroom through meaningful contributions to our field.

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# Teaching Psychology Research Methodology Across the Curriculum to Promote Undergraduate Publication: An Eight-Course Structure and Two Helpful Practices

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**Keywords:** teaching, research methods, course structure, critical discussion, replication

## GOALS FOR TEACHING RESEARCH METHODS TO UNDERGRADUATES

Teaching research methods is challenging because we not only wish to convey formal knowledge and encourage critical thinking, as with any course, but also to enable our students to dream up meaningful research projects, translate them into logical steps, conduct the research in a professional manner, analyze the data, and write a report in APA style. We also wish to spark interest in research, but in teaching undergraduates we have learned how elusive these goals can be (McKelvie, 1994). Even faculty have not mastered research design and writing. From serving as journal reviewers, we have found that many submissions show flaws such as elementary errors of logic (e.g., using a null control condition instead of a placebo treatment), tangled statistics, missing graphs, and ungrammatical, unclear writing that violates APA rules. Yet these manuscripts are sometimes written by people with doctorates and years of experience. Moreover, published papers may contain egregious faults (Standing and McKelvie, 1987). And although we have both published widely, we still hone our skills. It requires optimism to expect that a typical undergraduate will do better, after just a year or two of studies in psychology. In this paper, we describe a *systematic set of methodology courses* and two *specific practices* that we think can help.

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## METHODOLOGY COURSES AS THE BACKBONE OF OUR PSYCHOLOGY PROGRAM

How can methodology courses promote undergraduate involvement in publishable research? In our undergraduate liberal arts institution in Québec, where the Bachelor's degree normally takes 3 years following 2 years of college, we require more, rather than less: our psychology program has evolved since the 1960s to require a solid backbone of mandatory methods-related courses that is considerably more extensive than in most universities (McKelvie, 2000). Psychology majors take two consecutive introductory statistics courses in the first academic year, reaching the level of two-way ANOVA. Simultaneous with the second course, they take an introductory research methods course with lectures and discussion of important concepts, including theory, and involvement (participation, testing, writing) in instructor-planned projects that usually extend past research. In the second year, intending honors students take an advanced methods course that builds on the first one. It uses the same text, and continues active participation in project work. An unusual requirement (McKelvie, 2000) is a course in Psychometrics and Psychological Testing, reflecting

our belief in the importance of measurement. In the third year, students with a program average of 80% or better, *and* a combined average of 75% in the advanced research methods course plus the second statistics course, may enter the honors program. They take a multivariate statistics course, and produce an idea for a data-based honors thesis under the direction of a main and a secondary supervisor. Students are encouraged to create their own research question on a topic of their choosing. Over two semesters, they discuss this project in a seminar course and write a formal proposal, and then in the thesis course, they conduct the research and write the report.

These eight required methods-related courses produce well-grounded and motivated honors graduates, and gives them an opportunity to publish. Our students accept with good grace the challenge of this program, where only about one-fifth of them will obtain an honors degree rather than a major, and our departmental numbers have risen considerably over the years.

## TRADITIONAL SOLUTIONS FOR TEACHING STUDENTS TO GRAPPLE WITH RESEARCH METHODS

A traditional solution in teaching research methods and exposing students to the research process has been first to lead them through a series of short, pre-packaged lab projects that demonstrate some well-established phenomena, and require brief write-ups, likely in APA format. This approach still has merit at the introductory stage, and the Online Psychology Laboratory experiments provided by the APA (<https://opl.apa.org/>) are valuable exercises for the neophyte. However, it appears that today more emphasis is commonly placed on original individual methods projects, perhaps to prepare students for an honors thesis, where they commonly choose the topic.

The basic problem is that too many original student course projects lack a valid idea to test, coherent methods, and a valid formal design. Additionally, sample sizes are usually too low, yielding inadequate statistical power. More fundamentally, students habitually gravitate to correlational relationships rather than to randomized controlled experiments. They must learn to better justify proposals for non-experimental research.

## TWO SPECIFIC RESEARCH METHODS TEACHING STRATEGIES

### Class Discussion of Published Articles (Introductory Methods Course)

Critical class discussion of published articles can spark student interest in research papers and help them design better studies (McKelvie, 1994, 2013). Papers are carefully chosen to capture student attention and expose them to methodological issues. Study questions focus on important points in each reading. Students are also encouraged to generate their own critical comments and queries (McKelvie, 2013). This approach sits well with the typical case-oriented contents of leading methods texts (e.g., Morling, 2018).

Five study questions are common to all papers (McKelvie, 2013): What type(s) of research method is (are) involved? In particular, is it a true experiment? What inferential statistics were used? Were they appropriate? What is (are) the sources of the problem (theory, past research, practical intervention, everyday life)? One example is Motley and Camden's (1985) study of sexual double entendres in lexical selection. It employed both experimental (manipulation of experimenter attractiveness) and non-experimental methods (sexual anxiety as a subject variable). Independent samples *t*-tests, chi square, and ANOVA were used. The study was based on theory and on everyday life. Another example is Milgram's (1963) seminal observational study of obedience. It is non-experimental, only contains descriptive statistics, and is based on everyday life. Students find it challenging to identify the research method. Realizing that "laboratory" does not mean "experiment" is a valuable lesson. A complete list of study questions and discussion papers is available (see link to McKelvie, 2013).

### Replication Projects (Advanced Methods Course)

Although the traditional laboratory approach has merit, the projects may only be demonstrations, or suffer from inadequate sample size. Original individual student projects share this problem, and have other difficulties.

One solution is for all the class to work on the *same* research project, created by the instructor in an area of their expertise. This study may be *original* as described in detail by LoSchiavo (2019). Advantages are that sample sizes will be healthy, increasing the likelihood of publication, and that students are motivated to create new knowledge. Alternatively, the instructor can plan a *replication* study, selecting a paper from the literature that is widely quoted and of manageable scope, and leading the class through either a conceptual or (better) an exact replication of the target study. Sample sizes will again be healthy, but other advantages are that planning is simplified, a rationale for the study exists, the method is pre-established, and students are educated about the replication debate (Maxwell et al., 2015). Their involvement may also be promoted by the realization that we can grapple together with the same issues as published authors, and that they are engaging in "real" research that is potentially publishable. The experience also prepares honors students in the seminar and thesis courses to create an original project, or one that replicates and extends previous work (e.g., Benmergui et al., 2017).

### The Parallel Teams Approach

A class may be divided into teams which each work on a different target article. Preferably, the teams can each try to replicate the *same* paper, which has the advantage of maximizing *N*, and we note that replications to be adequately powered should use *more* than the number of participants listed in the target article (Simonsohn, 2015). Additionally, the team results can be compared for consistency, before pooling the data to increase power. When the teams are of perhaps half a dozen members each, they can function most effectively as small, cohesive groups under the direction of

an elected or designated team leader (for practical details see Standing, 2016).

An example of a project using four parallel replication teams is described by Standing et al. (2016). This study successfully replicated Experiment 8 in the study by Gailliot et al. (2007), which made the controversial claim that self-control can be raised by consuming glucose rather than a placebo drink. As possible authorship is motivating to many students, the four team leaders here were included as coauthors of the instructor, with the remaining members of the class acknowledged in a footnote. Alternatively, all members of a class team may be listed as authors, as with a previous attempt focusing on the claim that priming a participant with a trait such as “intelligence,” or a stereotype such as “professor,” raises their cognitive performance in the form of Trivial Pursuit scores (Dijksterhuis and van Knippenberg, 1998). This replication attempt did not succeed (Roberts et al., 2013). Subsequently both a 9-experiment study (Shanks et al., 2013), and a preregistered replication study, involving 40 labs, have likewise failed to replicate the target study’s results (O’Donnell et al., 2018).

The results of student replication projects are most effectively communicated by posting them as summaries on the PsychFileDrawer.org website, which provides a refereed “Archive of Brief Reports of Replication Attempts in Experimental Psychology.”

## CHALLENGES

Major challenges in teaching research methods include students’ limited ability to (a) build a study that makes a clear prediction with rival hypotheses, and (b) to think clearly and logically through key issues such as randomization, control conditions, double-blind testing, counterbalancing, power, sample size, experimenter effects, and demand characteristics (McKelvie, 1994). Another challenge is to have the student exert tighter controls in non-experimental studies [e.g., match groups on subject variables (Lemieux et al., 2002), and include a dependent variable on which no difference is expected]. Fundamentally, we ask honors students to propose a new study that is valid and interesting, with a clear connection to previous work. We confront these issues explicitly, in class and in personal interactions with students. Another major issue is that of obtaining prior approval from institutional research ethics boards, which requires careful time scheduling and attention to detail in the required documentation. To plan ahead of time, pilot testing is vitally needed, and this testing itself may require ethics approval, leading possibly to an infinite logical regress unless common sense is applied.

The problems of writing skills, correct citation, and APA format are also pervasive. We find it useful to

break reports into sections (staggered over time), to allow resubmission (after editing by the instructor), and to encourage students to consciously imitate the style of the APA model manuscript (American Psychological Association., 2010, pp. 41–53), rather than to memorize formal rules. Students also receive detailed handouts explaining these rules ([https://www.ubishops.ca/wp-content/uploads/McKelvie\\_GuidetowritingreportsAPA6thedition-converted.pdf](https://www.ubishops.ca/wp-content/uploads/McKelvie_GuidetowritingreportsAPA6thedition-converted.pdf); <http://www.ubishops.ca/wp-content/uploads/plagia04.pdf>).

## OUTCOMES

In addition to the replications published in *PsychFileDrawer*, the present approach, developed over several decades, has yielded a variety of PsycINFO-listed refereed articles with undergraduates: 71 and 50 papers for the present authors, respectively. Most papers are based on honors theses (e.g., McKelvie and Demers, 1979; Knight and McKelvie, 1986; Martel et al., 1987; Shackell and Standing, 2007; Standing et al., 2008, 2014; Sigal and McKelvie, 2012; Clohery et al., 2015; Morin-Lessard and McKelvie, 2017), where students usually earn the right to primary authorship because they proposed and conducted the research, even if we led the conversion from thesis report to manuscript. In other cases (e.g., McKelvie et al., 2013), where students assisted in our projects, we were primary authors. Disputes can be avoided by clarifying authorship ground rules at the outset.

As an example (Benmergui et al., 2017), one investigation attempted to replicate a report (Beauchamp, 2002) that false recall in the Deese-Roediger-McDermott-Read-Solso (DRMRS) procedure would be smaller when the materials were pictures rather than words. Items for remembering are constructed around a theme that is not on the list (e.g., thread, pin, sewing around needle). False memory occurs when the theme word (needle) is recalled. This replication was successful, and the experiment extended previous research with new materials, new conditions, and a measure of confidence.

## CONCLUSION

Involving undergraduates in the publication process is not easy, but we believe that the present seeming success is related in part to our cumulative course structure, to the explicit identification and discussion of challenges, and to the two systematic exercises outlined here.

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Both authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# From the Classroom to the Lab: How Faculty Can Extend Curriculum Oriented Research Experiences to Publish With Undergraduates

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## CURRICULUM ORIENTED RESEARCH EXPERIENCES (SM)

Providence College is a private liberal arts institution with ~4,300 undergraduate and 600 graduate students. Like other colleges that offer some master's and no doctoral programs, it relies on an intimate learning environment to prepare its student body for future success. Indeed, the small student-faculty ratios typically found at these schools can result in more hands-on and personalized scientific training than at large research universities (Cech, 1999; Kaiser et al., 2014). Providing undergraduates with immersive research experiences is particularly critical, given their established benefits to student engagement, intellectual achievement, and post-graduate opportunities (Elmes, 2002).

Our psychology department offers a 12-course major that exposes students to a wide variety of subdisciplines that are grouped in domains and offers them specialized seminars to go further in depth in their preferred areas. Throughout these courses, there is a strong emphasis on the scientific nature of the field and the development of critical thinking and writing skills via curriculum oriented research experiences (henceforth referred to as C.O.R.E. strictly for the purpose of this article). During the first 2 years of the major, our declared students take a year-long sequence of Research Design and Statistical Analysis (RDSA). Rather than splitting the topics into separate semesters, we find that this integrative approach better synthesizes the theoretical and practical aspects of research, thereby making the material more accessible to students (see Barron and Apple, 2014). Within the lecture-based portion of the class, students learn about ethical responsibilities, sampling techniques, measurement, and study design, as well as practice reading, summarizing, and critiquing research. Within the complementary weekly lab, students work in groups of 2–4 to design and conduct consecutive research studies, usually a survey-based project followed by an experiment. Selection of research topics, creation of study materials, and data collection are

supervised by the instructor, but are primarily completed by the students. Over the course of the year, they also practice data entry with SPSS and learn to perform reliability, correlational, regression, *t*-test, and ANOVA analyses. Students culminate their projects by individually writing up their results in an APA-style manuscript and presenting a formal poster in a campus-wide psychology conference organized by our Psi Chi chapter.

By getting involved in every step of the research process early on, our majors are able to form the analytical skills necessary for them to succeed in more concentrated research experiences (see Perlman and McCann, 2005). By their junior year, students can begin to take an advanced lab in their preferred sub-discipline, such as Animal Learning, Bio, Cognitive, Developmental, Health, Neuro, and Social Psychology. These small seminars center around the discussion of empirical articles and have a lab component in which students develop more complex research studies that are presented as talks in our local psychology conference. Although certain students may be ready to join and contribute to a faculty lab earlier in their studies, we believe that the step-wise progression of the C.O.R.E. helps develop our majors into critical consumers and producers of research, and better prepares them to collaboratively conduct publishable research.

## IMPACT: A STUDENT PERSPECTIVE OF C.O.R.E. (LM)

The general consensus in the literature is that smaller classroom sizes promote student engagement, commitment, and motivation (Mulryan-Kyne, 2010). Further, students who perceive faculty members to be approachable and available tend to report greater intrinsic motivation and academic achievement (Komarraju et al., 2010). These components were indeed reflected in my educational experience at Providence College. Right from the start of my psychology major, an optimal learning dynamic was achieved by faculty members who were able to fully draw in their students by making the course content more personally relevant. This individualized classroom experience was especially critical to engaging me in research. As a sophomore taking RDSA, the intimate classroom setting and increased faculty support motivated me to succeed in a course that can produce anxiety in many students (Sandoz et al., 2017). Statistics and research design can often feel dull or difficult for students to whom these concepts do not yet have pertinence. However, independently designing and conducting research projects lessened these feelings for me and drove my desire to thoroughly learn the challenging material (Kember et al., 2008).

Without students gaining a solid foundation in statistics and research design, their lab contributions would be limited in a manner that could directly affect faculty productivity. The time and effort required to mentor students, as well as the lack of foundational skills obtained by the students, can serve as roadblocks to producing meaningful research collaborations between professors and undergraduates (Johnson et al., 2015; Brew and Mantai, 2017). My education at Providence College minimized these obstacles by emphasizing the empirical nature

of psychology and equipping me with adequate research skills by the time I joined a faculty member's lab during my junior year. Consequently, I was able to focus my lab efforts on refining these proficiencies and developing my individual research identity, both of which prepared me for graduate school.

## FACULTY DEVELOPMENT & MENTORSHIP IN RESEARCH LABS (SM)

Although critical to the training of undergraduates, a research-focused curriculum should be seen as only the first step toward productive collaborations between students and faculty. To further promote research success, professors should consider using a graduate school model to select, develop, and mentor their lab members. For instance, our Social Perception and Attitudes Lab requires all interested individuals to submit a written application, along with a copy of their résumé and academic transcript. Students who have completed the preferred course pre-requisites and thoughtfully expressed their research interests and intentions are then invited for a personal interview. This extensive process generally produces applicants who are truly motivated to engage in the research process and pursue the principle investigator's questions. Furthermore, since new members usually serve as volunteers before being offered course credit, the lab is comprised of undergraduates who often display a high level of intrinsic motivation (Deci, 1971).

In line with goal setting theory (Locke and Latham, 2002), lab members fill out learning agreements each semester in which they identify specific and challenging (yet reachable) goals. These "educational contracts" are discussed in individual meetings throughout the semester and serve the dual purpose of motivating students and holding professors accountable. Having already received initial training through their course curriculum, undergraduates are able to take a more active role in the research process. Students work closely with the principle investigator to identify gaps in the literature, create study materials, write IRB protocols, program studies, run subjects, and participate in data analysis. Instead of being trained on the basics of research, undergraduates focus their lab contributions on formulating theoretically grounded hypotheses and developing impactful studies that are more likely to be published.

Faculty members who seek productive collaborations with undergraduates must also be willing to serve as mentors. This begins with instilling confidence in the students, both on an interpersonal and academic level. One effective way to accomplish this is by having research assistants work in pairs on projects of primary interest to them. Teamwork not only increases the lab's output, but it also helps students dive deeper into specific research questions and build their expertise (Waite and Davis, 2006a). Through this process, students become increasingly comfortable with discussing research findings and ultimately presenting them at conferences. Such opportunities are invaluable, as students are exposed to a variety of psychological disciplines and are able to begin networking with the aid of their faculty mentor. Moreover, the constructive feedback provided during poster sessions can inspire students to



independently pursue new research questions and add to their overall professional development (Thiry et al., 2011). Students at this stage should be encouraged to apply for undergraduate research grants, which help produce publishable projects with larger, more variable samples that can be obtained through paid platforms like Amazon MTurk. Lastly, when lab members fulfill the expectations for authorship set forth by the American Psychological Association, faculty members should invite their students to draft sections of the manuscript, making sure to also include them in the submission and review process so they can become familiar with these crucial aspects of research. It is important to be open-minded about possible publication outlets, as some journals often have certain sections dedicated to single-study projects that can be feasibly carried out and co-authored by undergraduates who are working with a condensed timeline. In short, taking on the full responsibility of a mentor can help professors at teaching institutions produce fruitful collaborations with their undergraduates and send students down the right path early in their research careers.

## IMPACT: A STUDENT EXPERIENCE IN A FACULTY LAB (LM)

While the curriculum at Providence College served as a catalyst for my interest in research, working collaboratively with a faculty member and like-minded peers fully engaged me in the scientific process. First, my faculty advisor and I filled out a learning contract to agree on expectations and goals for the semester. This helped instill a sense of assurance that the faculty member would provide practical and personal support, and that I as a student would provide my active effort and dedication to the lab. Further, students work in pairs on projects of mutual interest. Collectively making decisions, discussing ideas, and trouble-shooting problems heightened our individual motivation to carry out quality research (Waite and Davis, 2006b). Moreover, joining a faculty-led lab allowed me to move beyond the C.O.R.E. and elevated my critical thinking skills to a level appropriate for graduate school. By actively taking part in every aspect of the research process as an undergraduate, I was a stronger candidate for graduate school (Karazsia and Smith, 2016), and once admitted, was able to immediately begin making progress toward my independent master's projects and thesis proposal.

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I attribute most of my preparedness to the opportunities provided by my faculty mentor. He served as a model for how to formulate theory-based research questions, a teacher for how to carry out publishable research, and a guide for choosing paths that would lead to professional success, even as an undergraduate. Combined with my dedication to research, these mentorship qualities led me to presenting my lab project as a first-author poster at the Association for Psychological Science Annual Convention. More importantly, I was able to work with my mentor during my senior year on a special issue article submission that was accepted for publication. The feedback and multi-disciplinary exposure during both of these experiences expanded my knowledge of psychological research, enhanced my writing skills, and increased my self-confidence as a scientist (Helm and Bailey, 2013). Opportunities such as these promote the production of meaningful publishable research as an undergraduate, and especially now as a graduate student.

## CONCLUSION

In order for psychological research to progress, it is necessary for scientists to be fully committed to teaching and mentoring students, beginning at the undergraduate level. By offering a curriculum that emphasizes the scientific nature of psychology, departments can develop students into confident and competent researchers who are then able to collaborate with invested faculty members. Although this dual-prong approach does not necessarily guarantee publication success, we believe that it can serve as a recipe for increasing faculty and student productivity at more teaching-focused institutions that have limited research resources.

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# Use of a Creative Problem Solving (CPS) Approach in a Senior Thesis Course to Advance Undergraduate Publications

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We outline a creativity-based course model for supervising and promoting undergraduate research at a small liberal arts college of about 1,600 undergraduate students, with no graduate offerings. This approach could easily be modified and implemented at weekly brownbag or joint laboratory meetings at similar and larger types of schools. At our institution this course is required of all psychology research thesis students (on average 8 per year) and requires the cooperation of the students, their thesis supervisors, and the course instructor. In part because of this course, during the past 20 years, our department faculty have published a total of 47 publications with undergraduates in peer-reviewed outlets such as *Personality and Individual Differences*, *Psychology of Music*, *Psychology of Women Quarterly*, and *Sex Roles*. Importantly, according to PsycINFO, these undergraduate-generated publications have garnered more than 500 citations, attesting to the impact that undergraduate research can have on the larger field in terms of knowledge generation. In addition to impactful peer-reviewed publications, our undergraduate students have presented 163 posters at national conferences such as the Association for Psychological Science, Society for Personality and Social Psychology, Society for Neuroscience, and Psychonomic Society. Below we outline how our senior thesis course stimulates the creative dissemination of knowledge that is required during the publication process.

Our senior thesis course structure is based on the Creative Problem Solving (CPS) framework, a well-known and validated approach to creativity enhancement in educational settings. This approach emphasizes creative and critical thinking in instruction—both at an individual and a group level (Baer, 1988; Isaksen et al., 1994; Treffinger et al., 2006). In the CPS framework, creative thinking occurs when a problem or challenge is considered from many different perspectives, which leads to a multitude of possible solutions or answers (this is also known as divergent thinking—see Wieth and Francis, 2018 for a review). In this stage of creative problem solving, many original solutions or answers are desired (Boynton, 2001). The second aspect of the CPS framework is critical thinking (also known as convergent thinking—see Wieth and Francis, 2018 for a review). After generating possible solutions to a problem or challenge, it is essential for the student to converge on a single most useful solution for that particular problem or challenge (Campbell, 1960; Mednick, 1962; Lundsteen, 1986; Amabile, 1988; Mumford, 2003; Sternberg, 2010). In this article, we outline how using the CPS framework in our senior thesis research course has prepare and enable our students to thrive during the publication process.

Reiterative critical feedback of written and oral production is an essential component of the CPS approach used in our senior thesis course. Written assignments in this course are no different than what advisors usually ask of their thesis students (e.g., complete a draft of the Introduction or Method), but in keeping with the CPS approach, each written component goes through a cycle of creative and critical feedback from several peers during class. As can be seen from the

most recent syllabus, available as **Supplementary Material**, students must bring their writing to class four times across the semester to be reviewed by peers. Collaboration, social support (John-Steiner, 2000), and honest critique (Nemeth et al., 2001) are viewed as key factors in creative breakthroughs. Therefore, each time peer-review occurs, students are asked to provide and receive constructive feedback from at least two peers in the course. The instructor of the course orchestrates the pairings to ensure that students receive a diverse set of feedback. Typically, a student is paired with a classmate using a similar research approach AND with a classmate using a very different research approach. At a liberal arts college, there is often only one faculty member per psychological discipline (e.g., cognitive psychology), so a student may be working with an advisor that is a cognitive psychologist but receiving feedback from a student working with a social psychologist or neuroscientist. Receiving feedback from someone in a different area of psychology often encourages more divergent thinking and helps students understand the greater context of their research. In other words, the first step in the peer-review process is designed to encourage more creative thinking.

The second part of the CPS framework employed during peer-review in the senior thesis course is designed to encourage critical thinking by having students to practice converging on a best solution to a problem or challenge. For example, during the peer-review process, each student must decide which suggestions are appropriate and helpful for their project and which suggestions are counter to the purpose of the project. However, unlike when students receive feedback from their faculty advisor or an outside faculty member, students feel more comfortable critically evaluating the suggestions from their peers. This provides an excellent mechanism for students to practice critical evaluation after being exposed to a wide range of feedback.

Another way we encourage critical thinking in our course is to scaffold students' research by having students make four platform presentations, each with a different focus for a different audience. During the class, students make two 20-min platform presentations to their peers and other faculty. After receiving feedback from peers on the written portion of the Introduction and Method, the student must give a presentation that covers the Introduction and Method sections. After receiving feedback from peers on the written portion of the Results and Discussion, the student must give a presentation that covers the Results and Discussion sections. After presenting for the allotted time, there is approximately 15 min of discussion devoted to each student's project and presentation. The student's research advisor along with other faculty in the department attend these presentations throughout the semester and provide feedback in an intellectually safe environment. The attendance of faculty other than the instructor is of critical importance during these presentations and serves several purposes. In addition to instruction and practice of psychology presentation skills, the discussion after the presentation allows the faculty to model appropriate conflict resolution and problem solving strategies. Research has shown that fostering an environment where honest and thoughtful dissent is accepted and appreciated enhances productivity and fosters creativity (Nemeth et al., 2004). At first students are often surprised and perhaps a bit intimidated when they

experience two or more faculty members debating some aspect of their project, but by the end of the semester, students are more comfortable joining in the debate in a meaningful and appropriate way. Modeling critical and thoughtful responses not only leads our students to hone their thinking and presentation skills, it also provides them essential experience for responding to comments during the peer-review publication process.

As a culminating experience, students must also present their work in two other venues: a regional undergraduate psychology conference and a college-wide research symposium. The purpose of these myriad presentations is for students to learn what components of all the work they have done are essential for presentation to different audiences. In other words, students must converge on a best solution depending on the audience to whom they are presenting. In each situation, the student must modify their presentation for the audience. For many of our research students, this is their first foray into professional psychology meetings, so rather than going initially to a national meeting, we require students in the course to present at regional undergraduate psychology research conference held each spring. This meeting provides students with the opportunity to receive additional reviews of their work, this time from psychology faculty and other psychology majors at different schools who may bring perspectives different from those in our department. To develop more critical feedback response skills, students are required to present at a college-wide symposium given to faculty and students outside the psychology department. For the all-college symposium, students learn how to present their research in a very different way than they have done for their theses and presentations to "psychology-oriented" audiences. For instance, although the importance of basic research into personality may be self-evident to psychologists, it is less obvious to faculty and students not trained in our discipline. Thus, students need to, again, think about their work from a wider perspective, this time including a very diverse audience, to find the most effective way of presenting their research. Much like the peer-review process often provides researchers with different and sometimes even conflicting suggestions; these presentations help students see their own work from multiple perspectives and forces them to choose a presentation and feedback response format that best fits the audience.

Our course outlined here prepares students for what is required during publication by exposing our students to diverse feedback from students, psychology faculty, and college-wide faculty. This is similar to the sundry reviews authors often receive after submitting a manuscript. In addition, our creativity focused classroom model also promotes critical thinking, a fundamental component of creativity, as outlined by the CPS framework (Isaksen et al., 1994). By teaching students to evaluate feedback from a variety of individuals and adjust their presentations to various audiences, we are encouraging critical thinking that helps students understand the importance of finding the best way to present their research. Furthermore, these critical thinking skills help students not get overwhelmed by reviews of their manuscript and the, often many, demands reviewers make. Providing this course to all thesis students in our department has enabled us to teach students more about the research and

publication process, allowed us to include more students on publications and national presentations that arise from their own research, and support our fellow faculty in their senior thesis advising endeavors by ensuring that their students meet their goals and deadlines. Using the CPS framework in a course, does take a certain amount of effort and collaboration from advisors, students, and other faculty, but we, and our fellow faculty in the department, believe that those efforts are well-spent as our senior thesis students' work often turns into influential publications in their respective fields.

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## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# The Summer Undergraduate Research Experience as a Work-Integrated Learning Opportunity and Potential Pathway to Publication in Psychology

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Unlike disciplines which focus on skill development from year one of a bachelor's degree, training in psychology in Australia follows the scientist-practitioner model. According to this model, an undergraduate psychology degree should focus on the scientific principles underpinning the discipline and provide a foundation for the development of professional skills in graduate school. However, most Australian psychology undergraduates do not continue into graduate school, and concerns have been raised about their lack of applied skills and work-readiness. Work-integrated learning (WIL) refers to strategies aimed at providing students with practical experiences (e.g., fieldwork, placements, and internships) directly related to their course of study. The objective of WIL is to increase work-readiness. Accreditation standards coupled with the norms of the discipline have historically prevented the inclusion of typical WIL experiences in Australian undergraduate psychology degrees. However, one particular type of WIL activity—the undergraduate research experience (URE)—is particularly suited to psychology. In a typical URE, students collaborate with faculty to conduct research designed to make an original contribution to their field. The current study is a qualitative investigation of stakeholder perceptions of a competitive summer URE program ran from 2012 to 2016. Six faculty members and seven undergraduate students were engaged in semi-structured interviews about their URE experiences. Constructed themes broadly reflected the benefits and challenges of the program and included *work-readiness and additional research experience, networking and teamwork, publication, quality of experience and equity of opportunities*. Faculty members and students spoke favorably of their UREs in most cases, although issues of administration and financial concerns were mentioned consistently, as were concerns about the length, timing, and nature of projects. Students reported skill development and networking as two of the key benefits of their participation in the program, and article publication was seen as particularly beneficial to career prospects. Our findings suggest that student co-authored publications resulting from UREs are possible, but careful thought is required to optimize their likelihood. Overall, this research adds to a growing literature

suggesting that UREs can confer a range of benefits to Australian psychology schools related to increased research capacity and student satisfaction.

**Keywords:** undergraduate research experience, work-integrated learning, psychology, undergraduate publication, research supervision

## INTRODUCTION

Work-integrated learning (WIL) refers to “approaches and strategies to integrate theory with the practice of work within a purposefully designed curriculum” (Patrick et al., 2009, p. v). The primary objective of WIL is to improve graduate employability by providing students with practical experiences that are directly related to their course of study (Smith et al., 2014; Universities Australia et al., 2015). WIL activities are diverse and commonly include fieldwork, placements, practicums, and internships. Such WIL activities are routinely embedded in many undergraduate degree courses, particularly those that graduate students “ready” for entry-level practice in their chosen professions (e.g., nursing, accounting, engineering, architecture, among many others). Research suggests that opportunities to engage in and/or facilitate such activities are associated with a range of positive outcomes for students (Dressler and Keeling, 2011), employers (Braunstein et al., 2011), and education providers (Crump and Johnsson, 2011).

Unlike disciplines which focus on the development of specialized skills from the first year of the bachelor’s degree, training in psychology in Australia follows the “scientist-practitioner” model (Lipp et al., 2007; Provost et al., 2010). According to this model, a four-year undergraduate psychology degree should focus on the scientific principles underpinning the discipline and the development of generic competencies, such as the ability to conduct valid research, think critically, behave ethically, communicate effectively, and demonstrate psychological literacy (Cranney et al., 2009; Provost et al., 2010). These competencies position graduates for employment in a range of industries (Appleby, 2018; Halonen and Dunn, 2018), though not for immediate employment as a registered psychologist (Littlefield, 2016). Most Australian psychology undergraduates do not continue into graduate school, which is the key pathway for employment as a psychologist (Hamilton et al., 2018). The absence of practicum/placement opportunities is the most frequent criticism of Australian undergraduate psychology courses, and psychology graduates tend to report that they lack professional and practical skills after completing a bachelor’s degree (Martin et al., 2013). Furthermore, employers and graduate placement supervisors often comment on the limited practical skills of four-year graduates (Breen et al., 2003; Pachana et al., 2011; Sheen et al., 2015).

Although there are moves toward increasing specialized skill training in the final year of the bachelor’s degree (see the pre-professional competencies specified in the Australian Psychology Accreditation Council’s [APAC], 2018, new standards, which became effective in January 2019), historical accreditation standards (APAC, 2010) combined with the norms of the discipline have precluded the inclusion of most typical WIL experiences in Australian undergraduate psychology degrees. However, one

particular type of WIL activity—the undergraduate research experience (URE)—seems particularly suited to psychology.

In a typical URE, a student will collaborate (either individually, or as part of a small team) with a professional researcher/faculty member to conduct a piece of research designed to make an original intellectual contribution to their discipline (National Conferences on Undergraduate Research and the Council on Undergraduate Research, 2005). UREs can be considered as apprenticeships (Zimbardi and Myatt, 2014) and a form of professional socialization (Hunter et al., 2007), and research indicates that they afford students a range of benefits. For example, Kardash (2000) observed that science undergraduates self-reported significant gains in reading and using primary literature, formulating hypotheses, conducting data analysis, and interpreting and communicating scientific findings following URE participation. Liberal arts college students self-reported similar skill development, numerous personal/professional gains (e.g., increased confidence in their ability to conduct research, contribute to science, establish collegial relationships etc.), and an increased capacity to think and work like a scientist (Seymour et al., 2004). In a large study comparing alumni who had engaged in UREs with alumni matched on a range of personal characteristics, but without such experiences, Bauer and Bennett (2003) observed similar effects. Those alumni who had participated in UREs self-reported a greater ability to apply and understand scientific findings, think logically, solve problems creatively, use statistics and information technologies, adapt to change, critically consume research literature, work independently, and communicate effectively. The alumni who had participated in UREs also self-reported greater overall satisfaction with their college/university experience and were more likely to have subsequently enrolled in graduate studies. The magnitude of the effects observed by Bauer and Bennett (2003) appeared to increase commensurate with the length/intensity of the URE.

Multiple points of interest emerge when reviewing the URE literature. First, it has overwhelmingly originated from the United States, where a large national infrastructure has developed to fund and support UREs. For example, the National Science Foundation alone typically budgets over US\$70 million per annum for their research experiences for undergraduates program (McDevitt et al., 2017). No comparable infrastructure exists in Australia. Second, many of the skills gained from a URE (e.g., the ability to conduct valid research, communicate effectively, behave professionally, etc.) map closely onto the graduate attributes for the four-year Australian undergraduate psychology degree articulated by Cranney et al. (2009) and subsequently endorsed by APAC (2010). Third, UREs have the potential to provide meaningful WIL



experiences in Australian undergraduate psychology courses, where more traditional forms of WIL are difficult, or impossible. Increasing the WIL opportunities afforded to Australian university students has been identified as a priority by both government and industry bodies (Universities Australia et al., 2015). Despite these points, no research that we are aware of has focused on a URE as a potential WIL opportunity from the perspectives of Australian psychology undergraduates and faculty members. The first purpose of the current research was to redress this deficit. Additionally, given the established potential of UREs to contribute to knowledge generation and dissemination, we also wanted to explore the potential for UREs to lead to publication opportunities for undergraduate students in psychology.

## METHOD

### Context

The School of Psychology at Curtin University initiated an annual “summer scholarship” URE program in 2012, which ran until 2016 when budgetary constraints forced its cancellation. The program allowed students to work closely with one or more faculty members on a project of mutual interest. Each student was paid AU\$2,000 for up to 30 days’ work. During that time, students completed a variety of tasks oriented toward progressing the project (e.g., participant recruitment, data collection, data analysis and interpretation, reviewing and synthesizing literature, report writing, and dissemination). The URE scholarship program was intended to give students applied research experience prior to their third year of study.

Participation in the program was competitive for both faculty and students. Faculty members proposed projects that were evaluated according to their feasibility and the quality and variety of opportunities they were likely to afford students. Student applicants were selected based on their prior academic performance. Student applications numbered approximately 40–50 per year, and up to seven scholarships were awarded annually. Each participating faculty participant was asked to complete a brief written report on the project following the completion of the scholarship.

### Research Design

We addressed our research question qualitatively. This afforded us opportunities to explore and understand the meaning and value (or otherwise) of an understudied phenomenon, an Australian psychology URE program, from the perspectives of key stakeholders. We adopted the epistemological position of critical realism (Forrester, 2010). That is, we recognize that knowledge is constructed and context bound, and that research is a social process. However, this process can provide (imperfect) access to an authentic reality that exists beyond our methods. Consequently, critical realism can be seen as taking a middle ground between social constructionism and extreme positivism, allowing for rigor and reflexivity concurrently (Forrester, 2010). Semi-structured interviews were conducted and thematically analyzed (Braun and Clarke, 2006). These data were

complemented with archival records (including faculty members’ written reports) of the longer-term outcomes of scholarship projects, where available.

### Participants

Between 2012 and 2016, 22 psychology students and 16 faculty member supervisors were involved in the URE program. Following ethics approval (reference: HRE2017-0380), each of these stakeholders (with the exception of two authors who previously supervised UREs and two supervisors no longer employed by the university) was emailed an invitation to participate in the study by a school administrator independent of the research team. Seven students and six faculty members (total  $N = 13$ ) responded to this invitation and were subsequently interviewed for this study. Consequently, our response rate was 34%. Gender descriptions have been purposefully withheld from this article to assure participant confidentiality (Kaiser, 2009). It was estimated that approximately 12 interviews would result in saturation (Ryan et al., 2007), although it is recognized that the concept of saturation is contentious (O’Reilly and Parker, 2013), particularly when multiple stakeholder perspectives are being considered. In our case, we believe that saturation at the theme level was reached (Guest et al., 2006), and this determination was informed by the concept of information power (Malterud et al., 2015).

### Materials

The literature review informed the development of separate semi-structured interview protocols for student and faculty member participants. The student protocol included questions about the nature of the URE experience and if/how it has informed subsequent academic and professional development. The faculty protocol included questions about the experience of supervising projects and the role that UREs can play in the undergraduate curriculum and employment preparation. Both protocols are included in our **Supplementary Material**.

### Procedure

Individual interviews were scheduled at mutually convenient times and locations with all of the students and faculty members who responded to our call for participants. All interviews were conducted by the first author, lasted between 18 and 42 min ( $M = 33$  min), and were audio recorded with the consent of participants. They were semi-structured in the sense that all the main questions on the interview protocols were asked of participants, although not necessarily in the same order. Furthermore, the number and nature of prompts used varied according to participants’ responses. Such flexibility allowed for the development of rapport and exploration of issues as they were raised by participants, which explains the variability in interview length. The interview recordings were transcribed verbatim before being securely erased.

### Data Analysis

The interview transcripts were imported into NVivo for data management and analysis. The transcripts were thematically

analyzed following the six-step procedure described by Braun and Clarke (2006). This entailed (a) initial familiarization with the data, (b) line-by-line coding, (c) collation of recurrent codes into potential themes, (d) theme checking throughout single transcripts, followed by the entire dataset, (e) creation of labels and definitions for emergent themes, and (f) utilization of themes and representative quotes to construct findings addressing the aims of the study (Braun and Clarke, 2006). The first author led the analysis, whilst the remaining authors contributed to peer coding and provided regular feedback on emergent themes and the development of the analysis. Names and pseudonyms were avoided in favor of gender-neutral pronouns (e.g., their) in the preparation of this manuscript to increase the confidentiality of interviewees who are known to each other and are therefore potentially identifiable (Kaiser, 2009). These decisions afforded participant anonymity beyond the research team. Themes and selected data extracts were drawn from the whole data corpus to reflect the entire sample. Data extracts appear with a code indicating faculty (F1–6) or student (S1–7) status. Journaling and memo writing were used as an audit trail to track research decisions (Forrester, 2010). The memos included daily research activity lists, queries, thoughts, anticipated categories, data issues, collation of earlier memos, summaries of meetings, and reflections.

## FINDINGS

The constructed themes were grouped broadly as benefits or challenges. Benefits included *work-readiness and additional research experience, networking and teamwork, and publication*. All participants were also critical about aspects of the program, highlighting particular challenges with the program. Notably, themes concerning the *quality of the experience* and the *equity* of the program highlight these challenges.

### Work-Readiness and Additional Research Experience

Most participants ( $n = 11$ ) described their involvement in the URE positively, with both faculty and students reporting a range of benefits associated with perceived work-readiness. The URE was described as positive, enriching, advantageous to future endeavors and employment options, and an opportunity to foster professional connections that are not easily made via the usual undergraduate course-based experiences.

Within the URE context, there were benefits attained via participation in a new research-based experience that might simulate skill development and thus help prepare students for future employment opportunities: *"In my experience, they are greatly beneficial because they give students an opportunity to do things that otherwise, they wouldn't be able to"* (F2). Here, the faculty member aptly summarizes a benefit of the URE opportunity, also synonymous with exposure to new experiences, such as tutoring positions, research assistant employment, and national or international networking via project involvement, conference presentations, and article publication, all of which were outcomes described in interviews with students.

*It seemed like a pretty great opportunity to further my skills, and so I only could see the benefit in that. I was really really set on quantitative research at the time, as well, and so I really wanted to be professional more than proficient at it. I thought it would be really beneficial.* (S4)

Here, we see the enthusiasm that URE participation evokes in students whose experiences were positive and productive.

Related to, or possibly because of, developing research skills, the URE program enhanced perceived employability and even created future opportunities for research experiences. Four of the seven student interviewees reported securing employment as research assistants as a direct consequence of their involvement in the URE.

*Afterwards they asked me to come back and do a couple more things, but as paid work. I did that for about half a year.* (S2)

*I just continued working as a research assistant the whole time, so that was good and very flexible. So during semester I didn't do very many hours and then I did a lot of hours over summer, so that was good.* (S1)

This suggests that the skill development that occurs in a URE many promote student employability, at least in research contexts. Two further cases were mentioned by faculty. For instance, one faculty member said *"I think it's a really, really good opportunity for the students. It becomes a CV [curriculum vitae] item; we work towards getting them some kind of output [i.e., publication or conference presentation] that they can list as well as the experience"* (F5). In this way, program participation was perceived to bolster work-readiness skills prior to graduation, where these types of skills will be essential for career success.

### Networking and Teamwork

The URE was seen by many participants as a platform for initiating and developing professional relationships. This theme was evident in all student interviews and five of the six faculty interviews. Faculty described the URE as an opportunity to recruit future research (e.g., honors and graduate) students. For example, one faculty member described how their role did not include regular undergraduate teaching, and thus their ability to meet and capture the interest of prospective research students was limited. This faculty member explained that many students select honors and graduate projects based on who they know, rather than what they will be researching. Thus, involvement in the URE program provided an important opportunity to achieve some name, face, and research area recognition:

*It's a networking opportunity. The first thing is to give a student who is interested in research an opportunity to do some, and get their hands dirty and see what it means to actually work in a lab ... and then hopefully interest them enough, or sufficiently in the stuff that we're doing so that they may come back to do honours, or further [graduate research].* (F2)

The URE can be a microcosm of later, more substantial research experiences, and an environment that can foster relationships that may continue well beyond the summer. This is reflected in student perspectives, with one student explaining:

*The best thing to come out of it was the relationship I built with my supervisor, who then went on to be my supervisor for honors and now graduate [studies] ... the people I worked with in the team. That was probably the best experience, and what I was hoping for. (S1)*

It appears that, when decisions about future study are made, subject matter can play a secondary role to personal relationships. At least some students make decisions about future study based primarily on who they know, which can make it difficult for faculty without undergraduate teaching responsibilities to attract capable research students. UREs can provide a valuable recruitment vehicle for such faculty.

Students who participated in projects that were situated in research labs or teams appeared to have particularly valued the experience of teamwork. For example, “I really learned about the value of working together. I mean, I already believed in it, but I just saw what that team achieved by working together” (S4). Equally, faculty members described the value of supervising in a team, which ensured that students were appropriately supported, even during very busy times.

*The students were able to come in and sit with us. They were with us nine-to-five, five days a week. They got to hear what was going on. So if I couldn't help them immediately when they had a query, there were all my postdocs around who could give them assistance. And I made sure they were part of teams so there were other people always working on whatever they were working on as well. (F5)*

## Publication

For faculty, the key motivation behind applying for a scholarship student was usually the prospect of progressing a specific piece of research. “We got a rather wonderful student who then worked with us on a systematic review...” (F1). This meant that they designed the scholarship opportunity to lead to eventual publication. In such cases, the URE often helped faculty achieve this goal. “This paper [would have been] impossible without this scholarship in the beginning ... [it] made that paper possible” (F3). However, a completed manuscript for publication was not a program guarantee. For example, just 8 of the 24 projects that we were able to locate records for led to published papers (with a ninth about to be submitted). Faculty generally acknowledged that although undergraduate students can contribute to the work involved in publishing research, the majority of it is beyond their level of ability and expertise.

*When the student finished, there was still an awful lot of work to do... (F1)*

*It really is dependent on you having the kind of data that someone at that level can work with. They don't have the skills yet to write it up in a way that could be immediately publishable, or even in a report... Both those students were good though, but it still takes reworking. (F6)*

This may account for why, of the eight papers we identified, only three were co-authored by students. However, the contributions of the relevant students were acknowledged on most of the rest.

For students, the prospect of publication did not drive their decision to apply for a scholarship. However, for some, it was a favorable consequence of their involvement with the program.

*She'd always also mentioned that this could turn into a publication for me as well... So I was like "yeah, that sounds like a great opportunity". (S5)*

*...I went straight into data cleaning and screening ... and then we went into the analysis. From there, we ended up writing up a paper. Well, we wrote up a draft and then our supervisor made changes to it. From there, [the supervisor] submitted it for publication. I think not long ago we got approved, so that was really cool! (S3)*

S3 described in detail how they were involved in multiple steps of the publication process, from initial journal selection, through rejections, revisions, and acceptance. However, the other students were not so involved. Some lost contact with their work at the conclusion of their URE, and others did not contribute sufficiently to justify co-authorship, or were involved in a project that supervisors ultimately decided not to pursue.

*Maybe some of the data analysis was used, but I don't think my name was actually put on any papers because I probably would have been notified. (S2)*

*Nothing's happened in five months. Maybe five months ago they decided it was all a waste of time and they weren't going to do it anymore and that was the end of it. Maybe I'll look in a couple years and search my name in one of the databases and see if my name pops up somewhere. (S7)*

Finally, the opportunity to co-author a conference presentation served as satisfactory outcome for some students:

*So from that then the opportunity came to speak at a conference with this paper, cause it was rejected for publications. (S1)*

## Quality of Experience

Although most faculty and students described the URE in positive terms, challenges and criticisms of the program were also expressed by every student to varying degrees. In these cases, the challenges often stemmed from the reality of the program not meeting students' and faculty members' expectations.



This theme, *quality of experience*, concerned issues around administrative matters, whether expectations were met, and the quality of the supervision and learning opportunities.

*My expectation was that I would get access to people and that it would be a collegiate kind of environment. It would be an exciting practical experience in research, so it would give me some skills that I hadn't been exposed to before and that it was an opportunity to develop some relationships with strictly academic staff. I guess, truth be told, none of that really happened. (S7)*

One student reported that their experience was tarnished by issues concerning administration, remuneration, and isolation throughout the project. Although the scheme was advertised as a “scholarship,” the scholarship holders were paid as employees of the university, with their pay subject to income tax. For many, this meant that their \$2,000 scholarship was worth around \$1,600 (with the remaining \$400 withheld to offset their potential tax liability at the end of the financial year). Additionally, students were not typically assigned a workspace and, therefore, completed much of their work away from campus and the project supervisor/research teams.

Also linked to the administration of the URE was a desire on the part of students to have more input into the nature of their experience:

*It certainly wasn't a project that I feel like I would have chosen if I'd known a lot of detail about it. I just went in blind and heard about it when I got the notification that I got in. Then learned who I was going to be working with, so no real choice about any of that stuff. (S7)*

A further common criticism of the program was that experiences tended to fall within skill areas that students felt they had already developed, such as literature searches, rather than providing opportunities for new experiences. Additionally, students and faculty at times were frustrated that the quality of the learning experience was not optimized, meaning that at least some URE projects were an under-utilized opportunity. For example, one student was assigned to a project that did not yet have ethics approval, which reduced the availability of tasks and learning opportunities and resulted in the student mainly practicing skills they felt were already well developed:

*It could have been way better. I could have been used better. I could have learned more than the same old things. I mean through the degree obviously we already do a lot of finding articles. And Googling isn't anything revolutionary. It's quite boring. (S6)*

This sense of mismatched expectations was echoed by some faculty, suggesting that a more rigorous matching procedure could potentially offer more value to the experiences of all involved parties.

*...a better marrying up of us knowing what they want to do and them knowing what we want them to do and seeing*

*where we can find parallels, but hopefully with them being prepared to just 'suck it and see' a little bit as well. (F5)*

Faculty also felt that their ability to provide rich learning experiences for students was limited by the capabilities and knowledge of students within the context of available projects and datasets.

*Maybe whether there's some sort of a matching scheme between the skills students have and the projects was possible, but again, given how limited the students are in where they are in their career ... maybe not. It's hard to tell, but maybe a little bit more background on the student so that we can say, okay, they have done this unit or they haven't done this unit or they're terrible at stats. Maybe we would reconsider or do a qualitative component. As I said, with the student we had, that wasn't an issue, but I could see there being a potential mismatch there where your strengths are in one thing, but you're put onto another project because you like the sound of it. Actually sometimes it's not the topic area that's important so much as the research skills that you've got. (F1)*

Another faculty member found the program disappointing when assigned a student who was unable to complete assigned tasks: “I was expecting commitment. I always had commitment, and I didn't get any commitment. It was disappointing, but I just thought, well that's life, but I'm not doing another one” (F6). Faculty members clearly acknowledged that the quality of the experience was contingent on how well people, topics, work ethic, and skills aligned.

Student and faculty experiences of un-met and mismatched expectations speak to the need for quality controls that ensure URE projects provide a diversity of opportunities for student participants as well as those providing supervision. A faculty member spoke passionately about their love of supervision, and the potential to shape the next generation, with insightful observations about the quality of the experience being so important:

*Making sure that supervisors don't see it as just cheap labour. There's a risk that even with honours projects, some supervisors can be seen to be putting their [own] needs first. They might not necessarily be, but the students can sometimes feel like they are a research assistant, not doing a research project. (F1)*

Although there was an acknowledged framework for the research component of the URE, there did not appear to be a framework in place to monitor the quality of supervision, as evidenced when F1 was probed further:

*When you put the proposal in, there's rules as to what a proposal has to do, and so there's clear-ish guidelines about [how] it has to be a learning experience and it has to fulfil certain criteria. Regarding the skills the student has to*

*obtain, there are rules. Regarding how to manage the relationship with the supervisor, there's nothing that I'm aware of. (F1)*

Beyond relying on the teaching experiences of each supervisor, the experiences of the students in our study suggested a need for explicit guidance to supervisors around facilitating a diversity of learning opportunities for students, as well as ongoing oversight to ensure these guidelines are followed.

*It was quite useful because essentially, from a selfish perspective, it enabled me to get some research assistant work without paying because the school was covering the cost. Because the students volunteered ... they were quite motivated. (F4)*

## Equity

This theme was evident in the interviews with two students and three faculty members. It refers to the extent to which the URE was accessible to all students, versus only relatively affluent high achievers. Obviously, when there is competition for limited places, a selection process is required. This theme questions the extent to which this selection process should be purely grades-based and disregard qualities like motivation and diligence. For example, one student said:

*The individuals who get certain grades, or pass a certain grade point, are given set opportunities that I don't know are experienced by everyone. So, what if someone really did want to further their quantitative skills and do some research assistant work for a scholarship program, but they couldn't because their grades were not high enough, or something like that? And so, I just wonder about how this shapes individuals' opportunities. The people who are doing well get more opportunities, and the people who didn't get it the first time have less opportunities, and how that might perpetuate certain expectations. (S5)*

Here, we can see an altruistic concern from a student of high ability toward peers, and recognition of the notion that unless all students have equal access to opportunities like this URE program, the best students are set up to succeed in future endeavors, while more average students remain where they are. This perspective sets up an interesting dichotomy between faculty perceptions of student ability as being quite limited when only having completed half the degree, while successful applicants to the program are all high achievers, and considered more skilled than the general psychology cohort. From another faculty member, a similar although more economically driven equity criticism was raised:

*The difficulty with the program as it stands is it probably excludes a lot of our other students because they can't give up a month because they're working and so on and so forth. Again, a part-time thing might open it up to [all] students*

*rather than the better off who are able to say, "All right, I'll give up my time for a month and I don't have to go and work in [a supermarket] or whatever". I think for the learning experience but also in terms of equity, maybe part-time over a little bit of a longer period might work. The student has to balance that against work and so on. (F1)*

The point about running the URE less intensively over a longer period of time was raised by several faculty members ( $n = 4$ ) and students ( $n = 4$ ). Concerns were also raised about its timing over the summer tuition free break, when faculty tend to take annual leave, and because the subject pool is only operational during semesters, recruiting participants for many research projects is challenging.

## DISCUSSION

The aim of this qualitative study was to illuminate the experiences of supervisors and students involved in an Australian summer URE. We were particularly interested in understanding the URE as a potential WIL opportunity from the perspectives of Australian psychology undergraduates and faculty members and to explore the potential for UREs to lead to publication opportunities for undergraduate students in psychology. Overall, the URE was a positive and engaging experience for most of the faculty and student participants interviewed in that it (1) exposed students to the research process and helped them develop skills and opportunities for additional research opportunities during and immediately after their undergraduate studies; (2) enabled networking, teamwork, and mentoring opportunities; (3) provided some students with the opportunity to work in research teams and labs; and (4) engaged some students in publishable research, through journal article and conference presentation co-authorship.

Although progressing publishable research was a higher priority for faculty than students when applying for one of the competitive URE scholarships, both benefitted when a scholarship project ended up in print. Our interviews suggested that, although by no means guaranteed, this happened with some degree of regularity. So far, 8 of the 24 projects led to a published paper. In light of the strict requirements for authorship (National Health and Medical Research Council, 2018), students co-authored three of these (Roberts and Rajah-Kanagasabai, 2013; Allen et al., 2016, 2017), though their contributions were acknowledged on most of the rest.

Four of the seven student participants described further employment in research-related roles to be a result of their URE, which suggests that UREs may confer advantages vis-a-vis work-readiness and employability. UREs are a way for educators to help students build confidence and self-efficacy (Hamilton et al., 2018). In a study on the benefits of conference presentations, something experienced by two student participants in our study, 53% of students described improvement in their ability to perform well on various tasks and 41% of students cited increased confidence about transitioning to the workplace (Freudenberg et al., 2008). Work readiness and graduate employability are

currently priority areas in Australian higher education and are likely to have future funding implications. UREs can help universities address these priority areas (Hamilton et al., 2018). Further, although not all students in the current study had clear career goals, the URE provided an opportunity to consider the possibility of a research career. For others, the URE prompted greater commitment to nonresearch career pathways. Either way, exposure to UREs can help focus undergraduate students on career possibilities, contribute to development of their professional identities, and consequently enhance their employability (Cranney et al., 2008; Nyström et al., 2008).

Undergraduate psychology degrees train generic skills, including collaboration, communication, and problem solving, that are valued by employers in a range of industries (Halonen and Dunn, 2018; Hamilton et al., 2018). Further, the benefits of interdisciplinary collaborations are becoming more widely recognized as necessary in undergraduate psychology degrees, to mirror the multidisciplinary nature of many workplaces (Cranney and Dunn, 2011). Consequently, an ability to demonstrate success in team environments, such as those provided in UREs, can be an advantage to psychology graduates (Hamilton et al., 2018). Teamwork within UREs enables students to seek advice from multiple colleagues and supervisors and faculty to juggle demanding schedules more easily. This structure is likely to reflect the realities of many workplaces (Cranney, 2013). This appeared to be the case in our study, although the benefits of teamwork and networking and were unevenly spread across student participants.

Equity was a recurring theme for faculty and students, with two perspectives linked to student ability and student affluence. Grades have been the leading indicator of success in academia; however, research is beginning to question how well grades translate to success and capability in the workplace (Hamilton et al., 2018). One Australian study suggested that 60% of graduates felt advantaged by participation in WIL and 74% of graduates saw a relationship between the WIL and their career trajectory (Crebert et al., 2004). In the specific context of undergraduate psychology in Australia, it has been suggested that exposure to WIL and UREs too early, or in conditions where the student does not have a positive experience, can negatively impact confidence, course engagement, and the motivation to conduct future research (Hamilton et al., 2018). Access to these opportunities needs to be delivered in a way that is less grade-reliant and more sensitive to individual circumstances. An interview process is one possibility here (Hamilton et al., 2018) and could have the additional benefit of aiding the match between students, faculty, and projects. However, the feasibility of this process would depend on adequate resourcing.

The URE was not immune to criticism, and the experiences of students and faculty were not universally positive. Participants provided more detail in describing challenges, and this is reflected in the length of extracts reported in our findings section. Reflecting on their views regarding the program's shortcomings can provide suggestions for the future development and administration of psychology UREs. This is most clearly illustrated when considering whether the URE opportunity met the expectations of faculty and students. The discord between these expectations and the realities of the URE was a reason why some students did not evaluate their experience positively.

The success of student integration into an academic community is contingent on the degree to which they have opportunities to adopt the normative values of peers, faculty, and the institution (Krabacher, 2008). Such opportunities were abundant in some projects, affording consequential advantages including further employment and honors/graduate research supervision. Some projects, however, provided few networking opportunities, with students assigned to these projects largely directed to work from home, in a solitary learning environment. Given that good research is often the product of collaboration (Krabacher, 2008), UREs that require excessive independence can provide an impoverished learning experience for students. Psychology educators need to place a greater emphasis on providing avenues for students to develop professional networks during their undergraduate studies, which is likely to garner other collegial benefits including a greater sense of community within the institution (Bridgstock, 2016). UREs can serve this purpose. Interestingly, while supervision is an integral part of WIL and UREs in most learning institutions, it is an area that appears to be poorly understood and regulated. The mechanisms for monitoring the quality and consistency of supervision are not clearly defined, nor standardized from one situation to another (Lipp et al., 2007; Roberts and Seaman, 2018a). The limited oversight of the URE we studied resulted in an insufficient variety of experiences (and particularly social experiences) in some projects, and thus some students appeared to reap greater benefits than others. Perhaps there is a need to support the URE supervisors to provide an optimal experience for students, in a way that is increasingly recognized as important for dissertation supervisors (Roberts and Seaman, 2018a,b).

As evidenced by comments concerning expectations made by both faculty and student participants, the quality of a URE, and its potential to lead to a publication on which an undergraduate student is a co-author, is shaped by an interaction between content, supervision, other relationships, and student attitudes (Salm, 2015). As was clear with regard to the present URE program, providing money to involve students in research was not enough. Indeed, while the financial element of the URE program attracted participants, it did not necessarily provide space, teams, and supervisor training. These aspects appear to be integral to providing a high-quality experience—positive for both students and faculty—which could potentially result in additional outcomes, such as increased publication rates. Perhaps the selection process for admission to the scholarship program could include more information about topics and reveal the faculty running them, students could then filter their choices accordingly to tailor the experience to their strengths and preferences. Likewise, faculty could propose a list of project-specific desirable skills, which would enable the student to gain maximum benefit from the URE. Granted, more information may make the matching process more complicated to administer. However, it may also provide students with the choice to decline a project from the outset, if it is unlikely to meet their expectations. Interestingly, three of the students interviewed, who had positive experiences, spoke openly about having no interest in their topic in the beginning, but about enjoying it by the end. This shifting of



interests has been documented in previous URE research, suggesting that students' initial affinity with a topic is not critical to the success of a URE, although it can impact on student motivation in the early stages of a project (Krabacher, 2008). When considering the implications for developing future WIL and URE opportunities, if funding is prohibitive, most participants did express their willingness to participate in UREs as volunteers. The opportunities for professional development and the possibility of publication or conference presentations are sufficient motivation to become involved. However, such schemes run the risk of exposing keen students to exploitation and must be managed carefully.

When interpreting the results of this study, readers should keep in mind the usual caveats around small sample sizes and generalizability. The small sample size is vulnerable to homogeneity, with convenience sampling making it impossible to ensure diversity of demographics. Due to the competitive nature of the program, all students in the study were high achievers, and therefore, this study was unable to focus on how UREs can engage students with average grades. Furthermore, our study appears to have a responder bias in that we captured only those students who were studying at the university (either completing the undergraduate course or enrolled in graduate programs). We were not able to reach graduated students, due most likely to outdated contact details in university records. These issues reduce the extent to which this study can comment on the perceptions of students no longer affiliated with the university in some way.

In terms of future research, longitudinal tracking of the students could afford greater insights into how UREs can promote undergraduate publication. This is important to know so that those specific components or "key ingredients" of UREs that are more likely to facilitate publication can be encouraged. This topic lends itself to mixed methods research. Conducting surveys after every URE could enable quantification of key issues, with interviews to capture the nuances that surveys might overlook. Future research could also focus on devising mechanisms to monitor supervision quality, ensure that UREs afford a diversity of opportunities, and that they are accessible to a broader cross-section of students. Further, given that the program we have described has been discontinued due to funding cuts, voluntary schemes, which were recommended by both students and faculty, should be developed and studied.

