

Exploring the Relationship Between Depression and Graduate School Among Life

Sciences Ph.D. Students

by

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A Thesis Presented in Partial Fulfillment  
of the Requirements for the Degree  
Master of Science

Approved October 2022 by the  
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ARIZONA STATE UNIVERSITY

December 2022

## ABSTRACT

Depression is one of the top mental health concerns among biology graduate students and has contributed to the “graduate student mental health crisis” declared in 2018. Prominent science outlets have called for interventions to improve graduate student mental health, but few studies have examined the relationship between depression and graduate school among life sciences Ph.D. students. In this coupled set of qualitative interview studies, 50 life sciences Ph.D. students from 28 institutions across the United States were interviewed. The first study explored how research and teaching affect depression in Ph.D. students and how depression in turn also affects students’ experiences in graduate school. Using inductive coding, four overarching aspects of graduate school that influenced student depression were highlighted, (1) structure in teaching and research, (2) positive and negative reinforcement, (3) success and failure, and (4) social support and isolation. The second study explored depression as a concealable stigmatized identity (CSI) by examining (1) to what extent and why graduate students revealed their depression to faculty advisors, graduate students, and undergraduate researchers, and (2) the consequences or benefits that they perceive are associated with revealing one’s depression through a hybrid approach of deductive and inductive coding. Graduate students most commonly revealed their depression to other graduate students; however, most were reluctant to share their depression with undergraduate researchers. These qualitative interview studies provide insights into creating more inclusive life science graduate programs for students with depression.

## DEDICATION

To my boyfriend, my mother, my father, my siblings, my grandparents, and my great grandmother for supporting me both professionally and personally throughout my journey of life and academics. To the mentors, supervisors, peers, and inspirations who ignited a culminated flame of scientific curiosity and creativity which ultimately led to my passion for pushing the boundaries of mental health and its relationship with STEM education. To Beamer and Bonnie who have been at my side every day and constantly remind me of the importance found in kindness, simplicity, and gratitude.

## ACKNOWLEDGMENTS

In 2020, I was first given the opportunity to work with my mentor, Dr. Katelyn Cooper as an undergraduate researcher. Since then, I have been nothing but thankful to have a mentor such as Dr. Katelyn Cooper who not only took a chance by bringing me on as a graduate student within her lab, but also as someone who believed in me as a researcher. Dr. Katelyn Cooper was my first glimpse into the world of biology education research, specifically through a lens of mental health accessibility and the inequities found within these types of learning and research spaces. Without her dedication and motivation to push me to be a better researcher, I firmly believe I would not be in the state I am today compared to where I was almost 3 years ago.

I thank Dr. Jane Maienschein for being a source of inspiration during my time of being a graduate student and a person who exemplifies great leadership. I am also grateful for my time with Dr. James Collins who I had the opportunity to work with as a graduate teaching assistant during my first semester at ASU. His thoughtfulness and continuous curiosity towards the unknown in science is not only admirable, but inspiring for a young researcher. I also thank Dr. Sara Brownell for the opportunity to work with the RISE Center and learn professional development skills while also working together to explore how we can make science education more inclusive for undergraduate and graduate students.

I am grateful for my colleagues, peers, and lab mates who I have worked alongside during my time as a graduate student including Tasneem Mohammed, Logan Gin, Carly Busch, Emma Goodwin, Samantha Maas, and Erika Nadile.

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## INTRODUCTION

### **The Graduate Student Mental Health Crisis**

Three years ago, the remarkably high rates of depression among graduate science students in concert with the negative impact that depression can have on student experiences in graduate school led scientists to declare a “graduate student mental health crisis” (Evans et al., 2018; Flaherty et al., 2018). Research estimates depression affects around 55% of life sciences Ph.D. students and disproportionately affects groups of individuals who are already underrepresented or underserved in science, including, women (American College Health Association, 2019; Evans et al., 2018), individuals from low socioeconomic backgrounds (Eisenberg et al., 2007), and members of the LGBTQ+ community (Eisenberg et al., 2007; Evans et al., 2018). In response to this mental health crisis (Evans et al., 2018), researchers have begun to identify aspects of graduate school that correlate with depression including a lack of work-life balance (Evans et al., 2018; Liu et al., 2019) and poor mentor-mentee relationships (Hish et al., 2019; Peluso et al., 2011). However, the impact of graduate research and teaching on students’ depression is noticeably absent from the literature.

### **Depression in Graduate Research and Teaching**

In the first interview study presented in this thesis, my lab and I wanted to explore the factors found in research and teaching that exacerbate or alleviate graduate student depressive symptoms. This would aid in highlighting the unknown underlying factors within life science graduate programs that affect graduate student depression. In turn, I also wanted to explore in this first interview study, the reverse effect of one’s depressive symptoms on their experiences in graduate research and teaching. The insights found

within this study could highlight recommendations that faculty advisors, and graduate school departments across the United States could utilize when creating more accessible and include graduate research and teaching spaces for students with depression. While these recommendations may be helpful in creating more inclusive spaces for graduate student mental health, this may not allow for these recommendations to be maximized for students who are not vocal about their depression in their graduate program.

### **Depression as a Concealable Stigmatized Identity**

Depression has been labeled as a concealable stigmatized identity (CSI), or an identity that is invisible or easily stigmatized (Chaudoir & Quinn, 2010). Despite the prominence of depression among graduate students and the general concern for graduate student well-being, it is unclear to what extent graduate students share their depression with others in their life sciences Ph.D. programs. In the second study presented within this thesis, I wanted to examine depression as a CSI and explore the extent to which graduate students reveal or conceal their depression to those in their research spaces. Exploring depression as a CSI in graduate spaces can allow faculty advisors and other individuals found in graduate programs to tailor the recommendations found in the first study to maximize their impact from the results found examining depression as a CSI in graduate student research.

### **Future Uses**

The work found within the two presented studies pinpoint specific aspects of Ph.D. programs that administrators and mentors can target to improve the mental health of life sciences Ph.D. students and tailor those specific aspects to students who have either revealed or concealed their depression within their life sciences Ph.D. programs.

PHDEPRESSION: EXAMING HOW GRADUATE RESEARCH AND TEACHING  
AFFECT DEPRESSION IN LIFE SCIENCES PHD STUDENTS

**INTRODUCTION**

In 2018, researchers found that graduate students were more than six times as likely to report experiencing depression and anxiety compared with the general population and subsequently declared a “graduate student mental health crisis” (Evans *et al.*, 2018; Flaherty, 2018). Calls to identify which factors exacerbate graduate student mental health problems followed (“The Mental Health of PhD Researchers,” 2019; Woolston, 2019a). However, few studies have taken an inductive approach to identifying what aspects of graduate school in particular affect student mental health. More commonly, large quantitative studies propose a limited number of factors that may affect student mental health that participants select from, few of which directly relate to graduate research or teaching (Peluso *et al.*, 2011; Levecque *et al.*, 2017; Evans *et al.*, 2018; Liu *et al.*, 2019). In this interview study, we focus on depression in life sciences PhD students and examine which specific aspects of research and teaching graduate students report as affecting their depression. We also explore how depression affects students’ experiences in graduate school.

The American Psychiatric Association defines depression as a common and serious medical illness that negatively affects how one feels, the way one thinks, and how one acts (American Psychiatric Association, 2020). Depression is characterized by nine symptoms: depressed mood; markedly diminished interest or pleasure in activities; reduced ability to think or concentrate, or indecisiveness; feelings of worthlessness, or excessive or inappropriate guilt; recurrent thoughts of death or suicidal ideation, or

suicide attempts or plans; insomnia or hypersomnia; significant change in appetite or weight; psychomotor agitation or retardation; and fatigue or loss of energy (American Psychiatric Association, 2013; Schmidt and Tolentino, 2018). For depression to be diagnosed, the presence of at least five of the symptoms is required most of the day, nearly every day, for at least 2 weeks in addition to the occurrence of either depressed mood or diminished interest or pleasure (American Psychiatric Association, 2013). In the general

U.S. population, depression affects approximately 6.7% of individuals and is estimated to affect 16.6% of individuals at some point in their lifetime.

Graduate students are far more likely to report experiencing depression compared with the general population (Evans *et al.*, 2018; Barreira *et al.*, 2020). Specifically, a recent study of master's and PhD students in programs across the world, spanning a variety of disciplines, found that 39% of graduate students reported having moderate to severe depression (Evans *et al.*, 2018). Similar studies have demonstrated high rates of depression in graduate students in specific disciplines such as economics (Barreira *et al.*, 2020), biochemistry (Helmers *et al.*, 1997), pharmacology (Helmers *et al.*, 1997), and physiology (Helmers *et al.*, 1997). Depression rates have surged in recent years among graduate students (American College Health Association, 2014, 2019). Talking about depression has become more socially acceptable, particularly among younger adults (Anxiety and Depression Association of America, 2015; Lipson *et al.*, 2019), which may have contributed to the number of students willing to reveal that they are struggling with mental health. Additionally, depression is highly related to burnout, defined as a work-related chronic stress syndrome involving emotional exhaustion, depersonalization, and

reduced personal accomplishment (Maslach *et al.*, 2001; Bianchi *et al.*, 2014). Graduate work environments appear to be increasingly characterized as stressful and demanding (American College Health Association, 2014, 2019; Woolston, 2017), which may also be contributing to the increase in graduate depression rates.

Increasingly, scientists, psychologists, and education researchers are recognizing graduate student mental health as a concern and calling for further investigation of graduate student mental health in hopes of identifying interventions to improve graduate student quality of life (“The Mental Health of PhD Researchers,” 2019; Woolston, 2019a,b). For example, in 2019, *Nature* added a question to its annual survey of PhD students asking students from around the world whether they had sought help for anxiety or depression, and more than one-third (36%) confirmed they had (Woolston, 2019b). Additionally, notable publication outlets such as *Nature* (“The Mental Health of PhD Researchers,” 2019), *Scientific American* (Puri, 2019), and *Science* (Pain, 2018) have published blogs or editorials spotlighting the need to improve graduate student mental health.

Some recent studies have sought to uncover the factors affecting depression in graduate students. Primarily, survey studies with predetermined factors that researchers hypothesized impact student mental health have identified poor mentor–mentee relationships (Peluso *et al.*, 2011; Evans *et al.*, 2018; Hish *et al.*, 2019; Liu *et al.*, 2019; Charles *et al.*, 2021), financial stress (Hish *et al.*, 2019; Jones-White *et al.*, 2020; Charles *et al.*, 2021), and lack of work–life balance (Evans *et al.*, 2018; Liu *et al.*, 2019) to be associated with depression or depressive symptoms among graduate students in various disciplines. Other variables shown to be predictive of depression include low research

self-efficacy, defined as low confidence in one's ability to do research (Liu *et al.*, 2019), difficulty publishing papers (Liu *et al.*, 2019), hours worked per week (Peluso *et al.*, 2011), and perceived institutional discrimination (Charles *et al.*, 2021). Factors that appear to be protective of depressive symptoms include social support (Charles *et al.*, 2021), mastery, defined as the extent to which individuals perceive themselves to be in control of the forces that impact their lives (Hish *et al.*, 2019), positive departmental social climate (Charles *et al.*, 2021), optimism about career prospects (Charles *et al.*, 2021), and sense of belonging to one's graduate program (Jones-White *et al.*, 2020). While these studies have identified some depression-related factors associated with graduate school broadly and emphasize the importance of positive mentor-mentee relationships, few studies have explored factors specifically associated with research and teaching, the two activities that graduate students engage in most frequently during their time in a program. Additionally, the extant literature has primarily focused on surface causes of graduate student depression yet understanding the underlying causes may be key to developing meaningful interventions. For example, while it is well established that student perception of poor mentorship is related to student depression (Evans *et al.*, 2018; Hish *et al.*, 2019; Liu *et al.*, 2019; Charles *et al.*, 2021), it is less well understood what specific behaviors mentors exhibit and how such behaviors negatively affect the cognitive and behavioral underpinnings of graduate student depression. Without this knowledge, it is difficult to develop strategies to help mentors be more inclusive of students.

Theories of depression seek to explain the causes of depression. No theoretical model is widely accepted as an overarching framework for depression within the



psychological and psychiatric communities (Mcleod, 2015; Ramnerö *et al.*, 2016); instead, there are a number of models addressing how different aspects of depression are associated with the disorder. Arguably, the three most prominent models are cognitive (Beck *et al.*, 1979), behavioral (Martell *et al.*, 2001), and psychodynamic (Busch *et al.*, 2016). In brief, cognitive theories focus on an individual's beliefs and propose that changes in thinking precede depressive symptoms; for example, negative views of oneself, the world, and the future are thought to be common for individuals with depression (Beck *et al.*, 1979; Leahy, 2002). Behavioral theories emphasize that depression is a result of one's interaction with the environment; depressive symptoms are thought to be the result of decreased reward, lack of positive reinforcement, encouragement of depressive or passive behaviors, and discouragement of healthy behaviors (Lewinsohn, 1974; Martell *et al.*, 2001; Carvalho *et al.*, 2011). Psychodynamic theories of depression consider the role of feelings and behaviors in the etiology and persistence of depressive symptoms; these theories often focus on 1) one's biology and temperamental vulnerabilities, 2) earliest attachment relationships, and 3) childhood experiences associated with frustration, helplessness, loss, guilty, or loneliness (Busch *et al.*, 2016). While each group of theories has been critiqued and no one theory fully explains one's experience with depression (Mcleod, 2015; Ramnerö *et al.*, 2016), we propose that each may be helpful in understanding how aspects of graduate school may affect depression among PhD students.

The thoughts and behaviors associated with depression may in turn affect students' experiences in graduate school, particularly their experiences with research and teaching. While no studies have examined how depression explicitly affects graduate

students' research experiences, studies have identified ways in which depression can affect students' experiences in under-graduate research (Cooper *et al.*, 2020a,b).

Undergraduate researchers report that their depression negatively affected their motivation, ability to concentrate and remember, intellectual engagement, and creativity in research (Cooper *et al.*, 2020b). Undergraduates described that their depression also caused them to be overly self-critical, less social, and ultimately negatively affected their research productivity. Additionally, under-graduates have been reluctant to share their depression with others in the lab because they fear that they will be judged (Cooper *et al.*, 2020b). While these studies provide some insight into how depression may affect graduate students' experience in research, there is much less information about how depression may affect graduate teaching.

In this study, we interviewed 50 PhD students in the life sciences who self-identified with having depression with the intent of answering two research questions that address gaps in the literature: 1) What specific aspects of graduate research and teaching affect PhD student depression? 2) How does PhD students' depression affect their experience in research and teaching?

## **METHODS**

### **Student Interviews**

This study was done under an approved Arizona State University Institutional Review Board protocol (no. 00011040).

In Fall 2019, I surveyed graduate students by sending an email out to program administrators of all life sciences graduate programs in the United States that are listed in *U.S. News & World Report* (2019). Of the 259 graduate programs that were contacted; 75

(29.0%) program administrators agreed to forward our survey to students enrolled in their graduate programs. Of the 840 graduate students who participated in the survey, 459 (54.6%) self-identified as having depression based on general demographic questions on the survey. Of the 459 students who identified as having depression, 327 (71.2%) agreed to be contacted for a follow-up interview. In Summer 2020, a recruitment email was sent out to the 327 students who identified as having depression, asking to interview them about their experiences with depression in a PhD program. Students were not required to be diagnosed with depression in order to participate in the interview study. I did not want to bias our sample, as mental health care is disproportionately unavailable to Black and Latinx individuals, as well as to those who come from low socioeconomic backgrounds (Howell and McFeeters, 2008; Kataoka *et al.*, 2002; Santiago *et al.*, 2013). Of the students who were contacted, 50 PhD students (15.3%) enrolled across 28 life sciences PhD programs completed an interview.

The interview script was based on a previous interview script that we had developed, which successfully elicited what aspects of research affect depression in undergraduates and how depression affects their research (Cooper *et al.*, 2020a). Our previous work has shown that research experiences do not exclusively worsen depression, but that aspects of research can also help students manage their depression (Cooper *et al.*, 2020a). As such, our interview questions explored what aspects of research helped students manage their depression (positively affecting depression), and what aspects worsened students' depression (negatively affecting depression). Additionally, we hypothesized that other prominent aspects of graduate school, such as teaching, would also affect PhD student depression and revised the interview script to include questions

focused on examining the relationship between depression and teaching. We asked students what aspects of graduate research and teaching made their depression worse and what aspects helped them manage their depression. Participants were invited to come up with as many aspects as possible. We also asked how students perceived their depression affected their research and teaching. With the knowledge that we would be conducting interviews during summer of 2020 in the midst of the COVID-19 pandemic, and that the pandemic had likely exacerbated graduate student depression (Chirikov *et al.*, 2020), we directed students to *not* reference aspects of research and teaching that were uniquely related to the pandemic (e.g., teaching remotely or halted research) when discussing the relationship between research, teaching, and depression. We were specifically interested in aspects of teaching and research that affected student depression before the pandemic and would presumably affect student depression afterward. We conducted think-aloud interviews with four graduate students who identified as having depression to ensure that our questions would not offend anyone with depression and to establish cognitive validity of the interview script by ensuring that each student understood what each question was asking. The interview script was iteratively revised after each think-aloud interview (Trenor *et al.*, 2011). A final copy of the interview script can be found in the Supplemental Material.

