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Exploring the Role of Mindsets in a Sophomore Level Undergraduate Research Course

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Cover Page Footnote

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Introduction

Undergraduate research presents itself in many forms, including course-based, one-on-one collaboration with a faculty mentor, small group collaboration with a faculty member, and lab-based models. In Communication Sciences and Disorders (CSD), emphasis is placed on undergraduate research as the American Speech-Language-Hearing Association (ASHA, 2020) requires the following standard for certification in speech language pathology and audiology: "The applicant must have demonstrated knowledge of processes used in research and of the integration of research principles into evidence based clinical practice" (ASHA, 2020, Standard IV-F). CSD prepares students to become speech-language pathologists, audiologists, and related professionals. Speech-language pathologists must acquire a Master's degree to practice, while audiologists must earn a clinical doctorate (AuD). Both professions prepare clinical practitioners who must be able to consume and apply research to evidence-based practice. The Council on Academic Accreditation in Audiology and Speech-Language Pathology (CAA, 2017) includes evidence-based practice within its program standards. Standard 3.1.1A indicates that programs must have opportunities for students to develop information literacy and the ability to apply evidence-based practices (EBP) to support clinical decision making (CAA, 2017). While EBP is crucial to practice, conducting and evaluating research may not be intuitive to students who chose this discipline with a broad interest in human service. Within the CSD discipline, some students seem to demonstrate intimidation with courses that draw heavily upon basic sciences and/or research principles. Recognizing the relevance of research to all clinical contexts is a critical realization for CSD students. Thompson and colleagues (2001) examined outcomes of nursing students who participated in data collection in an investigation of pain management. This exposure to clinical research helped students to make the connection between research and practice. Further, their perceptions toward the importance of clinical research became more positive so that they viewed research as an important part of clinical work.

Acknowledging that research is an important element of preparation in the CSD discipline, it is relevant to consider evidence about research education in other disciplines. Recent research has studied the value of undergraduate student research. Further, the effect of mindsets on research intimidation has been examined. Little has been done to consider the effect of research-intimidation on course-based research outcomes. The present investigation seeks to address this void, first addressing the benefits of undergraduate research and then addressing potential influence of mindsets on research engagement.

The Council on Undergraduate Research (CUR) defines undergraduate research as, "an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline" (n.d.). Though CUR's definition seems limited to formal processes, research participation may be better defined as a continuum of experiences. Clark and Johnstone (2018) note that research includes a range of publicly disseminated versus educational-only endeavors, beginning with searching for past research to conducting and disseminating findings. This definition denotes that research is initiated in both formal and informal settings throughout one's education and beyond.

Founding director of the National Survey of Student Experiences (NSSE), George Kuh, suggests that all university students participate in at least two *high impact practices* throughout their

undergraduate career (McCormick et al., 2013). Collaborative research with a faculty member is considered to be *high impact*, as it positively effects student learning and development. Further, there is a correlation between undergraduate research experiences and an increase in GPA (Fauria & Fuller, 2015; Fechheimer et al., 2011; Kinkel & Henke, 2006; Pacifici & Thomson, 2011). Web-based surveys, conducted from 2003-2005, show that 88% of students felt an increase in understanding of how to conduct a research project and 83% reported increased confidence in research skills (Russell et al.,2007). Within the science, technology, engineering, and mathematics (STEM) and social sciences disciplines, undergraduate research has shown many benefits including improved research skills and preparation for graduate education. A study of STEM research demonstrated the impact of undergraduate research within two courses (Balster et al., 2010). While research experiences embedded within an undergraduate course is meaningful, a single course does not always match the timeline needed to develop research skills and/or complete a project. Often, course-based research experiences are continued at the graduate level. Balster and colleagues (2010) developed an *Entering Research* course, catered towards undergraduates, which teaches the basics of the research process. A second course, *Entering Mentoring*, is catered towards graduate students and faculty members. Similar multi-semester course sequences have been implemented at the undergraduate student level, including at-risk students.

Undergraduate Course-based Research. The Collegiate Bridge Research Experience (CBRE) program was implemented to support students identified as academically at-risk (Olson-McBride et al., 2016). The curriculum of this course included study skills training, activities to foster engagement in the university community, and a collaborative research experience. The portion related to undergraduate research was addressed with three modules across two semesters. These modules used a variety of elements to expose students to the basic components of the research process, as well as examples of research projects. The goal was to decrease intimidation regarding research and build confidence to support these students as they continued in college (Olson-McBride et al., 2016). Further, students collaborated in groups to complete a research project from start to finish. Quantitative results indicated that programs such as this, when joined with the traditional curriculum, have a positive impact on academic retention and engagement in future undergraduate research. Qualitative feedback indicated the value of this program in developing research skills, building confidence, and fostering interest in future research experiences (Olson-McBride et al., 2016).