This study contributes to existing literature on UREs in psychology by exploring factors that may promote and undermine their success and their ability to promote publication by undergraduate students in psychology. For most participants, the opportunities afforded by the program

were positive and advantageous, confirming the raft of literature suggesting that UREs can make a significant contribution to outcome such as employability (Lipp et al., 2007; Cranney et al., 2008; Hamilton et al., 2018). Additionally, the experience of faculty and staff reported here provides guidance for future iterations of UREs in undergraduate psychology programs. In particular, publishing with undergraduates is possible but any such URE programs must be given careful thought to optimize student and faculty experiences and promote the likelihood of publication. The lessons we have learned suggest that the variability in quality of UREs depends on networking, supervision, access to teams versus isolation, resourcing, and matching of topics and people, which were all areas found to contribute toward either strong positive or strong negative outcomes. The value of UREs is well established outside of psychology, but there is a need to develop and administer them in a way that affords the opportunity to more students beyond the target demographic of only high achieving students so that more can benefit from the opportunity to contribute to and co-author publishable work from URE experiences.

## ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the Human Research Ethics Committee at Curtin University with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Human Research Ethics Committee at Curtin University.

## AUTHOR CONTRIBUTIONS

This research was conducted by RG under the supervision of LB and PA. All four authors contributed to the design of the study. RG collected and analyzed the data with contributions from LB and PA. RG led the writing of the manuscript, with input from LB, AK, and PA.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00541/full#supplementary-material>

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# The Psychology Undergraduate Research Conference: A Pathway to Publishing?

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## INTRODUCTION

The benefits associated with regularly engaging undergraduate psychology students in authentic research are widely recognized (Miller et al., 2008) and reflected in the learning goals and graduate attributes/requirements specified by psychology course accreditors worldwide. For example, UK accreditation standards (British Psychological Society, 2017, p. 12) state that students should graduate from an undergraduate psychology course able to demonstrate a range of research skills, and that such skills are best developed via engagement in a diversity of empirical experiences across the duration of the course. In the UK, the last and largest of these experiences is the undergraduate dissertation or research thesis project (Brewer et al., 2012). Accreditation is similar in the US (American Psychological Association., 2016) where psychology majors will have designed and conducted multiple research studies prior to graduation (Perlman and McCann, 2005; Stolfoff et al., 2015). Although less ubiquitous in the US than in the UK, capstone research projects are growing in popularity, particularly in liberal arts colleges (Schermer and Gray, 2012; Chew, 2015).

Substantial infrastructure exists to support the supervision and conduct of undergraduate research. Considerably fewer resources are invested in its dissemination. Thus, for most students, submission of the project report or dissertation, which is intended for consumption by just one or two assessors, is the final stage of the research process (Garde-Hansen and Calvert, 2007). As noted by Kneale et al. (2016, p. 160), “although involvement in research is recognized as offering transformational experiences for undergraduates... the dissemination phase is generally underplayed.” In this paper we discuss the role that undergraduate research conferences can play in the dissemination of undergraduate research generally, as well as the specific role they can play in stimulating student-staff collaboration on publications developed from undergraduate research projects.

## UNDERGRADUATE RESEARCH CONFERENCES

Undergraduate research conferences can offer students a forum for dissemination of their research findings and opportunities to “complete the research cycle” (Spronken-Smith et al., 2013, p. 105) through to, in some instances, a peer-reviewed publication. They also provide a mechanism through which students can practice communicating complex ideas and research findings. This is a graduate attribute for undergraduate psychology courses on both sides of the Atlantic (American Psychological Association., 2016; British Psychological Society, 2017). The ability to communicate effectively is a skill valued by employers (Appleby, 2018), and the communication skills of psychology graduates can advantage them relative to majors from other disciplines when competing for graduate level positions in many different industries (Halonen and Dunn, 2018). Preparing a talk for a lay psychology audience, rather than for assessment or a limited lab-group, provides

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students with experience of communicating complex ideas concisely and at a more general level of abstraction.

In the US, there are many local, regional and national undergraduate research conferences held annually (Miller et al., 2008). Educators have documented various conference models since at least the 1970s (e.g., Carsrud, 1975), and the number of such events has “exploded” in more recent years (Kierniesky, 2005). Preparing for and participating in such conferences promotes the development of research and communication skills, a sense of professional identity, self-efficacy, independence and collegiality (Stuber-McEwen and Thielen-Belveal, 2008; Helm and Bailey, 2013). Presenting at a conference correlates with graduate school attendance (Stoloff et al., 2015), and may provide students with the motivation and confidence to work with supervisors to develop their research into publishable papers (Seymour et al., 2004).

Compared to the US, opportunities for students to present at undergraduate research conferences in the UK are limited, and the literature on such opportunities is sparse. In 2011, Dancey et al. described an event where second year students were assessed on posters presented within the Second Life virtual world. Although described as a “conference,” the event would not correspond with most tacit definitions of this term. All 27 student attendees were members of the same class, participation was required, and the social networking opportunities inherent to face-to-face conferences were largely absent. Nevertheless, most students described the experience in positive terms. A non-virtual conference described by Lund (2013) aimed to “mimic the format and atmosphere of a professional conference” (p. 186). The conference could not achieve these aims because all delegates were from a single course, attendance was mandatory, and presentations were assessed. Nonetheless, most students valued it as both a learning experience and social event (Lund, 2013). Student delegates at the British Conference on Undergraduate Research (BCUR) shared similar sentiments (Kneale et al., 2016). Unlike the events described by Dancey et al. (2011) and Lund (2013), BCUR attendance is voluntary and open to students from across the UK. However, it is multidisciplinary, and only a small minority of 200+ presentations and posters at the 2018 event were delivered by psychology students (University of Sheffield, 2018). The development of conference presentations into publishable papers was not explored by Dancey et al. (2011), Lund (2013), or Kneale et al. (2016).

## THE SOUTH WEST UNDERGRADUATE PSYCHOLOGY CONFERENCE

Our experiences of undergraduate psychology conferences are based on the South West Undergraduate Psychology Conference (SWUC). The SWUC, running for over 20 years, is a collaboration between six universities and the British Psychological Society (BPS). Hosting duties rotate and the conference attracts approximately 150 students and academics annually. The one-day event includes multiple oral streams and a lunch-time poster session, concluding with a keynote presentation by an established academic.

A morning coffee-break and post-conference reception are scheduled to encourage networking between the students across institutions (see e.g., <http://www.bris.ac.uk/psychology/news/2017/110.html>). The event receives very positive feedback from both students and academics. Part of its success is attributed to bringing together students from different universities with diverse psychological approaches, to share their research experiences in a setting resembling a professional conference. For many students attendance is motivated by the opportunity to receive feedback about methodology and interpretation of their results which could improve their final thesis. The majority of the universities recognize attendance at the conference as extra-curricular professional development (<http://www.bristol.ac.uk/careers/employable/plus-award/>). The conference showcases some of the very best undergraduate research from the South West Universities, with all abstracts being published by the BPS (<https://www.bps.org.uk/publications/south-west-review/>).

In recent years, the research presented at the conference by at least two undergraduate students has been published (Kent et al., 2014; Blackwell et al., 2018). Despite the authors’ sense that both papers would have been published regardless of presentation at SWUC, what did the students gain from presenting, and could we further increase engagement in the publication process? Typically, the dissertation is only read by one or two examiners—one of which is the supervisor. The conference therefore offered the only other opportunity for communicating their research to a larger audience (given that this would be too early to consider publication). The conference thus helped to complete the research cycle for the students. As well as the inherent transferable skills involved in giving an oral presentation, informal discussion with previous presenters indicates that the conference reflects what they believe to be real academic conferences in structure and professional environment (including a conference booklet, refreshments, and dedicated conference staff), and thus offers insights into everything a professional conference involves. Although courses often require students to give assessed oral presentations, attendance and presentation at SWUC serves very different purposes, with different expectations and demands. Engagement with SWUC might signal that the student is motivated to pursue further academic study and, potentially, a career as an academic. This, in turn, facilitates a conversation with dissertation supervisors about engagement with the publication process. For those students not wishing to pursue a career in academia, the conference nonetheless offers an excellent opportunity to demonstrate to potential employers their transferrable skill of communicating complex ideas concisely to new audiences.

A barrier preventing SWUC from immediately leading to engagement in the publication process is the delay between data collection (and presentation at SWUC) and manuscript preparation. After students complete their dissertation there is typically an extended period before the supervisor (usually) instigates the publication process. Students will have moved on from undergraduate studies, which may limit the extent to which they are available and able to engage. We note that neither student is first author on the single experiment papers published subsequent to SWUC attendance (Kent et al., 2014; Blackwell



et al., 2018). Although students do not have a full appreciation of their work until it is submitted in written form, a supervisor can gain perspective from the presentation at SWUC to help judge suitability for publication.

## STRATEGIES TO STRENGTHEN THE PATHWAY FROM PRESENTATION TO PUBLICATION

Academics typically attend conferences for a variety of reasons, including a desire for early feedback on research and networking opportunities (Sousa and Clark, 2017). Having not had a conference experience before, undergraduate students are not able to maximize the networking opportunities. One suggestion is that the undergraduate conference should not be an end point (or completion of the cycle) but rather a focal point for pre- and post-discussion of student work outside of the conference setting. Furthermore, academics will take their work to specialist conferences for expert feedback which can directly influence and help shape the manuscript. SWUC, however, spans the full range of research topics in both qualitative and quantitative methods. While feedback from a general audience may be difficult to directly apply to their work, at this stage in their development as researchers, this general feedback can provide students with alternative perspectives, allowing critical reflection on their work.

Considering the experience and insights provided by organizing and evaluating SWUC, building on the established good practice, we must consider what more undergraduate conferences could do in order to maximize the engagement of undergraduates in the publication process. One clear direction for future undergraduate conferences is to ensure pre- and post-event community building opportunities. This can be achieved through integration of online forums designed around the conference sessions. Using online forums would not only encourage students to independently seek out their own peer support networks but also enable inter-university collaboration, offer opportunities for peer-to-peer formative feedback and insight into alternative research perspectives that might directly impact on their project report. Forums can be run with a light touch affording minimal administration and could be set up in such a way that there are specific threads to stimulate discussion and consideration of engagement with publishable research. This creates a framework around which students can independently

organize and manage their research, including dissemination and thinking about long-term publication plans. A further strategy to maximize the benefits of engaging with conferences would be to incorporate such experiences into the culture of studying for a BPS accredited undergraduate psychology course and the dissertation supervision process. If conferences were more fully incorporated into undergraduate studies as standard practice such events could be extended over a greater amount of time. This would allow for non-presenting activities such as informal networking events and conference dinners, both of which foster opportunity to collaborate and discuss research akin to professional conferences. Principally, additional time would allow for workshops to be held focusing on future careers, development of quality research and the publication process. As a final consideration, co-designing such experiences with students can offer great insight into avenues for further improvement on best practice, and allows students to develop other transferrable skills. It would be advisable when running future undergraduate research conferences to give students time to reflect on the conference process and the benefits of engaging with publishable research.

## CONCLUSION

Running SWUC demonstrates the worth of offering students an opportunity to attend inter-university psychology-focused conferences. Further improvements of this practice, as discussed, could enhance student engagement in publishable research. Adoption of this approach by other universities as a matter of standard practice could allow students and staff to capitalize on such an immersive experience increasing opportunity for more high-quality research and undergraduate engagement in the publication process.

## AUTHOR CONTRIBUTIONS

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# Incorporating a Professional-Grade All-Class Project Into a Research Methods Course

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## INTRODUCTION

Because psychology is a young and ever-expanding science, research methods courses play a particularly important role in the undergraduate curriculum. For example, the American Psychological Association (APA, 2013) recommends that undergraduate psychology programs require students to complete research methods courses early so that advanced courses can build upon a commonly shared understanding of empirical psychology. Research methods courses also provide most students with their first opportunity to collaborate with their professors and peers on data-collection projects. Thus, the tone set by a research methods course is critically important, because more so than any other class, it will color the way students view psychological science. It is during that initial research methods course that we should set our collective expectations high and require undergraduate students to conduct professional-grade, potentially publishable research projects.

That said, faculty cannot demand potentially publishable research from their novice students without offering them sufficient instructional support. The teaching model I have developed provides effective support and incorporates best practices designed to maximize the probability of producing publishable research. This new model abandons traditional teaching techniques that focus primarily on daily lectures, classroom demonstrations, and brief research projects, because those techniques may oversimplify psychological science and may unintentionally teach students that they are not yet ready to publish their own professional-quality research.

## PROFESSIONAL-GRADE ALL-CLASS PROJECT

My research methods courses focus on conducting group research projects of my choosing. For example, a previous class immersed themselves in a semester-long laboratory experiment designed to test the dubious claim that specialized software (i.e., Truster, 1997) could detect deception via voice stress analysis (Meyer, 1998; Van Damme, 2001; Taylor, 2002; for a review, see Lykken, 1998). Although the class read a brief (350-page) introductory research methods textbook (i.e., Martin, 2000) and was tested on its content via a midterm examination, they spent most of their time reviewing the literature on deception, designing the study, collecting data, analyzing results, and writing APA-style manuscripts. That project debunked the now-defunct software manufacturer's surprisingly positive claims and led to a published article coauthored by an undergraduate student (LoSchiavo and Roberts, 2005).

Although research methods courses are tough to teach, weaving an entire course around a single, professional-grade, group project can make the task more manageable. For example, when an entire class collaborates on a single project, data-collection efforts are more efficient and result in larger samples. Such efficiencies allow the students and the instructor to focus on mastering the topic

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of investigation and on the necessary methods to be used. And because professional research is often programmatic, results from one study point student investigators to the need for additional, but related, research. Thus, results obtained by current students can replicate results conducted by previous students and inform research conducted by future students. This continuity can provide the course with more coherence. Furthermore, as future students refine hypotheses and improve upon their predecessors' methods, results will more likely support predictions, and consequently, research projects will become more publishable.

## BEST PRACTICES FOR DESIGNING THE COURSE

Lessons learned over time have helped me develop several best practices that guide current course projects. The basic guidelines that follow allow instructors to cover a great deal of ground within a single semester.

### GUIDELINE 1: NEGOTIATE DEPARTMENTAL SUPPORT

Although some faculty have complete autonomy over how they structure their courses, many do not, typically because departmental policies standardize specific courses, or because departments mandate that particular course objectives be met by all instructors. Thus, some faculty may need to argue the merits of conducting professional-grade projects while negotiating variances from standard departmental procedures.

Furthermore, some departments may not possess the requisite equipment or infrastructure for a particular research study. For example, when a campus building project left my department without laboratory space for a class study on extrasensory perception (ESP), we successfully negotiated use of soundproof practice rooms in the music department.

### GUIDELINE 2: SELECT PROJECTS THAT MAXIMIZE INTEREST AND PUBLISHABILITY

I initially selected course projects designed to test pseudoscientific claims (e.g., communication via ESP), but it became clear that students were less excited by studies predicting null results, which often remain inconclusive. Now I select projects that focus on emerging topics that prove interesting and publishable regardless of the outcome. For example, a recent class tested whether thermal imaging could distinguish between liars and truth-tellers during an interrogation that followed a simulated theft. Previously published results suggest that thermal imaging might be useful for detecting deception (e.g., Pavlidis et al., 2002; Warmelink et al., 2011), but the technology's usefulness is constrained by many factors, so virtually all new data is publishable at this time.

It is also wise to select projects that students can master quickly, both conceptually and methodologically. Topics in applied psychology make ideal candidates. Research on

detecting deception, for example, is relatively straightforward, yet conceptually relevant to psychology, and it offers a host of methodologies that novice researchers can employ (e.g., simulated thefts and concealed information tests).

### GUIDELINE 3: COMPLETE PRE-SEMESTER PREPARATORY WORK

My teaching model requires considerable preparatory work prior to the start of the semester. For example, if the project requires institutional review, instructors should submit a proposal before the course begins, because review boards are slow to grant approval. In addition, instructors should conduct a literature review and create a local information archive comprised of key books and articles that students may want to read once they have been tasked with reviewing the literature themselves. This local archive will allow students to obtain sources quickly, without having to suffer the delays of interlibrary loans. It will also eliminate the possibility of some students hoarding sources that other students would like to borrow.

### GUIDELINE 4: DEVELOP A BASIC COURSE CALENDAR

If instructors hope to teach the basics of research methods and to conduct a professional-grade, group research project within one 15-week semester, then it is critically important for them to create an efficient course calendar. In the teaching model that I have developed, students spend the first 4 weeks of the semester plowing through a brief research methods textbook (e.g., Patten, 2014). The book is designed to provide an overview of the essential concepts typically covered in a research methods course. Although I support their readings with short lectures, students spend considerable class time during these first few weeks reviewing the project literature and completing online research-ethics training, which is mandatory at our university. Then, during the fifth week, students complete a midterm examination covering the basic concepts discussed in class and in the textbook.

The fun begins in the sixth and seventh weeks, when students design the study, practice the laboratory procedures, and then pilot test a small group of participants during week eight. By the ninth week, data collection is well underway, with students taking laboratory shifts as their schedules permit. During the twelfth and thirteenth weeks, the class meets to analyze the data and discuss strategies for writing research reports. Then, during the fourteenth and fifteenth weeks of the semester, groups of 2–3 students write APA-style manuscripts chronicling the entire project that they submit for a grade instead of completing a final examination. Although students form their own groups and write much of the manuscript outside of class, all students meet in class during the final few weeks of the semester to exchange ideas and to seek my feedback on what they have written so far.

Depending on the results of the study and the quality of the manuscripts, I may (or may not) encourage particularly talented groups to collaborate on a multiauthor final manuscript that can

be submitted for publication, knowing that some students might find the challenge exciting, while others might not be interested in additional work. Students who accept the challenge must determine who will be responsible for various sections of the manuscript, and they must agree on authorship issues, with the understanding that the entire class will be credited in a footnote.

## GUIDELINE 5: EXPLOIT TIME EFFICIENCIES

Although creating a basic course calendar is a good start, a simple timeline is often too unidimensional to capture the nuances behind successful time management. To complete so much work in one semester, instructors must constantly search for ways to make efficient use of time, and that usually involves planning specific activities a few weeks in advance. For example, when students conduct literature reviews during week two, I assign key articles for summarization so that students will be familiar with basic findings and fundamental methods when it is time to design the research project in week six. Likewise, when students create skeleton SPSS data files during week eleven, we spend class time declaring hypotheses so that they are in place before entering and analyzing data in week thirteen.

These subtle efficiencies can save considerable class time. They can also help students organize their thoughts as they complete complex assignments. For example, when students create SPSS syntax files during week twelve, we order the programming code for each analysis so that it coincides with where we estimate results will be reported in the manuscript. This preparation helps students during the final weeks of the semester, as they work in small groups writing APA-style research reports. Thus, it is important to understand that each component of the course calendar is interconnected, and that instructors can prime future topics by introducing key aspects of those topics several weeks in advance.

## GUIDELINE 6: DO NOT OVERESTIMATE YOUR STUDENTS' ABILITIES

Success using the teaching model I have proposed depends upon estimating students' abilities accurately, and as I mentioned previously, research methods courses provide most students with their first opportunity to collaborate on data-collection projects. In other words, these students are novice researchers. Without necessary leadership, their projects will likely fail, often because students lack the experience necessary to see hurdles hidden far down the road. Thus, to complete a research project worthy of

publication within a single semester, instructors may need to make key methodological decisions, and they will be required to do significant work in between classes. For example, after my students brainstorm general ideas in class, I often find myself working on the details in my office. Based on student input, I have created comprehensive laboratory manuals (which have included step-by-step methodological instructions), survey instruments, and other project-related materials. Furthermore, I often spend considerable time recruiting participants from other classes. In fact, I have spent so much time recruiting participants that some days I have felt less like an instructor and more like a laboratory assistant.

## GUIDELINE 7: DO NOT UNDERESTIMATE YOUR STUDENTS' ABILITIES

With so much to accomplish in one semester, the preceding guidelines have focused on how instructors can structure research methods courses to maximize efficiency and productivity. Although instructors should make key decisions while serving as class leaders, they should avoid underestimating their students' abilities, and they should allow students as much autonomy as possible. I have always been impressed with how creative students can be in finding solutions both to small problems that occur daily and to large methodological issues that might otherwise stall an entire project. For example, while designing a class project on ESP, my students developed an elaborate knocking procedure that allowed them to communicate between themselves while research participants thought they were simply knocking to enter a room.

## CONCLUDING REMARKS

As a discipline, we expect our graduate students to publish their research, and we have built an elaborate pedagogical system that encourages it. I suggest that we consider expecting a bit more from our undergraduate students, as well. But first, we need to make changes to how we typically teach introductory research methods courses. By focusing on professional-grade, potentially publishable research projects, my students have developed a better understanding of the steps necessary to produce published research of their own.

## AUTHOR CONTRIBUTIONS

FL confirms being the sole contributor of this work.

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# The “Writing Spiral”: A Practical Tool for Teaching Undergraduates to Write Publication-Quality Manuscripts

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## INTRODUCTION

One of the perceived barriers to publishing with undergraduates (especially with undergraduates as first author; see Giuliano, 2019) is the concern that students lack the requisite writing skills to make a significant contribution. For example, several authors in a recent special issue devoted to publishing with undergraduates (see “Engaging Undergraduates in Publishable Research: Best Practices,” *Frontiers in Psychology*) discuss this challenge (e.g., McKelvie and Standing, 2018; Detweiler-Bedell and Detweiler-Bedell, 2019; Reavis and Thomas, 2019; Scisco et al., 2019). Unfortunately, despite the numerous individual articles describing tips for teaching writing in psychology (in journals such as *Teaching of Psychology*), as well as step-by-step books that teach students to improve their writing, there is no widely-accepted comprehensive resource to guide faculty in teaching psychological writing to students (see Ishak and Salter, 2017, for a review). The purpose of this paper is to address this gap, with a focus on teaching undergraduates to write publication-quality manuscripts. Although there are many important factors in teaching writing, one tool that I have developed—which students call “the writing spiral”—has been successfully used to guide numerous undergraduates through the publication process<sup>1</sup>. After describing the purpose and benefits of the writing spiral, I provide a detailed description of its contents in the hopes that interested readers might successfully incorporate some of this material into their own writing instruction<sup>2</sup>.

## PURPOSE AND BENEFITS OF THE WRITING SPIRAL

As an undergraduate, I always appreciated detailed handouts and clear expectations for assignments, so it is not surprising that as a professor I would become well-known for my prolific handouts. A handout typically is “born” when I realize that my frustration that students are not producing higher quality work on an assignment could be ameliorated by giving them more clear expectations and examples. Indeed, each time I have produced a new handout, I have been rewarded with improved student work. Early in my career, many of these handouts originated from students’ lack of skills in grammar, writing mechanics, scientific tone, and APA style—especially in my research methods course. Although some discourage teaching such mechanics in

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<sup>1</sup>I include my track record of publications with students later in this paper as suggestive evidence of the spiral’s effectiveness; however, because I’ve used these handouts for much of my career, I didn’t have the opportunity to collect empirical data (e.g., before and after the use of these handouts) to support my claims, which are primarily based on my own experiences guiding students to publication (as well as their self-reports). Future research (e.g., conducted by faculty who adopt the spiral in their work with students) would be helpful to verify the empirical effectiveness of the writing spiral.

<sup>2</sup>Please include a footer on any handouts based on these materials (e.g., “Reprinted [Adapted] with permission. © 2019 Traci Giuliano. All Rights Reserved.”).

discipline-specific writing (e.g., arguing that it is time consuming, distracts from content, and that students should be willing, and able to achieve competence in these areas on their own; Willingham, 1990), my experience has been consistent with research showing that direct training in grammar and APA style significantly improves students' skills and confidence (see, for example, Goddard, 2003, who found significant positive changes in students' attitude toward writing, confidence in writing empirical papers, and skills in grammar and APA style following a writing course for psychology majors).

Over time, the handouts became longer and more numerous, and the writing spiral was created in response to my research methods students' request that I collate the handouts (which were posted online as separate documents) into a single printed resource that they could carry with them. The benefits of the writing spiral are many: First, in addition to what students learn from the contents, they are much more likely to actually use the handouts in this form (they report that they always have the spiral open while they are researching and writing papers). In addition, students also learn a general consistency in writing style and convention specific to me that is helpful if they later take my capstone research course (a junior/senior level course in which 5–6 students collaborate with faculty for two consecutive semesters)<sup>3</sup>. Finally, the spiral is used by students in their capstone courses, in other psychology courses, as well as when pursuing post-graduate degrees in psychology or related fields (e.g., social work, counseling, nursing, medical school).

## CONTENTS OF THE WRITING SPIRAL

The writing spiral is officially titled "Dr. G's Guide to Writing, Grammar, and APA Style" and consists of a collection of handouts printed on different-colored paper and bound into a spiral with a clear cover over the index (The writing spiral can be downloaded at <https://drive.google.com/file/d/1dYWhky4FaJ9jepBAj29JXUsbQbLY2ytc/view?usp=sharing>). It contains 10 handouts as follows:

1. **Southwestern University Guide to Writing in Psychology.** I wrote this brief guide as a resource for our campus writing center, which asks each department to develop a disciplinary writing guide. This guide describes tips for writing common types of assignments in psychology (e.g., a literature review, a research report, a journal critique), a description of rules about evidence and citation, and a "Do's" and "Don'ts" list (with examples) of discipline-specific writing conventions and formatting (e.g., APA style).
2. **Writing Competently Grammar Handout.** This handout consists of a section on grammar from the "Writing

<sup>3</sup>In our department, the general expectation is that students will co-author publications from these capstone projects if the results are good. In research methods, publication is not an expectation, although conference presentation is fairly common, either at our campus-wide undergraduate research symposium or at a regional psychology conference; however, to motivate students on the first class day, I tell them that with good results and an excellent final paper, publication is a possibility, and I show them examples of published articles written by past students.

Competently" chapter in the *Psychology Student Writer's Manual* (Scott et al., 2002). In particular, I like its description of parallelism, comma splices, fragments, vague pronoun references, and other word-choice errors (e.g., *since* vs. *because*, *while* vs. *although/whereas*) that are common (but rarely understood) mistakes made by my students<sup>4</sup>.

3. **Intro to APA Style/APA Template.** Because research shows that intensive instruction in APA style leads to improved skills and is a precursor to better scientific writing (e.g., Goddard, 2003; Fallahi et al., 2006; Luttrell et al., 2010), there are three handouts on APA style in the spiral. Unfortunately, I am unable to locate the source for this first handout, which I encountered during graduate school at UCLA almost three decades ago. It cleverly describes many APA rules and conventions, all in a format that is itself in an APA-style paper, thus providing a good, gentle introduction to APA style for students.
4. **Dr. G's Guide to APA Citation.** I wrote this handout (which has evolved significantly over the years) to help students understand some of finer points of APA citation, including what secondary citations are and why they should be avoided, how to write in a way that minimizes tedious citation (i.e., the same citation in parentheses after several sentences in a row), and the difference between "word" and "idea" plagiarism, which I have found improves students' understanding of plagiarism in general.
5. **Dr. G's Step-by-Step Guide to Writing an APA Paper.** This handout teaches students that APA style is much more than idiosyncratic formatting rules, and that it helps with paper organization (Goddard, 2003), structure (i.e., the "hourglass" shape recommended by Bem, 2003), and content (i.e., the "recipe" or formula for each section is described and then supplemented with examples from my own published research). Although I still require students to consult the APA manual, this handout is one of the most frequently used in the spiral, and provides a starting point for writing each section of a paper.
6. **Dr. G's Manuscript Comment Codes.** I developed this one-page handout—which contains the "codes" or abbreviations that I write on student papers while grading (such as "PC" to indicate a parallel construction error, "Ch" for choppiness, or "Cas" for casual/informal language), as well as examples of each—both to save myself the extra writing of explaining the same comments over and over and to help us develop a consistent language (i.e., a "shared understanding" of feedback; Glover and Brown, 2006) for discussing writing issues in my courses (see also Beins et al., 2010).
7. **Dr. G's Turds in the Punchbowl.** Borrowing an idea from an English department colleague who famously says that bad writing, much like a "turd floating in a punchbowl," tends to "spoil the party," I've compiled a list of words and phrases frequently used by my students that are either

<sup>4</sup>The chapter is not included in the linked writing spiral because I do not own the copyright to this book. The publisher's website for this book can be found at <https://www.pearson.com/us/higher-education/program/Scott-Psychology-Student-Writer-s-Manual-The-2nd-Edition/PGM226289.html>

grammatically incorrect or awkward (e.g., "In congruence with the hypothesis," "the researcher *states/goes on to say* that..."), or that violate scientific convention or tone (e.g., "the results *prove* that..." "the results were *insignificant*"). Interestingly, students who introduce new terms to the list in their own papers are surprisingly honored to make the next year's version of the handout.

8. **Dr. G's Transitions Cheatsheet.** Smooth flow is incredibly important to a paper's readability, but I find that students have rarely been taught to use transitions in their writing. Thus, in this one-page handout, I briefly explain the difference between transition *sentences* (which are used to logically link the ideas in one paragraph to the ideas at the beginning of a subsequent paragraph) and transition *words and phrases* (which are used between sentences to prevent "choppiness" and improve flow). Several examples of transition words and phrases (e.g., "As such," "That is," "In a similar vein," "Specifically") are grouped together in this handout by common meaning for students to use as they write. Although students sometimes try to use transition phrases interchangeably despite differences in meaning, with feedback and practice even the weakest writers begin to write much smoother, easier-to-read papers.
9. **Dr. G's Discussion Phrases Cheatsheet.** Because writing empirical papers in psychology follows a pretty specific formula or "recipe," and because many beginning writers do not have enough expertise to know the "ingredients," I provide students with examples of common phrases that good writers use in specific situations, an approach advocated by Graff and Birkenstein (2014) in their best-selling book, *They Say, I Say: The Moves That Matter in Academic Writing* (I also use their approach to teach writing in my first year seminar course; see Giuliano, 2014). These template phrases include choices for several parts of the discussion section, including linking findings to previous research (e.g., "This pattern of results is consistent with previous literature showing that..."), introducing limitations (e.g., "Although the present results offer clear support for..., it is appropriate to recognize several potential limitations"), discussing practical implications (e.g., "Despite these limitations, our results suggest several practical implications"), and making suggestions for future research ("In terms of future research, it would be useful to extend the current findings by examining...").
10. **Dr. G's Sample Student Manuscript in APA Style.** The final handout contains a recently-published article (Matthews et al., 2018) that was first-authored by a past student based on a research methods class project. The paper was created in Word format and is printed in double-spaced, APA-style

manuscript form (rather than in the single-spaced, two-column format as it appears in the journal) so that students not only have an excellent content model to follow, but they can easily follow the formatting example for an APA-style manuscript (see also Ware et al., 2002). I have found that using a publication from a previous student shows current research methods students that writing publication-quality manuscripts (and subsequently publishing papers) is possible.

## CONCLUSION

Although some might think my approach is too heavy-handed (certainly reasonable people can disagree about the best strategy for teaching writing), my experience has shown that the use of the writing spiral dramatically increases students' writing skills and has led to many co-authored ( $n = 30$  papers involving a total of 73 undergraduates)—and especially first-authored ( $n = 25$ )—student publications (see Giuliano, 2019). Consistent with Fallahi et al. (2006), who concluded that student-friendly models of teaching basic writing skills are well-worth the time and effort, students report that the writing spiral is a convenient tool that helps them become stronger writers overall (in both psychology and non-psychology courses, and even in graduate school and beyond). On end-of-semester course evaluations, the writing spiral has received extremely positive ratings thus far (i.e., the average rating for both "usefulness" and "recommend keeping" is 5.0 out of 5.0 for the two semesters that I've used the spiral;  $n = 19$ ). Even years after students graduate, they email me to tell me that they are still using the spiral, and that they are sharing it with their graduate school colleagues who were not as fortunate to receive strong writing training during their undergraduate careers. Ultimately, the writing spiral helps counteract two common concerns that faculty have about teaching writing-intensive courses, namely the increased workload and negative reactions from students about writing (Boice, 1990). In short, the writing spiral decreases my workload while improving student writing in a way that is helpful and less unpleasant to them.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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## APPENDIX

### Undergraduate\* Coauthored Publications

- \*Rosa, M. N., Matthews, S. J., Giuliano, T. A., \*Thomas, K. H., \*Swift, B. A., and \*Mills, M. M. (in press). Encouraging erotic variety: Identifying correlates of, and strategies for promoting, sexual novelty in romantic relationships. *Pers. Individ. Dif.*
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# Scholarship of Discovery and Beyond: Thinking About Multiple Forms of Scholarship and Elements of Project-Based Learning to Engage Undergraduates in Publishable Research

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Boyer (1990) encouraged academia to expand its definition of scholarship to include the scholarship of discovery, teaching, integration, and engagement. Since then, institutions of higher education have implemented mechanisms or policies that recognize multiple forms of scholarship (O'Meara, 2006). Proponents of this argue that it can help diversify and appropriately recognize faculty work (Park, 1996; Creamer, 1998), and create better alignment between faculty endeavors and institutional missions and goals (Diamond, 1999). Research indicates that implementing policies that encourage multiple forms of scholarship increases the likelihood that faculty: diversify the types of scholarship they engage in, feel satisfied, and want to stay at their institution (O'Meara, 2005). In addition, research shows that institutional effectiveness increases when policies include multiple forms of scholarship (O'Meara, 2006). At my own institution, a new promotion policy went into effect in 2017 that recognizes multiple forms of scholarship, and we received funding from the National Science Foundation to help with the advancement of women within this new policy (Skorinko et al., 2018). Therefore, I felt it was important in a special issue on engaging undergraduates in publishable research to consider how to work with undergraduates through multiple forms of scholarship.

One way in which I think that we can engage students in publishable work in each of the forms of scholarship is through project-based learning (Blumenfeld et al., 1991; Barron et al., 1998; Bell, 2010). In project-based learning, students participate in a project that examines a problem related to what they are learning. Project-based learning positively influences learning (Bell, 2010), and increases learning motivation, helps change student's thinking (Blumenfeld et al., 1991), and is considered a high impact practice (Kuh, 2008). Reflection on how the project relates to what is being learned is an important component of effective project-based learning (Barron et al., 1998). The key elements involved in setting up a project include: (1) setting appropriate learning goals, (2) developing authentic questions, (3) requiring sustained inquiry, (4) enabling students to take the driver's seat, and (5) encouraging reflection of how the project relates to their learning (Barron et al., 1998; Buck Institute for Education, 2018).

While there is work on problem-based learning (Dahlgren and Dahlgren, 2002; Hmelo-Silver, 2004) and service learning (Fleck et al., 2017) in psychology, there is less work directly examining project-based learning. While the literature may not market an approach as project-based learning, this type of learning is often hinted at in teaching of psychology practices. For instance, a recent paper suggested different ways to implement research into Introduction to Psychology courses to

improve and unify the experience for undergraduates, but never calls any of the approaches project-based learning (Gurung and Hackathorn, 2018). Likewise, project-based learning is often used in undergraduate research methods courses, even if it is not referred to directly by name (Chapdelaine and Chapman, 1999; Pliske et al., 2015). At some institutions, fourth year students are encouraged (or required) to complete a research project (or senior thesis)—or engage in project-based learning. Thus, psychologists often engage in project-based learning, even if they do not directly refer to this technique by name.

By considering how to engage undergraduates into multiple forms of scholarship through a project-based learning framework, we can expand learning outcomes, diversify the work we do as psychologists, and encourage different forms of thinking amongst ourselves and our students. I will consider three forms of scholarship (discovery, teaching, and engagement) and how we can use project-based learning to engage students in publishable research.

## SCHOLARSHIP OF DISCOVERY

The scholarship of discovery is the gold standard within Psychological Science. It involves engaging in research endeavors that expand our knowledge (Boyer, 1990). We may apply for research funding to support these endeavors, and we share our knowledge through conference presentations, peer-reviewed publications, book chapters, and books. Many of the articles in this special edition feature strategies for engaging students, including diverse students (Chan, 2019; Frohardt, 2019; Peifer, 2019; Ahmad et al., under review) in publishable work using the scholarship of discovery. As mentioned earlier, one mechanism for engaging undergraduates in publishable work within this type of scholarship is to use project-based learning in a research methods and/or statistics course to heighten their understanding of research and statistics (LoSchiavo, 2018; McKelvie and Standing, 2018; Mendoza and Martone, 2019).

In addition, many psychologists run research laboratories where they engaged students in research. Many articles in this special issue feature strategies that can be implemented to engage students in publishable research from a research lab perspective (Adams, 2019; Dunbar, 2019; Holmes and Roberts, 2019; Mendoza and Martone, 2019; Overman, 2019; Reavis and Thomas, 2019; Scisco et al., 2019; Stefanucci, 2019; Wood, 2019; Scherman, under review). Some researchers use collaborations to expand the possibilities of publishable work with undergraduate students (Bukach et al., 2019; Hammersley et al., 2019). Others engage students in publishable work through direct replication projects (Strand and Brown, 2019; Wagge et al., 2019). And, some engage undergraduates in cross-cultural research projects (Ashdown, 2019; Burns-Cusato and Cusato, 2019; Hill and Karlin, 2019).

In many cases, project-based learning is how students engage in a research methods course or in a research lab. However, it is important to consider the key elements of project-based learning (see above) and incorporate them into a sustained inquiry. Utilizing these elements can increase

student learning, motivation, engagement, and the likelihood of publishable work. For instance, I incorporate reflection in the research lab. As a lab, we reflect through discussions or a written reflection on what we learned from the projects conducted. These reflections help students synthesize how the project they are working on connects to other concepts they are learning (design, methods, ethics, statistics, etc.), and the reflections enable me to figure out what is working and what needs tweaking.

## SCHOLARSHIP OF TEACHING

The scholarship of teaching is also a natural fit for psychologists. In this form of scholarship, researchers investigate processes for teaching and learning effectively. It is argued that the scholarship of teaching “must be public, available for peer review and critique according to accepted standards, able to be reproduced and built on by other scholars” (Glassick, 2000, p. 879). One mechanism of making the work public is to publish it in teaching/learning journals within the field (or via special issues). For instance, in this special issue, we had one manuscript describe publishable research experiences from an undergraduate perspective (Matthews and Rose, 2018) and another provided perspectives from a faculty member and an undergraduate (Mendoza and Martone, 2019).

On the surface, it may seem more difficult to engage undergraduate students in this form of research (other than being participants). However, using a project-based learning framework, it becomes easier to see ways to engage students in this form of scholarship. For instance, one project that students could engage in is developing a teaching demonstration that highlights a key theory/component from that class. Those who develop creative and potentially effective demonstrations could then work with their professor to publish their demonstration in a teaching-related journal or other public venue (podcast, YouTube). This was a project in my Psychology of Gender course when I was an undergraduate. While my demonstration was not creative enough to move to the publication phase, other students’ demonstrations have been (Ganske and Hebl, 2001; Hebl and King, 2004; Knight et al., 2004; Hebl et al., 2008; Fa-Kaji et al., 2016). These types of projects facilitate learning by requiring students to take a deep dive into a topic and clearly demonstrate why the topic is relevant to the course. Moreover, these projects/publications could be even more meaningful to undergraduates as they have something tangible to show—a demonstration. In addition, to publish this type of work, a sound methodology of determining its effectiveness on learning is required. This type of project could be integrated into any psychology course, such as a topic course like psychology of gender or human sexuality. It is particularly relevant to courses on learning, education, and teaching.

## SCHOLARSHIP OF ENGAGEMENT

The scholarship of engagement is another avenue of scholarship for psychologists, especially those with applied interests. The scholarship of engagement involves the integration of theoretical

and applied research and works with local, regional, national, or international communities. Some academic institutions have missions to work and give back to their local communities and one way of doing that is through engaged scholarship (Stanton, 2012). As with the scholarship of teaching, the scholarship of engagement needs to be publicly available and open for peer-review. Again, one mechanism of making the work public is through publication in an applied or community psychology journal (e.g., the *Journal of Social Issues*). Publication could also take other forms, such as an op-ed, amicus brief, creation/publication of an app or computer program, or the integration of some of the work/materials by a community organization.

Again, project-based learning provides a framework to engage undergraduates in this form of scholarship, enhance their learning, and increase the likelihood of producing something publishable. This could be a project in a course (see Smirles, 2011; Fleck et al., 2017), a project through a lab (see Schlehofer, 2018), or a project required in a curriculum (department or institution; see WPI, 2018). In my own experiences, I have utilized all three approaches. For instance, in Human Sexuality, students conduct a Public Service Announcement (PSA) project where they have the option of working with a local organization. The goal of this project is to pick a topic that is important to them and develop an effective public service announcement for that topic and relevant organization. While certainly not a traditional form of publication, the students work is public and organizations may benefit. Students have designed (and sent) PSAs to domestic violence shelters, the Capetown Holocaust and Genocide Center, Planned Parenthood, and several on-campus student organizations. This project enables students to synthesize what they learned and apply it to a real-world context.

In addition, I collaborate with colleagues in computer science and robotics engineering to develop assistive technologies for individuals with disabilities. We engaged undergraduate students in these projects whether on a volunteer basis or via their third or fourth year required projects. Currently, a colleague and I have a grant with the Disabled Persons Protection

Commission in Massachusetts to develop assistive technologies for individuals with intellectual and developmental disabilities to recognize, report, and respond to abuse. We recruited interested undergraduate students (i.e., computer science and psychological science) to work on the project with us. These students will be conducting focus groups and interviews with individuals and their caregivers. They will also develop an app, computer program, or other assistive technology. Depending on their level of interest and engagement, they will assist with other forms of presentation and publication that we complete (e.g., op-eds, conference proceedings—a standard in computer science, or peer-reviewed publications). Working on this project, undergraduates are able to put theory into practice—an important learning outcome.

## CONCLUSION

While the engagement of undergraduates in the scholarship of discovery is the main focus for many psychologists, it is important to think about the multiple forms of scholarship and how we can engage ourselves, as well as undergraduates, into these forms of scholarship. Project-based learning in the classroom, research lab, or curriculum is a high impact learning practice. While it may start through instructions from a project leader, one aim is to help students foster their own insights, and then apply those insights to different research questions in the future. Project-based learning is also one way to engage students in publishable research regardless of the type of scholarship one engages in. By thinking more broadly about the types of scholarship we can engaged undergraduates in and the ways in which we can make that work public, we can increase learning outcomes for students, as well as the diversity of the faculty, the undergraduate students, and scholarship conducted within psychological science.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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# Generating Civically-Engaged Undergraduate Student Scientists in General Education Classrooms

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Historically, teaching and research have been closely intertwined in academic settings (e.g., Brown and McCartney, 1998; Deakin, 2006; Harland, 2016; Jucks and Hillbrink, 2017). Because the pressure to be both an excellent lecturer and a renowned researcher can lead faculty to perceive teaching or research as a burden, several approaches to linking teaching and scholarship have been empirically investigated (e.g., Freestone and Wood, 2006; Dexter and Seden, 2012; Pan et al., 2014; Harland, 2016; Jucks and Hillbrink, 2017). This “teaching-research nexus” (Neumann, 1994) connection can assume many forms (Brew, 2010).

Most research in this field has focused on how faculty can introduce students to their own scholarship as it relates to the content of their courses (Moses, 1990; Brew, 1999; Dexter and Seden, 2012). Two past studies found that students value faculty enthusiasm when they are teaching their area of expertise, appreciate learning from well-known researchers, and recognize the enhanced credibility of faculty and institutions with strong scholarship records (Jenkins et al., 1998; Healey et al., 2010). At the same time, students may perceive disadvantages; they may believe that faculty who are strong scholars are less available and accessible, prioritize research over teaching, and do not afford students ownership of the research conducted at their institution.

Involving students directly in faculty scholarship is an alternative approach that could alleviate these issues. This approach builds valuable mentoring relationships between faculty and student collaborators (Eby et al., 2008), offers students “the excitement and enthusiasm of inquiry,” teaches research skills (Dexter and Seden, 2012), and gives students a better understanding of the scientific process (Pan et al., 2014). Although these advantages reinforce the value of involving students as collaborators on faculty-led scholarship, faculty are often limited in the number of students they can mentor due to other demands on their time (Healey et al., 2010).

A third, potentially equally impactful but likely farther-reaching way to link teaching and research is designing classes that develop student scientists by involving them in faculty scholarship within the context of their courses. Harland (2016) investigated this “teaching-led research” approach within an Ecology curriculum designed to replace the previous method of teaching majors content early in their undergraduate years and introducing inquiry-based learning later. He found that teaching students to be researchers in the classroom was beneficial. Beyond the advantages of involving undergraduates in research more generally, faculty became more excited and expanded their thinking about their scholarship, in part due to the unique perspectives offered by their students.

Designing classes that directly support faculty research also has potential pitfalls. Few universities have reward systems in place for this type of approach, and these types of courses may lead students to believe that faculty are promoting their own interests rather than taking the students’ educational needs into account (Harland, 2016). Likewise, Pan et al. (2014) warn against an overcrowding of the curriculum; focusing on content as well as on teaching students how to implement the research process consumes vast amounts of class time. Thus, these types of efforts may fit best in courses where mastering content is not the primary objective, but rather

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introducing students to a discipline or to scientific inquiry more generally is the goal.

To capitalize on the benefits and overcome the limitations of teaching-led research, we adopted this approach in a general education course. Unlike the previous examples (Dexter and Seden, 2012; Pan et al., 2014; Harland, 2016), we taught students from diverse backgrounds about science early in their academic career—a core curriculum class designed for first- and second-year non-science majors—and trained them to serve as student scientists in the community. This approach not only developed students' scientific knowledge and skills and made them stakeholders in the research process, but also allowed us to progress on our own scholarship without detracting from our teaching (Dexter and Seden, 2012; Harland, 2016). Here, we outline eight steps to establish a teaching-led research course based on our experiences and offer ideas for expanding the model beyond one semester to promote publishable student research.

## DESIGN A RESEARCH PROJECT

For a successful balance of teaching and research, we suggest designing a research project that allows faculty to train students as student scientists quickly and that demonstrates the value of science to non-science majors. A project that links science to the community helps students see the applied value of the scientific approach. Our “Music First!” project combines music, psychology, pharmacy, and communication sciences and disorders toward addressing a key community issue: older adult nursing home residents nationwide experience dementia-related symptoms that lead physicians to prescribe medications that can worsen cognitive decline and cause physical harm (Reus et al., 2016). We investigate whether playing individualized music playlists for these residents improves their quality of life, decreases their dementia-related symptoms, and leads to a reduction in their medications.

## DESIGN A TEACHING-LED RESEARCH COURSE

To reach a diverse student population, we created a class that fit into the natural science portion of our core curriculum. This five credit-hour co-taught course included three hours of lecture each week plus a three-hour lab. The course focused around the science of music, the auditory system, emotion, memory, and dementia. While covering this content, we also taught students the scientific method and trained them to act as student scientists with responsibility for conducting the “Music First!” research project.

## INTRODUCE STUDENTS TO THE SCIENTIFIC METHOD

We taught students the scientific method by engaging them as student scientists from the beginning of the semester to the

end. Early in the semester, students learned about the scientific method, research design, data collection, reliability and validity of data, and research ethics, which prepared them to understand our specific research project.

## INTRODUCE STUDENTS TO THE RESEARCH PROJECT

During the lab portion of the course, we introduced students to the research problem and familiarized them with the research methods we designed to address the issue. We trained them in the necessary data collection techniques and in how to interact effectively and comfortably with the older adult dementia patients they would serve. To accomplish this training quickly, we created online modules for students to complete outside of the classroom that prepared them for class-based training sessions.

By Week 5 of the 16-week semester, students spent their lab time each week visiting the nursing home, playing personalized music playlists for the residents, and collecting data for the project. Specifically, they evaluated nursing home residents' sundowning symptoms prior to and after music listening.

## GENERATE HYPOTHESES

During Week 7, students generated their own hypotheses related to the study. We asked individual students to brainstorm multiple hypotheses, submitted all of these hypotheses to a class vote, and assigned groups of 4–5 students to focus on the five hypotheses that were of greatest interest to the class.

## REVIEW THE LITERATURE

We trained students to search the literature, read scientific articles, and understand the key components of a published manuscript. They completed an assignment in which each student located one article related to their groups' hypothesis and described the goals, hypotheses, key variables, research design, results, conclusions, limitations and future directions of the study.

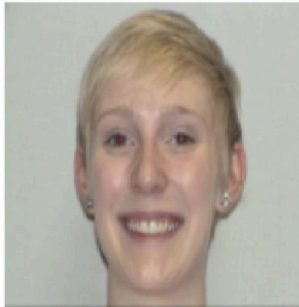
## ANALYZE THE DATA

During Week 13, we provided each group of students a dataset containing the variables that pertained to their sample and hypothesis. We introduced students to data analysis and statistics. Working in groups, they investigated their assigned hypotheses by analyzing the data they had collected.

## PREPARE PRESENTATIONS

During the last few weeks of the course, students prepared an end-of-the-semester oral presentation summarizing relevant background research built from their literature review assignment, their research goals and hypotheses, their approach to analysis, and their results, conclusions and the implications of

## Quotes from Student Scientists

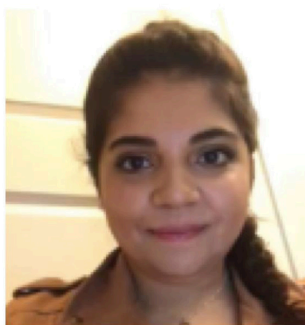
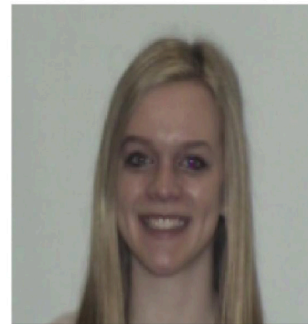


"Before this class, I didn't have a positive view of science...I had always imagined that it was something that someone else could do, someone who wasn't me. What I've learned is that science is really about being curious about the world, asking questions, searching for answers, and then repeating. I've learned that I can do those things and that I actually enjoy doing so!...Naïvely, I never thought about how philanthropic science can be...the course showed me one way of giving back to the community. The course goes beyond teaching students about science; it shows how it can directly apply to making the world a better place."

*-Theater student*

"For my remaining years at Butler University ... I will remember the impact I made on the patients and how good giving back to the community feels. I have gained a more profound appreciation for life and how precious it is... Going to the nursing home has made me realize that there are so many people in this world that need help. It has given me a love for volunteering and wanting to give back to the community. Up until this point, I feel as though I have not done all I can to serve the community. However, because of this service-learning component of this class, I have decided that in the future I want to do more things to give back to others."

*- Exploratory Studies student*



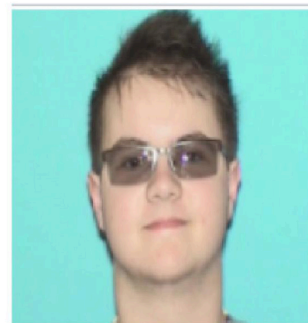
"I honestly took the class because it fulfilled the science requirement...I didn't really know that the class was actually going to change my life. We learned about the impact that the project was having on our community, and, to be honest, I fell in love. I wanted to continue working with residents when the semester was over...so I joined the research group that is working on this project. I get to present my results in San Francisco this year, and I have been able to write papers on it. It is awesome that such a simple decision that I made as a student blossomed into an opportunity to do my own research and continue my career as a student scientist. I honestly wouldn't trade any memories with my residents or anything about this opportunity for the world."

*- Psychology student and*

*Undergraduate student Co-Author on a Manuscript in Preparation for Publication*

"My experiences at the nursing home will continue to influence the remainder of my time here at Butler, and beyond. This has been a huge reminder for me of reasons why I am a music major. I love seeing the emotions that people experience when they listen to music, whether it is songs that they love, hate, feel sad about, or experience any particular emotion with. It is awe-inspiring to see how music from these older adults' childhoods impacts them in their current age. Even if they cannot remember what song they had just listened to, while they were listening to it, they seemed like they were back in their youth hearing it for the first time again... I can definitely imagine myself taking time out and playing music for residents at nursing homes in the future."

*- Music student*



**FIGURE 1 |** Quotes from student scientists' post-course reflections that demonstrate their enhanced appreciation of science, civic engagement, and their majors as a result of the course. Written informed consent was obtained from the individuals pictured in this figure for the publication of these images.

their findings. The students presented their talks in class, with the faculty and community members involved in the research in attendance. Although our students did not present their work at local undergraduate or national conferences, their presentations certainly were of a caliber to do so, and this model could easily expand to include external presentations or publishable papers as culminating events.

At the end of the semester, our students reflected on the course and their role as student scientists. Consistently, students valued the teaching-led research approach and appreciated the opportunity the course gave them to both serve their community and grow as scientists, regardless of their discipline. **Figure 1** includes quotes from students and demonstrates the value of this model toward generating civically-engaged undergraduate student scientists in general education classrooms.

## Publishable Research

Although in one semester with non-science majors, we did not accomplish professional presentations or publications, we envision two paths for expanding this model to achieve that ambitious goal. The first approach, which we have not yet tried, has great potential to involve a large number of students in publishable research. The second approach, we have used with less far-reaching, but no less successful, outcomes.

A first path to student publications would be to add a required, optional, or by-invitation-only second semester course focused on further developing the skills the students established in their first semester (e.g., expanding their search and review of the literature) and on teaching them additional skills necessary for generating a manuscript (e.g., the basics of scientific writing). Together, this would allow them to translate their presentations into manuscript form. Those who enroll could focus their manuscripts on the strongest hypotheses and results from the first-semester projects or could continue the work they, specifically, started in the first semester. Because data collection would be complete and the results previously analyzed, we believe that taking a step-by-step approach with 4 weeks spent on each section of the paper would allow a full manuscript to be written within the confines of a semester.

The second path to moving students from the course to published co-authors is to recruit or accept selected students into research labs at the conclusion of the course. Across the approximately 100 students we taught during four semesters, 10 chose to continue collaborating with us. Some students approached us asking how to continue their work with nursing home residents; we actively recruited other highly engaged students to join our labs. While some have simply continued to collect data, others have served as project leaders, making this or related studies the primary focus of their ongoing

undergraduate research. To date, these 10 students have authored three presentations at undergraduate conferences and four at state/national conferences. One is co-authoring a manuscript that is currently in preparation.

Based on our experiences, we are confident that this teaching-led research approach offers great promise as a means to link scholarship and teaching because it addresses several pressing issues in settings where faculty must both teach well and be productive researchers (Pan et al., 2014). By engaging undergraduate students in publishable research, students become collaborators in the classroom rather than passive learners of information (Ramsden, 2009). This challenges students to think (Harland, 2016) and actively engages them in their own learning (Pan et al., 2014). Additionally, teaching-led research helps to address the switch from valuing teaching to valuing research that is occurring at many midsize institutions, where growing student enrollments demand more time dedicated to teaching and leave only limited time for highly prized scholarship (Dexter and Seden, 2012; Harland, 2016). Thus, teaching-led research may be particularly useful at institutions with high teaching loads because it directly links teaching to productive, publishable scholarship. At the same time, this approach may fit well at larger institutions where undergraduate students otherwise may face limited opportunities to engage in productive scholarship due to a shortage of available spots for research lab experiences. Regardless of the setting, by designing courses in a way that involves students in scholarship within their classes, a broader cohort of students can grow in their research expertise. Expanding student involvement beyond one semester could also result in many undergraduate students co-authoring professional presentations and manuscripts. Perhaps most importantly, this model gets students off campus and into the community, conducting applied research with real-world applications that are highly recognizable while promoting publishable faculty and student scholarship.

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All authors listed have made a substantial, direct and intellectual contribution to the work and have approved it for publication.

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# Strategies for Selecting, Managing, and Engaging Undergraduate Coauthors: A Multi-Site Perspective

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**Keywords:** publishing, undergraduates, selection, management, engagement

In 2018, we delivered a symposium on publishing with undergraduate coauthors in the *Psi Chi Journal of Psychological Research* (Fallon, 2018a; Fallon and Domenech Rodríguez, 2018a,b; Fallon and Scisco, 2018; McCabe and Mendoza, 2018). Based on our collective experience, we identified three common challenges: effectively selecting, managing, and engaging students throughout the publication process. We use our perspectives from different institutions (i.e., small liberal arts colleges, mid-sized regional universities, and a large research university) and evidence from past research to provide strategies to successfully meet these challenges. Ultimately, the actionable strategies we describe could be used by a wide faculty readership to increase rates of successful publishing with undergraduate students.

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## SELECTING UNDERGRADUATE COAUTHORS

To maximize the chances of successful publication, it is desirable to select students whose academic and interpersonal qualities predict publishing success (1). Additionally, to increase diverse perspectives within psychology, faculty can recruit students from traditionally underrepresented groups (2).

1. Certain habits of mind may predict proactive behaviors (e.g., seeking feedback) needed to be successful undergraduate researchers (Eagan et al., 2011). Specifically, faculty should seek students who exhibit a growth mindset (Dweck, 2006): those who concern themselves with learning (vs. looking smart); who persist through challenges (vs. taking the easy path); who learn from criticism (vs. ignore or avoid it); and who believe effort (vs. innate intelligence) is the means to mastery. Sometimes the “smartest” students on paper may not embrace a growth mindset.

Thus, mentors should consider potential student-collaborators from all levels and classes (Detweiler-Bedell et al., 2016). Though you are more likely to find someone (e.g., a student who has taken research methods) more prepared to engage in research writing in an advanced course, this overt training is not the only factor in evaluating potential. Keep an eye out for that special student—that diamond in the rough—who shows a curiosity about learning, dedication to academics, enthusiasm in “going the extra mile,” and an interpersonal style that meshes well with yours. If you are inclined to have potential research assistants complete an application as an initial screening, include not only their interest in working with you and their strengths/weaknesses as a researcher, but also their motivations for learning.

2. Non-first-generation students and those who identify as male are more likely to engage in undergraduate research compared to those who identify as female and first-generation students (Webber et al., 2013). Yet research suggests that ethnic minority students who are engaged in faculty-mentored research are more likely to be retained, persist in their studies, and academically succeed (Nagda et al., 1998; Jones et al., 2010).



Faculty can help make scientific research more inclusive by revealing the “hidden curriculum” of college. Some students arrive in college inherently recognizing the value of research collaboration and knowingly approach faculty about such opportunities. But many—especially first-generation college students and those from racial and ethnic minority groups—do not. Thus, faculty should make an overt effort with *all* students to clearly define collaborative research and emphasize its value for skill development in preparation for the workforce and/or graduate school (Bangera and Brownell, 2014).

One strategy is to introduce the idea of research collaboration or even assign an article on the value of student publication (see Anderson et al., 2015), even in introductory courses. If you have lab assistants or directed research students, have them discuss their experiences and their aspirations with the class. Although many students may not move forward, you may discover a potential coauthor who may have otherwise flown under the radar. Finally, take a retrospective and current look at the diversity of your undergraduate collaborators. Be aware of potential implicit bias in student-collaborator choice. Intentionally consider the students of color and whether they have the attributes discussed in point 1. Reach out to students who you suspect have this potential, even if they have not fully demonstrated it. Invite them to a conversation about what you do, why you love it, and how they can be involved. These are a few small but important steps toward equity and inclusion.

## MANAGING UNDERGRADUATE COAUTHORS

After students have been selected to write a manuscript as a coauthor, faculty should make a clear plan for publishing which includes: developing realistic timelines and expectations (1), identifying appropriate journals (2), discussing authorship order (3), and teaching students how to write publishable manuscripts (4).

1. Managing students' expectations about publishing may begin with an evaluation of the research topic to ensure that it is neither too difficult nor too trivial for publication. Managing expectations also begins with discussing and agreeing on a timeline of tasks as well as an outline of expectations in the progression of the manuscript. Roig (2007) and Cramblet Alvarez (2013) provide examples of student-faculty research and publication agreements which include weekly tasks and deadline dates, academic integrity policies, and specific guidelines on how tasks connect to authorship. This agreement could also explicitly articulate behaviors faculty expect to observe in student collaborators, including being honest about mistakes, asking questions well before deadlines, and responding to emails in a timely manner. In each step of the publication process, mentors may also consider incorporating learning exercises to make explicit the tasks needed to publish research (e.g., critically

evaluating a journal article; Gottfried, 2009 or mastering APA style; Freimuth, 2008).