All interviews were conducted using Zoom by one of two researchers (L.E.G. or K.M.C.). The average interview time was about 45 minutes. After the interview, all participants were sent a short survey to collect their demographics and additional information about their depression (a copy of the survey can be found in the

Supplemental Material). Participants were provided a small monetary gift card in exchange for their time. All interviews were deidentified and transcribed before analysis.

### **Interview Analysis**

Three researchers (L.E.G., N.J.W., and K.M.C.) independently reviewed 12 of the same randomly selected interviews to explore each idea that a participant expressed and to identify recurring themes (Charmaz, 2006). Each researcher took detailed analytic notes during the review. After, the three researchers met to discuss their notes and to identify an initial set of recurring themes that occurred throughout the interviews (Saldaña, 2015). The authors created an initial codebook outlining each theme and the related description. Together, the authors then reviewed the same set of five additional interviews to validate the themes outlined in the codebook and to identify any themes that may have been missed during the initial review. The researchers used constant comparison methods to compare quotes from the interviews to each theme and to establish whether any quotes were different enough from a particular theme to warrant an additional code (Glesne and Peshkin, 1992). Together, the three researchers revised the codebook until they were confident that it captured the most common themes and that no new themes were emerging. A final copy of the codebook can be found in the Supplemental Material. Two authors (L.E.G. and N.J.W.) used the final codebook to code five randomly selected interviews (10% of all interviews) and their Cohen's kappa interrater score was at an acceptable level (Cohen's kappa = 0.94; Landis and Koch, 1977). Then, one researcher (N.J.W.) coded the remaining 45 interviews. In the text, we present themes mentioned by at least 10% of interviewees and use quotes to highlight themes. Some quotes were lightly edited for clarity.

## **Author Positionality**

Some of the authors identify as having depression and some do not. One author had completed a PhD program (K.M.C.), one author was in the process of completing a PhD program (L.E.G.), and two authors were undergraduates (N.J.W. and I.F.) at the time when the interviews and analyses took place.

## **Interview Participants**

Fifty PhD students agreed to participate in the study. Students were primarily women (58%), white (74%), and continuing-generation college students (78%). Twelve percent of students were international students, and the average age of the participants was 28 years old. While 20% of students were unsure of their career goals, 32% of students planned to pursue a career in academia, and 24% were planning to pursue a career in industry. Students reported how severe they perceived their depression to be, on average, during the time they had spent in their PhD programs. Most students reported their depression as either moderate (50%) or severe (28%). Eighty percent of students reported being diagnosed with depression, and 74% reported receiving treatment for depression. Participants were at different stages in their PhD programs ranging from first year to sixth year or more. Three students had graduated between the time they completed the initial survey and when they participated in the interview in Summer 2020. Students self-reported their main research areas and represented a broad range, with ecology and evolutionary biology (26%), animal science (14%), molecular biology (14%), and neurobiology (10%) being the most common. Eighty-six percent of students had experience teaching undergraduates, primarily as teaching assistants (TAs), at the time of the interviews. All student demographics are summarized in Table 1.

**Table 1.** Participant Demographics

<b>Student-level demographics</b>	<b>Interview participants (N = 50) n (%)</b>	<b>Research/teaching demographics</b>	<b>Interview participants (N = 50) n (%)</b>	<b>Depression demographics</b>	<b>Interview participants (N = 50) n (%)</b>
<b><u>Gender</u></b>		<b><u>Program year</u></b>		<b><u>Severity of depression during graduate school</u></b>	
Woman	29 (58)	First year	4 (8)	Mild	7 (14)
Man	17 (34)	Second year	13 (26)	Moderate	25 (50)
Nonbinary/gender fluid	4 (8)	Third year	12 (24)	Severe	14 (28)
<b><u>Race/ethnicity</u></b>		Fourth year	5 (10)	Extremely Severe	4 (8)
Asian/Pacific Islander	4 (8)	Fifth year	7 (14)	<b><u>Diagnosed with Depression</u></b>	
Black/African American	1 (2)	Sixth year or more	6 (12)	Yes	40 (80)
Hispanic/Latinx	4 (8)	Recently Graduated	3 (6)	No	8 (16)
White/Caucasian	37 (74)	<b><u>Focus area of research</u></b>		Decline to state	2 (4)
One or more race/ethnicity	3 (6)	Animal science	7 (14)	<b><u>Treated for Depression</u></b>	
Decline to state	1 (2)	Biochemistry	3 (6)	Yes	37 (74)

<b><u>College generation status</u></b>		Biological anthropology	1 (2)	No	11 (22)
First generation	11 (22)	Biology education	1 (2)	Decline to state	2 (4)
Non-first generation	39 (78)	Ecology/evolutionary biology	13 (26)	<b><u>Treatment methods for depression</u></b>	
<b><u>International Status</u></b>		Environmental and conservation biology	2 (4)	Medication	3 (6)
Yes	6 (12)	History and philosophy of science	1 (2)	Therapy/counseling	12 (24)
No	44 (88)	Immunology	4 (8)	Both medication and therapy/counseling	21 (42)
<b><u>Age</u></b>		Microbiology	1 (2)	Decline to state	14 (28)
Mean (SD)	28 (3.4)	Molecular biology and genetics	7 (14)		
Range	23 - 40	Neurobiology	5 (10)		
<b><u>Career goal</u></b>		Physiology	2 (4)		
Academia	16 (32)	Plant science	3 (6)		
General research assistant	8 (16)	<b><u>Teaching experience</u></b>			
Industry	12 (24)	Yes	43 (86)		
Science Policy	4 (8)	No	7 (14)		
Undecided	10 (20)				



## **RESULTS**

### **The Effect of Research on Graduate Student Depression**

Students more commonly identified ways that research negatively affected their depression than ways research positively affected their depression. Considering all factors that students listed and not just those that were most common, students on average listed two ways in which an aspect of research negatively affected their depression and one way in which an aspect of research positively affected their depression.

The most commonly reported aspect of research that worsened students' depression was experiencing failures, obstacles, or setbacks in research. Specifically, students cited that failed experiments, failed research projects, and the rejection of manuscripts and grants was particularly difficult for their depression. Conversely, students highlighted that their depression was positively affected when they were able to make substantial progress on their research projects; for example, if they wrote part of a manuscript or if an experiment worked. Students also explained that accomplishing smaller or mundane research tasks was helpful for their depression, both because they felt as though they were checking off a box and also because it allowed them to focus on something other than the negative thoughts often associated with depression.

Students also highlighted that the unstructured nature of graduate research worsened their depression. Specifically, students described that, in graduate research, there are often no clear directions, sets of guidelines, or deadlines to help structure their day-to-day activities. Without this structure, students need to rely on their own motivation to outline goals, accomplish tasks, or seek help, which participants described can be difficult when one is experiencing a depressive episode. However, students also

felt as though the unstructured nature of research benefited their depression, because it allowed for flexibility. Those who did not have frequent deadlines or strict schedules were able to not conduct research on days when they needed to recover from a depressive episode or schedule research around therapy or other activities that had a positive impact on their depression. Finally, students highlighted that their passion for their research was protective against depression. Their love for the subject of their research or thinking about how their work may have a positive impact on others could positively affect their motivation or mood.

Students described that their relationships with others in the lab also affected their depression. Specifically, if their mentors or others in their lab had unreasonable or overwhelming expectations of them, it could make them feel as though they would never be able to meet such expectations. Research also provides an environment for students to constantly compare themselves with others, both those in supervisory roles as well as peers. Notably, when students mentioned comparing themselves with others, this comparison never made them feel good about themselves, but was exclusively detrimental to their depression; they felt as though they would never be able to accomplish what others had already accomplished. Students' relationships with their mentors also seemed to have a notable impact on their depression. Having a positive relationship with their mentors or a mentor who provided psychosocial support positively affected their depression, whereas perceiving a negative relationship with their mentors, particularly a mentor who provided consistently harsh or negative feedback, was detrimental. Students who had absent mentors or mentors who provided infrequent technical support and guidance also felt as though this situation worsened their

depression, because it prevented or prolonged their success in research. Finally, students high- lighted that conducting graduate research can be isolating, because you are often working on something different from those in the lab or because those outside graduate school cannot relate to the stress and struggles associated with research. However, in instances in which students were able to collabo- rate with others, this could be protective against depression, because it gave students a sense of comradery or validated their feelings about specific aspects of research. The most common research-related factors that students reported negatively and positively affected their depression and example student quotes of each factor are reported in Tables 2 and 3, respectively.

**Table 2.** Research-Related Factors that PhD Students Reported Negatively Affected their Depression

<b>Factor</b>	<b>% (n) (N = 50)</b>	<b>Example Quote</b>	<b>Example Quote</b>
Failures, obstacles, or setbacks during research	48 (24)	Student 20: “Everything just fails and you have zero positive results and nothing you can publish. That was one of the worst things for me. The stress of knowing that you are not succeeding is really bad [for depression].”	Student 5: “I could do everything perfectly and for one reason or another the whole project could just fail. So, I think the breakdown of that link between my actions and the outcome, that was hard.”
Unstructur ed research experience s	38 (19)	Student 34: “My depression has not enjoyed or been spared by the fact that research is self-directed. Finding the equipment, finding the questions, finding the method rests on me.”	Student 12: “For me, I think the periods of time post-classes were a lot harder in terms of mental health, where there aren’t as many external deadlines.

			You're mostly driven by your own goals and ambitions every day. (...) But when [goals and ambitions] are dropped, it's really easy for depression to kick in."
Negative reinforcement	34 (17)	Student 26: "[Your mentor] will tell you how poorly you're doing to inspire you to work harder, and that's not something that works with me, because I already see everything that I'm doing wrong, and all the problems in a project, so I don't need a mentor that points out those problems to me again, because I'm like, 'Yeah, I [expletive] know all the problems! I should just quit, right?'"	Student 7: "You say something stupid and your PI (principal investigator) suddenly says how stupid that is. And then all that just [makes me think] 'I'm an idiot, I can't do it.'"
Unreasonable or overwhelming expectations	34 (17)	Student 4: "My [previous] advisor had really high expectations and was really pushy. It really exacerbated my depression a lot, because I felt like I could never live up to the expectations."	Student 29: "I think when I'm working hard and where my hours are going doesn't necessarily make sense to my advisor [it affects my depression]. I'm like, 'No, I'm working, I'm working, I'm working.' And then they're like, 'Well, but maybe work harder.' That feels pretty bad."
Opportunity to compare self to others	28 (14)	Student 24: "I think that I'm a huge person that compares themselves to others. When I hear others speak about their research or their progress, though it may not be light years away	Student 44: "Sometimes I see my other cohort students succeeding and not even in a jealous way necessarily, but I do

		<p>from mine, it feels that way. I get sad. I feel like I'm not where I'm supposed to be or that I don't deserve to be where I'm at compared to others."</p>	<p>measure myself against them. If I haven't gotten my first author publication yet or whatever, that means I'm behind the curve. I think part of [my depression] is just comparing myself to others."</p>
<p>Lack of technical support or guidance</p>	<p>22 (11)</p>	<p>Student 18: "I've experienced my PI being very absent. And so, not having that touchstone of advice like, 'Stop now, maybe stop while you're ahead, or maybe you can change this,' and then wasting all that time or feeling like I've wasted all that time can make it harder [on my depression]."</p>	<p>Student 49: "You get thrown in the deep end on projects, and the lab has been so busy that there's been no support. So, if you fall a little flat, then it's just all on you where they're like, 'Oh man, I wish I could help you out with that or give you this support,' and I feel like I've been set up to fail a lot."</p>
<p>Social isolation</p>	<p>18 (9)</p>	<p>Student 8: "[Doing research] is very isolating because obviously not many people go for PhDs. I can't talk to [my friends] about research struggles because they're like, 'OK, how do I fix that? You did that to yourself.' And I'm like, 'I mean, you're right, but...' Nobody understands you."</p>	<p>Student 20: "I think that's one thing [that affects my depression], when it comes to research, it's quite a lonely experience sometimes when you're working on your own project and everybody else has their own project. They have their own worries to think about and all you are stressing about is your own thing."</p>

**Table 3.** Research-Related Factors that PhD Students Reported Positively Affected their Depression

<b>Factor</b>	<b>% (n) (N = 50)</b>	<b>Example Quote</b>	<b>Example Quote</b>
Completing small or concrete research tasks	26 (13)	Student 24: “When I’m doing wet lab work I’m in the zone, [it is good for my depression]. When I’m in that mode, it doesn’t allow me to be depressed, because I’m too busy to really overthink things.”	Student 35: “I have a very simple goal, which is to collect my data and that’s all I think about for the entire day. I’m hiking, I’m listening to audio books, whatever. And so, there’s literally just no time for me to get caught up in my own mind.”
Working with others	22 (11)	Student 43: “Working collaboratively with other students and working consistently with faculty helps a lot [with my depression].”	Student 20: “Friends, obviously, colleagues, people who share the same sentiment [help my depression]. It’s amazing to have people right next to you say, ‘Don’t worry about it, this happens to everyone. Try this, try that.’”
Passionate about research topic	18 (9)	Student 10: “I love vaccines, I love immunology, I love recombinant genetic engineering. That in itself actually does help [my depression] a lot because I get to learn more every day. (...) That absolutely helps [my depression] because it drives me.”	Student 25: “I study plants and I really love plants and being around them. And so that’s been the best part is getting to work with plants in the greenhouse, and that feels helpful [for my depression].”

Flexibility	18 (9)	Student 12: “I can schedule therapy whenever. I’m not confined to a specific nine-to-five workday. (...) If I wake up one day and I’m really struggling, I can shift my weekends. I can be like, ‘All right. Today I need to take care of me,’ and then maybe I’ll work an extra day of the weekend if I need to catch up or something. So that flexibility can be really supportive.”	Student 47: “Some jobs, you have to be there, whereas with grad school if I’m having a really bad day and I really feel like I can’t handle being in the lab, it’s a little easier for me to not have to be there or for me to rearrange my schedule so I’m doing [tasks] that are a little bit less stressful for me.”
Research progress	16 (8)	Student 46: “I will say [something that helps my depression] is when you are working really hard on the experiment, on the goal, and then finally you get something, when you get good data. This makes all of my effort worth it.”	Student 1: “Making progress helps me feel less [depressed], when I am getting a lot of data. I never feel stressed about my productivity at those points in time.”
Emotionally supportive PI	12 (6)	Student 23: “Things that help [my depression] are having a supportive PI who you’re able to talk to about your mental illness, and who’s understanding.”	Student 38: “If I didn’t have the advisors that I have now, I don’t know that I would be able to proceed through getting a PhD, because I have been able to be very open with them about my mental health struggles and the reality of how mental illness affects me and affects my life and my productivity. And they haven’t really rigorously pushed me beyond my stated limitations.”

## **The Effect of Teaching on Graduate Student Depression**

We asked all graduate students who had teaching experience ( $n = 43$ ) how teaching affected their depression. Graduate students more commonly identified ways that teaching positively affected their depression than ways teaching negatively affected their depression. On average, considering all factors that graduate students listed and not just those that were most common, participants listed two ways in which teaching positively affected their depression and one way in which teaching negatively affected their depression.

Graduate students most commonly highlighted that teaching provided positive reinforcement from undergraduates, which helped them manage their depression. This positive reinforcement came in multiple forms ranging from formal teaching evaluations to positive verbal comments from undergraduates about how good a graduate student was at teaching to watching undergraduates accomplish academic goals or grasp complex concepts. A subset of graduate students highlighted that teaching was good for their depression, because it was something they were passionate about or that they genuinely enjoyed. As such, it was a source of happiness, as was being able to collaborate and form friendships with other TAs or instructors. Some graduate students also acknowledged that they felt confident teaching, often because they had mastered content that undergraduates had not. However, this was not always the case; some graduate students highlighted that a lack of teaching training and preparation negatively affected their self-efficacy as instructors, which in turn exacerbated their depression. This was further exacerbated by the pressure that graduate students put on themselves to perform well as instructors. The potential to have a negative impact on undergraduates and their learning experiences



could worsen students' depression by increasing the stress surrounding their performance as a teacher. Additionally, some graduate students received negative reinforcement from undergraduates, in the form of negative comments on formal teaching evaluations or disrespectful behavior from undergraduates such as groans or eye rolls, which graduate students explained negatively affected their self-efficacy, further worsening their depression.

Students also highlighted that teaching could negatively affect their depression because it interfered with the time they felt they needed to be spending on research or added to the large number of responsibilities they had as graduate students. However, some students welcomed time away from research; teaching sometimes served as a distraction from research-related stressors. Students also highlighted that teaching is structured, which positively affected their depression. That is, there are concrete tasks, such as grading, that need to be accomplished or places that the graduate student needs to be during a specific time. This structure helped motivate them to accomplish teaching goals, even if they were feeling a lack of motivation because of their depression. The most common teaching-related factors that graduate students reported negatively and positively affected their depression and example student quotes for each factor are reported in Tables 4 and 5, respectively.