More broadly, course-based undergraduate research has potential to engage more students in research. Bangera and Brownell (2014) identified course-based undergraduate research (CURE) as a mechanism to foster broader access and exposure to research experiences. CURE may involve more diverse students in research by addressing several barriers to engaging in student-faculty collaborative research, including awareness of opportunities, awareness of the broader benefits of such research experiences, perceived barriers to interacting with faculty, as well as financial and personal barriers. Faculty typically select students based on a set of criteria that does not necessarily foster access to more diverse students (Bangera & Brownell, 2014). This includes seeking the strongest academic students. CURE engages a broader group of students in scientific practices, places emphasis on the process and collaboration over product, addresses topics broadly relevant to a discipline, and explores real-unanswered questions, within the context of a course. Bangera and Brownell (2014) make the case that such courses need to be required, introductory-level courses so that it gives all students the opportunity. Part of the hope is that exposure to

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research in the course will serve as a gateway to engagement in other research experiences. Corwin et al., (2015) examined the implementation and design of the CURE model, utilizing a systems approach to explore pathway models for creating the most effective and efficient CURE program. Through this study, they concluded that CUREs are distinctive because they: "1) involve students in multiple science practices, 2) provide opportunities for students to make discoveries, 3) involve students in work that has relevance outside the classroom, 4) involve students, in collaborative work, and 5) provide opportunities for iteration" (Corwin et al., 2014, p. 10).

Springboard for Future Research. Undergraduate research can be considered a transformative experience, as it refines career paths and higher education plans. Including an authentic research experience as a part of undergraduate education in the social sciences can increase understanding of research, the value of research, and motivate students to consider a career in research (Cuthbert et al., 2012). Thirty-nine percent of students participating in undergraduate research reported their experience was helpful in finding "what makes them happy" (Hunter et al., 2007). Survey results show that 80% of student researchers felt their undergraduate experience had a substantial effect on their choice of career and career satisfaction, as 46% believed it was critical for their career choice (Yaffe et al., 2014). This further influences their decision to attend graduate school or pursue a career in research. Interest in higher education also increases for some students; 29% reported a new expectation of obtaining a Ph.D. after an undergraduate research opportunity (Hu et al., 2008; Pacifici & Thomson, 2011; Russell et al., 2007; Smith et al. 2016;).

Students who participated in collaborative undergraduate research with faculty early in their education reported significant gains in the ability to (1) think analytically and logically, (2) put ideas together, and (3) learn on their own (Ishiyama, 2002). These gains were greater than those reported by students who did not participate in research. Harrison et al. (1991) examined undergraduate nursing students' knowledge and attitudes towards research, following completion of a course that focused on teaching research methods to nursing students. They used a traditional teaching approach to have students critique research articles, complete objective examinations of research knowledge, and create a research proposal in small groups. Students reported more positive attitudes towards research at the end of the course versus the at the outset.

Research Anxiety and Mindsets. Intimidating content can produce a preemptive behavioral response by students. Students, when asked to develop a research paper of ten pages or more, may feel overwhelming stress and doubt their ability to create what is asked of them (Kracker, 2002). In contrast, those asked to write a shorter paper experience less anxiety and stress (Kracker, 2002). Kuhlthau (2000) investigated perspectives on the research process and how this may impact emotions, along with overall satisfaction in the process. She found that strong emotions are an important piece of the research process. These emotions may range from confusion and anxiety in the start of the process, to confidence and overall satisfaction or disappointment with the results. In addition, improved student awareness of the process led to improved understanding of the student's personal style of research. Mellon (1986) coined the term "library anxiety" to characterize those with intimidation about library searches and information literacy. This investigation found that 75-85% of students felt fear and anxiety when confronted with assignments that required library use. Some experienced levels of anxiety high enough to interfere with their ability to work logically and effectively. Mech and Brooks (1997) found that this state

of anxiety decreased with experience. Teaching students about the research process may reduce overall anxiety and discomfort (Fister, 1992; Pitts, 1995; Swain, 1996; Valentine, 1993).

