Perspectives of the ASHA Special Interest Groups
SIG 10, Vol. 3(Part 2), 2018, Copyright © 2018 American Speech-Language-Hearing Association

Development of a Neuroimaging Course to Increase Research Engagement in Master's Degree Students

Melissa Randazzo

Reem Khamis-Dakwar

Department of Communication Sciences and Disorders, Adelphi University
Garden City, NY

Disclosures
Financial: Melissa Randazzo has no financial interests to disclose. Reem Khamis-Dakwar has no financial interests to disclose.
Nonfinancial: Melissa Randazzo has no relevant nonfinancial interests to disclose. Reem Khamis-Dakwar has no relevant nonfinancial interests to disclose.

Purpose: *The discipline of communication sciences and disorders continues to face a shortage of doctoral level faculty and researchers. We describe the development of an elective course on electroencephalographic (EEG) research methods for clinical Master of Science students as a mechanism to introduce them to academic and research careers in communication sciences and disorders. The 5 objectives of the course are to expose students to EEG research methodology, introduce the path to doctor of philosophy studies, guide the development of research projects, provide hands-on practice with research equipment, and offer opportunities to disseminate research. We report students' perceived impact of the EEG Research Methods course to illustrate the potential benefits of such offerings to the recruitment of future doctoral level scholars.*

Conclusions: *Course evaluation and research self-efficacy measures completed at 3 time points over the semester show enhanced research self-efficacy, faculty–student collaboration, scholarly engagement, and desire to pursue a doctoral degree. We argue that a specialized research methods course has the potential to address the doctor of philosophy shortage in our discipline. The information provided in this report can be adapted to research programs with different types of faculty expertise, technology, methodology, or research facilities to increase research engagement in our future clinicians.*

In response to the impending shortage of teacher-scholars in our field, the Joint Ad Hoc Committee on the Shortage of PhD Students and Faculty recommended that this issue be addressed as a focused initiative, which was incorporated into the American Speech-Language-Hearing Association's (ASHA's) 2005–2007 Strategic Plan. This initiative includes the impetus to increase the number of students recruited to become faculty researchers to fill upcoming vacancies (McCrea et al., 2008). Mueller and Lisko (2003) noted that the shortage of doctoral level scholars will ultimately impact our knowledge base, negatively cascading to limit our capacity to educate future clinicians and serve our patients. Primarily, interest in pursuing a doctor of philosophy (PhD) must be fostered in students and clinicians to rectify the shortage of doctoral level instructors and researchers. Several studies have examined how communication sciences and disorders (CSD) students' research engagement creates interest in pursuing a PhD. Davidson, Weismer, Alt, and Hogan (2013) reported that over 80% of the students interested in pursuing a PhD had prior research experience. Similarly, Witter and Brackenbury (2014) found that students with prior research experience had more knowledge about what the PhD degree entails, and such knowledge is associated with interest in obtaining the degree. Another survey reported that the prospect of developing a research project was a significant deterrent in the desire to pursue a PhD (Madison, Guy, & Koch, 2004). Thus, greater exposure to the research process and the path to PhD studies may be necessary to motivate more students to pursue doctoral studies.

Research Training for CSD Students

Research Self-Efficacy

One outcome of research training is enhanced research self-efficacy. Self-efficacy is a social cognitive construct that refers to one's beliefs and confidence in his or her ability to carry out a specific task. It has been established as a construct of measuring what people perceive they can accomplish given their knowledge and skills (Bandura, 1997). Self-efficacy beliefs are correlated with productivity, performance on specific tasks, and persistence in completing tasks (Bailey, 1999; Dundar & Lewis, 1998; Kahn & Scott, 1997; Pasupathy & Siwatu, 2014; Phillips & Russell, 1994). Self-efficacy beliefs have been studied across many professions including clinical and research self-efficacy in health care (Petzold et al., 2012; Vax, Schreuer, & Sachs, 2012) and particularly in speech-language pathology (Lee & Schmaman, 1987; Rudolf, Manning, & Sewell, 1983).

In the field of speech-language pathology, clinical self-efficacy, or one's confidence in performing tasks related to speech and language assessment and intervention, is correlated with both clinical performance and clinical experience in graduate students (Pasupathy & Bogschutz, 2013). Research self-efficacy, one's perceptions and confidence in his or her ability to carry out research-related tasks, is correlated with research productivity in both doctoral students and faculty members (Bieschke, Bishop, & Garcia, 1996; Love, Bahner, Jones, & Nilsson, 2007). Pasupathy (2018) examined differential gains in research self-efficacy between clinical and research doctoral students in rehabilitation sciences. Doctoral students on a research track were more confident in their research abilities than clinical doctoral students who completed fewer research credit hours. These findings are aligned with the body of literature showing that research self-efficacy hinges upon positive research experiences and mentorship (Lambie, Hayes, Griffith, Limberg, & Mullen, 2013). Considering research self-efficacy is associated with research experience, it may be related to the desire to pursue a PhD. Research self-efficacy as an outcome of research training has not been studied in CSD students at the undergraduate and master's degree levels.

Research Training at the Undergraduate and Graduate Levels

Emphasis is often placed on undergraduate research opportunities to catalyze students' interest in doctoral level education (Coston & Myers-Jennings, 2014; Friberg, Folkins, Harten, & Pershey, 2013; Hagstrom, Baker, & Agan, 2009; Mueller & Lisko, 2003). A survey of undergraduate research opportunities in CSD academic programs reveals that most of the undergraduate engagement activities involve assisting faculty members (27%) and taking part in data collection (27%). However, few programs (13%) report offering engagement in the full process of systematic research inquiry—formation of research questions, study design, hypothesis formation, data collection, data analysis, and dissemination of scholarly work (Mueller & Lisko, 2003). Furthermore, although early entry into research and hands-on practice will enhance the undergraduate students' experience later in their master's program, there are several years and many other responsibilities that intercede between the undergraduate experience and the master's degree.

The focus on graduate level academic programs in CSD is to prepare students to be evidence-based practitioners of speech-language pathology services (Rosenfeld, 2017). However, there is a dearth of information regarding research opportunities and experiences during the master's program. ASHA's final report on the strategic plan to increase the student pipeline for PhD researchers addresses only undergraduate and PhD level education (McNeil et al., 2013). Generally, master's programs maintain the obligatory clinical focus, with a demanding academic curriculum and large clinical hour requirement. The research focus in the master's program is often on implementing evidence-based practice (EBP). Some programs may offer a thesis track, allowing students to further explore research in an independent study format (Council of Academic Programs in Communication Sciences and Disorders & ASHA, 2018). Some master's students may assist professors in their laboratories (Blanchet, 2015). However, outside the required general overview of research methods in standard courses, little has been reported about other research-infused curricular offerings at the master's level. Many graduate programs in CSD offer research engagement opportunities in

research laboratories and through thesis tracks. However, these offerings may not be integrated as part of the academic program and may engage only a limited number of self-selected students. Providing hands-on experience with research integrated in the curriculum may foster greater interest and demystify the research process, while providing training of core skills and research self-efficacy required to pursue a PhD.