**Table 4.** Teaching-Related Factors that PhD Students Reported Negatively Affected their Depression

Factor	% (n) (N = 43) <sup>a</sup>	Example Quote	Example Quote
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Increases number of responsibilities/time away from research	47 (20)	Student 10: “As a PhD student, you’re expected to publish, do all this research, and then also teach. A little while ago, I was both designing a class and teaching two sections at the same time, and I was spending so much time on that class. It was close to 40 hours per week plus research. I definitely was feeling overwhelmed, and I do think that can affect [my depression], because it leads to burnout.”	Student 12: “Teaching often regularly leaves you with less time to focus on research. So, it is time away from research. And if I’m already feeling like I’m not doing enough, having the extra load of teaching can just amp that feeling up.”
Negative reinforcement from undergraduates	28 (12)	Student 29: “It [is hard for my depression] and really bums me out when [the undergraduates] don’t try. I put a lot into [teaching]. (...) The ones that are just like, ‘I don’t want to do this,’ and roll their eyes, it’s just hard. It’s like, I put so much into making [the content] clear and I’m trying. So, when the students are not really trying, it does not feel great.”	Student 19: I’ve had students straight up tell me, ‘This is the least important class that I have to take this semester. I’m not going to put in much effort.’ And it makes me feel kind of crummy, kind of bad. When at the end of the semester, I get the teaching evaluations saying, ‘I just took this class because I need it or I had to. I didn’t think it added anything to my education.’ I feel very low.”
Personal pressure to teach well	26 (11)	Student 16: “[My depression related to teaching] all comes back to the stress of having to do a good job for my students. I didn’t want to fail them. So that was difficult and I took [being a teacher] very seriously.”	Student 40: “I think feeling like there were these undergrads depending on me [negatively affected by depression]. (...) If I haven’t sufficiently prepared to lead a discussion section or whatever, there are

			undergrads whose education will suffer. That added pressure was hard [on my depression] and just being afraid of letting them down.”
Lack of teaching training or guidance	16 (7)	Student 25: “[My depression worsened] because I was concerned about the lack of supervision and the lack of support for how to teach. (...) I just felt like I was doing a terrible job, which was really discouraging.”	Student 26: “I didn’t feel like I had enough guidance as to what I should be teaching [the undergraduates in my class] and how to control a classroom, so not having the respect of the students and not knowing how to get it was really stressful.”
<p><sup>a</sup>Forty-three out of the 50 students who participated in the study had experience teaching undergraduates either as a TA or as an instructor of record. We only considered the responses from the TAs with teaching experiences when calculating the percent of students who reported each factor.</p>			

**Table 5.** Teaching-Related Factors that PhD Students Reported Positively Affected their Depression.

Factor	% (n) (N = 43) <sup>a</sup>	Example Quote	Example Quote
Positive reinforcement from undergraduates	58 (25)	Student 15: “What really helped me during those depressive times were that my students would say like, ‘Sulfates in my shampoo, they’re not good for the water. I learned that from you.’”	Student 5: “Interacting with my undergraduates and feeling like I made a difference for them [helps my depression]. Even if it was just something as simple as them saying like, ‘Oh, wow [Student 5], I feel

			like I actually really get this now,' or 'I did better on this exam after we went over material together.'”
Teaching as a structured task	33 (14)	Student 27: “Sometimes having concrete tasks does [help my depression]. With research, you never have deadlines or things that get accomplished or finished. Where at least with teaching, you can sit down and you can grade for three hours. You can do things.”	Student 8: “I have to have the test made by the time class starts on an exam day. I have to make sure that I’m there on time and that I don’t go over time, things like that. So just having that kind of strict schedule, I think helped [my depression].”
Passion for teaching	30 (13)	Student 48: “I’ve always enjoyed teaching. One main reason I did a PhD was to teach at the postsecondary level. So, for me, honestly, the experience of interacting with students is energizing, and does rejuvenate me a lot.”	Student 15: “[Teaching] gave me motivation and kind of like a reason to keep going. I love science, but I love the access to science that I can give to other people.”
Distraction from research	23 (10)	Student 42: “Research is tedious and difficult and honestly I have to admit I never really had fun with it. But teaching is kind of a way away from that. It’s something that you can still do and you can still contribute like you’ve got a good job and you’re doing things. (...) It helped take my mind off of the hardships of what was going on during research.”	Student 4: “[Teaching] is a good respite from my research sometimes. It’s a different side to being in school.”
Confidence about teaching	14 (6)	Student 42: “[Teaching] is helpful for my depression because, like I am sorry if this is	Student 50: “It’s good to feel like an expert in front of this group of

		cocky sounding, but I'm really good at teaching and when I go in to teach, it's like, 'I know that this is right.'"	undergrads. When you come from maybe a lab, or field experience where you feel like you don't know what you're doing, it can be very positively reinforcing working with undergrads."
Positive relationships with others teaching	12 (5)	Student 16: "[Teaching] was really helpful for my depression, because I made friends with the other TAs, especially during my first year as a TA, and we were all new."	Student 28: "I had a co-TA giving a lecture with me and he was a very nice person. So, we became friends. Yeah. It helped [my depression] a little bit."
<p><sup>a</sup>Forty-three out of the 50 students who participated in the study had experience teaching undergraduates either as a TA or as an instructor of record. We only considered the responses from the TAs with teaching experiences when calculating the percent of students who reported each factor.</p>			

### **The Effect of Depression on Graduate Research**

In the interviews, we asked graduate students how their depression affected their graduate research, if at all. They identified three primary ways in which depression could affect research, all of which were negative. The most common way depression affected research was interfering with students' motivation, which in turn affected their productivity. Students described that their productivity was affected immediately, for example, struggling to execute daily tasks like collecting or analyzing data. However, graduate students described that their lack of motivation ultimately resulted in larger consequences, such as delays in getting papers submitted and published. In fact, some graduate students explicitly stated that they felt as though they would have been able to graduate earlier if they had not had depression. The second way in which depression

affected graduate students' research is that it interfered with their ability to focus or concentrate. Students primarily explained that the lack of focus did not delay their research but caused their research to be less enjoyable or made them frustrated because they had to expend additional mental energy to execute tasks. Depression also caused students to be less confident or overly critical of themselves. Specifically, if an experiment did not go right or they experienced rejection of a manuscript, they tended to internalize it and blame themselves. This lack of confidence often inhibited students' abilities to make decisions about research or take risks in research. They described frequently second-guessing themselves, which made decisions and taking risks in research more difficult. The most common ways students reported that their depression affected their research and example student quotes are reported in Table 6.

**Table 6.** Self-Reported Ways that Depression Affected PhD Students' Research or the Graduate Student as a Researcher

Factor	% (n) (N = 50)	Example Quote	Example Quote
Lack of motivation and productivity	64 (32)	Student 3: "When I'm really depressed and I'm trying to do something that's pretty positive and challenging, like write a manuscript, it tends to be really difficult. I can go from, when I'm not depressed, banging out some really good work, and then when I become depressed, that definitely tanks."	Student 35: "[Depression] keeps me from doing the things that I want to do, like every single day and be consistent. Like reading a paper every day or writing for an hour every day and it's just like, I am so exhausted that I feel like I can't do that. It increases procrastination."

Low self-esteem or overly self-critical	58 (29)	Student 10: “Sometimes I feel I’m an imposter. Internally I know that I have intelligence, but then it’s like I don’t know if I can do it. Everything is harder, and then my research will suffer.”	Student 19: “[My depression] brings on this imposter syndrome. Like, ‘What am I doing in this program?’ So, I’m constantly struggling and battling those thoughts. Never feeling that you fit in, struggling with, ‘Are you good enough? Is what you’re doing good enough? Should I stay in this program?’”
Difficulty focusing and concentrating	28 (14)	Student 9: “Because I was going through kind of a mental instability, I was unable to actually focus on what I was actively doing in lab. I was kind of like a zombie going in to work and getting out every day.”	Student 40: “The trouble concentrating just makes everything harder when you just can’t seem to sit down and focus and get things done. I would say it’s made grad school harder, more frustrating, and less enjoyable because I just constantly feel like I’m behind and not doing enough.”

### **The Effect of Depression on Teaching**

Graduate students described one positive way and two negative ways that depression affected their teaching. Students explained that, because they had experienced depression, they were more compassionate and empathetic toward the undergraduates in their courses. Specifically, they felt they could better understand some of the struggles that undergraduates experience and were sometimes more likely to be flexible or lenient about

course requirements and deadlines if an undergraduate was struggling. However, graduate students reported that depression also negatively affected their teaching. Specifically, depression could cause graduate students to feel disconnected or disengaged from undergraduates. It could also cause graduate students to feel as though they had a lack of energy or felt down when teaching. The common self-reported ways that depression affected PhD students' teaching and example quotes are reported in Table 7.

**Table 7.** Self-Reported ways that Depression Affected PhD Students' Teaching or the Graduate Student as an Instructor

Factor	% (n) (N = 43) <sup>a</sup>	Example Quote	Example Quote
<b>Negative effects of depression on graduate student teaching</b>			
Disconnected or disengaged from undergraduates	16 (7)	Student 18: “[When I have depression], I can feel disconnected from the [undergraduates]. I’ll go to my day of teaching, I lead these discussion sections and I’m going through the motions. I don’t really put my full heart into it in terms of going out of my way to connect with the [undergraduates] or being more enthusiastic.”	Student 49: “But there were many days that my depression, through various avenues, caused me to be absentminded [while teaching]. (...) Just less attentive and [less] engaged.”
Felt down or lacked energy when teaching	14 (6)	Student 4: “There’s been times where I’ve just been unable to prep for classes, or have prepped very little, just because I’m just struggling with myself and trying to get through things. It upsets me, because I feel like I’m letting the undergrads down.”	Student 13: “I’m sure [my students] have been able to tell when I’ve shown up to classrooms just depressed. And that’s not what they’re paying for, and they’re paying a lot.”



<b>Positive effect of depression on graduate student teaching</b>			
Understanding of student issues	23 (10)	Student 16: “[My depression] maybe makes me a little more empathetic with the undergraduates that I teach. And I know that since depression is a big deal for me, it may be as big deal for them. I’m able to empathize better and help people seek out the right resources if necessary, and also give them a leniency that they need if they can’t accomplish something in the time it’s due because of their illness.”	Student 48: “I think it makes me more empathetic to the plights of undergraduate students, because I know that they also experience a lot of these [mental health] problems, and so I think it makes me more sympathetic to their problems.”
<p><sup>a</sup>Forty-three out of the 50 students who participated in the study had experience teaching undergraduates either as a TA or as an instructor of record. We only considered the responses from the TAs with teaching experiences when calculating the percent of students who reported each factor.</p>			

## **DISCUSSION**

Despite the increasing concern about graduate student mental health among those in the scientific community (Pain, 2018; “The Mental Health of PhD Researchers,” 2019; Puri, 2019), there is a lack of information about how specific aspects of science PhD programs affect students with depression. This is the first study to explicitly investigate which particular aspects of research and teaching affect depression among life sciences PhD students and how depression, in turn, affects graduate students’ experiences in research and teaching. Overall, graduate students highlighted factors related to teaching and research that both alleviated and exacerbated their symptoms of depression. Graduate students more commonly brought up ways that research negatively affected their depression, than ways that it positively affected their depression. Conversely, graduate

students more commonly mentioned ways that teaching had a positive effect on their depression compared with a negative effect. The requirement and opportunity to teach differs among life sciences graduate programs (Schussler *et al.*, 2015; Shortlidge and Eddy, 2018). As such, future research should investigate whether the amount of teaching one engages in during graduate school is related to levels of graduate student depression. Despite differences in how teaching and research affect student depression, this study unveiled factors that protect against or worsen depressive symptoms. Specifically, four overarching factors affecting graduate student depression emerged from the interviews: 1) Structure; 2) Positive and Negative Reinforcement; 3) Failure and Success; 4) Social Support and Isolation. We discuss here how each of these factors may positively and negatively affect graduate student depression.

### **Structure**

One stark contrast between research and teaching is the amount of structure in each activity. That is, students expressed that research goals are often amorphous, that there are not concrete instructions for what needs to be accomplished, and that there is often no set schedule for when particular tasks need to be accomplished. Conversely, with teaching, graduate students often knew what the goals were (e.g., to help students learn), exactly what they needed to accomplish each week (e.g., what to grade, what to teach), and when and where they needed to show up to teach (e.g., a class meets at a particular time). Graduate students highlighted that a lack of structure, particularly in research, was detrimental for their depression. Their depression often made it difficult for them to feel motivated when there was not a concrete task to accomplish. Major depression can interfere with executive function and cognition, making goal setting and goal

achievement particularly difficult (Elliott, 1998; Watkins and Brown, 2002). In fact, research has documented that individuals with depression generate fewer specific goals and less specific explanations for approaching a goal than individuals who do not have depression (Dickson and Moberly, 2013). As such, it may be particularly helpful for students with depression when an activity is structured, relieving the student from the need to articulate specific goals and steps to achieve goals. Students noted that the lack of structure or the flexibility in research was helpful for their depression in one way: It allowed them to better treat their depression. Specifically, students highlighted that they were able to take time to go to therapy or to not go into the lab or to avoid stressful tasks, which may be important for successful recovery from a depressive episode (Judd *et al.*, 2000).

Compared with conducting research, many participants reported that the concrete tasks associated with teaching under- graduates were helpful for their depression. This is supported by literature that illustrates that concrete thinking, as opposed to abstract thinking, can reduce difficulty making decisions in individuals with depression (Dey *et al.*, 2018), presuming that teaching often requires more concrete thinking compared with research, which can be more abstract. Additionally, cognitive-behavioral treatments for depression have demonstrated that developing concrete goals for completing tasks is helpful for individuals with depression (Detweiler-Bedell and Whisman, 2005), which aligns with graduate students' perceptions that having concrete goals for completing teaching tasks was particularly helpful for their depression.

### **Positive and Negative Reinforcement**

Graduate students reported that the negative reinforcement experienced in research and teaching had a significant negative effect on their depression, while the positive reinforcement students experienced only in teaching had a positive effect. Notably, students did not mention how positive reinforcement affected their depression in the context of research. Based on student interviews, we predict that this is not because they were unaffected by positive reinforcement in research, but because they experienced it so infrequently. Drawing from behavioral theories of depression, the concept of response-contingent positive reinforcement (RCPR; Lewinsohn, 1974; Kanter *et al.*, 2004) helps explain this finding. As summarized by Kanter and colleagues (2004), RCPR describes someone seeking a response and being positively reinforced; for example, graduate students seeking feedback on their research are told that what they have accomplished is impressive. Infrequent RCPR may lead to cognitive symptoms of depression, such as low self-esteem or guilt, resulting in somatic symptoms of depression, such as fatigue and dysphoria (Lewinsohn, 1974; Martell *et al.*, 2001; Manos *et al.*, 2010). RCPR is determined by three factors. 1) How many potential events may be positively reinforcing to an individual. For example, some people may find an undergraduate scoring highly on an exam in a class they are teaching to be reinforcing and others may find that they only feel reinforced when an undergraduate explicitly compliments their teaching. 2) The availability of reinforcing events in the environment. If graduate students' mentors have the ability to provide them with RCPR but are never able to meet with them, these reinforcing events are unavailable to them. 3) The instrumental behavior of an individual. Does the individual exhibit the behavior required to obtain RCPR? If graduate students do not accomplish their research-related tasks on time, they may not receive RCPR from

their mentor. If individuals are not positively reinforced for a particular behavior, they may stop exhibiting it, further exacerbating the depressive cycle (Manos *et al.*, 2010). Therefore, the lack of positive reinforcement in research may be particularly damaging to graduate students, because it may discourage them from completing tasks, leading to additional depressive symptoms. Conversely, teaching presents many opportunities for positive reinforcement. Every time graduate students teach, they have the opportunity to receive positive reinforcement from their students or to witness a student's academic accomplishment, such as an undergraduate expressing excitement when they understand a concept. As such, it is not surprising that positive reinforcement was the primary teaching-related factor that graduate students reported helped with their depression. Despite the positive reinforcement of teaching for graduate students with depression, we are not suggesting that graduate students should take on additional teaching loads or that teaching should be viewed as the sole respite for graduate students with depression. Overwhelming students with increased responsibilities may counteract any positive impact that teaching could have on students' depression.

### **Failure and Success**

Failure and success affected student depression, but only in the context of research; contrary to research, students rarely mentioned concrete metrics for success and failure in teaching. While graduate students highlighted receiving positive or negative reinforcement from undergraduates, they did not relate this to being a "successful" instructor. It is unsurprising that graduate students did not mention failing or succeeding at teaching, given that experts in teaching agree that it is difficult to objectively evaluate quality teaching (d'Apollonia and Abrami, 1997; Kember *et al.*, 2002; Gormally *et al.*,

2014). In fact, the lack of teacher training and knowledge about how to teach effectively negatively affected student depression, because it could cause students to feel unprepared as an instructor. Integrating teacher training into graduate programs has been championed for decades (Torvi, 1994; Tanner and Allen, 2006; Schussler *et al.*, 2015); however, the potential for such training to bolster graduate student mental health is new and should be considered in future research. With regard to graduate students' research, the concept of success and failure was far more concrete; students mentioned failing in terms of failed experiments, research projects, and rejected manuscripts and grant proposals. Successes included accepted manuscripts, funded grant proposals, and concrete progress on significant tasks, such as writing or conducting an experiment that yielded usable data. Failure has been shown to negatively affect depression among undergraduate researchers (Cooper *et al.*, 2020a), who are hypothesized to be inadequately prepared to experience failure in science (Henry *et al.*, 2019). However, it is less clear how well prepared graduate students are to experience failure (Simpson and Maltese, 2017). Drawing from cognitive theories of depression, depression is associated with dysfunctional cognitive schemas or dysfunctional thinking that can lead individuals with depression to have negative thoughts about the world, themselves, and the future and to interpret information more negatively than is actually the case (called negative information-processing biases; Beck, 1967; Beck *et al.*, 1979; Gotlib and Krasnoperova, 1998; Maj *et al.*, 2020). Related to failure, individuals with dysfunctional cognitive schemas may harbor beliefs such as if something fails at work (or in graduate research), they are a failure as a person or that a small failure can be as detrimental as a larger failure (Weissman, 1979; Miranda and Persons, 1988). As such, setbacks in research may be particularly difficult for PhD

students with depression. Graduate students in our study also mentioned how failing in research was often out of their control, particularly failure related to experiments and research projects. The extent to which one feels they can control their environment is important for mental health, and lower estimates of control have been hypothesized to be an important factor for depression (Grahek *et al.*, 2019). Therefore, this feeling of being unable to control success in research may further exacerbate student depression, but this would need to be tested. Importantly, these findings do not imply that individuals with depression are unable to cope with failure; they only suggest that individuals perceive that failure in science can exacerbate their depression.