Yeager and Dweck (2012) identified the concept of mindsets as a way to operationalize a learner's internal response to new, challenging content/concepts/skills. A "fixed mindset" assumes that our character, intelligence, and creative ability are static factors, which we cannot change in any meaningful way. Success is the affirmation of that inherent intelligence, an assessment of how those static factors measure up against an equally fixed standard. Striving for success and avoiding failure at all costs become a way of maintaining the sense of being smart or skilled. For those with a "fixed mindset," struggles are interpreted as a shortcoming in their ability. Those with a "growth mindset," on the other hand, thrive on challenge and see failure not as evidence of unintelligence but as a springboard for growth and for stretching their existing abilities. Students with a growth mindset tend to show higher achievement across challenging school transitions. They also appear to have a higher course completion rate in difficult courses, such as math (Yeager & Dweck, 2012).

How do we build a growth mindset? Dweck (2010) makes some recommendations to implement at the primary school level. While college is clearly a different context, there seem to be parallels across all levels of education. Teachers must emphasize challenge, rather than success. This can be done by presenting those challenges in a positive and exciting manner. Further, teachers must give students a sense of their progress by creating meaningful learning tasks. These tasks must require students to apply what they have learned to real-life experiences. Dweck also suggests using the word "yet" when grading assignments. She calls this *grading for growth*. She suggests that instead of giving a student an "F" on an assignment, mark it with a "not yet." This teaches students that while they have not mastered the material at that time, they may master it in the future. While this may not translate well to summative assessments at the college level, it could apply to more formative learning experiences, including research and writing drafts. Lastly, promotion of long-term success is recommended. Teachers should speak to the students in a way that displays long-term success is the end goal. While Dweck's research is primarily focused on students prior to college, other studies have explored this at the college level.

Chen and Wong (2015) examined the relationship between mindset and a college student's goal setting approach among 418 university students. The students who had a growth mindset tended to have more mastery goals and performance-approach goals (Chen & Wong, 2015; Elliot & McGregor, 2001). Those students identified learning as incremental and strived to exceed performance of peers. Students who had a fixed mindset tended to have more performance-avoidance goals (Chen & Wong, 2015; Elliot & McGregor, 2001). Such students focused on avoiding looking less competent or inferior to peers. Student mindset can also be linked to leadership. Instructional improvement and a hands-on approach can facilitate internships and coaching during coursework.

Like many of the science or math courses that are affected by mindsets, research courses may elicit a mindset response. Kracker and Wang (2002) explored feelings associated with research in an upper division research course. The study employed Kuhlthau's (1991) Information Search Process (ISP) model for addressing awareness and feelings associated with the research process. The ISP training included a 30-minute presentation by a guest speaker, who talked about their emotions and challenges within the research process and how they persevered. The goal of the ISP

training was to improve awareness of thoughts associated with the research process and improve awareness of feelings associated with the process. Awareness was defined as a state of being mindful or aware of internal and/or external experiences related to the research process. This is intended to ease anxiety and improve satisfaction with the research process. In this two-part study, there was a reduction in anxiety levels associated with research, shifting from quite high prior to the course towards significant decreases following the course. Anxiety was measured directly in part 1 (Kracker, 2002) with a State-Trait Anxiety Inventory (STAI Y-1; Spielberger, 1983). Part two employed mixed methods to examine reflections designed to explore student feelings related to research experiences (Kracker & Wang, 2002). Anxiety was mentioned by students at 59%, difficulty at 47%, confidence at 41%, and interest at 40%. Further, they identified an increase in feelings of satisfaction or affinity to research. Awareness of cognitive aspects improved for all aspects but students were more aware of task initiation, information collection, overall, and writing. These four cognitive aspects also correspond with strong feelings. It is important to note that change scores were calculated based upon mentions of factors later coded qualitatively as anxiety, affinity, and cognitive factors. Recognize that students were not prompted directly to address these factors, so change scores for the group may reflect unequal gains across individuals. Collectively, these quantitative and qualitative findings suggest that the Information Search Process (ISP) training led to a reduction in anxiety and increased interest in research. Papananstasiou (2005) explored this further, identifying five student attitudes toward research: usefulness of research, anxiety, affect indicating positive feelings about research, life relevancy of research to the students' daily lives, and difficulty of research. These attitudes may be of concern among educators since it has been found that anxiety negatively affects learning (Onwuegbuzie & Seaman, 1995). Monahan (1994), found that educators who did not complete a research methods course were less motivated to complete research on their own.