Research Training and Implementation of EBP

Although implementation of EBP is a fundamental focus of the Master of Science (MS) degree, several barriers in integrating research with clinical practice remain. Jette et al. (2003) found that core research skills such as formulating clinical research questions, conducting a literature search, determining the validity of studies, understanding research design, and applying research to specific patients or clinical situations are barriers to implementation of EBP in physical therapy. These findings from an allied profession indicate that clinicians may need further training in core research skills and greater exposure to working with researchers. Fundamental to these core research skills is the ability to think critically and apply new knowledge. Finn, Brundage, and DiLollo (2016) argue that the pedagogical literature provides minimal direction to instructors for supporting our future clinicians in the development and use of the critical thinking skills that are necessary for EBP. Likewise, little has been reported on the standard research methods courses in CSD master's programs. The Council on Academic Accreditation in Audiology and Speech-Language Pathology (2017) outlined requirements for review relating to acquisition of research skills for students. Item 3.5B states that the program must be organized so the scientific and research foundations of the profession are evident. In addition to curriculum that addresses basic science skills, the scientific bases of the profession, and application of science to clinical practice, programs "must include research and scholarship participation opportunities that are consistent with the mission and goals of the program." It is likely that these criteria are applied broadly across many different programs for both research methods courses and extracurricular research opportunities.

We argue that new research courses, designed to promote critical thinking through hands-on, problem-based learning, will foster the development of core research skills, which can be applied to EBP in clinical practice. In an effort to increase EBP in academic programs, ASHA issued an Academic Program Self-Assessment regarding quality indicators for integrating research and clinical practice in CSD programs (ASHA, 2014). Academic programs rate aspects of their research resources, problem-based learning, and clinical practica on a scale of 1–5 (major program need to major program strength). Items numbered 21–25 of the Academic Program Self-Assessment address students' access to and training in the use of laboratory equipment, opportunities to participate in research activities, and submission of projects for publication and presentations. In response to Items 21–25, we identified a program need to increase resources for student research engagement. Upon reflection of our department resources for student research, we developed a three-credit elective course on electroencephalographic (EEG) research methodology for clinical master's students to foster interest in the PhD degree, enhance the development of core research skills, and promote critical thinking in clinical trainees.

Methodologically Tailored Research Course at the Master's Level

Academic programs seeking to expand students' engagement in research, other than the traditional research assistantship opportunities or standard research methods course, may consider developing additional, methodologically tailored courses. The specific methodology for the course may be selected based on the capacity and resources within each program and may, for example, be on phenomenology, eye tracking, priming, conversational analysis, and so forth. The purpose of such a course is to facilitate students' hands-on engagement in clinical research in several phases of experimentation (e.g., development of research questions, stimulus and experiment design, data collection and analysis). The course may also introduce students to the path to doctoral studies while underlining the generation of evidence for clinical decision making.

Moreover, such an endeavor also highlights the specializations unique to the faculty within the program and promotes a scholarly clinical research collaborative community (McComas, Fry, Frank, & Fraley, 2010). We argue that offering these additional research training courses during the master's program would be as effective in addressing the shortage of doctoral level faculty researchers as existing mechanisms for undergraduate students because master's students are further advanced in their clinical education and have the necessary depth of knowledge to develop clinically relevant research questions. Moreover, the short time between completion of the master's degree and initiation of clinical practice makes it more likely for a student to consider continuation of his or her research project during the clinical fellowship year or eventual transition to doctoral studies.

EEG Research

EEG Research in CSD

Neuroimaging techniques have been used to investigate speech and language disorders over the past few decades. Research in neuroimaging has contributed to understanding of the neural networks involved in speech perception and production, linguistic representation and processing, and literacy acquisition and reading abilities (Key, Dove, & Maguire, 2005). Advances in understanding human communication and the brain have informed theories and models of speech and language processing, validated treatment approaches, and introduced new methods of intervention such as transcranial direct current stimulation. In the fields of psychiatry and psychology, hands-on neuroimaging has been incorporated into coursework to give students exposure to research technology. An intensive week of neuroimaging coursework improved medical students in psychiatry's familiarity and comfort with neuroimaging (Downar, Krizova, Ghaffar, & Zaretsky, 2010). Similarly, Stewart (2015) reports that psychology students who participated in hands-on practice with EEG equipment had statistically significant higher examination scores compared with students who received lecture-only content.

EEG enables direct measurement of brain activity during linguistic and cognitive processing with high temporal resolution. This method allows the investigator to examine processing across linguistic domains and is highly effective in informing clinically driven queries in CSD. Research utilizing EEG yields neural signatures of cognitive and linguistic processes from the electrophysiological signal called *event-related potentials* (ERPs). Such investigations may be related to understanding the nature of a communication disorder, the course of language development in CSD populations, and changes to linguistic processing as an outcome of intervention (Khamis-Dakwar, 2012). EEG research utilizing ERPs has the potential to inform speech-language pathology practice for many clinical populations. Some exemplary ERP work includes the impact of timing of bilingual exposure on grammatical processing of open and closed class words (Weber-Fox & Neville, 1996), semantic processing in children who stutter as a prognostic index of persistence of stuttering (Kreidler, Wray, Usler, & Weber, 2017), word processing in children with autism spectrum disorder (Sandbank, Yoder, & Key, 2017), and speech processing difficulties in children with language impairment (LI; Shafer, Morr, Datta, Kurtzberg, & Schwartz, 2005).

EEG Research Methods Course in the CSD Master's Program at Adelphi University

In this article, we introduce an EEG Research Methods course developed as an elective within the Communication Sciences and Disorders Department at Adelphi University. We present the course here as one example for facilitating research engagement and addressing the PhD shortage in CSD. The course ran over three semesters with enrollment as follows: Spring 2017 (10 students), Summer 2017 (10 students), and Spring 2018 (12 students). Spring cohorts included first-year MS students in their second semester of the program. The Summer 2017 cohort included students who had just completed their first year of the MS program. We report here the latest version of the course from Spring 2018, as it has been refined over the three semesters it has been offered. The course is offered in spring and summer semesters as part of a flat-rate tuition program, which enables students to take electives at no extra cost. There were no

prerequisites for the course, and all students took it for a letter grade. The purpose of the course is to provide MS students with hands-on training utilizing laboratory equipment and introduce them to the path to a PhD degree.

In order to accommodate the substantial academic and clinical requirements of the MS program, we adopted a flipped classroom approach, a type of blended learning utilizing both online and classroom/laboratory contents. The hybrid course was presented as an intensive 8-week neuroimaging course on EEG Research Methods. In the hybrid format in our department, the students attend five in-class periods with three additional online lectures and laboratory-based assignments. This format allows us to make use of class time for hands-on practice with neuroimaging equipment, in-depth discussion of topics, attendance at guest lectures, and collaborative group work on projects. The format of the five in-class meetings, each 4 hr long, generally includes a seminar-style discussion of assigned research articles, guest research talk by a current PhD student, and "workshop" time in which students and the instructor work collaboratively on research proposals, build experiments in the laboratory, or pilot experimental tasks.

Advantages of utilizing a flipped classroom include freeing up time for activities in the classroom, increasing student preparation prior to in-class meetings, learning at an individualized pace, and increasing learning performance (Albert & Beatty, 2014; Gilboy, Heinerichs, & Pazzaglia, 2015; Shea & Bidjerano, 2010; Thai, De Wever, & Valcke, 2017). This type of instructional approach has been successful in other content areas in CSD. Berg, Ibrahim, Magaster, and Salbod (2015) compared students in Introduction to Audiology in two cohorts: flipped and traditional classrooms. Students in the flipped classroom scored higher on a case study assignment and earned higher overall grades than students in the traditional lecture class. Moreover, students in the flipped classroom cohort were reported to have engaged in more in-depth discussion and more hands-on experience with audiograms, due to additional time in class for practical activities.

Objectives of the EEG Research Methods Course

We describe here the five objectives of the EEG Research Methods course and how these objectives can be adapted to other university research and academic programs. Identifying objectives is the first step in designing the course. Below, we describe the general objectives for the EEG course and the planning associated with each objective, which can be adapted for other techniques or methodologies depending on the resources of the instructor's department.