### **Social Support and Isolation**

Graduate students reported that feelings of isolation in research could worsen their depression. Specifically, they highlighted that it can be difficult for their mental health when their friends outside graduate school cannot relate to their struggles in research and when others in their research group are not working on similar projects. One study of more than 1400 graduate students at a single university found that feeling isolated from fellow graduate students and faculty positively predicted imposter phenomenon (Cohen and McConnell, 2019), defined as the worry that they were fooling others about their abilities and that their fraudulence would be exposed (Clance and Imes, 1978), which is positively correlated with depression among college students (McGregor *et al.*, 2008). Developing a positive lab environment, where undergraduates, graduate students, and postgraduates develop positive relationships, has been shown to positively affect undergraduates (Cooper *et al.*, 2019) and may also positively affect graduate students who experience such feelings of isolation. Graduate students in this study described that

both teaching and research had the potential to be a source for relationship development and social support. Students who described positive collaborative relationships in research and teaching felt this had a positive impact on their depression, which aligns with a review of studies in psychiatry concluding that being connected to a large number of people and having individuals who are able to provide emotional support by listening or giving advice is protective against depression (Santini *et al.*, 2015), as well as a study that found that social support is protective against depression, specifically among the graduate population (Charles *et al.*, 2021).

These four factors provide clear targets for graduate programs looking to improve the experiences of students with depression. For example, increasing structure in research could be particularly helpful for graduate students with depression. Ensuring that students have concrete plans to accomplish each week may not only positively impact depression by increasing structure, but ultimately by increasing a student's success in research. Research mentors can also emphasize the role of failure in science, helping students realize that failure is more common than they may perceive. Increasing opportunities for positive reinforcement in teaching and research may be another avenue to improving student mental health. Providing students with appropriate teacher training is a first step to enhancing their teaching skills and potential for positive reinforcement from undergraduate students (Schussler *et al.*, 2015). Additionally, teaching evaluations, a common form of both positive and negative reinforcement, are known to be biased and disadvantage women, People of Color, and those with non-English speaking backgrounds (Fan *et al.*, 2019; Chávez and Mitchell, 2020) and arguably should not be used to assess teaching. In research, mentors can make an effort to provide positive



feedback or praise in meetings in addition to critiques. Finally, to provide social support to graduate students with depression, graduate programs could consider creating specific initiatives that are related to supporting the mental health of graduate students in their departments, such as a support group for students to meet and discuss their experiences in graduate school and how those experience pertain to their mental health.

### **Limitations and Directions for Future Research**

In this study, we chose to only interview students with the identity of interest (depression), as is common with exploratory studies of individuals with underserved, underrepresented, or marginalized identities (e.g. Carlone and Johnson, 2007; Cooper and Brownell, 2016; Barnes *et al.*, 2017, 2021; Downing *et al.*, 2020; Gin *et al.*, 2021; Pfeifer *et al.*, 2021). However, in future studies, it would be beneficial to also examine the experiences of individuals who do not have depression. This would provide information about the extent to which specific aspects of graduate research and teaching are disproportionately beneficial or challenging for students with depression. In this study, we did not explicitly examine whether there was a relationship between students' identities and depression because of the small number of students in particular demographic groups. However, a theme that occurred rather infrequently (but is included in the Supplemental Material) is that discrimination or prejudice in the lab or academia could affect depression, which was reported exclusively by women and People of Color. As such, disaggregating whether gender and race/ethnicity predicts unique factors that exacerbate student depression is an important next step in understanding how to create more equitable and inclusive research and teaching environments for graduate students. Moreover, our sample included a significant number of students from ecology and

evolutionary biology PhD programs, which may limit the generalizability of some findings. It is important to acknowledge potential interdisciplinary differences when considering how research may affect depression. Additionally, some of the factors that affect student depression, such as lack of teaching training and confidence in teaching, may be correlated with time spent in a graduate program. Future quantitative studies would benefit from examining whether the factors that affect student depression depend on the student's subdiscipline and time spent in the graduate program. The primary focus of this study was the relationship between depression and graduate teaching/research. Many of the factors that emerged from the interviews are also associated with burnout (Bianchi *et al.*, 2014; Maslach *et al.*, 2001). Burnout and depression are known to be highly related and often difficult to disaggregate (Bianchi *et al.*, 2014). It was beyond the scope and design of this study to disaggregate which factors relate exclusively to the condition of burnout. Additionally, the interviews in this study were collected at a single time point. Thus, we are unable to differentiate between students who had depression before starting graduate school and students who experienced depression after starting graduate school. Future longitudinal studies could explore the effects of students' experiences in research and teaching on their depression over time as well as on long-term outcomes such as persistence in graduate programs, length of time for degree completion, and career trajectory. This study identified a number of factors that graduate programs can address to benefit graduate student mental health, and we hope that future studies design and test interventions designed to improve the experiences of graduate students in teaching and research.

## CONCLUSION

In this interview study of 50 life sciences PhD students with depression, we examined how graduate research and teaching affect students' depressive symptoms. We also explored how depression affected graduate students' teaching and research. We found that graduate students more commonly highlighted ways that research negatively affected their depression and ways that teaching positively affected their depression. Four overarching factors, three of which were related to both teaching and research, were commonly associated with student depression, including the amount of structure provided in research and teaching, failure and success, positive and negative reinforcement, and social connections and isolation. Additionally, graduate students identified depression as having an exclusively negative effect on their research, often hindering motivation, concentration, and self-esteem. However, they did note that depression made them more compassionate teachers, but also could cause them to have low energy or feel disconnected when teaching. This study provides concrete factors that graduate programs can target in hopes of improving the experiences of life sciences PhD students with depression.

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FACE NEGOTATION IN GRADUATE SCHOOL: THE DECISION TO CONCEAL  
OR REVEAL DEPRESSION AMONG LIFE SCIENCES PH.D. STUDENTS IN THE  
UNITED STATES

## **INTRODUCTION**

### **Depression in graduate researchers**

Depression is one of the most frequently reported mental health concerns among graduate students (American College Health Association, 2021; Evans et al., 2018; Forrester, 2021), and recent studies indicate that depression may be more common among graduate students compared to their peers in the general public (Bolotnyy et al., 2020; Evans et al., 2018). Depression is defined by the American Psychiatric Association as a common and serious mental illness that negatively affects how one feels, thinks, and acts (American Psychiatric Association, 2020). Researchers have identified that depression among graduate students can be exacerbated by financial stress (Charles et al., 2021; Hish et al., 2019; Jones-White et al., 2021), lack of a work-life balance (Evans et al., 2018; Liu et al., 2019), and poor advisor-advisee relationships (Charles et al., 2021; Evans et al., 2018; Hish et al., 2019; Liu et al., 2019; Peluso et al., 2011). Conducting graduate research has been identified as a specific aspect of science graduate programs that can worsen depressive symptoms (Gin et al., 2021); science Ph.D. students report that encountering failure and being tasked with carrying out unstructured research projects can be particularly challenging. In addition, aspects of graduate teaching, including negative reinforcement from undergraduates and feeling unprepared to teach, can also exacerbate depressive symptoms among science graduate students (Gin et al., 2021).

Given the substantial negative effects that depression can have on graduate students' social lives (K. M. Cooper, Gin, Barnes, et al., 2020; Steger & Kashdan, 2009), professional lives (Hish et al., 2019; Peluso et al., 2011), and overall quality of life (Eisenberg et al., 2007; Evans et al., 2018), the scientific community is increasingly recognizing the importance of improving graduate student mental health (National Academies of Sciences, Engineering, and Medicine, 2021; Pain, 2018; Puri, 2019; "The Mental Health of PhD Researchers Demands Urgent Attention," 2019; Woolston, 2020). While efforts have been made to increase access to student mental health resources (Kodish et al., 2021; Lipson et al., 2019), students would likely also benefit from graduate programs and research advisors fostering graduate school environments that promote mental health (Gin et al., 2021; Langin, 2021).

### **Depression as a concealable stigmatized identity**

Helping science graduate students cope with depression and alleviating aspects of graduate school that exacerbate student depression may be uniquely difficult due to the concealable nature of this identity. Specifically, depression is considered a concealable stigmatized identity (CSI), meaning that it can often be kept hidden or concealed and is associated with negative stereotypes that can result in discrimination and loss of status in society (Link & Phelan, 2001; Quinn & Earnshaw, 2011). Concealable stigmatized identities also include identities such as LGBTQ+ identities, other mental illnesses, and chronic health conditions (A. H. Crisp et al., 2000; Earnshaw & Quinn, 2012; Link et al., 2001; Meyer, 2003). Individuals with CSIs are faced with the unique decision reveal or conceal their identity in social situations. Choosing to reveal the identity has been shown to yield various results. Individuals who reveal CSIs report experiencing judgement,

stigmatization, or prejudiced treatment (Chaudoir & Fisher, 2010; Flett, 2012; Pachankis, 2007; Ragins et al., 2007), and this has been shown to be true for individuals with depression in the workplace (Evans-Lacko et al., 2012; Krupa et al., 2009; Ridge et al., 2019). While CSIs are commonly concealed in order to avoid such discrimination, research has shown that concealing the identity can also lead to psychological distress (Quinn et al., 2014; Quinn & Chaudoir, 2009). However, when one is able to reveal their CSI to an accepting confidant, the psychological distress can be alleviated and the individual may experience increased emotional support (Black & Miles, 2002; K. M. Cooper, Gin, & Brownell, 2020; Corrigan & Matthews, 2003; Rodriguez & Kelly, 2006).

### **Choosing to conceal and reveal depression in science graduate programs**

Studies of how individuals navigate their CSIs primarily focus on work environments (Flett, 2012; Follmer & Jones, 2018; Webster et al., 2018; Yoder & Mattheis, 2016), academic environments (K. Cooper et al., 2019; England, 2016; Varjas et al., 2016; Yerbury & Yerbury, 2021), or personal environments (Brooks et al., 2018; Kaushansky et al., 2017; Pahwa et al., 2017). However, science graduate programs provide a unique context in which to explore the revealing of CSIs since they encompass a unique blend of professional duties, academic expectations, and personal relationships. Notably, graduate students operate within an array of power structures; they interact with superiors (e.g., primary investigators), peers (e.g., fellow graduate students), and subordinates (e.g., undergraduate researchers). Depression can negatively affect graduate students' performance in research, and graduate students with depression perceive that a change in their performance is sometimes noticed by advisors, fellow graduate students, and undergraduates working with the graduate student (Gin et al., 2021). However, it is

unknown to what extent graduate students choose to discuss their depression with individuals with whom they do research. We hypothesize that the power dynamics within each of these relationships may influence how science graduate students navigate their depression. Notably, graduate students operate within an array of power structures; they interact with superiors (e.g., primary investigators), peers (e.g., fellow graduate students), and subordinates (e.g., undergraduate researchers). Depression can negatively affect graduate students' performance in research, and graduate students with depression perceive that a change in their performance is sometimes noticed by advisors, fellow graduate students, and undergraduates working with the graduate student (Gin et al., 2021). However, it is unknown to what extent graduate students choose to discuss their depression with individuals with whom they do research. We hypothesize that the power dynamics within each of these relationships may influence how science graduate students navigate their depression.

### **Theoretical framework: face negotiation theory**

Previously, our research group has drawn from the Disclosure Decision Model (DDM) (Omarzu, 2000) and the Disclosure Process Model (DPM) (Chaudoir & Fisher, 2010) to understand individuals' decisions to reveal their depression in academic environments (K. M. Cooper, Gin, & Brownell, 2020). Briefly, the DDM describes why individuals decide to self-disclose personal information in various types of situations (Omarzu, 2000); it suggests that individuals need to possess one of the five possible goals related to disclosing their CSI: (1) approval, (2) intimacy, (3) relief, (4) identity, or (5) control. The DPM highlights when and why self-disclosure can be beneficial to the individual. Specifically, disclosing one's CSI can result in three scenarios: (1) it can

alleviate inhibition or psychological distress, (2) it can promote social support, and (3) it can change the social information between the discloser and their confidant (Chaudoir & Fisher, 2010). While both models provide important insight about when and why graduate students choose to disclose their depression, we argue that understanding the decision to *conceal* depression require the consideration of additional theories.

We draw from the concept of facework and face negotiation theory to further our understanding of graduate students' decisions to reveal or conceal their depression in the context of research environments. The term "face" refers to a favorable sense of social self-worth (Ting-Toomey, 1982; Ting-toomey & Kurogi, 1998). Face negotiation theory describes the process of facework, defined as a set of communicative behaviors that individuals use to regulate their social dignity or that of others. Traditionally, face-management has been referenced when analyzing common situations in business including negotiation and conflict management. However, we propose that face-management is applicable to graduate school, as Ph.D. students interact with faculty advisors, fellow graduate students, and undergraduate mentees and engage in exchanges, negotiations, and, at times, conflict management during their time in their graduate program (Gin et al., 2021).

One's culture(s) is assumed to play a key role in face-management (Ting-toomey & Kurogi, 1998). Theorists distinguish between small power distance cultures, defined as cultures where equal power distributions are valued, and large power distance cultures, defined as cultures where hierarchical roles are valued (Hofstede, 1991). The U.S. is thought to have a medium power-distance culture, where subordinates' dependency needs are neither too high nor too low (Hofstede, 1991). However, academia is notorious for



having a large power distance culture, particularly between tenure-track/tenured faculty and the staff and students at a college or university (Tormey, 2021; Xu & Ran, 2021). The power dynamics between two individuals often dictate the types of facework that individuals engage in (Ting-Toomey and Kurogi, 1998). While assumptions about culture have resulted in cultural-specific facework such as Chinese facework (Bond, 1991), Mexican facework (Garcia, 1996), and Japanese facework (Morisaki & Gudykunst, 1994), we argue that it is worth considering the culture of academia when discussing facework in the context of graduate research, particularly as it relates to whether one chooses to reveal or conceal a CSI such as depression.

Ting-Toomey and Cole (1990) describe three styles of facework, or communication behaviors that people use to maintain social dignity. **Preventative facework (face saving)** refers to a strategy to prevent conflict by preparing others about potential conflicts and proactively avoiding them. **Supportive facework** refers to a strategy that assumes mutual respect, security, and value among those who are interacting, and it often reflects the way that one would want to be treated by others. Finally, **corrective facework (face restoration)** encompasses strategies deployed to save face, or repair one's reputation, often by offering explanations or apologizing for mistakes.

### **Current study**

In this study, we examine Ph.D. students' decisions to reveal or conceal their depression in the context of research, with the intent to identify differences in the motivation of Ph.D. students' choices to reveal or conceal their identity to faculty research advisors, fellow graduate students, and undergraduate researchers. Our research questions are:

- To what extent and why do Ph.D. students reveal or conceal their depression to faculty advisors, fellow graduate students, and undergraduate researchers in the context of their research experiences?
- What do Ph.D. students perceive to be the benefits and consequences of revealing their depression to faculty advisors, graduate students, and undergraduate researchers in the context of their research experiences, and do these perceptions differ between students who have revealed their depression and those who have chosen to conceal it?

## **METHODS**

### **Student interviews**

This study was conducted with an approved Arizona State University Institutional Review Board protocol #00011040.

In fall 2019 we recruited life sciences Ph.D. students to participate in a survey study about their experiences in graduate school. We sent an email to every program administrator of U.S. life science graduate programs recorded in U.S. News and World Report (*U.S. News & World Report*, 2019). Out of the 259 graduate programs that were contacted for this study, 75 (29%) sent our survey to students registered in their respective Ph.D. programs. Of the 840 graduate students who completed the survey, 459 (55%) students self-identified as having depression and 327 (71%) of those students expressed interest in participating in follow-up interview. We used this list of students to recruit for the current study.

We sent a recruitment email out to the 327 Ph.D. students with depression in the summer of 2020 inviting them to be interviewed about their experiences with depression while

enrolled in a life sciences Ph.D. program. Because mental healthcare is often made inaccessible for Black and Latin\* individuals, as well those from low socioeconomic backgrounds, we did not require students to be clinically diagnosed with depression to participate in this interview study (Howell & McFeeters, 2008; Kataoka et al., 2002; Santiago et al., 2013). A total of 50 Ph.D. students (15% of those contacted) from 28 life sciences Ph.D. programs participated in an interview.