The Current Investigation

In the fall of 2015, the University of Wisconsin – Eau Claire Communication Sciences and Disorders department initiated a required, stand-alone undergraduate course in research methods, which occurs at the freshman–sophomore level. Undergraduate research methods had previously been embedded within the CSD 353 – Speech and Hearing Science course, which also focused heavily on acoustics. As such, students were constrained to research topics associated with acoustic assessment of the voice, speech, or hearing process. This represents only a small segment of research in the discipline. The new course, CSD 235 – Undergraduate Research in CSD, stands-alone and offers students the opportunity to engage in a broader range of research topics. It was intentionally created to occur earlier in the major sequence in order to foster intentional applications to future, disorder-based courses. This framework was modeled after Olson-McBride et al., 2016.

Instructional Methods. This course, under the instruction of Dr. Hemmerich, focused on team-based research and discussion-based learning. Her teaching style, comparable with the pedagogies used throughout CSD Department, included minimal lectures while emphasizing discussion amongst small and large groups. This approach was supported by the use of instructional interns, offering three more individuals to help facilitate small group discussions and consultations. Instructional interns were students who had previously engaged in research within a course and/or

student-faculty collaborative research. See Hemmerich et al. (2015) for an expanded description of instructional interns.

Current students learned about the research process through many experiences. These experiences were divided into two major components, beginning with *learning about the research process* and ending with *conducting a research project*, although there was some overlap of these elements.

Learning about the research process. Students initially learned about the research process through textbook readings, screencasts, and small group discussions. These included topics such as research ethics, institutional review boards, variables, and research designs. Assignments associated with each of these areas were designed to ensure a basic level of understanding in order to move forward in conducting research. As a way to expose students to research within the CSD discipline, they were required to view videos from past student researchers and faculty members, discussing their experiences with research. These researcher videos were intentionally stratified, highlighting undergraduate student-researchers, honors research, graduate research, and faculty research experiences and released throughout the semester from most basic to advanced. Articles from the CSD disciplines, depicting various research designs, were used to contextualize discussions of variables and research design. Students were expected to read an assigned research article before class and be prepared to discuss it in small groups. Within these small jigsaw discussion groups, they discussed the article and practiced extracting pertinent information with the support of the instructor or an instructional intern. Each of the jigsaw groups shared their readings with other groups. As students transitioned from learning about the research process to conducting their own research projects, they reviewed a few example papers from the instructional interns' previous projects. These helped the students recognize expectations for their research project. At the end of the semester and following conduction of their own research project, a research panel composed of current undergraduate and graduate student researchers shared their experiences. This panel was intentionally stratified to display a range of complexity and designs. The goal each of these interventions was to reduce intimidation with regards to research.

Conducting a research project. Throughout the semester, students completed a research project with a small group, using existing clinical datasets. Those datasets were in the form of three cases (i.e., a child with a phonological disorder, a child with Down syndrome, and an adult with aphasia). This included video recordings of each client's sessions across one semester of intervention. A release was obtained to use these videos for course-based instruction and results were not disseminated outside of the classroom. Students formulated their own research questions related to the existing cases, analyzing data related to their research questions. As they learned about each step of the research process, they applied those skills to their own project. Throughout the process, they were provided with formative feedback on their progress and written drafts, providing numerous opportunities to refine their project. They were supported by many resources, including a visit from the campus librarian to learn about database search tools. Following this visit, they practiced creating an outline of a literature review using collaborative assembly. Students made notecards with annotations for specific content ideas from each article and worked collaboratively to assemble them in an intuitive order. Once students began the process of analyzing data and interpreting their findings, they worked in their teams and had daily consultations with the instructor and/or instructional interns. This process allowed them to complete a research project from start to finish, including developing the literature review, asking a research question given

their existing dataset, determining the best design, analyzing and interpreting data, and disseminating their results through an in-class presentation. Note that none of the projects were intended to be disseminated beyond the course.

Research questions:
1) What mindsets toward research are present in an introductory, undergraduate research course?
2) Is there growth in students' perspectives toward research following a guided, hands-on, and course-based research experience?

Methods

Participants. The 2-credit course, CSD 235: Undergraduate Research in Communication Sciences and Disorders, was introduced as a specific required course in the CSD comprehensive major in the Fall of 2015. This investigation was approved by the (removed for blind review) Internal Review Board for the Protection of Human Subjects protocol number 53202016. There were 41 students participating in the course that were primarily sophomore standing CSD majors. Note that credit-level standing does not equate to program standing, which is determined by status in the undergraduate sequence. All 41 students agreed to be a part of the investigation, although only 40 submitted pre- and post-course reflections. For a detailed depiction of participant demographics, see Table 1.

Table 1. Participant demographic information.