2. Currently, there are several psychology journals that specifically encourage and welcome submissions from undergraduate coauthors, including the *Psi Chi Journal of Psychological Research*, the *Journal of Psychology and Behavioral Sciences*, and the *Yale Review of Undergraduate Research in Psychology* (University of Nebraska-Lincoln (UNL) Libraries, 2018). If the research provides a unique contribution within a specific subfield, the faculty mentor may use her expertise to develop a list of appropriate outlets. Then, the faculty mentor and student can evaluate the submission and evaluation criteria for relevant journals as well as the timeline of publication to decide if the journal is a good fit for the project.
3. Clearly establishing author ordership and corresponding responsibilities at the start of the writing process can be very helpful for avoiding possible confusion and conflict. Some journals dictate that the lead author be an undergraduate or was an undergraduate when the research was conducted. As a guide, Fine and Kurdek (1993) propose ethical considerations and scenarios as well as practical recommendations to determine authorship between students and faculty mentors. For example, it may be helpful for both parties to engage in an informed consent process of sorts (written agreements recommended), in which the student is informed of the authorship decision-making process including the tasks necessary for publication (e.g., revising drafts before submission, reading submission guidelines), expectations for order of authorship (e.g., who completes what section, who addresses what revisions), and renegotiations of authorship depending on the amount of revision necessary (APA Science Student Council, 2006).
4. Although writing a research paper for a methods course and writing a research manuscript draw upon the same skills, undergraduates may be surprised at how challenging this transition can be. Before embarking on the writing, it may be helpful for students and faculty to read articles geared toward emergent researchers about writing empirical manuscripts in psychology (Fallon, 2018b). Detweiler-Bedell and Detweiler-Bedell's (2013) comprehensive guide for collaboratively writing manuscripts in APA style is particularly useful for addressing the challenges of group writing. It would also be helpful to review other manuscripts from the target journal or manuscripts from published undergraduates as exemplars. Checklists for each section of the manuscript can guide students through the writing process and keep them focused (Appelbaum et al., 2018). Faculty members may choose to focus on aspects of the manuscript requiring their expertise, such as locating high-fidelity citations, ensuring that effect sizes are included in statistical analyses, and justifying small sample sizes. Ultimately, the writing process will involve numerous rounds of revision, leading to the next challenge: keeping undergraduate coauthors engaged in the writing process.

## ENGAGING UNDERGRADUATE COAUTHORS

Students' time demands—coursework, internships, and employment—may compete with time dedicated to the writing process. Furthermore, given the lengthy nature of the publication process, students may graduate prior to manuscript publication. To engage undergraduate coauthors throughout the publication pipeline, we advocate providing timely communication and feedback on student work (1), offering regular encouragement and support (2), emphasizing the contribution to the field (3), and mentoring students in their response to reviewers (4).

1. At the beginning of the project, in addition to developing student timelines as described above, faculty members can establish guidelines for when they will respond to students' work. For example, faculty members may indicate that they will respond to emails within 24 h during the work week, and that they will provide feedback on manuscript drafts within 1 week. Following through on these communication and feedback guidelines can keep the project moving forward and continually engage the student. Weekly meetings with the student can be exceptionally helpful because they provide an opportunity to ask questions, discuss feedback, develop a positive working relationship, and keep both faculty and students on track. If students have graduated and are living nearby, face-to-face meetings could be continued. However, if on-campus meetings are not feasible, meetings can be held using video conferencing. Programs that allow for screen sharing (e.g., Skype, Zoom, GoogleDocs) are particularly helpful for simultaneously viewing parts of the manuscript.
2. First-time undergraduate coauthors may find faculty mentors' extensive, ongoing feedback and editing overwhelming or discouraging. To keep the student engaged, feedback should be positive and instructive. For example, if students struggle with integration of sources for a literature review, faculty members might say: "I see you have worked really hard to find relevant sources and describe each one. The next step is to tie these studies together into one paragraph around a common theme. Here is an example of how to start with a strong topic sentence and use the literature to develop that topic." Such feedback helps students learn how to improve their writing and implicitly conveys that students can reach this goal, thereby increasing their writing motivation (Truax, 2018).
3. For undergraduate psychology students, benefits of co-writing and publishing research may include improved critical thinking and investigative skills (Beckman and Hensel, 2009) and increased confidence and interest to further produce publishable research (Griffiths, 2015). Benefits to

the scientific community and broader society may include the dissemination of new knowledge, replication of previous findings, support for existing theories, ideas for future research, or practical implications of the findings. Faculty could tie these personal and broader benefits to students' futures. For example, if students aim to apply to graduate school, a published manuscript can provide a competitive advantage (Hartley, 2014). Students who plan to enter the job market can leverage the skills in communication, self-assessment, project management, and collaboration.

4. After providing clear communication, giving supportive feedback, and motivating students to continue the writing process, the completed manuscript will be submitted, and many students will feel as if they have reached the end of a long journey. However, the excitement of submission may be tempered by receiving many comments from reviewers and editors. To address students' potential deflation, faculty can share reviewer responses from other published works, demonstrating that multiple reviewer suggestions are a normal part of the publication process. Faculty can also model ways to appropriately respond to reviewers' comments including thanking the reviewer for their time and effort, acknowledging and changing unclear elements of the paper, and addressing each reviewer comment with an individual response (Guyatt and Brian Haynes, 2006). Further, faculty mentors play a critical role in helping students decide when they should respectfully disagree with reviewer suggestions. Sharing previous response letters and revisions that resulted in successful publication will give students a model to follow.

## CONCLUSION

Publishing with undergraduate coauthors may introduce unique challenges for faculty mentors, but employing the strategies we have described can make the publication process manageable, enjoyable, and successful. With a clear and thorough plan, faculty mentors will not only help students meaningfully contribute to our science, but will also prepare a new generation of scientifically literate and skilled young adults.

## AUTHOR CONTRIBUTIONS

JS, JM, AM, MF, and MD conceptualized and revised the manuscript. JS, JM, and AM wrote the first draft of the manuscript.

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# Empowering and Motivating Undergraduate Students Through the Process of Developing Publishable Research

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Mentoring undergraduates in research is a truly rewarding endeavor. There are immense benefits for both students and faculty mentors who engage in high-quality undergraduate research mentorship (Bowman and Stage, 2002; Osborn and Karukstis, 2009). For students, the experience allows them to expand their skills and knowledge, increase self-efficacy and self-confidence, increase learning gains, and connect classroom learning to real-world settings (Palmer et al., 2015). Becoming part of a research lab can inspire future graduate studies or job paths in a certain field, and provide a competitive edge over peers (Shellito et al., 2001; Davis and Jones, 2017). For faculty, mentorship can promote the transfer of academic “DNA” and generate meaningful scholarship (Lancy, 2003). The focus of this paper is to discuss principles that I have found effective in guiding undergraduates to produce publishable research. These principles are largely informed by learner-centered practices (Cornelius-White, 2007) including rapport building, facilitating motivation, empowering students by honoring their ideas and opinions, encouraging problem solving, scaffolding, and internal and external self-reflection.

## PRODUCTIVE LABS BEGIN WITH GOOD RECRUITMENT AND RAPPORT BUILDING

Over my time in academia, I have recruited many undergraduate research assistants (URA). I often recruit from my courses where I cover similar content to my research. I describe the types research that I engage in, as well as the benefits of working closely with a faculty member, which include fostering a close working relationship with faculty and peers, increasing confidence and knowledge, and preparation for future roles in research (Seymour et al., 2004). Best practice is to set GPA requirements and a high grade in research methods courses (Shellito et al., 2001). However, I do not share these requirements with students, as I want all students who are personally motivated by the opportunity to apply. Students are asked to submit a paragraph stating why they want to become an URA. If students do not meet the requirements but have a compelling case for how the experience with help meet their personal goals, I most often invite them to become an URA.

Despite the processes described above, at times I have inadvertently recruited students who “just need credit” and may not possess the intrinsic motivation to engage in research as a means to an end of a larger personal goal. One of most important lessons that I have learned from this is how to increase motivation. For example, positive faculty attitudes and behaviors can promote a culture of excellence in undergraduate settings (Umbach and Wawrzynski, 2005). Building rapport and a relationship with students is one of the most powerful influences on motivation, as well as the cognitive and emotional development of students (Umbach and Wawrzynski, 2005; Shanahan et al., 2015). Being approachable, respectful, and friendly have all been shown to increase students’ intrinsic and extrinsic motivation (Komarraju et al., 2010) and allow students to safely explore their ideas and interests. In my lab, I make every effort to get to know my students as individuals



and convey genuine interest and concern about their lives (Shellito et al., 2001; Behar-Horenstein et al., 2010). For example, during lab meeting I talk about my family and ask students about their families, their classes or other topics of interest. These informal conversations provide a window into their emotional state, stressors they may be experiencing, and specific learning challenges or strengths (Shanahan et al., 2015). Developing a deeper relationship also sets the stage for mentees who are more likely to commit to engaging in the process of publishing research beyond their semester-long laboratory experience. This is a key factor in mentoring students through publishable research and increasing faculty productivity, as most publishable works take longer than a semester to complete (Cooley et al., 2008). Finally, strong rapport increases the likelihood that students will recruit their peers to join the lab in the future, which is a helpful recruitment tool.

## **FACILITATING STRUCTURE, COMMUNICATION AND SCAFFOLDED EXPECTATIONS**

After recruiting motivated students, the onus is on the faculty mentor to structure a laboratory environment that is organized, sets a standard for clear communication, and identifies expectations for the student (Mabrouk, 2003). The National Mentoring Research Network (e.g., Vishwanatha et al., 2016) suggests using “compacts” which are syllabi-like document that identify the laboratory rules and expectations. I often use a compact that includes projects for the semester, expectations for professionalism, time commitments, and how to problem solve issues (see **Appendix 1**). As a lab, we update this document as significant research tasks arise. I also review the compact individually with students at three points in the semester to track progress toward personalized goals. Regular review also helps me to match tasks with the students best equipped and motivated to complete them in a thorough manner.

Clear expectations of the work to be performed *between* meetings also helps to facilitate productivity and well scaffolded activity (Shanahan et al., 2015). In my laboratory, I utilize shared Google drive to do lists that are updated weekly. This structure is useful in ensuring that students know who is assigned to a task during the week, which increases workflow momentum. At each lab meeting we review the tasks on the to do list, and I allow students to choose new activities of interest to them. Students are then required to update the to do list with the status of the task throughout the week.

To facilitate a sense of community, I pair students into working groups of two and ask them to work on specific tasks together so that they are accountable to another person and can co-problem solve any issues that arise (Shanahan et al., 2015). I regularly check in with individuals about whether their partner has been accountable on tasks. If students do not complete tasks assigned to them, I gently remind them that they are part of a team that is working toward a shared goal. If issues continue, I privately discuss the issue with the student to better understand any situational factors that might be impacting their work. We problem solve strategies that could help to improve productivity,

such as assigning tasks with which they are comfortable and competent to complete (Shellito et al., 2001).

Mentors should also consider each student's zone of proximal development and scaffold tasks that aid to enhance development (Thiry and Laursen, 2011). Providing meaningful experiences that are linked to clear outcomes allows students to have experiences that can feel fundamentally different from traditional didactic learning. Teaching students to actively apply their knowledge to problem based learning may contribute to a shift in students' understanding of themselves as competent researchers and life-long learners who can actively apply knowledge to solve problems (Hmelo-Silver, 2004; Davis and Jones, 2017). To demonstrate, I spend time during lab meetings discussing research methodology issues that have to be solved. Allowing students the space to think and contribute their ideas to the problem solving process fosters increased mastery in active problem solving, creates team cohesion and feelings of competence, which results an elevation in the quality of work produced (Lopatto, 2003; Shanahan et al., 2015). I also consider the developmental zones of individual students and intentionally assign task leaders who will be able to scaffold higher levels of learning beyond my direct mentorship (Gilmore et al., 2015). This structure increases the likelihood that students will receive the reinforcement of concepts at multiple times throughout the week and decrease questions directed at the mentor.

## **PRODUCING PUBLISHABLE-QUALITY WORK WITH UNDERGRADUATES**

Creating publishable-quality work takes time and effort. It is important to acknowledge that not all undergraduate students are capable of publishable work—yet. Writing is a skill that blossoms over time, and if undergraduate students came from diverse and underserved schools with limited supports for writing, we might expect that their skills will require extra time to flourish (Early and DeCosta-Smith, 2010). I often wait until the end of a research experience to assess if someone is ready and capable of engaging in the publication process. Students who are reliably working toward achieving their learning goals, show high levels of intrinsic motivation, and have future professional goals that align with research are the best candidates. As I discuss the opportunities with qualified students, I am very clear that publishing is a long and iterative process. I explain how the publication process works, ranging from the amount of effort and time that it takes to collect and analyze data, the steps of writing a manuscript, and the review process. Students are told that they will be required to have direct and substantial intellectual contributions toward the paper, which will depend on the order of authorship (Burks and Chumchal, 2009). Students who are driven to maintain a working relationship with their faculty mentor and continue to work in the lab over the course of semesters, with or without credit, are already demonstrating the first important facet to achieving publishable work—self motivation to engage in the process (Gilmore et al., 2015).

Understanding and practicing good writing is also essential to producing publishable-quality work (Guilford, 2001). Therefore, throughout the research experience I ask students read a variety



of articles and apply their foundations in research methods. We also read journal articles written with former URAs so that they can see that a journal article is an achievable goal. I then scaffold a process of guided dissemination (Shanahan et al., 2015), by first asking students to create a poster abstract which will be submitted to smaller institutional or regional conferences. This helps them to think deeper about how they would communicate the conceptual work of the research lab, both in writing and in images. Finally, for students who will continue working toward publication, I tailor manuscript writing to the student's strengths. I provide clear expectations that there will be numerous revisions before submission. To help students better achieve the goals, I break up the writing into smaller sections and provide approachable examples as models. Perhaps most importantly, however, is to have patience, provide constructive feedback, and allow the student to make multiple revisions (Guilford, 2001). It is important to emphasize that publishable writing is unlike a mastery approach where assignments are completed once (Pierce and Kalkman, 2003), but rather requires continued thought and revision over time. Rewriting the sections may be quicker for the faculty mentor (Burks and Chumchal, 2009), but it does not allow the student to learn the skills of writing and can undermine their self-esteem by sending the message that “*You can't do it, so I am going to do it for you*” (Wilson and Devereux, 2014).

## THE VALUE OF MENTOR SELF-REFLECTION

Lastly, a faculty mentor's ability to successfully lead a URA through research should include both inward and outward reflection. Most faculty mentors have not received training in pedagogy, writing, zones of proximal development, or research mentorship. However, faculty are intrinsically motivated by a

number of factors, including their prior experience as a student, professional agendas and alignment with the mission of their institution (Baker et al., 2015). In addition to motivational factors, faculty mentors should continually engage in outward self-reflection about how mentorship can meet the goals of both themselves and their students. Recognizing the changing social, emotional, physical and educational needs of the whole learner can result in lifelong learning, employability, and intellectual socialization, as well as an important frame of reference for why the time and energy spent on undergraduate mentorship is worthwhile (Cornelius-White, 2007; Thiry and Laursen, 2011).

It only takes one authority figure to either bolster or undermine a student's belief in themselves. Whether or not the final project gets published is a relatively minor issue compared to whether students believe that they are capable of achieving their goals. It is important to remember that students will not necessarily remember what you said or what you did, but rather how you made them feel. If they feel motivated to achieve the goals that you have set out for them, faculty mentors will pave the way for engaged students who commit to the process of producing publishable-quality work.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01007/full#supplementary-material>

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# Using Research Agreements to Build Respectful, Publication-Grade Scholarly Relationships in Liberal-Arts Settings

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## INTRODUCTION

Collaboration with undergraduate students at a small liberal-arts college has accelerated our research programs. Liberal-arts students bring interdisciplinary flair—or sometimes just a fresh perspective not yet pigeonholed by post-graduate specialization. Liberal-arts students come from diverse backgrounds and reach beyond their comfort zones to try an eclectic mix of scholarly work. However, given the liberal-arts emphasis on collaboration, community, and compromise, these students bring a different set of sensibilities about work, accountability, and authorship than might appear in research-university laboratories designed to function as a well-oiled research machine (van der Wende, 2011; Kilgo et al., 2015; Lewis, 2018). So, generating publication-grade research with students at a liberal-arts college is as much about reflecting on science as one of many distinct ways of knowing as about designing experiments, collecting data, and disseminating that knowledge through publication.

The most rewarding faculty-student collaborations for our lab have been experiences that begin and end with space for students and faculty to learn together about science as a culture. Implementing a research agreement has become a best practice for our faculty-student collaborations in that it sets up an ideal atmosphere for producing publishable research. It has helped us to foster important discussions about scientific culture that help educate students about how to approach scientific work responsibly, respectfully, productively, and with the most rewarding learning outcomes. Indeed, scientific culture has its own values, and the blessing of research with liberal-arts undergraduates is the opportunity to reflect on how those values align with or diverge from those of other cultures.

## OPENING DIALOGUES TO INITIATE STUDENTS INTO THE CULTURAL FOUNDATION FOR PUBLISHABLE RESEARCH

Undergraduate research experiences can be both immensely positive but also immensely challenging. We are privileged to have motivated students eager to embark on new intellectual journeys, journeys with the potential to shape and transform their entire educational trajectory. Then again, undergraduate education is not just an intellectual exercise but coincides with major life changes and challenges that follow naturally from young adults living on their own, very often for the first time, and learning how to manage a complex set of obligations (McKinsey, 2016; Tieken, 2016). Publishable research is no small responsibility to add to these circumstances. Whether the experience becomes professionally formative for each student, faculty mentors have the real liability that their own anxieties, plans, and concerns for research could easily upset the already challenging balance

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of student obligations and student wellness. No matter the course credit or wages that we offer students, the higher stakes of working toward publishable research outcomes in a professional academic laboratory leave students more prone to feelings of isolation, anxiety, stress, uncertainty, bewilderment, and disengagement than students experiencing the same work through a safer lower-stakes course-based research experience with a classroom full of peers (Rand, 2015; Shapiro et al., 2015; Barrow et al., 2016; Kobulnicky and Dale, 2016; Frantz et al., 2017; Kamangar et al., 2017).

For research with undergraduates to warrant any public communication, internal communication is crucial for making research a constructive, positive occasion for undergraduate students' growth and education. The very same institutional structures allowing faculty members to recruit undergraduate students also produce power differentials that can stifle open, constructive dialogue. Faculty may be poor judges of when constructive challenge of research has turned from opportunity for growth and self-discovery into harmful stressor, whether from insensitive faculty demands or from unspoken student decisions to compromise other professional goals or wellness. Ideally, research can help students drive their own academic narrative, but this entire benefit is lost when undergraduates are not yet in the habit of reflecting on their goals and efforts. Faculty are in a position to communicate explicitly with students about how to approach this research field and to model mutual respect as a clear and necessary counterweight to the power differential. Faculty have the expertise and the authority to set the tone for the research relationship, and students do not normally have the expectation to begin that discussion. The hope to engage in publishable research could become an unhealthy burden when faculty fail to set that tone.

Sounding out cultural foundations is as good as an initiation for students into publishable research as it is an opportunity for seasoned researchers to keep a fresh look on old habits and values. Science is slow to change by design, but it is important to compare expectations and values in the research lab with social changes or pressures in the broader world outside the lab—where our undergraduates come from (Popejoy and Fullerton (2016), Gauchat and Andrews (2018), Ioannidis (2018)). In a time when science is considering how it promotes respect for all participating members (e.g., National Academies of Sciences Engineering and Medicine, 2018), faculty might constructively reflect on what it means to make every new visitor to scientific culture feel respected and welcome, especially if these visitors are to be coauthors. It is an occasion to unpack implicit faculty values and to examine them explicitly for undergraduate students to understand at the outset of the project.

## BACKGROUND FOR RESEARCH AGREEMENTS

Our idea for the research agreement grew naturally out of the concept of the course syllabus as an agreement, a long tradition in the pedagogical literature about setting expectations for faculty-student working relationships (Parkes and Harris, 2002;

Habaneck, 2005). This tradition of contract-like syllabi provokes mixed responses that we hoped to navigate intentionally as we developed the agreement. Bleak extremes risk manifesting as “commodification” of scholarly labor in which instructors offer graded credits in exchange for hours worked and efforts expended. These authoritarian syllabi enumerate rules for student conduct and threaten penalties, in the form of grade deductions or recrimination by the institutional administration (Agger and Shelton, 2017). Legal scholars have cautioned that the “contract” description is not just fraught with legal liability but is actually at odds with court decisions (Kauffman, 2014; Rumore, 2016). Despite discouraging the “contract” description, these legal perspectives have nevertheless encouraged the design of collaborative documents in which faculty and students work to outline expectations and responsibilities. And in fact, collaborative syllabus design in which faculty and students can negotiate on the terms has become an important part of recent attempts to make academia more inclusive and to help invite student investment in the learning process (Hudd, 2003; Hess, 2008; Shaw, 2009; Stocker and Reddad, 2013; Fornaciari and Lund Dean, 2014; Kaplan and Renard, 2015).

In this spirit of collaborative syllabus-like agreements, we start research collaboration with an in-person meeting. The eventual goal of the meeting is for both student and faculty to sign a potentially revised copy of the existing agreement before research work started, but crucially, the face-to-face dialogue aims to empower students to ask for clarification or propose amendments pending mutual agreement before signing. It is fully possible that, in the process of explaining the values that the faculty takes as self-evident, the student's line of questioning could help the faculty to see old values in new light. Students may get the benefit of an explanation of scientific culture, and faculty may get the benefit of letting the student perspectives help them discover that, maybe, some values are outdated or no longer suitable. But more certainly, this discussion lays a foundation for high standards and communication—a foundation essential for generating publishable work.

## AGREEMENT: AIMS AND CONTENT

The research agreement that we have piloted scaffolds better communication between faculty and students to launch the research collaboration and to support publishable work to follow. The agreement sets a tone of mutual respect from the outset particularly by acknowledging the joint-authorship expectation, allowing students to provide input for editing the document. This research-agreement framework acknowledges student questions and uncertainties about research as valuable points of concern for discussion rather than any sign of unsuitability for research. Such a framework empowers undergraduates to ask important questions and to open the faculty members' eyes to yet unimagined but meaningful new directions—both in pursuing or developing professional research and in running a laboratory. Constructive discussion and research is only viable if students respect themselves enough to be able to seek clarification or explanation from their faculty mentor. Empowered students

might seem to some like an obstacle to forward progress for junior faculty feeling “publish or perish” pressures. However, we know of no evidence of student rebellion. And on the contrary, under the faculty-student power differential, we urge greater vigilance in minimizing the much more probable risk that high-stakes publication-grade research could easily press mentors into abusing student effort or diminishing student self-worth (Straus and Sackett, 2014; Vianden, 2015; Kibbe et al., 2016; Kobulnicky and Dale, 2016; Colbert-White and Simpson, 2017). There is plenty of room in organic collaboration for faculty to lead by example and by reasoned instruction, and treating research students less like hired labor and more like collaborators could actually be beneficial for meeting goals and for more creative research (Gornall et al., 2018).

Reflecting on both the press of deadlines and rigor and the benefits of publishable research, this agreement emphasizes both rights and responsibilities of students producing research. Rights might also be responsibilities, or vice versa, reflecting our hope that this open, social process of science works best when collaborators are honest about needs and respectful of others' needs as well (Barajas and Frossard, 2018). These points include but are not limited to

1. How to reflect about daily work (e.g., with updates to faculty indicating plans at the beginning of the day and a summary of progress and challenges at the end of the day).
2. How students will get the most out of research work by exercising good self-care (e.g., regular sleep, eating, and exercise).
3. How to reflect on internal communication within the lab, particularly insofar as each colleague's professional development requires mutual respect, regular information sharing, and sometimes critical feedback with their rights to disagree.
4. How to reflect on coauthorship as a shared privilege to participate in public communication.

The current agreement (available in its entirety as a **Supplemental Material**) aims to discuss long-range issues of authorship up front and before any research begins in order to reduce all subsequent ambiguity about expectations and roles (Roberts, 2017). It discourages sparse definitions of coauthorship as about generating enough words toward the final draft of a manuscript. Instead, it encourages the broader notion of coauthorship as a contribution to the communal effort from the initial phases of hypothesis development, through experimental

design, through manuscript preparation and revision, and all the way past manuscript composition or submission to the responsible defense and accountability to respond intelligently to interested readers. The agreement is definitely biased to individual faculty's own particular scientific acculturation: different scientific subcultures will inevitably disagree somehow. However, the process of welcoming students to the scientific process with full disclosure and open dialogue about scientific values has been a fulfilling experiment in guaranteeing that all students get the best out of their brush with science. Publication or not, the research agreement builds a context that supports long-term professional relationships.

## CONCLUSION

The promise of publishing research falls unevenly across long-term goals of faculty and of student. The inevitable disparity between faculty goals and student goals opens up a potentially vast pitfall in which research collaborations could slip needlessly into personal strife and professional failures (Moskal et al., 2013; Moore et al., 2018; Niehaus and Wegener, 2018). Student should have full view of the stakes and the larger setting of concerns in which research labs produce work. The agreement also gives the faculty the opportunity to express their goals and make sure they are either equal to the student's goals or in separate but parallel alignment (e.g., meeting departmental goals of providing research training). The co-authored research agreement offers a safe and mutually respectful context in which faculty and students can reflect on shared and unshared goals. Enhancing students' sense of professionalism, control, and ownership leads to a stronger commitment to seeing a project through from data collection to publication (Araujo et al., 2018; Cavanagh et al., 2018).

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# Guiding Undergraduates Through the Process of First Authorship

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**Keywords:** undergraduate research, undergraduate publication, publishing, first authorship, faculty-student collaboration

## INTRODUCTION

Dozens of excellent papers have recently been written that describe best practices for publishing journal articles with undergraduates (see “Engaging Undergraduates in Publishable Research: Best Practices,” *Frontiers in Psychology*); for the most part, these involve students as co-authors in general rather than as lead authors. In this paper, I specifically focus on how to guide undergraduates through the process of first authorship. After describing potential barriers, I discuss issues of authorship contribution before outlining several successful strategies I’ve developed during my 24 years of collaborating with undergraduates. Although mentoring students to be first authors can be challenging, the rewards can also be immense—for both the students and the faculty mentors who are up to the challenge.

## THE UNDERGRADUATE FIRST AUTHOR: A UNICORN?

A literature search revealed not a single article on the topic of undergraduates publishing as first author. Without any data, it’s hard to know for certain how common it is for undergraduates to publish as first authors, but informal discussions with psychology colleagues around the world who collaborate with undergraduates (and examinations of faculty vitae) suggest that it is far less common than undergraduates publishing as non-lead authors.

## BARRIERS (REAL OR PERCEIVED) TO UNDERGRADUATE FIRST AUTHORSHIP

Because it is rare to see undergraduate first authors, many faculty are likely unaware that at least some undergraduates can—with proper training, encouragement, and careful mentoring—be capable of serving as first authors on papers in refereed journals. Even if faculty members are made aware of this fact (as I hope to accomplish with this article), other barriers exist. For example, many faculty work under a reward system in which publications (and first author publications in particular) determine tenure, promotion, pay, likelihood of securing grants, and job security (e.g., Costa and Gatz, 1992; Fine and Kurdek, 1993; Wilcox, 1998). The primary tradeoff is that the time it takes to mentor undergraduates through first authorship is generally much longer than the time it would take for the faculty member to be the lead author. The great experience provided to the student (see Matthews and Rosa, 2018), therefore, can come at the cost of decreased productivity (e.g., fewer publications overall, fewer first author publications, publications in lower-tier journals), which could be problematic for faculty at institutions that don’t highly value faculty-undergraduate research. Finally, recent trends in psychological science, such as the difficulty of publishing single-study papers in some subfields and the “open science” movement calling for large sample sizes, pre-registration, and replication (see Chambers, 2017; Nelson et al., 2018) can seem like roadblocks to publishing with undergraduates. Fortunately, faculty from diverse subfields have come up

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with creative solutions involving high-quality replications (e.g., McKelvie and Standing, 2018; Wagge et al., 2019), preregistered projects (e.g., Strand and Brown, 2019), large-scale single-experiment class projects designed for publication (e.g., LoSchiavo, 2018; Mickley Steinmetz and Reid, 2019), and multi-study projects involving student coauthors across years (e.g., Grysman and Lodi-Smith, 2019; Holmes and Roberts, 2019).

## AUTHORSHIP CONTRIBUTION AND ORDER OF AUTHORSHIP

Much has been written about the ethics of assigning authorship credit in the sciences and social sciences (see Maurer, 2017, for a review), and attempts have been made to fairly determine authorship order by (a) surveying past authors about their experiences (e.g., Wagner et al., 1994; Sandler and Russell, 2005; Moore and Griffin, 2006; Geelhoed et al., 2007), (b) assessing reactions to hypothetical authorship scenarios (e.g., Costa and Gatz, 1992; Bartle et al., 2000; Apgar and Congress, 2005), (c) proposing step-by-step decision-making models (Fine and Kurdek, 1993; Foster and Ray, 2012; Maurer, 2017), and (d) outlining quantitative systems that assign weighted points to tasks associated with publishing (e.g., Winston, 1985; Kosslyn, 2015). The consensus seems to be that writing the manuscript is either the most important factor in determining first authorship (e.g., Winston, 1985; Bartle et al., 2000; Apgar and Congress, 2005) or at least tied with idea origination as the most important factor (Wagner et al., 1994; Kosslyn, 2015). The “authorship determination scorecard” on the American Psychological Association’s website (<https://www.apa.org/science/leadership/students/authorship-paper.aspx>), for example, allots 170 of 1,040 points (16%) for idea generation/refinement; 110 points (11%) for design/measures; 160 points (15%) for statistical analysis, and 600 points (58%) for writing/revision.

Given the clear importance of writing as a factor in first authorship, and because students’ contributions to idea generation, design, and analysis are often similar to those of their collaborators up to this point, I always require students to take responsibility for the manuscript drafts and revisions (with my feedback and editing help) to earn their first authorship. I am typically second author (consistent with the “order of contribution” norm in social psychology) because I play a significant role in the publication process, but less than the first author. The remaining student authors tend to be less involved (consistent with Geelhoed et al., 2007) because of lack of time or interest, or geographical distance. Nonetheless, all authors are always asked to read and approve the final manuscript before submission.

## PATHS TO UNDERGRADUATE FIRST AUTHORSHIP

My mentor, the late Dan Wegner (a social psychologist who ended his career at Harvard but started at a small liberal arts university doing research with undergraduates) advised me as I

began my career at an undergraduate-only institution that “the best undergraduates are often better than graduate students” because they are “not only very bright, but often are more intrinsically motivated—if you hold them to high standards, they will meet or exceed them, and you can publish great work with them.” I followed his advice, and indeed have published the vast majority of my papers with undergraduates as co-authors, and especially as first authors: Of my 33 post-graduate school publications, 29 papers involve a total of 68 undergraduate co-authors, and 24 of the 29 are first-authored by undergraduates<sup>1</sup>.

In my experience, there have been three primary paths to undergraduate first authorship, each representing approximately one-third of my publications with students. First, during our one-semester research methods course with a lab (capped at 12 students), sophomores and sometimes juniors complete two original projects and manuscript write-ups, and conducting high quality, original projects is a big factor (see LoSchiavo, 2018); about 10% of my class projects lead to publication. Second, each faculty member has a capstone course in which they work with 5 to 6 seniors (or sometimes juniors) for two consecutive semesters; about 90% of my capstone projects lead to publication<sup>2</sup>. Third, I occasionally accept projects for individual honors theses or independent studies (independent research outside of capstone is rare in our department, perhaps one senior every several years) if I think they are publishable; about 90% of these projects lead to publication.

## BEST PRACTICES

Here are some of the strategies I’ve developed over the years to successfully mentor students to first authorship:

1. **Provide good writing instruction throughout the curriculum.** It is crucial to teach good writing skills throughout the curriculum (Soysa et al., 2013) so that the largest number of students possible has a strong background and the potential capacity to be first author. (My university has 1,400 students, and we graduate 25–30 psychology majors annually, so with 4–5 faculty members striving to publish with students each year, this step is crucial). Our department places a strong emphasis on students learning APA style as well as proper grammar (see Giuliano, 2019), and all instructors provide copious feedback on student drafts. Although group writing is popular elsewhere (e.g., small groups of students who write APA-style papers

<sup>1</sup>Four are in the *Psi Chi Journal of Undergraduate Research*; the remainder are in professional, peer-reviewed journals.

<sup>2</sup>It should be noted that our department recently switched from an informal system in which either faculty or students approached the other about the possibility of research collaboration to a more formal capstone assignment process in which all students (during their required research methods course) complete a written application describing their interest in conducting a research-based capstone and rank their preference for faculty labs. This process not only improved transparency, but also provided more equitable information, access, and opportunity for all students, who are assigned to labs by fit and interest. Recent articles have addressed both the benefits of increasing diversity and inclusion in undergraduate research and publication (e.g., Peifer, 2019) and specific strategies for doing so (e.g., Ahmad et al., under review; Chan, 2019; Scisco et al., 2019) and are highly recommended.

together on their research methods project), instructors in our department require individual writing (as well as peer review) in both research methods and capstone courses so that every student improves and gets the maximum amount of practice.

2. **Select the most “first-author-ready” students.** I’ve found that it is important to select students with certain characteristics—those who not only have the strongest writing skills, but who are hardworking, independent, intellectually curious, and intrinsically motivated<sup>3</sup>. The process starts when I read a paper (e.g., a research methods final paper, a senior capstone paper, or an honors thesis) that has good results, that is “close enough” that I can envision grooming it into a publishable paper, and that has been written by a student with the characteristics described above.
3. **Explain what authorship entails.** At that point, I ask the student if she or he would like to first author a publication under my supervision (Virtually every invitee will have already first-authored a conference presentation with me, so I know that we are a “good fit” and that they know exactly what to expect when working with me.). As recommended by Foster and Ray (2012), I explain which contributions determine first authorship: I tell them they have already earned authorship by making significant contributions in the idea, design, and analysis stages, as have their student collaborators, so they will earn first authorship by being responsible for writing the manuscript, with plenty of feedback and supervision from me. To provide “informed consent” about this decision (Fine and Kurdek, 1993), I outline clear expectations (i.e., that they can expect to write 10–15 drafts or more over a period of several months, that this will be a much higher standard of writing than they have ever done in the past, and that at times this process could get frustrating and tedious) and let them know that they are free to accept or decline without any adverse consequences (about 95% of students accept). I also tell them that first authorship is not guaranteed and that authorship order may need to be revised if contributions change (Only once or twice in 24 years has first authorship changed; my students have generally been excellent at following through with their commitments.).
4. **Get them ready to write.** Once students agree to be first author, the next step is to provide them with exemplar articles (I use past publications from my own students). I then set an initial calendar of deadlines (e.g., when their drafts are due to me, when my feedback is due to them); I usually draft this first and then allow students to make modifications according to

their schedule. Finally, I have students research and take notes on potential target journals (we then discuss the pros and cons together and decide where to send the paper once finished).

5. **Find time to write.** Finding time to write can be tricky, because students are often either busy with other courses or have moved on to jobs or graduate school. Summers are usually optimal for both students and me. For research methods class projects, I usually suggest writing during the summer after the course is over (setting the final deadline before the new semester starts). If students are in town, we meet in person occasionally but generally trade drafts over email and have in-person or by-phone meetings when necessary. Writing with students who have graduated is often more difficult because those with jobs are busy working during the day and no longer in “academic mode,” so I find that it takes more patience and encouragement to get them back into the writing. If they are in graduate school, they are already immersed in research, which is helpful, but projects with their graduate advisor compete for their attention. Students who have graduated are also more likely to be out of town, which is only a problem if in-person meetings (e.g., to re-analyze data) are necessary, although online meeting applications (e.g., Facetime, Skype) work fine. Ultimately, it may take some creativity to find the time and space for writing, as in “writing weekends” (see Scherman, under review), but in the end, it is worth it.

## CONCLUSION

Publishing with students is truly my favorite part of being a professor—the thrill I get upon seeing a student’s name in print (especially in the lead position) is often greater than the thrill I get from seeing my own name. As others have argued (e.g., Malachowski, 2012; Maurer, 2017), when working with students, it is best to treat them as equals and true partners in the collaboration process, with high levels of autonomy and a strong focus on student learning. In doing so, the rewards—for both students and faculty alike—are incredibly worthwhile.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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## UNDERGRADUATE\* FIRST-AUTHOR PUBLICATIONS

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# Student Writing Weekends: A Model for Encouraging Undergraduate Student Publication

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**Keywords:** writing retreat, tertiary student, publication, research dissemination, undergraduate, mentoring, supervision, contributing to the greater good

*“Research should be alive and shared, it should lead to something. Publishing research outputs in scholarly journals will continue to have value if these outputs add to our knowledge and thereby move the field ahead. Rather than relying on published works as the final evidence of impact, professors should be challenged to develop agency for passing on what they know to the next generation of scholars” (Meyer, 2012, p. 216).*

## RATIONALE FOR UNDERGRADUATE PUBLICATION

Meyer (2012) succinctly articulates the importance of publishing research—for advancing knowledge, which benefits the academic and those in her field. Moreover, Meyer argues that as academics, through our research and dissemination, we also have a responsibility to contribute to the social good. I fervently support this idea—as do others (e.g., Parija and Kate, 2017), and I would add that as researchers and supervisors, we have the added responsibility to help our students achieve the same goal. Yet, for most students, graduation and getting a job are the goals of tertiary study. Many undergraduate students do not think about publishing (Pittam et al., 2009), and may lack opportunities for publication (Weiner and Watkinson, 2014), as well as the skills, confidence and motivation to publish (Aitchison and Lee, 2006; Kamler, 2008; Maher et al., 2008).

Research tells us that *writing retreats* are an efficient and widely utilized model of enhancing academic publication (Grant, 2006; Singh, 2012; Dowling et al., 2013). They are based on a model of bringing together people who share the same goals of writing, in a live-in space for a specified number of days. Writing retreats usually involve a mix of individual and group activities, with large chunks of time dedicated to writing, in either communal or private spaces. Depending on the setting, meals may be provided, further decreasing distractions of daily life. In this way, writing retreats have been found to address many of the known barriers to publication (e.g., dedicated and protected time to write; removal of work and family distractions). They also improve collegiality, provide pastoral support, and are cost-effective. Using writing retreats for post-graduate students builds confidence (Aitchison, 2009; Jackson, 2009), is motivating and furthers employment (Petrova and Coughlin, 2012), and is said to be satisfying and productive (MacLeod et al., 2012).

Armed with a passionate belief that students share in the social responsibility to disseminate their research findings; that with instruction and support, students have the ability to publish; and a robust body of knowledge on the benefits of writing retreats to improve academic publication, I developed a model for encouraging undergraduate dissemination through supervisor-led *Student Writing Weekends* (SWW). Below I describe the SWW, interspersed with reflexive comments on what worked, where changes were needed going forward, and some tips for anyone wishing to develop their own student writing weekends.

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## DESCRIPTION OF THE STUDENT WRITING WEEKENDS

For me, creating a space where students could work individually and collaboratively was essential to the success of the SWW. So, too, was working in an environment where distractions to writing were minimized. Lastly, I felt that some consecutive days of writing and instruction were needed in order to create momentum.

## LOCATION

Staying overnight in my home achieved all three objectives. I acknowledge, however, that the location, layout and number of rooms were major factors in my ability to host the SWW. I further accept that some readers will be uncomfortable having students in their homes. As an alternative, Jackson (2009) holds larger writing retreats for post-graduate students at locations like hotels where students can share rooms, and where they will also have few distractions. If a campus has student housing, that could be another possibility. Additionally, if one's university is willing to share in the costs (and/or the students themselves), one can hire a venue. Ultimately, the location will not be as important as the features needed to mimic the "writing retreat" format. This would include overnight accommodation (for momentum and immersion); quiet spaces for writing; communal spaces for talking, collaborating or instructing; a kitchen for preparation of meals (if not provided by the venue); and in a geographical location away from external distractions. Finally, while I prefer students overnight so they maximize writing time and do not lose time traveling, it could be worth trialing consecutive day-only writing retreats. Modern university libraries, with their individual and shared work spaces, might offer the ideal location for such a format.

## SPACES INSIDE THE HOUSE

Common sitting areas were labeled as *quiet-spaces* where students could focus and write. The kitchen and my home-office were both *talking-spaces*, with the later where students met with me to read over drafts and discuss projects. Sleeping arrangements were fairly arbitrary, often dictated by order of arrival. My home has two extra bedrooms. It also has two common sitting areas, each with furniture to sit on for writing, which also converted to sleeping surfaces at night.

## STRUCTURE AND FORMAT OF ACTIVITIES

For the first SWW, students were asked to arrive by 10 a.m. on Saturday morning, at which time we would have introductions, set guidelines for the weekend, and review some writing and publishing conventions. Unfortunately, several students arrived late, complicating these plans. So as not to delay the work of those already there, introductions had to be made *ad hoc*. In hindsight, this was problematic to workflow due to periodic interruptions as new people arrived. For SWW#2, students were asked to

arrive on the Friday night before; this way, everyone could meet over dinner, settle into their spaces in the house, and awaken on Saturday morning prepared to start right into their work. For subsequent SWW, if students already knew one another, we returned to the Saturday morning start; if new students were joining, students were asked to arrive Friday night.

For me, the goal of the SWW was to build capacity, offer instruction, model the processes, and support the students through the shared experience of a writing retreat. As such, when it came to writing, I chose to let the students organize their writing times and activities as suited them—not "crack-a-whip." Some readers will find this too relaxed, and upon reflexion, I would agree that more prescribed structure would be valuable.

The students were also urged to "make themselves at home," so they would awaken and eat their morning and mid-day meals as suited them. The evening meal, on the other hand, was always prepared and eaten as a group, which brought us back together and offered some shared time to debrief about the day. During dinner, we would discuss writing projects, tackle any writing issues, and plan out writing for the next day. As needed, I would also give additional instruction on writing or publication. After dinner, anyone wishing to continue writing could do. Some did, but most chose to relax, talk, or play games—which served to strengthen the collegial atmosphere.

## COSTS

The novelty and uncertainty of the first SWW incited me to cover food costs associated with the entire weekend. In subsequent SWW, students brought their own food for breakfast, lunch and snacks, and contributed something to the shared dinner. I would provide basics like tea, coffee, milk, bread, butter, etc., and the Friday night meal, when it occurs, is always provided by me. Others wishing to develop their own SWW might consider a small fee that covers the purchase of food for the group. However, the current system of having some shared and some personal food has worked well, and would likely be the best format for alternative retreat locations that lack dedicated food preparation services.

## CHARACTERISTICS OF THE STUDENTS

Over the years, I have had from two to six students at any single SWW. They were all psychology students that I supervised in some research capacity. Most were former fourth-year Honors degree students who I supervised for their dissertations; others had taken an "independent study" class with me, during which time the students carried out small research projects or systematic literature reviews. Anyone who had previously worked with me in those contexts was welcomed with no further vetting criteria other than the desire to publish their work.

Most SWW attendees were only a year out from the previous research projects, meaning that virtually all were attempting to publish from earlier research, as they undertook further study. This fact created unique challenges that influenced the development—and outcomes—of the SWW. For instance, in



light of their ongoing study, the students had only their semester breaks available for writing on previous projects. Unfortunately, many students needed those breaks to complete current assessments, preventing them from attending. For those who did attend, it meant taking a mental break from their current work, to reconnect to their former projects—a task of compartmentalizing that turned out to be too challenging for some of my students.

## PUBLICATIONS ACHIEVED

While I believe that my students have a responsibility to disseminate, I do not believe it must only be in scholarly journals. That objective is neither achievable for every student, nor always desired; non-scholarly mediums are sometimes preferable, in order to reach one's stakeholders. Additionally, non-scholarly publications can be more achievable but equally rewarding for the students.

Since starting the retreats in 2014, my students and I have co-published a journal article (Jamieson and Scherman, 2014), book review (Scherman and Prakash, 2016), two magazine articles (Mousa and Scherman, 2014; Prakash and Scherman, 2016), and delivered two presentations (Scherman and Mousa, 2013; Scherman et al., 2013). Notwithstanding those successes, no manuscripts were completed in a single weekend, so the SWW served mainly to jump-start writing. For some, this was enough motivation to prioritize the manuscript among other coursework. For many, however, the time-constraints associated with ongoing coursework remained a real impediment to publishing.

## GOING FORWARD

Upon reflection, there were two major barriers to more consistently publishing with my undergraduate students: (1) trying to reconnect to the former projects in the face of new coursework and assessments; and (2) the added challenge of having too little time in which to complete a manuscript for publication, if being done in the semester breaks. In trying to resolve these challenges, I have wondered if the writing that served to meet the academic requirements of the course or assessment, could be altered to more closely mimic the planned manuscript. Sadly, the learning outcomes associated with different coursework do not always align with manuscript styles. Another possible solution could be to situate manuscript

writing as close as possible to the end of the term (prior to the next term). For the mid-year break, this may not be achievable given that academics are likely to be occupied with upcoming semester activities. This leaves only the longer summer break—a period of time when I, myself, might trial running some longer writing retreats, in the hope of greater publication success.

## SUMMARY

There are many reasons to encourage undergraduates to publish: it expands their learning and employability; offers a chance to share findings; and (potentially) provides the supervising academic (if co-authoring) increased outputs. Yet, most students lack the awareness, motivation or skills necessary to publish from their research. To address this, I developed a model of *student writing weekends*, to guide students toward publication. The writing weekends offer students a small window of protected time to write in a supportive, encouraging, and dedicated environment, which serves to demystify the process of writing, and create some writing momentum. The writing weekends, in bringing like-minded students together, allow supervisors to more easily role model the value and responsibility of dissemination, and to co-write with their students. Nonetheless, as students move onto subsequent study, trying to publish from previous research project is not without its challenges. Even with those added complications, I would still encourage academic staff with multiple research students to try this model—adapted to their individual needs—for developing and jump-starting undergraduate publication capacity.

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The author confirms being the sole contributor of this work and has approved it for publication.

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# Publishing Open, Reproducible Research With Undergraduates

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In response to growing concern in psychology and other sciences about low rates of replicability of published findings (Open Science Collaboration, 2015), there has been a movement toward conducting open and transparent research (see Chambers, 2017). This has led to changes in statistical reporting guidelines in journals (Appelbaum et al., 2018), new professional societies (e.g., Society for the Improvement of Psychological Science), frameworks for posting materials, data, code, and manuscripts (e.g., Open Science Framework, PsyArXiv), initiatives for sharing data and collaborating (e.g., Psych Science Accelerator, Study Swap), and educational resources for teaching through replication (e.g., Collaborative Replications and Education Project). This “credibility revolution” (Vazire, 2018) provides many opportunities for researchers. However, given the recency of the changes and the rapid pace of advancements (see Houtkoop et al., 2018), it may be overwhelming for faculty to know whether and how to begin incorporating open science practices into research with undergraduates.

In this paper, we will not attempt to catalog the entirety of the open science movement (see recommended resources below for more information), but will instead highlight why adopting open science practices may be particularly beneficial to conducting and publishing research with undergraduates. The first author is a faculty member at Carleton College (a small, undergraduate-only liberal arts college) and the second is a former undergraduate research assistant (URA) and lab manager in Dr. Strand’s lab, now pursuing a PhD at Washington University in St. Louis. We argue that open science practices have tremendous benefits for undergraduate students, both in creating publishable results and in preparing students to be critical consumers of science.

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## READING

A simple way to introduce open science practices is to ask URAs to read papers related to the replication crisis, as this may be novel content even for those who have taken a research methods class. When students join the lab, we typically spend one lab meeting discussing *False Positive Psychology* (Simmons et al., 2011, see also Simmons et al., 2018), an engaging introduction to *researcher degrees of freedom*—the choices made during the research process that enable researchers to “publish ‘statistically significant’ evidence consistent with any hypothesis” (Simmons et al., 2011). Articles like this, or Chris Chambers’ book *The Seven Deadly Sins of Psychology* (Chambers, 2017), are more accessible than empirical articles to inexperienced lab students. These readings allow URAs to engage with the material and contribute to group discussions more quickly than they typically can for research content, which requires greater familiarity with the literature and discipline-specific conventions. These readings can inform students about questionable research practices (John et al., 2012) that increase the likelihood of Type I error, such as Hypothesizing After the Results are Known (HARKing; Kerr, 1998) or *p*-hacking (conducting multiple analyses and only reporting those that render statistically significant results). Once students are familiar with these topics, we point out places in our own research process where bias could enter (e.g., “How should we decide what counts as an outlier in a reaction time task? When should we make those decisions?”), and discuss how to combat these biases.

## WRITING AND PRE-REGISTERING

We begin new projects by collaboratively writing a manuscript-style proposal containing detailed introduction, methods, and analysis sections. Writing the paper before we conduct the study means that incoming URAs have a reference document that they can read and review independently prior to group discussion. We have found that this is far more effective at helping new students master the content than referring them to related published papers and giving brief verbal descriptions of the new project. As a result, students are more able and willing to contribute early on, and therefore more quickly feel like members of the lab community. Further, given that one role for new URAs is often to collect data for ongoing experiments, the methods section in the project proposal can serve as a less daunting avenue for asking questions than the theory-driven introduction section.

As an assignment for lab meeting, we ask new URAs to write about the consequences of certain methodological decisions (e.g., between- vs. within-subjects design or blocked vs. intermixed trials), and have returning students contribute to writing the introduction section of the research proposal. We have found that this exercise not only benefits students, but also helps us notice potential methodological shortcomings ahead of time. Armed with a more thorough understanding of the literature and methodological considerations, students have the knowledge and experience to play a more substantial role in the next project, and consequently become authors on published papers earlier in their academic careers.

A clear benefit to writing project proposals ahead of time is that it relieves the burden of writing the introduction and methods sections later, when the theoretical background is no longer fresh in mind. This is work that must be completed eventually if the project is going to be submitted for publication, and can make the writing process less daunting later on, particularly for URAs with little experience. Indeed, this process can cut down on the number of datasets waiting to be written up because the amount of work that is required to turn the project proposal into a manuscript is minimal. This rapid publication rate has proved extremely beneficial for undergraduates, as student co-authors have the opportunity to see the submission and review process from start to finish. Thus, writing a project proposal with URAs helps them become involved early in their research career, which increases the number of projects to which they can make substantial contributions, and encourages them to publish findings that otherwise may not have made it into the scientific record.

Once we have finalized the proposal, we pre-register the project on the Open Science Framework (OSF). Pre-registration involves creating a timestamped, uneditable document containing hypotheses (or research questions) and analysis plans (Wagenmakers et al., 2012; Lindsay et al., 2016; Nosek et al., 2018 for more information). It is important to note that a pre-registration is “a plan, not a prison” (DeHaven, 2017); if you realize you need to deviate from your pre-registered plan, you simply explain in the manuscript how and why you did so. Thus, pre-registration makes clear which analyses were confirmatory (pre-registered) versus exploratory (not

pre-registered). An eventual manuscript can then link to the pre-registration document to demonstrate that the experiment reported is consistent with the experiment planned (e.g., all conditions are reported, data exclusions are justified, analyses were planned, etc.), and therefore helps combat HARKing and *p*-hacking.

A benefit of pre-registration is that in our experience, it has made it easier to publish interesting and informative null results. Two of our lab's recent publications included unexpected null findings—in both cases we had theory-driven hypotheses about directional effects, so the null effects make important theoretical contributions to the field. Data like these are liable to languish in the file drawer (e.g., see Rosenthal, 1979; Chambers, 2017), but given that most of the writing was already done, the work needed to finish the papers was relatively light. Reviewers have been overwhelmingly positive about pre-registration, leading us to believe that they are more accepting of theoretically interesting null results when the hypotheses are pre-registered (note that pre-registration is a relatively recent development, so there is not yet data on whether it systematically affects the likelihood of publication).

## SHARING DATA AND MATERIALS

At the time of manuscript submission, we make all of our data, code, and stimuli publicly available on the OSF—a practice that reviewers consistently praise. Not only does transparency benefit the research community at large by facilitating re-use of stimuli, independent examination of results, the potential for re-analysis or meta-analysis, and examples of how to conduct statistical analyses (see Klein et al., 2018), but this practice can also benefit the researchers themselves. In one recent paper of ours, a reviewer recommend a change to how we presented data in a figure. Instead of simply describing the change, they accessed the code, edited it to make the change, and included the updated code and altered figure with their review. In addition, open research is associated with more citations, increased media coverage, and improved funding opportunities (McKiernan et al., 2016).

Knowing that others can see our code means writing and commenting much more carefully than we might do for just ourselves. To ensure the transparency of our analyses, we use our own R (R Core Team, 2016) scripts as reading assignments for lab meetings. Given that we do not require that incoming URAs have statistical backgrounds, the code must be commented carefully enough that a naïve reader can interpret it. The biggest benefit we have found to writing code this way is that the script becomes a valuable resource for future students. Not only can these scripts expose students without statistical background to coding in R, but they can also serve as excellent templates for conducting future analyses, thereby streamlining data analysis for subsequent publications. Instilling good habits by writing clean, commented code also helps URAs build a strong foundation for graduate school, where learning statistics and R can be daunting if they have never been exposed to them.



## CONNECTING WITH THE OPEN SCIENCE COMMUNITY

Finally, we have found that transitioning to open science practices has been helped by connecting with others. In person, this has involved attending the Society for the Improvement of Psychological Science meeting and related meet-ups at conferences. Connecting with the open science community digitally has also proved valuable through blogs, podcasts, and Twitter. There is active and spirited discussion about open science on Twitter, and we have found it to be very effective for staying up to date with issues and advancements, discovering new papers, getting rapid answers to questions, and networking. Indeed, one of the studies currently underway in our lab is a collaboration with a colleague we initially connected with via Twitter. This joint venture is a project neither lab is likely to have conducted alone, so this experience can serve as an example to URAs of the potential professional benefits of digital networking.

Though it might seem unprofessional to include social media as a recommendation, Twitter is currently the primary platform on which open science researchers communicate. Research practices are changing quickly, and though publications about research transparency are certainly valuable, they may be more limited in scope, speed, and breadth of views than the conversations that occur on social media. An additional benefit to URAs of becoming involved in the open science community online is that it becomes easier to approach senior researchers in person (e.g., at conferences) when they are familiar with each other online. Therefore, making digital contact can facilitate students forming professional connections that may benefit future careers.

## CONCLUSIONS

Although there are benefits to introducing open science practices at any stage, it may be particularly fruitful for undergraduates. A given URA is less likely to pursue a career in their lab's

research area than a graduate student is, so broad training in open science and meta-science may help provide more generalizable knowledge than learning only area-specific techniques would. URAs may also be particularly receptive to these approaches because they are likely to tend to think that "calling your shots" and being transparent is how science should work. That is, being naïve scientists makes them the perfect audience. Finally, given the disciplinary shift toward using open science practices (e.g., Kidwell et al., 2016; Nosek et al., 2018), early experience is likely to benefit the careers of students going into research.

Importantly, the practices described here can be incorporated incrementally and piecemeal into existing research programs. We began adding these practices to our lab in roughly the order that we describe them, and have found considerable benefits to our lab and our students that far outweigh any costs of adopting new practices.

## RECOMMENDED RESOURCES

- Introductions to open science and replication: Simmons et al. (2011), Vazire (2016), Chambers (2017); Engber (2017) Mellor et al. (2018), and Simmons et al. (2018).
- Guides on implementing open science practices: Hardwicke (2016), Crüwell et al. (2018), and Klein et al. (2018).
- Data on the consequences of teaching the replication crisis to undergraduates: Chopik et al. (2018).
- Podcasts: The Black Goat, ReproducibiliTea, EverythingHertz.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# Publishing Research With Undergraduate Students via Replication Work: The Collaborative Replications and Education Project

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The Collaborative Replications and Education Project (CREP; <http://osf.io/wfc6u>) is a framework for undergraduate students to participate in the production of high-quality direct replications. Staffed by volunteers (including the seven authors<sup>1</sup> of this paper) and incorporated into coursework, CREP helps produce high-quality data using existing resources and provides structure for research projects from conceptualization to dissemination. Most notably, student research generated through CREP make an impact: data from these projects are available for meta-analyses, some of which are published with student authors.

The call for direct replications of published psychological research has been pronounced and sustained in recent years (e.g., Lindsay, 2015), yet accomplishing this in light of the current incentive structure for faculty is challenging (Nosek et al., 2012). There is pressure for faculty to publish original research in high-impact journals and report significant effects (Franco et al., 2014), and so replication work often does not get the attention that it requires or deserves (Martin and Clarke, 2017). CREP harnesses the potential of student research to answer this call.

## CREP BACKGROUND

CREP's primary purpose is educational: to teach students good scientific practices by performing direct replications of highly cited works in the field using open science methods. The focus on students is what sets CREP apart from other large-scale collaborations with similar methodological priorities, such as the ongoing Psych Science Accelerator (Moshontz et al., 2018), and one-off projects such as the Reproducibility Project: Psychology (Open Science Collaboration., 2015) and the Many Labs projects (Ebersole et al., 2016; Klein et al., 2018). The CREP approach also differs from typical undergraduate research projects because CREP results are aimed to have an impact on psychological science as a field.

To select the studies for crowdsourced direct replications, the CREP team samples the most highly cited papers from the top-cited journals in each of nine sub-disciplines published 3 years before the present year (e.g., 2010 in 2013, 2015 in 2018). From this sample, our administrative

<sup>1</sup>Jon Grahe is the Executive Director of CREP, Jordan Wagge is the Associate Director, and the other five authors are Executive Reviewers. The CREP was founded in 2013 by Jon Grahe, Mark Brandt, and Hans IJzerman.

advisors (CREP student alumni) rate papers for how feasible<sup>2</sup> they would be for a student to replicate in a semester, as well as how interesting students would find the topic. If there is more than one study in a paper, the CREP team selects just one for replication (typically the one judged as most feasible). The top-rated studies are then reviewed by one or more Executive Reviewers before making a final selection as a group. The CREP team then notifies the original authors of the study selections and requests materials and replication guidance with the goal of creating the most high-fidelity replication possible. Documentation of the study selection process can be found at [osf.io/9kzje/](https://osf.io/9kzje/).

For a student, the CREP process ideally looks like this: they are introduced to CREP by a faculty instructor at their home institution—typically in a research methods course, capstone course, or individual laboratory. **Figure 1** shows the CREP process from that point on from the students' perspective. Student groups usually conduct direct replications, but can also include additional measures or conditions that the students add to test their own, original hypotheses. This Direct+ replication option can be performed out of student interest (e.g., theory-driven and based on previous findings) or out of a course or departmental requirement that students develop and test original hypotheses.

**Figure 1** highlights that students are, along the way, participating in some of the critical requirements of open science and transparent methodology: open methods, open data, and preregistration of hypotheses (Kidwell et al., 2016). Students are also engaged in standard scholarly peer-review processes that many students do not get exposed to in their curricula. One notable piece of this process is that the CREP team participates in a revise-and-resubmit procedure of their project page until it meets the high standards the review team has set for replication fidelity and quality both before and after data collection. Being told about peer-review is one thing, but being a participant in the revise-and-resubmit process lends a greater appreciation for published scholarly work and how the peer review process works. For students who will enter academia, this training is essential for their careers. For students not pursuing academic careers, they gain skills in critically evaluating scientific claims by asking whether reported research has engaged these practices. For students who complete CREP projects and contribute to manuscripts, it prepares them for the revise-and-resubmit process that happens during the publication process.

## DISSEMINATION OF STUDENT WORK

CREP may be a more likely vehicle for student publication and citation compared to other teaching models that rely on student-generated hypotheses and single-site data collection. Student projects are rarely powered well enough for publication on their own. In a recent survey of instructors, who supervise research projects, we found that less than a third of instructors agreed with the statement that "Enough data is collected to make appropriate statistical conclusions" (only 4.9% strongly agreed) and less than

a third of students complete a power analysis prior to data collection (Wagge et al., manuscript in preparation). While close to  $\frac{2}{3}$  of instructors reported that the research questions for the projects were student-generated, only just over half agreed that student-generated hypotheses are interesting and <20% agreed that student research questions are typically grounded in theory. Unsurprisingly, these typical student projects completed as part of courses are not likely to lead to publication. Indeed, while instructors said that 79.5% of students presented their projects in class, just 30.4% reported presentations outside of class, and only 4.6% published in a journal. We believe these estimates may also be high given the nature of our specific sample (recruited from Twitter and Facebook methods groups, with large networks of open science advocates). For CREP replications, we anticipate that *all* completed student projects that meet our specifications will be included in meta-analyses. Indeed, this has been the case for our meta-analyses that have been published or are under review. The data are practically guaranteed life beyond the institution walls.

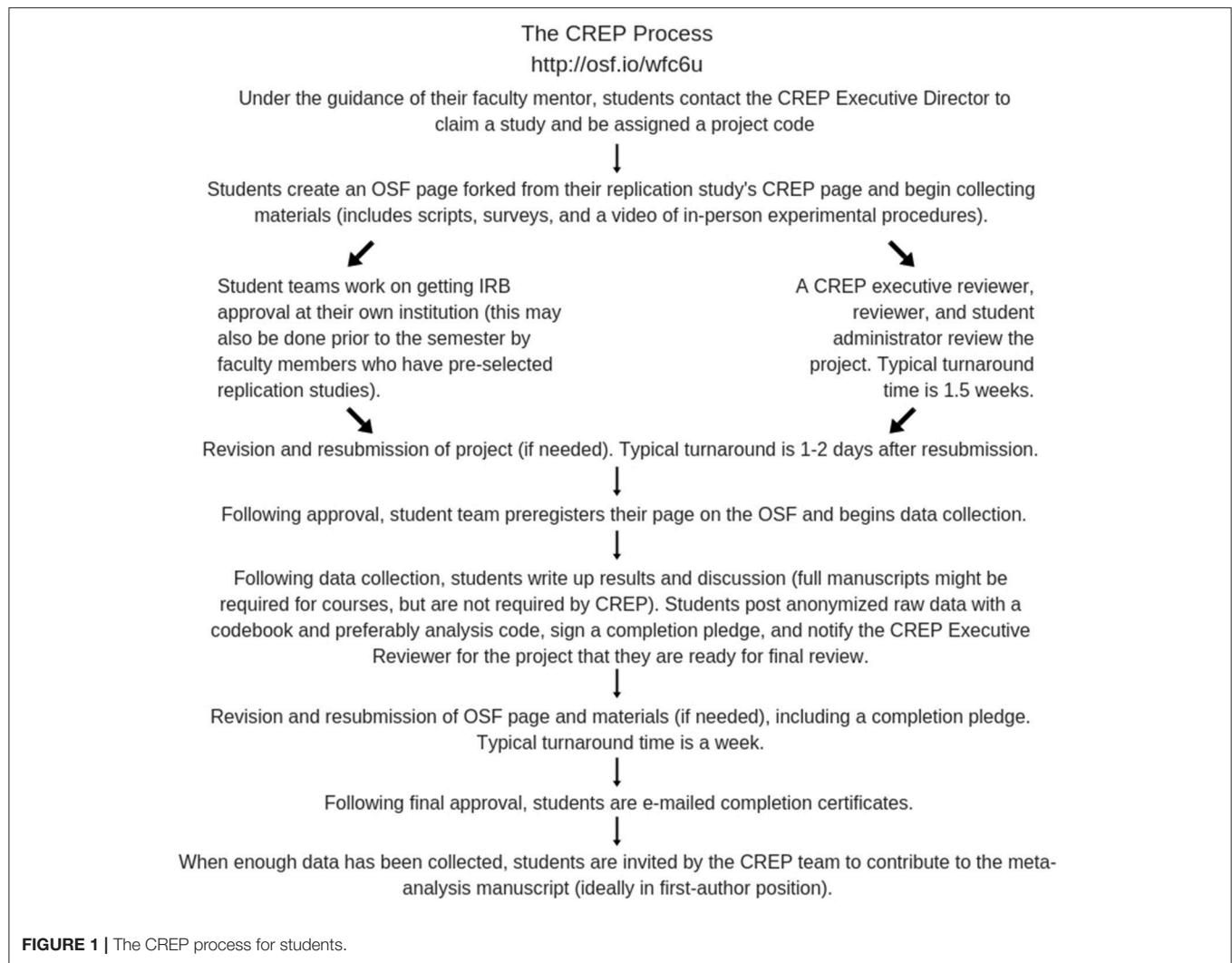
We strongly discourage contributors from writing their single studies for publication because any single CREP replication is not sufficiently powered to draw a strong inference. Instead, we wait until at least five samples are completed to begin a meta-analysis. Ultimately, the goal of the CREP is for completed projects to be reported in peer-reviewed manuscripts. There are currently several CREP meta-analyses in various stages of publication: two have been published (Leighton et al., 2018; Wagge et al., 2019), one has been submitted for publication (Ghelfi et al., 2018), one is in preparation (Lazarevic et al., manuscript in preparation), and an additional Phase 1 Registered Replication Report is in the review process (Hall et al., 2018) for a pilot partnership with the Psychological Science Accelerator (Moshontz et al., 2018).

Generally speaking, CREP can help students get first-hand experience with scientific dissemination in three ways. The first and most obvious way is that students can present their replication results at a conference (e.g., Peck et al., 2017). Second, students who complete replications that are used in CREP manuscripts have their OSF pages cited in those manuscripts. Students can therefore meaningfully contribute to science without needing the time and skill to write a professional paper themselves. OSF pages are also permanently and publicly available for other researchers to use. Our meta-analyses include only CREP direct replications, but other external meta-analyses may consist of conceptual replications and other, non-CREP direct replications. For example, a meta-analysis by Lehmann et al. (2018) of the red-rank-romance effect (e.g., Elliot et al., 2010) cites many of the individual projects completed by CREP groups. Therefore, by doing nothing beyond making their datasets publicly available (a requirement for CREP projects), students who completed replications for this project automatically gain cited authorship of their project's OSF page in a scholarly publication.

Third, and most importantly, students are invited to contribute to the authorship process when enough data has been collected for a meta-analysis. CREP has not been tracking student conference presentations systematically, but 27 CREP projects have been cited in three manuscripts currently published or under review, and 17 co-authors on these manuscripts were

<sup>2</sup>Feasibility considerations include sample size, sample characteristics, access to technology and equipment, and duration of study.





student CREP contributors. When possible, the CREP Executive team avoids taking lead authorship roles on meta-analysis manuscripts, offering these roles first to motivated students who have collected data and junior faculty who have supervised teams.

Replication work may be *more* likely to help students get published than other research models—while direct replications and null effect findings might not typically be considered “interesting” for journals, both null and confirmatory effects are interesting and important when they are replications of highly cited published works. For example, Royal Society Open Science recently committed to publishing close replications of work that was originally published in their journal (“Replication Studies”<sup>3</sup>). Further, the Psi Chi Journal has taken a step toward encouraging replications by offering authors a “Replication” badge in addition to the standard badges developed by the Center for Open Science (Kidwell et al., 2016). Recently, as a result, the first official CREP publication received the first “Replication” badge offered by any journal (Leighton et al., 2018). This publication

included a student co-author and cited seven completed projects by students.

While we face many of the same challenges as other approaches to publishing with undergraduates (e.g., difficulty contacting former students to request their involvement), we believe that this approach is generally more productive than single-site projects as this has been the experience of several of us who have served as supervisors as well as manuscript authors. First, individual projects don’t require collection from more participants than would be feasible for student teams in a typical semester. Second, students don’t need a deep background in theory and the literature to run a CREP study and contribute to the manuscript. Third, publication doesn’t require multiple studies or pretests, and we are unlikely to get feedback that more data needs to be collected to publish results.

## BENEFITS OF CREP

Data from direct replications help establish credibility for the discipline. CREP also has the benefits for students and instructors. Students get training in cutting-edge research

<sup>3</sup>Replication studies (n.d.). Retrieved from <http://rsos.royalsocietypublishing.org/page/replication-studies>.

practices including pre-registration, open data, open materials, and large-scale collaboration. The selection of a replication study may lower barriers for beginning researchers, as students are not required to have extensive knowledge of a literature or research design before making a contribution with impact.

Instructors benefit from using CREP in four ways. First, CREP offers a supportive entry-point for faculty who are new to open science and large-scale collaborations. Second, because the data collected are meant to be included in a high-quality meta-analysis, CREP helps with fidelity and quality checks. Third, CREP eliminates the need for instructors to vet every hypothesis and design for student research projects. Instructors need not be experts in a topic to determine whether the hypothesis and design are relevant to the field and because we also try to provide stimuli and code for replications they do not need to learn new programs. Fourth, CREP is a rare opportunity for instructors to have a documentable experience blending teaching, scholarship, and close mentoring. These experiences are useful for tenure and promotion reviews. Faculty who choose who work as reviewers at CREP have an additional opportunity for meaningful international service experience.

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- In 5 years, more than 120 student groups have initiated CREP projects, and we hope to broaden the project's impact in future years. These projects offer the power, the rigor, and the fidelity needed for good replication work, all while providing the student the chance to learn, to publish, and to apprentice by following in the footsteps of scholars in the field. Given the CREP's benefits and initial success, we also believe this model can be successfully applied in other scientific disciplines.

## AUTHOR CONTRIBUTIONS

JW wrote the original manuscript draft, revised the draft, and coordinated collaboration. MB, LL, NL, CC, BW, and JG provided feedback on drafts. All authors have made significant intellectual and time contributions to the CREP project.

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# Mentor as Sculptor, Makeover Artist, Coach, or CEO: Evaluating Contrasting Models for Mentoring Undergraduates' Mesearch Toward Publishable Research

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For undergraduate students, doing original research under the guidance of an experienced scholar can be a transformative experience. Faculty-mentored undergraduate research fosters students' intellectual curiosity, reasoning and communication skills, and self-confidence, among other benefits (Lopatto, 2007; Thiry et al., 2012). Efforts to bolster institutional support for undergraduate research also trumpet its potential to advance faculty research and generate new knowledge (e.g., Elgren and Hensel, 2006). Skeptics argue, however, that the time and specialized training required to make even modest scientific contributions renders publishable research with undergraduates more aspirational than achievable (Anderson and Shore, 2008).

Here we point to an additional challenge to conducting publishable research with undergraduates, especially in psychology: the expectations that students bring to the research experience. Many students are drawn to psychology for its potential to provide insight into their own personality and experiences, fueling a desire to pursue *mesearch*—research about oneself (Kille, 2011). Mesearch is intrinsically rewarding to students (and to working scientists, for whom life events can be a valuable source of research inspiration; Brockman, 2004), and teaching-focused institutions such as small, residential liberal arts colleges (SLACs) often promote it. On our institution's website, for example, students are exhorted to apply for funds to “travel to India and [explore] the impacts of tourism” or to “independently study the bioethical issues of life and death” (Welcome to Colorado College, 2019). Such encouragement, coupled with students' digital-native status and the ubiquity of search engines and surveys, may give students the impression that they are already skilled at research, yet less than one-third of undergraduates show proficiency with college-level research skills such as developing a topic and distinguishing peer-reviewed articles from other sources (Library Journal, 2017). For faculty, mentoring novice researchers' mesearch endeavors while also producing publishable research of their own—both of which are expected for tenure and promotion (Volkwein and Sweitzer, 2006)—can be challenging.

Satisfying these dual demands requires a mentoring model that prioritizes both student and faculty interests in the research process. Describing such models as metaphors, as in educational psychology (e.g., educators are “gardeners” who “fertilize with interesting lectures”; McEwan, 2007), can illuminate the priorities and assumptions underlying faculty members' mentoring approaches. Two metaphors suggested in the literature—*mentor-as-sculptor* and *mentor-as-makeover-artist*—integrate students' mesearch interests and faculty research goals in resourceful ways, and thus are well-suited to accommodating these demands. Below we outline the goals and strategies guiding the two models, which we have employed successfully in our own research with undergraduates, judging from publication output and student feedback. We contrast these with two other popular

models (*mentor-as-coach* and *mentor-as-CEO*), which we argue are less suited to mesearch-oriented settings because they privilege either student or faculty interests at the expense of the other.

## OUR MENTORING MODELS: SCULPTOR AND MAKEOVER ARTIST

In the mentor-as-sculptor model (Ganser, 1999) employed by author T.A.R., students bring their mesearch ideas to a faculty mentor, who “sculpts” them into theoretically grounded, methodologically rigorous research projects. The goal in this model is publishable research that is also meaningful and rewarding to students by working with them to expand beyond Google searches to connect their mesearch ideas to existing theories (including the mentor’s; e.g., Objectification Theory; Roberts et al., 2018) and empirical findings. Strategic assignments in this approach include directed readings and the creation of an annotated bibliography of sources focusing on “key words” that show students how psychological science examines a construct they might have first encountered elsewhere, such as “hegemonic masculinity” or “intersectionality.” This helps students understand how such constructs are connected to the faculty member’s own theory and research program, and can now be operationalized and studied scientifically. Thus, the sculpting process can result in “molding” students’ ideas into a collaboratively designed study that the mentor is willing to support, or even one the mentor had already considered but not yet developed.

In the mentor-as-makeover-artist model employed by author K.J.H., the goal is to transform, or “make over,” the mentor’s research into mesearch—to show students that the questions probed in the mentor’s work are relevant to their own interests. This model can work especially well when the mentor’s subfield is one that undergraduates do not find immediately accessible (e.g., cognitive psychology), thus requiring some convincing that the research is mesearch-worthy. To achieve such a makeover, the mentor engages students in ongoing scientific debates (e.g., whether language shapes thought), prompting them to consider their own intuitions (e.g., perhaps based on their own language-learning experiences) in light of empirical findings (including the mentor’s; e.g., Holmes et al., 2017). Through in-depth discussion with the mentor, students gain the confidence to venture a theoretical position, which they can then put to the test by taking ownership of a study in the mentor’s lab. This approach, though not explicitly accorded the term “makeover” in the mentoring literature, draws on established practices for socializing students into the scholarly community (Thiry and Laursen, 2011).

Our models differ in whether they take the student’s mesearch ideas or the mentor’s research program as the starting point, but they also have much in common. In both, the student works collaboratively *with* the mentor and contributes valued ideas, but the mentor remains authoritative and the student still has much to learn. Both models also describe the mentoring process in artistic terms, highlighting the innovation needed to conduct quality research. To the extent that our models are discernible to

students, they may communicate the view held by many scientists that “scientific research is an art form” (Wilson, 1998, p. 7) that creatively deploys the tools of a researcher’s trade.

## OTHER MENTORING MODELS: COACH AND CEO

Two other models carry more costs than benefits in mesearch-oriented settings, in our experience. In the mentor-as-coach model (Ganser, 1999), students are positioned as players, and the mentor’s role is to support, scaffold, and cheer on their mesearch pursuits. Here the student is the one playing the research game, and winning is determined by the depth of learning and reflected in a course grade. This model may be well-suited to full professors, who have the freedom to prioritize students’ learning over their own research goals. However, for earlier-career faculty, for whom publishable research is critical, the coach model leaves precious little time for their own work. Regardless of career stage, the coach model has other drawbacks. Merely “coaching” others may be viewed as a waste of doctoral training, and the research produced in this model tends to be exploratory and not immediately publishable, yet may be difficult to continue with other students, who bring different mesearch interests to be cultivated.

In another common model, mentor-as-CEO, students are positioned as workers and the goal is publishable research that advances knowledge in the mentor’s subfield. Students carry out tasks in the mentor’s lab, surely acquiring skills along the way, but rarely do they have the option to pursue their own mesearch interests. This model, though standard at research-intensive universities (cf. Weldon and Reyna, 2015), poses several problems for faculty at teaching-focused institutions. First, CEO mentors may have difficulty retaining student researchers, whose mesearch expectations go unfulfilled. Second, the CEO approach may not facilitate the kind of intellectual ownership provided by the best undergraduate research experiences (Lopatto, 2007), and may even be detrimental to the faculty member upon review for tenure or promotion if it is seen as falling short in promoting student learning. A final problem is that the CEO model may be challenging to embody by faculty from marginalized groups. Female faculty and faculty of color, particularly in the sciences, are consistently evaluated more negatively by students than white male faculty, reflecting implicit biases (e.g., Reid, 2010). Only those professors who fit cultural stereotypes of “brilliant, awesome, and knowledgeable,” as white male faculty do, may be seen as possessing the authority to treat students essentially as employees. Other faculty who attempt the CEO model may be seen, in contrast, as “bossy and annoying” (MacNell et al., 2015), with negative consequences for their student evaluations, research productivity, and tenure prospects.

## CHALLENGES IN IMPLEMENTING OUR MODELS

Implementing the sculptor and makeover-artist models involves some special considerations. First is the question of authorship.



Unlike in the coach and CEO models (where the student and mentor, respectively, would likely be the first author), authorship is harder to determine in our models. In establishing standards, mentors might weigh several elements such as the balance of writing (who did more? did the student's writing improve over drafts?), the idea and its innovation, the time, energy, and skill devoted to collecting and analyzing data, and even the mentor's career stage (with early-career faculty facing greater pressure to produce "independent" scholarship in the form of first-authored publications). In some cases, sculptor mentors might relinquish first-authorship in the service of recognizing students' efforts to "own" the project, while makeover-artist mentors may be apt to do so only when students have demonstrated successful ownership (e.g., fluency in communicating the research). We would urge those adopting these models to communicate their criteria clearly to students and to involve students in the authorship decision-making process by inviting them to reflect on their research contributions (Fine and Kurdek, 1993).

Second, given that our models require significant intellectual ownership on the part of students, including mastery of theoretical concepts not encountered until upper-level classes, most are not ready for such responsibility until their senior year. This means that we typically work with them for only 1 year, which can go by quickly at institutions with heavy teaching loads and demands on students' time. Therefore, publishable output is often paced more slowly than in other models, and multiple students may contribute over several years (requiring careful consideration of each student's contributions when determining authorship). Another downside of the responsibility required of our students is that they may fail, make errors, or otherwise disappoint us. Faculty adopting these models must be patient with their students, fully expecting that they will not always succeed.

Third, students can develop a vexing lack of humility because of their close relationship with us and their genuine investment in the work. This can be seen in their pushing of boundaries (e.g., wishing to socialize with us off-campus) and in their behavior at conferences, where they may make bolder claims than they ought in presentations or have the temerity to demand the attention of esteemed colleagues. We have found that an earnest etiquette speech about how to comport oneself as a serious scholar both on and off campus is sometimes in order.

Finally, although we have focused on how these models operate at teaching-focused institutions like ours, faculty at

research-intensive institutions who wish to prioritize student learning via our models may be unable to devote the extensive time to undergraduate training that the models demand. In such settings, graduate students who serve as undergraduate researchers' most proximal mentors might be trained to adopt the sculptor or makeover-artist model, rather than defaulting to the CEO model common at research-intensive institutions. Indeed, this "mentored mentoring" approach may be especially effective in undergraduate-targeted research programs such as the National Science Foundation's Research Experiences for Undergraduates, for which funding often hinges on the promise of substantive student involvement in publishable work (Wenzel, 2003).

Despite the risks posed by the sculptor and makeover-artist models, we believe that they yield higher rewards compared to the others. Our students enjoy the satisfaction of seeing their mesearch ideas come to fruition (sculptor model), or of discovering that ideas they once viewed as far removed from their own lives have become mesearch (makeover-artist model). When we attend conferences with our students, we have the wonderful opportunity to connect them to important researchers in our fields, and to see them display the intellectual skills and self-confidence that we helped them develop. We also find fulfillment in placing our students into excellent graduate programs that will further enhance these skills and launch their careers. Finally, of course, our models often result in published research, which not only advances our students' development and our own research goals, but also advances science.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# Strategies for Group-Level Mentoring of Undergraduates: Creating a Laboratory Environment That Supports Publications and Funding

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**Keywords:** mentoring activities, shared vision, cohort building, interlocked projects, undergraduate research, grant writing, peer mentoring

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While one-on-one mentoring relationships (Shellito et al., 2001) and institution-level support for mentoring (Rowlett et al., 2012) are essential aspects of undergraduate research, little emphasis has been placed on developing mentoring strategies at the level of the research group or laboratory. Many of us, especially in the sciences, mentor several undergraduate students in research during a semester and over multiple years. Some, or all, of the students may be working on shared or related projects. Successful mentoring of students requires constructive relationships at both the individual and group levels (Shanahan et al., 2015). However, the literature on group-level mentoring primarily focuses on student outcomes, rather than on how group-level mentoring benefits *faculty* by creating an infrastructure for producing publishable research and securing external funding.

This article describes several strategies for group-level mentoring of undergraduates to foster research productivity and simultaneously provide valuable high-impact educational experiences for students (Kuh, 2008). These strategies can be considered forms of cohort building, which has been shown to support positive outcomes for students in STEM fields, including an increased sense of belongingness (Gross et al., 2015). Belongingness, in turn, is an important aspect of motivation (Baumeister and Leary, 1995) and of student academic performance and health (Ames, 1992; Walton and Cohen, 2011), and is a prominent topic in higher education with regard to student retention, graduation rates, and transformative learning (Felten et al., 2016). In my experience, applying cohort-building practices at the laboratory group level also increases faculty productivity. In the following sections, I describe three types of strategies for group-level mentoring and provide a description of how each strategy supports the tangible research outcomes of publications and external funding.

## SHARED VISION

Shared vision is a common management concept (e.g., Kouzes and Posner, 2009), and many readers have some experience with generating or maintaining vision statements at their institutions. A shared vision results in more investment and work satisfaction (Slack et al., 2010), yet we often do not take the time to construct a shared vision with the undergraduate researchers we mentor. As novices, undergraduates may know what hypotheses are being tested and what other researchers have published on a topic but fail to understand the value of the study to the field and how it contributes to long-term goals in our own faculty research agenda.

There are two important pieces of developing shared vision: developing students' personal vision of themselves as scientific researchers, and aligning that personal vision with the larger-scale group

vision for the lab's research, including how that research contributes to the field and to society. Here, I describe activities that can shape both aspects of shared vision.

## Promoting a Sense of Scientific Identity

Effective personal vision is thought to be based on an "ideal self," which includes the person's core identity (Boyatzis et al., 2015). Sustained undergraduate research participation fosters scientific identity (Linn et al., 2015), and mentors can enhance this development through simple habits such as frequently and explicitly talking with students about their identity as scientists and the nature of science, and assigning activities that require students to reflect on these topics. For example, I assign students a reading about core traits of successful scientists from *Science* magazine's website (Jensen, 2018), and students write about how they have already demonstrated, and will demonstrate, those traits in their work as a researcher in my lab. Through such assignments and conversations, I have seen students internalize a scientific identity that helps them to fully embrace the research vision of the lab.

Likewise, the group's larger vision can be strengthened through frequent and explicit reinforcement of how specific research projects in the laboratory serve a greater purpose. Research suggests that the alignment of personal and group visions in this way supports greater commitment and engagement (Berg, 2015). One way I iteratively encourage this alignment each semester is to ask each student to complete an undergraduate research mentoring agreement. This agreement includes specific details about the lab's research vision and how the student is expected to support that vision during the semester.

## Encouraging Shared Vision Through Grant Writing

An especially powerful way to solidify shared vision in students' minds is by incorporating mentored students into the grant-writing process. Grant proposals are a rallying point for students, making explicit how their own research findings benefit society, and giving them a tangible way to "root for" the laboratory in the competitive funding process. Students in my lab participate in writing their own internal and external grant applications and have been part of the process when I applied for external funding.

Students are usually unfamiliar with grants, so I encourage a grant-seeking mindset by explicitly discussing the role of funding in the advancement of research, sharing undergraduate funding opportunities with them, and providing feedback on their applications. Throughout this process, students must articulate why their research matters and how it is valuable in advancing the field. Students in my lab have applied for, and been awarded, competitive external summer research fellowships as well as external funding for their research projects via organizations such as Psi Chi.

When I was writing the application for my current National Institutes of Health R15 award, I regularly discussed the application process with my mentored students. They were

unfamiliar with the NIH, so I assigned portions of the NIH website and program announcement for them to read, and asked them to write about what they learned. We discussed the criteria by which the grant would be evaluated, and the students gave feedback on what I'd written. Students also contributed to the pilot studies that were included in the grant, which increased their sense of accomplishment and excitement, in addition to helping move those studies to publication.

## Benefits to Research Productivity

Effectively fostering shared vision in the laboratory has numerous concrete benefits to research productivity. One of the greatest benefits is that shared vision helps motivate students to work on projects that support and extend existing lines of research. This is crucial in establishing a record of publication in a concentrated area, which is necessary for securing external funding. Additionally, students who embrace a scientific identity are more likely to participate long-term, invest, and take ownership of their projects (Hanauer et al., 2012), increasing the likelihood of producing high-quality publications. Furthermore, getting students involved and excited about the process of competing for funding can provide a motivational boost to the faculty member in getting proposals initiated and submitted. Finally, receiving grant funding has been shown to increase faculty co-authorship of publications with undergraduates (Morales et al., 2017).

## INTERLOCKING PROJECTS

A second major strategy I employ is to guide students' interests in a way that creates intersections among projects in the lab while preserving students' agency in developing their own ideas. When students express interest in conducting research, I ask them to describe how their strengths align with the work of the lab and to identify what particularly appeals to them and why. Then, I outline possibilities for new projects that connect research areas in the lab. If we begin a mentoring relationship, the student, with guidance, develops a project that lives in the space between existing projects, and interlocks with them like a missing puzzle piece. For example, one current student's project focuses on how word generation affects young adults' memory for contextual information. This project connects to another project focused on older adults' memory for context and to another project investigating item-specific aspects of generation effects in memory. The interconnectedness amongst projects allows me to cross-train students and allows students to share knowledge with each other because there is always at least one similarity between two projects that provides common ground.

## Structuring Projects for Peer Mentoring

An additional element of the interlocking-project strategy is intentionally arranging peer-mentoring matches between newer and experienced lab members. The benefits of peer mentoring in research are well-documented (Lopatto, 2010; Packard et al., 2014). Because of the interlocked nature of lab projects, I can assign peer mentors primarily based on skill set, rather than according to the project topic. The 2-fold goal is to scaffold skill



learning for the newer member and to allow the experienced lab member to serve as a resource and guide. Peer mentors meet with me to discuss elements of good mentoring, the specific goals for the peer mentoring relationship (e.g., understanding research processes and tasks, imparting lab culture, personal development), and how best to reach those goals. For example, if an experienced student is particularly good at data analysis, I partner her with a student who has less analysis experience. The newer student shadows several times before moving on to conduct his own data analysis, while being observed by the experienced student who then gives feedback to him on how he performed. This happens in parallel with my own direct guidance and feedback to the student who is learning the new skill and to the peer mentor regarding their mentoring. Experienced students consistently report that it helps them realize how much they have learned as a researcher and that they enjoy sharing knowledge and tips for success. Newer students consistently report how helpful it is to learn from someone who was relatively recently at their current stage, and how partnering with the experienced student helped them feel more confident in their ability to learn and more connected to the lab as a whole.

## Benefits to Research Productivity

Interlocking projects and peer mentoring extend the benefits of the shared vision strategy. In addition to broadly investing in a common set of goals and ideas, students also focus their specific work on closely-related skills, concepts, and scientific questions, which enables the faculty mentor to lead them collectively to produce more sustained and higher-impact research than would be possible through one-off projects with individual students. I have guided students' parallel projects with the aim of incorporating several of them into a multi-experiment paper, and sequential projects to create a series of publications on a single topic. Peer mentoring that is facilitated by an interlocking project structure also enables new students to move projects toward publication more efficiently than if they were solely mentored by the faculty member.

## LAB COMMUNITY

Shared vision and interlocking projects create a strong foundation for lab community and productivity, which is cemented through intentional investment in the social facets of working together. The role of social interaction and support in building a sense of community is well-documented (Hoffman et al., 2002) but prior literature on community-building in research mentoring has focused on institution-level practices (Bender et al., 2008).

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One way I intentionally work to strengthen relationships among students is to assign students to share coffee or a meal with someone in the lab with whom they do not collaborate. They are instructed to share details of their projects, similarities and differences between their projects, what they hope to learn during their time in the lab, what is most valuable that they've already learned, and what advice they would give new researchers. Lastly, they are required to discuss two things unrelated to research. Students consistently report surprise and delight at the common ground they discover with their peers.

## Benefits to Research Productivity

Beyond the inherent benefits to students' development and well-being, strengthening community through relationship-oriented interactions enhances productivity in the research laboratory. The sense of belongingness bolsters motivation when students hit inevitable low points in the research process. Additionally, lab friends are a resource that students can access when their own problem-solving hits a wall, which reduces the demand on the faculty member to address smaller issues like coding or analysis snags. Both of these effects help students to work independently and keep projects moving toward completion and dissemination with less prompting from the faculty mentor.

## CONCLUSION

Group-level strategies can be implemented to successfully engage undergraduates in research that is high-quality and likely to be published and funded. The aforementioned strategies and activities are aimed at the collective development and organization of the research group or whole laboratory. They can also be adapted to research groups that include graduate students, or to teams of student researchers being led by a graduate student or post-doctoral researcher within a larger research lab. When thoughtfully applied, these strategies can help mentors to develop high-impact, productive research programs with undergraduate students.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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# Undergraduate Research Teams That Build Bridges, Produce Publishable Research, and Strengthen Grant Proposals

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## INTRODUCTION

Engaging undergraduates in the research process is one of the most rewarding aspects of being a professor because it more deeply connects us to our work and helps shape the professional futures of students by immersing them in the culture of research (including peer-to-peer mentoring and authoring publications; Russell et al., 2007). But there is a real trick to working with undergraduates in a way that both shapes students' futures *and* produces high-quality, publishable research because mentors must invest a great deal of time developing undergraduates' technical and writing abilities, and this effort is time not spent on the research itself. In this article, we describe a powerful, flexible approach that makes the production of publishable research possible.

For context, we teach and conduct research at a small liberal arts college with a population of just over 2,000 undergraduates. Research at primarily undergraduate institutions (PUIs) does not benefit from a system of graduate students, post-docs, and paid research staff, so we have found it necessary to develop a structured, team-based approach to faculty-student research that provides excellent mentorship and produces publishable research (see Detweiler-Bedell and Detweiler-Bedell, 2013). Importantly, this team-based model can be put into practice with a broad array of students, including underrepresented and first-generation students. What we have learned in adopting this approach reflects a deeper appreciation of why certain details of faculty-student research (i.e., systematically laddering students' experiences to foster a sense of belonging and increase the efficiency of research) matter as much as they do, as well as the importance of best practices in designing and managing effective teams. Specifically, the most effective teams, according to Hackman (2002): (1) have clear boundaries, interdependence, and stability of membership (yet are semi-permeable) over time; (2) are given and share a compelling direction; (3) utilize a structure that enables teamwork; (4) have a supportive social context; and (5) receive competent coaching to help navigate challenges and take advantage of opportunities.

Although it is beyond the scope of this short article to describe every aspect of our approach to structuring and mentoring undergraduate research teams, the value of this approach to a few

key aspects of producing publishable research stand out: enhancing students' sense of belonging in order to build bridges to more diverse student populations, teaching collaborative writing, and securing funding for one's research.

## USING A TEAM-BASED APPROACH

In our lab, we organize students into multiple, 3-person ladder teams (Detweiler-Bedell and Detweiler-Bedell, 2007), with an experienced student (the team leader; usually a senior psychology major with past experience in our lab) mentoring a mid-level student (the team associate; usually a sophomore or junior) alongside a student new to the research lab (the team assistant; see **Table 1**). As the faculty mentors, we give teams a clear, compelling vision and direction for their projects, but the teams work on their own at least twice weekly and have great autonomy over their process of working together. To provide a supportive context for this work (i.e., an iterative system of technical guidance and oversight), we provide 3–4 hours of leadership training and meet regularly with the team leaders to ensure that clear research protocols are developed and followed. Likewise, we meet weekly with the lab as a whole, enabling us to assess each team's progress and provide educational lessons, coaching, and oversight on particular research tasks. We find that undergraduates need insight over simple direction, so we ask them *why* even the smallest technical details might matter to the research project's overall vision, and we guide each of these conversations to a clear principle that informs the work.

Team leaders then take ownership of the day-to-day operations of the lab, which sets a powerful example for the less experienced students. Leaders are charged with having their team work interdependently and in a manner that transmits the skills necessary for the team associate and assistant to carry out high-quality research. This places significant responsibility on our

team leaders, who are hand-selected based on their development as effective near-peer mentors. We rarely encounter problematic dynamics that stem from our student leaders, in part because only about one-third of our students ultimately grow into this role. Moreover, the lab is a close-knit environment, and even small issues are noticed quickly because we hold each other accountable to the principles and practices we introduce during leadership training.

We make clear to potential lab members at the time of their interview that most students stay with the lab over a number of semesters (and even years) and that we hope, if the fit is right, they will too. Team membership does remain relatively stable over time, with most students engaged in research long-term. Such multi-year research experiences result in a number of benefits for undergraduates (Thiry et al., 2012; Adedokun et al., 2014), and in our lab this commitment builds a strong sense of shared ownership as teams develop a robust set of collective skills over time. This maximizes the usefulness of each student's contributions to their team as they learn and grow, with each team in turn making a sustained contribution to publishable research. It also creates efficiencies for research mentors, allowing them to focus in particular on mentoring the team leaders, who are able to work as young colleagues in advancing the mentor's lines of research.

## ENHANCING STUDENTS' SENSE OF BELONGING

Our approach to mentoring undergraduates is supported by research on team-based learning and leadership (Hackman, 2002) and work underscoring the importance of creating a sense of belonging among undergraduate students, especially those from traditionally underrepresented groups (Walton and Cohen, 2007). When students first make the college transition,

**TABLE 1 |** Team structure, recruitment, and responsibilities.

Role	Team assistant	Team associate	Team leader
Time commitment	4–6 h/week	6–8 h/week	8–10 h/week
Class standing	First-years & sophomores new to psychology	Advanced sophomore, junior & senior psychology students	Advanced junior or senior psychology students who are veteran lab members
Recruitment strategies	<ul style="list-style-type: none"> <li>Recruitment of first-year, first-generation students through a college-wide program</li> <li>Identification of students from classes taught by mentors such as Introductory Psychology &amp; Statistics</li> <li>Word of mouth</li> </ul>	<ul style="list-style-type: none"> <li>Retention of team assistants (who become associates in year 2)</li> <li>Identification of students from classes such as Research Methodology and mid-level psychology classes taught by mentors</li> <li>Word of mouth</li> </ul>	<ul style="list-style-type: none"> <li>Selection of students who have at least 1 year of experience in the lab &amp; are prepared to take on this level of commitment</li> <li>Preparation and training of leaders through weekly mentor meetings outside the regular lab meetings</li> </ul>
Tasks	<ul style="list-style-type: none"> <li>Attend weekly lab &amp; team meetings</li> <li>Initial training in how to conduct literature searches, design surveys, &amp; run experiments</li> <li>Read relevant background literature</li> <li>Assist in design of experimental materials</li> <li>Help run experiments</li> <li>Present research to lab</li> <li>Assist with conference presentation preparation</li> </ul>	<ul style="list-style-type: none"> <li>Attend weekly lab &amp; team meetings</li> <li>Mentor team assistant</li> <li>Collect and read relevant background literature</li> <li>Design experimental materials</li> <li>Run experiments</li> <li>Assist with IRB applications &amp; data preparation and analysis</li> <li>Present research to lab</li> <li>Assist with conference presentation preparation</li> </ul>	<ul style="list-style-type: none"> <li>Attend weekly lab, team, supervisory &amp; leadership meetings</li> <li>Mentor assistant &amp; associate;</li> <li>Integrate team members' efforts, providing work one consistent "voice"</li> <li>Organize &amp; oversee daily operations: choice of background literature, experimental design, IRB applications, data collection &amp; analysis</li> <li>Present research to lab</li> <li>Lead conference presentation preparation</li> <li>Assist mentor with manuscript writing</li> </ul>



**TABLE 2 |** Policy agreement signed by new lab members.

<b>To foster a successful, productive, and ethical research experience, we use the following set of policies for all student members of our research teams:</b>	
Ethical obligations	All team members are required to follow the American Psychological Association's (APA) guidelines pertaining to the participation of human subjects in psychological research. This includes, but is not limited to, using only research materials that have been approved by the appropriate institutional review board committee, securing informed and free consent from all study participants, and keeping participants' identities and data strictly confidential. In addition, team members agree to have all research materials and procedures approved by one of the faculty advisors prior to implementation. Finally, team members agree to follow APA guidelines in properly citing the work of others. Academic integrity is an essential part of the research process. Plagiarism or the deliberate misrepresentation of any information or data is unacceptable.
Authorship expectations	On poster presentations, all active team members and the faculty advisors will be listed as co-authors. Other scholarly works (i.e., journal articles, book chapters) generally will be co-authored by the faculty advisors and the team leader(s), whose team-based growth over at least one full year on top of their coursework in statistics and research methodology has prepared them for the technical demands of writing a publishable manuscript. In some instances, at the discretion of the faculty advisors, a team associate also may be included as a co-author of these works. Order of authorship will be determined by level of involvement in conducting the research and writing the manuscript. Research associates and assistants who participated in aspects of the research project (e.g., data collection) but were not involved in its write-up will be acknowledged (thanked) in these works.
Team responsibilities	Team members are expected to carry out all of their obligations as described above. These obligations include regularly attending collaborative research meetings and activities as well as consistently carrying out individual work assigned by the team. Students choosing not to remain in the lab can step down at any time. Students not upholding their obligations or failing to abide by these policies will be asked to step down from their positions, and replacements will be made by the faculty advisors.

it's natural for them to question the extent to which they belong at their new institution, but first-generation and minority students often fail to recognize that *all students* feel the same way. Helping these students appreciate this early on can transform subsequent challenges into evidence that they have things in common with other students and are a valued member of the community (Walton and Brady, 2017). For this reason, we intentionally engage students early in their college careers, often in their first semester. For example, with funding from the Sherman Fairchild Foundation and, previously, the National Science Foundation (NSF), we recruit first-generation students to our lab in their first month of college. This effort is designed to help increase first-generation students' levels of achievement and persistence in STEM and related fields, building on findings that suggest minority students are more likely to persist and achieve positive academic outcomes if they engage in undergraduate research (e.g., Jones et al., 2010; Clayton-Pedersen et al., 2017).

Our first-semester recruits often stay with us throughout their 4 years at the college, setting them up to become team leaders in their senior year. This continuity of engagement creates a built-in community where all students know they belong, and it also enables students to see a series of research studies through to fruition. This latter quality is essential to the mentor's program of research—it enables undergraduates to build the individual and collective skills needed to be sufficiently expert so they can conduct high-quality research efficiently and contribute collaboratively to the writing of a publishable manuscript.

## BUILDING BRIDGES

We have successfully leveraged our team-based approach to build bridges to high school students as well as community college students. High school students (including those from underrepresented backgrounds) can be incorporated into

summer research teams at the assistant level and paired with one or two college students who provide near-peer mentoring. The challenge is to identify students who are sufficiently prepared to benefit from the summer research experience. We have accomplished this by partnering with a small number of high schools and having our undergraduates design and deliver exciting research-based lessons at these schools. This generates a pool of potential applicants, and those identified as ready for a summer research experience are invited to apply. Nearly the same approach can be used with community college students, with instructors at partner schools identifying a pool of candidates prepared to do summer research at the team associate level. Bringing community college students in as associates (rather than assistants) is essential to foster their sense of belonging (i.e., avoiding the combination of their being fellow undergraduates but nevertheless outsiders *and* low status).

## TEACHING COLLABORATIVE WRITING

To produce publishable manuscripts in a team-based setting, we find it most productive to share the writing process with the most senior members of our research teams. Their team-based growth over at least one full year (plus coursework in statistics and research methodology) has prepared them for the technical demands of writing a publishable manuscript, and we make this trajectory clear to all students at the time they join our lab (see **Table 2**). We then adopt a best practices approach to the writing process (Silvia, 2007; Detweiler-Bedell and Detweiler-Bedell, 2013):

- Successful writing comes from breaking the process up into small, manageable steps. Outline the paper before beginning to write, then set regular deadlines for each step in the writing process.

- Collaborative writing is an iterative process, characterized by periods of solitary writing, peer editing, exchange of ideas, and team-based discussion.
- Because the skills necessary to write papers in psychology take time to develop, avoid giving ownership of sections to particular individuals. Conduct round-robin editing, where team members trade sections and take turns adding to and editing content.

This egalitarian approach to writing consolidates the team's vision, collective feeling of ownership, and sense of togetherness. Regularly sharing progress gives meaning and longevity to the team's project and final written product.

## SECURING FUNDING

Publishable research often starts with and is funded by a well-conceived grant proposal. Treating grant proposals as if they were themselves a publication, and involving undergraduates in writing them, can strengthen proposals and speed up proposal writing (especially at smaller institutions where grant writing is otherwise a lower priority relative to teaching). Moreover, adopting and describing a structured, team-based approach to undergraduate research provides evidence of the resources necessary to bring high-quality faculty-student collaborative research to fruition. It also gives proposals a distinct advantage in terms of their broader impact. Organizations such as NSF require grant proposals to demonstrate not only the publishable, intellectual merit of a project, but also the broader impact of the work (National Science Foundation, 2016). In our experience, the team-based model we've described is compelling to reviewers in terms of its ability to provide transformative research experiences to a broad array of undergraduates. This strength can be leveraged regardless of institution type, and it can set the stage for impactful collaborations between different types of institutions, as described earlier. Our experience on both sides of the table—securing grants and reviewing grant proposals—attests to how compelling it can be to do research in a way that demonstrably includes and impacts students from diverse backgrounds.

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## CONCLUSION

Whether you are a faculty member or a graduate student working with undergraduates, a systematic approach to mentoring undergraduates lays the foundation for the creation of publishable research. Grounded in best practices, our structured, team-based model provides high quality mentorship, and a strong sense of belonging for students, while mitigating the challenges of securing funding and producing high-quality publishable research with undergraduates (for alternative approaches, see Miller et al., 2008). This type of approach is flexible and can be tailored to a wide range of settings from PUIs to community colleges, and from summer programs that bridge different types of institutions to teams of undergraduates led by graduate students at a research university. Most importantly, it works, as demonstrated by the success we have had in providing this systematic mentoring to 9–15 students per year and in sending half of these students to doctoral and other graduate programs in psychology or a related field (Detweiler-Bedell et al., 2010), together with our ability to obtain individual and institution-wide extramural funding and to publish with students at a consistent rate (about every other year) in the context of a small liberal arts college.

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BD-B and JD-B contributed equally to writing this opinion piece. Each author drafted different parts of the opinion piece, edited and added to the entire manuscript, and worked together to finalize and submit. BD-B is listed as the first author alphabetically and JD-B is the corresponding author.

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# Strategies to Maximize the Involvement of Undergraduates in Publishable Research at an R2 University

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**Keywords:** peer-mentoring, team-based research, R2 university, graduate-student mentoring, interdisciplinary programs

## INTRODUCTION

In 1987, I was hired by the Department of Psychology at Central Michigan University (CMU) with the primary responsibility of teaching courses in physiological psychology, which were required for accreditation of our Doctor of Psychology (Psy.D.) program, the only doctoral program at CMU at that time. I was given \$3,500 start-up and lab space which consisted of a 12' X 24' storage room and a similarly sized retrofitted classroom to house rodents. However, by refurbishing discarded equipment from companies, like Dow Chemical and Dow Corning, and building our own rat mazes, my students and I were able to put together a functioning behavioral neuroscience laboratory that allowed students to engage in hands-on, inquiry-based research (Dunbar, 1998). Although CMU had a M.A. program in experimental psychology, nearly all the department-supported graduate assistantships went to the Psy.D. program, so my lab mainly consisted of undergraduates, with two self-funded M.A. students. With the help of two equipment and course improvement grants garnered through the National Science Foundation and by partnering with a Michigan-based pharmaceutical company (Upjohn), we were soon able to conduct publishable research, which included undergraduate students. Our undergraduate research blossomed with the infusion of innovative ideas and interactions with members of a new organization, the Faculty for Undergraduate Neuroscience (FUN).

## THE FUN BEGINS

At the annual meeting of the Society for Neuroscience in 1991, a group of neuroscience faculty members with a shared passion for teaching and involving undergraduates in research formed a new organization, the Faculty for Undergraduate Neuroscience (FUN) (Ramirez and Normansell, 2003; Dunbar and Symonds, 2018). The networking that FUN provided had a major impact on my ability to engage undergraduates in publishable research. Ideas of peer-mentoring among students (Mickley et al., 2003) and helpful tips on writing successful grants translated into accommodating more students in my lab and into writing a successful R15 grant from the National Institutes of Health.

In 1995, the first FUN workshop took place at Davidson College (Ramirez and Normansell, 2003; Hardwick et al., 2006), which initiated a series of national blueprints for a core undergraduate neuroscience curriculum (Ramirez, 1997; Ramirez et al., 1998; Wiertelak and Ramirez, 2008; Kerchner et al., 2012; Wiertelak et al., 2018). In addition, there were sessions on neuroscience pedagogy and on ways to augment publishable research for undergraduates (Dunbar, 1998, 2001; Mickley et al., 2003). The Davidson workshop provided the impetus for establishing

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an interdisciplinary program in neuroscience at CMU and to develop the first undergraduate neuroscience major in Michigan in 1999 (Dunbar, 2015). We were able to do this by patching together a curriculum of existing courses from biology, chemistry, psychology, and health sciences, which minimized the costs. In addition, faculty who served the program did this as a voluntary overload, in addition to their contractual obligations to their home departments. However, we later found that because the solid academic structure of a department was lacking in our interdisciplinary program we were particularly vulnerable to the machinations of inter-departmental politics that gave us no voice or seat at critical decision-making tables. Nonetheless, the establishment of the new program in neuroscience provided a huge boost to our research programs and provided a foundation that would lead to a significant increase in the number of publications involving our undergraduates (Dunbar, 2015).

## FUN LESSONS LEARNED

By employing some of the critical lessons received from FUN workshops (which occur every 3 years) and publications, such as FUN newsletters and the Journal of Undergraduate Neuroscience Education (Lom, 2002; Dunbar et al., 2009), our neuroscience program at CMU flourished and garnered attention from the CMU administration, which soon translated into internal support for our program.

The key to our success has been the implementation of a team-based, peer-mentor approach, whereby experienced, more senior undergraduates serve as research mentors to less-experienced undergraduates who assist the advanced students with designated parts of a research project for which they are responsible (Mickley et al., 2003). These less experienced undergraduates work with their mentors to help complete a larger study, such as a senior thesis of the advanced student, or, in most cases, some component of a larger, more comprehensive project which is overseen by the faculty member or graduate student.

All students in my lab are required to write a proposal that includes a new aspect of the research being formulated (such

as an additional behavioral test) that would enhance the scope of the overall project. This allows students the opportunity to provide intellectual contributions and ensures that they are conceptually connected with their portion of the work and to the overall project. Students present their specific proposal at lab meetings where they are assessed in a manner that simulates how peer-reviewed panels of granting agencies evaluate proposals. After receiving feedback on their proposals, the students refine their ideas and present them at subsequent meetings until they convince their fellow team members and others in the lab that one of their ideas should be incorporated as a part of the overall study.

The advanced undergraduates and all the graduate students in my lab are then required to write up a grant proposal over their portion of the overall project and submit it for possible funding to either our internal, university-wide student grant program or to external granting agencies. These students and their mentees then help collect and analyze data, as well as provide drafts of their portion of the manuscript. Finally, the students review the completed manuscript and provide suggested edits prior to submission and during the re-submission process. This step is critical for honing the writing skills of the students.

At first, we started with 2–3 teams of 4–5 students per team, and though less than one-third of the projects we conducted resulted in a publishable outcome, students learned the rudiments of how to conceptualize and conduct a research project and how to present their results, including giving oral presentations and producing written manuscripts. Over time, the quality of the manuscripts continued to improve, resulting in an increase in the number of publications that involved undergraduates from my lab (Dunbar, 2015). Much of the improvement in the quantity and quality of published articles from my lab should be credited to the growing number of graduate students working in my lab, an advantage afforded at an R2 university. However, the growth of our program and the greater emphasis on garnering more grant money made it increasingly difficult to focus on the student-centered research that elevated the stature of our lab and program.

**TABLE 1 |** Numbre of publications involving undergraduate students in the lab of the author from 1987 to 2018.

Year	Number of publications from the lab	Number of publications involving undergraduates	Number of undergraduate coauthors	Number of undergraduate first-authors
1987–2012	47	11	20	2
2012	7	2	4	0
2013	2	2	6	0
2014	8	4	17	1
2015	8	2	9	0
2016	7	1	4	1
2017	14	5	11	0
2018	13	6	13	0

*The relative number of undergraduate authors increased (as did the relative quality of publication) with the addition of senior graduate students in the lab of the author (by the year 2012), although the relative number of first-author publications by undergraduates remained lower than would be expected if there were no graduate students in the program.*

## R2 ADVANTAGES AND DISADVANTAGES

Although there are several advantages that my colleagues at smaller, liberal arts colleges have in terms of being able to forge interdisciplinary programs with less complications than many of us encounter at larger universities (González, 2001), there are some major advantages to being at an R2 institution. One of these is to utilize graduate students in a team-centered approach to student research. In 2008, we successfully launched an M.S. and Ph.D. program in neuroscience at CMU that was designed to bolster our undergraduate program by increasing the number of graduate students to help mentor our undergraduates. Specifically, we utilized some of the ideas promulgated at the FUN workshops, especially utilizing teams of undergraduates with upperclassmen (and, for our program, graduate students) providing mentorship to the lower classmen.

The major advantage of successfully utilizing our graduate students as mentors for the undergraduates became apparent by 2012, when senior graduate students began supervising 2–3 of the undergraduate teams. These senior graduate students formulated parallel projects that, when combined with experiments of the undergraduate team, provided for stronger research findings, which eventually found their way into higher impact journals. Each of the advanced undergraduate team leaders still took a great deal of ownership of their portion of these projects and was responsible for writing up the early drafts of their part of the study. However, more of these eventually became merged into larger manuscripts which provided much stronger, multiexperiment papers, resulting in more undergraduate co-authorships, albeit with only a few undergraduates becoming first authors (Table 1).

The proof of the success of this approach became obvious when our undergraduates started winning most of the undergraduate research awards at the annual meetings of the Michigan Chapter of the Society for Neuroscience (at one point winning 8 out of the 10 successive Outstanding Undergraduate Research Awards). This TEAM (together everyone achieves more) approach was the primary basis for CMU winning the Outstanding Undergraduate Program of the Year Award in 2013, given by the Society for Neuroscience (Dunbar, 2015). Our approach utilized this R2 advantage (i.e., graduate student mentors) to build on a similar team approach to research that was utilized by Baldwin-Wallace College, which received the award the preceding year (Mickley et al., 2003).

However, the growth of our program and the university has caused a strain on our ability to continue to increase the proportion of our majors engaged in published research. During the past 4 years, our program has grown to over 200 majors, which, in conjunction with escalating costs for animal care to allow vivarium space for CMU's new medical school, has forced us to drop the requirement that all our majors complete a research project. As a result, less than half of our majors are now engaged in research or belong to a lab at CMU. The cost of supporting undergraduate student research became prohibitively high for many faculty mentors and a greater emphasis on

conducting research so that faculty can obtain individual grants rather than focusing on student-centered research has negatively impacted our ability to expand the proportion of undergraduates engaged in publishable research.

## FUTURE DIRECTIONS

Although my colleagues and I may have maximized our ability to increase the proportion of our majors who are engaged in publishable research in our labs, we continue to focus our efforts on increasing the quality of student research. Utilizing ideas propagated by advocates for “open science” (e.g., Yong, 2012; Cummings and Calin-Jageman, 2017) who emphasize reproducibility and transparency, we are now initiating new standards for students in our lab to register their research proposals at the Open Science Framework (<http://help.osf.io/m/registrations/1/524205-registeryour-project>). In this way, we are committing ourselves to full disclosure of what measures we will be using and how they will be analyzed. This will ensure that all our data and the analyses we employed will be available and will minimize the temptation to “cherry pick” positive results for publication. Our hope is that this increased rigor will translate into more impactful research articles authored or co-authored by our undergraduates.

## CONCLUSIONS

A peer-mentoring, team-approach to involving students in publishable research can be very effective and may be augmented by the addition of graduate students as team leaders in R2 universities. The strategies we have employed over the years have proven to be very effective in maximizing the involvement of undergraduates, while increasing the quantity and quality of our published research. However, the advantages of employing this at a growing R2 university, which requires an expanded infrastructure and the support of graduate students, necessitates a delicate balance between focusing on faculty-driven research that is geared toward garnering grant money and concentrating on student-centered research, which prioritizes nurturing students and immersing them in publishable research. Importantly, we are committed to increasing the quality of undergraduate research and by ensuring our students register their proposals, we will be taking another critical step in mentoring students to produce high-quality, transparent publications.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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# Trials, Tribulations, and Triumphs: Research and Publishing From the Undergraduate Perspective

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## INTRODUCTION

Demanding, engaging, and yes—frustrating at times—conducting research as an undergraduate can be an incredibly transformative personal and academic experience. As members of a year-long senior-level research lab in social psychology at a primarily undergraduate institution, we are grateful for the opportunity to have participated in all phases of the research process, including publication. Having less structure and requiring more involvement than many college courses, conducting high-level research comes with unique challenges and benefits. As such, we are excited to offer our perspective on these obstacles and rewards, along with specific tips for research instructors based on how our lab successfully produced publishable research.

## BACKGROUND ON OUR LAB

Our research lab consisted of five undergraduate research assistants working with one faculty research advisor. For best practices on engaging undergraduates in publishable research from her perspective as an instructor, see Giuliano (2019a,b). Research assistants were invited by our advisor to collaborate in her lab based on our performance in previous classes (e.g., a year-long research methods course that required complete APA paper write-ups on four projects: one experimental replication plus original observational, correlational, and  $2 \times 2$  experimental projects). Our lab met once a week for two and a half hours under the supervision of our lab instructor, and we were expected to work an average of 8 to 10 hours per week outside of meetings (although we often worked more) on tasks such as searching the literature, generating hypotheses, designing studies, collecting data, analyzing data, and writing up the results. Assessment for each semester was a letter grade, and As were not automatic (i.e., they had to be earned). The expectation of our instructor's lab was that we work at a much more advanced level than during our research methods class, that we write multiple manuscript drafts, and that with good results, we would present our work at conferences and submit it for publication to a non-undergraduate refereed journal.

## CHALLENGES OF RESEARCH

From the beginning, working collaboratively on such an intensive project posed considerable challenges. Our research group was comprised of diverse personality types, and we had to learn to communicate in ways that were effective, yet respectful, in order to advance our project while maintaining group rapport. Speaking up when we felt it was necessary, especially when disagreeing with another's opinion, proved to be an uncomfortable yet essential lesson. We also had to learn to trust our own judgment and the judgment of other group members. We readily accepted criticism and constructive feedback in order to make progress, and we had to overcome procrastination



and complacency in order to stay on course as a group. Academically, conducting research was much more “messy” than previous coursework anyone in our group had participated in; the lack of structure and increased ambiguity could be confusing and frustrating, and preventing tension within our lab became a priority.

Perhaps most importantly, our involvement in research did not end after our year together in the lab. Although our class project was complete, the process of publishing our findings provided a new set of challenges. Aside from no longer being together physically, we were juggling other responsibilities; graduation, graduate school and job applications, and post-graduate employment got in the way as we stumbled through the uncertainty of life in our early 20s. As such, new obstacles arose, including staying immersed in the research, staying in contact, and staying motivated without official meeting times. From a practical perspective, there was less access to resources such as SPSS software, online literature databases, and our lab instructor. Additionally, because of our distance, communication more often took the form of emails or phone calls rather than in-person meetings. As lead authors on our manuscripts, we found the continual process of revision and submission to be time consuming, and, in the face of rejection, occasionally disheartening. The time that elapsed between submitting work to a journal and receiving feedback (sometimes several months) created an “out of sight, out of mind” effect, which made returning to our manuscript and diving back into our work a motivational challenge.

## BENEFITS OF RESEARCH

Thankfully, the advantages of a rigorous research experience are numerous and far outweigh the challenges, and previous research substantiates the widespread benefits we experienced. For example, Russell et al. (2007) found that, after participating in undergraduate research opportunities, students reported increased understanding of how to conduct research and increased confidence in their skills as researchers. For us, completing a research project in social psychology improved our work ethic and transformed how we approached problems. Specifically, our research experience trained us to be diligent, critical thinkers who were capable of using our time efficiently by being responsible, independent, and proactive. These lessons led to arguably the most important benefit in line with previous research that each of us experienced—an increased confidence in ourselves and the work we produced.

In addition to becoming more confident and capable researchers, Russell et al. (2007) showed that participation in undergraduate research led to an increased awareness of what graduate schools are like. By participating in an experience normally reserved for graduate students, our undergraduate research experience provided us with a greater understanding of what to expect—and what will be expected of us—in graduate school, ultimately allowing us to clarify our future goals. In a similar vein, Hathaway et al. (2002) found that undergraduate research participation influences postgraduate aspirations and

faculty relationships, as students who conducted research were more likely to pursue graduate education, more likely to pursue law, medical, or doctoral degrees, and more likely to ask faculty for job recommendations compared to students who did not conduct undergraduate research. Similarly, we experienced professional benefits such as the opportunity to present at conferences and the possibility of strong letters of recommendation from our advisor. The detail to which she can speak to our abilities as students is vital to us getting into graduate and postgraduate programs (including law school and medical school) that we are interested in pursuing. For those of us who decided not to pursue graduate school in psychology, the conscientiousness, responsibility, and perseverance that research requires prepared us for an easier transition to higher forms of education and post-graduation employment.

## TIPS FOR SUCCESS

Having experienced firsthand the challenges and benefits of research during our time as undergraduates, we are very proud of all that we accomplished (i.e., 3 national conference presentations, 2 publications, and 1 paper under review; see **Appendix**). As such, we wanted to share some of our specific practices that we believe contributed to our success as an undergraduate research group in hopes these tips may benefit other instructors in creating more productive research labs.

One of the most critical practices that we implemented was to motivate everyone to propose new ideas and to ask questions, which allowed our lab to function as a supportive, creative environment. Importantly, our lab instructor was extremely welcoming and encouraging. Her positivity and enthusiasm were critical to us seeking guidance when we became confused or insecure, therefore preventing us from falling behind and getting discouraged. However, as more introverted members of the group, both of us still found sharing ideas and questions difficult at times, despite the supportive environment. To combat this issue, our lab instructor often went around the room asking for each student's input. Although intimidating at first, this practice made everyone more comfortable speaking up during our lab meetings, as well as in our group conversations outside the lab. As the research process went on, we became more secure and confident in our thoughts and opinions.

In the beginning of our time as a research lab, each of us had difficulty using our time efficiently because we had a week between our scheduled class meetings. At our instructor's suggestion, we chose to address this problem by taking detailed notes during our weekly meetings that included everything that we discussed and that documented our progress. To avoid diffusion of responsibility (Latané and Darley, 1968), we also created a list of tasks to be completed before our next group meeting. At the end of each meeting, our to-do list was divided as we each volunteered to take on a number of tasks depending on our interests, skills, and the amount of time we had that week considering our course loads and other responsibilities (e.g., jobs, clubs, sports). The assignment of tasks led to a more even distribution of the workload and made us more responsible

contributors because other group members could hold us accountable. Weekly progress reports (required by the instructor) were completed by each lab member to document how many hours we spent on our specific tasks, further contributing to a more fair and equitable division of our time. Taken together, these steps helped reduce social loafing, the phenomena in which individuals are less motivated to work hard on group tasks (Latané et al., 1979). Furthermore, our lab instructor continually stressed the potential opportunities we could experience if our research was successful (e.g., presenting at conferences and publishing our work). In doing so, she activated the collective effort model (Karau and Williams, 2001), as individuals in the group believed their efforts were meaningful in achieving our desired outcomes, another factor that reduces the likelihood of social loafing.

To use our time apart efficiently, our lab instructor asked us to first brainstorm research ideas and designs separately. Despite popular belief that brainstorming in groups is highly productive, research has shown that group brainstorming is actually less effective compared to group members brainstorming alone (Mullen et al., 1991). When asked to quickly brainstorm in a group setting without preparing beforehand, undergraduate research assistants may feel self-conscious and hesitant to share their thoughts. Consequently, being forced to generate a certain number of well-thought out ideas on our own proved helpful, especially at the beginning of our project when we used lab meetings to go over each student's ideas. Each student contributed suggestions for research topics, potential variables, and correlational and experimental designs, and we were able to build and expand on each others' original ideas to create the highest-quality project possible.

For the writing aspect of our research, our instructor had multiple methods for producing publication-quality papers. First, group members wrote their own individual papers, allowing for multiple conceptualizations of our research. Second, our instructor had us write our papers in sections according to where we were in the research process. For example, the first semester,

we completed our literature review, designed the study, and coded our survey; thus, the introduction and methods of our paper were due before our winter break. (The second semester, we analyzed the data and wrote our results and discussion sections before going back to polish and revise our introduction and method sections from the previous semester.) As a result, all of the relevant information was fresh on our minds, and we were able to easily remember and discuss all the details within our papers. Third, we used a peer review process that allowed us to see how other group members discussed our project. By doing so, we were able to strengthen our own papers by incorporating what other group members had explained more clearly and effectively. On a more general note, our lab instructor stressed meticulousness and diligence in our writing (see Giuliano, 2019a,b). Thus, we always allotted more time to work on our paper than we thought was necessary to allow sufficient time for careful writing, rewriting, and proofreading of our papers. Thankfully, the time we dedicated to the writing of our research resulted in high-quality work that was accepted for presentation and publication.