We developed an interview script to answer our research questions based on a previous interview script used to elicit information about undergraduates' decisions to reveal or conceal their depression in undergraduate research experiences (K. M. Cooper, Gin, & Brownell, 2020). We adapted this script to probe whether Ph.D. students have revealed their depression to at least one faculty advisor, one graduate student, and one undergraduate researcher with whom they work with regularly in a research environment. We explored students' reasoning for either choosing to reveal or conceal their depression in each situation; however, if graduate students did not report working regularly with an undergraduate, they were not asked undergraduate-specific questions about revealing/concealing their depression. We asked Ph.D. students who concealed their depression about the potential benefits and consequences they perceived they would encounter if they did reveal their depression to others in their lab. Relatedly, we asked students who chose to reveal their depression to others in the lab what benefits and consequences they actually experienced after revealing. A final copy of the interview script can be found in the **Appendix**.

All interviews were conducted during the COVID-19 pandemic in summer of 2020, and we hypothesized that students' depression was likely exacerbated because of

these circumstances (Chirikov et al., 2020). As such, we asked students to consider their experience in research prior to the pandemic when answering the interview questions. To ensure that the interview questions were understandable and were in no way offensive to students with depression, we conducted think-aloud interviews with four graduate students who self-identified as having depression (Trenor et al., 2011). After each think-aloud interview, the researchers revised the interview script until all interview questions appeared to be interpreted as intended by the interviewee. The final copy of the interview script can be found in the **Appendix**.

The interviews were recorded using Zoom by one of two researchers (K.M.C. or L.E.G.) and averaged 45 minutes. All participants were sent a survey after the interview to collect additional information regarding their depression and demographics. The finalized survey sent out to the participants can be found in the **Appendix**. Students were given a gift card in exchange for the time they spent participating in the interview. To protect the participants' identities, all interviews were deidentified and transcribed, and all interview participants have been given a pseudonym.

### **Interview analysis**

We used a hybrid approach of deductive and inductive coding to answer our research questions (Fereday & Muir-Cochrane, 2006). We used deductive coding to identify whether Ph.D. students reported revealing their depression to faculty advisors, fellow graduate students, and undergraduate researchers. We used inductive coding methods to allow themes to emerge from students' responses (Saldaña, 2015). Specifically, we examined students' responses for reasons why they chose to reveal or conceal their depression and the benefits and consequences they associated with

revealing in three separate situations: to faculty advisors, to graduate researchers, and to undergraduate researchers. Three researchers (N.J.W., K.M.C., and L.E.G.) were assigned a randomly selected set of 12 interviews to review for common themes and individually annotated each interview. The researchers then came together to discuss their findings and create an initial codebook of emergent themes. Each of the three researchers reviewed a separate randomly selected set of five interviews to validate the initial themes outlined in the codebook and to see if any additional themes emerged. The researchers then came back together and used constant comparison methods to further validate all themes by comparing quotes from the interviews they reviewed to their respective themes (Glesne & Peshkin, 2016). If quotes were too different from the themes outlined in the codebook, a new theme was created (Glesne & Peshkin, 2016). A copy of the final codebook can be found in the **Appendix**. The final codebook was used by two researchers (N.J.W. and L.E.G.) to individually code a randomly selected set of five interviews (10% of all interviews), and the researchers' interrater score was rated at an acceptable level ( $k = 0.94$ , (Landis & Koch, 1977)). The remaining 45 interviews were then coded by one author (N.J.W.). Quotes from the interviews were used to demonstrate themes that were reported by at least 10% of the participants. Some student quotes were slightly edited for grammar or clarity.

### **Author Positionality**

Some of the authors identify with having depression and some do not. The researchers' personal experiences with depression informed the coding rubric; the researcher(s) perceived that having depression made it easier to identify themes that were emerging, while not having depression helped counteract any potential biases (Chenail,

2011). At the time of the interviews, one of the authors had completed a Ph.D. program and was serving as a research advisor (K.M.C.), and two authors were in the process of completing a Ph.D. program (N.J.W. and L.E.G.).

## RESULTS

### Participant Demographics

Of the 50 life sciences Ph.D. students who completed interviews, students most commonly identified as being a woman (58%), white (74%), and as having been a continuing generation college student (78%). Students primarily identified as either being in the second (26%) or third (24%) year of their Ph.D. program. Participants' depression during their Ph.D. program was primarily moderate (50%) or severe (28%), and nearly 75% reported being treated for depression. All student demographic data are summarized in **Table 8**.

**Table 8.** Demographics of the 50 Interview Participants

<b>Student-level demographics</b>	<b>Interview participants (N = 50) n (%)</b>	<b>Research/teaching demographics</b>	<b>Interview participants (N = 50) n (%)</b>	<b>Depression demographics</b>	<b>Interview participants (N = 50) n (%)</b>
<b><u>Gender</u></b>		<b><u>Program year</u></b>		<b><u>Severity of depression during graduate school</u></b>	
Woman	29 (58)	First year	4 (8)	Mild	7 (14)
Man	17 (34)	Second year	13 (26)	Moderate	25 (50)

Nonbinary/ gender fluid	4 (8)	Third year	12 (24)	Severe	14 (28)
<b><u>Race/ethnicity</u></b>		Fourth year	5 (10)	Extremely Severe	4 (8)
Asian/Pacific Islander	4 (8)	Fifth year	7 (14)	<b><u>Treated for Depression</u></b>	
Black/African American	1 (2)	Sixth year or more	6 (12)	Yes	37 (74)
Hispanic/Latinx	4 (8)	Recently Graduated	3 (6)	No	11 (22)
White/Caucasian	37 (74)			Decline to state	2 (4)
One or more race/ethnicity	3 (6)			<b><u>Treatment methods for depression</u></b>	
Decline to state	1 (2)			Medication	3 (6)
<b><u>College generation status</u></b>				Therapy/counseling	12 (24)
First generation	11 (22)			Both medication and therapy/counseling	21 (42)
Non-first generation	39 (78)			Decline to state	14 (28)

*Graduate students most commonly revealed their depression to fellow graduate students and infrequently revealed their depression to undergraduate researchers.*

Graduate students frequently reported that they had revealed their depression to at least

one other graduate student (74%), while more than half had revealed their depression to their faculty advisor (58%). Of the 38 graduate students who reported that they regularly worked with at least one undergraduate researcher, only 37% reported that they had revealed their depression to an undergraduate. Below we report graduate students' reasoning for revealing or concealing their depression to faculty advisors, graduate students, and undergraduate researchers. We also summarize the benefits and consequences students experienced or predicted they would experience as a result of revealing depression in each situation.

### **Revealing and concealing depression to faculty advisors**

*Ph.D. students primarily revealed their depression to faculty advisors because their depression was affecting their research, or they worried their depression would eventually affect their research.* Graduate students commonly reported four reasons why they revealed their depression to their faculty advisor (**Table 9**). Nearly half of the students who revealed their depression (48%) described engaging in preventative facework; they perceived depression would or already was affecting their attendance in the lab or productivity in research and preemptively wanted to let their faculty advisor know to prevent future judgement or conflict. Conversely, 41% of graduate students reported engaging in corrective facework after depression interfered with their mood or behavior in research and it was noticed by others; they revealed their depression as a means of explaining the noted behavioral or mood change. For example, some students described that their faculty advisor inquired about their mood or behavior when they were particularly sad or upset or when they were absent from the lab. Additionally, students described situations where they experienced extreme sadness or hopelessness while in the



presence of their faculty advisor, such as when crying in a one-on-one meeting.

Additionally, graduates reported revealing their depression to faculty advisors because they perceived they would not be judged, either because their faculty advisor had demonstrated that they are a caring or understanding individual (22%) or because they had developed a close personal relationship with the graduate student (17%).

**Table 9.** Reasons Why Ph.D. Students Revealed their Depression to their Faculty Advisor

Theme	Per cent (N = 29) <sup>a</sup>	Example Quote	Example Quote
Preventative reveal	48%	Student 6: “I had to come clean to [my faculty advisor] a couple of times. If I was coming into the lab less, I would say, ‘Hey advisor, I am struggling with depression right now. I am taking proactive steps to do this, this, and this about it.’”	Student 34: “Hiding [my depression] doesn't help because if I don't mention it then [my faculty advisor] is not going to know why my productivity comes and goes in waves.”
Corrective reveal	41%	Student 12: “We had a lab meeting that was just a rough day for me. [My faculty advisor] emailed me afterwards and said, ‘Hey. You didn't look good today. Are you okay? What's up?’ I decided to just be forthright with her and tell her what was going on [with my depression].”	Student 5: “It was actually after a committee meeting [when I revealed my depression]. I was talking about career stuff and [my faculty advisor] pulled me aside the next day and was just like, ‘Hey, you seem really depressed.’ And I was like, ‘Well, I am.’ And it was a really hard conversation.”

No judgment - understanding	22%	Student 3: “My advisor laid out some very clear objectives for herself as our advisor. Part of it wasn't directly stating like, ‘Hey, as your advisor, I want to help you with your mental health,’ but it was, ‘As your advisor, I want to help you as a person.’”	Student 8: “[My faculty advisor] sent an email to [everyone in the lab] and was like, ‘I want to say it again. If you're struggling with anything, come talk to me. Let's help each other out.’ So, me and [another grad student] know that if [our depression] gets really bad then we're like, we should probably loop in [our faculty advisor].”
No judgment - personal relationship	17%	Student 13: “My priority was making sure that [my faculty advisor] was someone that I could become friends with. So, from the get-go I knew that if something happened [with my depression] I could talk to him about it.”	Student 9: “[My faculty advisor] made me feel very comfortable in telling her about things I'm going through [with my depression]. Our friendship really contributed to the fact that I was comfortable with her and that I could reveal to her what I was feeling without fearing that she would judge me.”
<p><sup>a</sup>Percentages add to more than 100 because students often described more than one reason for revealing their depression to their faculty advisor.</p>			

*Ph.D. students primarily concealed their depression to faculty because they worried about being perceived negatively or because they are not personally comfortable with their depression.* Five common themes emerged as to why graduate students concealed their CSI from their faculty advisor (**Table 10**). Students most

commonly feared that their faculty advisor would perceive or treat them differently or negatively (57%). Students used their faculty advisor's past behaviors and opinions toward mental health issues or other marginalized identities to gauge how they might respond to knowing that they had depression. For example, students described noting when their peers brought up mental health and their advisor perceived they were making an excuse for a change in productivity. Further, students also concealed their depression if they perceived a cultural or age difference between themselves and their faculty advisor (19%). For example, students who had advisors who they considered much older or who they perceived had an easy time in graduate school were reluctant to reveal their depression because they assumed their advisor would not understand and could result in expressed conflicting opinions of mental health. Concealing to avoid being judged or concealing to avoid conflicting opinions are both reflective of preventative facework, since students are concealing to prevent negative interactions and stereotyping. Some students perceived that revealing their depression to their faculty advisor was unnecessary (29%) because it did not affect their performance in graduate school, and some (14%) felt that revealing their depression to their faculty advisor would be inappropriate. Participants who described that revealing their depression would be inappropriate often discussed a lab culture that encouraged students to separate their personal lives and emotions from their work. Finally, 38% of students highlighted that they are personally uncomfortable with their depression and therefore do not reveal their depression to anyone.

**Table 10.** Reasons Why Ph.D. Students Concealed their Depression from their Faculty Advisor

Theme	Per cent (N = 21) <sup>a</sup>	Example Quote	Example Quote
May be perceived or treated differently or in a negative way	57%	Student 2: “I guess it's really just that idea of like, I don't want to be treated differently [because of my depression]. I don't want to be handled with kid gloves. I want to be able to say when I get through grad school that I got through it just like everybody else.”	Student 18: “I guess I really don't want [my faculty advisor] to see me as only someone [who has depression], or really see me through a lens of ‘oh my student is depressed.’ I don't want her to think that I am making any excuses.”
Is uncomfortable with depression	38%	Student 44: “I think it was mostly that I didn't feel comfortable [revealing my depression], because I sometimes still don't feel comfortable sharing it with other people.”	Student 50: “I have always not felt super comfortable talking about [my depression] with people in general, and especially people that I work for.”
Perceives revealing to be unnecessary	29%	Student 17: “I decided not to [reveal my depression] explicitly because I didn't think it was necessary. I think if something changed and I felt like it was affecting me a lot more and it would be helpful for [my faculty advisor] to know, then I would tell [my advisor].”	Student 27: “[My depression] has never been something that's really affected my ability to do things. So, it's never been something that was necessary to bring up.”
Perceives an identity cultural or age difference	19%	Student 14: “[My faculty advisor] is in her late fifties, so she comes from a different generation. Even her response to different things makes me feel like she wouldn't	Student 43: “So [my faculty advisor] will constantly remind me and other students that grad school is

between them and their advisor		be able to respond [to my depression].”	supposed to be the best time of your life. He just doesn't seem to understand why and how grad school would be very hard [on someone's depression]. Because I guess for him, it was a very enjoyable stress-free experience.”
Perceives revealing to be inappropriate	14%	Student 39: “It's just [my faculty advisor's] personality, where emotional or personal problems don't necessarily have to interfere with your work.”	Student 14: "I came from a very competitive [graduate] program, and I think being kind to [your mental health] was not part of the culture. I remember telling someone I worked with [in my program] that I struggled with [depression] and they said, 'Oh, really? When we were young, I guess these things happened. And we just used to sort of get over it.' And I think that has stayed with me."
<p><sup>a</sup>Percentages add to more than 100 because students often described more than one reason for revealing their depression to their faculty advisor.</p>			

*Ph.D. students perceived that the primary benefits of revealing their depression to their faculty advisor are increased flexibility and support.* Students who revealed their depression commonly highlighted that their faculty advisor became more flexible or understanding after learning of their depression (48%). For example, students explained

that their faculty advisors were sometimes more understanding of their outward emotions (e.g., sadness) or behaviors (e.g., missing a deadline) related to their depression.

However, only 19% of students who had concealed their depression anticipated that revealing it would result in such flexibility. Both students who revealed their depression and those who concealed it commonly agreed that being open about their depression resulted (48%), or could result (43%), in their faculty advisor being more supportive of them. For example, students who had revealed their depression described their faculty advisor was more likely to check in on them or provide opportunities to talk about how their work was affecting their depression or vice versa. Finally, students felt that by revealing their depression they were able to be more honest with their faculty advisor if they could not fulfill a research-related obligation or meet a deadline (10%), yet no student who concealed their depression mentioned this theme.

*Ph.D. students perceived that the primary consequence of revealing one's depression is being judged by their faculty advisor.* Graduate students who concealed their depression from their faculty advisor identified more consequences associated with revealing than those who actually revealed their depression. Students who revealed their depression sometimes highlighted that they felt judged by their faculty advisor after sharing their depression (21%), which was a common fear of those who concealed (24%). Students who concealed their depression feared that revealing it could result in being prevented from carrying out their usual responsibilities as a graduate student (14%), but this was not reported as a consequence by students who revealed.

### **Revealing and concealing depression to fellow graduate students**

*Ph.D. students primarily revealed their depression to other fellow graduate students because they had established a personal relationship.* Graduate students commonly reported six factors that motivated them to reveal their depression to their peers (**Table 11**). Most commonly students discussed that they were willing to reveal because they would not be judged, owing to a personal relationship (49%), a mutual struggle with mental health (43%), or shared negative experiences in graduate school (20%). Students also reported that they revealed their depression to other graduate students in an act of supportive facework: to serve as a role model and destigmatize mental health, often in hopes that their peers might feel comfortable speaking about their own mental health (20%). Notably, graduate students were less likely to engage in preventative facework by revealing their depression to preemptively avoid conflicts or concern resulting from changes in their mood or behavior in lab (17%) or corrective facework by revealing depression to offer an explanation after others commented on a change in their mood or behavior (11%).

**Table 11.** Reasons Why Ph.D. Students Revealed their Depression to Other Graduate Students

Theme	Per cent (N = 35) <sup>a</sup>	Example Quote	Example Quote
No judgement - personal relationship	49%	Student 3: “[The other graduate students and I] are just a supportive group. (...) From the beginning, my advisor set an environment where she wants it to be a family. Family can mean different things for different people, but at least in our family	Student 23: “[The other graduates and I] are a family in my lab. We have some kind of relationship that's in-between a sibling and coworker. And I socialize with them a

		unit, we try to be there for each other.”	lot on the weekends and on weeknights, and we eat lunch together every day, and we talk all the time.”
No judgement - other person struggles with mental health	43%	Student 5: “I think [another graduate student] mentioned that he was vaguely struggling [with depression] and I was like, ‘No way. Me too.’ So, we sat down and had lunch together and it all really came out. We were just like, ‘Dude, we're going through the same things.’”	Student 8: “The fact that [another graduate student] revealed to me that he was experiencing [depressive symptoms] when he was getting his graduate degree made me feel like he could understand my experience.”
No judgement – shared (often negative) experiences in graduate school	20%	Student 4: “There's such a sense of camaraderie in which [the other graduate students and I] are all experiencing this together, and so it was really easy [to reveal my depression]. The other graduate students at my institution talk about really personal issues all the time and are very supportive as a group in general.”	Student 17: First you're talking about things that you and the other student both worry about, and then those conversations become deeper, and more than just like, ‘I'm worried about how this experiment will go. I'm disappointed about this.’ Over time it becomes more [about depressive symptoms] like, ‘I don't know if I can do this. There's something that might be wrong with me.’”
Supportive reveal	20%	Student 21: “I've just felt like I'm instilling the groundwork and [the other graduate students and I] should be allowed to talk about anything because we're suffering	Student 23: “It was really important to me that I share my experience because I think that mental



		through this together. (...) So I was trying to make it comfortable for everyone to talk about [their mental health].”	illness is so isolating, it's really important to be a role model so that it can be accepted and let [my peers] know that other people around you are suffering with [depression].”
Preventative reveal	17%	Student 26: “I mean, basically I kind of disappeared for a little while because I was getting treatments [for my depression], so I was not able to come to work for various things. Once I was starting to feel better and stronger, I sat [the other graduate students] all down together, and I said, ‘You guys probably noticed that these weird things have been happening. I haven’t been behaving like myself, and this is why.’”	Student 40: “[The postdoc] and I collaborated a lot, and I was working with her on writing a paper and it just kind of got to the point where things probably weren’t adding up to her. I gave her a general heads up and said, ‘I’m really sorry I’m not making as much progress on this. I’ve kind of been struggling with some mental health stuff and I’m doing the best I can.’”
Corrective reveal	11%	Student 4: “[The other graduate students] saw me getting worse and worse [with my depression] during my first year of graduate school. I think it was physically obvious because I would show up in the same clothes that I was wearing yesterday and was clearly very tired and sometimes checked out.”	Student 31: “I was having a really bad depressive episode in the middle of the lab. (...) My heart was going like a million miles an hour and I just started crying my eyes out at my desk after having closed the door. [Another graduate student] walked in five minutes later and saw me obviously in tears.”