Expose students to EEG research methodology and its applicability in CSD research. The research methodology was taught within a meaningful, clinically relevant context. In order to make the course clinically relevant, an inquiry-based approach was implemented. Justice et al. (2006) provide an overview of the operational definitions of inquiry-based learning in higher education as a process that incorporates both student-driven and instructor-guided investigations of student-generated questions. Thus, the systematic process of inquiry in the course is a metaprocess for the type of inquiry performed by researchers. Students develop their understanding of the inquiry-based topic and the contribution of the research methodology in addressing the question while progressing to more in-depth levels of understanding. Inquiry-based learning approaches have been found effective in fostering critical thinking skills in nursing students (Magnussen, Ishida, & Itano, 2000) and increasing gains in science literacy and research skills in undergraduate biology students (Gormally, Brickman, Armstrong, & Hallar, 2009).

For inquiry, students were presented with a broad question in the discipline of CSD that can be answered using EEG methodology. Central auditory processing disorder or (C)APD in children as a unique diagnostic entity has been questioned due to its uncertain diagnostic boundaries, overlapping with LI and attention-deficit/hyperactivity disorder (ADHD; de Wit et al., 2016; Vermiglio, 2018). Moreover, the diagnostic testing for (C)APD is confounded by both language and attention. For example, many of the diagnostic measures used by audiologists require word repetition or recall of a stimulus (Yathiraj & Vanaja, 2018). Certain ERP paradigms are using passive participation, circumventing the confounds of attention. Additionally, they have the capacity to examine the

neural correlates of responses to both linguistic and nonlinguistic stimuli across auditory and visual modalities. Therefore, research questions regarding (C)APD were ideal for EEG instrumentation (Bishop, 2007).

As a backdrop to the inquiry-based focus on (C)APD, students developed their knowledge of EEG methodology and its applicability to CSD more broadly. For each class meeting, students read one to two research articles highlighting different aspects of EEG research applied to different language domains and clinical populations. For example, students read research about phonological processing in stuttering and childhood apraxia of speech, syntactic processing in traumatic brain injury, and semantic processing in children who are hard of hearing. Students were provided with a research article discussion guide, as depicted in Table 1. During discussion, emphasis was placed on the role of clinical experience in conducting EEG research. Clinicians with expertise in a given population can better determine whether standardized measures are adequate for inclusion criteria and the validity of experimental tasks in indexing the intended behaviors.

Table 1. Research article discussion guide.

What are the core research questions this study attempts to address?
Which event-related potentials (ERPs) are they using to address these questions? How did the current literature inform these questions?
How were participants chosen for the study?
What were the diagnostic criteria for clinical populations? Do you agree/disagree with the assessments chosen by the researchers?
Describe the tasks and stimuli in the experiment. How do these tasks and stimuli relate to the ERPs of interest?
What are the results of this study? Were there group differences?
What are the implications of these results? How do they inform or change clinical practice?

The discussion also focused on EBP and the clinical implications of the studies, encouraging students to connect the research to practice and academic content in their other classes. These articles allowed students to engage in a critical analysis of study designs with a focus on inclusion criteria, limitations of behavioral measurements, and discussion of follow-up studies using EEG. This focus, which emphasizes aspects of research they are already familiar with, bridges current knowledge to the advanced technical aspects emphasized in the EEG course. Following the article discussion, the instructor challenged the students to think of a similar paradigm that could address a potential gap in our understanding of (C)APD. For example, upon reading a study examining phonological perception in children with childhood apraxia of speech (Froud & Khamis-Dakwar, 2012), students were challenged to extend the EEG paradigm and study methods to compare children with (C)APD to children with LI.

Introduce students to the path in PhD studies. In order to expose students to research questions that originated from clinical practice and to the path to doctoral level studies, PhD students presented their EEG research projects to the class. In addition to the full research talk on their dissertation project, the PhD students discussed why they decided to pursue a PhD, how their clinical practice informed their research questions, and the opportunities and challenges they faced during their doctoral studies. The MS students were encouraged to ask questions about the path to PhD studies, clinical practice, and the experience of learning how to become a researcher. For example, one PhD student discussed her clinical findings that patients with Alzheimer's disease are better at recalling category names than specific labels during treatment

sessions. She outlined how her clinical experience with the population with Alzheimer's disease led to the development of her research question and the basis for her dissertation project, which uses EEG to examine semantic representation in patients with Alzheimer's disease. Students were invited to participate in her experiment, providing an opportunity for a connection between the theoretical foundations of the experiment and the actual procedure of the paradigm.

During presentations by current PhD students, the MS students filled out a speaker evaluation form. This form helped guide their thinking and the subsequent class discussion of the research project, path to PhD studies, and the bridge from clinical practice to scientific inquiry. The speaker evaluation form included questions and prompts such as "What are the speaker's main research questions?", "How did the speaker develop his or her research questions based on his or her own clinical experience?", "What did you find most interesting about the speaker's research study?", and "How did this presentation inform you of the path to becoming a clinical researcher?".

Guide students in the development of research questions and proposals. Utilizing the inquiry-based topic of diagnostic overlap of (C)APD with LI and ADHD, students were guided in the development of research questions that could be addressed with EEG. In preparation for writing their own research questions, students read articles that described the development of clinically relevant research questions (Farrugia, Petrisor, Farrokhyar, & Bhandari, 2010; Tully, 2014). In small, collaborative working groups of two to three, students completed a research questions assignment that provided a structured format to identify research questions in the existing literature, evaluate these questions, brainstorm their own questions, and refine the wording of the question (see Appendix). Once students developed their own research questions regarding the inquiry-based topic, they wrote abstracts and constructed research proposals. Projects related to (C)APD include examination of neural correlates of dichotic listening and interhemispheric sound processing, mismatch negativity indexes of speech and nonspeech processing in comparison with children with LI, and visual and auditory attention in comparison with ADHD.

During workshop time for the in-class meeting, each group shared their research questions. Class discussion focused on the clinical significance of the questions. The instructor (first author) and department colleague (second author) offered ideas regarding specific paradigms derived from the seminar readings and discussions that could address the broad questions. As the semester progressed, the instructor used workshop time in class for mentoring students in developing the study procedure, piloting tasks in the laboratory, and analyzing and interpreting pilot data collected during class. Work on this objective continued throughout the 8 weeks of the course, culminating in a final 30-min research proposal presentation including literature review of previous studies, research questions, research significance, proposed methodology (inclusion/exclusion criteria, behavioral testing, EEG procedure), expected results or pilot results, discussion, and future directions.

Provide students with hands-on training utilizing research equipment. All students partook in laboratory trainings throughout the 8 weeks, in which they learned about the basic experiment setup and technology used in the laboratory. At the start of their training, students participated as a subject in a current EEG study in the laboratory. They completed the CITI Program IRB Human Subjects Training (CITI Program, 2018) before their first laboratory visit. The participant experience provides them with the insight of how it feels to sit through an experiment, which types of instructions to participants are informative, and the challenges of sitting through a paradigm. This experience then informs their ability to design their own experiments. During their first visit as participants, further discussion and instruction focused on how to obtain informed consent from someone with a communication impairment along with assigned readings (Brady, Fredrick, & Williams, 2013; Penn, Frankel, Watermeyer, & Müller, 2008). The discussion emphasized the types of skills and strategies they are learning in clinical and academic courses that would support comprehension and/or expression regarding informed consent procedures.