## CONCLUSION

In closing, participating in an intensive, graduate-level research lab as undergraduates challenged us in ways that neither of us had been challenged before. However, through the process of finding out what worked for us under the guidance of our instructor, we are grateful to have become published authors confident in our research and in our abilities as scholars, scientists, and critical thinkers ( $n = 1999$ ).

## AUTHOR CONTRIBUTIONS

Both authors worked collaboratively on this paper. SM and MR brainstormed together, and each author wrote sections of the paper. SM did the majority of editing, and both SM and MR proofread and made final edits to the manuscript.

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## APPENDIX

### Conference Presentations and Publications Resulting from Our 1-Year Lab Experience

#### \*Undergraduate authors

\*Matthews, S. J., Giuliano, T. A., \*Rosa, M. N., \*Thomas, K. H., \*Swift, B. A., \*Ahearn, N. D., \*Garcia, A. G., \*Smith, S. R., \*Niblett, C. M., & \*Mills, M. M. (2018). The battle against bedroom boredom: Development and validation of a brief measure of sexual novelty in relationships. *Canadian Journal of Human Sexuality*. Advance online publication. doi: 10.3138/cjhs.2017-0041

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\*Rosa, M. N., \*Matthews, S. J., Giuliano, T. A., \*Thomas, K. H., \*Swift, B. A., & \*Mills, M. M. (2018). Encouraging erotic variety: Identifying correlates of, and strategies

for promoting, sexual novelty in romantic relationships. Manuscript submitted for publication.

\*Thomas, K. H., \*Rosa, M. N., \*Swift, B. A., \*Mills, M. M., \*Matthews, S. J., & Giuliano, T. A. (2017). More than missionary: Predictors and correlates of sexual novelty in committed relationships. Poster presented at the annual meeting of the Society for the Scientific Study of Sexuality, Atlanta, November.

\*Rosa, M. N., \*Matthews, S. J., \*Thomas, K. H., \*Swift, B. A., \*Mills, M. M., & Giuliano, T. A. (2017). Encouraging erotic variety: The effects of persuasion on attitudes toward sexual novelty. Poster presented at the annual meeting of the Society for the Scientific Study of Sexuality, Atlanta, November.

\*Matthews, S. J., \*Thomas, K. H., \*Rosa, M. N., \*Swift, B. A., \*Mills, M. M., \*Smith, S., \*Niblett, C. M., \*Ahearn, N. D., \*Garcia, A. G., & Giuliano, T. A. (2017). Development and validation of a brief measure of sexual novelty in relationships. Poster presented at the annual meeting of the Association for Psychological Science, Boston, May.



# Looking Back at Undergraduate Research Experiences to Promote the Engagement of Undergraduates in Publishable Research at an R2 Institution

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By the end of my undergraduate career, I worked on six research projects, presented some of this work, and prepared two manuscripts for publication (Hebl and Skorinko, 2005; Skorinko et al., 2006). More importantly, my early engagement in research instilled in me an intellectual curiosity that I had not previously experienced. I started to question everything, and I devoted time to think critically about what I was reading and learning. My love of research grew daily and ultimately changed my career trajectory. Now, as a professor, I find myself drawing upon these experiences, as well as best practices, to develop strategies to conduct publishable research with undergraduate students.

Before delving into the specifics, it is important to set up the institution and program that I am in because this influences the strategies I utilize. My institution is a small-medium private polytechnic institution that has recently moved from an R3 to an R2 by the Carnegie Classification of Institutions of Higher Education. It has a distinct project-based curriculum that allows undergraduates to participate in a unique study abroad program that centers on cross-cultural research experiences. High quality research (including funding) and high quality teaching (including project advising) are expected for tenure and promotion.

Psychological Science is an undergraduate only program within a Social Science department. While Psychological Science tends to be a popular major (Princeton Review, 2018), at my institution it is a smaller, albeit growing, major/minor program. All majors complete a senior thesis. I teach and work with: majors, double majors, minors, those curious about psychology, and those needing a social science requirement. There are benefits (e.g., institutional norm of conducting research with undergraduates), but also challenges (e.g., small number of majors) when engaging undergraduates in publishable research.

Given these institutional parameters, my undergraduate experiences, and my role as faculty, I utilize nine strategies to engage undergraduates in publishable research:

1. **Mindset That All Research Is Publishable.** By adopting the mindset that all research is publishable, I am more engaged and invested in each project—whether my idea or a student's idea. Since I rely on undergraduate research assistants, this mindset is vital.
2. **Enthusiasm.** Research shows that undergraduates relish faculty that are enthusiastic (and approachable) about their empirical investigations (Komarraju et al., 2010; Roberts and Seaman, 2018). As an undergraduate, I gravitated toward faculty who were excited about the work they were conducting. Therefore, I let my enthusiasm for research come out to attract undergraduates to work with me.



3. **Engage Early/Research First Approach.** I engaged in research during my first year as an undergraduate. I had no prior experience, but this was not a hindrance because I was motivated and invested in the project so I wanted to learn methodology and statistics along the way (Pacquiao, 2007). I conducted an ethnographic study that taught me the art of interviewing. I also received a healthy dose of realism about what it takes to conduct qualitative research. The oral histories were presented formally to the community and published in a local magazine. Most importantly, I was hooked. I found a love of asking questions, thinking deeply about topics, and I wanted to keep conducting research. Later on, I discovered that my different research experiences helped me learn methods and statistics *better* because I had real examples I could apply what I was learning to.

Since early engagement was so important to my undergraduate career, I take a research first approach. If a student wants to learn about research, they can join my lab, regardless of their year or prior experience. I teach them what they need to know along the way. I also use this approach in the classroom. Students conduct small research projects to test theories and practice different methodologies (e.g., observation study, interviews, surveys, or mini-experiments). Student testimonials support early engagement, and others echo the benefits of early engagement as well (Detweiler-Bedell and Detweiler-Bedell, 2019; Dutta et al., 2019).

4. **Recruit Diverse Students.** As an undergraduate, I worked in a diverse lab where different perspectives regarding the research were discussed and incorporated into the projects. I saw firsthand how these novel ideas strengthened the work we were doing. Valuing this, I run a lab whose members are diverse in year in school, experience, academic interests, ethnic background, gender, sexual orientation, etc. There are challenges to managing a diverse lab as it requires flexibility and time (Brew and Mantai, 2017; Peifer, 2019). For example, some students may need to engage in paid work (in the lab or elsewhere), some may struggle academically, and some may not feel like they belong. However, the benefits for the students and the research are worth it. Diverse students who engage in research develop stronger mentoring relationships, feel less isolated, learn to think critically, and are more likely to pursue graduate school (Chan, 2019; Frohardt, 2019; Peifer, 2019; Ahmad et al., under review). By incorporating diverse minds into the process, the research conducted becomes stronger and more inclusive.

5. **Meet Students Where They Are.** When joining the lab, I try to match students on two components: (1) interest in a particular project, and (2) skills they want to learn. This stems from my own experiences because for my first project I simply wanted to gain experience, but after that I had a better understanding of what else I wanted to learn. With more experiences, my confidence and desire to tackle a project on my own grew, and in my senior year I conducted two separate publishable experiments (Hebl and Skorinko, 2005; Skorinko et al., 2006). I find many first-time research assistants want to get their feet wet, but with time and more experience they crave something more. So, I try to have projects in all phases,

so I can match students' interests and skills. We also encourage undergraduates to rotate and/or work in multiple labs. I have found that meeting students where they are gets them hooked and keeps them coming back.

6. **Set Realistic Expectations.** We seek different collaborators based on their strengths, and we should do the same with undergraduates. As an undergraduate, I had time to learn programs that my mentor did not have time to learn. For instance, I learned video editing for one project and how to write code that allowed us to put studies online and recruit a non-student population (this was before Survey Monkey, Qualtrics, and MTurk). But, I needed help synthesizing the literature, conducting statistical analyses, and dealing with reviewers. I have to remind myself that an undergraduate does not have the same knowledge or motivation that I do for a project. Therefore, I need to set realistic expectations. For instance, I cannot expect students to know the intricate nuances of the theories as I do; rather, I have to help them develop those insights. Likewise, I cannot expect them to know how to analyze data, but after working through an example, I can have them apply that knowledge to a different research question. To help articulate expectations, some have had success with lab learning agreements/syllabi (Whiteside et al., 2007; Adams, 2019; Bloomfield et al., 2019; Mendoza and Martone, 2019).

7. **Develop Your Mentoring Style.** We are not always given the opportunity to think about and develop *how* we want to work with students. Thinking back to my undergraduate days, my advisor used her enthusiasm for research to get students interested and engaged in her work. Holmes and Roberts (2019) would classify this as a Mentor-as-a-Makeover-Artist strategy because it gets students interested in one's own ideas. As a faculty member, especially pre-tenure, I gravitated to this approach because I had the expertise and natural enthusiasm to best guide projects. However, students do not have the depth of knowledge, so involving them in this way can be challenging. Since all majors need a thesis to graduate, I also cannot always rely on this strategy. Sometimes, I need to allow students to explore their own ideas, but I need to transform those ideas into something rigorous and publishable. Holmes and Roberts (2019) refer to this as the Mentor-as-a-Sculptor style. In this approach, students take ownership of a project, but the ideas typically fall outside the advisor's area of expertise making it more challenging to mentor. I have found that I am more willing to engage in this mentoring style now that I am post-tenure. Overall, taking time to think critically about how I want to mentor students has helped in the management of the research projects.

8. **Utilize Resources.**

a. **Institutional Resources.** It is important to look at what your institution offers, and see which of those resources can be useful (Dutta et al., 2019; Mickley Steinmetz and Reid, 2019). For instance, I use our project-based curriculum to attract students into the lab, and I encourage students to apply for the summer research fellowship. I also utilize our study abroad program to engage students in publishable

cross-cultural research (Skorinko et al., 2015). However, it is important to note that cross-cultural research requires care, sensitivity, and flexibility (Ashdown, 2019; Burns-Cusato and Cusato, 2019; Hill and Karlin, 2019).

- b. **The Classroom.** I also use the classroom to engage students in research. Regardless of the topic, I always cover methodologies to provide a foundation for the research we will discuss throughout the term. I also create assignments that incorporate these methods. For instance, students test theories through observational studies or surveys/interviews. While these projects will most likely not be published, they engage students and pique their interest in research opportunities outside of class.
- c. **Research Methods/Statistics Courses.** There are a number of different models for teaching Research Methods and Statistics courses (LoSchiavo, 2018; McKelvie and Standing, 2018; Mendoza and Martone, 2019). In my own course, I develop several 2 x 2 between-participant projects that could be publishable. The ideas come from my lab, my colleagues', and my collaborators'. Students rank their preferences, form into teams, and I use the Mentor as a Make-Over Artist Approach (Holmes and Roberts, 2019) to help them take ownership and develop the project. We utilize our participant pool and Amazon's Mechanical Turk for data collection. In the end, students show deep learning and understanding about experimental design and analysis, are excited about their work, and sometimes it is publishable (most recent example: Riemer et al., 2018).
- d. **Collaboration.** Like others, I also develop collaborations, research networks, and mentoring opportunities with colleagues at my home institution and other institutions (Bukach et al., 2019; Hammersley et al., 2019). However, all

my collaborators know that the work I conduct will involve undergraduate research assistants (and co-authors).

9. **Be Mindful of Your Time.** At each stage in my career, I needed to protect my time, in different ways, to achieve tenure or promotion (Mendoza and Golden, 2019). This special issue provides a number of different strategies to enable efficiency (Stefanucci, 2019) and management of undergraduate co-authors and teams (Adams, 2019; Mendoza and Martone, 2019; Scisco et al., 2019; Wood, 2019). For instance, you can have students in the lab mentor one another (Overman, 2019; Reavis and Thomas, 2019).

## CONCLUSION

I realize the tremendous beneficial effect my undergraduate research experiences had on my education (Lopatto, 2003; Russell et al., 2007). As others have reported, I learned research was both tedious and eye-opening (Todd et al., 2004; Matthews and Rose, 2018). I also developed skills and a mindset that would not have been possible if I waited. I became intellectually curious, learned to think critically, and found myself asking more questions (Hathaway et al., 2002). For the students I have engaged early on, they are reporting the same outcomes. Thus, in my experience (as an undergraduate and as a faculty member), the benefits of engaging undergraduates in publishable research, especially early on, outweigh the challenges.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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# Students' Experiences of Undergraduate Dissertation Supervision

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Increasingly, students completing undergraduate dissertations in Australia are expected by their supervisors to produce publishable research. Despite this, limited resources are available for supervisors of undergraduate dissertation students on how best to supervise students toward this aim. Building on our previous research on the perspectives of supervisors and dissertation coordinators of what constitutes good undergraduate dissertation supervision, we present here the findings on student perspectives of good supervision. Twenty-five students (seventeen students who were currently completing an undergraduate dissertation and eight who had recently completed an undergraduate dissertation) were interviewed about their experiences in being supervised. A critical incident methodology was used to invite students to reflect on times when supervision had gone well, and times when it had not. Interviews were recorded and transcribed and analyzed using thematic analysis. Key themes to emerge were that students viewed "good" supervisors as those that were supportive and empowering, directed learning, and whose style and interests aligned with those of the students. Challenges in supervision related to lack of clarity and inconsistencies, perceived power imbalances between students and supervisors, and perceived inequities in the amount of supervision provided across students. Whilst the publication of undergraduate research is a worthy aim, the pressure to publish for some students resulted in feelings of inadequacy and perceptions of supervisors losing interest when findings were not deemed publishable.

**Keywords:** undergraduates, dissertations, student perceptions, supervision, undergraduate research

## INTRODUCTION

Undergraduate dissertations are capstone experiences that provide students with an opportunity to answer a research question within a disciplinary framework under supervision (Ashwin et al., 2017). They form an essential component of many undergraduate degrees, provide a transition between course work and independent research, and may result in publishable research. Publication of findings can benefit both student and supervisor in the "publish or perish" culture of neoliberal universities (Besley and Peters, 2009) which function on a market-driven corporate governance model (Enright et al., 2017). However, this drive to publish also potentially positions students as research assistants completing research tasks proscribed by the supervisor to further their own research rather than learners developing independence in designing and conducting research (Kiley et al., 2011). Despite these tensions, limited research has examined supervisory practices or the experiences of undergraduate dissertation students. The plethora of research on doctoral students



(see Bastalich, 2017 for a review) cannot be readily applied to undergraduate dissertation students as undergraduate students have no or limited previous independent research experience (Cook, 1980), may have lower interest in conducting research (Cook, 1980) and need to complete their research in a shorter timeframe (Rowley and Slack, 2004).

Research conducted with supervisors of undergraduate dissertation students indicates that supervisors perceive they contribute to good supervision through providing directed and clear advice, supporting and instilling confidence in students and fostering student independence and growth (Roberts and Seaman, 2018). However, in this and previous studies examining supervisors' perspectives (e.g., Todd et al., 2006; Wiggins et al., 2016), the paucity of training and resource materials available for supervisors of dissertations at this level has been noted.

Previous research with students indicates that while they valued the increased autonomy, support of supervisors, and authenticity of completing an undergraduate dissertation, they faced uncertainty and challenges in collecting data and managing time (Todd et al., 2004). A recent quantitative exploration of students' experiences of undergraduate dissertation supervision (Vera and Briones, 2015) suggests that upwards of a third of students may not be satisfied with the supervision they receive. In the research presented here we further explore students' perceptions of undergraduate dissertation supervision.

The current research is situated in a large university that is repositioning as a research-intensive university within the Australian higher education sector, where government financial assistance to universities increases with research output (Heffernan, 2017). Reflecting the increasing emphasis on research outputs, the format of honors dissertations in some disciplines has changed from a traditional dissertation to a journal article format<sup>1</sup>, a strategy intended to increase the number of publications resulting from honors research projects.

## METHODS

### Participants

Twenty-five students from health science disciplines (including psychology and speech pathology) within one Australian university were interviewed for this research. At the time of the interview, 17 students were currently completing an undergraduate dissertation and eight had recently completed an undergraduate dissertation (five within the last year; not all within the same university) and were now enrolled in a masters or PhD program. Seventeen students discussed their experiences in undertaking an honors dissertation (ten current and 6 completed), while 8 students discussed completing an undergraduate dissertation in the pass stream (non-honors) of a program (7 current and 1 completed). The majority of students (56%) were aged between 20 and 29 years, and all but three of the honors students were female.

<sup>1</sup>For example, the Australian psychology guidelines for undergraduate dissertations currently permit either a traditional dissertation or a journal article format (Australian Psychology Accreditation Standards for Psychology Courses, 2010).

Students experienced a range of supervisory arrangements. Honors students received individual supervision (although for some this occurred in a group setting) while pass stream students worked together in groups and received group supervision. Six of the female students had one female supervisor, five had one male supervisor, and ten had two supervisors (six had two female supervisors, 1 had two male supervisor and three had one female and one male supervisor). One male student had a female supervisor and two had male supervisors. Supervision arrangements changed for some students over time with supervisors leaving or being added, or in one case being replaced altogether.

## Measures

A semi-structured interview guide was developed based on critical incident methodology (Flanagan, 1954; Butterfield et al., 2005). Preliminary questions asked the student to describe their dissertation project, the supervisory arrangements for their project and their relationship with their supervisors. Critical incident methodology questions asked students to identify and describe times when from their perspective supervision had gone well, and not so well. Prompts invited students to reflect on contributing factors to these situations. The final question invited students to make any further comments about their supervisory experiences.

## Procedure

This research was approved by Curtin University Human Research Ethics Committee (Approval No. PSYCH SP 2013-13). Interviews were conducted by the first author, audio-recorded, transcribed and entered into NVivo (v.10), a qualitative data analysis computer software package, for analysis. An inductive thematic analysis was conducted, following the procedures outlined by Braun and Clarke (2006). Both authors read all transcripts as part of the familiarization phase. The first author conducted a preliminary analysis. As a form of respondent validation, a summary of findings from the preliminary analysis was returned to participating students and comments invited. This was followed by the second author coding all transcripts independently and developing themes. Good concordance was found between themes developed in the two analyses.

## RESULTS

From students' discussions of good supervisory practice, three key themes emerged: supportive supervisory relationships, directing learning to empower students, and an alignment of student-supervisor interests and approaches. Each of these themes, along with definitions and example quotes is presented in **Table 1**. While each of these themes places the emphasis on the role of the supervisor, students acknowledged that good supervisory experiences also required effort on their part. Good supervision was enabled by students taking ownership of the research project and preparing for supervisory meetings. Where

**TABLE 1** | Themes underlying students' perceptions of good supervision.

Theme	Definition	Example quotes
Supportive supervisory relationships	Good supervisors were perceived by students as approachable, available and a person they may turn to for emotional support	<p>"I always feel like I can go to her for help and I never feel like I'm a burden."</p> <p>"She takes interest in my life outside of uni, so she's like, 'How are you going?' And whatever, and she's always like, 'If you have any other problems?' I don't know. I know that if anything comes up, that door is open, that I can communicate with her about that stuff."</p> <p>"She's always replying to e-mails at a drop of a hat."</p> <p>"...knowing that you can access a bit of emotional support as well, not therapy, but just having that understanding and someone who's sort of compassionate and flexible and understanding."</p> <p>"I've always felt like she's made more than enough time for me to have my questions answered or to have the support from her and stuff."</p>
Directing learning to empower students	Moving from explicit directions at the beginning to challenging students' thinking as they progress instills confidence and empowers students to become competent, independent researchers	<p>"You have this ideology of what supervision should be, okay, and when you think about what it is and who the people who are involved, you envisage a mentor. We are students; we need to be shown"</p> <p>"So really clear good direction and time really well spent because it's directing us exactly where we need to go"</p> <p>"I would bring it to him and then he would say, 'No, that's good but perhaps you should also think about this because this might also be impacting. So go back, have a read into that and then come back and then we'll discuss.'"</p> <p>"I do feel like a sheep. Not like a sheep, but I'm like this new fresh lamb and these are my shepherds. &lt;laughs&gt; They're helping me along like, 'Here's the best grass over here.' Without telling me what to do."</p> <p>"..she's really good at guiding the research and if we're ever at a loss, she'll be able to fill in the gaps but she would do it in a way which we do it ourselves. She just facilitates it."</p> <p>"He was initially like, I guess, sort of a repository of experiential knowledge and information and that. But he soon became a bit more of a mentor or a coach, and I felt he would kind of facilitate my own learning rather than tell me what to do. Toward the end, ... it took on, say, more of a supportive role. I felt like my supervisor knew I was capable of completing the dissertation and was just there to sort of allay any concerns I had, those sorts of things."</p> <p>"And I think a good balance between giving suggestions without taking over and saying, 'Just do this.' So just giving enough sort of food for thought and feedback so that I felt like I still had some sort of input into the changes and the corrections and whatever, but it wasn't just totally sort of placed on me."</p>
Student-supervisor alignment	Compatibility of interests and preferred approaches to supervision	<p>"She's so passionate about this area and so that makes it interesting and sort of fun to work alongside her in"</p> <p>"I think she has a better idea of who I am, therefore she knows how far she can throw me in the deep end."</p> <p>"When I first approached one of the supervisors last year she was like, 'I'm not going to hold your hand and if that's what you wanted in a supervisor then we won't work well together.' And I went, 'No that's exactly what I want.' Like I'm a person that works fairly independently."</p> <p>"I'm relatively independent and I just like being able to touch base for important things and just to check in that things are going okay and like, my supervisor now knows that that's sort of how I work and probably has learned to trust that."</p>

supervision meetings went well, students reported feeling re-motivated, with increased focus and clarity about the project.

Whilst most students reported positive supervisory experiences, some experienced difficulties in the relationship. From students' discussions of times when supervision did not go well, five themes emerged: lack of clarity, inconsistencies, power imbalances, inequities and overworked supervisors who are under pressure to publish. Each of these themes, along with definitions and example quotes is presented in **Table 2**. Underlying these themes are differences in expectations between students and supervisors.

The key differences emerging between honors and pass stream students related to the group composition. Honors students

choose their own supervisor(s) and topics (at least to some degree) while pass stream students were assigned to groups and had limited choice of supervisor or topic. Overall, pass stream students expressed less passion about their topics (at least in the early stages) and sometimes experienced conflict with other group members (e.g., social loafing, dominant group members).

## DISCUSSION

This research aimed to explore students' conception of good supervision of undergraduate dissertations. Encouragingly, all but one student were able to highlight a time when supervision had gone well, with students able to identify both the supervisors

**TABLE 2 |** Themes relating to students' perceptions of supervisory challenges.

Theme	Definition	Example quotes
Lack of clarity	Lack of specific guidance on how to progress with research projects impacting on speed of progress	<p>"It's challenging because sometimes he's not directive in what he's saying. He's, "Well you could do this," and "You could do this," and "You could do this," and "You could do this"."</p> <p>"They're [supervisors] still not a 100 percent and sometimes it takes chunks of time, them going back to somebody else and then relaying the information back. So in total it's put us back about 2 or 3 weeks."</p> <p>"The only problem that I've been having is that with my analysis, it's been completely mucked up. And that was on the level that my supervisors were confused by my analysis, which means that I have only just run the correct analysis just now."</p>
Inconsistencies	Inconsistencies in advice given by supervisors, and between supervisors and marking guides	<p>"It's harder being two supervisors that think differently and give conflicting advice."</p> <p>"On occasion I would get sometimes different feedback on like the same sort of I guess draft."</p> <p>"My supervisor said that, "yeah, those guidelines are just—if you want to get good marks and stuff but I, personally, think you don't have to do all those things."</p> <p>"I wanted to satisfy the requirements of the dissertation and do the by-the-book approach, but I didn't wanna offend my supervisor. I didn't wanna put his nose out of joint."</p> <p>"The supervisor is perhaps not being familiar with the requirements for honors or not perceiving them as very important to themselves."</p>
Power imbalances	Perceived power imbalance between students and supervisors results in students feeling powerless to voice concerns	<p>"I think there's this power differential. You know, it's an "us" and "them." And as a student I've always felt it."</p> <p>"But then I didn't have the courage to say to them, "Hang on a minute. This is not right." So instead I would just stay quiet and mumble and grumble."</p> <p>"...one of my supervisors is hopefully my supervisor for a PhD. So I really felt like I couldn't alienate myself in any way and being like, 'You guys are wrong. You kind of let me down.' And then have the potential for that to backfire on me in the future."</p> <p>"But the times that I have plucked up the courage to say something they've got defensive at me. So then I retreat back again and then I'm fearing well if I take it any further then what do I do about my future prospects?"</p>
Inequities	Students' perceptions that the amount and quality of supervision provided varies greatly	<p>"...some students may get an hour, one student may only get half an hour, some will get their results read three times, some will only get it once. There's a lot of differences"</p> <p>"There's a little group that we share the same [supervisors], and my goodness their supervision is fabulous and they'll have a different perspective. But we see what they get, it's actually really soul destroying."</p> <p>"On a more personal note, some of my colleagues and people that I know have not had the same type of treatment or support and that's caused a lot of conflict for me personally."</p>
Overworked supervisors who are under pressure to publish	Students perceptions that supervisors are overworked and under pressure to publish, negatively impacting on the supervisory experience	<p>"I think they've got too many students. And they're forgetting, I think that's what is happening. They're overloaded, big time. And they're overworked.."</p> <p>"They're too tired, you see it, and they're exhausted. They keep saying, I'm tired, I'm tired. I hear you, I see it, you can actually see how exhausted you are, you know, and yeah."</p> <p>"I think that there's been added pressure with supervisors having to publish more, we feel it, it's all about publish, publish, publish. I found non-significant results and I felt inadequate almost"</p> <p>"Fishing is soul-destroying, and you don't even know what you're looking for anymore, and changing of hypotheses."</p> <p>"I think as well the pressure of publications because I didn't find anything, they seem to lose a little bit of interest."</p>

and their own contribution to positive experiences. In accordance with previous research in this area (Todd et al., 2004) students valued the support of supervisors and their increasing autonomy.

Most students were also able to describe a time when supervision had not gone so well, and these experiences were characterized by differences in expectations between students and supervisors. Consistent with Todd's (2004) finding of students experiencing uncertainty, lack of clarity and inconsistencies were key themes to emerge in this research. However, unlike Vera

and Briones (2015) finding of upwards of a third of students not being satisfied with their students, a more nuanced picture emerged in this study with students able to identify both times when supervision was going well, and times when it did not.

Of concern, the findings indicate that the pressure to publish experienced by academics within a neoliberal university setting is in some cases being transmitted to students and has the potential to impact upon supervisory experiences for undergraduate students. While only a minority of students

interviewed referred to this tension, the findings highlight the need for supervisors to not let their own disappointment translate into poorer supervision when students' research is not publishable. One participant reported "fishing" for significant results, aligning with recent research reporting that supervisors shape students' attitudes toward questionable research practices (Krishna and Peter, 2018). Student engagement in questionable research practices has also been documented earlier in the undergraduate degree (Rajah-Kanagasabai and Roberts, 2015), further highlighting the need for supervisors to clearly articulate best practices and demonstrate these in their own research. The primary purpose of the undergraduate dissertation is the research learning experience for the student, and potential publication needs to be viewed as a bonus rather than an expectation. Whilst publication in high impact peer-reviewed journals may be a priority for supervisors, students can also benefit from other avenues of dissemination, such as presenting findings at conferences or publishing in student research journals.

This research was conducted within one university that is repositioning as a research-intensive university. Supervisory practices may vary across universities according to the focus of the university (teaching vs. research) and the resources provided, and may also vary across disciplines. Given the range of supervisory arrangements (single vs. multiple supervisors, single vs. multiple students) and gender mixes within these arrangements, it was not possible to tease out potential differences in perceptions of supervision according to gender concordance/discordance between supervisors and students. This is an area that warrants further research.

Despite these limitations, the findings provide insight into what students' value and find challenging in their undergraduate dissertation supervisory relationships, and may have some transferability across different academic settings. The findings from this research, along with interviews with new supervisors

and workshops with experienced supervisors (see Roberts and Seaman, 2018) informed the development of a range of supervisory resources. A guide for supervisors and a range of supervisory tools for use by supervisors are freely available from <http://www.dissertationsupervision.org/>, and provide advice on some of the issues raised here, such as the student-supervisor relationship, co-supervision and managing your supervisory workload. A guide for students is also freely available from [https://www.researchgate.net/publication/286239145\\_Guide\\_for\\_Honors\\_and\\_Coursework\\_Dissertation\\_Students/download](https://www.researchgate.net/publication/286239145_Guide_for_Honors_and_Coursework_Dissertation_Students/download). This guide covers preparing for supervision, forms of supervision and getting the most from supervision, along with advice for specific stages of the project from the first supervision meeting through to data collection, analysis and interpretation, with a section on overcoming difficulties in managing a research project. We encourage readers to access and use these materials.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher.

## AUTHOR CONTRIBUTIONS

LR was responsible for designing the research, conducting the interviews, reviewing the analysis, and leading the writing of the paper. KS analyzed the interview data.

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# Using Collaborative Models to Overcome Obstacles to Undergraduate Publication in Cognitive Neuroscience

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The value of authentic research experience to undergraduates is well-established (Seymour et al., 2004; Lopatto, 2007). These benefits are stronger when associated with conference presentations and published articles (Russell et al., 2007). In addition to advancing knowledge, undergraduate publications are associated with improved writing skills, success in graduate and job applications, clarification of career choice, and are positively associated with continued productivity (Russell et al., 2007; Salsman et al., 2013; Yaffe et al., 2014; Anderson et al., 2015). Publishing with undergraduates benefits both teaching and research programs of faculty mentors (Petrella and Jung, 2008). Despite the benefits of undergraduate publication, faculty continue to face many challenges in providing undergraduates with substantive experiences worthy of publication and in guiding them through the final stage to peer-reviewed publication. Publishing with undergraduate co-authors is particularly challenging for disciplines such as cognitive neuroscience that require complex technologies, multistep data processing, and an understanding of advanced interdisciplinary concepts.

Cognitive neuroscience relates cognitive processes to brain activity and integrates knowledge and skills from many fields. Cognitive electrophysiology (electroencephalography/EEG and event-related potential/ERP) is particularly well-suited to undergraduate education because it is a direct measure of human brain activity that corresponds to cognitive processing in real time, it is relatively inexpensive compared to other cognitive neuroscience methods, and the skills are transferable to many areas of research and to practical applications of science in medicine, engineering, law, etc.

Despite the advantages of cognitive electrophysiology for undergraduate education and its contemporary relevance, few opportunities exist for undergraduates to gain the type of research experience in an EEG/ERP lab that would enable them to publish. Meaningful research experience requires an understanding of experimental techniques and background knowledge to formulate research questions, develop a research plan, collect, analyze and interpret data (Edelson et al., 1999). Moreover, in-depth understanding and exposure to all aspects of the research project are necessary to participate in the dissemination phase of research (VanderStoep and Trent-Brown, 2012). Unfortunately, multiple surveys show that many undergraduate research experiences primarily develop data collection skills and, as a result, students lack the deeper understanding of research design and interpretation necessary to publish results (for a recent review, see Linn et al., 2015).

This is especially true for EEG/ERP labs, where student involvement is typically limited to capping and, if they are lucky, cursory preprocessing steps such as eye-blink detection. *If undergraduates lack a conceptual understanding of experimental design, data analysis and interpretation, they cannot be expected to contribute substantively to a peer-reviewed paper.* **Table 1** lists knowledge and skills necessary for undergraduates to co-author an ERP publication, divided into three units that can be taught serially.

We suggest that the major roadblock to preparing students for publication using cognitive electrophysiology lies in the enormous time and effort needed to create a curriculum that can effectively allow large numbers of students to learn and integrate the many concepts and skills involved in ERP research. The majority of colleges and universities do not offer undergraduates a course in cognitive electrophysiology, and cognitive neuroscience courses often do not include a cognitive electrophysiology lab component (Bukach et al., 2015). As a result, undergraduates have little understanding of experimental design, data analysis, data interpretation, and may struggle to read an electrophysiology paper when they begin their research experience, making it difficult to bring an EEG/ERP project to publication before they graduate. In 2015, we conducted a faculty survey, and of 206 respondents from both research institutions and primarily undergraduate institutions, 86% indicated a “moderate” or “great” need for electrophysiology undergraduate training materials (Bukach et al., 2015). Additional challenges that can hinder undergraduate publications in this field include limited access to participants or equipment, inadequate technology support, and time constraints on research.

## COLLABORATIVE SHARED-RESOURCE MODEL: PURSUE

We propose that many of the roadblocks to publishing with undergraduates in disciplines such as cognitive neuroscience can be addressed by a collaborative, shared-resource model that includes both cross-institutional faculty collaboration as well as student-faculty collaboration. Opportunities for engaging students in publishable research increase when faculty from diverse institutions share their time, expertise, and resources. Further, student-faculty collaboration provides opportunities for students to develop their skills and knowledge and ensures that training materials are effective and engaging. The benefits of such collaborative models are numerous, but those most relevant to student publication include an increase in student abilities to apply and generalize learning to new problems and solutions, ask good questions, think critically, synthesize information and ideas, and collaborate (Cox, 2004; Nadelson et al., 2013).

As a working example, we describe how our current initiative, Preparing Undergraduates for Research in STEM-related fields Using Electrophysiology (PURSUE), enhances publication opportunities for not only for those directly involved, but also for others who will benefit from the materials and community established by the project. PURSUE was kickstarted by a grant

from the Association of Psychological Science and is currently supported by the National Science Foundation's program for *Improving Undergraduate STEM Education: Education and Human Resources* (2016). The program is led by three principle investigators (co-authors Bukach, Couperus, and Reed) plus six additional faculty from geographically diverse institutions across the US (North, Northeast, South, Midwest, and West) with disparate student body sizes (1,300–10,200 students), demographics (50–100% female; 11–84% acceptance rate selectivity; 14–61% students of color/international), and interests (applied career focus to experiential focus). The goal of PURSUE is to disseminate and implement best practices in cognitive electrophysiology education for undergraduates with the aim of increasing the quality and number of training opportunities for undergraduates, and increasing research outcomes that involve undergraduate co-authors.

## CRITICAL COMPONENTS OF PURSUE

A student-centered semester-long course using evidence-based pedagogy provides undergraduates with a strong conceptual understanding of how EEG/ERP methodology can be used to test theoretical questions, the ability to read original research articles, and the practical knowledge of EEG/ERP experimental design. The addition of lab components that cover data preprocessing, analysis, and interpretation enables students to understand the rationale behind the various choices they must make during data processing and apply their knowledge to interpret novel data. PURSUE incorporates backward course design principles (Wiggins and McTighe, 2005) to first identify the necessary learning outcomes and assessments, and then combine our ideas and best practices to create an engaging and effective set of course materials. Our process involves a continuous cycle of innovation (American Society for Engineering Education, 2009) whereby materials are created, implemented, assessed and revised. The inclusion of faculty from a diverse set of institutions and research areas ensures that the materials are accurate, effective across a variety of contexts, and can be implemented in a flexible manner. The collaborative approach distributes the workload and enhances the quality and creativity of the materials. Undergraduates also contribute to the design, creation, and testing of the materials. Student collaboration ensures that materials are engaging, appropriately scaffolded, and target concepts that are most problematic. Students benefit by developing professional skills and by disseminating the results. Sample undergraduate tutorial videos, animations and interactive simulations can be found on [pursueerp.com](http://pursueerp.com). Undergraduates conducted experiments to test material efficacy and presented their findings at national conferences (Hagen et al., 2018; Jackson et al., 2018), and are now preparing manuscripts for peer-review. Once course materials have undergone a broader controlled implementation and revision cycle they will be freely available on the Pursue.com website.

A shared database of core ERP experiments and individual difference measures enhances publishing opportunities for undergraduates by reducing the time and resources required

**TABLE 1 |** Knowledge and skills necessary for undergraduates to co-author an ERP publication.

General Knowledge	Study-specific Knowledge	Skills
<b>DESIGNING AND CONDUCTING AN ERP EXPERIMENT</b>		
What ERPs measure and what they reveal about cognitive processing	The specific research question and how it relates to prior knowledge	How to read an ERP paper and conduct a literature search
The nature of the ERP component of interest and its associated cognitive processes	The research hypothesis and how it answers the research question	How to formulate a research hypothesis
Experimental design principles	Elements of the specific experiment design	How to collect ERP data
<b>ANALYZING ERP DATA</b>		
The function of each pre-processing stage (baseline correction, filtering, re-referencing epoching, binning, artifact rejection, artifact correction, and averaging)	What processing decisions are appropriate for the study	How to use software to preprocess ERP
Basic statistical knowledge	Which statistical tests are appropriate for the study	How to use statistical software and interpret the output
What differences in amplitudes, latencies and topography mean	The interpretation of the results of the study	How to create and explain ERP figures
<b>WRITING AN ERP PAPER</b>		
APA style formatting	A coherent story for the study	How to write clearly and concisely

*General knowledge refers to knowledge that will generalize across any ERP study. Study-specific knowledge refers to knowledge that relates to the particular study that the student is running. Skills refer to generalizable abilities that students must develop through hands-on experience and practice. The table is broken into three units that can be taught across different timeframes or levels of curriculum/experience.*

to design, program, and conduct an experiment and increases the size and diversity of the sample. EEG/ERP studies often take 2–3 h per participant. Undergraduates have limited time in the lab and may graduate before their project is complete. Further, primarily undergraduate institutions may have limited access to EEG/ERP equipment or subject pools. The PURSUE database is composed of six classic ERP experiments yielding seven ERP components (<http://www.erpinfo.org/erp-core>) and a rich set of individual difference measures. The database will be used for lab exercises and allows our undergraduates to explore authentic research questions and publish their findings. The three PIs worked collaboratively with undergraduates at every stage of the project. The collaborative model allowed faculty to consult one another on technical issues and share best practices that enhanced the quality and ease of data collection and analysis. Moreover, although still in process, the database has already provided rich opportunities for undergraduate publication: this year 20 undergraduates presented preliminary findings at seven national conferences, four additional undergraduate-led EEG experiments are now in various stages of completion, and one manuscript is submitted for peer-review. As our work shifts to data analysis, the database will provide additional opportunities for undergraduate publication at conferences and in peer-reviewed journals.

A website ([pursueerp.com](http://pursueerp.com)) will freely disseminate our materials, share resources, and build community to expand opportunities for undergraduates beyond PURSUE. The website will facilitate undergraduate publications in cognitive neuroscience by hosting the PURSUE training materials and other resources such as EEG/ERP readings for undergraduates, tips for setting up and running an undergraduate EEG lab,

tutorial videos, links to sample experiments, and tips for publishing with undergraduates. We note that PURSUE is still in the design phase, and encourage readers to watch our website for new materials.

A faculty community increases faculty support and opportunities for cross-institutional collaboration. PURSUE faculty participants not only work collaboratively to create training materials and build a database, we also share teaching, procedural, technical and publishing advice, and provide emotional and practical support. Consistent with prior research, PURSUE faculty participants report that their experience provided a sense of community, met needs for academic mentorship, increased motivation to improve their courses, and invigorated their enthusiasm for working with undergraduates in research. It also generated new research collaborations among the members.

## ADVANTAGES OF PURSUE MODEL

The PURSUE collaborative model can be adopted to facilitate undergraduate opportunities for publication in other academic fields. Because we are geographically dispersed, the PURSUE team meets regularly online, but we have found that in-person meetings at conferences and the occasional local workshops are also crucial to making progress and building community. A “divide and conquer” strategy of forming subgroups also helps to constrain and focus the work. Student-faculty collaboration is slower-paced, due to undergraduate schedules and time necessary for students to develop skills. Team meetings, time management software, and weekly goal-setting help to manage these challenges. We found converting the data collection and



analysis protocols to an online survey format helped to guide and document student work. Additionally, setting publication goals for different aspects of the project that are within the timeframe of undergraduate activities is critical. For example, early work on simulations and database collection have been presented at conferences soon after involvement in the work (i.e., within a year).

The advantages of PURSUE's collaborative model for engaging students in publishable research is also perceived by our students. Undergraduates report that the PURSUE experience is unique among other undergraduate research experiences as it allows for direct involvement in every step of the research process, from setting up EEG equipment, establishing a standardized experimental protocol, designing tasks, collecting and analyzing data, and preparing a manuscript. This direct involvement gives them the skills to design and carry out their own ERP studies, as well as a greater understanding of what it means to pursue Cognitive Neuroscience research post-graduation. They find that collaborating with faculty to conduct ERP studies gives them an understanding of the publishing process, and develops the ability to present research topics on a poster and convey information in a concise and meaningful way. Undergraduates also report that with guidance, they learn the nuances of manuscript submission and publication: what is and is not important to include in the methods section of an academic paper, how to form a logical cohesive story with data, and how to speak to the future directions of the conducted research.

## CONCLUSION

Engaging undergraduates in publishable research necessitates adequate training and resources. A collaborative model in which students and faculty from multiple institutions work together

and share their resources helps lead both faculty and students to publishable research outcomes.

## AUTHOR CONTRIBUTIONS

The model and work described herein was developed and carried out collaboratively by CB, JC, and CR. CB wrote the first draft of the manuscript. KS wrote sections of the manuscript. JC and CR provided comments for revision.

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# Spit-Tacular Science: Collaborating With Undergraduates on Publishable Research With Salivary Biomarkers

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Training in physiological methods substantially increases students' competitiveness for graduate school, medical school, and multiple career paths. For example, when asked to rank the value of various types of research skills among applicants to PhD programs, neuroscience graduate program directors ranked background knowledge in the student's application area first, closely followed by bench skills (Boyette-Davis, 2018). Physiological measures are also increasingly incorporated within personality and social psychology, especially when studying relationship processes or social stress and marginalization (e.g., Smyth et al., 2013). This suggests that faculty can best serve students who want to study biology-behavior interactions in graduate school or in their careers by providing them with research experience in physiological methods. However, collaborating with undergraduates on physiological research is often challenging given extensive training and equipment costs associated with many biopsychological methods (e.g., fMRI, PET), especially when the goal is to publish with undergraduate students as authors.

Here, we present a model for collaborative faculty-undergraduate research involving human salivary biomarkers. We outline opportunities presented by faculty-student research with salivary biomarkers, strategies for addressing challenges of this approach, and concrete recommendations for success. Although our recommendations are based on our experiences as faculty at small liberal arts universities (1,400 to 4,000 undergraduates), many of our suggestions could apply to other types of institutions, especially regional comprehensives to larger institutions. We focus on the research design, data collection, and data analysis stages, given that best practices for writing and publishing with undergraduates are similar to those in other domains of psychology and will be addressed elsewhere in this issue (see also Jones et al., 2006; Burks and Chumchal, 2009).

## OPPORTUNITIES

A wide variety of hormones (e.g., testosterone, cortisol, CCK), cytokines, opioids, and immunoglobulins can be measured via saliva using commercially-available enzyme immunoassay (or ELISA) kits. Salivary biomarkers can thus address questions of intrinsic interest to students and are relevant to multiple subdisciplines of psychology. Examples of topics students have investigated under our supervision include how testosterone predicts pain responding in women (Archey et al., 2018), how thinking about competition affects testosterone, how non-suicidal self-injury is related to opioid levels, associations between sexual compliance and cortisol levels (Hartmann and Crockett, 2016), and the effects of support processes on cortisol reactivity (Crockett et al., 2017). These topics often link biomarkers to physical and mental health, which is becoming increasingly relevant as researchers think more critically about health and wellness. Moreover, biomarker research is very popular with students: in our labs, we each run one to three studies a year in collaboration with 5–10 students total; we each turn away 10–20 additional students due to limited resources.

Working with salivary biomarkers teaches students important theoretical skills (e.g., principles of behavioral endocrinology, how ELISAs work), research skills (e.g., data collection with human participants), and practical laboratory skills (e.g., pipetting, creating serial dilutions). This approach encourages students to make connections between social and natural sciences and attracts an interdisciplinary group of students, including Behavioral Neuroscience, Psychology, Biology, and Kinesiology majors with future plans ranging from PhD programs to health professions. For these reasons, research with salivary biomarkers is ideal for educating students while also providing practical preparation for careers. Compared to blood samples, saliva samples are far more feasible for working with undergraduates, given that they pose low (to no) biohazard risk and do not require invasive techniques.

## CHALLENGES AND SOLUTIONS

Although less expensive than some physiological methods, research with salivary biomarkers requires equipment (plate reader, centrifuge, plate mixer, pipettes, and optionally a plate washer) and disposable materials (ELISA kits, pipette tips, etc.). Startup costs can be as low as \$6k with used equipment or up to \$10–15k with new equipment, and yearly costs range from \$3–5k. Compared with neuroimaging, which requires significant grant contributions and thousands of dollars per study, salivary biomarker research is feasible (albeit challenging) on a tight budget. We have funded our research programs by supplementing departmental funding with small grants from Psi Chi or professional societies and by purchasing secondhand equipment. These strategies carry the added bonus of developing undergraduates' grant-writing and budgeting skills.

A second challenge, particularly when producing publishable salivary biomarker research at smaller universities, is obtaining a sufficient sample size. For example, when measuring testosterone in females, salivary measures underestimate hormone-behavior associations compared to blood measures, necessitating large sample sizes (e.g., 30–50 participants per experimental condition or group; Granger et al., 2004). Additionally, some health conditions and the use of hormonal contraceptives may confound results, requiring sample sizes robust enough to allow for the exclusion of some participants or the addition of multiple control variables to statistical models. We have addressed these issues by planning for data collection to span two to three semesters, which presents its own challenges when students need to complete a project before graduation. We encourage students to include at least one relevant non-hormonal outcome, such as survey responses or behavioral data; this allows for students to present preliminary results at on-campus or regional conferences and to have the potential for publication in the event of null biomarker results. Larger teams of students can also facilitate recruitment as each student can recruit from different student organizations or courses. Even with modest incentives (extra credit offered at professors' discretion and raffles for gift cards), our highly motivated students have succeeded in recruiting 100 participants in two semesters.

## RECOMMENDATIONS

So you've decided you want to collaborate with undergraduates on salivary biomarker research with the goal of publication – how do you start? The first step toward publication is for undergraduates to produce high-quality research. Here, we discuss best practices with a focus on processes unique to salivary biomarkers.

- 1) Undergraduate students must be trained in sampling issues and ethical considerations associated with salivary biomarker collection before drafting Institutional Review Board (IRB) proposals. For example, most biomarkers require querying participants' medication use, nicotine use, sleep/wake habits, relevant health conditions, and relevant social behaviors (e.g., relationship status as a covariate for testosterone) via questionnaires (Kirschbaum and Hellhammer, 1994; Smyth et al., 2013; van Anders et al., 2014). Additionally, sample collection is typically limited to specific times of day (e.g., 2 h after eating for CCK; Ekström et al., 2019). All analytes we have tested show a lag time to respond to social stimuli, such that the timing of samples in experimental studies must be carefully planned (Dickerson and Kemeny, 2004; van Anders et al., 2014; Archey et al., 2018). Reading and discussing a paper that reviews methodology for the biomarkers of interest is a useful way to introduce students to these issues, and students are often intrinsically interested to learn how everyday behaviors such as waking time or social variables such as relationship status affect hormones. We require students to draft the IRB protocol and to prepare a research proposal (Introduction and Method sections), which teaches scientific writing skills and helps prepare for the goal of publication.
- 2) Second, students must be trained on the collection and storage of saliva samples. Collection is relatively easy, as biomarkers can be collected via passive drool into tubes or via salivette (a sterile piece of dental cotton about 2 in long), depending on the analyte. Undergraduates can practice providing instructions for saliva collection to one another, and students can gain leadership experience by training new lab members.
- 3) The assay process is the most involved in terms of training. In this phase, we each employ different strategies to balance students' need to practice bench skills with the need to obtain reliable results suitable for publication with student co-authors. If mentors want students to complete all steps of the assay, including pipetting the plate, students should ideally be given the opportunity to run a test assay if funding for one extra kit is available. Otherwise, students can practice pipetting with water and a non-antibody coated plate and watch an experienced student pipet an assay before completing an assay themselves. While students complete an assay, the mentor should oversee each step; this supervision means that the process takes longer but helps maintain consistency. Alternatively, the mentor can pipette the plate while students assist in other ways – by centrifuging and organizing samples, operating the plate mixer and reader,



etc. Regardless of the strategies used, the assay process is an excellent opportunity for students to gain hands-on research skills, practice troubleshooting when the process does not work as expected, and learn about how ELISAs work via the principle of competitive binding. This firsthand knowledge of the assay process is useful to students when constructing the Materials subsection of an eventual publication.

- 4) When analyzing data with biomarkers, two important considerations are necessary to achieve publishable results. Biomarker variables should be screened for outliers prior to analysis, and a selection of the most important biomarker confounds/covariates should be included in statistical models. Learning to account for these variables is an invaluable opportunity for students.

## THE VALUE OF CROSS-CAMPUS COLLABORATION: A CASE STUDY

The above best practices can be challenging to balance against teaching and service responsibilities at smaller institutions, and equipment costs might be prohibitive for some institutions. Cross-campus collaborations provide an ideal way to share resources and time commitments as well as knowledge and expertise. This expertise is especially useful for new faculty in the process of establishing their labs, or for faculty who are new to salivary biomarker research and were not trained on these methods in graduate school. Collaborative approaches also allow faculty to apply their various expertise in combination with specific student interests. For example, in our most recent publication on associations between testosterone and pain responses in women, JBD contributed her expertise on sex differences in the neurobiology of pain, KLG shared guidelines for salivary testosterone data collection, and EEC led the assay process. Ultimately, our collaboration resulted in a publication (Archey et al., 2018), a national conference presentation, and a travel award for the undergraduate first author, now a neuroscience PhD student.

There were several advantages to this collaborative approach. It allowed for resources to be pooled, students to access different faculty mentors, and faculty to share the responsibility and time commitment associated with training students. Combining multiple faculty members' expertise also meant more varied and interdisciplinary perspectives to provide feedback on the manuscript. There are some important logistical considerations with cross-campus collaborations, some relevant to any human subjects research (e.g., where does IRB oversight rest?), others specific to biomarker research (e.g., transporting samples on ice

in a cooler between campuses), and some basic issues such as travel time. Finding collaborators or transporting samples may be more difficult in locations where other universities are not in close proximity.

Even when physical proximity makes close collaborations difficult, it is still possible to form cross-campus collaborations. Recent developments of sites like Study Swap (<https://christopherchartier.com/>) and Psi Chi's Network for International Collaborative Exchange (NICE) program ([https://www.psichi.org/page/Res\\_Opps#.XEnzSKIME8Y](https://www.psichi.org/page/Res_Opps#.XEnzSKIME8Y)) connect universities across the globe, allowing researchers to post resources they can offer as well as research needs they have. These provide interesting opportunities specific to biomarkers. Often when running experiments with salivary biomarkers, researchers have more time from participants than they need because of the lag time for many biomarkers to respond to social stimuli. Timing samples necessitates having surveys completed, even when the self-reported information is not essential to the research question. As a result, collected self-report data from our participants is often something we can offer in exchange for access to potentially eligible participants at universities where human participant pools are larger than university demands.

## FURTHER READING AND RESOURCES

For overviews of salivary cortisol and testosterone methodology (saliva collection and storage, sample timing, confounds/covariates, etc.), see Kirschbaum and Hellhammer (1994), Smyth et al. (2013), and van Anders et al. (2014).

Instructions we use for saliva collection for cortisol (Salivette) and testosterone (passive drool), as well as the slides we use to teach students about ELISAs for cortisol and testosterone are in the **Supplementary Material** files.

## AUTHOR CONTRIBUTIONS

KG, EC, and JB-D conceived and outlined the article. KG wrote the first draft of the article. EC and JB-D wrote sections of the article and revised the article. All authors read and approved the submitted version.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00562/full#supplementary-material>

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# Use of Peer Mentoring, Interdisciplinary Collaboration, and Archival Datasets for Engaging Undergraduates in Publishable Research

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We agree wholeheartedly with Dr. Sharon Brehm, the 2007 President of the American Psychological Association, who stated: “*I believe that undergraduate research is one of the three most valuable experiences that colleges and universities can offer their undergraduate students* (Keynote Address, 24th Annual Mid-America Undergraduate Psychology Research Conference).” We would add that engaging in undergraduate research can be enjoyable and rewarding, for students as well as their faculty mentors. There is nothing quite like observing students becoming interested and engaged in research, planning and carrying their own projects, getting excited to analyze their data, and then experiencing the pride of presenting or publishing their project. This is perhaps one of the best aspects of being a psychology faculty member.

Teaching at large state universities, or at small liberal arts colleges, comes with certain challenges for conducting research with undergraduates. Other authors have addressed models for involving undergraduates in high-quality research and encouraging presentation and publication of findings (e.g., Gibson et al., 1996; Hughes, 2014; McKelvie and Standing, 2018). A plethora of research literature also addresses challenges of improving writing (Stellmack et al., 2012; Jorgensen and Marek, 2013; Greenberg, 2015) and statistical skills (e.g., Lyle and Crawford, 2011; Lim et al., 2015; Hartnett, 2016); or for a truly novel approach to teaching statistics, see Irving (2015). Other practices, such as fostering interest in quality research during introductory psychology courses, are also beyond the scope of our article.

Our article focuses on challenges inherent in engaging undergraduate students in high quality, publishable research at underfunded colleges and universities, which often have fewer resources dedicated to conducting research (lack of time, participants, equipment, and other support) and whose faculty have high teaching loads and service commitments. We also focus on the difficulties of researching certain topics and describe some potential solutions that could include collaborative efforts and utilization of archival data.

## CHALLENGES

### Engaging Students

Engaging undergraduates in publishable research projects is challenging. Despite many clear benefits to both students and faculty (Landrum and Nelsen, 2002; Hughes, 2014; Woodzicka et al., 2015), a relatively low percentage of students take advantage of opportunities to conduct research. In the National Survey of Student Engagement through the Center for Postsecondary Research at Indiana University (National Survey of Student Engagement, 2018), only 21% of college seniors at public universities and 25% at private universities reported engaging in research with faculty.

This number varies across institutions, such as Research I universities (26%), schools with fewer than 2,500 total students (30%), and with Arts & Sciences focus (44%), perhaps partly due to different definitions of research activities. Certain students (non-traditional seniors age 25+, 14%; first generation college students, 20%) report less involvement in research.

Thus, fostering student interest in faculty research programs is a significant challenge.

We have advertised research studies and the potential for undergraduate involvement within and outside of the department. Student abstracts from conference presentations are also displayed prominently within the department, so students are aware of research achievements of other students. Our labs have been fortunate in that the topics that we study seem to stimulate student interest and involvement: suicidality, depressive and anxiety symptoms, attentional deficits, traumatic experiences, mental health treatments, and drug use, for example.

## Clinical Research

Clinical and counseling psychology graduate program admissions are popular aspirations for undergraduates, and as the largest subspecialties in psychology, faculty can expect students to inquire about gaining experience researching clinical topics (Norcross et al., 2014). Further, students with aspirations for doctoral study in clinical or counseling psychology Ph.D. programs can expect requirements to include laboratory courses and research experience, strong letters of recommendations, and well-crafted personal statements, as well as high GPA and GRE scores (Norcross and Sayette, 2014).

However, it can also be very challenging to establish a clinical research program, especially at universities without access to psychiatric clients, that are not attached to teaching hospitals or clinics. Below we offer several further recommendations for establishing interesting research programs that can involve students.

## RECOMMENDATIONS

### Peer Mentoring

Clinical research and other interesting subtopics can be beneficial for recruiting student researchers potentially interested in becoming involved in publishable research. We just concluded a project on caffeine and nicotine use that involved many undergraduates and is likely to result in publications, and we recently began a multi-institutional collaborative project examining video game imagery, that has seemed popular among undergraduates looking for research experience.

One way we achieve undergraduate involvement is through the use of vertical peer supervision within labs, in which graduate students or more advanced undergraduate students can help supervise and mentor small teams of undergraduates. Undergraduates may relate to and feel less intimidated by fellow students, and may feel more comfortable asking questions or discussing mistakes or become more engaged in the research when noticing the enthusiasm of graduate students.

## Forming Research Collaborations

There are a number of advantages of interdisciplinary research collaboration as well as a few potential drawbacks. For example, interdisciplinary research teams tend to produce research that receives more citations and is thus influential (Wuchty et al., 2007). Scientific research, especially certain STEM and medical fields, appears to have become more collaborative in recent decades (Wuchty et al., 2007; Burroughs, 2017). Interdisciplinary collaboration can be complicated, and there may be risks involved, especially for early career, tenure-track faculty (Rhoten and Andrew, 2004; Moore et al., 2018); however, complex problems such as poverty, violence, and human behaviors or social issues may be best approached by diverse interdisciplinary research teams who bring a broad range of skills and knowledge (Gehlert et al., 2014; Graesser et al., 2018). Collaborative research can result in synergy (Katz and Martin, 1997) as well as increased creativity, motivation, and deeper, more nuanced understanding for students (Woodzicka et al., 2015). Interdisciplinary problem-based learning, a collaborative group learning process, developed to prompt students in health professions to learn beyond rote memory and to develop critical thinking, problem-solving, and research skills, which are associated with enhanced cognitive outcomes as well as student satisfaction, engagement, and perceived usefulness (Davidson and Major, 2014).

Moreover, as a result of the Job Outlook 2018 survey, (National Association of Colleges Employers, 2017) recently found that the popular skills that current employers now value included abilities in problem-solving (82.9%), work in a team (82.9%), written communication (80.3%), leadership (72.6%), analytical/quantitative areas (67.5%), and verbal communication (67.5%). Some faculty (Szostak, 2007; Everett, 2016) have suggested that these findings may speak to the importance of interdisciplinary training and research, to assist students in developing such skills.

In our experiences, collaborating across institutions and disciplines is an effective way to pool funds and resources such as equipment, supplies, and research assistants. For example, successful completion of interdisciplinary projects in collaboration with biology and chemistry departments, which allowed faculty and students from these disciplines to work together and learn about new areas of science and research from one another, demonstrate the potential of such arrangements. One project involving health effects of consuming alkalized water, which was carried out between the psychology and chemistry departments at a small liberal arts college, allowed faculty and students to work together across disciplines and learn about one another's respective disciplines and research methodology. Several students were able to use the project for senior seminar capstone projects and presented the results on campus.

In another project carried out in a collaboration between psychology and biology departments at Western Illinois University, we are examining neurotransmitter genotypes related to addictive behaviors, from DNA obtained from saliva. Portions of this project have been presented both on campus and at major psychological conferences, and are also currently being written

up for publication by faculty and students. Our labs have also collaborated on several occasions with other labs within the university and at other state universities to pool efforts and resources, resulting in a number of conference presentations and manuscript submissions. Between 5 and 10 students each year from 2014 through 2018 were also able to obtain excellent research experience and training from these endeavors.

Although interdisciplinary writing and research groups have been utilized at the graduate postgraduate levels (Cuthbert et al., 2009), a relative dearth of research literature exists on interdisciplinary research teams in undergraduate psychology. Models do exist for interdisciplinary integration of undergraduate psychology coursework at both liberal arts and Research I institutions (Golding and Kraemer, 2000; Ebersole and Kelty-Stephen, 2017), which might help students and faculty across departments appreciate and value concepts and scientific methods from other disciplines. Other faculty have also created courses with interdisciplinary assignments and teaching techniques (Ross et al., 2013) or “cluster courses” that revolve around an interdisciplinary topic (Wingert et al., 2014).

Burroughs (2017) recommends utilizing the expertise of librarians to help set up collaborative relationships, or searching for departments and individuals on campus who have shown a propensity for collaborative research. At Western Illinois University, our Center for Innovation in Teaching and Research has a searchable database of faculty research topics which can also be used to set up potential collaborations (<http://www.wiu.edu/CITR/services/research.php>).

## Archival Data

Another way in which we have successfully developed research programs that incorporate students is to utilize archival, or publicly available, databases to examine clinical topics. A primary benefit of accessing and analyzing archival data has been the study of topics that otherwise would not be possible (or would be very difficult) outside of medical schools or Research I universities.

In addition to studying clinical topics, especially behaviors with relatively low base rates (e.g., suicidality, inhalant abuse) or treatment outcomes that would otherwise take years to complete, additional benefits of archival data analysis might include the study of behaviors and epidemiology in large, nationally representative samples across genders, sexual orientation, or socioeconomic, that also allow for the use of statistics that require large sample sizes (e.g., structural equation modeling, moderation, and mediation analysis). In our lab, we have benefited from learning and refining new statistical approaches. Some behaviors we have been able to study would also have been difficult for a small college Institutional Review Board to review and approve.

While there can be many benefits to using archival data, several possible drawbacks also exist. For example, available archival data is often several years to decades old, and data collected through surveys often (though not always) preclude experimental designs and require correlational analyses. The available data from surveys or clinical ratings may not be

a direct measurement of a behavior. Moreover, the datasets are often very complicated and can take weeks or months to clean and organize. Two archival datasets we have utilized for research projects (American College Health Association, 2009; Center for Collegiate Mental Health, 2015) required a lengthy application and review process, similar to a grant or journal submission. We have also used data from the SAHMSA Treatment Episodes Dataset (Substance Abuse Mental Health Services Administration, 2005), the Carolina Abecedarian Project (ABC; Campbell and Ramey, 2010), and mandated, publicly reported crime statistics on university websites for clinically relevant projects. Other colleagues have used Amazon’s Mechanical Turk (MTurk; <http://www.mturk.com>; reviewed by Shapiro et al., 2013), the Institute for Social Research (<https://www.icpsr.umich.edu/icpsrweb/>), the Henry Murray Archive (<https://murray.harvard.edu/>), or the Midlife Development in the U.S. Study (MIDUS; <http://midus.wisc.edu/>) and have collected data through Reddit, Facebook, or other social media. Psi Chi has also been moving toward crowdsourcing and data sharing.

## CONCLUSION

We strongly encourage engaging undergraduates in faculty research programs, so that both students and faculty can experience the satisfaction and enjoyment that result from this collaboration. However, involving undergraduate students in quality research projects, especially clinical research that involves examining psychopathology or addiction, can be quite challenging. Strategically implementing procedures that include vertical peer mentoring, collaborating with colleagues across department/disciplines or institutions, and utilizing available archival databases can help faculty from all subdisciplines overcome some of the challenges. All in all, such procedures can be useful and allow for interesting and rewarding experiences while increasing the likelihood of publishable undergraduate research.

## AUTHOR CONTRIBUTIONS

JJH developed the initial concept for the article, wrote the initial draft and revisions and was the primary author. MLW contributed to drafts of the article, reviewed and provided critical revisions, and created the reference list. KMK helped develop the initial concepts for the article and provided critical revisions. All authors approved the paper for submission.

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# Methods for Conducting and Publishing Narrative Research With Undergraduates

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## INTRODUCTION

Narrative research systematically codes individual differences in the ways in which participants story crucial events in their lives to understand the extent to which they create meaning and purpose (McAdams, 2008). These narrative descriptions of life events address a diverse array of topics, such as personality (McAdams and Guo, 2015), development (Fivush et al., 2006), clinical applications (Banks and Salmon, 2013), well-being (Adler et al., 2016), gender (Grysman et al., 2016), and older adult memory decline (Levine et al., 2002).

Narrative research is an ideal way to involve undergraduate students as contributors to broader projects and often as co-authors. In narrative or mixed method research, undergraduates have the opportunity to think critically about methodology during study construction and implementation, and then by engaging with questions of construct validity when exploring how different methods yield complementary data on one topic. In narrative research in psychology, students collect data, as in many traditional psychology laboratories, but they collect either typed or spoken narratives and then extensively code narratives before quantitative data analysis can occur. Narrative research thus provides a unique opportunity to blend the psychological realities captured by qualitative data with the rigors of quantitative methods.

## Background

Narrative researchers start by establishing the construct of interest, deciding when coding narratives for this construct is the most effective form of measurement, rather than a questionnaire or some other form of assessment. A coding manual is developed or adopted, and all coders study the manual, practice implementing it, and discuss the process and any disagreements until the team is confident that all coders are implementing the rules in a similar way. A reliability set is then initiated, such that coders assess a group of narratives from the data of interest independently, compare their codes, and conduct reliability statistics (e.g., Intraclass coefficient, Cohen's kappa). When a predetermined threshold of agreement has been reached and a sufficient percentage of the narrative data has been coded, the two raters are deemed sufficiently similar, disagreements are resolved (by conversation or vote), and one coder completes the remainder of the narrative data. Readers are directed to Syed and Nelson (2015) and to Adler et al. (2017) for further details regarding this process, as these papers provide greater depth regarding best practices coding.

## NARRATIVE CODING IN AN UNDERGRADUATE LABORATORY: COMMON CHALLENGES AND BEST PRACTICES

### When Are Students Co-authors?

Narrative coding requires heavy investment of time and energy from the student, but time and energy are not the only qualities that matter when deciding on authorship. Because students are

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often shielded from hypotheses for the duration of coding in order to maintain objectivity and to not bias them in their coding decisions, researchers may be in a bind when data finally arrive; they want to move toward writing but students are not yet sufficiently knowledgeable to act as co-authors. Kosslyn (2002) outlines six criteria for establishing authorship (see also Fine and Kurdek, 1993), and includes a scoring system for the idea, design, implementation (i.e., creation of materials), conducting the experiment, data analysis, and writing. A student who puts countless hours into narrative coding has still only contributed to conducting the experiment or data analysis. If the goal is including students as authors, researchers should consider these many stages as entry points into the research process. After coding has completed, students should read background literature while data are analyzed and be included in the writing process, as detailed below (see “the route to publishing”). In addition, explicit conversations with students about their roles and expectations in a project are always advised.

## Roadblocks to Student Education

One concern of a researcher managing a narrative lab is communicating the goals and methods of the interrater process to student research assistants, who have likely never encountered a process like this before. Adding to this challenge is the fact that often researchers shield undergraduates from the study’s hypotheses to reduce bias and maintain their objectivity, which can serve as a roadblock both for students’ education and involvement in the project and for their ability to make decisions in borderline cases. Clearly communicating the goals and methods involved in a coding project are essential, as is planning for the time needed to orient students to the hypotheses after coding if they are to be included in the later steps of data analysis and writing. In the following two sections, we expand on challenges that arise in this vein and how we have addressed them.

## Interpersonal Dynamics

A critical challenge in the interrater process addresses students’ experience of power relationships, self-esteem, and internalization of the coding process. In the early stages, students often disagree on how to code a given narrative. Especially when the professor mediates these early disagreements, students might feel intimidated by a professor who sides with one student more consistently than another. Furthermore, disagreeing with a fellow student may be perceived as putting them down; students often hedge explanations with statements like “I was on the fence between those two,” and “you’re probably right.” These interpersonal concerns must be addressed early in the coding process, with the goal of translating a theoretical construct into guidelines for making difficult decisions with idiosyncratic data. In the course of this process, students make the most progress by explaining their assumptions and decision process, to help identify points of divergence. Rules-of-thumb that are established in this process will be essential for future cases, increasing agreement but also creating a shared sense of coding goals so that it can be implemented consistently in new circumstances. Thus, interpersonal concerns and intimidation

undermine the interrater process by introducing motivations for picking a particular code, ultimately creating a bias in the name of saving face and achieving agreement rather than leading toward agreement because of a shared representation of micro-level decisions that support the coding system.

Clearly communicating the goal of the interrater process is key to establishing a productive coding environment, mitigating the pitfalls described above. One of us (AG) begins coding meetings by discussing the goals of the interrater process, emphasizing that disagreeing ultimately helps us clarify assumptions and prevents future disagreements. If the professor agrees with one person more than another, it is not a sign of favoritism or greater intelligence. Given the novelty of the coding task and undergraduate students’ developmental stage, students sometimes need reassurance emphasizing that some people are better at some coding systems than others, or even that some are better coders, and that these skills should not be connected to overall worth.

## Time

The next set of challenges pertains to students’ own life settings. Depending on the structure of research opportunities in a given department, students work limited hours per week on a project, are commonly only available during the academic semester, and are often pulled by competing commitments. Researchers should establish a framework to help students stay focused on the coding project and complete a meaningful unit of coding before various vacations, semesters abroad, or leaving the laboratory to pursue other interests. This paper discusses best practices that help circumvent these pitfalls, but we recommend designing projects with them in mind. Some coding systems are better suited to semester-long commitments of 3 h per week whereas others need larger time commitments, such as from students completing summer research. It is helpful to identify RAs’ long-term plans across semesters, knowing who is going abroad, who expects to stay in the lab, and assigning projects accordingly.

Building a robust collaborative environment can shape an invested team who will be engaged in the sustained efforts needed for successful narrative research. In one of our labs (JLS), general lab meetings are conducted to discuss coding protocols and do collaborative practice. Then an experienced coder is paired with a new lab member. The experienced coder codes while walking the new coder through the decision process for a week’s worth of assigned coding. The new coder practices on a standard set of practice narratives under the supervision of the experienced coder, discussing the process throughout. The new coder’s work is checked for agreement with published codes and years of other practice coders. The new coder then codes new narratives under the supervision of the experienced coder for 2 weeks or until comfortable coding independently. The most experienced and conscientious junior applies for an internal grant each year to be the lab manager during senior year. This lab manager assigns weekly coding and assists with practical concerns. Coding challenges are discussed at weekly lab meetings. More experienced coders also lead weekly “discrepancy meetings” where two or three trained coders review discrepancies in a coded data set and come to a consensus

rating. Such meetings give the students further learning and leadership opportunities. These meetings are done in small teams to accommodate the students' differing schedules and help build understanding of the constructs and a good dynamic in the team.

## THE ROUTE TO PUBLISHING WITH UNDERGRADUATES IN NARRATIVE PSYCHOLOGY

When coding has successfully been completed, researchers then have the opportunity to publish their work with undergraduates. When talented students are involved on projects, the transition to writing completes their research experience. A timeline should be established and a process clearly identified: who is the lead author? Is that person writing the whole manuscript and the second author editing or are different sections being written? We have considered all these approaches depending on the abilities and circumstances of the undergraduate. In one example Grysman and Denney (2017), AG sent successive sections to the student for editing throughout the writing process. In another, because of the student's ability in quantitative analysis and figure creation (Grysman and Dimakis, 2018), the undergraduate took the lead on results, and edited the researcher's writing for the introduction and discussion. In a third (Meisels and Grysman, submitted), the undergraduate more centrally designed the study as an honors thesis, and is writing up the manuscript while the researcher edits and writes the heavier statistics and methodological pieces. In another example, Lodi-Smith et al. (2009) archival open-ended responses were available to code for new constructs, allowing for a shorter project time frame than collecting new narrative data. The undergraduate student's three-semester honors thesis provided the time, scope, and opportunity to code and analyze archival narratives of personality change during college. As narrative labs often have a rich pool of archival data from which new studies can emerge, they can be a rich source of novel data for undergraduate projects.

In sum, there isn't one model of how to yield publishable work, but once the core of a narrative lab has been established, the researcher can flexibly include undergraduates in the writing process to differing degrees. As in other programs of research, students have the opportunity to learn best practices in data collection and analysis in projects they are not actively coding. Because of the need to keep coders blind to study hypotheses it is often helpful to maintain multiple projects in different points of development. Students can gain experience across the research process helping collect new data, coding existing narratives, and analyzing and writing up the coding of previous cohorts of students.

Most importantly, narrative research gives students an opportunity to learn about individuals beyond what they learn in the systematic research process and outcomes of their research. The majority of undergraduate research assistants are not going on to careers as psychologists conducting academic research on narrative identity. Many undergraduate psychology students will work in clinical/counseling settings, in social work, or in related mental health fields. The skills learned in a narrative research lab can generalize far beyond the specific goals of the research team. By reading individual narratives, students and faculty have the opportunity to learn about the lived life, hearing the reality in how people story trauma, success, challenges, and change. They can begin to see subtlety and nuance beyond their own experience and come to appreciate the importance of asking questions and learning from the answers.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# Conducting Publishable Research From Special Populations: Studying Children and Non-human Primates With Undergraduate Research Assistants

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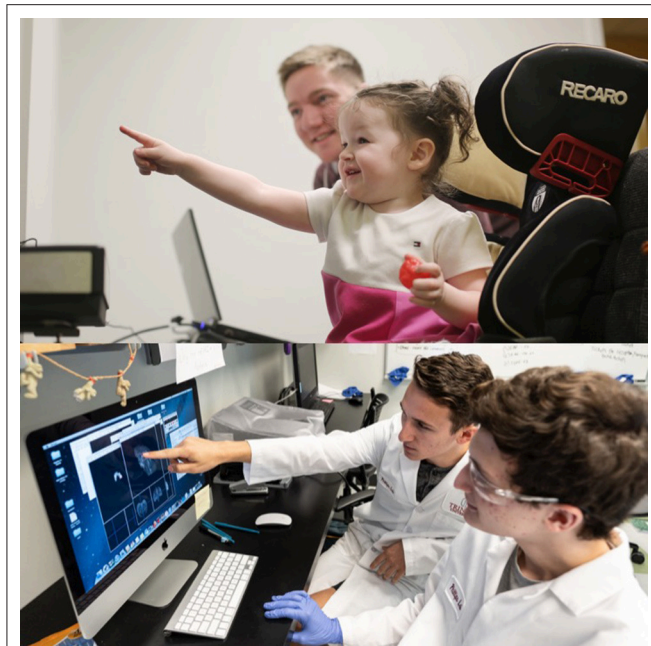
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## SETTING GOALS

A primary strategy is to set long-term, high-level goals, and work backwards to identify short-term tasks that keep the work focused toward these goals (e.g., Wilkowski and Ferguson, 2016). We subscribe to the “2 weeks, 2 months, 2 years” method, wherein we identify goals (i.e., project completed, manuscript submitted) to be accomplished in 2 years. We then identify tasks to be completed in the next 2 weeks (i.e., literature search) and 2 months (i.e., number of participants run). Involving RAs in this process allows them to see how their contributions contribute to long-term goals. Additionally, we have found that setting up schedules for training and working in the lab within the first week of each semester is a key to getting undergraduates successfully engaged. Undergraduates can be overcommitted, and their schedules fill rapidly. Putting lab times into their schedules early, in writing, is important.

## RECRUITING UNDERGRADUATE RESEARCH ASSISTANTS

Recruiting good students and encouraging them to stay in the lab multiple semesters is important to enculturating students into scientific practices (Thiry and Laursen, 2011; Thiry et al., 2012; Linn et al., 2015). Students who move from the “performing without understanding” stage into the “performing with understanding” stage are invaluable team members, who can contribute insights which can lead to co-authorship (Ankrum, 2018). We have developed strategies for identifying students who are likely to be a good match. First, prospective RAs need to have some specific background knowledge, such as successful completion of an introductory course in neuroscience (KAP) or other coursework in Psychology (JC). Students submit a written application, which includes questions pertaining to coursework, motivation, work ethic, and ethical considerations when working with special populations. We then talk informally with other faculty and interview students before accepting them. Prior experience engaging with young children or working with



**FIGURE 1 |** Undergraduate Research assistant collecting data from a child using an eye-tracker (**top panel**); undergraduates discussing analysis of MRI scan (**bottom panel**). Written informed consent was obtained from the depicted adults and students, and the parents of the depicted child, for the publication of this image. All appropriate permissions were obtained from the University/copyright holders for the use of this image in the manuscript. Photo credit: Trinity University.

animals helps students more quickly make meaningful contributions to research projects. We seek out students who can work independently and collaboratively, and can enrich our labs with diverse backgrounds and perspectives. We have found that a student's drive and passion for research are typically better predictors of success than is GPA, though maintaining a minimum GPA is required.

We usually have more students interested in being in the lab than positions, and previously have accepted additional students which resulted in a larger lab group than we found to be manageable (<12 students/semester). As a consequence, the productivity of the lab actually slowed. Thus, we now only accept a set number of students (typically 5 or less for KAP; 8–10 for JC). Returning students have priority over new students, as long as they have shown productivity.

## ADDITIONAL CHALLENGES WHEN CONDUCTING STUDIES OFF CAMPUS

Our data collection is largely accomplished off campus at a National Primate Research Center (KAP) or at local child care centers (JC). Thus, two hurdles must be addressed early: planning transportation to and from sites, and completing the background and security checks needed for working with these special populations. Transportation can be a barrier, particularly for students of underrepresented groups. We coordinate student schedules so that they can carpool to the research sites, which

incurs the additional benefit of ensuring students are collecting data in pairs, increasing fidelity to protocols. (For liability reasons, we do not have students carpool with us.) In addition, an Office of Risk Management aids with the various legal forms that must be completed and filed, including fingerprint background checks. Some University support is helpful, as a fingerprint background check is costly (~\$40). Students working at the National Primate Research Center must undergo additional security clearances and medical screenings, which can take up to 2 months. By planning for these obstacles, we can quickly incorporate new RAs into our research teams.

## DESIGNING RESEARCH PROCEDURES FOR UNDERGRADUATE RAs

Another key consideration is designing studies that can be conducted with undergraduate RAs (see **Figure 1**). While we have been fortunate to continue our research programs with children and nonhuman primates (NHPs), we have modified our research agendas for success at a PUI. First, procedures must be tailored to the participants available in the environment. For JC, this meant not conducting research with infants (who often need to be brought to campus) but focusing on preschool-aged children (who can be recruited in child care centers). KAP utilizes the resources of a National Primate Research Center (at which a veterinarian and other technical staff are available) rather than house animals at an on-campus vivarium.

The procedures we use in our research include some that are highly technical—including eye tracking and magnetic resonance imaging (MRI). We find our RAs to be quite capable of understanding and successfully working with, and analyzing data from, these techniques. We work with our students to develop written protocols for these procedures. Repeating students can be given the responsibility of training new students in person on each procedure, with the PI in attendance to be sure training is accurate. Students create their own training videos (with supervision), to help remind new RAs of procedures after training. These activities help continuing students take ownership of projects, develop a deeper investment in research, and foster leadership skills.

JC's team typically conducts multiple studies simultaneously, with some of these studies including procedures that are easier to use (e.g., behavioral enactment and studies that use iPads), and some studies including procedures that are more technical (i.e., using an eye tracker which uses near-infrared light and corneal reflectance to track where in a dynamic event a child is visually attending; funded through an NIH R15 grant). Using a more technical procedure has its costs in terms of potential data loss due to equipment issues, but at the same time, provides students with experiences that can give students an edge when applying to positions after college. These procedures allow students the chance to assist with stimuli creation (e.g., filming and editing video; creating "live" events), which also enriches their experience. A difficulty in working with 2- to 4-year-olds is that participants are not always engaged or compliant in obvious ways. To help students prepare for this, new students code videos

of prior experimental sessions to see how other students have handled different situations (and to provide interrater reliability coding). We also pair a new student with a returning student who can mentor them, especially when they are collecting data off campus.

KAP integrates behavioral or cognitive data with analyses of brain structure and function obtained from neuroimaging. She utilizes the research imaging scanners at the local medical school for acquisition of structural MRI, resting-state functional MRI, and diffusion tensor imaging. She works closely with MRI physicists to develop the scanning protocols and veterinary staff to care for the animals. Students collect the behavioral or cognitive data (e.g., motor learning) from NHPs and assist with the acquisition of the scans. Although analysis and interpretation of neuroimaging can be challenging for students, many are eager for the opportunity and devote considerable time to the task. Such work often requires troubleshooting that involves editing Unix code, as the brain image analysis software was developed for humans. In addition to brain scans, KAP also uses some behavioral protocols (e.g., testing the effects of exercise on cognition; primate problem solving) that RAs can help develop and administer.

As undergraduate RAs collect data, systems must be in place to monitor their progress and be sure students are not engaging in “experimenter drift.” We use multiple coders of behavioral data, have students submit weekly lab reports (short emails of progress and challenges), and provide opportunities for students to write. Often, papers are part of our Supervised Research course, which gives students course credit for research, provides faculty with a course that can count toward their teaching load, and gives students practice at delivering oral presentations as well as writing up projects. These papers can be helpful because they provide a record of where each project was in a semester—which can be useful as projects evolve. Additionally, a poster can be presented at the end of the summer research session, and students are given chances to present posters (or rarely papers) at major national and international conferences. Inviting RAs who have contributed meaningfully to the research over multiple semesters to write portions of conference abstracts encourages students to continue in the lab. It also serves as great experience as they later create a research poster that they often have a chance to present at a conference. At times, strong students are encouraged to complete an undergraduate thesis which stems from research in the lab. Theses take three semesters so that students have ample time to design and implement the study (S1 and S2), and have time to write (S2 and S3). Multiple drafts are submitted for revision in stages. These thesis papers have been great starts to papers that

can later be submitted for publication with student(s) as a co-author (Childers et al., 2012, 2014, 2016; Phillips et al., 2018; Phillips et al., 2019).

## FINANCIAL SUPPORT

Research is expensive. Our institution helps us fund our highly productive undergraduate-centered research programs by providing some departmental support for research and by employing a Sponsored Research Officer to assist with applying for external support. We have been successful in applying for Federal grants, including the NIH R15 and NSF REU grant programs. We have also found that connecting with local Foundations for possible funding can be useful; initiating and sustaining these relationships may yield not only funding but also opportunities for collaboration.

We know our undergraduate RAs are juggling courses, work, and time in the lab. One study reported 70–80% of college students are also in the labor market (Carnevale et al., 2015). If students enroll in 15 credit hours/semester, and study 3 h for every 1 h in class, students are spending approximately 45 h/week with class-related activities. We have found that providing students with support can ensure a minimum number of hours are spent in the lab. Many students during the school year and summer receive course credit. Some top students can be funded through internal funding or grants during the summer, which they must apply for—and this helps them to start thinking about research and promotes writing.

## CONCLUSIONS

In summary, even at PUIs, it is possible to conduct high quality, publishable research with undergraduate RAs. Building the capacity of undergraduate RAs to contribute to the success of the lab has been instrumental in allowing us to regularly publish our findings.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# Involving Undergraduates in Publishable International Research: Experiences in Latin America

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Involving undergraduates in research is important to many sciences such as biology, chemistry, physics, and psychology (Russell et al., 2007; Thiry and Laursen, 2011). Cultural psychological research often occurs in “the field,” far from home. This scholarship has specific challenges that can make it difficult to involve undergraduates. These challenges, however, are worth the rewards of introducing them to international and culturally-based research. Here, I provide suggestions from my experiences guiding 26 undergraduates while conducting psychological research in Guatemala. This work has resulted in five publications (including nine undergraduate co-authors), various conference presentations, and other ongoing projects with another seven student collaborators (García Egan et al., 2014; Faherty et al., 2016; Ashdown and Buck, 2018; Ashdown et al., 2018; Rohner et al., 2019).

Many challenges of conducting research with undergraduates while abroad are similar to working with undergraduates on campus. Undergraduates are research novices, requiring significant supervision and training (Shellito et al., 2001; Thiry and Laursen, 2011). Challenges specific to international research, like working in unfamiliar locations and avoiding specific cultural and ethical pitfalls, can be managed by focusing on five issues: (1) establish local collaborations, (2) avoid “safari” research, (3) understand students’ cultural and research skills, (4) get official institutional support for students’ travel and work, and (5) model international research ethics.

## ESTABLISH LOCAL COLLABORATIONS

International research requires partnerships with local collaborators (Pao, 1992; Ashdown and Buck, 2018). Such collaborations are more successful (Pao, 1992), and local collaborators have better access to local populations, understand local customs, and can serve as cultural ambassadors in addition to collaborators. It is important to model these collaborations for undergraduates to teach them the value of such collaborators. Working with local collaborators can also lead to the opportunity to include local undergraduates as collaborators, a worthy goal of any international psychologist. For example, I worked with two Guatemalan students on a project exploring Guatemalan mothers’ parenting beliefs (García Egan et al., 2014). I was introduced to these student collaborators through my previous collaborations with other local Guatemalan scholars.

Working with local collaborators helps researchers avoid falling into the trap of the “White savior complex” (Straubhaar, 2014; Belcher, 2016; Bex and Craps, 2016; Jailani, 2016; Ashdown and Buck, 2018). This complex occurs when researchers (usually highly-educated, relatively wealthy White people from the Global North) view themselves (and are sometimes viewed by participants) as having all necessary skills and knowledge to research an issue or solve a problem. With deep roots in colonialism (Rigney, 1999; Rios, 2015; Aronson, 2017; Ashdown and Buck, 2018), this behavior should be avoided at all costs. Conducting research in partnership with local collaborators ensures investigators avoid culturally imperialistic research practices (Dupre, 1994; Wilmshurst, 1997), while teaching undergraduates this important practice.

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## AVOID “SAFARI” RESEARCH

The term “safari research” describes scholarship by researchers who lack deep understandings of the cultures they study. This practice is unethical, promotes the White savior complex, and should never be modeled for undergraduates. Otherwise, scholars may reify the structures of colonialism in their work and perpetuate it in a new generation of researchers. Instead, researchers should limit themselves to working in cultural contexts where they have experience, and where they can receive support from, and in turn support, local collaborators. This issue is closely tied the White savior complex, and of such importance that I recently published a critique of the way cultural psychologists interact with foreign cultures (Ashdown and Buck, 2018). This publication has an undergraduate author and is based on her honors thesis—a good example of how students can do good scholarship *about* cultural psychology as well as *within* cultural psychology.

Safari research intensifies the complexities of working in a foreign language. I believe researchers should not work in a language they cannot speak. Even when fluent in a second language, they should work with local collaborators who are native speakers. Translations of measures and surveys should always utilize rigorous back-translation processes that involve native speakers of the language—regardless of how well a researcher might speak both languages (Brislin, 1970; Dorcas et al., 2000; Hambleton and Zenisky, 2011).

Language is an area where undergraduate students can be of great help. In past projects, I involved undergraduates who were native Spanish speakers (often bilingual in Spanish and English) to help with the translation process. While translation work alone does not meet the requirements for authorship, it is valuable and always recognized in the authors’ note of publications and presentations (Ashdown et al., 2017). Often, this effort serves as the first step, or “try out” aspect, of getting a new undergraduate researcher involved in my scholarship.

Related to the complexities of language is an awareness of local cultural norms (Rigney, 1999; Rogler, 1999; Finnemore, 2009). It is impossible for safari researchers to practice ethical scholarship in a culture where they do not understand customs surrounding concepts like gender relations or social hierarchies. When I take undergraduates abroad, I require a significant amount of reading and meetings before departure. These are not replacements for the years of immersion necessary for cultural proficiency (Ruben, 1989), but serve to prepare undergraduates for international field work. For example, students who work with me read *The Guatemalan Reader* (Grandin et al., 2011) before our trip and meet with me 2–3 times a month to discuss their reading.

Finally, for students (or other researchers) hoping to begin a research program in a culture with which they are currently unfamiliar there are some tactics that will help them avoid the pitfalls of safari research. Begin establishing relationships with potential local collaborators before traveling (e.g., via email listservs and Internet groups), and try to build bridges with other international researchers working in the same area with an eye toward future collaborations and a “foot in the door” to learn about the culture. And, in the end, it is better to take someone

with you who is familiar with the culture (or hire a translator to accompany you) than it is to become a safari researcher.

## UNDERSTAND AND SUPPORT STUDENTS’ CURRENT SKILLS

Many undergraduates have international experience, and may have studied abroad in cultures similar to the one where you work. They come with valuable cultural skills and understanding—though their experience maybe more superficial than you would like. It is important to talk with these students to determine the intercultural skills they have developed from their experiences and what others need cultivating.

Students without international experience can still be valuable research assistants. They do not need to travel to conduct research, nor do they need previous international experiences to be important assets in international scholarship. Students who do not travel to collect data can be members of a research team assigned other tasks. On my team, these students aid in data analysis, literature searches, and writing. In all of my publications based on data from Guatemala that have undergraduate co-authors, some of those authors did not travel with me, but did significant work on writing once I returned to campus with data. I still require them to have a solid grounding in Guatemalan culture—just as students who travel with me are required to complete certain readings and meet to discuss cultural and current events, so are students who do not.

Keep in mind that whether or not students have relevant cultural experience, it does not compensate for a lack of research skills. Undergraduates conducting international research need support and training in basic skills related to the project. These skills often include interviewing, managing focus groups, or navigating local research customs. The line between cultural skills and research skills can blur—a student with great interviewing skills still needs to understand local norms around social interactions and speak the language in which the interviews occur. Working with undergraduates in international contexts requires that you balance the need for these skills with providing the students the experiences needed to gain and develop the skills.

## OBTAIN INSTITUTIONAL SUPPORT

Institutional support is important for any scholarship involving undergraduates; this support is particularly important for international research, as travel costs can exceed what many researchers can pay, and there can be higher liability connected to travel. Because of the costs of traveling, my institution has a few competitive scholarships to support students’ international work. Official institutional support may also make it easier for students to apply for external funding.

Keep in mind that while having institutional support makes the process of traveling with students to conduct research more feasible for various reasons, it may not be necessary (you should check institutional policies). I have traveled with students both as part of an official program with my institution and as individual students (or small groups of students) accompanying me during

summer break. The comfort you have traveling without official institutional support should have the largest influence on how you make this decision.

One aspect of this decision might be whether the institution will provide liability protection for you, which is something I always consider when I take students to Guatemala. I have yet to experience personal risk while traveling with students, but I take steps to protect myself. For example, I edited a copy of the legal liability paperwork students complete, sign, and notarize before they travel on an official institutional program (e.g., study abroad) so that it acts as a contract between me and the students. It serves the purpose of protecting me from liability in many situations. I also suggest having a discussion with your insurance agent about possible insurance coverage.

## MODEL GOOD INTERNATIONAL RESEARCH ETHICS

My last suggestion, to model good research ethics, may seem like a suggestion that all researchers should follow. I believe this modeling deserves special consideration when conducting international research. As mentioned previously, these ethics include avoiding a “White savior complex,” getting nowhere near cultural or scientific colonialism, and not engaging in safari research. It also includes a few methodological ethics specific to international research.

First, we should always get Institutional Review Board (IRB) approval for any research that involves human participants (or an Institutional Animal Care and Use Committee for non-human participants), which clearly is not specific to international research (Amdur and Biddle, 1997; Oakes, 2002). This, however, is not enough. We should ensure that we get approval from a local IRB, too (Greene and Geiger, 2006; Ravina et al., 2009). If there is not an appropriate and relevant local IRB, we should get ethics approval from an authorized and appropriate person in the community or organization where we are working, such as a village elder, elected official, or program director.

Second, in addition to working with local collaborators, we should ensure that collaborators receive appropriate authorship recognition. No matter where our collaborators live and work, if their effort on our project would constitute authorship recognition on a publication or presentation for a USA-based colleague, our international collaborators are entitled to that same recognition. Not including collaborators as authors simply because they do not work in a traditional research setting such as university (e.g., community organizers, program directors, etc.) is inappropriate. Simply put, all contributions to a project should be ethically and appropriately recognized.

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Third, and related to the second point, I have made a conscious decision to publish my Guatemala-based work in journals that are accessible to local Guatemalan scholars. This decision often means publishing in open-access journals because many Guatemalan scholars cannot afford the excessive cost of accessing databases and journals. Because many highly-ranked open-access journals have hefty publication fees (which my institution will not pay), I often choose to publish in good journals that are not at the top of the journal ranks. Otherwise, I would find it difficult to ethically justify my research because it would not be accessible to my collaborators, their institutions, or other local scholars (Kansa et al., 2013; Butler, 2016; Schiltz, 2018). For example, I have published with student collaborators in the *Revista Interamericana de Psicología* (García Egan et al., 2014), the *Psi Chi Journal of Psychological Research* (Faherty et al., 2016), and the *Acta de Investigación Psicológica* (with a recently graduated local collaborator; Gomez and Ashdown, 2013).

## CONCLUSION

Involving undergraduates in high-quality international research is one of the aspects of my career I most enjoy. As a cultural psychologist, my research occurs in the context of the beautiful, colorful, and exciting culture and geography of Guatemala. While working with students is a highlight of my work, it can be challenging to involve undergraduates in this type of research process. I have found, though, that challenges pale in comparison to the rewards that come from introducing my undergraduates to the process of international and culturally-based research, and to the splendor of Guatemala.

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# Reflections on an International Research Immersion Field Study as a High Impact Practice to Produce Publishable Papers by Underrepresented Undergraduates

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Engaging undergraduates in publishable research is challenging. Skills including researching topics, statistical knowledge, and writing abilities are necessary; however, students often face time constraints or financial challenges that impede them from engaging in these experiences. Conducting research with underrepresented students can be an even bigger challenge, as these groups are known to face additional financial or family burdens that the traditional student does not face. This essay reports on the development of an international field study with the goal of producing publishable research by undergraduates. To date, 27 students (68% Hispanic, 52% first generation) have participated in a week-long immersion field experience in Roatán, Honduras. As an interdisciplinary field study, students were exposed to animal behavior, ecology concepts, and research methods through a two-course sequence that incorporated the field experience. In this essay, we share our best practices for conducting a field study with students from underrepresented populations with the goal of producing publishable research. We include the evolution of the course curriculum that was informed by self-reported student experiences and a brief description of some of the projects students designed. Students reported that the field experience highlighted the importance of adjusting research plans and expectations. Ultimately, this program exposed students to advantages and disadvantages of conducting field research while increasing confidence in their ability to conduct effective and meaningful research. A minimum of two semesters may be needed to create publishable research projects and 1 week of data collection is not sufficient for successful research projects.

**Keywords:** high impact practices, immersion experience, field study, study abroad, undergraduate research, psychology

## INTRODUCTION

Engaging undergraduates in research at a minority-serving institution has many challenges. Competing factors such as family expectations, financial constraints, lack of awareness regarding the importance of research, and the underdevelopment of critical research skills are some of the obstacles encountered by faculty working with underrepresented students (Ortiz, 2004; Bridges et al., 2008; Kuh, 2008; Bangera and Brownell, 2014). These obstacles may be amplified if the institution is also a primarily undergraduate teaching university, where research is expected of



faculty in addition to teaching and service duties, but the financial support for research may be lacking (Smith and Brown, 2012; Anastasio, 2016). However, high impact practices such as field studies and immersion experiences are known to be both transformative and productive for participants and need to be encouraged for all students, regardless of circumstances (Barnett, 1997; Lopatto, 2007; Jones et al., 2010; Kuh et al., 2010; Finley and McNair, 2013; Bangera and Brownell, 2014). Our research immersion program combines curriculum-based research with an international, field immersion experience. The purpose of this essay is to share our best practices for conducting an interdisciplinary, week-long, international field immersion study supported by curriculum-based research experiences with the goal of collecting data for a publishable research project.

## LOGISTICS OF THE FIELD COURSE

To date, we have completed two field studies on the island of Roatán, Honduras with a total of 27 undergraduate students, including two repeat students. Of the 25 unique students, 68% self-identified as Hispanic, and 52% as first generation/low income. Our institution, St. Mary's University located in south central Texas, serves over 2,000 undergraduates and is a Hispanic Serving Institution (HSI) with a high percentage of first generation and low-income students. Our recruitment efforts reflect the distribution of our university and the disciplines of the two authors. The field study is interdisciplinary with emphases on comparative psychology and environmental science, and students had the opportunity to design independent research projects involving animal behavior and cognition with bottlenose dolphins as the study animal, or conservation biology/environmental science topics related to the marine environment. The majority of the students had taken either statistics and/or research methods courses or have been involved in smaller, independent research projects prior to attending the field study. Completing at least one of these courses or a previous research experience is necessary for students to create a research study that is publishable. The field study has gone through two iterations thus far with important lessons learned from the inaugural field study that were then implemented in the second iteration to try and increase the likelihood of successfully completing a publishable research project (Figure 1 illustrates the two iterations).

### Iteration 1

In the first iteration, we had 13 students, of which 9 identified as Hispanic and 1 additional identified as non-Caucasian; all 13 were female. The students took either conservation biology or comparative psychology in the spring semester, which was paired with a laboratory course that consisted of the field study during spring break. Both courses were coordinated prior to spring break so that students in each course attending the field study could learn the skills necessary to complete their research projects while in Roatán. The students who were not attending the spring break field study completed similar research projects but with local resources (e.g., local zoo, campus, or surrounding natural

parks and reserves). Students in both classes read original, peer-reviewed scientific literature on topics involving animal behavior that targeted constructs that could be examined in the field, conservation issues and efforts (with special emphasis on the tropics), ecological diversity, and research methods for behavioral and environmental sciences. With guidance from the coordinator of the field study and the two authors, the students also developed research proposals for projects to be collected during the 6-day field immersion period. Students developed their projects independently of one another, although topics and data collection methodology could overlap. Example project topics included: Species diversity of seagrass in Anthony's Key and Bailey's Key in Sandy Bay, Roatán, Honduras; and type and frequency of play behavior by dolphins and frequency of pair swims in same-sex and mixed-sex dolphin dyads. Once in Roatán, all students assisted on data collection for all projects so that they could be cross-trained on the different methods employed by each discipline; however, each student was using the data collected for their own, unique research project. In addition to data collection for their projects, the field study experience included lectures, discussions, and special presentations by local educators and trainers on topics unique to the island and marine ecosystem, snorkeling, and kayaking every day. Following the field study, the participants and their classmates completed their data analyses and formal write-ups as the final project requirement of the two courses. Ideally, any of these projects could have been publishable if enough data had been gathered. Unfortunately, given the individual nature of the projects and the time available to collect data during the field study itself, the majority of the projects did not have sufficient data to warrant a publication. However, several of the projects were presented at our university's symposium that spring and one conservation biology project investigating soil and water quality on Roatán was presented at an international conference, earning an outstanding undergraduate research award and travel grant.

### Iteration 2

Based on the semester-long style for iteration 1, which is a common approach for many field studies, and the feedback provided by the 13 students, we modified the format and required a two-semester commitment by the students participating in the field study. We had 14 students in the second iteration, of which 9 identified as Hispanic and an additional 1 identified as not Caucasian, and we had 10 females. The first semester, the field study students enrolled in a special topics course for 3 h of credit in the spring. The format of this course was the same as in the first iteration, meaning that all required reading was completed before attending the field study (which had been a challenge in the first iteration since the field study occurred 8 weeks into the semester), and students were required to develop their individual research projects in collaboration with another classmate or two. At the end of this first course, students had a well-defined plan for data collection and an independent research proposal. All proposals had been guided and were approved by H. Hill and M. Karlin, the instructors of the field study. Example project topics included: Estimating marine species richness and evenness of seagrass habitat in Roatán, Honduras; and activity



level of dolphins before, during, and after the presence of a swimmer or number of dolphins in a designated safe zone area during a swim program. The field study itself occurred later in the summer the week before the fall semester began. Upon the students' return from the field study, students began a second special topics course, which emphasized advanced research methods and ended with a drafted research manuscript and oral presentation. Students were also required to present their field study research in either oral or poster format at the university's research symposium in the spring following the field study experience.

## SUMMARY OF STUDENT EXPERIENCES

All students in both field studies completed a post-field study survey immediately at the end of the week. The second field study students also completed a pre-field study survey at the beginning of the spring semester course. The surveys included questions specific to the program we developed as well as four previously validated instruments: Interest in Research Questionnaire (Bishop and Bieschke, 1998); Research Self-Efficacy Scale (Greeley et al., 1989); general self-efficacy (NGSE, Chen et al., 2001); New Ecological Paradigm scale (NEP, Dunlap et al., 2000). The student free responses supported previous research findings for international immersion experiences (Barnett, 1997; Lopatto, 2007; Jones et al., 2010; Kuh et al., 2010; Finley and McNair, 2013; Banger and Brownell, 2014): our students reported testing and pushing their personal boundaries and comfort zones while increasing their confidence and becoming more aware of the culture, economy, and pressures of those in the country they visited (**Tables 1–4**). The results from the quantitative data from these surveys are available for review (Karlin and Hill, unpublished). Many of the students reported that the field experience highlighted the importance of adjusting research plans and expectations (**Tables 1–4**). Whether the students developed their ethograms for data collection during the first 2 days of the field study (first iteration) or prior to the field study (second iteration), all the students had to modify their selected research projects to account for field conditions. Having never conducted their own research study or developed a study with live subjects in an ever-changing field conditions (e.g., weather changes, availability of animals for data collection, access to locations for data), all the students reported being overwhelmed initially (**Tables 2–4**). During and following both field studies, the students reported that working in a small group setting with peers that were conducting similar research helped them to develop, refine, and implement their projects more successfully. Example responses from the post-survey responses include (**Tables 1–4**): “This study offered experiences that one may not normally have the time or money to do after he/she has graduated from school.”; “This field study was absolutely transformative, I was able to gain critical research experience while also making lots of new friends and priceless memories.”; “... I feel like my learning capabilities have transformed into something much bigger than a classroom.”

## FINANCIAL CONSIDERATIONS

During iteration 1, the program fees were incorporated into the laboratory course fee that only the students participating in the immersion experience were enrolled. Therefore, students were able to use their financial aid packages to cover the expenses associated with the experience. Students also held a number of fundraisers prior to the immersion experience, to try and offset some costs. The amount of money raised was minimal; however, it did help to bring the students together and work as a team prior to the trip to Roatán.

During iteration 2, the program fees were incorporated into the spring Roatán class that only the student attending the immersion program were enrolled. Like iteration 1, this meant that the students could use their financial aid packages to cover the costs. However, unlike in iteration 1, the authors wrote and were awarded an internal research grant, the purpose of which was to report on the successes of creating this immersion program. The majority of this award was diverted to the students enrolled in the immersion program to help offset some costs (approximately 20% of the total costs per student).

## LESSONS LEARNED

Ultimately, these two field immersion courses point to the conclusion that to produce a publishable research project, the students need a minimum of two semesters to refine skills previously learned in pre-requisite courses/research projects, develop the research project, analyze the data, and write an initial draft of the paper. Highly motivated students may be able to complete a final publishable product by the end of the second semester with a course devoted to preparing the paper, but most students will likely need a third semester devoted to revising and refining the initial draft to prepare for submission to a journal. Moreover, the data collected during a week-long field study that involves so many other components (in this case, snorkeling trips, discussions, lectures, data processing time) is not sufficient time for meaningful parametric analyses, which then means students must learn about non-parametric statistics while trying to process their data. This limitation may be addressed if students work as teams and collect data across multiple individuals, but this solution has its own issues, namely reliable data collection. It took the students 2 days of practice before they were comfortable with collecting data officially for the project, which limited their data collection opportunities. No publishable research resulted from either iteration (**Figure 1**). We believe that the students' can develop successful research ideas; however, the key is the amount of data collected and how much time is spent in the field immersion. Based on our results after 2 iterations, we are recommending at least 2 weeks of data collection, in addition to allowing students to work in groups. These modifications will allow for additional time to collect data, and additional division of data collection amongst the group members, ultimately increasing the sample size of their data. Several students identified working as part as a group

one of the elements they considered helpful. The additional time will also partially alleviate issues with uncontrollable field conditions. In our field study, the students were allowed to collect data in teams because their targeted datasets often overlapped, but they had to develop their own hypotheses so that they could write individual papers. It may have been more efficient to allow the students to work as a team on the same project topic as well as for writing the final research paper. Previous research has suggested that working in teams facilitates the research process and makes it less overwhelming (Love et al., 2007).

## FUTURE DIRECTIONS

Overall, the field immersion experience at an international location has been met with enthusiasm and increased interest by our student population, which is majority minority and underrepresented. In addition to self-reporting increased confidence in their research abilities and enthusiasm for conducting field research (reported in the qualitative comments presented in this essay and the quantitative data Karlin and Hill, unpublished), the international setting and novel experiences led students to report being surprised at

**TABLE 1** | Summary of themes and comments produced by field study students regarding goal achievement.

Cohort	Number of responses per theme categories <sup>a</sup>		Comment
	Achieved goals	Did not achieve goals	
2016 (n = 13)	12	1	<p>Everything I did was something I never thought I would do.</p> <p>I had a great time and was able to learn more about the island and the country through some of the articles about Roatán and their conservation efforts.</p> <p>I feel like the trip enhanced my education and gave me experiences I wouldn't get anywhere else. It's also a unique experience for an undergraduate and I feel lucky that I got it.</p> <p>However, I did accomplish a lot and learned even more.</p> <p>I feel like I did it was a wonderful experience!</p> <p>So, it was pretty much AMAZING!</p> <p>I conquered many fears coming on this trip and I have grown so much from this experience. I am forever grateful to the wonderful people that made it possible for me to even be here. I feel accomplished and ready to take on the world.</p> <p>It was purely amazing I overcame many many fears and did thing that I thought I would never have the opportunity or bravery to do this was great thank you both for making this possible.</p>
2018 (n = 14)	13	1	<p>I wanted to identify weak points and needed improvements in the brainstorm process for designing a research study. From this, I wished to learn limitations, foster a more rational and developed thinking process for scientific understanding, and learn how to step back and take different ideas and challenges into new modifications and procedures. It felt quite different, as I wanted to know how to identify measures that may have been missed in the research process, such as stimulus effects or factors that may have been overlooked in the data collection process. It felt good to be challenged, and to understand why it was challenging.</p> <p>but i am sure i accomplished them.</p> <p>This trip showed me a lot, it taught me a lot and it gave me amazing memories that will last a lifetime.</p> <p>Yes, it was very fulfilling to be able to accomplish so much in such a short amount of time.</p> <p>Yes! It felt good to be able to come ok out of this experience not only well rested and relaxed but so much smarter and experienced.</p> <p>I feel quite accomplished. I gathered sufficient data, made connections with the group got a refresher about limitations and live data gathering.</p> <p>but I like to think that I got everything I possibly could out of this trip.</p> <p>I possibly could out of this trip. I learned so much about research and marine life.</p> <p>collect enough data to publish a paper. We did not accomplish this, which was sad but we can always right a methodology for others to continue.</p> <p>identify all of the dolphins. I was unable to do this, but as the week went on I got a lot better, which was rewarding.</p> <p>-learn how to collect data on dolphins from the surface level compared to under water. We learned of many different ways to collect data from the surface level from our classmates and we learned how to collect data from the underwater camera.</p> <p>Carry out a research plan (able to problem solve when conditions could potentially change) on my own.</p> <p>*Experience traveling with a group.</p> <p>*Delegate responsibilities to other team members.</p> <p>*Experience the marine biodiversity.</p> <p>All goals were achieved and it felt enriching and rewarding.</p> <p>I believe I did reach the 4 goals I set for this week and that felt quite fulfilling.</p> <p>I believe I achieved my goals and it felt amazing. I feel a lot more confident in myself and in my studies because this trip has helped me take the first step to overcoming some of my fears and this included research.</p>

Question (post-survey only): Cohort 1 – Did you achieve the 4 goals you set for this week? Explain how it felt. Cohort 2 – You identified four goals you wanted to accomplish during the field study. Did you achieve the four goals you set for this week? Explain how it felt. <sup>a</sup>Not all students provided full responses. Student responses were corrected for typographic errors only.

**TABLE 2 |** Summary of themes and comments produced by field study students regarding preparing for the field study.

Cohort	Number of responses per theme categories <sup>a</sup>			Comment
	Read papers before	Develop projects more fully	Practice dolphin ID	
2016 (n = 13)	8	1	2	Read and summarize all the articles in advance so they can get to bed earlier. If readings are not done for class, read far ahead. Take the time to read the summaries briefly and starts summaries before the trip. Read and summarize all your articles before the trip, be flexible and prepared to change your projects. It should be definitely a 3-h class. Having all the articles read beforehand will definitely make the Roatán trip more enjoyable. read a lot of background on the Island itself also on what you will chose to study. Do your homework before you come. Read and summarize all the articles in advance so they can get to bed earlier.
2018 (n = 14)	4	6	2	Along with reading academic articles on Roatán, look at social blogs and forums to learn more about Roatán to ensure you are prepared. Bring copies of articles/notes of articles; paper and writing utensils. always have everything for the day prepared the night before. Read and brainstorm ideas more carefully. Most importantly, collaborate efficiently and effectively. I would say if they are planning to collect data on dolphin behavior it would be good to familiarize themselves with the different kinds of behavior that they display. refresh yourself on the articles and research methodology. Review video of the dolphins prior to research question. going to the lab and practice coding. going to the spring class and reading the articles. Take the articles with you on the trip so you can reference them at night or during the lectures. students make a detailed and specific ethogram so it's less work once they start collecting data. Think of a few factors that may impact your project and think of back up plans for those factors.

Question (post-survey only): Cohort 1 – What would you recommend to help students prepare for the field study in the future?; Cohort 2 – What would you recommend to help students prepare for the field study in the future? <sup>a</sup>Not all students provided responses that fell into each theme. Also, theme categories were not mutually exclusive, and a student could contribute to multiple categories. The numbers will not add up to the sample totals for these reasons. Student responses were corrected for typographic errors only.

**TABLE 3 |** Summary of themes and comments produced by field study students cohort 1 regarding recommended changes to field study.

Cohort	Number of responses per theme categories <sup>a</sup>		Comment
	Class should have students read papers before	Class should develop projects more fully	
2016 (n = 13)	4	3	There was too much activity happening back to back and adding class time and discussion to it was hard. I think we were too tired and stressed out trying to get school work done that we missed time enjoying the island and the things around us. We got a feel of the environmental science folks way of doing things as they also got a feel of what we do. By the time we were done with everything, we were physically and mentally tired and had to pull into reserve energy to attempt the articles enough to somewhat comprehend them enough to remember them in the morning. There were a lot of changes at the beginning or just before the trip with our research papers. The conservation bio class completely changed their projects and a lot of the comparative psych class had to change their projects (mostly because of the absence of calves or other issues). It would have been good if we'd been able to find out the population before the trip. I recommend for this trip to be 2 weeks long to get the ids down and have more time to get data without being stressed.

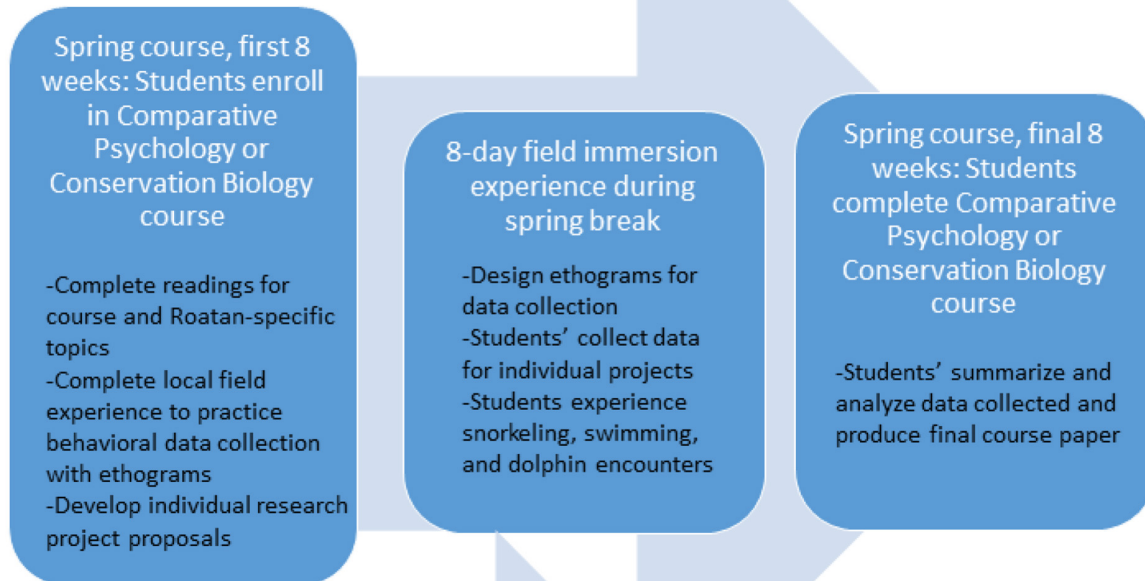
Question (post-survey only): Cohort 1 – If there is one thing that could be done differently, what would you recommend? <sup>a</sup>Not all students provided responses that fell into each theme. Also, theme categories were not mutually exclusive, and a student could contribute to multiple categories. The numbers will not add up to the sample totals for these reasons. Student responses were corrected for typographic errors only.

**TABLE 4 |** Summary of themes and comments produced by field study students cohort 2 regarding the transformative nature of the experience.

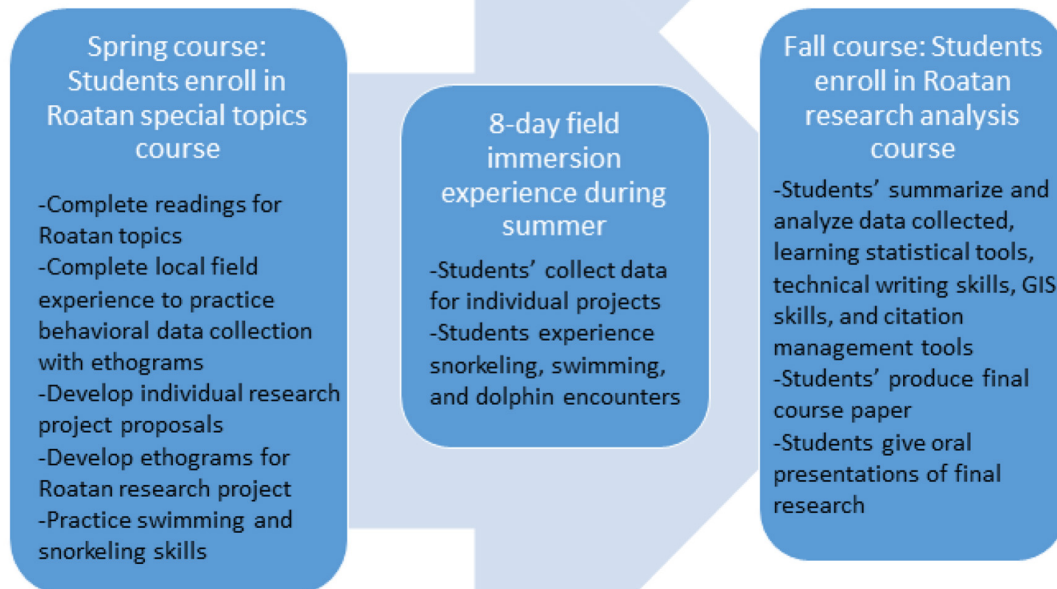
Cohort	Number of responses per yes/no question <sup>a</sup>		Number of responses per how/why theme categories <sup>a</sup>				Comment
	Transformative experience	Not a transformative experience	Overcame fears	Connected with nature	Research experience	Connected with others	
2018 (n = 14)	12	1	3	5	7	4	<p>YES SO TRANSFORMATIVE! I have so many feelings for dolphins and I want to learn more and more about them :-),</p> <p>Yes. This study offered experiences that one may not normally have the time or money to do after he/she has graduated from school. These experiences, I feel, offer students a deeper connection and/or appreciation for nature, and especially marine ecosystems.</p> <p>Yes, it is fun, informative, provides research experience, and makes you feel close to the group of people you go with.</p> <p>Yes. It gave me steps to understand why a research project could need improvement or replication. I learned many new terms, as well as ideas and insights that will help me in the future. Most importantly, it provided knowledge to take the skills I have even further in such a field of study.</p> <p>I would describe this field study as transformative, because I learned a lot of new things that I don't think I would have without this trip. It was one of the most beautiful places I have ever seen!</p> <p>This field study was absolutely transformative, I was able to gain critical research experience while also making lots of new friends and priceless memories.</p> <p>Yes I've never had a chance to do a field study and to be able to go in and say "I did this" was awesome</p> <p>I wouldn't say transformative but it was a great lesson. It taught us to the down falls and benefits of having real life data collection.</p> <p>Yes! I got an experience with marine life that I have never had before. I felt in touch with the outdoors and made some amazing friends.</p> <p>Yes, because of the knowledge I now have about dolphins, but even deeper the knowledge I have about myself. This trip takes most people out of their comfort zone and helps them grow as a person. Not only are you learning about the ocean and the animals it entails, but you are also learning about yourself and the future and how you can do research in this field.</p> <p>Yes, I've extended my self-preservation ideology to other individuals lol.</p> <p>Yes, being able to have that experience with the coral reef helped me to really appreciate its role and the role of conservation efforts.</p> <p>Yes, because I feel like my learning capabilities have transformed into something much bigger than a classroom.</p> <p>Extremely, this trip was all out of my comfort zone but it taught me so much and I feel like my outlook on what I may want to do has changed in a good way. By this, I mean that this trip allowed me to become more outgoing and helped me learn to controls some of my reactions to my fears.</p>

Question (post-survey only): Cohort 2 – Would you describe this field study transformative? If so, how and why? <sup>a</sup>Not all students provided responses that fell into each theme. Also, theme categories were not mutually exclusive, and a student could contribute to multiple categories. The numbers will not add up to the sample totals for these reasons. Student responses were corrected for typographic errors only.

### Iteration 1: Single course with field immersion experience during spring break



### Iteration 2: Multiple courses with field immersion experience during summer between courses



**FIGURE 1 |** Flow process of Iteration 1 and 2. Neither iteration resulted in publishable research, mainly due to quantity and quality of data collected. However, Iteration 2 enabled the students more time to conduct the necessary background research, learn essential research skills, and practice presenting their research in an oral format. Based on feedback from the students' in each iteration, and the progress made in research skills and results in Iteration 2, we recommend future experiences incorporate longer field immersion experiences.



the unexpected bonds they developed with their classmates in such a short period (**Tables 1, 4**). To increase diversity in field study or research experiences, we recommend that instructors recruit from underrepresented student-serving programs such as McNair, MARC-U\*STAR, or other TRIO support programs. If instructors give students at least a year to plan for a similar experience, the financial burden can be alleviated by spreading out payments or using financial aid. Some study abroad offices also offer scholarships.

Incorporating a special topics course that was dedicated to the field experience itself was critical in both preparing the students for the field experience (e.g., practice swimming and snorkeling) and developing the research projects more fully. While having the pre-requisite class of either comparative psychology or conservation biology with a laboratory course (iteration 1) was helpful, we found that students felt rushed and more overwhelmed trying to read all of the field study content and prepare a proposal at the same time as managing the rest of the course content in the first 8 weeks of the semester (**Figure 1** and **Tables 1–3**). This iteration was not conducive to creating publishable data (i.e., insufficient data collection period, minimal manuscript preparation time). By requiring a two-course sequence with recommended pre-requisite classes/experiences (e.g., statistics, research methods, comparative psychology, conservation biology, relevant research experience), the second iteration was more successful in creating projects that were potentially publishable. Even with the changes employed in iteration 2, we still had issues with students having sufficient data for a publishable manuscript.

Becoming engaged in a research project, having the time to devote to sufficient data collection, and then writing a publishable paper on an original research project is extremely challenging for upper-division undergraduates in general, and especially at schools with characteristics such as ours. Having the second full semester allows the students to develop their projects more formally for the potential to publish in an external research journal, if they collected sufficient data during the field study. In response to these two experiences, our next iteration will involve a three-course sequence with the field study and data collection experience occurring immediately after the spring semester rather than immediately before the fall semester. The first course will be either comparative psychology or conservation biology, which will be the pre-requisite courses to enroll in the field study special topics course the following semester. These are courses that also count toward their major degree requirements and do not add to their degree load. These pre-requisites will allow the students to learn and practice methods they may implement in their research projects while also learning about different research topics. The second course will involve preparing a research proposal and data collection methodology. Students will be allowed to work in groups and prepare a group research proposal, so that during the field immersion experience they

have the opportunity to collect more data than was possible during our previous two iterations. Within this semester-long -field-study course, students will also acquire more comfort with swimming, snorkeling, and data collection techniques to be employed in the field, which was a highly recommended component of our second iteration. Following the second course and the field study experience, the third course will mirror the second course format in our second iteration, and all the students will analyze their data and prepare manuscripts for submission to an appropriate journal and/or conference. All students within each research group would serve as authors (arranged alphabetically by last name) on any papers or presentations that result from the research. Although it may take a little time to set up, we believe this model would be the most efficient process to produce publishable undergraduate research.

One other model that we are currently considering that may facilitate undergraduate research projects into publishable formats is to have student groups use data on three or four previously established projects with reliable and validated protocols, but develop and test their own novel hypotheses while adding to the existing data archive. Whichever path one selects, an immersion field study, such as the one we have conducted, exposes students from all backgrounds to the advantages and disadvantages of conducting field research while increasing their confidence and beliefs in their ability to conduct effective and meaningful research that is ultimately publishable. Adequate preparation through a research-based curriculum and sufficient time collecting data and refining methodologies are key to producing publishable research for undergraduates.

## ETHICS STATEMENT

Students gave permission to share their anonymous responses and approval to conduct the study was granted by St. Mary's University Institutional Review Board.

## AUTHOR CONTRIBUTIONS

HH initially drafted the manuscript, co-taught the field study, one class, and collected and analyzed the data for the original study cited in this study. MK edited the manuscript, co-taught the field study, one class, and analyzed the data for the original study cited in this study.

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# Where in the World Is This Research Taking Us? Collaborating on Publishable Research With Undergraduates Abroad

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**Keywords:** research collaboration, undergraduate students, abroad, publishing, field study

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The value of undergraduate student-faculty collaborative research has been well-documented in recent years (e.g., Hernandez et al., 2018), and as more colleges and universities recognize this, the models by which it is accomplished have become more varied. Some students engage in collaborative research with faculty at their home institutions while others spend the summer months researching at an institution other than their own. For students in the latter category, engaging in collaborative research away from one's home institution often exposes students to a greater variety of research questions and methodologies and facilitates the development of a professional network that often leads to important opportunities and future career success. In our research, we take this idea a step further by offering students the opportunity to conduct a research project in another country. This model of undergraduate collaboration aims to develop a more experienced, agile student researcher with a broader world view and a strong sense of global citizenship. In this paper we describe the benefits and challenges of collaborative research while abroad, through the lens of our own field research with students conducted over the past 10 years studying green monkeys on the Caribbean Island of Barbados.

## BENEFITS OF COLLABORATIVE RESEARCH ABROAD

Conducting collaborative research abroad presents both benefits and challenges to students and the faculty who mentor them. It has all of the characteristics associated with collaborative research in general, plus a host of additional attributes rooted in being immersed in a new and sometimes unfamiliar environment with new people, opportunities, expectations, and challenges that push students out of their comfort zone. For these and many other reasons, student-faculty collaborative research abroad has all of the advantages of study abroad—it enhances creativity (Godart et al., 2015), stimulates new ideas (Tadmor et al., 2012b), and improves communication skills (Marcotte et al., 2007). Moreover, study abroad has a lasting impact on student skills that directly impact their success in STEM-related fields—improved confidence and social competence (Walsh and Walsh, 2018), tolerance to ambiguity (Vande Berg et al., 2009), autonomy (Marcotte et al., 2007), critical thinking skills (Savicki et al., 2004), and cognitive flexibility (Tadmor et al., 2012a). In these ways and many more, experiences abroad are more likely to be transformative for students compared to traditional on-campus classes (Stone et al., 2017).

## GENERAL CONSIDERATIONS AND PREPARATIONS FOR FACULTY MENTORS

Whether traveling alone or with students, one must weigh pros and cons and anticipate inherent challenges before taking on research in another country. There are considerable time lags to

consider when acquiring travel documents (e.g., passports, travel visas), and many countries require special research permits and/or restrict the use of specialized research equipment. Moreover, dealing with two sets of bureaucratic requirements (e.g., U.S. and host country's IRB or IACUC) can be both time consuming and labor intensive. We recommend addressing these details, and others such as transportation, research site availability, and access to equipment and supplies as part of long-term planning. These tasks can be undertaken after arrival but anticipating and overcoming known challenges prior to departure maximizes productivity while abroad. Similarly, establishing a relationship with a researcher in the destination country is highly recommended. They will likely be more familiar with government offices, local requirements, and regulations regarding your planned activities.

## PREPARING STUDENT RESEARCHERS FOR LIFE ABROAD

When taking undergraduate research assistants abroad, the research mentor assumes more responsibility for the students' well-being than would be the case when conducting research at one's home institution. Thus, it is essential that great care is taken, and more refined criteria employed, when selecting research assistants for travel. In addition to academic preparedness, consider the applicants' emotional stability (including their penchant for drama) and potential for engaging in risky behavior since mental health counselors and other campus support services are often unavailable while abroad. One must also consider health and well-being challenges associated with the host country. Prior to departure, review government websites like the one maintained by the US Department of State<sup>1</sup> for current travel advisories. Vaccinations are required or recommended when visiting many foreign destinations. The Center for Disease Control Traveler's Health website<sup>2</sup> provides a comprehensive list of vaccinations, other medical precautions to take prior to travel, and recommendations on how to avoid common medical problems while traveling in your host country. As an additional precaution, identify the best source of medical care near your lodging and study site before medical issues arise and share these details with your students, including all available transportation options. You should consider purchasing travel insurance for yourself and research assistants (some institutions provide this). This relatively inexpensive investment covers many unexpected expenses, including medical emergencies, that may occur while researching abroad.

The research mentor should also spend time prior to departure preparing research assistants for cultural differences they are likely to encounter while abroad. We have found that discussing cultural differences before students experience them facilitates their assimilation into the new environment. Common customs, traditions, and behavioral norms and expectations should be discussed, including culturally-appropriate dress. College-age students are more likely to take risks while traveling,

and this can lead to "romantic encounters" with locals. Hence, it is best to educate your students about cultural differences in these interactions. For instance, polite discouragement may quell the advances of a suitor in one culture, but be interpreted as encouragement in another, resulting in a very uncomfortable misunderstanding, at best. Risk of sexual assault is much higher when traveling abroad (Kimble et al., 2013). Remind students of common sense safety measures instead of letting them surprise you with their naivety. Moreover, students tend to consume more alcohol while abroad compared to their drinking activity at home (Pedersen et al., 2010) which can potentially lead to alcohol-related problems (Hummer et al., 2010). Discussing dangerous drinking patterns can reduce alcohol use among college students (Cronce and Larimer, 2004) even during abroad experiences (Pedersen et al., 2017). Once safety and responsibility parameters are established, encourage students to embrace cultural differences and be open to new perspectives. Doing so will help students successfully navigate cultural nuances and better ensure a safe and successful research experience.

## TWO MODELS FOR COLLABORATIVE RESEARCH ABROAD

Once you have identified a good reason to conduct research in another country, there are two common models to consider. In one, the research mentor receives funding to support student collaborators and the research proceeds as a stand-alone project. In the other, research collaboration is embedded in a study abroad course led by the research mentor. Administrators looking to broaden study abroad opportunities are likely to view such a course very favorably since science and research courses abroad are relatively rare. With funding to support the project, a research mentor can focus efforts on the project and mentoring students through the research process. However, research budgets often provide support for only a small number of undergraduate assistants, thus limiting the amount of work that can be completed. In contrast, a study abroad course (ideally one focused on research methods) can be populated by capable students motivated to complete a research project for a grade. This is the model we have used with considerable success. In addition to traditional course requirements (e.g., assigned readings, presentations, exams), students in our Research in Primate Behavior course work in small groups on separate but related projects that are completed within a three-week winter or summer term. After the course has ended, we sometimes work at the study site with select research assistants for another 2 weeks. Although not necessary, this time is used to run additional studies, or collect additional data related to the student projects that have promise for publication. We have found these models, alone, or in some combination, very useful when collaborating with students on publishable research abroad.

Regardless of whether one's research abroad follows the funded research project model or the course abroad model, likelihood of publication will be increased if the research team is able to complete multiple related studies during the time abroad. Conducting multiple studies simultaneously may be easiest to

<sup>1</sup><https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories.html>

<sup>2</sup><https://wwwnc.cdc.gov/travel/destinations/list>

achieve by assigning each research assistant or group of students a different study to oversee. When preparing our students for their research abroad, we begin by introducing them to our overarching research theme (e.g., anti-predator behavior in isolated green monkeys) and to our previous findings (Burns-Cusato et al., 2013, 2016). Special emphasis is placed on gaps in the literature and potential future directions. This process introduces important considerations, pointing students in appropriate directions without stifling creativity. We then give students the opportunity to develop ideas in brainstorming sessions. This strategy allows students to derive their own research questions, engendering intellectual ownership and personal investment in *their* projects, not projects we have hand-delivered. At the same time, we carefully mold these student-generated ideas into a cohesive collection of important (and feasible) research questions, based on our own knowledge and experience. While it may be counter to traditional scientific practices, we have students come up with their initial research ideas prior to reading the literature as a means of maximizing creativity. We use our familiarity with the literature to direct them away from unnecessary replications of prior work and ineffective research designs. Only after research questions have been vetted and first drafts of research designs have been determined do we provide students with a starter set of relevant literature. They are then required to do an extensive literature search on their specific project. After reading several related articles, we bring the students back together, and as a group, refine experimental designs and procedures.

Prior to arriving in the host country, students should be trained to properly execute experimental procedures. The mentor should then carefully oversee the start of every study, helping students hone data collection skills. As is often the case with student-faculty collaborations, early data may need to be discarded as you help students work toward accuracy and autonomy. When the mentor is confident in the students' abilities to follow the research protocol, students can collect data on their own during the day while nightly teaching efforts shift to data coding, analysis, and interpretation. During this phase, we have found it helpful to the success of student projects and hence, the likelihood of publication, to conduct research team meetings

every evening. Here the research team reviews the progress of every project, including unexpected issues that occur during data collection or coding, how they may be addressed, and what preliminary analysis of the data has revealed. Examining the data during data collection is not typically a best practice, but when faced with time constraints, such analyses can reveal whether it is necessary to change methods or revise operational definitions before too much time is lost. Finally, we use these nightly meetings to review and discuss core concepts and emphasize the importance of every student's work to the overall research team and to the expansion of scientific knowledge.

## FINAL THOUGHTS

There are a few additional details to keep in mind before setting off on your research abroad adventure. First, carefully manage expectations for success. Unforeseen logistical challenges are likely, but overcoming these will provide invaluable knowledge in future excursions. Second, your research will not always go as planned. While this is true with domestic research, it is far more likely to be the case when you are working in an unfamiliar location and within a different culture. We encourage you to view these roadblocks as opportunities to step deeper into your host country's culture as you and your students interact with locals to help solve the problems you encounter. Overall, we are confident you will find research abroad a rewarding endeavor that expands student perspectives and skill sets, improves their ability to adapt to an ever-changing research landscape, and fosters ownership of their research projects. Ultimately, these outcomes will lead to success in publishing research findings.

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# Community-Based Research as an Alternative to Traditional Research Courses as a Method of Promoting Undergraduate Publication

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**Keywords:** teaching-research, community-based research, engagement, publishable, undergraduate, research methods

Engaging undergraduate students in research that leads to publishable research is difficult at institutions of all sizes. At small colleges (those with a total enrollment of under 1,000 undergraduate students), it can be even more challenging. One method of addressing this issue is to engage undergraduate students with external community organizations who can provide the students with a larger and more varied data set than if the students conducted research on their own campus. Community-Based Research (CBR) is an effective alternative to teaching an undergraduate research methods course through the participation of off-campus (and sometimes on-campus) community partners (Mettetal and Bryant, 1996). Collaboration, critical thinking, and creativity on the part of both instructors and students are fostered to produce an engaging yet quality research experience. CBR also can be a successful alternative for engaging undergraduate students in publishable research that would be useful at colleges of all sizes.

CBR provides students with real-world experience of developing research and statistical skills along with other career-essential skills such as collaboration, critical thinking, application of knowledge, and social justice. Community partners and students work together to first identify a research topic. In forming a partnership with an academic institution, community members, faculty, and students work together as a research team during all stages of the project—a more collaborative approach than the process in a more traditionally taught research course. Collectively, the research team frames the research question, operationalizes the variables, weighs research design alternatives, details sampling techniques to be utilized, collects and analyzes data, and disseminates the results of their work. By focusing on community-driven questions and ongoing collaboration, CBR provides maximum community input into each stage of the research process. Not only does CBR result in useful publishable data for the community partner and student researchers, but it provides students with the opportunity to apply their research skills in the “real world,” while also helping them learn how to act as socially responsible community members (Ingman, 2016). Research and statistics courses need not only help students develop quantitative reasoning, critical thinking, or problem-solving skills. When CBR involves external partners that are organizations focusing on social and cultural issues, students will develop skills to help them more effectively address issues in their local and/or global community. Consequently, findings of CBR studies are more likely to yield action-based outcomes and be sensitive to ethical concerns and the needs of diverse communities. CBR also provides these community partners, many of whom are non-profit organizations, with the assistance in collecting the data to evaluate their programs needed for continued and future funding opportunities.

At Pine Manor College (a “very” small college with a current total enrollment of under 500 undergraduate students in Chestnut Hill, MA), the Psychology program has been utilizing CBR for more than 10 years. Following this model, engaging in CBR and other types of community partnerships can provide opportunities for colleges of all sizes to have access to large data sets and to provide students with the opportunity for hands-on applied research in a non-academic setting. Given its inclusive nature, CBR holds tremendous promise for all involved by bridging the gap between scholarship and community needs. As collaborators in the research process,

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the community partners view the college as an ally rather than an esoteric institution that does not have relevance to their mission. Students enrolled in a research methods course that offers a CBR focus are provided with a powerful service-learning opportunity to apply classroom instruction to real-world problem solving while also developing the research skills that will be useful later in graduate school or in their careers. By drawing on the expertise of community members, students develop critical thinking skills while simultaneously gaining sensitivity to community needs (Chapdelaine and Chapman, 1999). The benefits of CBR also extend to other types of partnerships with these community organizations beyond the collaborative research experience for undergraduate students, including networking opportunities for future research opportunities, future internships, or post-graduate job offers (all of which have occurred for the students at Pine Manor College—"When I found my internship it was at Sportsmen's Tennis and Enrichment Center (STEC). It was convenient because I did research there for my Research and Statistics class," Psychology "17 senior portfolio quote").

## PROCESS AND OUTCOMES

The CBR experience at Pine Manor College involves a two-semester course sequence across the fall and spring semesters required of all Psychology, Community Health, and Sociology and Political Science majors. Throughout the year students learn about the typical components of the scientific method. The fall semester involves more of an introduction into the various research designs, data collection techniques, and descriptive statistics, with the major paper at the end of the fall semester being a research proposal. During the spring students learn more advanced statistics, and throughout the semester the student groups work with their community partners to refine their project, collect data, analyze the data, and report the data in various forms. A full research report and presentation are the end products of the spring semester. Part of the presentation includes an executive summary shared with the community partner at the end of the semester. Since the purpose of CBR is to create research that can result in positive social change for the community (Strand et al., 2003), students learn how to present results for different audiences. Students also complete a conference-style poster they present to the college community and later submit to a regional psychological association conference (since 2012, typically 100% of students in the CBR class presented at a regional psychology conference with the exception being the 2 years when someone in the Psychology department did not teach the course). By having a college work with the same community partner over several years, this model also can provide students with access to a larger database that could yield more robust findings submitted for publication not only at a regional conference but to potential journals. Below lists examples of the Pine Manor College CBR community partners over the past several years:

- Boys and Girls Club (Boston, MA)
- Transition House-Dating Violence Intervention Program (Cambridge, MA)
- Sportsmen's Tennis and Enrichment Center (Dorchester, MA)
- Dearborn Middle School (Roxbury, MA)

- Partners Hospice (Waltham, MA)
- Cape Verdean Mentoring Program (Roxbury, MA)
- Germaine Lawrence School – a residential treatment center for adolescent girls (Arlington, MA)
- Institute for Community Health (Cambridge, MA)
- The Second Step (Newton, MA)
- The Pine Manor Child Study Center (Chestnut Hill, MA)
- Brookview House—an organization that provides homeless services for women and children in Boston (Dorchester, MA)
- Town of Brookline's Office of Community, Diversity, and Inclusion (Brookline, MA)
- Steps to Success—tutoring program (Brookline, MA).

## LESSONS STUDENTS LEARN FROM THIS EXPERIENCE

The CBR model can be a positive and thought-provoking experience for the students and instructors providing both with insights and interactions with individuals they may not otherwise be aware of or interact with ("...this is another program that I would be really interested to work..." Psychology "18 senior portfolio quote"). There are many benefits to the CBR model for undergraduate students with the most important being that students develop the same research and statistical skills contained in more traditional courses and collect publishable data. Besides the benefits already discussed, some others include the following:

- Students present their projects at a variety of forum and to a variety of groups—the college community, community partner, regional psychology conference. By presenting to community partners (many being non-profit organizations), students learn to communicate science to individuals and groups who have committed themselves to organizations and missions that science could but does not often inform.
- Sometimes, the research topic can be related to a social issue that is personally relevant to the students, "... (the topic of the project)... was all something everyone in the group experienced," Psychology "18 senior portfolio quote."
- Students learn the important skill of how to coordinate student and community partner schedules and learn to communicate through various methods. Setting the expectations before the start of the project is essential to prevent miscommunication becoming an issue, and all can learn to function as one team, "Good teamwork is vital for research projects and working with community partners," Psychology "15 senior portfolio quote." To ensure effective communication from the start, when soliciting partners, it is a good idea to present them with a description of your program and its goals along with expectations of the partner and questions for the partner to consider before their agreement. Setting a timeline for check-ins between the partner and group/faculty sponsor is also an important element for success. If the partner sees themselves as co-educators in this process, they are more likely to invest in the process and provide helpful feedback to the students throughout the project.
- Students learn about the importance of confidentiality and privacy issues with the collection of data. If the community partner is a non-profit organization that works with a clinical

population, undergraduate students may not be able to collect the data themselves. Effective communication and support from the community partner will alleviate this issue as many community partners typically collect data within their organization, "...we also learned about confidentiality when receiving information that is disclosed from others...it's important that you keep it that way," Psychology "15 senior portfolio quote."

- Students engage in self-reflection related to the research process as well as to the topic researched, "We needed to analyze our own assumptions as well as the assumptions of our participants when organizing the survey questions and study. Understanding that we could not include certain questions because of the younger participants in the group was just as important to our research as making sure we did include more difficult questions for teens... we respected the perspectives of our partners and the participants to show the other side," Psychology "16 senior portfolio quote."
- Along with research and statistical skills, students develop a sense of civic engagement and social justice that may not be possible in more traditional "shelf-research" undergraduate projects. This may influence the students to pursue future work with the same community partner, "We demonstrated social responsibility by participating in an afterschool program research for the younger generation to promote their interest in reading and education. I particularly got very involved and decided that I wanted to become an intern at the program," Psychology "12 senior portfolio quote."
- Evaluation is critical to ensure that CBR is successful for the students and partners. In the Pine Manor College CBR courses, the research process and group members are evaluated by the instructor (through their paper and group participation grade), as well as by peers, and the community partner. Community partners are also asked to reflect upon their experience at the end of the process to highlight what they perceived as successes as well as limitations and challenges.

## CONCLUSION

Engaging undergraduate students in the research and publication process is challenging at any college. At colleges that do not

have large research participant pools or active faculty research programs, the challenge is even greater. CBR presents an effective and engaging alternative to teaching research methods and provides students with the opportunity to conduct a research project that can result in a meaningful presentation and publication. At Pine Manor College, when seniors reflect upon their CBR experience in their senior portfolios (a graduation requirement that requires students to reflect upon the College's learning outcomes), almost all Psychology majors (92% over the last 2 years) mention how their CBR project allowed them to demonstrate their critical thinking skills, effective communication (written, visual, and oral), collaboration skills, citizenship and social responsibility, and application of knowledge. Students also describe how the experience helped them to develop a deeper understanding of their own cultural and global self-awareness, which will assist them in being more effective in their various future roles: "Being in those environments drew me out my comfort zone because it challenged me to find ways to improve these adolescent's skills," Psychology "17 senior portfolio quote." An end of semester survey assessing students' perceptions of the class found that students felt that CBR was a better way to learn about the concepts of research methods and statistics because it was a more active approach ( $M = 4.62$  on a 5-point scale with higher numbers indicating more positive ratings). The benefits to this method of teaching research far outweigh the costs, as students are engaged in publishable research while also developing important skills that are especially important for those who wish to work in the psychology field.

## AUTHOR CONTRIBUTIONS

DM-G wrote the manuscript based on past experiences.

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# Balancing Needs in Publishing With Undergraduate and Graduate Students at Doctoral Degree-Granting Universities

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**Keywords:** publishing, mentoring, writing experience, undergraduates, graduate students

## INTRODUCTION

Professors at doctoral-degree granting universities tend to focus on publishing with graduate students more than with undergraduates. While we argue that publishing with undergraduates is worthwhile, we first want to point to organizational structures that contribute to the focus on graduate students. First, the hierarchical structure of doctoral universities can make publishing with undergraduates more difficult. Although it is often possible to delegate mentoring of undergraduates to graduate students, faculty have primary responsibility for mentoring graduate students (Espinoza-Herold and Gonzalez, 2007; Ynalvez et al., 2014). Direct faculty mentoring of graduate students is necessary because success in obtaining postdoctoral positions, faculty appointments, and research-related employment is highly dependent on publishing with mentors while in graduate school (Hartley and Betts, 2009; Casanave, 2010). Second, compared with undergraduate programs, graduate programs tend to provide more field-specific knowledge, greater depth of study, and increased focus on conducting research (Mangematin, 2000; Austin, 2002; Hakala, 2009; Northwest Commission on Colleges Universities., 2018). A graduate student's knowledge of the subfield can make publishing with graduate students less time consuming. Third, faculty at high research activity universities are under considerable pressure to publish frequently and in high-impact journals (Nir and Zilberstein-Levy, 2006; Burks and Chumchal, 2009; Rizzo Parse, 2009; Everett and Earp, 2015), which makes publishing without students tempting. Nevertheless, publishing together can be rewarding for faculty, graduate students, and undergraduate students.

## REWARDS OF PUBLISHING WITH UNDERGRADUATE STUDENTS

Despite the understandable pressures to focus on graduate students, publishing with undergraduate researchers can be uniquely rewarding for faculty members (Kardash, 2000; Burks and Chumchal, 2009; Styles, 2009; Hartley, 2014). For example, engaging with undergraduate researchers sometimes reminds faculty of the curiosity they had as beginning researchers (Styles, 2009; Shanahan et al., 2015; Bathgate and Schunn, 2017). Several faculty researchers have noted that it is rewarding to train a new generation of researchers. Passing science on to undergraduate student researchers by writing and publishing with them plays a fundamental role in bringing new minds through the ranks (Burks and Chumchal, 2009; Lopatto, 2010; Rogers et al., 2012; Urias et al., 2012).

It is also true that the undergraduates who work directly with a faculty member tend to rate these experiences as highly beneficial (Hunter et al., 2007; Lopatto, 2010; Shanahan et al., 2015; Heiden, 2018). Research experience allows undergraduates to determine if they like research.

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Since writing and publishing are difficult, a student who can publish has strong evidence of their interest in research, persistence, and writing ability. In addition, writing about research can help undergraduates feel pride in contributing to scientific knowledge. Should the student apply to graduate school, the qualities they gain by doing and writing about research will be highly valued by admissions committees and graduate school mentors (Huss et al., 2002; Kierniesky, 2005; Burks and Chumchal, 2009).

## SUGGESTIONS FOR PUBLISHING WITH UNDERGRADUATE STUDENTS

Although publishing with undergraduates can be challenging, we (a lab director, graduate student, and former undergraduate research assistant) share strategies we have used while mentoring 130 undergraduate and six graduate student researchers over the past 5 years, with approximately 25 students participating in the lab at a time. We developed these suggestions with input from current and former undergraduate and graduate students. In short, we suggest that faculty provide a mentoring structure, recruit effectively, prepare research assistants, teach writing skills, set clear expectations, and employ graduate students wisely.

### Provide a Mentoring Structure

As might be imagined, in a large and productive lab, keeping track of everyone's projects and assignments can be challenging. To ease the faculty member's load, we suggest using a modified hierarchical structure for mentoring (Wilson et al., 2012; Newman et al., 2015; Shanahan et al., 2015). This structure usually involves graduate students mentoring undergraduates, which allows undergraduates to get many of their questions answered while graduate students gain experience in providing mentoring. We modify this approach by suggesting that faculty also interact directly with undergraduate researchers in key areas of impact. For example, we work in small groups with motivated and trained undergraduate research assistants to complete conference presentations and writing projects. We meet weekly or bi-weekly to discuss issues and make writing assignments (including for the faculty member). This approach has the benefit of maintaining faculty-undergraduate interaction while also saving some faculty time. I (RAL) have successfully used this approach to co-author with students on approximately 70% of my publications (see vita at <https://fhssfaculty.byu.edu/FacultyPage?id=lbecky64>).

### Recruit Effectively

There are other aspects of publishing with both graduate and undergraduate students that faculty researchers might want to consider. First, it is important to consider how to go about recruiting research assistants. Whatever skills a faculty member wants a research assistant to have must have been acquired or taught in previous research experiences, in courses, or by the faculty member or lab staff. Faculty members should also decide if they want to wait for students to seek them out or if they prefer actively recruiting. If the faculty member opts for actively

recruiting, some possibilities include announcing openings in their courses or emailing all current psychology majors. A course on preparing for graduate school, if offered, will be a promising source for recruiting students interested in research and publication. We have also had good experiences recruiting undergraduates who have recently completed a research methods course. If you do recruit, be careful not to overlook women and minorities, who are less likely to approach professors to ask about working in their labs (Chan, 2008; Hurtado et al., 2011). We have recruited more diverse research assistants by advertising that, "all students interested in research, including women and minorities, should apply." Even if you do not actively recruit, consider providing a statement on your faculty webpage indicating what interested undergraduates should do and providing a link to any application you would like them to complete (see the application at <https://cogdevelopment.byu.edu/Pages/home.aspx>). Having instructions and applications ready can simplify the process when students express interest in to working in your lab.

### Prepare Research Assistants

If getting undergraduates excited about research motivates a faculty member or graduate student, they should consider the needs of undergraduates and what will help them prepare for research careers. As mentioned above, undergraduates are often missing background in the faculty researcher's field, which can put more pressure on faculty at doctoral universities. During lab meetings and small-group meetings, we have provided general advice, including how to impress a potential reference letter-writer, deal with writer's block, develop time-management skills, and give 3-min summaries of their research projects. Undergraduate researchers may also need help understanding how researchers develop research ideas and designs to test them. These activities often seem mysterious to undergraduates and need to be made explicit (Wei and Woodin, 2011; Hampden-Thompson and Sundaram, 2013). Making research practices more explicit can prevent frustration and encourage undergraduates to become more involved and excited about research. The same is true for how to approach writing, for example, an introduction section. Making transparent whatever steps you take in these tasks (regardless of whether your processes are like other researchers'), can help undergraduates understand one way they can approach these tasks.

### Teach Writing Skills

Undergraduates often lack the experience in writing that graduate students have (Burks and Chumchal, 2009; Shanahan et al., 2015) and many do not learn about discipline-specific writing until they take an advanced writing course (Emerson et al., 2006; Grzyb et al., 2018). To help develop discipline-specific writing skills, we have had undergraduate researchers develop mini-research proposals and empirical reports (one page) on subsets of projects from the lab and present these at lab meetings. These follow the Introduction, Method, Results, and Discussion format (with Anticipated Results and Conclusion replacing the last two elements for proposals). Alternatively,

students may choose to present a simplified (one- or two-page) version of a faculty member's papers (i.e., a high-level summary of each section in an article) and discuss these in lab meetings. These activities may also help undergraduate researchers become more comfortable talking about research in a specific lab. While I acknowledge that other faculty members may engage in similar activities, a thorough review of all university library databases indicates that neither of these ideas has been discussed in the literature. Addressing the effectiveness of this approach in comparison to other approaches would be a good next step toward establishing best practices in writing with undergraduates.

## Set Clear Expectations

If you frequently publish with undergraduate students, word will get out. Undergraduates are frequently told in graduate school preparation courses that they need to present posters and publish manuscripts to stand out as applicants for graduate school. The advice they have received can make them eager to publish but not necessarily eager to engage with research more broadly. Therefore, we suggest that faculty members be clear about their expectations for involvement in other aspects of the lab and what qualifies for co-authorship on papers from the lab. If a student is not participating in research for course credit or as an employee (where expectations are often in writing), then a mentoring agreement can be helpful to clarify expectations. The mentoring agreement that we use was developed by our university general counsel in collaboration with our department (see <https://cogdevelopment.byu.edu/Pages/home.aspx>). The mentoring agreement defines mentoring as primarily for the benefit of the student, indicates data ownership, describes the right for either mentee or mentor to terminate the relationship with or without cause, and lists activities the mentee might be able to participate in (including, if desired, contributing to a manuscript). The mentee must acknowledge that there is no guarantee of publication or future employment. As advised by others, at least once a semester, we tell students what qualifies for credit in acknowledgments, co-authorship, and primary authorship (APA Science Student Council, 2006; Burks and Chumchal, 2009). Clear, consistent communication in these ways minimizes misunderstandings and makes students aware of the opportunities available to them.

## Employ Graduate Students Wisely

For researchers at doctoral degree-granting institutions, it is also important to decide how to employ graduate students wisely. Although graduate students going into academia will need

publications (Mangematin, 2000; Jalongo et al., 2014; Pennycook and Thompson, 2018), they may also need experience supervising undergraduates, who can help the graduate students on their research projects and publications. Undergraduates may find it easier to ask a graduate student some questions. Almost half of undergraduates in courses I (RAL) teach indicate that they feel more comfortable approaching a graduate student than a faculty member for help. However, they may feel neglected if the faculty member does not also take an interest in their work and get to know them. Therefore, it seems best to share responsibilities with graduate students in mentoring undergraduates.

## CONCLUSION

Faculty members at doctoral universities are sometimes hesitant to get involved in writing projects with undergraduate researchers. Undergraduates might have little background in the research areas of a faculty member and—due to less experience with writing—are also more likely than graduate students to need their writing extensively edited by the faculty member. Without minimizing the needs of graduate students for faculty mentoring or the challenges involved in mentoring undergraduate researchers, as a faculty member, I (RAL) nonetheless enjoy instilling excitement for research in undergraduates. As lab leaders, we try to remember that undergraduate and graduate students alike are often motivated by curiosity—which is a worthwhile attitude to encourage a new generation of researchers (Chin and Osborne, 2008; Gottfried et al., 2016; Bathgate and Schunn, 2017). Attending to different needs between student groups and involving graduate students in mentoring undergraduates can make researching and writing with undergraduates more feasible so faculty can support curiosity and still balance their own publishing needs (Haslam and Laham, 2009; Stanley et al., 2017).

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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# Engaging Community College Students in Publishable Research

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Community colleges in the United States of America provide their surrounding communities with completely open access, quality higher education opportunities at a fraction of the cost for a 4-year college or university. The average annual cost (tuition and fees in district) for community colleges is \$3,570, compared to \$9,970 for in-state students to attend a 4-year public college (College Board, 2017). According to the American Association of Community Colleges (AACC), 7.1 million students enrolled in community colleges for credit in the Fall of 2016, with another 5 million students enrolled for non-credit courses (American Association of Community Colleges, 2018a). To put these enrollment figures in perspective, 41% of all undergraduates in the U.S. (National Center for Educational Statistics, 2018) are being introduced to higher education by faculty members at a community college. The open access provided by community colleges confronts inequities observed in other sectors of higher education. For example, 52% of Hispanics, 43% of Blacks, 56% of Native Americans, and 40% of Asians and Pacific Islanders who enrolled in college in Fall 2015 attended community colleges (National Center for Educational Statistics, 2018). Thus, community colleges provide the opportunity to engage our most underrepresented students in educational and research activities.

As an academic administrator at a community college (Northwest Vista College; NVC), one of my main goals is to help students succeed in their academic journey—and their subsequent careers—by providing the highest quality experiential learning opportunities possible. An important type of experiential learning, especially for students in science fields such as psychology, is early exposure to research opportunities with passionate faculty scholars. Yes, I said passionate community college faculty **scholars**. While the teaching load is often heavy, and promotion and tenure requirements at community colleges focus less on scholarship than other higher education sectors, we have active researchers within our faculty who have found innovative ways to involve students in their scholarship. In this article, I explore several ways that we can best support the process of engaging undergraduates in publishable research at community colleges.

## FUNDING OPPORTUNITIES

My personal journey to become a scientist began with the opportunity to do research in a behavioral neuroscience lab and then present a poster of my work at the annual meeting of the Society for Neuroscience. I won't say how many years ago that was, but let's just say lots of spray glue was involved. That experience offered me the opportunity to speak with peers, mentors, and scientists from around the world about data and scientific methods. As a first-generation college student, I was fortunate to be afforded those opportunities through



scholarships, institutional support, and extramural funding at an R1 (Research 1 or highest research activity Carnegie classification) university. We can provide the same, or similar, experiences for students at Masters-granting comprehensive universities, liberal arts colleges, and universities... and community colleges.

Most professional organizations affiliated with psychology and neuroscience have scholarships, discounts, and other funding support for students and faculty to present at local, regional, and national meetings and to conduct original research in a variety of topic areas. For example, the American Psychological Association's (2018a,b) Grants, Awards and Funding page boasts more than 600 scholarships, grants, and awards sponsored by APA and other psychology-related organizations. Some opportunities are restricted to graduate students and postdoctoral fellows, but many of them are available to undergraduates and faculty members at any institute of higher education. Special attention should be paid to awards for military veterans and Division 19 (Society for Military Psychology), women and Division 35 (Society for the Psychology of Women), underrepresented groups, educators, and Division 2 (Society for the Teaching of Psychology). The Association for Psychological Science (2018a) also has grants and awards available, as well as links (Association for Psychological Science, 2018b) to other funding sources and psychological science organizations including the Society for Neuroscience (2018). Honor societies also support research and travel to conferences. Psi Beta, the national honor society for psychology at community colleges, has travel and research scholarships available to promote research conducted at community colleges at the annual APA conference (Psi Beta, 2019).

Some extramural funding opportunities are specifically designed to aid undergraduate research, STEM (science, technology, engineering, and math) fields, underrepresented student populations, and partnerships between community colleges and 4-year colleges, local school districts, government and industry, clinical practices, and other community groups. For example, the National Science Foundation's (2018) *Improving Undergraduate STEM Education: Hispanic-Serving Institutions (HSI) Program* requests proposals to improve STEM education at HSIs by bridging the transition between community colleges and 4-year institutions.

Grants from NSF also support research initiatives and conferences specific to community colleges through organizations such as the Community College Undergraduate Research Initiative (2019). Other funding opportunities, such as the U. S. Department of Education's (2018) Developing Hispanic-Serving Institutions (DHSI)-Title V program and the Howard Hughes Medical Institute (2018) encourage collaborations to further science and science education between colleges and universities, as well as K-12 schools and community organizations. Perhaps more important than providing the financial support that enables research and publication, these programs help students, particularly those coming from economically disadvantaged backgrounds, think of themselves

as scientists that can make meaningful contributions to their discipline.

## PRIORITIZING EXPERIENTIAL LEARNING

Funding from professional organizations in psychology and neuroscience are generally limited and competitive. To open up research, presentation, and publication opportunities for all students, institutions of higher education need to create a culture of support and funding for students, faculty, and staff that engage in these endeavors. Curricular and co-curricular activities can expose students to both the knowledge and skills necessary to produce publishable research in psychological science. Educators at all levels in higher education are recognizing the benefits of active learning inside and outside of the traditional classroom, getting away from the "sage on the stage" model of teaching (e.g., Bowen, 2012). Some techniques include the flipped classroom (i.e., delivering content outside of class via online content and readings, then doing activities, and "homework" in class), cooperative learning (i.e., small groups of students working on a common task), and problem-based learning (i.e., students experience a subject by solving an open-ended problem found in designated material; for a review, see Davidson et al., 2014). Such active forms of learning lay the groundwork for the types of inquiry required to conduct publishable research.

When traditional laboratory experiences are not a reasonable option, embedding scientific reasoning, and critical thinking modules into introductory psychology courses can significantly improve the skills important for conducting publishable research. For example, Stevens et al. (2016) found that students showed significant gains in scientific reasoning after experiencing carefully planned lectures and discussion modules designed to promote scientific reasoning and critical thinking. Such curricular enhancements, paired with experiential learning activities, promote faculty and student scholarship.

## SCAFFOLDING COMMUNITY COLLEGE STUDENTS TOWARD PUBLISHABLE RESEARCH

Many community colleges throughout the U.S. are attempting to enhance experiential learning opportunities by adopting a holistic model for supporting student success—the guided pathways model (Bailey et al., 2015; American Association of Community Colleges, 2018b). The model's first two dimensions clarify paths to student end goals and help students choose and enter a pathway (American Association of Community Colleges, 2018b; Community College Research Center and American Association of Community Colleges, 2018). The third and fourth dimensions help students stay on a path and ensure that students are learning. One of the essential practices under the third dimension is to embed academic and non-academic supports to promote student learning and persistence. Dimension 4 integrates applied learning experiences—such as research experiences—to enhance student success in courses



across programs of study. Although the main goal of the pathways approach is to ensure that students complete an educational path and earn a credential, the model has the added benefits of exposing students to scientific inquiry and hands-on activities early in their careers, laying the foundation for success.

Within NVC's community college system, district leadership (board and administration) has funded many experiential and applied components of the guided pathways model. These resources and emphasis on experiential learning encourage our faculty to design new ways to engage students in original research and enable students and faculty to present their scholarly projects. Further, we invite speakers to campus for talks about their scientific and applied projects, and develop internal events (e.g., Psychology Day) and community outreach events (e.g., Sci-Tober, a showcase of various science disciplines to current and incoming students).

At this point, you may be convinced that community colleges can lay the groundwork for developing the skills needed to produce publishable research at a 4-year institution. Yet, you may be skeptical that community college students can actually produce publishable research. They can and they do. For example, Dr. William Altman of SUNY Broome Community College teaches a psychology research capstone where students "perform original research in psychology, to produce professional publications or presentations" (Altman, 1995). The prerequisites include Introductory Psychology and College Writing—not statistics nor research methods. Although some disciplinary research would require students to have developed additional content, statistical, or laboratory skills (e.g., neuroscience), community college students can produce publishable research under the mentorship of innovative and dedicated professors.

## ENCOURAGING AND RECOGNIZING STRONG MENTORSHIP

Kimberly Bress, a recent winner of the Barry M. Goldwater Scholarship (a prestigious award for sophomores and juniors planning on research careers in STEM fields), offered one piece of advice to undergraduates who are thinking about doing lab research: "...find a good mentor—someone who answers your questions and really engages you in the research process." (Society for Neuroscience, 2017). Don Lucas, NVC's Psychology Discipline Coordinator, described his process for engaging students in research in a recent newsletter article for the Southwestern Psychological Association (Lucas, 2018). He recruits students who possess drive and curiosity—not

experience and a strong GPA. After completing ethics training, teams of students create testable hypotheses. Lucas then teaches students how to conduct literature reviews and read scientific articles. Students collect their own data and present their findings. Lucas and his colleagues regularly publish and present with undergraduates, and might engage even more students with the implementation of the guided pathways model described above.

## CONCLUSION

Forty percent of all first-time freshmen attend community college in the U.S (National Center for Educational Statistics, 2018). To engage more undergraduates at community colleges in publishable research, we need to increase resources, build research culture (perhaps embedded into the curriculum), and support faculty mentors. Increasing those resources may mean lobbying the local community and legislature to support more bond initiatives and state funding, convincing college administrators to provide more development opportunities and course release, and pursuing external grants. Building a research culture can grow from faculty and student journal clubs, co-teaching, college awards, hosting student research conferences, attending professional conferences, and co-curricular programming. Finally, it is important to encourage and reward faculty who mentor students. Community college faculty and staff are passionate about changing our students' lives. Building a foundation of scientific inquiry and writing in psychology at community colleges prepares students to conduct and publish original research while attending community college or beyond.

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The author confirms being the sole contributor of this work and has approved it for publication.

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# Undergraduate Research Assistant Leadership for Rigorous, High Quality Research

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**Keywords:** undergraduate research experience (URE), undergraduate publication, teaching-research, study drugs, qualitative research and education, teaching faculty

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Undergraduate research is an important experiential learning opportunity. Abundant previous work has outlined the benefits of research experiences for undergraduates (e.g., Landrum and Nelsen, 2002; Lopatto, 2004, 2007; although also see Linn et al., 2015). These include refinement of critical thinking skills and clarification of career goals (Seymour et al., 2004; Russell et al., 2007) as well as enhanced motivation to complete academic programs (Graham et al., 2013). Such benefits are found throughout science, engineering, and mathematics (Rodenbusch et al., 2016), particularly in underrepresented groups (Nagda et al., 1988; but see also Lopatto, 2004). The benefits to students seem clear, but what about the benefits to science? Can undergraduate research projects lead to data that is rigorous and worthy of publication? As a teaching stream faculty member at a research-intensive university, my lab consists solely of undergraduate research assistants. Allowing my students to take a leadership role over their projects, particularly projects involving controversial or sensitive topics, has proven to be an effective method, albeit a time intensive one, for generating high quality data.

## ENGAGING UNDERGRADUATES IN PUBLISHABLE RESEARCH AS TEACHING STREAM FACULTY

Teaching-focused positions have consistently been present at research institutions in relatively small numbers; fairly recently, “teaching stream” positions have become of growing interest in Ontario (Sanders, 2011). These positions are centered around teaching, with service rounding out the responsibilities. While no specific expectations regarding research are detailed for these positions, mixed into teaching is both pedagogical and discipline-specific research, ideally involving undergraduate research assistants. Financial support for research endeavors of teaching stream faculty is provided both at the level of the department (e.g., start-up funds), as well as the division (e.g., Faculty of Arts and Science’s Teaching Stream Pedagogical Grants). My department has additionally supported the research endeavors of its teaching stream faculty by providing us with a shared lab space. We are under no pressure to obtain large, federal grants to support our research endeavors (although obtaining funding from the university or outside sources is encouraged).

The intention behind research pursuits of teaching stream faculty is to further education, either by providing undergraduates with authentic research experiences or by systematically examining pedagogical practices. Engaging students in formative educational experiences is the primary outcome for undergraduate research at research universities (Ash Merkel, 2003). While publishing is encouraged for teaching stream faculty, it is generally seen as a mark of educational leadership rather than a necessary step for advancement, as it is viewed in the research stream. Under this framework, teaching stream faculties typically have a great deal of freedom in the type of research pursued with undergraduate research assistants. This freedom allows for potentially greater input from our undergraduates in determining the direction of our research and, ultimately,

our publications. Teaching stream faculty can also publish by collaborating with research stream colleagues in the supervision of undergraduates performing work in larger labs, typically in conjunction with graduate students or post-docs (e.g., Abela et al., 2019).

My own lab's research pursuits and publications, however, are entirely fueled by undergraduates. How to best mentor research students, balancing faculty professional directives and student educational goals, is not formally taught at universities, with rare exceptions (e.g., Pfund et al., 2006). In reflecting upon alternatives in setting up a lab, one option would be to structure projects for students before they enter the lab and to guide them through the process. I have chosen to go a slightly different route. While I typically suggest students focus within a certain realm of inquiry (currently, study drug use on campus), I believe the development of their own questions and methodologies serves both as an enriching learning experience, as well as a benefit to their research, more likely leading to publishable data. Indeed, I place a high value on the data generated by my students, as they are heavily invested in the integrity of their results.

## WHAT CAN UNDERGRADUATES DO?

This is an interesting question, which can be framed in one of two ways. On the one hand, we can consider “what can undergraduates do, anyhow?” From this perspective, we can come up with a list of weaknesses of undergraduate researchers compared to graduate students. There are many. Undergraduates have less experience than graduate students. They have fewer statistical tools under their belts and a weaker understanding of the field of research in which they are engaged. They have less time during the term to devote to research. Undergraduates will also be in a lab for a shorter window of time than a PhD student. This makes having continuity in the lab quite difficult and requires the principle investigator of the lab to engage in the vast majority of hands-on training. It is no wonder that research stream faculty, whose careers are defined primarily by their publications, tend to rely on graduate students and post-docs for producing publishable research. These more senior students and researchers in the lab can also serve as managers of the undergraduates, who may be more highly involved in running experiments rather than designing them (e.g., Weldon and Reyna, 2015), although a subset of research faculty, particularly junior faculty (Ash Merkel, 2003), directly mentor undergraduates, as well (Thiry and Laursen, 2011).

On the other hand, we can frame this question as, “what can undergraduates do that no one else can?” Undergraduate research assistants will have insight into campus culture that could remain otherwise opaque to faculty and graduate students. This insight could help lead a research project related to student behavior down a novel and ultimately fruitful path. Further, having a peer lead a study on a sensitive or controversial topic can put participants at ease, and could arguably lead to more valid data. For example, one of the first projects out of my lab (London-Nadeau et al., 2019), involved my undergraduate research assistants running focus groups on the use of study drugs on

campus. Study drugs refer to the use of prescription stimulants by those without a prescription for academic purposes. The undergraduates leading the project entered into my lab with little scientific knowledge about this topic; we spent a good deal of time meeting weekly to discuss papers. We concluded there was very little known about use at our institution and determined that focus groups would be a good starting point.

## STRENGTHS OF UNDERGRADUATE RESEARCH ASSISTANT LEADERSHIP

This is where the benefit of research assistant leadership shines through. I could not have led those focus groups, for both ethical and practical reasons. Ethically, there is a decent chance one or more participants would have been students in one of my classes. This would present a conflict in my dual roles as a teacher and a researcher. Knowing about illegal behavior of students in my classes could potentially bias my view of them, which could implicitly affect my evaluation of their performance. This teacher-researcher conflict is of great interest at my university, in regards to not only research on sensitive topics, but also on all pedagogical research projects. While traditional research practices allow us to provide “treatment as usual” in comparison to a new intervention that we believe to be superior, pedagogical research ethics dictate that we cannot withhold a pedagogical intervention we believe to be superior from a subset of our students (MacLean and Poole, 2010 for discussions of the ethics of classroom research; see Healey et al., 2013). While there are still ways to perform controlled, classroom-based pedagogical studies, the standards for ethical approval for these types of studies are higher than for lab-based studies (Martin, 2013 for helpful guides to navigating the ethics review process for classroom research; see Linder et al., 2014). Also, practically speaking, students would have been less likely to be open in a discussion about illegal behavior with a professor present. Even graduate students would have set a more formal tone than having peers running these focus groups. This concern holds true for both teaching and research stream faculty research pursuits involving sensitive topics, in particular.

In consideration of these factors, I needed to rely on my research assistants to be able to direct the conversation and make judgment calls about when to move on to a new topic. They needed to have a firm understanding of issues surrounding study drug use, as well as focus group methodology. The best way to ensure this high level of competency was to have these undergraduates take a leadership role in the development of this project. They understood the previous research surrounding the topic, as well as why each question was being asked, as they had developed the questions, themselves. They were better equipped to think on their feet, which is required for a successful focus group.

After data collection was complete, the undergraduate leading the project learned how to use software specific for coding and analyzing qualitative data. She then trained the other research assistants on the coding process. Writing up the results of this study and submitting for publication

was a process that continued after her graduation. However, there was no question she would continue working toward publication. This was her project; she was invested in it. This leadership role directly helped with publication, as this student completed the data analysis and the first draft of the write-up, with guidance. As a pre-tenure professor (technically, “pre-promotion” for teaching stream faculty), my teaching and service commitments would have restricted my ability to complete these last steps independently. I would not expect the same amount of dedication to the project from an undergraduate taking a more ancillary role to the intellectual development of the project.

## POTENTIAL WEAKNESSES OF UNDERGRADUATE RESEARCH ASSISTANT LEADERSHIP

There are potential weaknesses of this model worth considering. When given the freedom to design their own projects, undergraduates may gravitate toward a wide range of topics, some of which may be outside of the faculty member’s expertise. While supervising students on a range of topics is possible, the most productive mentor relationship would be when the student is working on a topic within the area of expertise of the faculty member. This scenario can be encouraged by the faculty member early on, by guiding the student to explore research possibilities within a specific field through journal club-like readings and discussions. This type of mentorship is similar to the mentor-as-sculptor model discussed and evaluated in another article in this special issue (Holmes and Roberts, in press). This could also be helpful to research stream faculty who are taking on undergraduate students for individual projects. As research

stream labs quite practically focus on a subset of questions whose exploration is being funded through grants, the undergraduate researchers in the lab would be best advised to focus on a topic directly related to those broader laboratory pursuits. This can be initially instantiated by the faculty leading the lab, though should also be bolstered by other members of the lab (e.g., graduate students and post-docs) with whom undergraduate researchers tend to spend more time and to develop a mentoring relationship (Behar-Horenstein et al., 2010; Weldon and Reyna, 2015).

## CONCLUSIONS

In sum, allowing the time for undergraduates to take ownership over a project can enhance the quality of their research endeavors and facilitate the production of publication-worthy data. To best position undergraduates for success, allocate time early in the term for discussing literature related to the area of expertise of the principal investigator of the lab. Examine recent results, compare current theoretical models, and explore what questions remain unanswered. Remain patient throughout the iterative process of providing feedback on the student’s proposed research ideas that will likely need to be reigned in, both in terms of complexity and expense. Once a research question and methodology have been agreed upon, the undergraduate researcher will still require close mentorship throughout the study, but will be in a strong position to take on a leadership role, remain invested in its completion, and produce reliable data, worthy of publication.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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# How Pre-tenure and Tenured Faculty Can Engage Undergraduates in Publishable Research

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Differences in career stage may influence work stress and job satisfaction (Olsen and Crawford, 1998), which in turn can impact attitudes about recruiting, managing, and mentoring undergraduates in publishable research endeavors. Written from the perspectives of a pre-tenure faculty member (i.e., in 4th year) at a primarily teaching institution (PTI) and a tenured faculty member (i.e., in 38th year) from a large research university (RU), this paper discusses obstacles faced by professors at different career stages and institutions while working on publishable research with undergraduates as well as strategies to overcome these obstacles.

## PRE-TENURE FACULTY

Early career psychologists (ECPs) are faculty members working in their academic position within 7 years and have not obtained tenure (Keeley et al., 2013). For ECPs in RUs/PTIs, an important first step is to ask senior faculty how mentorship and publication fit with the department's expectations (Crawford, 2013). In PTIs, the pressure to "publish or perish" is not as salient as in RUs; however, ECPs are still eager to collaborate and publish with students for various reasons. One motivation is to include publications in their evaluation portfolio.

However, ECPs may not have much experience with publishing in general. One strategy to increase their knowledge of the publication process and the quality of writing required by journals, ECPs can read resources tailored to writing publishable research reports (e.g., Carver, 1984; Fallon, 2016). To boost their publication knowledge as well as enhance their portfolios, ECPs can volunteer in journals with open calls for reviewers, with some (e.g., Psi Chi, 2018a) not requiring any publication experience. This may have an added benefit later on in that being a reviewer for a journal may lead to increased confidence when mentoring a student who is publishing in that journal.

As an extension of their publishing inexperience and because they may not have a reputation at their institution, ECPs may have trouble finding students to work with on publishable research. In RUs, projects are often mentor-centered and students may take on roles as research assistants. Thus, a strategy for ECPs in RUs and PTIs is to recruit students directly from the courses they teach. ECPs can also reach out to colleagues and have them send students their way. In PTIs, projects are often student-generated and perhaps faculty mentors do not have course releases to do research nor have research labs. Thus, a strategy is to seek out advanced graduate-school bound undergraduates (Starke, 1985) such as those in capstone courses or honor thesis classes and encourage them to collect data and publish their work with the ECP as mentor.

However, ECPs (perhaps due to their eagerness and inexperience) may have uninformed expectations. ECPs may trust senior-level honors students to complete tasks without much involvement, due to the expectation that these students possess a positive attitude, emotional

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maturity, and strong work ethic. However, students may not match the expectations nor demonstrate the behaviors needed for the publication process, so there may be disappointment, anger, and regret when a project does not get published. One strategy to clarify expectations/behaviors is to develop written research learning contracts (Mabrouk, 2003) which clearly describe and may include the objectives of both parties, the tasks involved, deadlines when tasks are due, what happens if deadlines are not met (e.g., will the project continue after graduation?), what behaviors are expected on both ends (e.g., how soon should emails be answered?), and what happens if behaviors are not demonstrated (e.g., how will this impact letters of recommendation?). Another strategy to set the stage from the get-go is to write an open letter (McGuire, 2008) to any potential student outlining expectations/behaviors. If a student is taking a course in which a publication-ready manuscript is the end product, a clear rubric (Clabough and Clabough, 2016) can outline tasks related to publication (e.g., read submission guidelines) as well as expectations for conduct (e.g., asked questions in a timely manner).

Another issue related to student expectations/behaviors is that ECPs may not yet have adopted their own managerial style (Crawford, 2013). They may not have learned the necessary skills in graduate school nor had enough opportunity to practice these skills. One strategy for learning a managerial style is to solicit input from senior colleagues, from within and outside the institution; and the earlier, the better (Ponjuan et al., 2011). Senior faculty can provide ECPs different models of what works best for them and for the institution when publishing with students (e.g., benefits of being more hands-off vs. more involved) as well as give concrete examples of what they did to help a student successfully publish their work. They can also direct ECPs to resources to help manage and mentor student researchers (e.g., Narendorf et al., 2015; Shanahan et al., 2015).

Due to the pressure of evaluation and the desire to impress their students and colleagues, ECPs may take on too much, especially in the years leading up to tenure. Professionally, a strategy to boost both scholarship and *teaching* in their portfolio is to integrate their research in their teaching. One way is to incorporate the data collected from their publishable research as class exercises on data analysis, APA style, ethics, etc. Another way is to teach courses that may provide the perfect arena for generating research based on the course content or the structure of the course, which then could spurn student interest in research and eventually recruit mentees. A strategy to boost both scholarship and *service* in their portfolio is for ECPs to become student organization advisors. An ECP can encourage students who have high academic standings such as those in Psi Chi (Lechago et al., 2009) to work together on a publishable research project. Personally, ECPs may feel that they need to prove their worth to others and thus, they may take things personally and believe that what their students do or do not do (i.e., successfully publish or not) is a reflection on their ability or ineptitude. One strategy is to reach out to peers, either within and/or outside the institution, who are trustworthy and like-minded. With this support system, ECPs can be honest about personal and professional challenges,

commiserate on like experiences, and brainstorm solutions to problems. If talking about sensitive issues with colleagues within the department/institution is uncomfortable, another strategy is to participate in a formal mentoring program (e.g., Finley, 2018) and discuss the aforementioned issues with more seasoned mentors outside the institution.

## TENURED FACULTY

Late-career faculty (LCPs) are faculty members working in their academic position for 20 or more years and have achieved tenure (Baldwin and Zeig, 2013). In RUs and some PTIs, post-tenure review serves as a motivator for LCPs to continue to be engaged in teaching, scholarship, and service activities. In terms of scholarship, LCPs may have more time to work with undergraduates on publications by having course preparations done. They may also have existing data that need to be analyzed, and students may be more committed to working on a publication if they do not have to collect data from scratch nor go through the IRB process.

Due to their established network, LCPs may have increased connection to funding sources. Einarson and Clarkberg (2004) found that outside funding increased the likelihood of faculty including undergraduates in their research. However, funding sources (e.g., Society for the Teaching of Psychology, 2018) may disappear after the early career “clock” has run out or after one gets tenure. Thus, it benefits LCPs to know what funding sources are available to them regardless of career stage. For example, many conferences have undergraduate research awards and/or venues specifically designed for student presentations (e.g., American Psychological Association, 2018). Additionally, funding for student-led research as well as travel to professional conferences may be available from funding through student organizations (e.g., Psi Chi, 2018b). LCPs in RUs and some PTIs may have access to participant pool management systems (e.g., SONA) and/or online survey methods (e.g., SurveyMonkey) paid for by either internal funds or external grants, which can support data collection and save time.

Due to their experience, LCPs in RUs/PTIs may use their time more efficiently when engaging undergraduates in publishable research by choosing students wisely. LCPs at RUs and some PTIs who have lost funding for costly graduate assistants can fill this gap with highly trained and skilled undergraduates. If undergraduates are identified early in their college years, they will actually be available longer than master’s level students. As these undergraduates assist, a natural vetting process takes place. It is easy to identify those undergraduates who are organized, meticulous, timely, and committed to doing the job well and getting it done; and ultimately perfect candidates for co-publishing. In addition, LCPs in RUs/PTIs are probably more adept at instructing, guiding, scaffolding, and knowing when to cut their losses.

Since LCPs in RUs/PTIs may have demands on their time with more administrative and leadership responsibilities, they may not have as much contact with undergraduates, particularly if they are not teaching undergraduate classes. Strategies to overcome this

lack of contact include developing a website for their research lab (more likely in RUs) or listing their research interests and previously completed published projects on a faculty website. LCPs in RUs and some PTIs who developed research labs, that are layered with both undergraduate and graduate students at various levels of their college years, can provide valuable and sustainable mentoring to undergraduates who are interested in and capable of publishing. Thus, in RUs where LCPs may not be teaching undergraduates, often their graduate students do teach undergraduate students and may inform these students about the research that they themselves are involved with in the lab of their faculty mentor. In RUs/PTIs, another strategy is being a guest speaker for introductory courses and student organizations (e.g., Psychology Club) and emphasizing the importance of research productivity in the difficult challenge of gaining admission to graduate school as well as the advantage of research-related skills (e.g., collaboration, project management) in the workplace. Students can also be reminded that engaging in publishable research with faculty can lead to stronger letters of recommendation.

Some LCPs, despite systemic disincentives and heavy workloads, still decide to mentor undergraduates in the research process. Individuals with high levels of job satisfaction and a strong commitment to their place of employment are more willing to voluntarily engage in activities outside their specific job-related duties (e.g., mentoring undergraduate students) if they perceive it as having relevance to their work (Mamiseishvili and Rosser, 2010). For LCPs in RUs/PTIs, perhaps a strategy to have high job satisfaction is to think back to previous students and see how engaging in publishable research has impacted their lives. Keeping memorabilia, cards, pictures, or gifts on display in the office can be reminders of rewarding work with students. For some LCPs, certain students may become close friends after graduation and keeping in contact with them may be another reminder of the positive impact of their job. Another strategy is to foster friendships with colleagues who themselves have an optimistic attitude and high commitment to the institution.

Overall, as they reflect on their tenure at their institution, LCPs who have been teaching and conducting research for many years may well find altruistic motivations for mentoring undergraduates as they begin to focus on the legacy and lasting effects of their careers.

## CONCLUSION

Working on publishable research provides hands-on skill development and close relationships between the undergraduate students and their faculty mentor, which helps those students bring their career aspirations to fruition (Seymour et al., 2004). Given these significant benefits to undergraduate students, it is important to highlight factors (e.g., career stage) that improve faculty's capability and willingness to publish with these students. Though the perspectives shared in this article may have some limitations (e.g., do not include mid-career faculty, do not include male viewpoints), when faculty mentors, no matter the career stage, collaborate with undergraduate students in publishable research, these students reap the benefits including improved cognitive skills and work ethic, increased preparation for graduate school, better career planning, and higher rates of retention (Hunter et al., 2006).

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AM conceptualized the manuscript, composed the ECP section, connected all parts of the paper, conducted the final edits, and completed the submission process. JG worked on the LCP sections and provided general feedback.

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# Publish With Undergraduates or Perish?: Strategies for Preserving Faculty Time in Undergraduate Research Supervision at Large Universities and Liberal Arts Colleges

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To promote “unique” undergraduate experiences, both research-intensive universities (designated R1 by the Carnegie Classification of Institutions of Higher Education) and liberal arts institutions (called Baccalaureate Colleges by the Carnegie Classification) are keen to involve undergraduates in faculty research projects (Masterson, 2017). Students who engage in these activities certainly receive a more enriching education than those who do not (Lopatto, 2007; Russell et al., 2007). Faculty may also experience a boost in morale from engaging in research with undergraduates (Wayment and Dickson, 2008). But how much time do undergraduate publications take for all involved? How do faculty at research-focused institutions determine whether they should publish with undergraduates? Here I present two strategies for ensuring efficiency in accomplishing publications with undergraduates. I believe that these strategies apply to faculty at R1 institutions as well as those at liberal arts/baccalaureate colleges with fairly high research expectations. I have been a faculty member at both types of institutions, including the University of Utah and the College of William and Mary. Obviously certain strategies will not work for every type of campus, but I do feel that the strategies I propose are effective in the different research environments present at R1 and liberal arts institutions with high research expectations. I argue that research collaboration with undergraduates if done wisely, helps advance one’s own research agenda (see also Petrella and Jung, 2008), thereby making preliminary work for grants and also publications with undergraduates helpful not only for possibly obtaining grants but also in achieving promotion or tenure. Further, these strategies can ensure productivity and protect faculty time while rewarding students and faculty alike.

My strategies aim to make the process of publishing with undergraduates as efficient as possible. Many factors play a role in the time taken to get from start to finish on an undergraduate publication. For example, the time needed for undergraduates and faculty mentors to develop a functional and productive team varies. Other factors include the level of preparation and motivation in the undergraduates themselves, the support structures (or lack thereof) for undergraduate research, and the faculty mentor’s obligations. I am not the first to bring up the time obstacles that can plague success in undergraduates publishing their work (Wendt, 2006). However, I feel that more discussion should ensue across institutions and experiences in order to support faculty (especially those at the junior level) who decide to mentor undergraduates in publishing. After all, mentoring undergraduates in publishing can be extremely rewarding!

## STRATEGY 1: DELEGATE OR DROWN

Professors at all types of institutions are increasingly asked to do more for the same salary and incentives (Milem et al., 2000; Link et al., 2008). Tenure-track faculty at liberal arts institutions are no longer expected simply to be excellent teachers; they are now expected to write grants to obtain extramural funding (Webb, 2008). Grant applications obviously take time, as does preliminary research to support proposals and a research group that can actually complete the work if funding is awarded. What should a faculty member consider before mentoring an undergraduate? The obvious first consideration should be the overall time commitment required given the professor's schedule, although the student's available time is relevant, too. Both the undergraduates and faculty need to be committed to the research in order for publications to result, but faculty may need to delegate some responsibilities to ensure efficiency.