<sup>a</sup>Percentages add to more than 100 because students often described more than one reason for revealing their depression to their faculty advisor.

*Ph.D. students were reluctant to reveal their depression to graduate students when they did not have a close personal relationship with them or if they were afraid of being treated differently.* The 26% of students who concealed their depression from other graduate students highlighted four common reasons why (**Table 12**). Like with those who revealed their depression, students’ personal connections with others most commonly affected their decision; specifically, graduate students often highlighted that the lack of a personal relationship with other graduate students in their lab prevented them from revealing their depression (58%). Participants also reported that they concealed their depression because of there being a fear of being judged or perceived negatively by other fellow graduate students within their lab (33%), a form of preventative facework (Brown, 1977; Ting-Toomey & Cole, 1990; Ting-toomey & Kurogi, 1998). Some students highlighted that their depression does not affect their research, as such, they find revealing their depression to be unnecessary to other graduate students (17%), and some generally feel uncomfortable with revealing their depression with others regardless of whom they are (17%).

**Table 12.** Reasons Why Ph.D. Students Concealed their Depression from Other Graduate Students

Theme	Per cent (N = 12) <sup>a</sup>	Example Quote	Example Quote
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Lack of personal relationship	58%	Student 13: “[The other graduate students and I] never got that close. I can remember instances where we were developing a closer bond and I would have been more comfortable sharing [my depression], but we just didn't get to that.”	Student 47: “I've never had a close friendship with anyone directly in my lab. We get along fine in day-to-day interactions and stuff like that, but none of the people who have gone through my lab, either students, postdocs, or otherwise, have been close enough friends that [my depression] is something I would talk about with them.”
May be perceived or treated in a negative way	33%	Student 44: “With [grad students], I think it is that I don't want them to treat me differently, but I also don't really want them to judge me for [my depression].”	Student 45: “[The other grad students] might not know how to respond to [my depression] or I guess might treat me a little bit differently based on that as opposed to ADHD, which I feel like there's a lot less stigma about.”
Perceives revealing to be unnecessary	17%	Student 37: “I just don't think [revealing my depression] is relevant. I'm all about talking about mental health and supporting one another, but I felt like I had enough of a support system with my boyfriend and my family that I didn't need to.”	Student 41: “It's just when it comes to [concealing my depression], I know I have a job to do. I just go about my own business.”
Is uncomfortable with depression	17%	Student 22: “It's just not something that I've spoken about with a lot of people. So, I'm just not the greatest at talking about it in general.”	Student 50: “For the grad students, I just don't like to talk about [my depression], as I wouldn't with anyone else, so it's less about

			that professional barrier, and more of a personal preference.”
<sup>a</sup> Percentages add to more than 100 because students often described more than one reason for revealing their depression to their faculty advisor.			

***The most commonly perceived benefit of revealing depression to fellow graduate students is increased support.*** The benefits associated with revealing depression to faculty advisors also applied to revealing depression to fellow graduate students. Both students who concealed (67%) and revealed (80%) their depression commonly highlighted that revealing one’s depression may result in or actually resulted in forming stronger relationships with fellow graduate students and receiving increased support demonstrated by checking in more frequently or helping with research tasks. Additionally, students who revealed their depression also described that they could be more honest with other graduate students if they were unable to fulfill their duties as a graduate student because of their depression (14%). However, this was not highlighted as a potential benefit by students who had not revealed their depression.

***Ph.D. students experienced no consequences from revealing their depression to fellow graduate students, and those who concealed only perceived one consequence.*** Notably, students who revealed their depression did not experience any consequences associated with revealing their depression to other graduate students, while those who concealed their depression only perceived there to be one consequence: other graduate students may be reluctant to provide feedback on their research if they know the student has depression (17%). Students worried others might feel they have to “walk on

eggshells” or “sugarcoat their words” when discussing research with a student who has depression.

### **Revealing and concealing depression to undergraduate researchers**

*Ph.D. students primarily revealed their depression to act as a mentor for undergraduate researchers and to destigmatize mental health while in graduate school.*

Out of 38 students who have interacted with an undergraduate student in their lab, only 14 students (37%) revealed their depression to an undergraduate student and highlighted four common themes why they did so (**Table 13**). Most graduate students’ behaviors could be categorized as supportive facework because the efforts were meant to help their undergraduates feel respected or secure (Brown, 1977; Ting-Toomey & Cole, 1990; Ting-toomey & Kurogi, 1998). Graduates most frequently reported that they revealed their depression because they wanted to act as a mentor for undergraduate researchers (50%). Graduate students stated that they felt it was their responsibility to reveal their depression to undergraduates to destigmatize mental health and to show the reality of student experiences while in graduate school. Additionally, as was seen with revealing depression to fellow graduate students, participants revealed their depression to undergraduates if they perceived they would not be judged either because they knew the undergraduate also struggled with mental health (43%), or because they had developed a personal relationship with them (36%). Finally, some graduate students engaged in preventative facework, revealing their depression preemptively to undergraduates to avoid conflict or judgement if their depression affected their presence or performance in the lab (14%).

**Table 13.** Reasons Why Ph.D. Students Revealed their Depression to Undergraduate Researchers

Theme	Per cent (N = 14) <sup>a</sup>	Example Quote	Example Quote
Supportive reveal	50%	Student 16: “It just felt like my duty to let [the undergraduates] know that graduate school is hard and I'm not going to fake that it's a really happy time so that they know what to expect.”	Student 21: “I think I just wanted [undergraduates] to understand if they were going to choose grad school, the [depressive] feelings they would have, and that they were not alone in them.”
No judgement - other person struggles with mental health	43%	Student 4: “I think it was kind of a sense of camaraderie because they were also struggling [with depression]. (...) When somebody tells me, ‘Oh, I'm struggling with depression right now,’ then I can be like, ‘Oh my God, me too.’ And then it feels very supportive.”	Student 15: “One of the undergraduates was like, ‘I have bipolar disorder and I'm really depressed sometimes.’ And I was like, ‘You know what? Thank you for sharing that. Here's the way that I identify with that and here's what we can do together.’”
No judgement - personal relationship	36%	Student 5: “The relationship [with the undergrad] has naturally changed [to a personal one]. It wasn't so much like I am the master, and you are the apprentice. It's more like, okay, you've seen what research is like. You're a coauthor, we're really more like colleagues now.”	Student 19: “I think [the undergrad and I] have known each other longer than we've worked together so we already had that relationship and that trust built in.”
Preventative reveal	14%	Student 29: “I felt bad that I was unprepared. I was late, basically.	Student 6: “Well, the people I worked over,

		So, I felt the need to explain why.”	the undergraduates, needed to know [about my depression] because that was rude of me when I was late.”
<sup>a</sup> Percentages add to more than 100 because students often described more than one reason for revealing their depression to their faculty advisor.			

***Ph.D. students primarily concealed their depression from undergraduate researchers because they want to maintain their status as a professional advisor.***

Participants were least likely to reveal their depression to undergraduates, with 63% concealing their depression from undergraduate researchers. Graduate students reported that there is a professional barrier between themselves and the undergraduates within their labs, and that as someone who acts as an authority figure, it would be inappropriate to reveal their depression (54%). Graduate students also concealed their depression because they didn’t feel that they had a close enough relationship with an undergraduate researcher to discuss mental health (38%), and some Ph.D. students perceived their undergraduates were too different from themselves either because of the undergraduate’s age or maturity level (21%). Finally, graduate students worried that by revealing their depression, they could possibly overwhelm the undergraduate researcher and concealed to avoid unintentionally burdening them (13%). All themes and respective example quotes can be found in **Table 14**.

**Table 14.** Reasons Why Ph.D. Students Concealed their Depression from Undergraduate Researchers.

Theme	Percent (N = 24) <sup>a</sup>	Example Quote	Example Quote
Would break professional barrier	54%	Student 48: “I feel an expectation to be in a position of greater wisdom as a superior to [the undergraduates]. So, I think it reflects poorly on my leadership ability to advisor them, not in any tangible way, but I think there's an expectation that leaders aren't necessarily supposed to disclose [their depression].”	Student 50: “There is more of a professional barrier between [the undergraduates] than there is between me and other lab mates, so it feels like your boss telling you all this personal information about themselves which might be seen as weird.”
Lack of personal relationship	38%	Student 22 “I have a good relationship with [the undergraduates] and talk to them, but not [a personal] one where I would think about discussing my mental health issues with them.”	Student 24: “Well, [the undergrads and I] are not acquainted as much. I see them sometimes and I train them. So, they're very superficial conversations or conversations about the research and never really about [my depression].”
Perceives cultural/maturity/age difference	21%	Student 33: “I also am wary of the maturity level, where I feel kind of less comfortable talking to [an undergraduate] who might not have the same life experiences as me and might see [my depression] in a different light.”	Student 22: “Well, there is a bit of an age gap between me and most of the undergrads. So, yeah, I don't know if I feel totally comfortable talking to somebody who is 10 years my



			junior about [my depression].”
Avoid burdening the undergraduate researcher	13%	Student 46: “I’m pretty sure that [undergraduate researchers] have problems of their own, so they don’t need to know and deal with my problems.”	Student 2: “It’s always somewhat emotionally taxing to know that somebody is struggling. I would say that pretty much anybody with a standard amount of empathy would feel at least some emotional burden from finding out that somebody that they associate with in some way is dealing with something like depression.”
<p><sup>a</sup>Percentages add to more than 100 because students often described more than one reason for revealing their depression to their faculty advisor.</p>			

***Revealing depression to undergraduate researchers could be beneficial by resulting in increased support or formation of stronger relationships.*** Students who revealed their identity experienced more support from undergraduates in the form of frequent check-ins and increased understanding from the undergraduate researcher (64%), which was also a benefit that was hypothesized by participants who concealed their depression (46%).

***Students who revealed their depression to undergraduates experienced no consequences, while those who concealed their identity perceived that they may be judged by undergraduate researchers if they were to reveal.*** Ph.D. students who revealed their depression to undergraduate researchers reported no consequences, and

those who concealed reported the sole potential consequence of experiencing judgment from an undergraduate researcher (17%). Specifically, participants described that an undergraduate researcher may “not take me seriously,” or might not “listen to me as much” if they knew about their depression.

## **DISCUSSION**

Graduate students were most likely to reveal their depression to fellow graduate students, followed by faculty research advisors, and least likely to reveal their depression to undergraduate researchers. Students’ motivation for revealing their depression in the context of graduate research differed based on who they were revealing to.

Graduate students were frequently motivated to share their depression with other graduate students because of the perceived social support and interpersonal relationships, which has consistently been reported as a major influence on an individual’s comfort level with revealing their depression to another individual (Beals et al., 2009; Jones & King, 2014) and is one of the top reasons why people report revealing their CSIs more broadly (Quinn & Earnshaw, 2011). While mutual relationships influenced graduates’ decisions to reveal their depression to their peers, Face Negotiation Theory helps explain their decisions to reveal their depression to both faculty advisors and undergraduates. In both cases, graduate students were navigating hierarchical relationships, meaning that the relationship is based on the individuals’ positions relative to each other. Graduate students primarily revealed their depression to their faculty advisors, those in superior positions, to maintain social dignity. Most commonly, graduate students reported engaging in preventative facework by revealing their depression with the intent to proactively avoid conflict. They also often engaged in corrective facework by revealing

their depression to repair their reputation by offering explanations for behavioral changes (Brown, 1977; Ting-Toomey, 1982; Ting-Toomey & Cole, 1990; Ting-toomey & Kurogi, 1998). The decision to preemptively reveal one's depression aligns with the disclosure process model (Chaudoir & Fisher, 2010). By disclosing one's depression it likely alleviated psychological and physiological stress because the student no longer had to worry that their advisor would get upset with for lack of productivity or missing meetings (Kranke et al., 2013; White & Labelle, 2019). When engaging with undergraduates, who are in subordinate positions, graduate students primarily engaged in supportive facework by revealing their depression to help undergraduates normalize mental health struggles (Brown, 1977; Ting-Toomey & Cole, 1990; Ting-toomey & Kurogi, 1998). Past literature has found that those in mentorship positions tend to feel responsible to self-disclose parts of their identity to show their willingness to share their own struggles as someone who holds power over another individual (G. Crisp & Cruz, 2009; Eller et al., 2014). However, graduate students commonly concealed their depression from undergraduate students in effort to maintain social dignity; there were many instances where graduate students were reinforcing a culture that associates depression with weakness (A. H. Crisp et al., 2000; Monteith & Pettit, 2011; Wang & Lai, 2008) and that supports concealing personal information in hierarchical relationships (Brougham & Haar, 2013; Dai et al., 2022; Follmer & Jones, 2018; Peters & Brown, 2009). Together, our data highlights that the impetus for revealing depression changes based on who the graduate student is interfacing with and supports that managing one's face, or reputation, is often dependent on the nature of the relationship and its hierarchy (Brown, 1977; Ting-Toomey, 1982; Ting-toomey & Kurogi, 1998).

Our study adds to a body of literature highlighting that revealing one's CSI in a safe environment can result in numerous benefits (Black & Miles, 2002; Chaudoir & Quinn, 2010; K. Cooper et al., 2019; K. M. Cooper, Gin, & Brownell, 2020; Kranke et al., 2013; Quinn & Earnshaw, 2011; Ridge et al., 2019). The graduate students in this study who revealed their depression reported that both faculty advisors and fellow graduate students who knew about their depression provided increased flexibility once they were aware of the Ph.D. student's depression, often by being more accommodating with deadlines, alleviating responsibilities, and providing additional help on work-related responsibilities. Notably, when we asked students who concealed their depression about possible benefits, only 20% identified this as a possible benefit of revealing to a faculty advisor and no student identified it as a possible benefit for revealing to graduate students. Relatedly, Ph.D. students who revealed their depression highlighted that they were able to be more honest with their faculty advisor and fellow graduate students in situations where their depression limited their ability to complete research tasks. However, this was also never mentioned by Ph.D. students who concealed their depression as a potential benefit. Therefore, these may be unexpected benefits of revealing depression that Ph.D. students may not consider as they weigh the decision to conceal or reveal. In addition to the positive impact that revealing depression appeared to have on graduate students themselves, there is reason to believe that the act of revealing one's CSI may have also benefitted others, particularly undergraduates. A study of 35 undergraduate researchers with depression revealed that only one-third of students knew a scientist with depression (K. M. Cooper, Gin, & Brownell, 2020). However, undergraduates who did not know a scientist with depression reported that if they did, it

would serve as proof that individuals with depression can be successful in science in addition to helping them feel less alone as someone experiencing depression in the context of research. Recent research suggests that when an instructor reveals a CSI in academic science, students who share that CSI may benefit disproportionately (Busch et al., 2022). In sum, the graduate students revealing their depression to others in the context of research has the potential to yield benefits that extend beyond themselves. Consequences of revealing depression were rarely reported by students who revealed their identity. The consequences that students who concealed their depression anticipated aligned closely with their reasons for concealing their identities, including concerns about being judged, being unfairly relieved of responsibilities, and being treated differently, which each echo concerns that undergraduates researchers have voiced about sharing their depression in research labs (K. M. Cooper, Gin, & Brownell, 2020). Participants most commonly reported that they concealed their depression from both their faculty advisor and fellow graduate students because they perceived they may be viewed or treated negatively, likely owing to the stigma that people with depression are weak and unpredictable (A. H. Crisp et al., 2000; Monteith & Pettit, 2011; Wang & Lai, 2008). Students who concealed their depression because they anticipated being stripped of responsibilities if they were to reveal demonstrated identity interference, where they perceive that their depression interferes with their identity as a scientist (National Academies of Sciences, Engineering, and Medicine, 2019). Ph.D. students also commonly reported concealing their depression because they were personally uncomfortable with it. One reason for such discomfort is internal stigma, which is often a result of learning stereotypes about depression early in one's life (Link, 1987; Quinn &

Earnshaw, 2011; Ritsher & Phelan, 2004) because depression is depicted in television shows as unattractive, violent, and criminal (WAHL, 2003) and referenced by family and friends in a derogatory way (Dovidio, 2010). Some Ph.D. students perceived revealing their depression in the context of research to be unnecessary, which aligns with literature highlighting that if one perceives their CSI will not interfere with their work, it is irrelevant to reveal in that particular context (Kranke et al., 2013; Meluch & Starcher, 2020). In addition, although a number of Ph.D. students viewed revealing depression as an important part of mentoring, others felt the need to conceal it in order to establish a professional barrier. Indeed, prior literature has highlighted that individuals who serve in advisor roles often perceive that it is necessary to conceal stigmatized identities to keep professionalism intact (Anderson & Shore, 2008; Ridge et al., 2019). This may be further exacerbated in the generally apathetic culture in both science and academia that encourages separation of work and emotion (Christopher Strenta et al., 1994; Ebenezer & Zoller, 1993)

### **Limitations**

While this study explored the benefits and consequences associated with revealing one's depression, we did not explore the benefits or challenges associated with concealing one's depression. Owing to the study design, we were unable to assess whether students are unaware of potential benefits of revealing depression, which lessens the chance that they will reveal, or whether students who are less likely to benefit are also less likely to reveal. Additionally, it was beyond the scope of this study to investigate the correlations between student demographics and their experiences with revealing or concealing their depression, owing to the small number of students in different

demographic groups. However, such relationships should be investigated in future large-scale quantitative studies.