Some of the hands-on training took place during flipped classroom dates, whereas other training occurred during workshop time in the regular class meetings. Students practiced the setup and breakdown for running a participant including sensor net care and net placement on the participant's head. Students also had the opportunity to engage in data preprocessing utilizing specialized software programs for EEG research (NetStation EEG Software, Electrical Geodesics) and several tutorials to build experiments utilizing experimental presentation software (E-prime, Psychology Software Tools). Some of the class projects had stimuli and/or paradigms already established in the laboratory, which allowed students to collect pilot data on each other for their specific project. In cases in which the stimuli or paradigms selected by students were not already developed in the laboratory, the students worked on creating stimuli or programming the new experiments during workshop time and flipped classroom dates.

Provide students with practice in research dissemination. In the final class, students did a 30-min presentation that addressed the following points:

- Background and significance: literature review; why is this topic important?
- Background on EEG studies regarding the disorder: What aspects of the topic have already been addressed?
- What are the unanswered questions that EEG research can address?
- Methods: recruitment, inclusion/exclusion criteria, behavioral measures, stimuli, experimental tasks
- Expected results in specific relation to the ERPs of interest or pilot results (if available)
- Clinical implications: How would the expected results inform diagnosis or treatment?

One major focus of this class was on the development of solid research proposals to practice dissemination on Research Day, an internal event to showcase student research at the university. Each group of two to three students submitted abstracts for Research Day, which culminated in poster presentations for the entire university. Students prepared poster presentations either as a proposal with anticipated results or as a pilot study with data on a small sample population. Students engaged in multiple practice sessions, providing feedback on each other's work prior to Research Day. Participation in Research Day was used as a stepping stone to disseminating research at larger conferences. Several students who have collected pilot data presented the next phase of their projects as posters at the ASHA Convention and Society for Psychophysical Research.

Methodologically Tailored Research Methods

Suggestions for Other Programs

The course and activities described here capitalize on the resources unique to our university and department. Instructors should consider available resources for both the logistical and practical aspects of a hands-on research course. Logistical considerations may include the timing of the course in the overall program of the study, the format of the course including number of sessions and length of sessions, and opportunities to use alternative learning approaches such as flipped classroom or online modules. Other practical considerations may include the available research equipment or technology in the department, the specific research expertise of the instructor, and how the course aligns with the instructor's overall research program. Some aspects of the course may be determined by community or university-wide resources. Although not all programs have doctoral students, guest speakers with a combined clinical and research background can certainly provide similar information that bridges clinical practice to research. Aside from CSD faculty in the instructor's department, faculty from other health-related professions such as nursing may also speak to the relationship between clinical practice and research. If an instructor's institution does not have an internal research symposium, smaller scale opportunities to present

to peers and department faculty can be arranged. Students should be encouraged to submit their work to local, state, and national conferences to gain experience discussing their work.

The course described here employed an inquiry-based instructional style focusing on a specific question in the field that could be addressed using the technology accessible in the department. Selection of an inquiry-based topic can support the instructor's research program while providing students with in-depth, hands-on practical experience (Fukami, 2013; Healey, 2005). In designing an inquiry-based course, the instructor must consider the students' current level of understanding of the aspect of communication disorders under study (e.g., speech perception) or the population to be investigated (e.g., children with developmental LI). The instructor should consider how the research methodology or use of laboratory technology will further build upon this knowledge through the process of inquiry. Next, students must be guided in developing clinically relevant research questions related to the inquiry-based topic that can be addressed with the methodology emphasized in the course. To facilitate this, instructors should select readings that cover the topic more broadly in the general literature and methodology-specific studies that may introduce applicable paradigms. Regarding inquiry and research questions, the instructor should also consider the timeline for the research project. For example, our course was only 8 weeks long, so most students focused on the process of posing the research question and developing an appropriate paradigm, along with gaining hands-on practice with the equipment during workshop time. Students have the option to pursue the later stages of the project as an independent study course in another semester.

Challenges

Although increasing student research engagement is a worthy endeavor that contributes greatly to their academic experience and potentially to the profession as a whole, such an undertaking has several inherent challenges. The research process takes a long time, and there is no immediate reward. This is particularly true for EEG research that generally requires a long period of piloting before experimental tasks are ready for the CSD participant population. Moreover, it may be difficult to incorporate specific patient populations into a research-oriented training course. Other limitations may include restrictions imposed by the institutional review board or the inherent amount of training required to utilize the available equipment. Some research, such as functional magnetic resonance imaging, may only have a minimal hands-on component due to the need for specialized technicians at outside facilities. Consequently, instructors will have to be creative in designing course modules to a scale of what is achievable with the amount of training they can provide to students in a limited time frame. Another challenge for the instructor is that supporting multiple student projects can be demanding and time consuming; therefore, the expectations for student projects should align with the instructor's time and resources. Finally, although MS students may be enthusiastic about research engagement throughout the course, they become more occupied with clinic and field placements as they advance through their program and may not be able to continue working on their projects after the course ends.

Preliminary Data on Course Outcomes

We present here preliminary pilot data regarding effectiveness of the course in fostering research engagement, meeting the course objectives, and increasing interest in the PhD degree for first-year MS students. Data are presented descriptively to illustrate the overall success of the course, as perceived by students, and to inform the objectives of future course offerings. The descriptive data also provide considerations for more systematic investigations of the impact of a methodologically tailored research methods course.

Data Collection

Students in the Spring 2018 course (n = 12) were surveyed at three time points over 16 weeks: Time 1 (T1), the week prior to the first class; Time 2 (T2), on the last day of class 8 weeks later; and Time 3 (T3), directly after participation in Research Day, 8 weeks following T2. Data were collected anonymously through Google Survey at all three time points. Questions posed to students

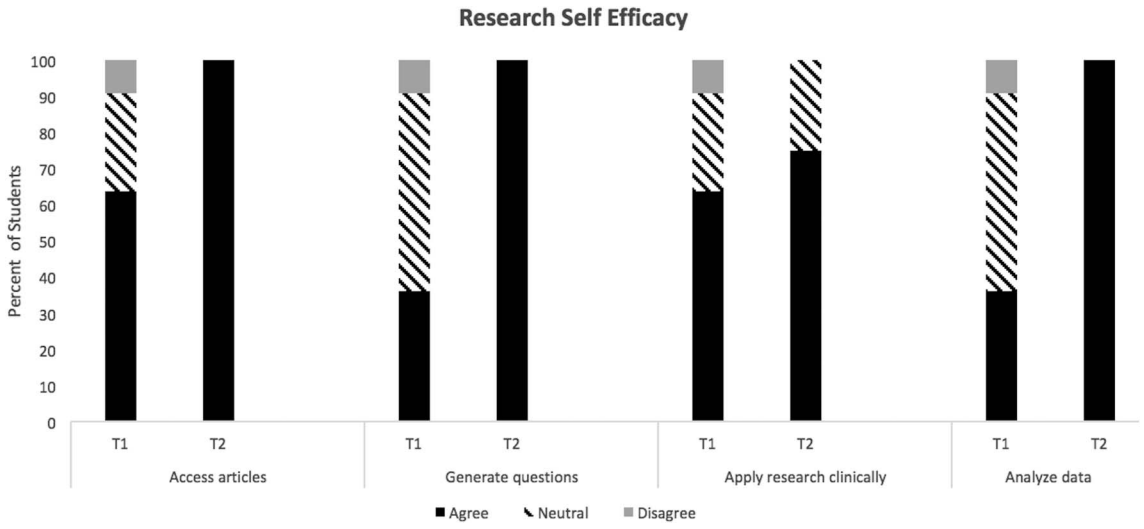
inquired about their perceptions of research self-efficacy before and after the course, interest in pursuing a PhD as a result of the course, effectiveness of course activities in meeting the course objectives, and their perceptions of the experience of disseminating research. As the course had a small number of students by design, the course evaluation data are presented descriptively here to characterize the overall success of the course in meeting its objectives. At T1, 36% of the students indicated that they had previous experience working in a research environment, and 45.5% indicated that they have been a participant in a research study.