The overall strategy of delegating involves several specific tactics. First, assume at least an hour of time per week to meet with each undergraduate. In my experience, regular check-ins with the undergraduates are necessary to gauge their level of expertise and to keep them focused and on track to complete research in a timeframe that will help rather than burden faculty. This meeting might be part of a weekly lab meeting where all students convene to "report" on their projects, but having more time available is useful for students who need specific attention or more feedback. However, it is not a good idea to suggest there is unlimited time for undergraduates!

Toward this end, I have found that at both types of institutions (liberal arts and R1), it is helpful to show students what they will be undertaking in terms of commitment and time. To do so, I ask prospective students to join the weekly meetings in order to see other students' progress. If all goes well, prospective students then decide to aid an already existing project (and earn themselves second or third authorship instead of first). Once they know other students in the lab, they may decide to assist ongoing projects, which can result in more senior students mentoring junior students (even at the undergraduate level). This situation is especially useful if one does not have graduate students available for mentoring. I often tell the "new" undergraduate students that we will evaluate their performance over the course of the semester in order to determine if we are willing to allow them to continue toward a potential publication. I also ask them to consider whether they have the time and energy to commit to conducting research for publication.

Finally, it is also wise to ask students to write small sections of papers or project reports to gauge their writing skills, as these are excellent predictors of whether they can carry a project through to publication. At larger institutions, graduate students are able to take on some of this early mentoring and can, in the process, help faculty identify which students are better suited for research and publication. The graduate students often ask the undergraduates to take a first pass at writing a method section and, in turn, offer them later authorship on a paper if we use this writing after revisions. Graduate students can also spearhead conducting preliminary data analyses with students if the undergraduates are less familiar with data processing and software.

One difference that I have experienced between large research institutions and smaller liberal arts colleges is that capstone courses requiring independent research projects for the major are more prevalent at the latter. Such courses allow faculty to "double dip" on teaching and research in that they can conduct research in classes with undergraduates that may lead to publications. The College of William and Mary had such a course; undergraduates designed and conducted experiments over the semester and then wrote up their findings in manuscript form. Two of these projects resulted in publications for my laboratory (see Geuss et al., 2010; Stefanucci et al., 2012). These courses allow for delegation of research activities given students may use class time to write sections of papers or meet to talk about research. In addition to capstone courses, options allowing students to conduct independent research projects with faculty for course credit can also include mentoring Honors students in writing and conducting theses. Honors students are self-motivated to complete a publication: their thesis. They also often have better training in writing from Honors-specific courses that usually require higher amounts of writing than their non-Honors counterpart.

So, to summarize this section, if you plan to publish with undergraduates, delegate as much of the mentoring as you can. In addition, reach out to students completing a capstone project (even if not yours) or writing an honors thesis. Whenever possible, try to double up on required tenure activities (i.e., teaching and research) to save time!

## STRATEGY 2: GET CREDIT WHEN CREDIT IS DUE

If you are going to invest time in mentoring undergraduates toward publication, then you need to make sure that your institution gives you the appropriate credit and recognition. Yes, publishing with an undergraduate is highly rewarding in and of itself (which is why we do it!), but it is nonetheless important to convey your level of commitment to your colleagues, especially if you are junior. This is even more important if undergraduate publications are a new "requirement" at your institution. The following section discusses ways in which various types of institutions credit undergraduate publication and offers suggestions for how to ask for credit if it is lacking.

In the interest of productivity and time, aim to make research supervision that results in undergraduate publications count as part of your teaching load. It is wise to keep track of the time you spend supervising outside research so that you can demonstrate whether it approaches (or exceeds!) the time you spend teaching a class. Some larger research institutions now equate mentoring to a class if the hours are commensurate; if your institution is not one of them, then this issue may be worth bringing up with fellow faculty or administration.

Another issue to raise with colleagues is how your institution weighs undergraduate publications for promotion and tenure. At the College of William and Mary, such publications were expected and given much weight at faculty reviews. My current R1 institution, the University of Utah, does not weight

papers published with undergraduates any differently than those published with graduate students. So, if you are at an institution that deemphasizes undergraduate research activities, aim to encourage committees to change this practice. Doing so will make investing in publications with undergraduates a better use of time.

In addition to the credit that you are due for mentoring, also consider the credit that your undergraduate students should be given for their work (such as authorship order for publications and presentations). The appropriate level of credit here can sometimes be hard to discern (especially when graduate students may be interacting with the students more regularly than you). At the very least, however, you and your students should be clear from the outset what you both hope and expect to get out of publishing—and how you will divide the labor and the author credits. This matter of authorship is especially important to discuss if you are junior faculty who need to have more first author publications before going up for tenure. I often candidly discussed the issue of authorship with my students when I was junior faculty, and I still do so today. We would agree upon the amount of work that would warrant first authorship as well as who had the original idea for the work. Then we would decide on a preliminary authorship order. Sometimes authorship can and should change in the process of writing, but we agreed that all parties would meet in person if someone felt authorship should be changed from the original arrangement. Again, this plan allows for flexibility if students end up doing more or less than planned. My current graduate students are also expected to mentor undergraduates in research for publication whenever possible. Doing so allows them to show evidence of effective and productive mentorship for post-doctoral or job applications,

which as I have said already is becoming more important for academic positions.

To conclude, the second primary strategy—getting credit where credit is due—helps make sure that your institution and colleagues do not overlook time invested in undergraduate publications. Instead, ideally, this time and investment should garner you more credit during faculty reviews and should garner your students the proper credit—as well as an excellent intellectual experience.

## CONCLUSIONS

I believe that publishing with undergraduates is one of the most rewarding aspects of faculty life. However, faculty need to consider how to preserve time when undertaking undergraduate publication. Overall, I suggest finding ways to delegate mentoring and also making sure that your efforts are rewarded. Doing so will help you publish with undergraduates without perishing from lack of time.

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The author confirms being the sole contributor of this work and has approved it for publication.

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# Providing Outstanding Undergraduate Research Experiences and Sustainable Faculty Development in Load

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When budgets are limited and teaching loads are high, colleges and universities often face challenges to provide opportunities for faculty development and superior undergraduate research experiences. However, conducting research in one's field and allowing undergraduates to engage in this research can deeply enrich the experience of both professors and students (Kuh et al., 2007; Kuh, 2008). Therefore, the psychology department at Wofford College solved these problems by incorporating research into most psychology courses (especially lab courses) and by designing a laboratory experience which includes original team-based research designed for publication, all within the normal faculty teaching load. This fits with our departmental learning goals, stressing the scientific method and reliance on empirical research in the development and testing of psychological theories. This unique structure of our department, including research in load, gives a double benefit: (1) enhancing the ability for professors to continue research in their area, and (2) allowing students to engage in publishable research. We describe how we implemented these opportunities, hoping that some readers might adopt features into their programs.

## RESEARCH OPPORTUNITIES

Wofford College is a 4-year, residential, undergraduate liberal arts college. The psychology program graduates 25–44 majors each year ( $M = 33$ ) with seven full-time professors. The psychology department prepares majors to produce publication-quality research by providing three types of research opportunities: (a) The apprenticeship-based Senior Thesis required of all majors; (b) The research-team core course (RTCC) in which classmates work as a research team during the laboratory component to carry out a single large-scale experiment designed for publication; and (c) Independent studies which provide additional opportunities for publication-quality research in various labs throughout the academic year. Because these independent studies are commonly provided by many schools, this article focuses on the novel characteristics of the first two categories: the senior thesis and the RTCC, with their strong records of undergraduate co-authorship with professors.

## THE RESEARCH TEAM CORE COURSE (RTCC)

Wofford's psychology department prepares its majors to produce peer-reviewed research by incorporating and progressively building upon research methods in most courses offered in the major. Empirical research, data analysis, critical thinking, and writing begin in their first introductory lab course and advance continually through their senior year (National Research Council, 2000; Kuh, 2008). Nevertheless, the Research Team Core Course (RTCC) is unique.



While the classroom provides the core course material commonly expected in most psychology programs (such as Learning, Sensation and Perception, or Cognitive Psychology), its laboratory component organizes upper-level students to work together on a single novel experiment designed for publication.

Learning and Adaptive Behavior is a required semester-long lab course offered once or twice each year by one of the authors [AKR] with around 24 students. We realized that our students would benefit more from the active, hands-on critical-thinking approach provided by original, verifiable, scientific research as a research team than they would by exposure to demonstration labs that are widely provided as research experiences (National Research Council, 2000; Kuh et al., 2007; Kuh, 2008; Brown et al., 2014). In creating this RTCC, we replaced all demonstration labs with one *original* semester-long experiment with rats, without altering program requirements for the major. We incorporated original publication-quality research as an active critical-thinking approach, so experiments are new every semester—not even the professor knows what the results will be [(Boyer, 2004); *Scholarship of Discovery*]. To prepare for the course, the professor must design a unique publication-quality experiment that can be completed in the time available (before Thanksgiving or Spring Break). Because this RTCC relies on computers and rats, the professor must obtain IACUC approval and the rats, and write the new computer programs for all training and experimental conditions before the course begins. The background reading for each experiment changes each semester, but by focusing on a consistent research topic across years, students begin by reading the relevant articles produced by previous students. These articles demonstrate the progression of scientific knowledge produced by students previously in this course, and students then integrate this research with other published articles on the same general topic (*Scholarship by Integration*). We identify several of these articles in the reference list below.

We ask all RTCC students to work in two-person teams as the class carries out the major research project. Each team splits the daily responsibilities for running their two rats, yielding 3–4 h per week per student. Each team writes a major research report in APA style in which they analyze and describe data from all subjects in the experiment. They also describe the data from their two rats to evaluate consistency across the different teams. By writing their graded research reports, students learn the role of statistical inference while working with data that they collected, and how to work both as a two-person team and as part of a larger research team. Writing their research report helps them learn how their research may create new knowledge in the field, and structured feedback strongly emphasizes appropriate ways of explaining their scientific research to other scholars (*Scholarship of Teaching: Public Dissemination*).

A self-selected group of 3–5 students from the course represents the class as they present this research in a formal oral presentation at the Wofford College Science Research Symposium held at the end of each semester. We normally invite these students to become coauthors of the manuscript that the professor and students prepare together and submit after the course is over. Of course, not every experiment results in publication, but many do. To achieve publication, the professor

may need to dedicate part of the following summer to writing and revising the manuscript with students (those willing to do the extra work of earning co-authorship after the course is over). This design has been highly successful and exposes these students to the rigors of the professional peer-review process. The course requires hard work, but students proudly speak about this experience for years. While the professor must put in substantial effort before and after the semester, this effort is usually not an increase in the steps needed for the professor to do this research as normal professional development outside of the course context. Professors could also involve students in the preparation of the RTCC experiment by offering elective course credit in experimental design.

Developing these RTCC courses is one way for the teacher/scholar to produce publication-quality research with student co-authors within the professor's normal teaching load and have the research funded by the teaching budget ("teaching through research mentoring"). Various designs of this RTCC can be implemented in any core laboratory course in the major, and the implementation details would vary across topics. We have offered this single RTCC as a program requirement for about 10 years, continually making improvements and working out the kinks. Now that we know that this course is highly effective, other Wofford psychology professors teaching core lab courses have the option and flexibility of including similar team-based research into their labs, creating their own RTCC. Naturally, this option is also available to readers of this paper and can be modified for different institutions, such as students becoming participants during class time, when class sizes are large or at institutions with many commuter students.

## THE APPRENTICESHIP-BASED SENIOR RESEARCH THESIS

The senior thesis often represents the capstone of a student's education in psychology. These sorts of culminating experiences have been shown to be a fruitful learning tool which also makes students attractive to future employers (Kinzie, 2013; Budwig and Jessen-Marshall, 2018). Liberal-arts colleges may offer a thesis option in many forms: (a) It may be available only for "honor" students in the department, offered to any interested student, or required for every major. (b) Students may work as a team, or students may have their own individual thesis project. (c) The thesis may last one semester or longer. (d) The thesis may require empirical research, data analysis, and a complete research report; or it may be limited to a review of the research literature and the design of an interesting experiment (without carrying out that experiment). These options have important implications on faculty load, the quality of the thesis project, and subsequent prospects for publication.

Given these considerations, the psychology department at Wofford College requires a one-semester apprenticeship-based senior thesis to be completed by every psychology major. The RTCC and other laboratory experiences provide an excellent background to carry out and write a publication-quality senior thesis. Each of our seven full-time psychology professors mentors



a small research team every academic year. This senior thesis is considered a laboratory course as part of the faculty credit load. By working in teams of 3–6 students, the daily responsibilities for carrying out the research project (experiment, data analysis, and research report) can be shared, which allows larger, higher-quality projects designed for publication to be completed within the timeline. Each professor designs the thesis project in his or her field of study and prepares for the research to start as the semester begins. The research team collaborates on all aspects of the research report and presents their research in a formal, college-wide oral presentation at the Science Symposium held at the end of each semester.

A second component of the senior thesis generally occurs in the first half of the semester while students are running the experiment(s)—the integrated review of the research literature written individually by each student (*Scholarship by Integration*). Under the professor's guidance, each student selects a topic for this comprehensive literature review. Depending upon the professor, the topic may be directly related to the research project or more related to the student's career goals—but the review must integrate scientific research published in journals. Each student submits the literature review for feedback as a graded APA-style paper (averaging 30–40 pages) in the format of *Psychological Bulletin*. All literature reviews and thesis reports are maintained indefinitely in the department archives. Students often include copies of both papers when they apply to graduate school. The combination of the group research project and the individually written literature review allows students to experience the two unique learning opportunities, completing a project that is entirely independently conceived (the literature review) along with one that is conducted as part of a team (the research project).

After the semester is over and students have presented their research at the symposium, the professor decides whether the research is appropriate for publication or whether more research is needed next year. Professors often encourage these students to become coauthors of the manuscript, conference presentation, or poster that the professor and student co-authors prepare and

submit after the semester is over. Some graduating students opt out. Though this differs from many traditional senior thesis programs where each student conceives of his or her own project, this design allows *every* student to engage in high-quality research and to receive an outstanding educational experience. Every psychology professor shares the same responsibilities and opportunities for faculty development, no matter what their field of study.

## CONCLUSION

The beauty of the RTCC and the Apprenticeship-Based Senior Thesis is that both are considered laboratory courses. Thus, funds that are set aside for the annual teaching budget can be used to conduct research within the faculty member's research area as part of the laboratory course. As a result, financial resources for all lab courses have been available reliably every semester. Much of this research is submitted for publication with student coauthors in peer-reviewed journals under the professors' guidance and contributes to the professor's professional development. Including the RTCC and Senior Thesis as part of the curriculum allows a unique opportunity to give undergraduates outstanding research experiences, while allowing professors to thrive within their own area of study without increasing their teaching load. This model could be adapted to different types of institutions as the data collection takes place in the context of a course. We have found since implementing this curriculum that while teaching loads did not increase, *every* psychology professor has continual faculty development opportunities, and *every* psychology major is involved in empirical research with opportunities to coauthor research published in high-quality peer-reviewed journals.

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Here are some recent articles with student coauthors from my RTCC on Learning and Adaptive Behavior. Each article contains one or more of our experiments related to skill learning—the central theme of our research. RTCC students read these articles in chronological order to understand the research, the evolving research questions, and how they (too) can become coauthors.—AKR.

Reid, A. K., DeMarco, G., Smith, K., Fort, T., and Cousins, E. (2013a). The influences of guiding cues on motor skill autonomy in rats. *Learn. Behav.* 41, 455–463. doi: 10.3758/s13420-013-0121-y

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Here are some articles that have come out of the apprenticeship-based senior thesis from my lab, all examining the effects of stress and emotion on memory.—KRMS

Mickley Steinmetz, K. R., Anderson, A., Brasher, K., and Brehmer, T. (2017a). Cortisol and stimulus-induced arousal level differentially impact memory for items and backgrounds. *Cogn. Emot.* 31, 325–338. doi: 10.1080/02699931.2015.1111197

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# Context and Reasons for Bolstering Diversity in Undergraduate Research

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**Keywords:** diversity, undergraduate research, publication, inclusion, undergraduate students

## INTRODUCTION

The field of psychology has a representation problem, and building diverse undergraduate research labs consistently generate publishable work may play a significant role in the solution. Although no differences exist in key quantitative academic qualifications (i.e., grade point average, graduate record examination scores), Black, American Indian/Alaskan Native, and Hispanic/Latino students of color are less likely to go onto and complete doctoral and other graduate programs in psychology (Callahan et al., 2018). Undergraduate research labs offer a unique opportunity to onboard students of color into the field early in the training-to-workforce pipeline and equip them with the skills to persist, succeed, and, eventually, lead as psychological professionals. These labs scaffold students from various backgrounds as they learn the intricate process of producing quality research for publication. They offer in-depth, ongoing, high-impact mentoring experiences to students that provide the networks necessary to navigate the complexities of graduate school, research, and the professional psychology landscape. Finally, by capturing students' potential during their undergraduate tenure equips them with specialized skills to thrive in both postgraduate academic and professional lives.

The diversification of undergraduate research labs—and the publications that arise from them—helps diversify the field of psychology more generally. Research and lines of inquiry draw from individuals' lenses, identities, and experiences. Henrich et al. (2010) found that while people from Western, educated, industrialized, rich, and democratic (WEIRD) backgrounds account for only 12 percent of the world's population, they represent 80 percent of the samples in published research. Without diversity in research, vital questions go unanswered, key perspectives ignored. Diversity within science can help increase the likelihood of innovation and creativity, as found by Page (2007) exploring the role of diverse perspectives in collective problem solving. Early cultivation of student researchers from diverse backgrounds enriches the breadth and depth of the overall scientific landscape.

## THE CURRENT ARTICLE

Whereas, another article in this special issue (Ahmad, Sabat, Trump, & King: "Evidence-Based Strategies for Improving Diversity and Inclusion in Undergraduate Research Labs") delineates evidenced-based action steps, this paper focuses on the context surrounding and reasons for bolstering diversity in undergraduate research. Specifically, the article explores barriers and opportunities to publishing research with individuals from diverse backgrounds and the role that mentored research plays in equity in the field of psychology. This paper hones in on three interconnected facets of diversity—racial, socio-economic, and family educational history—and examines how these facets of identity contribute meaningful breadth to scholarly inquiry.

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Within the United States social milieu, racial, socio-economic, and family educational history remain deeply linked. While many variations exist, students of color are more likely to hail from backgrounds with less accumulated wealth than White students (American Psychological Association, 2016). These factors affect an undergraduate student's engagement with the research and publication process. This paper will explore considerations for faculty mentoring undergraduate student researchers including historic and current underrepresentation of people of color in the fields of psychological science, inequality in pre-collegiate academic preparation for mentored research, and financial and cultural barriers that may shape students likelihood of participating in publishable research. The conclusion very briefly outlines strategies related to expanding access to high quality mentored research experiences.

## HISTORICAL CONTEXT

Historically, people of color and people from low-income backgrounds have not only been underrepresented in the field of psychology and in research, but also victimized by it at times. From the Eugenics movement of the nineteenth and twentieth centuries to psychological scientists' promotion of research positing the racial and intellectual inferiority of Black people, psychology's recent history has alienated people of color [see the edited volume by Abramson and Lack (2014), *Psychology Gone Astray: A Selection of Racist & Sexist Literature from Early Psychological Research*]. The makeup of doctoral-level psychologists does not reflect the United States' wider demographic breakdown, with less than 10 percent of the field coming from ethnic/racial minority backgrounds (American Psychological Association, 2015). Publications in our field remain dominated by the voices and perspectives of White, upper class scholars (Henrich et al., 2010). In fact, the vast majority of authors of publications in the top psychological journals are White males from the United States (Murray et al., 2018). This living history presents barriers to undergraduate students from underrepresented backgrounds who cannot see their place in the field and in its research. Faculty members must work actively and invest focused effort to both acknowledge and counteract these variables. By recognizing these complex dynamics at play, current faculty can work in concentrated ways. For example, they can strive to recruit and retain faculty from underrepresented groups, intentionally and thoughtfully recruit students from low income, first generation, and minority backgrounds into research early, and help groom students to produce publishable data through ongoing mentoring and advocacy. The truth is, publications within the field *need* much more inclusivity to stay relevant and respond to some of the most urgent questions of our time (Henrich et al., 2010). Yet, completing publishable research with undergraduate students can prove challenging. The process of recruiting and retaining students from underrepresented groups (i.e., racial minorities, first generation, and low-income students) presents specific complexities and considerations.

## BARRIERS TO DIVERSE RESEARCH

Most faculty ostensibly support the assertion that fostering diversity in psychological research and publication is a worthy aim to increase equity and bolster the quality and breadth of scientific inquiry. Yet, many faculty do not know how (or choose not) to enact inclusive strategies that support students from diverse backgrounds' participation in high quality, publishable research. While some faculty may have an abstract or philosophical commitment to equity, they may balk at or feel stymied by obstacles that may make the enactment of this complex objective challenging. For example, disproportionately, these students hail from school systems that inadequately prepare students to excel in college-level research courses (Engle and Tinto, 2008). First generation students and students from lower socioeconomic backgrounds are more likely to struggle academically (Jury et al., 2017), including in foundational psychology courses. Even students who persist in science majors are less likely than their White peers to participate in cocurricular activities, such as mentored research projects, lab training, or summer research experiences for undergraduates (REUs) that help prepare students to create publishable research (Willis, 2010). Without these vital introductions to active research, students' curriculum vitae do not differentiate them as graduate school applicants and their undergraduate training does not prepare them to thrive if and when they are accepted. Moreover, privileged students and those with parents with higher education backgrounds are more likely to participate in the unpaid, extensive work necessary to produce publishable research as an undergraduate student. First generation and low income students have higher incidences of engaging in part and full time work during their undergraduate tenure and often do so to support the cost of their education (Walpole, 2003; Aronson, 2008).

## SOME STRATEGIES FOR DIVERSIFICATION

Those seeking to increase diversity in publishable research with undergraduate psychology students must seek to understand and actively combat historic and current barriers, differential academic preparation, and financial and social factors. To do so, faculty members may prioritize sharing the full history of psychology with an inclusive lens that acknowledges psychology's background of damaging, racist actions. They can engage actively in discussions that center the long-term implications of this history and explore how it may shape students' relationship with the field, in their classrooms and labs. By foregrounding this reality and raising awareness of the potential dynamics at play, students and faculty have agency to choose how to engage with these challenges in active ways.

Additionally, equity-minded psychology faculty may work to provide additional academic assistance both before students arrive in the major (e.g., academic skill assessments to identify weaknesses, summer, and academic break bootcamps) and during the school year (e.g., tutoring hours, additional academic clinics, additional preparation courses) to help students

build the skills necessary to be able to complete publishable research eventually. Offering free tutoring services in courses where students may encounter roadblocks to progression (e.g., Introductory Psychology, lower-level statistics courses) will help students from a variety of backgrounds build a strong analytical foundation. Particularly relevant to publishing, having student tutors with a focus on writing and APA style skills will provide additional support to enable students to develop as scholarly writers. In addition, employing high need, skilled students in work-study or paid tutoring positions can provide a career and graduate school-aligned work experience for students who would otherwise have to work off-campus in non-academic positions that can detract from their study and cocurricular activities. Not only can students benefit from taking advantage of tutoring, but also having students from diverse backgrounds in these roles help build peer mentors who model the research and publication process and early professional networks.

Additionally, faculty labs can seek funding that attracts and enables students who would typically be unable to participate in mentored research to do so. Moreover, folding the process of mentored research into a series of core courses within the psychology major is another way to increase access to all students from all backgrounds to participate in high quality research with support and guidance. Developing several applied research courses for all students scaffolds the full process of research. These courses can demystify the publication process from initial concept all the way through editing and publication. Undoubtedly, publication is a complex, long, and work intensive process that can seem daunting

and inaccessible, especially for students from underrepresented backgrounds. The applied nature of the course can center on equipping students with the skills necessary to produce a final, publishable paper. Structurally, the course can fall within an accessible timeframe for students who may not have the flexibility to do summer, after hours, or weekend mentored research.

## CONCLUDING THOUGHTS

These small, actionable strategies help students create excellent, publishable research rich with the diversity of perspectives of the burgeoning researchers that create it. These adjustments also initiate a cascade of events that help bolster diversity in the future of the field of psychology as a whole. While psychological research still struggles with its living history of inequity, faculty mentors can play a key role as change agents in the field by mentoring students from underrepresented groups with intentionality.

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The author confirms being the sole contributor of this work and has approved it for publication.

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To my students—for always pushing the very edges of my perspective.

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# Evidence-Based Strategies for Improving Diversity and Inclusion in Undergraduate Research Labs

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Institutions of higher education strive to support diversity and inclusion efforts as they recognize the benefits at the undergraduate, graduate, and faculty levels (Terenzini et al., 2001; Denson and Chang, 2009; Pascarella et al., 2014; Morina, 2017). Diversity can be defined as “the varied perspectives and approaches to work which members of different identity groups bring” (Thomas and Ely, 1996) and inclusion can be described as a person’s ability to contribute fully and effectively to an organization (Miller, 1998; Mor Barak and Cherin, 1998). One strategy to diversify higher education is by focusing on creating a diverse pipeline, whereby undergraduates from different backgrounds engage in high quality research. These experiences provide students the ability to build competencies and achievement records that propel them to and through graduate school as well as beyond.

Previous research has demonstrated that undergraduates who participate in research projects and positively interact with faculty are more likely to pursue and attain post-baccalaureate degrees as well as subsequent careers as faculty or research scientists (Pascarella and Terenzini, 1991; Astin, 1993; Tinto, 1993; Adedokun et al., 2013; Yaffe et al., 2014). Opportunity and mentorship are particularly critical for underrepresented students, as previous research has found that students’ interactions with faculty members have a stronger influence on their decisions to pursue graduate education than their initial background characteristics (e.g., socio-economic status; Ethington and Smart, 1986; Pascarella and Terenzini, 1991; Carpi et al., 2017). While many mentors may intend to support minority student researchers, they may not be aware of how to do so. Thus, this paper will highlight some of the challenges faced by underrepresented students (i.e., students of color, lower socio-economic status, LGBT) and provide evidence-based solutions on how to recruit, select, retain students from diverse backgrounds to promote diversity and inclusion in undergraduate research labs working toward publishable research.

## PROMOTING AN INCLUSIVE RESEARCH LAB

Multiple studies have found that minority students report feeling isolated, unwelcomed, invisible and distant from faculty (Fullilove and Treisman, 1990; Rankin, 2003; Suarez-Balcazar et al., 2003; Love, 2008; Cherner et al., 2014). Inclusive research lab practices related to recruiting, selecting and retaining diverse student researchers can reduce the effects of these negative experiences.

## Recruitment

As recruitment may be one of the first barriers faced in achieving a diverse research lab, active recruitment efforts must complement other efforts to get diverse students in the door. Active recruitment is defined as efforts that may aid in an increase in applicants and have been used to attract minority applicants to different graduate program and professions (George et al., 1997; Muñoz-Dunbar and Stanton, 1999). Researchers in organizational psychology

have found that more diverse recruitment advertisements positively impact perceptions of organizational attractiveness, perceived compatibility, and evaluations of the organization's image (Perkins et al., 2000; Avery et al., 2004; Lambert, 2015; Baum et al., 2016). Based on these findings, we suggest that advertisements for student research opportunities should include pictures of diverse students and explicit statements encouraging students of all backgrounds to apply. Additionally, it is important for recruitment advertisements to use language that can directly combat some of the misperceptions about research labs that may persuade students from various backgrounds to select-out of participating, as they feel that they may not fit in. For example, students from lower socio-economic status backgrounds may be juggling both work and academic demands and feel that they are not able to participate in research. However, recruitment messages may be tailored to address this need by mentioning the option of flexibility in hours and location for work to be conducted, if applicable. These recruitment efforts may help to attract students from all backgrounds who typically feel excluded from these opportunities as they signal inclusiveness through pictures and messages.

Proactive types of recruitment efforts can take place by both faculty and lab members. For example, faculty members can engage in mentoring behaviors during the recruitment process. This can be done by faculty identifying and encouraging strong minority students in the classroom to apply for research opportunities. Oftentimes, students from underrepresented groups are anxious and feel they do not belong due to a lack of representation. Previous work in educational psychology found that high school students express self-doubt based on an unwelcoming culture of seeing an all-white AP classroom, even after being accepted to these challenging courses (Belcher, 2017). However, with further encouragement and longer discussion from mentors, 90% of those who opted not to originally take AP courses did eventually do so. Similarly, it is likely that minority students doubt their abilities to work in high quality research labs, but may overcome this barrier with appropriate mentorship.

Current lab members may also take an active role in recruiting diverse students. For example, research assistants can set time aside for community outreach events where diverse students may be involved in, such as sports, student clubs, or special events on campus. This can allow for the opportunity for current students to engage in conversation about their experiences working in a lab and the benefits of research for their future goals, specifically, articulating that they are working on publishable research which will be instrumental for pursuing graduate education.

## Selection

Biases can negatively influence minority students' experiences in being provided opportunities in a research lab. Research has found that minority students report experiences of discrimination and differential treatment from their advisors and from prospective advisors (Rankin, 2003; Suarez-Balcazar et al., 2003; Shammass, 2017). For example, faculty were more responsive to White male undergraduate students when contacted about prospective research and mentorship

opportunities compared to female or ethnically diverse students (Milkman et al., 2015). Additionally, faculty members rated male lab manager applicants (identical to female counterparts) as more competent and hireable, as well as deserving of a higher salary and more mentorship (Moss-Racusin et al., 2012). Biases are held by all, and faculty who consider themselves free from bias (Staats et al., 2015) or who share these minority characteristics are not immune (Durso and Latner, 2008; Herek et al., 2009, 2015).

In light of these findings, it is important for mentors to actively strive to minimize the influence of unintentional bias. One way to determine whether selection processes are impacted by these biases is to conduct regular audits of one's lab to ensure that certain types of students are not systematically being evaluated more poorly than others (Tetlock and Mitchell, 2009). To improve the fairness and accuracy of evaluations, faculty need to set clear, objective, behavior-based performance metrics. Indeed, more general and subjective ratings allow for a greater reliance on these subtle biases (Prendergast and Topel, 1993; Aranda et al., 2014). Research has also demonstrated the importance of learning about implicit biases and taking efforts to recognize and reduce behavioral manifestations of such biases. Ignoring implicit biases will negatively impact the validity of faculty's selection and evaluation systems preventing diverse students from working on impactful research.

Faculty members, especially at larger institutions, often develop some type of selection system for their research labs to engage students to support publishable projects. This process often involves using different sources of information, including SAT scores. However, standardized testing generally disadvantages marginalized applicants (Roth et al., 2001; Dean et al., 2008; Fagioli, 2013) due to several reasons including economic and socioeconomic factors, psychological factors, societal factors, cultural factors, test construction, and validation factors (Ployhart et al., 2003; Berry et al., 2011). As a consequence, organizational psychologists encourage decision makers in the workplace to broaden perspectives on selection in general. McKay and Davis (2008) argued that in addition to relying on valid, standardized selection instruments, organizations must "expand the number of predictor constructs measured by selection systems beyond cognitive-based tests" (p. 152). They further argue that, "personnel practitioners should include non-cognitive constructs in selection systems to complement organizations' diversity efforts" (p. 153). Following the model of workplace selection practices and extending them to selecting undergraduate researchers, faculty should conduct a job analysis to identify the responsibilities and qualifications that are necessary to be successful in working on publishable research projects and consider alternative ways to assess these skills.

For example, additional criteria that can be used to evaluate student researchers may include factors, such as motivation and research interests. The Council on Graduate Medical Education found motivation to commit time and effort to studying in high demanding programs to be a predictor of success among medical students from minority groups (Pacquiao, 2007). Additionally, we recommend incorporating qualitative approaches to elicit this information by asking students to write a short essay

describing their reasons for wanting to join a specific lab, their future career plans and research interests. Educational psychologists have found the essay approach to be useful in assessing underrepresented students' motivation for advanced placement (AP) courses in high school (Belcher, 2017).

## Retention

To retain and support diverse students after the recruitment and selection process, it is important for faculty to engage in mentorship, ally behaviors and encourage diversity more broadly to promote an inclusive lab environment.

## Mentorship

Students from diverse backgrounds report that a lack of mentorship is a challenge in navigating their educational experiences. Previous work has found that mentoring can be particularly vital to maintaining persistence toward a degree for African American students (Freeman, 1999; Dodson et al., 2009; Blackwell and Pinder, 2014). Notably, African-American students reported higher satisfaction with research-focused faculty support than other types of mentoring (Ishiyama, 2007; Strayhorn and Saddler, 2009; Kendrick et al., 2013; Castellanos et al., 2016).

Therefore, once students are in the lab, faculty members can take an active role in mentorship by providing developmental opportunities (i.e., co-authorship for publications or conferences) and feedback on research related tasks to build the skills of these students at the undergraduate level. These mentorship relationships between diverse students and faculty can foster research publications as well. A research study found that faculty members who had mentored Black or students with disabilities were more productive in publishing with their undergraduates (Morales et al., 2017). The authors suggest that research publication success is likely due to a mentor's commitment given that often additional time and support is needed for socially marginalized students (Sax et al., 2002; Eagan and Garvey, 2015) and team diversity contributing to broader knowledge and skills (Barjak and Robinson, 2008).

Mentors can also provide support for students working toward graduate degrees. The work of several researchers suggests that providing graduate applicants with guidance on what is being sought in professional statements, how to approach letter writers and what to share with them, and how decisions are made can help put those with less experience in higher education (e.g., first generation college students or graduate students, persons from under-represented groups) in a better position to pursue graduate studies (McKay and Davis, 2008; Sedlacek, 2017; Mathur et al., 2019). This process provides everyone with required information and support, creating a more level playing field for pursuing graduate education that otherwise might only be accessible to some. Overall, faculty mentorship enables the process of engaging diverse students in publishable research and beyond.

## Promote Ally Behaviors

Allies can be both faculty or other lab mentors with similar characteristics and background as diverse students (i.e., faculty of

color) or from a majority group (i.e., White student). Faculty can use their own positions of privilege to be allies and model these behaviors for all lab members. To be effective allies, lab mentors can educate themselves on the various barriers faced by each group as well as the strategies that are most effective at supporting and advocating for these groups (Sabat et al., 2013). This can be done by attending ally and other optional diversity training programs, reading, and staying current on research pertaining to organizational diversity and discrimination, participating in diversity-related events, examining one's own biases, and the ways in which they may be perpetuating systematic inequalities, and by developing and fostering diverse social support networks. Using this knowledge, mentors can engage in behaviors that outwardly support diversity by proactively expressing their ally identities and by role modeling their support for all diverse groups. Specifically, they can emphatically state their genuine support for minority groups and diversity-supportive causes, advertise diversity-related events on campus, and post-ally/diversity-supportive stickers in their offices. Individuals who express their ally identities in these ways are likely to create safe spaces.

## Promoting an Inclusive Lab

The positive environment cultivated in the research lab will likely support both minority and majority students. Mentors engaging and promoting inclusive behaviors may encourage students with concealable stigmas feel comfortable disclosing their identities within the research lab (Sabat et al., 2017). This will likely have a positive impact on marginalized research assistants as disclosure of more hidden identities (i.e., sexual orientation) has been consistently linked to improved satisfaction, commitment, and workplace health (Sabat et al., 2017). Additionally, mentors who disclose their ally identities are also likely to encourage majority members within the lab to feel comfortable acknowledging or disclosing their own ally identities, which will continue to spur a cycle of support allowing all students to thrive in the research lab.

Research has demonstrated that celebrating diversity and taking a multicultural, identity-affirming approach is more beneficial than taking a color-blind approach in which one ignores identity-based differences (Meeussen et al., 2014). Diversity likely already exists in all labs when considering an intersectional framework. Engaging in discussions regarding gender diversity, socio-economic status, sexual orientation, rural/urban upbringing, religious variations, and then seeking to diversify in specific ways (e.g., ethnic diversity) can help all members feel included in diversity related initiatives.

Diversity impacts all aspects of one's experiences and denying this perpetuates systematic disadvantages faced by minority groups (Purdie-Vaughns et al., 2008; Fryberg and Stephens, 2010; Offermann et al., 2014; Bonilla-Silva, 2015). For these reasons, as issues pertaining to diversity arise in the local or national contexts, faculty can allow their lab to be a safe place to address them. Previous evidence has found that broader diversity issues can impact the motivation, well-being, and performance of students, particularly those who are underrepresented (Cokley, 2000; Pugh et al., 2008; Sliter et al., 2014; Prewitt, 2015). Consequently, engaging in these potentially

challenging conversations in the lab can help to foster inclusion, model civil conversation, and allow the opportunity for diverse perspectives to be shared. These inclusive practices related to recruitment, selection, and lab management can allow diverse students to feel supported working on high quality research.

## CONCLUSION

In this paper, we have identified some ways to overcome the challenges faced by underrepresented students including experiences of bias, feelings of isolation, and a lack of mentorship. We have offered solutions to overcome these challenges with regards to recruiting, selecting, and retaining diverse undergraduate researchers working toward publishable work. As the country diversifies and the education system broadens to include online learning, all types of opportunities,

including participation in research labs should be accessible to everyone. Together, with our collective efforts, we can move toward more equitable educational institutions that can lead the way in providing equal educational opportunities to all. As noted by the Dean of Harvard College at commencement, “Diversity in the student body is important for the same reason that it is important in research. It is the only way to advance a field... through a diversity of perspectives” (Powell, 2018).

## AUTHOR CONTRIBUTIONS

AA, IS, RT-S, and EK worked together to create an outline for the manuscript. RT-S identified challenges. AS highlighted recruitment and selection efforts. IS worked on managing labs. All authors worked on revising the manuscript.

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# Student Research and Publication: Strategic Planning for Inclusion Using a Systems Mapping Approach

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**Keywords:** student research, climate, strategic planning, diversity, inclusion, publication

Students who are first-generation, from historically underrepresented groups, or from lower income backgrounds tend to be underrepresented in the participation of high impact educational practices (Stableton and Soria, 2012). In particular and relevant to the current volume, they publish comparatively less as student co-authors (Grineski et al., 2018). As faculty, we should examine where the leaks are along the pipeline of student research, from recruitment to publication. In addition to leading department level programming, faculty can be powerful advocates for institution level action that synergizes individual and departmental practices (Morales et al., 2017). This article will suggest strategic planning steps as well as actions for implementation that create a positive and inclusive climate along the entire undergraduate research pipeline from entry into research experiences to publication.

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## STEP 1: WHAT IS THE CLIMATE? A MULTI-SYSTEMS MAPPING EXERCISE

Faculty create and adopt impactful practices to foster undergraduate research success at the classroom and departmental level [e.g., incorporation of research into courses (LoSchiavo, 2018, this volume; Sharen et al., 2017) and integrated curriculum design (McKelvie and Standing, 2018), this volume]. However, to ensure that the impact is inclusive, we should consider how individual practices fit into the institution's climate.

The Systems View of School Climate (Rudasill et al., 2018) provides a practical framework for this mapping exercise. It posits that students' perception of climate is shaped at multiple levels. The *microsystem* is the most immediate context and is where faculty-led actions that directly impact student experiences typically reside. For example, this includes departmental policies and practices that encourage or restrict student research, such as mentoring programs, expectations and requirements, and peer learning communities. Wayment and Dickson (2008) describe a successful case of a departmental effort to increase student research participation by identifying existing microsystem barriers (student awareness, student access, curricular timing, publicity, and faculty incentives) and implementing targeted changes to remove the barriers (advertisement, application procedures, assessment and communication, newsletter, and faculty teaching load reassignment).

Nested within microsystems are *nanosystems* (e.g., identity-based peer groups, interest, or affinity within the major; tracks of study within the major) which affect students' identities and sense of belonging and in turn impact students' aspirations and attainment in academic and career outcomes such as engaging in research (Fisher et al., 2017). At the emergent level above microsystems, multiple microsystems such as different academic departments, administrative/student life offices, and students' family environments interact to create the *mesosystem*. For example, do departments share mentoring practices for student researchers or

are students hearing different messages from different departments? Do students get advice about research vs. internship opportunities that are at odds? Are financial and financial aid processes supportive for student research assistants or those who receive research grants? Do families understand the value of student research opportunities? Messages and practices are sometimes mutually reinforcing and encourage student research engagement, but other times the expectations and values from microsystems can conflict. Mapping a systems view is therefore crucial for sustained progress in encouraging undergraduate research that can lead to publication, because while practices adopted within the department could improve the climate at the microsystem level, they could end up with limited impact if other microsystems, nanosystems, and mesosystems are at odds.

Faculty interested in understanding their institutional climate for student research could consider this mapping exercise to identify the multiple layers of systems in their own department and institution. At this stage, critical questions include:

- What are the microsystems involved? E.g., your own department, other science and social science departments, student service offices, administrative offices.
- What are the nanosystems within your department? How do they extend beyond your department and cut across departments?
- Where do the microsystems interact and what are the alignments and conflicts?
- At each level, can you begin to identify positive practices and potential obstacles?

## STEP 2: CLIMATE AND ENGAGEMENT MAPPING—DASHBOARD AND GAP ANALYSIS

In order to effectively prioritize initiatives, faculty should also collaborate with institutional research offices to map the participation rates and diversity along the research pipeline of recruitment, retention, and advancement. By comparing the profiles at different points in the pipeline to the institution's demographics as a baseline, resources can be targeted at the leaky parts of the pipeline. Each department will need to identify the unique key points in its departmental and institutional pipeline, but some common metrics for such a dashboard could include the total number and the rates for student subgroups of interest (e.g., gender, race, ethnicity, international, first-generation status, Pell-eligibility):

- Retention rate within the major (expression of interest vs. graduating with the major) in psychology or in the sciences
- Participation in any kind of research (course-based and independent research)
- Participation as paid student assistants, or credit-gaining research assistant experiences
- Participation in summer research
- Receiving institutional funds for research expenses
- Receiving departmental or institutional awards for academic excellence

- Presentation as authors or co-authors at regional and national conferences
- Co-authorship with faculty.

Some of the data from this analysis could be posted as public information as a departmental or divisional dashboard to create a climate of transparency, collaboration, and accountability (e.g., <https://www.coloradocollege.edu/offices/dean/students/research-opportunities/score-facts>). These findings, along with departmental/institutional data on student engagement with High Impact Practices (Kuh, 2008), qualitative data from student focused groups, and campus climate surveys will give insights into the nano, micro, and mesosphere factors affecting the student research pipeline.

## STEP 3: STRATEGIC PLANNING: EARLY, MID, AND ADVANCED STAGES OF THE PIPELINE

Equipped with the qualitative and quantitative understanding of the climate and practices along the research pipeline, faculty can then strategize based on the nature of the gaps and patterns within and across departments.

### Early Pipeline

How does the department recruit students into the discipline and its research experiences? Entry experiences across different departments and programs affect the mesosystem climate by shaping student expectations and identity (Oyserman et al., 1995). Undergraduate students who participate in research tend to enter in their later years because research is typically structured as capstone experiences (Kenny et al., 2001). However, efforts to broaden and diversify the pipeline in the senior year may be too late. At our college, after quantitative study identified the gaps in undergraduate research, follow-up student surveys and focus groups suggested that first generation and minority students are often uncertain about who to and how to ask for research experiences, and some worry that they lack experience to start research. As a result, we implemented a pre-major advising program with and mentoring to help students navigate “how to get started” (<https://www.coloradocollege.edu/offices/dean/students/research-opportunities/getting-started/>).

We also began a science research apprenticeship program for first year students that provided paid student-employment positions for work-study eligible students. It is important that these are paid, not volunteer, positions because competing job responsibilities is a major academic obstacle for first-generation students (Stableton and Soria, 2012). In our program, faculty from psychology and other science departments were recruited to offer novice-level research assistant positions that were centrally funded. The postings and marketing for these apprenticeships were centralized, and each department did its own review, interviews, and selection. Students then began work in labs in mid-October under faculty mentorship while participating in professional development opportunities as a cohort. The initial cohort revealed the challenges of incorporating first years in research because of the variability in each student's knowledge in

the discipline, as well as the availability of novice-level work that a student can perform in each research field. In addition to directly engaging the cohort of first year research students, their early involvement and positive experience in the science community should positively impact the nanosystem climate for other first-generation and historically underrepresented students.

## Mid Pipeline

This part of the pipeline focuses on retention—how to foster sustained student engagement to produce work of publishable quality. Having a summer undergraduate research program is essential for long-term and focused research experiences (Rowlett et al., 2012) and some institutions further fund undergraduates to present their research at national conferences. However, while conference attendance is effective in motivating students to sustain their research after the summer, it is resource intensive and impacts only a small group of students. A scalable and economical mesosystem solution is to create a prominent campus symposium on undergraduate research co-hosted by administrative offices such as the academic affairs division, alumni office, advancement division, and career center. Such a symposium should ideally be run as a central part of an existing campus event, such as a fall semester Family Weekend or Homecoming Weekend, to maximize its impact on the mesosystem climate. At our college, we developed an Undergraduate Research and Internships Symposium as a major event for our Family Weekend. A few students deliver high quality oral presentations, followed by poster sessions showcasing students who received institutional funding for summer research or internships. The event has been well-attended by student peers, faculty, staff, and families and friends of the student researchers.

A symposium that is well-integrated at the mesosystem can align initiatives from multiple microsystems by creating synergies across academic departments and administrative offices. It also positively affects the nanosystems—The expectation to present their summer research early in the fall semester formed a learning community of student researchers that shared the experience of struggle and perseverance through challenges (deadlines, learning how to make posters, practicing public speaking); the event created a space where the voices and achievements of students from historically underrepresented groups can be recognized (especially when earlier pipeline issues are addressed and presenters represent campus student demographics); students not yet involved with research can encounter peer role models within and across departments; families can witness how student research and internships work side by side to promote postgraduate success.

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## End of Pipeline

Toward the end of the pipeline, what can create accountability and community to encourage publication? Returning to interactions between nano and microsystems, Grineski et al. (2018) points out that cultural factors associated with socioeconomic status complicate the way well-intentioned faculty-level actions might still fall short in terms of equitable and inclusive student publication rates—first-generation students were significantly less likely to publish, even after accounting for factors such as confidence, duration of research, mentoring, and major.

Research with graduate students found that writing groups and programs lead to increased publications (Cuthbert and Spark, 2008; Cargill and Smernik, 2016). This practice could be adapted for undergraduates by forming scholarly writing groups that are only for undergraduates, or by introducing undergraduates into existing writing communities of graduate students and faculty. The writing program should include community accountability (e.g., daily writing goals) as well as skill-building components that help undergraduates become better writers and editors of their writing. Opportunities for undergraduates to earn academic credit for this intensive writing and rewriting for publication will provide additional accountability. For institutions with a culture of student research grants, explicitly communicating grant availability for funding publication fees will further highlight the cross-system institutional support for student research publication.

## CONCLUSION

As faculty design and implement new ideas to foster student research, multi-system awareness will help faculty attend to the overall participation, inclusion, and effectiveness. The nature of student research is that only a small fraction will end up in publications, and therefore it is imperative to monitor for inclusion along all parts of the pipeline and adopt practices to ensure that no groups suffer disproportionate attrition in the research experience, and the opportunity to publish is attainable in an equitable way. With the changing demographics of the college-aged population in the next decade, strategic planning that accounts for inclusion and multisystem dynamics will create sustainable long-term success for students.

## AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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# From Consumers to Producers: Three Phases in the Research Journey With Undergraduates at a Regional University

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*As the daughter of a single mom, I took care of my younger siblings and worked two jobs to keep the family afloat. I knew I HAD to attend college if I wanted a different life. Talking to the faculty members at orientation made me decide to come here<sup>1</sup>.—Student 1*

*My advisor kept me involved in her project. She had faith in me, and that kept me motivated despite working full-time and commuting from out of town! We presented at a conference and later published it in a journal!—Student 2*

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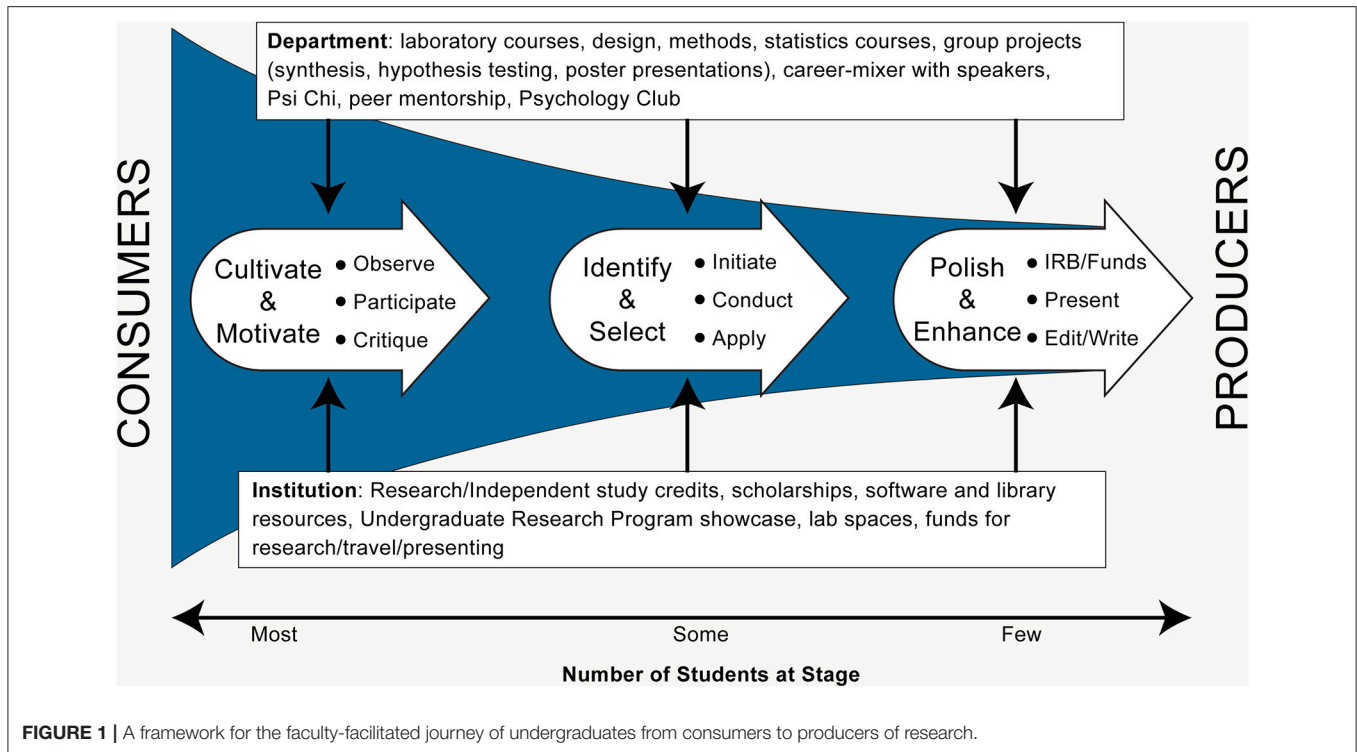
## INTRODUCTION: UNIQUE CHARACTERISTICS OF REGIONAL INSTITUTIONS

In this brief paper, we articulate suggestions and best practices for social science faculty to successfully mentor publishable research with undergraduate students. Valued for shaping students' career-choices across fields (Lent et al., 1994; Robnett et al., 2015; Frantz et al., 2017), we argue that regional universities present unique considerations which can complicate the process. Recent data show our student body is comprised of 33% first-generation college students—which often means they arrive less familiar with the cultural milieu of higher education, less prepared for the level of critical thinking required, and with less value of scholarly creation. Further, many commute, have transferred from community colleges, and work substantial hours to afford college. These characteristics mean that our students juggle numerous time-demands and view academics through a lens of efficiency (i.e., aiming to complete necessary tasks as quickly as possible to progress from college to career). They often view course content as static knowledge to be received and regurgitated. Per APA guidelines (American Psychological Association, 2013), we argue that the best undergraduate outcomes include augmenting that mindset from *consuming* empirical knowledge to critically examining and eventually *producing* scholarly information. In this paper, we outline three phases of this journey with students—cultivating/motivating, identifying/selecting, and enhancing/polishing skillsets to produce research (see **Figure 1**).

## PHASE 1: CULTIVATE AND MOTIVATE

Many of our incoming students—are unfamiliar with the details, design, and value of empirical studies, so they struggle with consuming (let alone producing) research. Thus, the first phase

<sup>1</sup>The quotes are fictive, representing synthesized conversations, and not a particular student.



is to kindle students' interest in the process of knowledge creation. Whether discussing how some research shaped existing views, demonstrating experiments with counterintuitive results, or doing analysis of research articles, a motivated teacher excites students about research and makes it relatable. Class-discussions repeatedly raise the question of "how we know?" We develop student competencies and increase self-efficacy via research-participation-, constructive evaluation of peers' research, critical analysis of current events through the lens of research methodology, and brainstorming new ways to replicate/modify studies (Hurtado et al., 2009).

The success of this phase rests on the planned pervasiveness of these tasks across the departmental and institutional curriculum so that students are consistently motivated toward research. Curricula should be designed to include research skills to produce knowledge in all students (Chamely-Wiik et al., 2014). The Association of American Colleges and Universities' VALUE rubrics (Association of American Colleges and Universities, 2009) offers recommendations. The Psychology department fosters research through various lab courses and a departmental poster session each semester to showcase student research projects. Faculty judiciously plan to involve first year students to participate in these projects for extra-credit and later attend the poster session to see the outcomes. We also deliberately plan a concurrent Psi Chi induction ceremony to model the value of research and build self-efficacy in junior students. Additionally, to motivate students, we offer "Career Preparation" mixers where invited guests provide experience-based insights into graduate school applications. At these informal mixers even the most diffident students can feel free to network with the faculty

and the guest speakers and gain relevant career information. With less savvy students, we need to advise students on how to pull together institutional resources (such as specific grants for independent/faculty-mentored research). We now organize an annual, university-wide, undergraduate research showcase to create an echo-chamber to cultivate research skills and motivate students.

## PHASE II: IDENTIFY AND SELECT

This phase involves identifying and providing opportunities to students who demonstrate potential for growth and success. At regional universities, many students lack readiness (e.g., deep-reading, argumentative writing, analytical thinking, interpersonal confidence, seeking mentoring, professional networking) which confound their initial appearance of competence. Thus, the faculty's task of detecting student potential is crucial and entails opening doors to those who are diamonds in the rough (inquisitive, skeptical, and insightful) and give them opportunity to show their talent with helpful mentorship in addition to those who are conspicuous or have good grades. This search for research acumen diversifies future researchers and allows us to live our mission as regional university faculty: providing *opportunity* to those less privileged. Indeed, mentored research facilitates frequent student-faculty contact, enhanced self-efficacy, and bolstered science identity, which in turn improve college experiences for underrepresented minorities and may help shrink the disparities between racial groups such as graduation rates and admission rates to graduate schools (Hurtado et al., 2009).

Identifying potential takes many forms and each faculty member handles this slightly differently providing opportunity in addition to the objective criteria of selection on grades and skills. Some commonalities we suggest are to look for potential in creative, skeptical, open-minded, detail-oriented students; market opportunities widely and include the hesitant along with the self-promoting students; consider team composition and synergy between students; include and pair promising students with experienced students to scaffold learning and assess growth with mentorship; seek out and encourage underrepresented student groups; encourage faculty mentors with resources; offer course credit, scholarships, or payment to student researchers so they do not have to choose between research and financial stability; and lastly, implement a formal application process. A formal process is doubly helpful because the applicant's CV/transcripts/essays serve as data for making wise choices to supplement interpersonal assessments, and it socializes students on the significance and preparation of these materials ahead of their eventual applications to jobs and/or graduate/professional schools.

To be successful, the process of identification and providing opportunity needs to be baked into the departmental and institutional culture. Collegial relationships benefit students when faculty members refer them to their colleagues with matching research interests. Thus creating otherwise missed mentorship opportunities. Further, the institution-wide dissemination opportunities for student research improve visibility of students, help us network across departments, build awareness of up-and-coming research programs, and spark novel research ideas. Each of these opportunities connect students to one another and creates an ethos that nurtures the production of scholarship, while also connecting faculty and university administrators. To other research mentors at regional universities, we strongly recommend taking a similar approach to identifying and providing opportunity to future mentees on their potential in addition to observed competence.

### PHASE III: POLISH AND ENHANCE

The final stages of producing with students (including posters and papers at conferences at the university, regional, or national level) can stall due to obstacles. As most research students are seniors, their availability and timelines are often not congruent with the length of time it takes to publish. For the challenges associated with this final stage of the journey, we offer added suggestions.

To enhance and polish research skills we have found the most success by delicately balancing “hands on” techniques with delegating meaningful tasks to pursue independently. We enhance skills by emphasizing, modeling, and adding important details—(logs of procedures, making analytic decisions explicit, suitability of measures, programming of stimuli, replicability of procedures and results). Besides orchestrating the pairing of novice and skilled peers to polish and enhance specific skills (such as analysis or writing), we also directly intervene. For example, we polish their communication skills in synthesizing research by giving independence to try tasks followed by immediate and collaborative feedback, such as coediting a manuscript or

speech and including them on professional correspondence. We enhance career skills by encouraging students to create an online presence and follow communication etiquette with professionals in the field (e.g., LinkedIn, ResearchGate, Mendeley). Presenting at regional or national research conferences is always an eye-opening experience and makes tangible the significance of clear dialogue in a research community (Gumbhir, 2014). To aid this we help them navigate conferences with us and overcome inhibition to speak with colleagues. We even examine journal outlets with them and rewrite drafts to hone the argument for the paper to fit with the literature giving them glimpses into our own incessant learning. Lastly, we encourage conversations about mutual expectations of interpersonal interactions to co-create meaningful mentor-mentee relationships (Shanahan et al., 2015).

Encouraging them to disseminate the knowledge produced, we conjointly examine conferences, peer-reviewed journals, and look for other creative ways of publishing which fit with the limited budgets of time (given heavy teaching loads) and funding for undergraduate research. We keep an eye for respectable non-peer-reviewed outlets as well (e.g., books, magazines, Twitter, blogs), as exemplified by a faculty member's ambitious project of coaching his entire class to co-author a book in social psychology (Fairchild and Fairchild, 2018). We are encouraged by non-traditional outlets such as the Wikipedia initiative of the Association for Psychological Science (APS), encouraging teachers to build writing skills with students by contributing to Wiki pages (Banaji, 2011). Such projects could serve as scaffolds of writing experiences for students on the way to professional dissemination in peer-reviewed journals.

Institutional policies and procedures are pivotal to creating the culture of research which is facilitative or prohibitive of the final steps on the students' journey from consumer to producer (Brew and Mantai, 2017). Institutions enhance the likelihood of publications by committing resources to funding the dissemination of research. Our institution supports polishing and dissemination of findings through a writing center where students can get feedback, a university-wide research symposium, financial support for conference presentations, and as well as institutional initiatives to publicize and promote awareness about colleagues participating in conferences or publishing through campus-wide newsletters, stories on websites, and press releases. The departmental poster sessions and the University showcase are the perfect low-risk environments for students to further polish their skills as they get feedback on design, analysis, and presentations from peers and other faculty members as well. At a regional university, this interconnecting of disparate functions which is largely done by committed faculty allows students (and the mentoring faculty) to consult with other expert faculty on methods, statistics, stimuli, questionnaire design, literature, and manuscript production.

### CONCLUSIONS

Although the strategies suggested in this paper would be beneficial at any university, we believe they are particularly critical at a regional university. The role of faculty in bringing together departmental and institutional resources is uniquely

pivotal and takes personal investment to help undergraduates navigate their journey from consumers to producers. Unlike other institutions, we engage with students from the outset, often even before they are admitted. Not only do we mentor students, we build their competence, cheer their accomplishments, and bolster their confidence all through their journey with us, and support them even after they graduate. We pay forward to the next generation of culturally diverse, economically challenged, and often first-generation students that come to us. Encouraging mentors of undergraduate research with funds and ongoing training is a great investment, as facilitating such research activities in social sciences at regional universities may be an important path to diversify future scientists and creators of knowledge (Meadon and Spurrett, 2010).

*Seeing my name on a published paper was pretty crazy... like "I DID THAT!" The research process really helped me understand*

*where knowledge comes from and helped me to see myself as having the potential to contribute to this field.—Student 3.*

## AUTHOR CONTRIBUTIONS

RD developed the initial ideas and submitted abstract along with TP as coauthor who also publishes with undergraduates and added additional ideas of how he manages to research teams and publication process. JM, JW, and MH added their thoughts on how they mentor research in fields of Communications and Social-Work. JW also assisted with making the figure. Additionally, JM provided the institutional perspective as she is Director of Undergraduate Research at the University.

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