## **CONCLUSION**

We conducted interviews with 50 life sciences Ph.D. students to examine to what extent and why they chose to reveal or conceal their depression to faculty, fellow graduate students, and undergraduate researchers. Nearly three-quarters of Ph.D. students reported having revealed their depression to another graduate student, and over half revealed their depression to their faculty advisor. Graduate students were least likely to report revealing their depression to undergraduate researchers within their lab. Students' decisions to reveal their depression to their peers were driven by strong mutual relationships, while their decision to reveal their depression to faculty research advisors was driven by preventative or restorative facework, and their decision to reveal to undergraduate researchers was driven by supportive facework. This research highlights the benefits of being able to work in a research environment where one feels comfortable revealing their depression and emphasizes the impact of hierarchical relationships on graduate students' decisions to reveal or conceal their depression in research.

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## CONCLUSION

### **The State of Graduate Student Mental Health**

Over the past few years, the high rates of depression among graduate science students led scientists to declare a “graduate student mental health crisis” (Evans et al., 2018). To fight this, researchers have begun to identify predictors of depression within graduate school including financial stress (Charles et al., 2021; Hish et al., 2019; Jones-White et al., 2020) and poor mentor-mentee relationships (Hish et al., 2019; Peluso et al., 2011). However, no studies have directly examined what specific aspects of graduate research and teaching affect depression among graduate students and the extent to which graduate students reveal or conceal their depression during their graduate school program.

### **The Relationship between Graduate Research and Teaching and Student Depression**

My lab group and I initially conducted an exploratory interview study contextualized within life science Ph.D. programs to examine (1) what specific aspects of graduate research and teaching affect Ph.D. student depression, and (2) how does Ph.D. students’ depression affect their experience in research and teaching? Of the students who were contacted for our interview study, 50 Ph.D. students enrolled across 28 life sciences Ph.D. programs across the United States agreed to participate in the interview studies. We utilized inductive coding to identify themes that emerged from the interviews in the first study. We found that the factors found in research and teaching that can alleviate or exacerbate graduate student depression can be split into 4 pillars: (1) structure, (2) positive and negative reinforcement, (3) success and failure, and (4) social isolation and

collaboration. We also found that depression in turn, can cause graduate students to have a lack of motivation, productivity, or energy in their graduate research and teaching duties. We also found that graduate students have difficulty concentrating and interacting with others in graduate research and teaching. With graduate teaching students did report that they felt they were able to have a sense of empathy or understanding for students' issues in learning spaces, specifically issues related to mental health.

### **Exploring Graduate Student Depression as a CSI**

I wanted to maximize our findings in the first study and find how we can tightly tailor the recommendations found for graduate student depression by exploring depression as a concealable stigmatized identity (CSI), or an identity that is hidden or invisible and carries a negative stigma (Chaudoir & Quinn, 2010). For the framework of our study, it was decided to look through the lens of Face Negotiation Theory, or a set of communicative behaviors that individuals use to regulate their social dignity when exploring depression as a CSI in graduate student programs (Tiny-Toomey, 1982; Ting-Toomey & Kurogi, 1998). This study was created to explore, (1) to what extent graduate students revealed their depression to faculty members, other graduate students, and undergraduates in their lab, (2) why do graduate students reveal or conceal their depression, and (3) what do graduate students perceive to be the benefits and consequences of revealing their depression? The same sample of 50 Ph.D. students enrolled across 28 life sciences graduate programs was utilized for the second study found in this thesis. It was found that graduate students most commonly revealed their depression to other graduate student peers and were least likely to reveal to undergraduate researchers found within their research space. Students most commonly

revealed their depression to others in their research space for the following reasons: (1) personal and mutual relationships, (2) preventative and corrective facework, and (3) to act as a role model to normalize mental health in graduate school. While on the other side, graduate students most commonly concealed their depression for the following reasons: (1) lack of a personal relationship, (2) fear of judgement or negative perception, (3) professional barriers, and (4) lack of comfort of one's depression. Meanwhile, students felt that there were both benefits and risks in revealing one's depression. Students felt that by revealing one's depression, other may become more flexible, honest, and supportive in nature, but students also felt that as a consequence for revealing one's depression, others may relieve the student of responsibilities, be reluctant to provide feedback, and be judgmental of the graduate student.

### **General Takeaways**

Both qualitative interview studies presented in this thesis further add evidence to the claim that depression is a prominent issue found in graduate programs within the United States and has inevitably led to a "mental health crisis" (Evans et al, 2018). These two studies highlight and maximize the underlying factors and root causes in both graduate research and teaching that can alleviate or exacerbate depressive-related symptoms in graduate students. Students feel most comfortable with revealing their depression when there is a positive, understanding, and supportive environment between the student and other individuals within their research and teaching spaces. To support graduate student mental health, future efforts should be made to create research and teaching-related spaces that are inclusive towards students with depression supported by the factors found within these two exploratory interview studies.

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APPENDIX A  
INTERVIEW QUESTIONS ANALYZED

*Thank you for agreeing to interview. My name is XXXXXXXX, I am a biology education researcher at [university], and I study ways to improve the experiences of Biology Ph.D. students. My goal for this work is to really just to learn more about you and your experience as a Ph.D. student with depression. I am going to ask you a series of questions. There are no right or wrong answers to any of these questions. Sometimes you may feel like you've already answered a question that I ask. That's OK. Just feel free to elaborate on your previous answer, since I have to ask all of the questions on my list.*

*Before we start, we sent out the interview consent to you. You agree to consent by participating in the interview. Are we OK to proceed?*

*I'm going to go ahead and start the interview recording now.*

### **Establishing depression and cause**

The goal of this study is to interview students about their experiences with depression, so my first question is, have you experienced depression while in your biology Ph.D. program?

Many people with depression also have extreme feelings of anxiety. Have you experienced extreme feelings of anxiety, either currently or in the past?

Is there a link between your feelings of depression and anxiety? (If Yes: Can you describe this. What tends to come first, anxiety or depression?)

### **Effect of graduate research on depression**

*In this interview we are going to ask you questions about how YOUR TIME IN GRAD SCHOOL AFFECTS YOUR DEPRESSION. Then, we are going to ask you about HOW YOUR DEPRESSION affects your time in graduate school. When I ask about your time in grad school, I'm going to ask you questions specifically about your research experience and then your teaching experience (if you have taught). I'd like you to answer these questions just referencing your time in your Ph.D. program before COVID-19 hit. I'm going to ask you about your research experience first.*

Could you briefly describe your graduate **research** experience and what you study?

What, if anything, about your graduate **research** experience makes your depression worse? What, if anything, about your graduate **research** experience helps you manage your depression?

### **Effect of graduate teaching on depression**

*Now, I'm going to ask you more about your graduate teaching experience. As I ask you about your graduate teaching experience, please feel free to reference any aspect of your teaching experience - from your relationships with others teaching, to your actual experience teaching.*

Can you tell me about the extent to which you have taught undergraduates during your Ph.D.?

What, if anything, about your graduate **teaching** experience makes your depression worse? What, if anything, about your graduate **teaching** experience helps you manage your depression?

### **Effect of depression on graduate research**

*We've asked you a bunch about how your grad school experience has impacted your depression. Now, we would like to switch gears and talk about how your depression has impacted your experience in graduate school.*

What are the symptoms of your depression broadly?

How, if at all, do you think depression affects your graduate **research** experience specifically? How, if at all, do you think depression affects your graduate **teaching**

experience specifically? **Recommendations for improving the experiences of graduates with depression**

*Now we'd like to identify some ways to improve the experiences of Ph.D. students with depression. Your ideas can be targeted at anyone - for example, faculty, graduate program directors, fellow graduate students, etc.*

Is there a way that you can think of to improve the experiences of graduate students with depression in the context of **research**?

Is there a way that you can think of to improve the experiences of graduate students with depression in the context of **teaching**?

**To what extent do you interact with your faculty research advisor/PI?**

Does your **faculty** research advisor know about your depression?

- If yes:
  - How did they find out?
  - What made you feel comfortable revealing your depression to those individuals?

- Were there any instances where you felt that they treated you differently in a **negative** way after they knew about your depression?
- Were there any instances where you felt that they treated you differently in a **positive** way after they knew about your depression?
  
- If no:
  - Why not?
  - What reasons, if any, made you feel uncomfortable revealing your depression to those individuals?
  - If they did know about your depression, do you think there would be instances where they would treat you differently in a **negative** way because of your depression?
  - If they did know about your depression, do you think there would be instances where they would treat you differently in a **positive** way because of your depression?

**Do you have other grad students or post-docs in your Ph.D. research group that you interact with?**



Do any **grad students or postdocs in your research group** know about your depression?

- If yes:
  - How many people know?
  - How did they find out?
  - What made you feel comfortable revealing your depression to those individuals?
  - Were there any instances where you felt that they treated you differently in a **negative** way after they knew about your depression?
  - Were there any instances where you felt that they treated you differently in a **positive** way after they knew about your depression?
  
- If no:
  - Why not?
  - Were there any reasons that you felt uncomfortable revealing your depression to those individuals?
  - If they did know about your depression, do you think there would be instances where they would treat you differently in a **negative** way because of your depression?

- If they did know about your depression, do you think there would be instances where they would treat you differently in a **positive** way because of your depression?

**Do you have any undergraduates in your Ph.D. research group that you interact with?**

Do any of the **undergraduate researchers in your Ph.D. research group know about your depression?**

- If yes:
  - How many?
  - How did they find out?
  - What made you feel comfortable revealing your depression to those individuals?
  - Were there any instances where you felt that they treated you differently in a **negative** way after they knew about your depression?
  - Were there any instances where you felt that they treated you differently in a **positive** way after they knew about your depression?

- If no:
  - Why not?
  - Were there any reasons that you felt uncomfortable revealing your depression to those individuals?
  - If they did know about your depression, do you think there would be instances where they would treat you differently in a **negative** way because of your depression?

If they did know about your depression, do you think there would be instances where they would treat you differently in a **positive** way because of your depression?

**Is there anything else you would like to share?**

APPENDIX B  
DEMOGRAPHIC SURVEY QUESTIONS ANALYZED

### **Student-level demographic survey questions**

I most closely identify as

- Woman
- Man
- Non-binary/Gender fluid
- Other (please describe)
- Decline to state

I most closely identify as

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic, Latinx, or Spanish origin
- Pacific Islander
- White/Caucasian
- Other (please describe)
- Decline to state

What is your parent's highest completed level of education? If you have more than one parent with differing levels of education, choose the higher of the two.

- Did not complete high school
- High school diploma or GED

- Some college but no degree
- Associate degree (for example: AA, AS)
- Bachelor's degree (for example: BA, AB, BS)
- Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA)
- Higher than a Master's degree (for example: PhD, MD, JD)
- Other (please describe)
- Decline to state

Are you an international student?

- Yes (If yes, which country are you from?)
- No
- Decline to state How old are you?

What is your career goal? (Please list)

**Research/Teaching-level demographic survey questions**

How long have you been in your PhD program?

- Less than one year
- One year
- Two years
- Three years
- Four years

- Five years
- Six years
- More than six years
- I have finished my PhD program

What is the focus area of your research? (e.g., animal behavior, neurobiology, cancer bio)

Do you any have experience teaching undergraduate students? For example, as a Teaching Assistant.

- Yes (If yes, how many courses have you taught either as an instructor of record or as a teaching assistant?)
- No

### **Depression demographic survey questions**

During your graduate research experience, in your opinion how severe is/was your depression?

- Mild
- Moderate
- Severe
- Extremely severe
- Decline to state

Have you been diagnosed with depression?

- Yes
- No
- Decline to state

Are you currently being treated for, or have you previously been treated for depression?

- Yes
- No
- Decline to state

If yes, how has your depression been treated? Select all that apply.

- Medication (e.g., antidepressants)
- Counseling/therapy (e.g., working with a psychologist or therapist)
- Other (please describe)
- Decline to state



APPENDIX C

CODING RUBRIC FOR RESEARCH-RELATED FACTORS THAT PH.D.  
STUDENTS REPORTED NEGATIVELY AFFECTED THEIR DEPRESSION

Theme	Description of theme	% (n) n = 50
Failures, obstacles, or setbacks during research	Student describes that having a failing/failed experiment or project can negatively impact their depression. This can also include a grant being rejected or the rejection of papers. Student can also describe that they feel like they are wasting time due to the obstacles or failures. This includes a lack of progress in research.	48 (24)
Unstructured research experience	Student describes the lack of structure of research contributes negatively to depression. This could be because research does not have clear goals, next steps, or is amorphous in general. This also include a lack of tasks that can be completed in a short period of time or that there are unclear measures of progress or markers of success in research.	38 (19)
Negative reinforcement	Student describes that they receive negative reinforcement from others in research such as harsh criticism, feedback, comments, or reviews about one's research or performance can negatively affect student depression. This can include the PI/mentor yelling or scolding the student or the PI/mentor being dismissive or condescending.	34 (17)
Unreasonable or overwhelming expectations	Student describes that their PI or lab places too high of expectations on them, particularly related to the progress that they are making. This is often an explicit expectation. However, the expectation can also be implied- it may be lab culture of long hours in lab, # of papers published, etc... Often a student will describe that the inability to meet these expectations contributes to their depression. This also includes students whose depression is negatively affected by the long hours or consecutive days they need to work.	34 (17)
Opportunity to compare self	Student describes that graduate school or research presents opportunities for them to	28 (14)

to others	compare themselves to others. When students do this, it negatively impacts their depression because they often feel inadequate compared to their peers (e.g., this can lead to feelings of imposter syndrome, but that is coded separately).	
Lack of technical support or guidance	Student describes that they do not have adequate support or guidance or a mentor to go to for help related to their research. This often comes up when a student is facing a barrier with a specific aspect of their research project. This would also include a student mentioning little oversight/advising/mentoring. If a student specifically describes a lack of structure or next steps, this is coded as "unstructured research experience." Whereas if a student specifically mentions a lack of mentor or an inability to have questions answered, then this is coded here.	22 (11)
Social isolation	Student describes that working alone, feeling lonely or isolated, or a lack of connection with others can negatively affect their depression. This can be because of the type of research (e.g., field work) or when they're going into the lab (e.g., nights and weekends).	18 (9)
Discrimination/prejudice in the lab or academia	Student describes that there are issues of overt or subtle discrimination or other biases that can negatively affect their depression and their research. This can be from the PI/mentor or others in the lab, department, or university (e.g., committee members). Examples can include sexism, racism, etc.	6 (3)
Research funding	Student describes that a potential lack of funding or not having funding for themselves or their research exacerbates their depression	4 (2)

APPENDIX D

CODING RUBRIC FOR RESEARCH-RELATED FACTORS THAT PH.D.  
STUDENTS REPORTED POSITIVELY AFFECTED THEIR DEPRESSION

<b>Theme</b>	<b>Description of theme</b>	<b>% (n) n = 50</b>
Completing small or concrete research tasks	Student describes that concrete/easy/straight-forward tasks are helpful because they can distract from negative thoughts. A student may also describe that checking a box, accomplishing a small task, getting something done is good for their depression.	26 (13)
Working with others	Student describes that interacting with others and collaborating can be beneficial. This can include mentoring or any positive interactions with peers or subordinates in the lab.	22 (11)
Passionate about research topic	Student describes that they are passionate about their research topic or project or that they care about the bigger impact of their work. Student can describe that the overall purpose of their research can alleviate their depression.	18 (9)
Flexibility	Student describes that research allows for some level of flexibility where they can schedule meetings, experiments, time in lab, etc. around their personal/mental health. For example, a student could say that they are able to go to therapy during the day because they can do research around their appointment.	18 (9)
Research progress	Student describes making progress on their project, that their science works, that things in lab are going well, etc. This must include significant progress on their research (as opposed to completing small tasks).	16 (8)
Emotionally supportive PI	Student describes a positive personal relationship with their PI. This can be described as connecting well or having similar personality types or the PI understanding them as a person. Student may also describe that the PI is a good or nice person but isn't specific that it's related to their mentoring. If student describes their PI positively, but provides a specific reason, then it is coded as that reason (e.g., provides enough	12 (6)

	guidance), but if it is a general liking of the PI, it is coded here. This can also be considered positive emotional or psychosocial support from PI.	
Support or guidance from mentor (technical support)	Student describes that having technical support or guidance specific to their research from a mentor can positively impact their depression. This is always someone in research in a position of authority (often a PI), but they can provide research or technical support.	8 (4)
Achievements that can be put on CV	Student describes a "tangible" accomplishment (e.g. receiving an award, getting a publication, passing comps, getting a grant). This could be something that the student could put on their CV.	6 (3)