Preliminary Results

The outcomes of the course presented here are indirect sources of data that provide insight into the students' perception of the course during the semester.

Research self-efficacy. We examined changes to research self-efficacy preexperience and postexperience in the neuroimaging course. Students rated their agreement (*strongly agree* to *strongly disagree*) on a Likert scale of 1–5 with statements regarding research self-efficacy, or skills and knowledge to carry out the following tasks: understand research articles, access relevant research articles, generate clinically relevant research questions, apply research to clinical practice, and analyze data. For the purposes of this analysis, "strongly agree" and "agree," and "strongly disagree" and "disagree" were merged, yielding three categories: agree, neutral, and disagree. Figure 1 depicts prechanges and postchanges to agreement with these statements.

Figure 1. Student responses to research self-efficacy questions at T1 and T2.

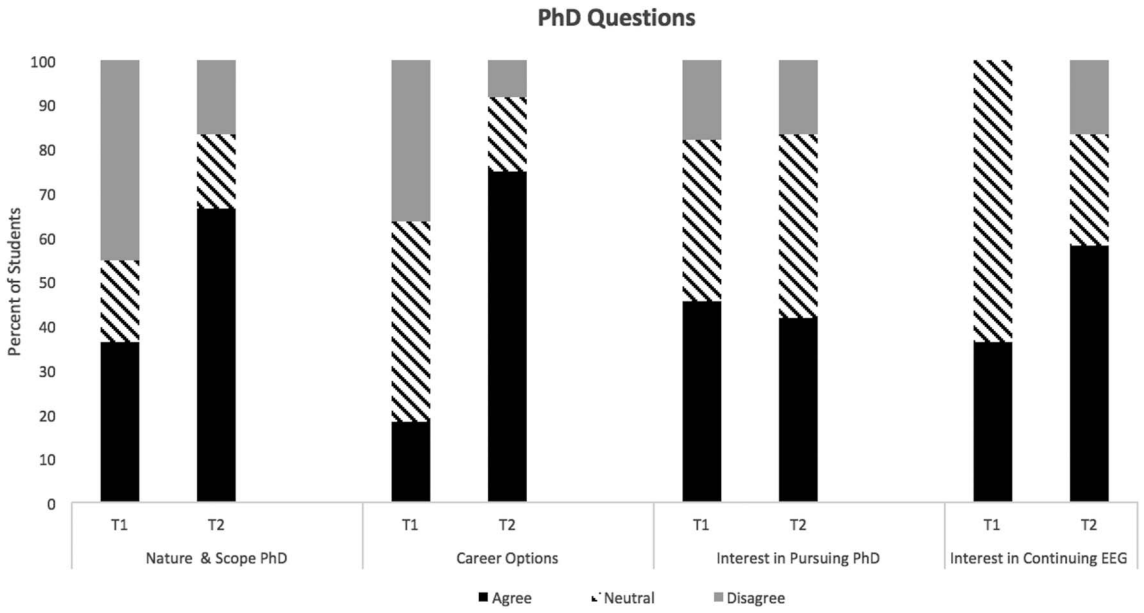


The precourse and postcourse data here indicate that hands-on experience contributed to an increase in research self-efficacy for core skills that have been cited to increase EBP. Between T1 and T2, the greatest increases in self-efficacy were noted for students' confidence in their ability to access research articles, generate clinically oriented research questions, and analyze data. Only a marginal change was noted in their self-efficacy in applying their research clinically.

Interest in PhD degree and continuing with research. Previous survey studies have shown that knowledge about the PhD degree increases interest in pursuing it (Witter & Brackenbury, 2014). Furthermore, prior research experience appears to foster this interest (Willis, Schall, & Piazza, 2018). Students were surveyed at T1 and T2 regarding their knowledge of and interest in the PhD degree. Four questions were posed as a Likert scale (1–5) of *strongly agree* to *strongly disagree* with statements of familiarity with the nature and scope of the PhD degree, career options in

research and higher education in CSD, interest in pursuing PhD, and plan to continue being involved in research after the course. At T1, only 36% of the students indicated they were familiar with the nature and scope of the PhD degree. This number doubled to 67% at T2, indicating that students learned more about the PhD degree during the course. At T2, 75% of the students enrolled in the course indicated that they were familiar with career options in research and higher education in CSD, compared with only 18% at T1. Between T1 and T2, interest in pursuing a PhD changed relatively little. However, at T3, following participation in Research Day, students were asked yes/no questions relating to interest in PhD. At T3, 100% of the students reported that participation in Research Day increased their interest in pursuing a PhD and that they plan to continue to do research in the future. Additionally, there was a 20% increase in students interested in continuing EEG research after the course. Figure 2 depicts students' responses to course evaluation questions regarding the PhD degree.

Figure 2. Student responses to questions about the doctor of philosophy (PhD) degree at Time 1 (T1) and Time 2 (T2). EEG = electroencephalographic.



Course objectives. At T2, students rated the effectiveness of class activities in meeting the corresponding course objectives on a Likert scale of *very effective* to *not very effective* (1–5). Responses were aggregated to derive three categories: effective, neutral, and not effective. Table 2 summarizes the percentage of students rating each activity as "very effective" to "effective." Overall, the majority of students rated each activity as effective in meeting the corresponding course objective. Hands-on neuroimaging practice was rated as effective in increasing technical skills by 100% of the students. The overall course was rated effective in learning about the research in CSD, learning how neuroscience applies to clinical practice, and learning how clinicians can contribute to the research in CSD by 92% of the students. The lowest rated activity was the data analysis demonstration, with 75% of the students indicating it was effective in helping them visualize how ERPs are derived from the EEG waveform. Overall, ratings for the effectiveness of class activities in meeting the course objectives were high.

Table 2. Student ratings of course objectives.

Course activity	Objective	% rating, very effective
Hands-on neuroimaging	Develop technical skills	100
PhD student presentations	Path to PhD, development of research questions	92
Research questions assignment	Develop research questions based on a testable hypothesis	92
Laboratory participant experience	Learn about ethical treatment of human subjects	92
E-prime software tutorial	Learn about experimental design	92
Overall course (a)	Learn about research in CSD	92
Overall course (b)	Learn how neuroscience applies to clinical practice	92
Overall course (c)	Learn how practicing clinicians contribute to research	92
Seminar article discussions	Guided practice reading research articles	83
Proposal presentation	Develop a research study based on a question and a hypothesis	83
Data analysis demonstration	Visualize how ERPs are derived from raw EEG signals	75

Note. PhD = doctor of philosophy; CSD = communication sciences and disorders; ERPs = event-related potentials; EEG = electroencephalographic.

Dissemination practice. At T3, students were queried regarding their experience participating in Research Day and how the course supported their abilities during their presentations. It was indicated that Research Day presentations should be a required element of the course by 60% of the students. Participation in Research Day increased interest in doing research with the current instructor or another instructor in the future for 100% of the students. Students rated the effectiveness of class activities in supporting their presentations at Research Day on a Likert scale of *very effective* to *not very effective* (1–5). Responses were aggregated to derive three categories: effective, neutral, and not effective. The majority of students rated the designated class activities as effective in preparing them to present on Research Day. Their ratings of the class activities are as follows:

- Ninety percent of the students rated presentations by PhD students, hands-on neuroimaging practice, final proposal presentation, data analysis demonstration, seminar discussions, workshop time in class, and individual meetings with the professor as effective in preparing them for Research Day.
- Eighty percent of the students reported that the research question assignment and E-prime (experimental presentation software) tutorial assignment were effective in preparing them for Research Day.
- Ninety percent of the students reported that presenting their research increased their confidence in discussing communication disorders and their ability to discuss complex ideas in a simple and straightforward manner and apply scientific literature to clinical practice.
- Eighty-two percent of the students reported that presenting research increased their confidence in their research skills.

- Sixty-four percent of the students reported they were likely to submit to present at research conferences in the future.

At the time of writing this article, five of the 12 students are continuing to develop their EEG projects in the laboratory.

Discussion

The purpose of this article is to describe a methodology-specific research course that allows students to engage in hands-on, practical activities. This course is unique in that it capitalizes on the resources within the department and institution to engage MS students in clinically relevant research. There is a need to further examine the impact of such offerings within graduate programs to address the PhD shortage in our field, to increase graduate students' preparation to contribute to the evidence base in clinical practice, and to improve future clinicians' participation in research. The PhD shortage and its negative impact on the future of the profession are widely acknowledged. Most of the initiatives to address this shortage are focused on increasing opportunities for research engagement at the undergraduate level or funding support for doctoral students. Alternatively, we propose offering a methodologically tailored research course at the master's level to increase students' involvement in research. Such a course creates a collaborative environment of planned interactions with doctoral students or other researchers. We argue that these initiatives focused on collaborative, hands-on, interactive research opportunities at the master's level enhance students' preparation as future evidence-based practitioners and foster interest in pursuing a PhD.

Previous investigations in CSD have shown that providing students with more information about doctoral studies and more research engagement opportunities increases their interest in pursuing a PhD (Willis et al., 2018; Witter & Brackenbury, 2014). Although many such efforts are aimed at undergraduate or doctoral students, the master's program may present an optimal time for engaging in research in tandem with the acquisition of clinical skills. We present here one example of a methodology-specific research course that emphasizes hands-on practice with technical equipment, the overall research process, and the path to doctoral studies. Although there are multiple inherent challenges, careful consideration of the course design, objectives, and logistics can circumvent some of these obstacles. Advances in educational technology allow instructors to apply alternative course delivery methods such as online or hybrid instruction. Implementing courses designed with an inquiry-based approach may further increase critical thinking via opportunity to explore topics in-depth (Berg et al., 2015; Finn et al., 2016; Justice et al., 2006; Magnussen et al., 2000).

Descriptive data from course evaluations show that research-infused curricular offerings in the master's program have the potential to increase research engagement and the number of doctoral level scholars. Overall, students rated the course activities as effective in meeting the specific course objectives. Evaluations of the course show that this methodology-specific research course increased students' perceived research self-efficacy, knowledge about the PhD degree, and interest in continuing with research. Although these findings are preliminary and descriptive in nature, they are aligned with the current literature on research self-efficacy and research experiences in CSD. Students in our EEG Research Methods course increased their interest in pursuing a PhD by T3, when they had the most exposure to aspects of the research process. The most influential activity in increasing their interest in PhD was the dissemination of their work at Research Day. Similarly, the survey by Willis et al. (2018) found that the odds of developing an interest in pursuing a PhD were higher for those students who had some research experience. Moreover, as the students in the EEG Research Methods course had learned explicitly about the path to PhD studies, they became more interested in pursuing the degree (Witter & Brackenbury, 2014). Most importantly, students in the course increased their research self-efficacy, which has implications for later research productivity if they choose to pursue doctoral studies (Bieschke et al., 1996; Love et al., 2007; Pasupathy, 2018). These findings suggest that offering elective master's level courses

incorporating technical, hands-on learning can facilitate students' gradual preparation to become researchers.

Accreditation standards for speech-language pathology programs review a program's research engagement opportunities for students during their graduate studies, highlighting EBP principles and students' preparation to become "knowledgeable consumers of research literature" (Standard 3.5.B, p. 24, Council on Academic Accreditation in Audiology and Speech-Language Pathology, 2017). For research consumption to translate into clinical practice, we must narrow the research-to-practice gap (Olswang & Goldstein, 2017). Olswang and Prelock (2015) identified some factors contributing to the research-to-practice gap in our field such as the expectation that the clinician will consume the disseminated research and independently figure out how to apply it. Pioneering initiatives to increase students' engagement in research provides an opportunity to more profoundly understand how experimental findings are derived and how they relate to clinical practice. Integration of both core research skills and clinical practice during academic preparation may move the profession toward increasing the number of clinician-researchers, which would ultimately lead to a transformative change in the field. Additionally, allowing CSD faculty to incorporate their research expertise more explicitly into the academic coursework provides students with greater access to the scientific aspects of the profession. Moreover, offering a specific research methods course unique to the instructor's expertise may support faculty research productivity and facilitate the ongoing research program at institutions with significant teaching commitments. Rigorous, systematic, and longitudinal research is needed to examine the effectiveness of such graduate offerings and the ultimate impact on our profession.

Acknowledgments

This work was supported by the Adelphi University Teaching Fellows Grant to Melissa Randazzo. The authors are grateful to their mentor and colleague, Karen Froud, for leading by example as a researcher and mentor. The neuroimaging course described in this article would not have been possible without Nathalie Zarisfi, Belle Gironda, and the Adelphi University Teaching Fellows Program. They would also like to thank their colleagues in Adelphi University Teaching Fellows 2017–2018 cohort for their support and feedback on this project. This work would not be possible without the future clinicians who are passionate about research and making contributions to the field.

References

Albert, M., & Beatty, B. J. (2014). Flipping the classroom applications to curriculum redesign for an introduction to management course: Impact on grades. *Journal of Education for Business, 89*(8), 419–424. https://doi.org/10.1080/08832323.2014.929559

American Speech-Language-Hearing Association. (2014). *Quality indicators: Self-assessment*. Retrieved from https://www.asha.org/uploadedFiles/Quality-Indicators-Self-Assessment.pdf

Bailey, J. G. (1999). Academics' motivation and self-efficacy for teaching and research. *Higher Education Research & Development, 18*(3), 343–359. https://doi.org/10.1080/0729436990180305

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Berg, A., Ibrahim, H., Magaster, S., & Salbod, S. (2015). Flipping over the flipped classroom. *Contemporary Issues in Communication Sciences and Disorders, 42,* 16–25.

Bieschke, K. J., Bishop, R. M., & Garcia, V. L. (1996). The utility of the research self-efficacy scale. *Journal of Career Assessment, 4*(1), 59–75. https://doi.org/10.1177/106907279600400104

Bishop, D. V. (2007). Using mismatch negativity to study central auditory processing in developmental language and literacy impairments: Where are we, and where should we be going? *Psychological Bulletin, 133*(4), 651–672. https://doi.org/10.1037/0033-2909.133.4.651

Blanchet, P. G. (2015). The apprentice: A model for mentoring students in research in communication sciences and disorders. *Contemporary Issues in Communication Sciences and Disorders, 42,* 26–32.

Brady, M. C., Fredrick, A., & Williams, B. (2013). People with aphasia: Capacity to consent, research participation and intervention inequalities. *International Journal of Stroke*, *8*(3), 193–196. https://doi.org/10.1111/j.1747-4949.2012.00900.x

CITI Program. (2018). *Research ethics and compliance training*. Retrieved from https://about.citiprogram.org/en/homepage/

Coston, J. H., & Myers-Jennings, C. (2014). Engaging undergraduate students in child language research. *Perspectives of the ASHA Special Interest Groups, 17*(1), 4–16. Retrieved from http://journals/asha.org/perspectives/terms.dtl

Council of Academic Programs in Communication Sciences and Disorders & American Speech-Language-Hearing Association. (2018). *Communication sciences and disorders (CSD) education survey national aggregate data report: 2016–2017 academic year*. Retrieved from https://www.asha.org/Academic/HES/CSD-Education-Survey-Data-Reports/

Council on Academic Accreditation in Audiology and Speech-Language Pathology. (2017). *Standards for accreditation of graduate education programs in audiology and speech-language pathology*. Retrieved from http://caa.asha.org/wpcontent/uploads/Accreditation-Standards-for-Graduate-Programs.pdf

Davidson, M. M., Weismer, S. E., Alt, M., & Hogan, T. P. (2013). Survey on perspectives of pursuing a PhD in communication sciences and disorders. *Contemporary Issues in Communication Sciences and Disorders*, *40,* 98–115.

de Wit, E., Visser-Bochane, M. I., Steenbergen, B., van Dijk, P., van der Schans, C. P., & Luinge, M. R. (2016). Characteristics of auditory processing disorders: A systematic review. *Journal of Speech, Language, and Hearing Research, 59*(2), 384–413. https://doi.org/10.1044/2015_JSLHR-H-15-0118

Downar, J., Krizova, A., Ghaffar, O., & Zaretsky, A. (2010). Neuroimaging week: A novel, engaging, and effective curriculum for teaching neuroimaging to junior psychiatric residents. *Academic Psychiatry, 34*(2), 119–124. https://doi.org/10.1176/appi.ap.34.2.119

Dundar, H., & Lewis, D. R. (1998). Determinants of research productivity in higher education. *Research in Higher Education, 39*(6), 607–631.

Farrugia, P., Petrisor, B. A., Farrokhyar, F., & Bhandari, M. (2010). Research questions, hypotheses and objectives. *Canadian Journal of Surgery, 53*(4), 278–281.

Finn, P., Brundage, S. B., & DiLollo, A. (2016). Preparing our future helping professionals to become critical thinkers: A tutorial. *Perspectives of the ASHA Special Interest Groups, 1*(10), 43–68. https://doi.org/10.1044/persp1.SIG10.43

Friberg, J., Folkins, J., Harten, A., & Pershey, M. (2013). SIGnatures: Undergrad Today, CSD PhD Tomorrow: What can we do to develop more undergraduate students as researchers? Expand our models of undergraduate research and send the students to our meetings, such as ASHA's annual convention. *The ASHA Leader, 18*(7), 54–55.

Froud, K., & Khamis-Dakwar, R. (2012). Mismatch negativity responses in children with a diagnosis of childhood apraxia of speech (CAS). *American Journal of Speech-Language Pathology, 21*(4), 302–312. https://doi.org/10.1044/1058-0360(2012/11-0003)

Fukami, T. (2013). Integrating inquiry-based teaching with faculty research. *Science, 339*(6127), 1536–1537. https://doi.org/10.1126/science.1229850

Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of Nutrition Education and Behavior, 47*(1), 109–114.

Gormally, C., Brickman, P., Armstrong, N., & Hallar, B. (2009). Effects of inquiry-based learning on students' science literacy skills and confidence. *International Journal for the Scholarship of Teaching and Learning*, *3*(2), Article 16. https://doi.org/10.20429/ijsotl.2009.030216

Hagstrom, F., Baker, K. F., & Agan, J. P. (2009). Undergraduate research: A cognitive apprenticeship model. *Perspectives on Issues in Higher Education, 12*(2), 45–52.

Healey, M. (2005). Linking research and teaching to benefit student learning. *Journal of Geography in Higher Education, 29*(2), 183–291. https://doi.org/10.1080/03098260500130387

Jette, D. U., Bacon, K., Batty, C., Carlson, M., Ferland, A., Hemingway, R. D., . . . Volk, D. (2003). Evidence-based practice: Beliefs, attitudes, knowledge, and behaviors of physical therapists. *Physical Therapy, 83*(9), 786–805.

Justice, C., Rice, J., Warry, W., Inglis, S., Miller, S., & Sammon, S. (2006). Inquiry in higher education: Reflections and directions on course design and teaching methods. *Innovative Higher Education, 31*(4), 201–214. https://doi.org/10.1007/s10755-006-9021-9

Kahn, J. H., & Scott, N. A. (1997). Predictors of research productivity and science-related career goals among counseling psychology doctoral students. *The Counseling Psychologist, 25*(1), 38–67. https://doi.org/10.1177/0011000097251005

Key, A. P. F., Dove, G. O., & Maguire, M. J. (2005). Linking brainwaves to the brain: An ERP primer. *Developmental Neuropsychology, 27*(2), 183–215.

Khamis-Dakwar, R. (2012). Translational display of neurophysiological investigations in communication sciences and disorders. In R. Goldfarb (Ed.), *Translational SLP/A: Essays in honor of Dr. Sadanand Singh*. San Diego, CA: Plural.

Kreidler, K., Wray, A. H., Usler, E., & Weber, C. (2017). Neural indices of semantic processing in early childhood distinguish eventual stuttering persistence and recovery. *Journal of Speech, Language, and Hearing Research, 60*(11), 3118–3134. https://doi.org/10.1044/2017_JSLHR-S-17-0081

Lambie, G. W., Hayes, B. G., Griffith, C., Limberg, D., & Mullen, P. R. (2013). An exploratory investigation of the research self-efficacy, interest in research, and research knowledge of Ph.D. in education students. *Innovative Higher Education, 39*(2), 139–153. https://doi.org/10.1007/s10755-013-9264-1

Lee, C., & Schmaman, F. (1987). Self-efficacy as a predictor of clinical skills among speech pathology students. *Higher Education, 16*(4), 407–416. https://doi.org/10.1007/BF00129113

Love, K. M., Bahner, A. D., Jones, L. N., & Nilsson, J. E. (2007). An investigation of early research experience and research self-efficacy. *Professional Psychology: Research and Practice*, *38*(3), 314–320. https://doi.org/10.1037/0735-7028.38.3.314

Madison, C. L., Guy, B., & Koch, M. (2004). Pursuit of the speech-language pathology doctorate: Who, why, why not. *Contemporary Issues in Communication Sciences and Disorders, 31,* 191–199.

Magnussen, L., Ishida, D., & Itano, J. (2000). The impact of the use of inquiry-based learning as a teaching methodology on the development of critical thinking. *Journal of Nursing Education, 39*(8), 360–364.

McComas, K. L., Fry, L., Frank, S. T., & Fraley, N. (2010). Community of research practice: A model for student research. *SIG 10 Perspectives on Issues in Higher Education, 13*(2), 63–68.

McCrea, E., Creaghead, N., Goldstein, H., O'Rourke, C., Ryals, B., Small, S., . . . Gladstone, V. (2008). *Report of the 2008 Joint Ad Hoc Committee on PhD shortages in communication sciences and disorders*. Rockville, MD: American Speech-Language-Hearing Association. Retrieved from http://www.asha.org/uploadedFiles/academic/reports/2008PhDAdHocComFullReport.pdf

McNeil, M. R., Armiento-DeMaria, M. T., Chapman, K. L., DiLollo, A., Ferraro, J. A., Honaker, J. A., . . . Nittrouer, S. N. (2013). *Final report: Strategic plan to increase the student pipeline and workforce for PhD researchers and faculty researchers*. Rockville, MD: Academic Affairs Board, American Speech-Language Hearing Association.

Mueller, P. B., & Lisko, D. (2003). Undergraduate research in CSD programs: A solution to the PhD shortage. *Contemporary Issues in Communication Sciences and Disorders, 30,* 123–126.

Olswang, L. B., & Goldstein, H. (2017). Role of SLP practitioners in research collaborations. *American Speech-Language-Hearing Association*. Retrieved from https://www.asha.org/Articles/Role-of-SLP-Practitioners-in-Research-Collaborations/

Olswang, L. B., & Prelock, P. A. (2015). Bridging the gap between research and practice: Implementation science. *Journal of Speech, Language, and Hearing Research, 58,* S1818–S1826. https://doi.org/10.1044/2015_JSLHR-L-14-0305

Pasupathy, R. (2018). Rehabilitation sciences doctoral education: A study of audiology, speech-language therapy, and physical therapy students' research self-efficacy beliefs. *Clinical Archives of Communication Disorders, 3*(1), 59–66. https://doi.org/10.21849/cacd.2018.00255

Pasupathy, R., & Bogschutz, R. J. (2013). An investigation of graduate speech-language pathology students' SLP clinical self-efficacy. *Contemporary Issues in Communication Sciences and Disorders, 40,* 151–159.

Pasupathy, R., & Siwatu, K. O. (2014). An investigation of research self-efficacy beliefs and research productivity among faculty members at an emerging research university in the USA. *Higher Education Research & Development, 33*(4), 728–741. https://doi.org/10.1080/07294360.2013.863843

Penn, C., Frankel, T., Watermeyer, J., & Müller, M. (2008). Informed consent and aphasia: Evidence of pitfalls in the process. *Aphasiology, 23*(1), 3–32. https://doi.org/10.1080/02687030701521786

Petzold, A., Korner-Bitensky, N., Salbach, N. M., Ahmed, S., Menon, A., & Ogourtsova, T. (2012). Increasing knowledge of best practices for occupational therapists treating post-stroke unilateral spatial neglect: Results of a knowledge-translation intervention study. *Journal of Rehabilitation Medicine, 44*(2), 118–124. https://doi.org/10.2340/16501977-0910

Phillips, J. C., & Russell, R. K. (1994). Research self-efficacy, the research training environment, and research productivity among graduate students in counseling psychology. *The Counseling Psychologist, 22*(4), 628–641. https://doi.org/10.1177/0011000094224008

Rosenfeld, M. (2017). *Speech-language pathology practice and curriculum analysis*. Retrieved from https://www.asha.org/uploadedFiles/SLP-Practice-and-Curriculum-Analysis-Executive-Summary.pdf

Rudolf, S. R., Manning, W. H., & Sewell, W. R. (1983). The use of self-efficacy scaling in training student clinicians: Implications for working with stutterers. *Journal of Fluency Disorders, 8*(1), 55–75. https://doi.org/10.1016/0094-730X(83)90021-9

Sandbank, M., Yoder, P., & Key, A. P. (2017). Word processing in children with autism spectrum disorders: Evidence from event-related potentials. *Journal of Speech, Language, and Hearing Research, 60*(12), 3441–3455.

Shafer, V. L., Morr, M. L., Datta, H., Kurtzberg, D., & Schwartz, R. G. (2005). Neurophysiological indexes of speech processing deficits in children with specific language impairment. *Journal of Cognitive Neuroscience, 17*(7), 1168–1180. https://doi.org/10.1162/0898929054475217

Shea, P., & Bidjerano, T. (2010). Learning presence: Towards a theory of self-efficacy, self regulation, and the development of a communities of inquiry in online and blended learning environments. *Computers & Education, 55*(4), 1721–1731. https://doi.org/10.1016/j.compedu.2010.07.017

Stewart, P. C. (2015). This is your brain on psychology. *Teaching of Psychology, 42*(3), 234–241. https://doi.org/10.1177/0098628315587621

Thai, N. T. T., De Wever, B., & Valcke, M. (2017). The impact of a flipped classroom design on learning performance in higher education: Looking for the best "blend" of lectures and guiding questions with feedback. *Computers & Education, 107,* 113–126. https://doi.org/10.1016/j.compedu.2017.01.003

Tully, M. P. (2014). Articulating questions, generating hypotheses, and choosing study designs. *The Canadian Journal of Hospital Pharmacy, 67*(1), 31–34. https://doi.org/10.4212/cjhp.v67i1.1320

Vax, S., Schreuer, N., & Sachs, D. (2012). Work-related self-efficacy of occupational therapists in mental health. *Scandinavian Journal of Occupational Therapy, 19*(1), 42–48. https://doi.org/10.3109/11038128.2010.527366

Vermiglio, A. J. (2018). The gold standard and auditory processing disorder. *Perspectives of the ASHA Special Interest Groups, 3*(6), 6–17. https://doi.org/10.1044/persp3.SIG6.6

Weber-Fox, C. M., & Neville, H. J. (1996). Maturational constraints on functional specializations for language processing: ERP and behavioral evidence in bilingual speakers. *Journal of Cognitive Neuroscience, 8*(3), 231–256. https://doi.org/10.1162/jocn.1996.8.3.231

Willis, L. B., Schall, K. C., & Piazza, L. (2018). A survey of communication sciences and disorders undergraduate students' research experience and interest in a Master's thesis and PhD degree. *Perspectives of the ASHA Special Interest Groups, 3*(10), 11–26. https://doi.org/10.1044/persp3.SIG10.11

Witter, E. A., & Brackenbury, T. (2014). Undergraduates' knowledge of and interest in the doctorate of philosophy degree for communication sciences and disorders. *Contemporary Issues in Communication Sciences and Disorders, 41,* 252–274.

Yathiraj, A., & Vanaja, C. S. (2018). Criteria to classify children as having auditory processing disorders. *American Journal of Audiology, 27*(2), 173–183. https://doi.org/10.1044/2018_AJA-17-0091

History:
Received June 27, 2018
Revised August 13, 2018
Accepted September 04, 2018
https://doi.org/10.1044/persp3.SIG10.83

Appendix. Instructions for Research Questions Assignment

Purpose

The starting point of a research endeavor is your research question. The research question should be the foundation for the rationale and methods of your research study. A solid research question will help guide you through the existing literature as you gather the essential information to design your experiment. Please follow the prompts below and fill in all requested information.

Learning Objectives

Upon completion of this assignment, students will

- state the definition of *research question* in their own words;
- identify research questions in articles related to their topic of choice;
- synthesize current research related to their research topic of interest;
- utilize FINER criteria to evaluate their research idea; and
- write up to two research questions based on the current literature and needs of the field.

Instructions

1. Background

Please read the following articles to guide the development of your research questions:

Farrugia, P., Petrisor, B. A., Farrokhyar, F., & Bhandari, M. (2010). Research questions, hypotheses and objectives. *Canadian Journal of Surgery, 53*(4), 278.

Tully, M. P. (2014). Articulating questions, generating hypotheses, and choosing study designs. *The Canadian Journal of Hospital Pharmacy, 67*(1), 31.

2. Define

In your own words, state the definition of a *research question*:

3. Brainstorming

Now, write down some general ideas about a research idea that you have. You can use bullet points, key words, or a paragraph.

4. Inform

Look up and read at least three research articles related to your question. Please list the full APA citation of each article. Under each citation, list the main research questions of the articles. At least one article should be an EEG study, and at least one article should be a non-EEG article related to the area of interest.

5. Synthesize

Write one paragraph summarizing the research to date regarding your idea. Please address what is known and what we still need to learn. What were the limitations of other studies that can be addressed using EEG?

6. Evaluate

Using the FINER criteria, evaluate your research idea. Please fill in the boxes next to each item explaining how your research idea fulfills each one of these requirements.

Feasible	
Interesting	
Novel	
Ethical	
Relevant	

7. Write

Utilizing all the information above, now draft one to two research questions about your idea that can be investigated using EEG methodology. Your question should include the ERP of interest.