Sex	# Credits	Class Level/Credit	*Program Level	Cum GPA	Grade 235
37F	58.49	27 sophomores	37 sophomore standing	3.39	3.86
4M	(41 – 128)	12 juniors	4 junior standing	(2.29 – 4.0)	(B – A)
		2 seniors			

*Note that program level is determined by typical curricular sequence in this department.

Materials and Procedures. Students completed a mindset survey with elements of the Personal Beliefs Survey (Flores et al., 2011), as well as the CSD 235: Undergraduate Research in CSD course outcomes as listed on the syllabus (pre- and post-course survey). Students also submitted reflections that answered prompts focused on exciting and intimidating elements of research, goals for the course and their future profession, and the relationship between clinicians and researchers at the beginning and end of the course (pre- and post-course reflections). Prior to qualitative analyses, all student reflections were de-identified by a research assistant, removing any indicators of time, in order to blind researchers to the who wrote the reflection and when. While codeable segments were identified by statement boundaries, researchers coded each individual reflection in its entirety to retain full context. That allowed researchers to make broad judgments about overall mindset of each essay.

Analyses. Aggregated data from the modified Personal Beliefs Survey (Flores et al., 2011) and course learner outcomes were analyzed quantitatively through descriptive statistics (i.e., mean ratings on a Likert scale of 1 – Strongly Disagree to 5 – Strongly Agree). Survey ratings from pre-course and post-course were compared using a Chi square. Course reflections were analyzed using

Graneheim and Lundman's (2004) qualitative content analysis. Statements were initially sorted by growth mindset, fixed mindset, or other statements, in order to make overall characterizations of individual reflections. Authors one and two completed multiple rounds of this initial sort, meeting to negotiate 100% consensus on all statements. Throughout this iterative process of broadly characterizing statements and essays, categories were identified in each of the three imposed elements of pre- and post-course reflections: goals and planning, exciting elements of research, and intimidating elements of research. It is worth noting that the instructor prompt also included reflections on the relationship of clinicians and researchers but this was not identified a priori as a prominent theme across essays. Authors one and two identified and negotiated categories for the initial two rounds prior to meeting with author three for a final round of consensus coding. Once codes were solidified, individual statements were re-identified as either a pre- or post-course reflection statement in order to foster comparisons in pre- to post-course reflection content. While bias in inherent in all research, the authors attempted to reduce the impact of research through de-identification, multiple rounds of iterative review, and consensus coding. None of the authors were involved in the instruction of the course and both student authors (first and second authors of this paper) had taken research as an embedded component of the previous version of course, Speech and Hearing Science.

Results

Quantitative findings. Aggregated data from the modified Personal Beliefs Survey (Flores et al., 2011) and undergraduate research course learning outcomes are presented as mean ratings on a scale of 1-5 (1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly Agree). See Table 2 for mean ratings pre- and post-course for the 17-item survey. Chi square results comparing pre- to post-course ratings are also included in Table 2, as are Cohen's D effect sizes. A Bonferroni correction was applied to account for number of comparisons.

Table 2. Mean ratings for pre- and post-course learner outcomes and modified personal beliefs.

Survey items	Pre-Course	Post-Course	Chi Square	Cohen's D
1. I feel confident when using the scientific method.	3.63	3.85	42.86, *p<1.11^{08}	0.22 small
2. I can learn new things but I can't really change how intelligent I am.	3.55	3.80	29.78, *p<9.48^{06}	0.23 small
3. I feel confident in my understanding of the principles of ethics in research.	3.98	4.45	38.88, *p<7.37^{08}	0.41 med
4. I can always change basic things about the kind of person that I am.	3.55	3.65	11.89, p<0.02	0.07 small
5. I can do things differently but the important parts of who I am can't really be changed.	2.30	2.6	4.48, p<0.35	0.33 med
6. I feel confident in my understanding of Evidence Based Practice.	3.43	3.98	20.76, *p<.0004	0.50 large
7. No matter how much intelligence I have, I can always change it quite a bit.	3.23	3.53	7.16, p<0.13	0.30 med
8. I feel confident when reading the components of a research paper.	3.20	3.95	49.53, *p<4.52^{10}	.60 large
9. I feel confident when conducting a comprehensive search of research literature.	3.30	3.65	7.60, p<0.11	0.28 small
10. No matter what kind of person I am, I can always change substantially.	3.23	3.30	4.06, p<0.40	0.06 small
11. I am a certain kind of person and there is not really much that can be done to change that.	3.20	3.40	3.64, p<0.46	0.17 small
12. I feel confident in summarizing and evaluating research in the field of Communication Sciences and Disorders.	3.18	3.90	26.96, *p<2.03^{05}	0.45 med
13. My intelligence is something very basic about myself that I can't change very much.	3.30	3.70	5.51, p<0.24	0.34 med
14. I feel confident in following and identifying research designs.	2.93	3.95	58.51, *p<5.97^{12}	0.69 large
15. I feel confident in developing my own rational research scientific question.	3.05	3.65	40.95, *p<2.74^{08}	0.78 large
16. I can always substantially change how intelligent I am.	3.15	3.40	7.91, p<0.10	0.25 small
17. I feel confident in my understanding of the roles and responsibilities of a researcher and clinician.	3.93	4.25	10.29, p<0.04	0.21 small

Note: *indicates significant difference in pre- to post. Plain text items are learner outcomes for CSD 235. *Italics* items are personal beliefs items, including bolded italics. ***Bold Italics*** items are personal beliefs and have been inverted.

Qualitative findings. A total of 518 statements were analyzed from pre-course reflections, along with 757 statements from post-course reflections. Recall that all statements were deidentified of any indicators of time and coded independent of knowledge of which statements were from pre- and post-course reflections. Of the 40 pre-course reflections, 37 were judged to have an overall growth mindset and three with a fixed mindset. Overall impressions of post-course reflections identified 39 with growth mindset and one with a fixed mindset.

Following the imposed framework of reflection prompts, qualitative analyses of pre- and post-course reflections identified three main themes: *goals and planning*, *exciting elements of research*, and *intimidating elements of research*. A number of categories within each theme were present in both pre- and post-course reflections. Some categories were only identified within post-course reflections.

Within the *goals and planning* theme, *applications to future courses* and *applications to future profession clinically*, were present in both pre- and post-course reflections. Eight percent of all *applications to future courses* statements were identified with pre-course reflections, compared to 92% within post-course reflections. Likewise, 17% of all *applications to future profession clinically* statements were present in pre-course, versus 83% post-course. After the course, categories of *understanding the research process* and *growth mindset* were present in student reflections. For a summary of categories and exemplars within each theme, see Table 3.

Table 3. Categories and exemplars for the goals and planning theme.

Theme	Category	Exemplar
Goals and Planning	**Applications to future courses*	*"All of the information I used on how to analyze data and basically how to read and interpret a research article will help me with a lot of future classes and in my future profession also."* (post-course) *"Speaking in terms of future courses, if a question ever came to my mind based on the content of that future course, I will know how to search for articles on the topic, and actually know how to read the articles, which I must admit was very confusing to me at first."* (post-course)
	**Applications to future profession clinically*	*"In my future profession, I will be able to search for past research studies and systematic reviews should I come across a problem I have never seen before in order to determine the best suited treatment option."* (post-course)
	***Understanding the research process*	*"Learning the different steps and stages of the scientific method, learning more about communication disorders as we are conducting our own research, and also widening my horizons and overall knowledge of all the different variables and effects of the research process."* (post-course)
	***Growth mindset*	*"Being familiar with the research process makes it less intimidating as a whole."* (post-course)

Note: *categories present in both pre- and post- reflections, **categories in only post- reflections

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Under the *exciting elements of research* theme, *skills for future research* and *collecting and interpreting data* were present in both pre- and post-course reflections. Twelve percent of all *skills for future research* statements were present pre-course versus 88% post-course. Similarly, 17% of *collecting and interpreting data* statements were identified in pre-course reflections, 73% in post-course reflections. Following the course, *acquiring new information*, *pride in dissemination*, and *many areas for exploration* were identified. *Collecting and interpreting data* and *many areas for exploration* were also present in the *intimidating elements of research* theme. For a summary of categories and exemplars within each theme, see Table 4.

Table 4. Categories and exemplars for the exciting elements of research theme.

Theme	Category	Exemplar
Exciting elements of research	**Skills for future research*	*"I think that gaining that experience and knowledge would be extremely beneficial for the future and developing some skills that I already have."* (pre-course)
	**Collecting and interpreting data*	*"Since there is such a wide spectrum of topics that can be researched, I am able to broaden develop a better understanding of anything I choose. It's exciting to think about what information is out there."* (post-course)
	***Acquiring new information*	*"I am excited that, by being a researcher, I can discover and collect new knowledge that I had not previously known. Since there is such a wide spectrum of topics that can be researched, I am able to broaden develop a better understanding of anything I choose. It's exciting to think about what information is out there."* (post-course)
	***Pride in dissemination*	*"I am now aware of how important it is for the livelihood of this field and cannot wait to contribute. The idea of being able to discover something new is what propels me to begin the research process."* (post-course)
	***Many areas for exploration*	*"There are many aspects of doing research that is exciting to me, beginning with the fact that most times it is an area that they have an interest in. It probably is not something that a teacher told them to research, but rather something they personally have a passion for."* (pre-course)

Note: *categories present in both pre- and post- reflections, **categories in only post- reflections, underlined statements are present in both exciting and intimidating themes.

Intimidating elements of research included *work/effort*, *understanding the research process*, *many areas for exploration*, *collecting and interpreting data*, *wanting/needing to ensure quality results,* and *limited experience* categories. *Work/effort* (36% pre-, 64% post-course) and *understanding the research process* (47% pre-, 53% post-course) were present in both pre- and post-course reflections. The remaining four categories were only identified in post-course reflections. *Collecting and interpreting data* and *many areas for exploration* were both present in the *exciting elements of research* theme as well. For a summary of categories and exemplars within each theme, see Table 5.

Table 5. Categories and exemplars for the intimidating elements of research theme.

Theme	Category	Exemplar
Intimidating elements of research	**Work/effort*	*"There is going to be a lot of hard work and information I will have to sift through, which intimidates me a lot. It seems impossible to do an entire research project in one semester."* (pre-course)
	**Understanding the research process*	*"One aspect of being a researcher that I am intimidated about is the actual scientific process. This would include forming a hypothesis, conducting the research and collecting the data. This is intimidating because I have never done research more extensive than basic science projects completed throughout previous schooling."* (pre-course)
	**Collecting and interpreting data*	*"Although I have learned a lot about research through taking this class, I still am intimidated by some aspects of the research process. For me, these aspects are mainly the collection of data and putting that all together to complete the results section of the research paper."* (post-course)
	***Many areas for exploration*	*"Aspects of being a researcher that is intimidating is figuring out what you want to research and focus your study on. This is probably the most challenging of all because you want to show an interest in the topic yet do research that isn't too complex and hard to conduct. Narrowing down the choices is a smart way to eliminate the ideas you have but it's still hard to decide on a question and even how to word this research question."*(post-course)
	***Wanting/needing to ensure quality results*	*"Also, the process of collecting data still intimidates me. It takes a long time and you need to be very thorough so that you get as accurate of results as possible."* (post-course)
	***Limited experience*	*"Because this is the first class I have taken that involves anything to do with research I had no idea what I was doing."* (pre-course)

Note: *categories present in both pre- and post- reflections, **categories in only post- reflections, underlined statements are present in both exciting and intimidating themes.

Discussion

Intentional scaffolding of an undergraduate research course may reduce intimidation and foster positive attitudes towards the importance of research in the discipline. Given the importance of research and information literacy in the CSD disciplines, exposing students to research early in their programs, reducing intimidation, and improving their ability to consume and produce research is crucial. The present investigation suggests that perceptions and confidence can be changed with a supportive instructional model.

Positive Research Mindsets. Nearly all students had a growth mindset regarding research at the outset of this course. Nevertheless, most students rated gains in perspectives on mindsets measured through the modified Personal Beliefs Survey and on their confidence regarding research-based learning outcomes. Significant gains in mindsets identified through the Personal Beliefs Survey were only seen on survey item 2 (I can learn new things but I can't really change how intelligent I am). This is not surprising given the presence of a growth mindset among most students at the outset. At the outset of class, students had relatively high confidence regarding their research related abilities. It is possible that previous research experiences in high school or college may have buoyed their ratings. On the other hand, some students may have overestimated their initial knowledge and abilities on those research items. Nevertheless, students perceived significant learning gains on 7/9 items related to confidence about research knowledge and skills from outset to end of course. Effect sizes were larger for confidence about research knowledge and skills as well. Given the relatively high ratings initially, this suggests that the course-based research experience provided a meaningful extension of their prior knowledge. The only two content-based items not significant were 9 (I feel confident when conducting a comprehensive search of research literature) and 17 (I feel confident in my understanding of the roles and responsibilities of a researcher and clinician). One could argue that those are among the highest level skills in the survey. As is evident in Table 1 (program level column), the course was predominantly made up of sophomores (n = 37) with a few juniors (n = 4). The intent was to make this course a freshman-sophomore level course; However, there was a backlog of sophomores and juniors who needed to take the course to meet new requirements in the major since the restructuring of this new curriculum change. Subsequent enrollments in the course have become dominated by freshman and a few sophomores. Regardless, this course fostered positive mindsets towards the relevance of research and strengthened confidence to consume and produce research.

Recognizing the Value and Importance of Research. Exposure to a guided, hands-on research experience increased student perspectives on the value of research knowledge in future classes within the CSD major. Students commented on the importance of being able to draw upon new skills to read, analyze, and interpret data. This is consistent with past findings where students recognize the value of research following a research experience (Cuthbert et al., 2012; Harrison et al., 1991). While some students remarked about this perceived value in their pre-course reflections, there was a stark increase in statements within the post-course reflection. Beyond coursework, students made extensions to clinical applications within the professions of speech-language pathology and audiology. Students specifically recognized the relevance to determining "…the best suited treatment option" by drawing upon previous studies and systematic reviews. This is consistent with findings from research in other clinical disciplines, which identified applications to clinical practice (Thompson et al., 2001). Students reported learning more about communication disorders by conducting their own research. Again, some students identified this value in their pre-course reflections but many more made that connection in the post-course reflection. This was fueled by a reported increased understanding of the research process and a growth mindset, indicating more openness to conducting research in the future (Cuthbert et al., 2012; Olson-McBride et al., 2016). While many students remarked about the decreased intimidation of the research process following this course, others noted that conducting research was not for them. Regardless of their interest in future research, there was a broad recognition, expressed in reflections, that understanding research is important for their future careers (Cuthbert et al., 2012; Harrison, 1991).

Along with perceptions of the value of research, students identified the value of skill development for future research, including collecting and interpreting data (Balster et al., 2010; Olson-McBride et al., 2016; Russell et al., 2007). Students remarked on the wide spectrum of topics to choose from and how research helps them to develop a deeper understanding of such topics. While some students recognized this value at the outset, there was a substantial increase in statements within the post-course reflections.

One potential finding that may warrant consideration as a way to foster further interest in research is the pride associated with sharing the results of their work. The idea of making a contribution and discovering something new is compelling to students. While students expressed a number of concerns about research that remain intimidating, there was clear pride in work that is well done. While the quality of student products varied substantially in this introductory course, there is a clear excitement when student groups present their research in the final weeks of class. This factor may help motivate them to overcome several factors that remain intimidating to students.

Some Intimidating Factors Remain. While students find it exciting that there are so many potential areas for future exploration in CSD, this realization is also seen as intimidating by many students. Knowing that there are many potential areas of investigation may make it feel feasible to make a meaningful research contribution to the discipline. Of course, that can feel overwhelming to a novice researcher who does not have a lot of experience to draw upon. In this course, an effort was made to emphasize the value of working with a team, particularly a team that includes more experienced mentorship.

A number of other elements associated with research intimidated undergraduate students in the present investigation. Many recognized the amount of work and effort it takes to conduct research. While they did not work towards submitting their work to a conference or publication in this course, many recognized the effort to coordinate work with collaborators in order to finalize their paper and oral presentation. While students recognized that their knowledge of the research process had increased, many also recognized how much they still need to learn. Likewise, while many students reported that their skills in collecting and interpreting data had developed as a result of this course, many students recognized that their skills were still very limited in the context of more complex or independent research. Perhaps this relates to the importance of being able to discern the quality of research works when making decisions about best practices. As such, many students were concerned about wanting/needing to ensure quality (reliable and meaningful) results in their own work. All of this likely relates to a common recognition that they have very limited experience in the big scheme of things.

In spite all of the potential intimidating factors associated with conducting research, many students expressed excitement about being involved in future research collaborations. An overwhelmingly positive, growth mindset about research was evident in most student reflections at the end of this introductory, hands-on research course.

Implications

From the standpoint of teaching and mentoring undergraduate students in research, we cautiously make several broad implications of this investigation.

- Surveying mindsets helps to identify student perceptions about research.
- Identifying what intimidates learners allows instructors to scaffold learning about those topics.
- Reducing intimidation can increase interest in research.
- Help students to recognize the relevance of research to their everyday future profession.
- This type of early, hands-on, and guided experience provides an opportunity to apply research to the Communication Sciences and Disorders field.

Limitations

Because this was a pilot investigation, we did not establish the validity of the modified Personal Beliefs Survey in combination with the course learner outcomes survey. In this initial iteration, we did not control for the past research experiences of students in the course, which could have contributed to their baseline comfort level and potential readiness for growth. Further, the majority of students in this course were sophomores, with some juniors. Future iterations of the course included primarily freshman and sophomores, which may alter mindsets at the outset and reduce the likelihood of previous exposure to learning that may influence perceptions. We hypothesize that freshman may have fewer experiences to draw upon and thus experience greater shifts in mindsets. This would be an interesting next step to examine.

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