APPENDIX E

CODING RUBRIC FOR TEACHING-RELATED FACTORS THAT PH.D.  
STUDENTS REPORTED NEGATIVELY AFFECTED THEIR DEPRESSION

Theme	Description of theme	% (n) n = 50
Time stress	Student describes that teaching adds to their total number of responsibilities, which can cause an extra stressor that they have to balance with either their research or other PhD program-related responsibilities. This includes if the demand of teaching is overwhelming or if the instructor of the course demands too much time/work from the graduate student TAs.	47 (20)
Negative reinforcement from undergraduates	Student describes that student(s) in their class are rude, disrespectful, not paying attention, disengaged, or disinterested. Student can also describe that they receive negative teaching evaluations (formal) from students or receive negative feedback about their teaching more generally from students (informal).	28 (12)
Personal pressure to teach well	Student describes an obligation to serve students well, to make sure they learn, to teach well, and make sure students understand the material, which can induce stress and exacerbate depression.	26 (11)
Lack of teaching training or guidance	Student describes that not being trained about how to teach, not having guidance about teaching, or not having enough knowledge in the discipline being taught can negatively affect their depression.	16 (7)



APPENDIX F

CODING RUBRIC FOR TEACHING-RELATED FACTORS THAT PH.D.  
STUDENTS REPORTED POSITIVELY AFFECTED THEIR DEPRESSION

Theme	Description of theme	% (n) n = 50
Positive reinforcement from undergraduates	Student gets positive feedback from undergraduates about their teaching in the form of a formal evaluation or more informally. Student describes that they get satisfaction out of working with students and seeing them learn. Student can also describe that it is helpful for their depression when they encounter an undergraduate who is passionate about the subject or engaged in their own learning or the material.	58 (25)
Teaching as a structured task	Student describes that teaching is helpful for depression because it allows them to accomplish a concrete task, which can range from tasks such as speed grading to completing the act of teaching the class for the day.	33 (14)
Passion for teaching	Student describes that they enjoy or are passionate about teaching which is helpful for their depression or when they are experiencing depressive symptoms.	30 (13)
Distraction from research	Student describes that teaching serves as something that distracts from their depression, particularly often how their research negatively affects their depression.	24 (10)
Confidence about teaching	Student describes that they know how to approach teaching, are good at teaching, or are an expert in the content knowledge. This is different from a student rating the graduate student highly in teaching, which would be coded as "positive reinforcement."	14 (6)
Positive relationships with others teaching	Student describes that having positive relationships with others who teach, for example with the head instructor or other Tas, can positively affect their depression.	12 (5)

APPENDIX G

CODING RUBRIC FOR SELF-REPORTED WAYS THAT DEPRESSION AFFECTED

PH.D. STUDENTS' RESEARCH OR THE STUDENT AS A RESEARCHER

Theme	Description of theme	% (n) n = 50
Lack of motivation and productivity	Student describes that their depression can make them feel less motivated or excited to do their research. This also includes producing fewer publications or research products.	64 (32)
Low self-esteem or overly self-critical	Student describes that they are more self-critical or hyperaware of any issues they may be having. This can also include perfectionism, making them more critical of what they are working on. Student describes that having depression can cause them to doubt their abilities to do science, making the student feel like they do not belong in science, or that they are a fake/fraud, and no one has noticed yet. This often is a result of the student comparing themselves to others or from being critiqued.	58 (29)
Difficulty focusing and concentrating	Student describes that their depression can cause them to feel distracted or unfocused, making it a struggle to pay attention to details.	28 (14)

APPENDIX H

CODING RUBRIC FOR SELF-REPORTED WAYS THAT DEPRESSION AFFECTED

PH.D. STUDENTS' TEACHING OR THE STUDENT AS AN INSTRUCTOR

<b>Theme</b>	<b>Description of theme</b>	<b>% (n) n = 50</b>
Understanding of student issues	Student describes that their depression positively impacts them as an instructor because they are more understanding or sympathetic to a student's personal situations, including mental health struggles.	23 (10)
Disconnected or disengaged undergraduates	Student describes that depression can cause them to feel disconnected from students or to have trouble interacting or connecting with students. They may intentionally try not to engage with students during class. This code has to do with the instructor's relationship with the students as opposed to a broad disengagement, which would be coded as "low mood/lack of energy."	16 (7)
Low mood/lack of energy when teaching	Student describes that their depression can cause them to be less energetic or less willing to teach for their students or that their general mood is down while teaching. This code does not have to do with the TAs interaction with students.	14 (6)
Lack of confidence	Student describes that they are less confident in their ability to teach due to their depression or depressive symptoms.	7 (3)
Cancel or reschedule	Student describes instances where they need to cancel class or office hours, reschedule, or ask someone to fill in for them during a time of depression.	5 (2)
Teaching is unenjoyable	Student describes that teaching becomes unenjoyable, a chore, or a hassle, because of their depression.	5 (2)

APPENDIX I

CODING RUBRICS SHOWING REASONS WHY PH.D. STUDENTS REVEALED  
OR CONCEALED THEIR DEPRESSION TO THEIR FACULTY ADVISOR AND  
THE PERCEIVED RISKS OR BENEFITS IN REVEALING ONE'S DEPRESSION

Theme	Description of theme
<b>Reasons why Ph.D. students revealed their depression to their faculty advisor</b>	
Preventative reveal	Student perceived that depression would impact or was impacting their mood or performance in research and revealed depression preemptively to avoid judgement or conflict. This includes if a student thinks other people might suspect something may be wrong and so they want to get ahead of it by revealing their depression before someone approaches them about it.
Corrective reveal	Student reports that depression negatively affected their mood or performance in research, which was noticed by others. The student revealed their depression in an attempt to explain their mood or behavior after it was noticed or commented on by others. The major difference between a preventative reveal and a corrective reveal is that corrective reveals only happen once another person has mentioned a problem or concern.
No judgment - understanding	Student perceived that they would not be judged if they revealed because their advisor's past actions indicated that the advisor is understanding, caring, or has a positive perception of mental health.
No judgment - personal relationship	Student perceived that they would not be judged for revealing because they had developed a close personal relationship with their faculty advisor.
No judgement: Other person struggles with mental health	Student knows or perceives that the person they are sharing their depression with also has mental health issues- often depression but may be another mental health concern such as anxiety. Students often describe that shared mental health experiences decrease the chance they will be judged negatively for their depression.
<b>Reasons why Ph.D. students concealed their depression from their faculty advisor</b>	
May be perceived or treated differently or in a negative	Student describes they were afraid they would be perceived or treated negatively if their advisor knew of their depression. Students often report using their advisor's prior behaviors to predict how they would react. This includes a fear of being treated negatively (e.g. being judged) or differently (having



way	people “walk on eggshells” around them).
Is uncomfortable with depression	Student describes that they are personally uncomfortable sharing their depression with anyone, so they would not share it with their faculty advisor.
Perceives revealing to be unnecessary	Student did not think it was necessary to share their depression, often because they did not perceive it affected their work.
Perceives an identity cultural or age difference between them and their advisor	Student does not reveal because they worry that the faculty advisor’s identity or culture would prevent them from understanding what the student is trying to explain. This includes faculty who had an easy time in graduate school or expressed that they remember graduate school being extremely fun and exciting, because these experiences do not align with those of the graduate student.
Perceives revealing to be inappropriate	Student perceives that it is inappropriate to reveal depression in a lab environment, often because of the assumption that emotion is not welcome in science.
Not enough of a personal relationship	Student describes that they don't talk about their depression because they haven't established a close enough relationship with another person they could reveal to.
Student worries that their depression might be revealed to others	Student is worried that the person in question may reveal their depression to others that they do not want to reveal to.
Doesn't want to be a burden to faculty	Student describes that they don't want faculty mentor to worry about the student or make adjustments to the student's work.
Ph.D. student perceived benefits in revealing their depression to their faculty mentor	

More flexible	Makes a change to accommodate student depression (e.g., extends deadline, modifies responsibilities). Student describes that person is more understanding of student's depression, actions or behaviors (e.g., missing deadlines, missed meeting, not accomplishing goals/tasks).
More support	Person provides additional mentorship/guidance (in research or personally), checks in on student, or can even provide mental health resources
More honest	Student is able to be honest about when they cannot fulfill an obligation, come into the lab, make a meeting, etc...
<b>Ph.D. student perceived consequences and risks of revealing their depression to their faculty mentor</b>	
Judged	Student reports that they felt judged by the faculty mentor and the faculty mentor has a negative view of them after revealing their depression. This is distinct from other categories which involve the person acting on those judgments.
Relieves/Prevents student of responsibilities	Faculty relieves student of responsibilities, doesn't give student the standard work they want, doesn't put student forward for opportunities

APPENDIX J

CODING RUBRICS SHOWING REASONS WHY PH.D. STUDENTS REVEALED  
OR CONCEALED THEIR DEPRESSION TO OTHER GRADUATE STUDENTS AND  
THE PERCEIVED RISKS OR BENEFITS IN REVEALING ONE'S DEPRESSION

Theme	Description of theme
<b>Reasons why Ph.D. students revealed their depression to other graduate students</b>	
No judgement - personal relationship	Student reports that they did not think they would be judged for revealing because they had developed a close personal relationship with a fellow graduate student.
No judgement - other person struggles with mental health	Student reports that they did not think they would be judged for revealing because the other graduate student also struggles with mental health.
No judgement – shared (often negative) experiences in graduate school	Student reports that they did not think they would be judged for revealing because they shared similar experiences, often negative ones, during graduate school.
Supportive reveal	Student wanted to reveal their depression to normalize struggling with mental health.
Preventative reveal	Student perceived that depression would impact or was impacting their mood or performance in research and revealed depression preemptively to avoid judgement or conflict.
Corrective reveal	Student reports that depression negatively affected their mood or performance in research, which was noticed by others. The student revealed their depression in an attempt to explain their mood or behavior after it was noticed or commented on by others.
No judgement: Person is understanding /caring/positive outlook on MH	Student perceives that they will likely not be judged because the person's past actions have indicated that they are understanding/caring/have a positive outlook on mental health.
<b>Reasons why Ph.D. students concealed their depression from other graduate students</b>	

Lack of personal relationship	Student describes that they did not reveal their depression because they did not establish a close enough relationship with other graduate students.
May be perceived or treated in a negative way	Student describes they were afraid they would be perceived or treated negatively if other graduate students knew of their depression. Students often report using their fellow graduate students' prior behaviors to predict how they would react.
Perceives revealing to be unnecessary	Student did not think it is necessary to share depression, often because they did not perceive it affected their work.
Is uncomfortable with depression	Student describes that they are personally uncomfortable sharing their depression with anyone.
Student worries that their depression might be revealed to others	Student is worried that the person in question may reveal their depression to others that they do not want to reveal to.
Misalignment of identity or culture between the student revealing and the person they're revealing to	Student does not reveal because they worry that the other graduate student's identity or culture prevents them from understanding what they are trying to say.
Doesn't want to be a burden to graduate student	Student describes that they don't want other graduate student to have to worry about the student or make adjustments.

Inappropriate: Research is a professional setting (no place for emotion)	Student feels that the lab/academia is no place for emotion, that it is inappropriate to share depression, etc.
<b>Ph.D. student perceived benefits in revealing their depression to other graduate students</b>	
More support	Person provides additional community, stronger friendship, opportunities to commiserate or to feel included. This also includes checking in with a student or sharing mutual experiences or hardships.
More honest	Student is able to be honest about when they cannot fulfill an obligation, come into the lab, make a meeting, etc.
<b>Ph.D. student perceived consequences and risks of revealing their depression to other graduate students</b>	
Reluctant to provide feedback	Student describes that fellow graduate students may be reluctant to be honest with them about their research if they were to know about their depression. Students also describe worrying that people will not share criticisms and critiques of their work in fear they will exacerbate their depression.

APPENDIX K

CODING RUBRICS SHOWING REASONS WHY PH.D. STUDENTS REVEALED  
OR CONCEALED THEIR DEPRESSION TO UNDERGRADUATE RESEARCHERS  
AND THE PERCEIVED RISKS OR BENEFITS IN REVEALING ONE'S  
DEPRESSION

Theme	Description of theme
<b>Reasons why Ph.D. students revealed their depression to undergraduate researchers</b>	
Supportive reveal	Student wanted to reveal their depression to normalize struggling with mental health.
No judgement - other person struggles with mental health	Student reports that they did not think they would be judged for revealing because the undergraduate also struggles with mental health.
No judgement - personal relationship	Student reports that they did not think they would be judged for revealing because they had developed a close personal relationship with the undergraduate researcher.
Preventative reveal	Student perceived that depression would impact or was impacting their mood or performance in research and revealed depression preemptively to avoid judgement or conflict.
Corrective reveal	Student reports that depression negatively affected their mood or performance in research, which was noticed by others. The student revealed their depression in an attempt to explain their mood or behavior after it was noticed or commented on by others.
No judgement – shared (often negative) experiences in graduate school	Student reports that they did not think they would be judged for revealing because they shared similar experiences, often negative ones, during graduate school and as an undergraduate.
No judgement - other person struggles with mental health	Student reports that they did not think they would be judged for revealing because the undergraduate researcher also struggles with mental health.
<b>Reasons why Ph.D. students concealed their depression from undergraduate researchers</b>	
Would break professional	Student describes that they want to maintain their status as a professional, credible, or good advisor or want to seem more



barrier	like an authority figure. If they reveal, it could compromise the integrity of their status as a advisor.
Lack of personal relationship	Student describes that they reveal their depression because they have not established a close enough relationship with the undergraduate.
Perceives cultural/maturity/age difference	Student perceives there is too much of a difference between them and the undergraduate regarding the culture between the undergrad and grad, their ages, or their maturity levels to share their depression.
Avoid burdening the undergraduate researcher	Student perceives that sharing depression may burden the undergraduate researcher.
May be perceived or treated in a negative way	Student describes they were afraid they would be perceived or treated negatively if undergraduate researchers knew of their depression. Students often report using the undergraduate researcher's prior behaviors to predict how they would react.
Is uncomfortable with depression	Student describes that they are personally uncomfortable sharing their depression with anyone.
<b>Ph.D. student perceived benefits in revealing their depression to undergraduate researchers</b>	
More support	Person provides additional community, stronger friendship, opportunities to commiserate or to feel included. This also includes checking in with a student or sharing mutual experiences or hardships.
<b>Ph.D. student perceived consequences and risks of revealing their depression to undergraduate researchers</b>	
Judgement	Student describes that undergraduates may judge them negatively for having depression.

APPENDIX L  
LETTER OF GRANTED PERMISSION

To whom it may concern,

The listed published and/or submitted manuscripts:

- PH.DEPRESSION: EXAMING HOW GRADUATE RESEARCH AND TEACHING AFFECT DEPRESSION IN LIFE SCIENCES PH.D. STUDENTS
- FACE NEGOTATION IN GRADUATE SCHOOL: THE DECISION TO CONCEAL OR REVEAL DEPRESSION AMONG LIFE SCIENCES PH.D. STUDENTS IN THE UNITED STATES

Have both been granted permission to be utilized within this thesis document by all authors involved. Nicholas J. Wiesenthal is listed as a first author and/or first co-author on both manuscripts and spoke with all authors involved before utilizing this work in his own thesis document and thesis defense.

If there are any concerns or issues with this letter, please reach out to Nicholas J Wiesenthal's faculty advisor, Dr. Katelyn M. Cooper (@Katelyn.Cooper@asu.edu), who is listed as an author on all utilized manuscripts as well.

Thank you,

Nicholas J. Wiesenthal

APPENDIX M  
IRB APPROVAL

PH.DEPRESSION: EXAMING HOW GRADUATE RESEARCH AND TEACHING AFFECT DEPRESSION IN LIFE SCIENCES PH.D. STUDENTS

FACE NEGOTIATION IN GRADUATE SCHOOL: THE DECISION TO CONCEAL OR REVEAL DEPRESSION AMONG LIFE SCIENCES PH.D. STUDENTS IN THE UNITED STATES



EXEMPTION GRANTED

[Sara Brownell](#)

[CLAS-NS: Life Sciences, School of \(SOLS\)](#)

-

[Sara.Brownell@asu.edu](mailto:Sara.Brownell@asu.edu)

Dear [Sara Brownell](#):

On 11/7/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Exploring graduate student perceptions of undergraduate researchers
Investigator:	<a href="#">Sara Brownell</a>
IRB ID:	STUDY00011040
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	<ul style="list-style-type: none"><li>• 19.11.5 Graduate student recruitment script.pdf, Category: Recruitment Materials;</li><li>• 19.11.5_Example survey.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li><li>• 19.11.5_Grad IRB.docx, Category: IRB Protocol;</li><li>• 19.11.7_Follow up interviews.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);</li><li>• 19.11.7_Graduate student consent statement.pdf, Category: Consent Form;</li></ul> Logan Gin CITI, Category: Non-ASU human subjects training (if taken within last 3 years to grandfather in);

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 on 11/7/2019.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator