Women's Safety Concerns and Academia: How Safety Concerns Can Create Opportunity Gaps

Sophie Trawalter[1], Jennifer Doleac[2], Lindsay Palmer[3], Kelly Hoffman[1], & Adrienne Carter-Sowell[2]

[1]University of Virginia

[2]Texas A&M University

[3]The Pennsylvania State University

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Author Biographies

Sophie Trawalter is an Associate Professor of Public Policy and Psychology at the University of Virginia. She studies social disparities in education, health, and other life domains. Jennifer Doleac is an Associate Professor of Economics at Texas A&M University. She studies crime and discrimination, with emphases on prisoner reentry and the effects of technology on public safety. Lindsay Palmer is a Ph.D. student in the dual-title degree program in Social Psychology and Women's, Gender, and Sexuality Studies. Her research interests include academic inclusion, prejudice, and stigma. Kelly Hoffman received her Ph.D. in Social Psychology at the University of Virginia, where she conducted this and related research. She is now Vice President of Research at Coqual, a global think tank that aims to understand and address workplace disparities through research and advisory services. Adrienne Carter-Sowell is an Associate Professor of Psychology, Africana Studies, and Women's and Gender Studies. She investigates group processes and social influence, and recently became Associate Head of Diversity, Equity and Inclusion.

Abstract

The present work documents safety concerns of men and women in academia, and how these concerns can create opportunity gaps. Across five samples including undergraduate and graduate students, postdoctoral fellows, and faculty (*N*=1812), women reported greater concerns about their safety than did men, and these concerns were associated with reduced workhours in libraries, offices, and/or labs afterhours. Additionally, although we were unable to manipulate safety concerns among women, in an experiment with men (*N*=117), increasing safety concerns decreased willingness to use the library afterhours. Lastly, in an archival study of swipe access data (*N*=350,364 swipes), a crime event that made safety concerns salient for women was associated with a decreased likelihood that women worked in their office afterhours, and a decreased likelihood that STEM women worked in their labs later at night. Collectively, these data suggest that women's safety concerns can restrict their work.

Keywords: Intergroup relations, gender disparities, higher education, socioecological perspective

Women's Safety Concerns and Academia: How Safety Concerns Can Create Opportunity Gaps

Nicole is an engineering professor at an R1 university. Her research focuses on micro-scale heat transfer and novel applications of heat pipes. To be productive, she must work afterhours in her lab. But, like many women, Nicole is concerned about her safety when she works late. She is nervous about walking to and from her car. She is also concerned about working alone in her lab late at night. She feels vulnerable to muggings and assaults. Over time, these concerns affect her work.

Academia has a long history of being male-dominated and gender-segregated. Today, women in academia continue to face many opportunity gaps in this system designed for and by men. They have less access to social networks including the "old boy network" (McDonald, 2011; Sonnert & Holton, 1995). This means less access to collaborators and mentors (Corley, 2005; Fox, 2001; Uhlya, Visserb, & Zippela, 2017), and fewer invitations to speak about their work at seminars and conferences (Schroeder et al., 2013). More generally, women's work is evaluated less positively (Steinpreis et al., 1999) and, not surprisingly then, less likely to be selected for grant funding (Witteman et al., 2019). Collectively, these gaps and other bias-related experiences create a "chilly climate" for women (Flim, 1991; National Academies, 2007). In the present work, we document another and heretofore unexamined opportunity gap. We examine how gender differences in safety concerns can make it more difficult for women to do their work, especially afterhours.

The fact that previous work has not examined how safety concerns affect women's work in academia is surprising. Anecdotal and empirical evidence suggest that women are concerned about their safety in university settings. Conversations about safety are recurrent, appearing with some regularity on the pages of university and local newspapers (Rodier, 1995; *The Daily Free press,* 2008; Barefoot, 2009). Moreover, researchers have documented large gender differences in feelings of safety on campus among students and faculty (Currle, 1994; Day, 1994; Fletcher & Bryden, 2007). Women are more concerned about safety; they are more worried about gun violence and assault, including sexual assault.

Indeed, we trust the opening paragraph about Nicole's experience will resonate with most women on college campuses and female readers more generally.

These concerns stem in part from experience, from everyday street harassment (e.g., Fairchild, 2015; Fairchild & Rudman, 2008) to harassment and assault at work (e.g., Berdahl, 2007; Clancy et al., 2014; Fairchild et al., 2018; Jahren, 2016). A recent Society for Personality and Social Psychology (SPSP) survey on sexual harassment, for instance, found that 28% of women reported having personally experienced sexual harassment at an SPSP event (SPSP Task Force on Sexual Harassment, 2019). Women in other fields report similar experiences. For example, in a recent American Economic Association survey, 23% of women reported that another economist or economics student made unwanted attempts, 6% reported attempted assaults, and 2% reported being assaulted (Committee on Equity, Diversity, and Professional Conduct, 2019). Given this, and little accountability to date, it is no wonder women are concerned about their safety at work.

We acknowledge that gender-based violence and harassment are more likely to happen at home, at the hands of a partner or acquaintance (Walby, 2006). Still, this does not mean women are safe at work, nor that we should be unconcerned about their felt safety at work. In fact, we argue that women's (and men's) safety concerns are crucial to consider. In our opening example, Nicole decided not to work late because of safety concerns. In other words, her safety took priority over her scholarship. This prioritization is reasonable and perhaps even common. Many theoretical perspectives suggest that basic, lower-level needs (e.g., food, water, and safety) can take priority over higher-level needs (e.g., esteem and belonging; Kenrick et al., 2010; Maslow, 1954; Tay & Diener, 2011). Some impressive data are generally consistent with this notion. For example, Tay and Diener (2011) analyzed World Gallup Poll data of more than 40,000 respondents from 123 countries. They found that the fulfillment of needs—basic needs, safety needs, belonging needs, and esteem-related needs—is positively related to well-being and, importantly, that people achieve basic and safety needs *before*

other, higher-level needs. We acknowledge that counterexamples are readily available, such as a journalist who puts herself in harm's way to report an important story (Kenrick et al., 2010; Wahba & Bridwell, 1976). Still, the claim that safety is important for thriving should not be controversial.

In the present work, we use correlational, experimental, and archival and longitudinal data to document safety concerns and then test whether these concerns can affect one's work. We examine whether safety concerns restrict use of on-campus facilities such as libraries, offices, and/or labs afterhours. Use of on-campus facilities afterhours is important for many reasons. It is related to productivity, especially for those whose work requires on-campus resources (e.g., lab equipment, special collection materials, library archives). It is also likely related to sense of place; research has shown that use of space is important for attachment to a particular place (Altman & Low, 1992; Trawalter et al., 2020; Tuan, 1974, 1977). In other words, when safety concerns constrain use of space, they likely affect objective outcomes (e.g., productivity) and subjective ones (e.g., sense of place). All data are available at https://osf.io/prx89/?view_only=4012f6d37d3e4774b8995a2c6161b42a.

Surveys

We began by documenting whether safety concerns are associated with work; specifically, working in university facilities such as libraries, labs, and offices afterhours. We collected survey data from five separate samples—three samples of undergraduate students from three different institutions, a sample of graduate students and postdoctoral fellows from one of these institutions, and a sample of faculty members from that same institution. These data, then, include individuals at various stages of the academic pipeline and from different academic institutions. Not knowing what effect size to expect, we collected as much data as possible from each population and institution. See Online Materials for data about these three institutions, here referred to as Universities A, B, and C.

Survey Method

Participants

Sample 1: Undergraduate students at University A. Researchers went to 19 undergraduate classrooms to conduct the study. All total, we collected data from 1099 students and, of those, 1053 answered all variables of interest. The final sample was 56% women, 63% white.

Sample 2: Faculty members at University A. We emailed all faculty at University A to complete a survey. 250 faculty started and 212 completed the survey. Of those, 163 completed all variables of interest (of those who did not complete all variables of interest, many did not answer the demographic questions). The final sample is 38% women and 82% white.

Sample 3: Graduate students and postdoctoral fellows at University A. We recruited graduate students by word of mouth and sent an email to all postdoctoral fellows at University A. 58 of 68 graduate students, and all 27 postdoctoral fellows completed the survey. The final sample was 47% women and 78% white.

Sample 4: Undergraduate students at University B. We recruited 171 undergraduate students from a departmental participant pool at a second public university. The sample was 67% women and 64% white.

Sample 5: **Undergraduate students at University C.** We recruited 245 undergraduate students from a departmental summer participant pool at a third public university. The sample was 52% women and 64% white.

Procedure

After consenting, participants completed a survey that included the primary variables of interest: 1) safety concerns; 2) academic engagement; and 3) demographic variables. Specifically, participants were asked, *How often do you feel unsafe on [campus]?* and, *Are you ever concerned about your safety if/when you are on [campus] at night?* Participants answered these questions using an ordinal scale with *Never, Rarely, Sometimes, Often,* and *Always* as response choices. Participants were also asked, *Do you think [campus is] too dark at night?* and, *Would you use university facilities (e.g.,*

libraries) later if Grounds were better lit at night? Participants answered these questions using one of three response choices: *Yes, No,* or *Not Sure.* See Online Materials for questions common to all surveys, which are the questions detailed and analyzed here, and questions unique to each sample.

Survey Results

Across all samples, compared with men, women reported feeling unsafe more often. See Figures 1 and 2 for distributions of responses by gender, and Table 1 for test of statistics. See Online Materials for all descriptive statistics.

The differences are especially striking for safety concerns at night. The modal answer for men across samples was "never" as in "never concerned about safety on campus at night" (see Figure 2). For women, in four of the five samples, the modal answer was "sometimes" as in "sometimes concerned about safety on campus at night" (again, see Figure 2). Moreover, compared with men, women in three of the five samples thought campus was too dark at night. See Figure 3 and, again, Table 1 for test of statistics. Importantly, across all five samples, women were more likely to report that they would use university facilities—such as libraries, labs, and offices—later at night if campus were better lit; that is, if campus felt safer. See Figure 4 and Table 1.

We next tested whether safety concerns (the average of the two safety questions) mediated gender differences in wanting to use facilities (e.g., libraries, labs, offices) later. See Table 2 and Figure 5. We used the PROCESS macro to conduct the bootstrapping analysis and test (Model 4; Hayes, 2017). We drew 10,000 random samples with replacement to estimate the size of the indirect effect of gender on desire to work later hours through safety concerns. The bootstrap analysis yielded 95% confidence intervals that did not include 0 for all five samples.

Table 1

Test Statistics for Outcome Variables by Gender, Samples 1-5

	Feeling Unsafe	**Concerns at Night**	**Too Dark**	**If Better Lit…**
Sample 1	*t* (1050) = 14.88 *p* < .0001 *d* = .93 [.80, 1.05]	*t* (1047) = 20.17 *p* < .0001 *d* = *1.26* [1.12, 1.39]	X^2 (1, N = 1048) = 87.00 *p* < .0001 OR = 3.97 [2.94, 5.36]	X^2 (1, N = 1053) = 89.04 *p* < .0001 OR = 3.47 [2.67, 4.52]
Sample 2	*t* (162) = 6.29 *p* < .0001 *d* = 1.01 [.69, 1.34]	*t* (153) = 7.96 *p* < .0001 *d* = 1.31 [.96, 1.66]	X^2 (1, N = 161) = 1.36 *p* = .243 OR = 1.48 [.77, 2.87]	X^2 (1, N = 164) = 5.87 *p* = .015 OR = 3.26 [1.21, 8.79]
Sample 3	*t* (77) = 4.79, *p* < .0001 *d* = 1.08 [.60, 1.56]	*t* (77) = 5.51, *p* < .0001 *d* = 1.24 [.75, 1.73]	X^2 (1, N = 85) = 25.80 *p* < .0001 OR = 12.19 [4.34, 34.23]	X^2 (1, N = 85) = 5.80 *p* = .016 OR = 3.85 [1.23, 12.06]
Sample 4	*t* (169) = 2.43 *p* = .016 *d* = .40 [.09, .70]	*t* (169) = 6.13 *p* < .0001 *d* = .99 [.68, 1.32]	X^2 (1, N = 171) = 3.24 *p* = .072 OR = 2.10 [.93, 4.77]	X^2 (1, N = 171) = 9.67 *p* = .002 OR = 2.80 [1.45, 5.40]
Sample 5	*t* (242) = 3.51, *p* = .0005 *d* = .45 [.20, .71]	*t* (242) = 6.93, *p* < .0001 *d* = .89 [.62, 1.15]	X^2 (1, N = 244) = 7.84 *p* = .005 OR = 2.24 [1.27, 4.00]	X^2 (1, N = 244) = 8.34 *p* = .004 OR = 2.12 [1.27, 3.55]

Notes: t-test statistics include Cohen's d effect sizes, and their 95% confidence intervals (in brackets) using the Kadel and Kip (2010) SAS macro. Chi-square statistics include Odds Ratios (OR) and their 95% confidence intervals (in brackets).

Table 2

Path coefficients (with SEs) and 95% CI for Mediation Models for Samples 1-5

	a	b	c	c'	Indirect effect	95% CI
Sample 1	.44 (.02)	.75 (.10)	.62 (.07)	.33 (.08)	.33 (.05)	[.25, .43]
Sample 2	.47 (.06)	1.10 (.34)	.59 (.25)	.002 (.33)	.51 (.19)	[.20, .89]
Sample 3	.97 (.18)	1.05 (.18)	1.86 (.59)	.18 (.71)	1.03 (.52)	[.26, 2.26]
Sample 4	.54 (.11)	.51 (.25)	1.03 (.33)	.78 (.36)	.28 (.16)	[.04, .66]
Sample 5	.62 (.10)	.73 (.17)	.75 (.26)	.35 (.29)	.45 (.14)	[.22, .78]

Note: the a-path is form gender to safety concerns, b-path from safety concerns to using facilities after hours more if campus were better lit, and c path from gender to using facilities after hours more if campus were better lit. c' is the direct effect.

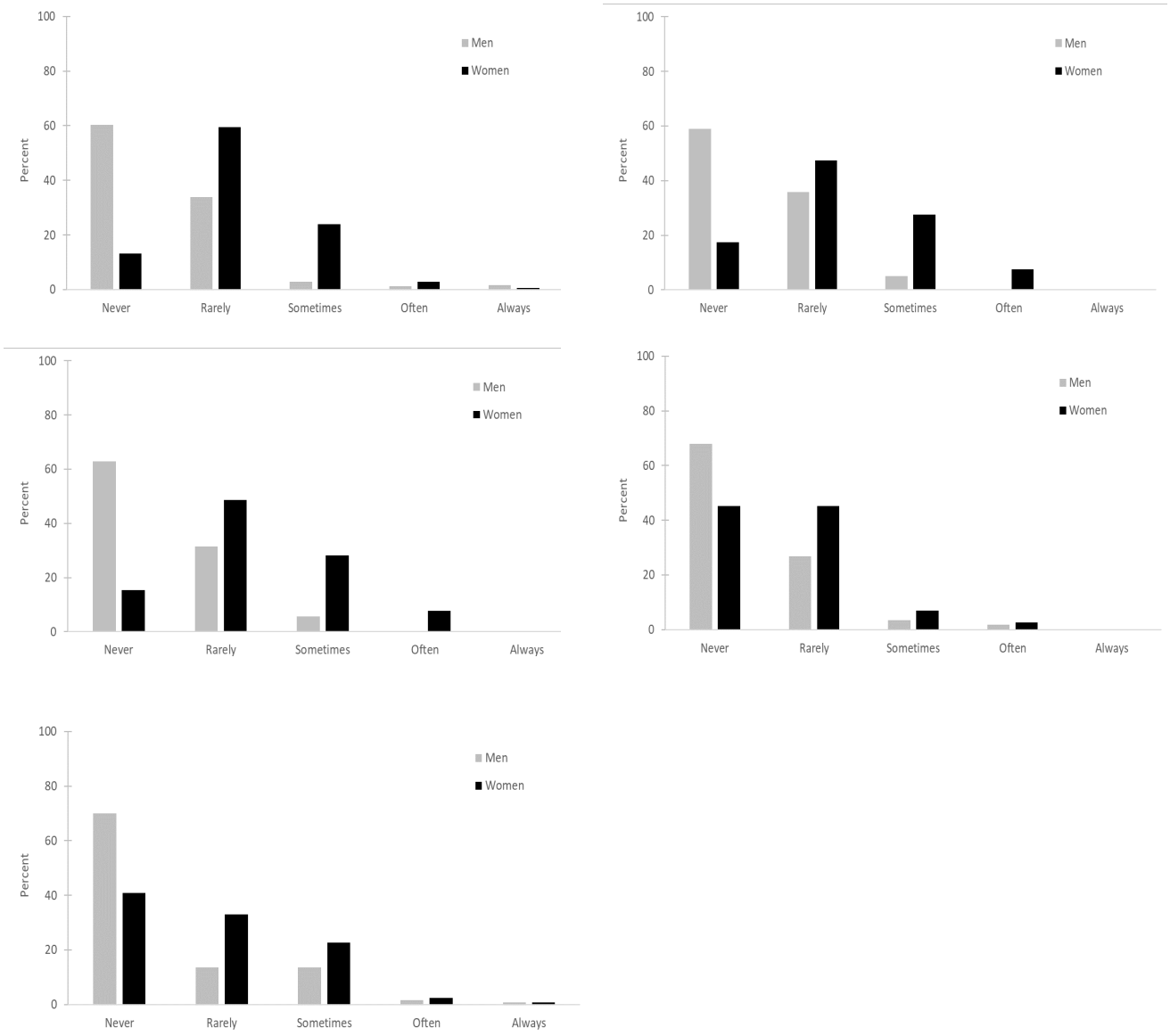

Figure 1. Percent of male and female participants who answered never, rarely, sometimes, often, and always to the question "How often do you feel unsafe on [campus]?" for Samples 1-5.

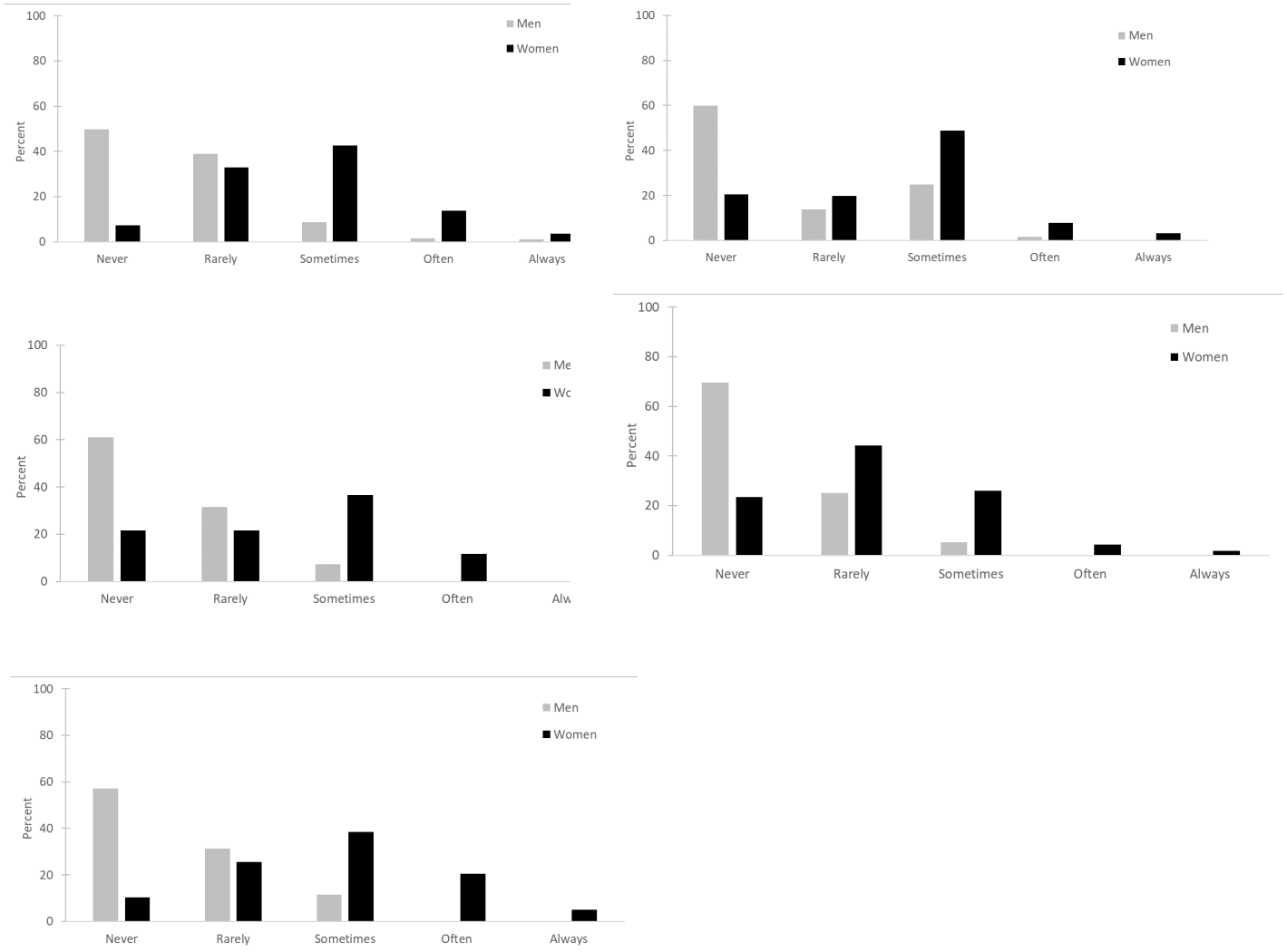

Figure 2. Percent of male and female participants who answered never, rarely, sometimes, often, and always to the question "Are you ever concerned about your safety if/when you are on [campus] late at night?" for Samples 1-5.

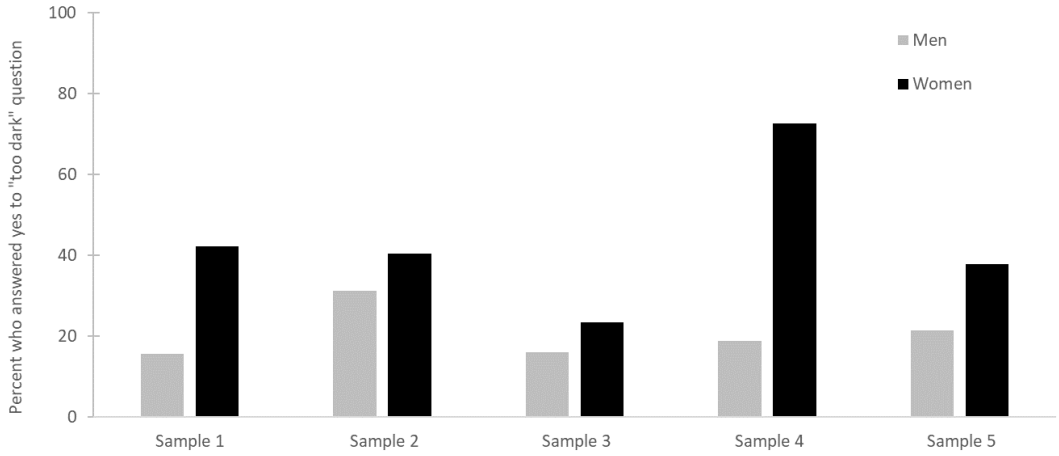

Figure 3. Percent of male and female participants who answered yes to the question "Do you think [campus] is too dark at night?" for Samples 1-5.

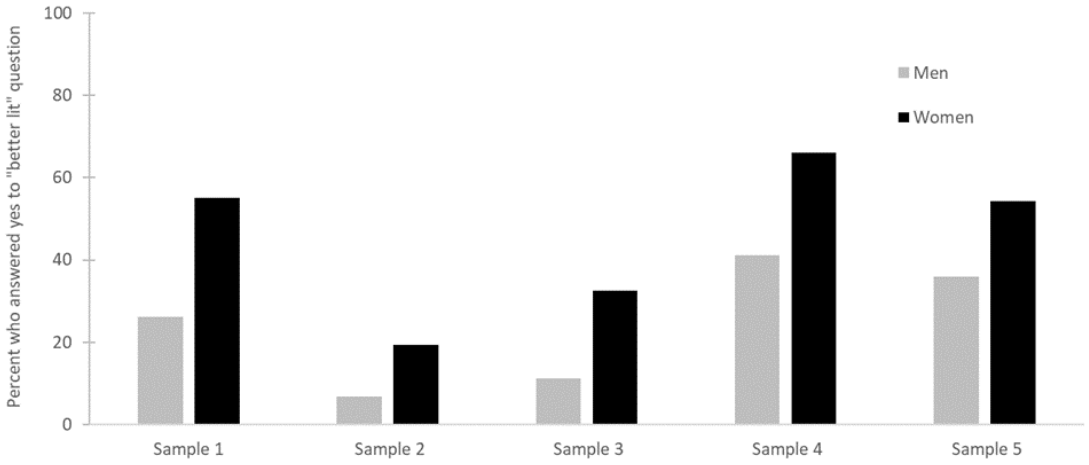

Figure 4. Percent of male and female participants who answered yes to the question "Would you use university facilities (e.g., libraries/your office, your lab) later if [campus] were better lit at night?" for Samples 1-5.

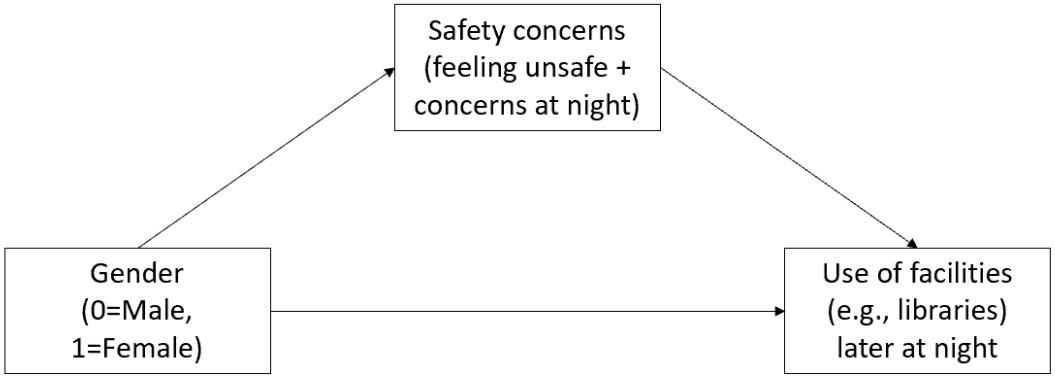

Figure 5. Conceptual mediation model for survey studies, Samples 1-5.

The survey data, then, are consistent with our claim that women are more concerned about safety and that safety concerns can constrain workhours spent in on-campus facilities such as libraries, labs, and office spaces. An important question is whether campus is or was, in fact, too dark. To examine this, we partnered with the Facilities and Management, and the Office of the Architect at one of the universities in our sample. Research assistants measured nighttime light levels at floor level at various locations identified by Facilities and Management as possibly too dark. We found that, at almost all identified locations, the median and modal light levels were at or close to zero foot-candles (fc). These levels differ from recommended light levels (.125 fc) set forth by the Illumination Engineer's Society. In other words, campus was too dark, at least in some locations. Women (and men) reporting that campus was too dark were accurate. (The university, in response to these data, added lights, replaced bulbs, and cut back shrubbery that obscured lights, to improve campus lighting.)

Experiments

Our survey data are cross-sectional and correlational, and as such do not provide causal evidence. To test for causality, we conducted a set of experiments. The aim of the experiments was to manipulate safety concerns and then measure academic engagement; specifically, willingness to use university on-campus facilities such as libraries, offices, and labs later at night. We attempted to

manipulate women's safety concerns across six experiments but failed. See Online Materials for experiment details. We think this is because women are socialized to be concerned about their safety (May et al., 2010), and because safety concerns were salient at our university due to several well-publicized crime-related events over the course of this research. Indeed, across studies, women's safety concerns were relatively high, ranging from 2.63 to 3.05 on a 5-point scale from Never to Always. Because men's safety concerns are lower and because men likely think about their safety less, their safety concerns may be more malleable. Indeed, in two studies with male participants, we were able to increase safety concerns. We report one of these studies here and the other in Online Materials.

Experimental Method

Participants

We recruited a convenience sample of 122 male participants from a departmental participant pool (68% white). One withdrew, one skipped survey questions, and three may not have been assigned to condition due to a computer or experimenter error[1]. The final sample was thus 117 men. A post-hoc sensitivity analysis with alpha set at .05 and power set at .80 suggests we can detect a main effect of condition as small as d = .31. Participants completed the study for course credit.

Procedure

After consenting, participants were randomly assigned to read one of two articles. In the control condition, they read an article about a new student center close to campus. In the experimental condition, they read an article about a mugging close to campus. See Online Materials for the articles. After reading the article, participants answered questions about their safety; specifically, the same questions as in the surveys described above (e.g., how often do you feel unsafe on campus?).

[1] Three participants did not have condition information in the output file. Rather than infer condition from their participant ID number, we exclude these participants from the analysis. Inferring condition from their participant ID number (i.e., even number=control, odd number=experimental) and including them in the analyses does not change the pattern of results.

Importantly, they answered three questions about working afterhours. They answered the question, *Would you use University facilities (e.g. libraries) later if the campus were better lit at night?* They answered using one of three choice options: *Yes, No,* or *Not sure.* They also answered these two questions, *How likely are you to go to the library to study this week?* and, *How likely are you to schedule group meetings at night this week?* They answered these questions on a 5-point scale ranging from -2 (*Very Unlikely*) to 2 (*Very Likely*). After answering these questions, they answered demographic questions and were debriefed.

Experimental Results

A Chi-square analysis revealed that men in the experimental (vs. control) condition were more likely to say that campus was too dark, 30% vs. 13%, $\chi^2 = 5.17$, $p = .023$, OR = 2.89, *95% CI* = [1.13, 7.37]. Moreover, a t-test revealed that men in the experimental (vs. control) condition were less likely to say that they would go to the library that week, $M = .97$, $SD = 1.34$ vs. $M = .36$, $SD = 1.67$, t (115) = 2.19, $p = .031$, $d = .40$, *95% CI* = [.04, .77], although no less likely to say that they would meet a group, t (155) = -1.01, $p = .313$, $d = .19$, *95% CI* = [.00, .55], perhaps because they assumed safety in numbers.

In a conceptual replication of this study described in Online Materials, we find broadly similar patterns. In that study, male (but not female) participants were more likely to say campus was too dark and were marginally less likely to say they would use university facilities (e.g., libraries) later if campus were better lit, after recalling a time they felt unsafe on campus (vs. something they did last Tuesday on campus). Taken together, then, we have some experimental evidence that safety concerns can constrain work afterhours, although that evidence is limited to male participants and to some, not all outcome variables.

Longitudinal Archival Data

Our experimental data suggest that it may be difficult to experimentally manipulate women's safety concerns. We thus turned to a real-world context. Specifically, we examined whether a high-

profile crime event in the community—which, anecdotally, had a large effect on women's safety concerns—was associated with a disproportionate impact on women's use of university academic and STEM facilities such as offices and labs.

The high-profile event of interest was the rape and murder of a female college student in the fall of 2014. This event received national attention and led to the conviction of a local community member and University employee, who was also linked to previous violent attacks and murders. In other words, not only did the college community lose one of their own to a violent predator, but the community then learned that that predator was a serial offender who had been living and working alongside them.

Here, we measure the effect of this event on swipe-card access into academic and STEM facilities, for female faculty and staff relative to male faculty and staff. Swipe card data provide information about the movement of students, faculty, and staff around campus. They record when an individual accessed a particular (locked) building, lab, or office. These data do not reveal when that individual left the location, and so the analyses might miss impacts on how late people stayed at the office. However, they provide a useful proxy for the use of university facilities. We are particularly interested in afterhours use of STEM facilities, as this is the type of academic engagement that is most likely to be disrupted by safety concerns. For academic work in the sciences, night and weekend lab work is often essential; concerns that might lead researchers to avoid such work could reduce their productivity. We focus on two outcomes in particular: (1) the likelihood that someone swiped into *any* locked room or building; and, among those who *did* swipe into a locked building or room, (2) the latest hour that they entered the facility.

Longitudinal Archival Method

We obtained all swipe access data from the fall 2014 and tested whether a high-profile crime event reduced the use of university facilities for women relative to men. We use the following specification to test the effect of this event on individuals' behavior:

$$Y_{t,i} = b_0 + b_1 Event_t * Female_i + b_2 Event_t + b_3 Female_i + b_4 \boldsymbol{X_t} + g_{dow} + e_{t,i}$$

The unit of observation is a person-day. Y is the outcome of interest; either (1) an indicator for whether an individual had any swipes on a given day, or (2) the latest hour that they swiped into any building. *Event* is the date that the perpetrator was arrested (*Arrest)* or the date that the victim's remains were found (*Found*); *Female* is an indicator for whether the individual is a woman; **X** is a vector of controls for whether classes were in session, whether it was a reading period, or whether it was an exam period; g_{dow} are fixed effects that absorb mean differences in behavior based on the day of the week. (Day of the week, whether classes are in session, etc., are highly predictive of behavior on campus; the inclusion of these controls reduces remaining variance in the outcome and allows us to measure the treatment effect with more precision.) Standard errors are clustered at the individual level. $b_1$is the coefficient of interest; it represents the differential effect of the crime event for women relative to men.

Longitudinal Archival Results

Figure 6 shows raw data on the share of faculty/staff that swipe into university facilities on a given day. The graph on the left shows all faculty/staff; the graph on the right shows STEM faculty/staff. Figure 7 shows raw data on the latest hour that faculty/staff swiped into a facility on a given day, for the sample with at least one swipe that day. Again, the graph on the left shows all faculty/staff; the graph on the right shows STEM faculty/staff. We note here that many faculty and staff in the full sample have the option to work from home afterhours. STEM faculty and staff, on the other hand, are more likely to need to work in a lab on campus. Hence, we examine this sample separately.

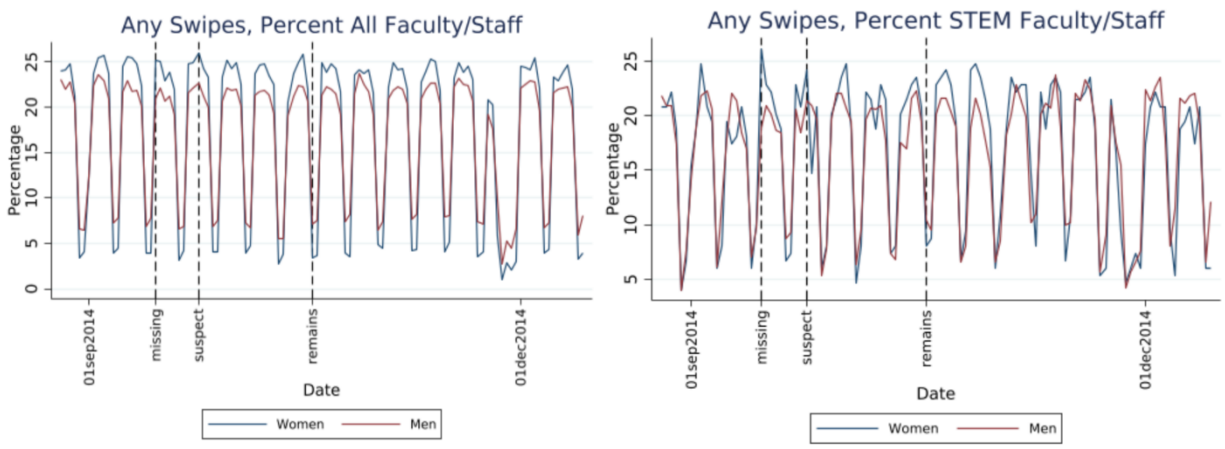

Figure 6. These figures graph the raw data on swipes into university facilities by faculty and staff, during the period before and after a crime event. The blue lines show the share of women that swiped into facilities, and the red lines show the share of men that swiped into facilities. Right: Full sample, all facilities. Left: STEM faculty and staff, STEM facilities.

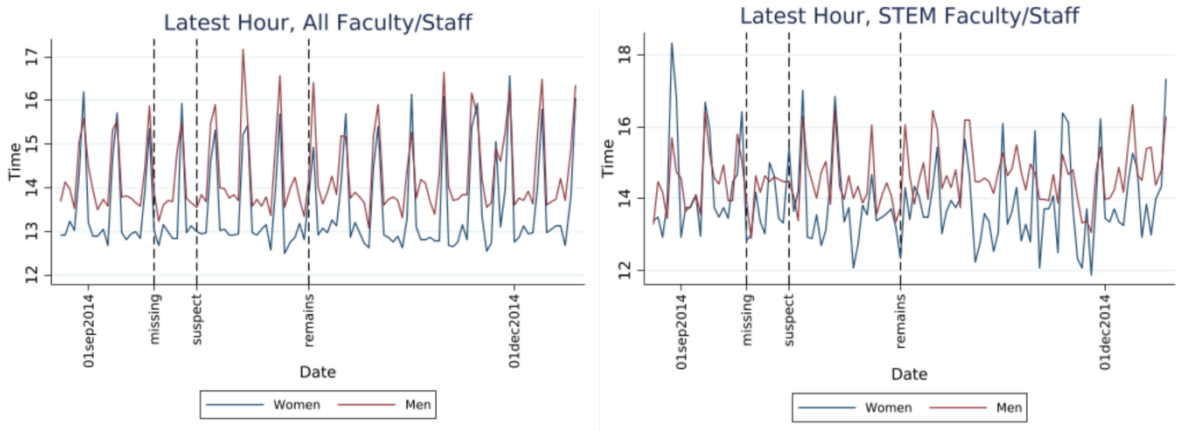

Figure 7. These figures graph the raw data on the average latest hour that faculty/staff swiped into university facilities on a given day, during the period before and after a crime event. The blue lines show the latest hour for women, and the red lines show the latest hour for men. The sample is restricted to faculty/staff with at least one swipe on that day. For these analyses, a day is defined as 5am to 4:59am the following morning (so time ranges from 5:00 to 28:59). Left: Full sample, all facilities. Right: STEM faculty and staff, STEM facilities.

Both Figures 6 and 7 denote three important points in the event timeline. The first vertical line marks the week that the victim's disappearance was announced. At that point, it was not clear to the community that something bad had happened. As additional information (e.g., security camera footage) was released, it gradually became clear that the woman may have been abducted and harmed. The second vertical line marks the week when the suspect, a local community member, was arrested. At this point, many in the community suspected that he had done something to the victim, but it was not yet certain. Searches for the victim were ongoing in the areas around the local county. The third vertical line marks the week during which the victim's remains were found.

These raw data plots show baseline patterns in behavior and how those patterns changed over time. There are clearly baseline differences between women and men in their likelihood of accessing facilities and the time at which they access them. There is also quite a bit of cyclicality, due to the day of the week, and there may be other confounding factors such as whether classes are in session on a given day. To formally test for a differential effect of the crime event on women's behavior, we need to control for other factors that might affect behavior (gender, day of the week, and whether classes were in session), as described above.

We thus test for differential effects of two key events on the behavior of women (relative to men): (1) the arrest of the suspect, and (2) the victim's remains being found. Based on anecdotal evidence of women's experience at the time, we expect a larger effect on behavior after the remains were found, but it is possible that behavior changed earlier as well. Table 3 shows the results of this analysis.

Table 3

Test statistics for regression analyses examining impact of crime events on academic facility use.

	All faculty and staff		STEM faculty and staff	
	Any swipes	Latest Hour	Any swipes (STEM)	Latest Hour (STEM)
	(1)	(2)	(3)	(4)
Arrest * Female	-0.0005	-0.0611	0.0083	-0.3839*
	(0.0029)	(0.0979)	(0.0092)	(0.2223)
	[0.857]	[0.532]	[0.366]	[0.085]
N	*350,364*	*60,857*	*52,164*	*8,663*
Outcome mean	*0.1817*	*13.056*	*0.1688*	*13.714*
Found * Female	-0.0077***	-0.0096	0.0083	-0.4943**
	(0.0029)	(0.1002)	(0.0095)	(0.2381)
	[0.007]	[0.923]	[0.378]	[0.038]
N	*350,364*	*60,857*	*52,164*	*8,663*
Outcome mean	*0.1817*	*13.056*	*0.1688*	*13.714*

Notes: Coefficients show the differential effects of the suspect's arrest (top panel) and the victim's remains being found (bottom panel) on the likelihood of any facility access ("any swipe") and the latest hour swiped into a campus facility ("latest hour") for female faculty and staff relative to male faculty and staff. Columns 1 and 2 use all faculty and staff as the sample and any facility use as the outcome; columns 3 and 4 use STEM faculty and staff as the sample and STEM facility use as the outcome. Standard errors are clustered by individual and shown in parentheses. P-values are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figures 8 and 9 show these same results, but in a different format. These graphs are coefficient plots, showing the differential effect on women's behavior during a particular week, controlling for those other factors that might affect behavior (gender, day of the week, week of the semester, and whether classes were in session). The purpose of these coefficient plots is to visualize the underlying trends that produce the main difference-in-difference estimates presented in Table 3.

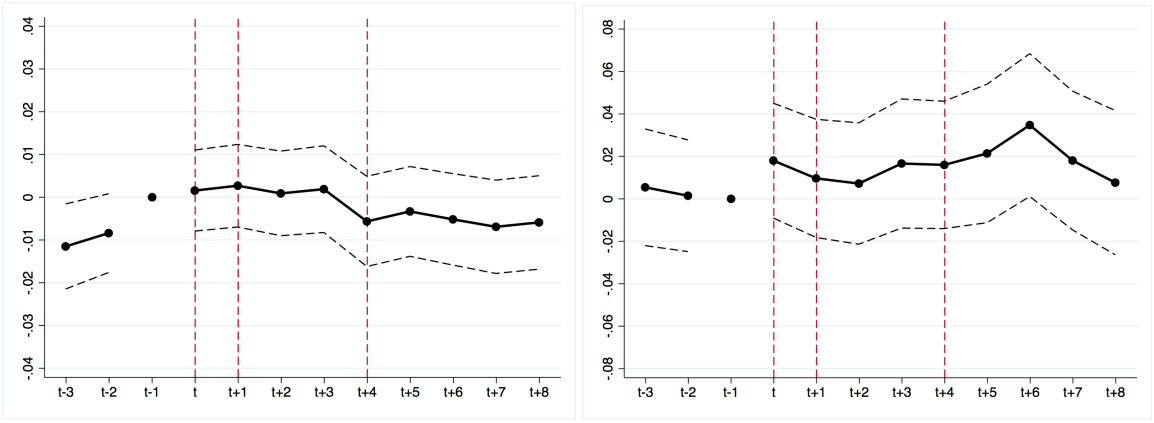

Figure 8. Effect of crime event on the likelihood that female faculty and staff swiped into *any* facility, relative to male faculty and staff. Left: Full sample, all facilities. Right: STEM faculty and staff, STEM facilities. The dots are estimated coefficients from our main regressions from Table 3, interacted with time-since-event (to show how the effect evolves over time). Dashed black lines show 95% confidence intervals. The x-axis shows weeks relative to the events of interest. The y-axis shows the change in the likelihood of any facility access (percent with "any swipe" recorded). The effect at week t-1 is held at 0, so all estimated effects are relative to what happened during that week. The first red dashed line is when the victim's disappearance was announced, the second red dashed line is when a suspect was arrested, and the third red dashed line is when the victim's remains were found. (These correspond to the events shown in Figures 6 and 7.)

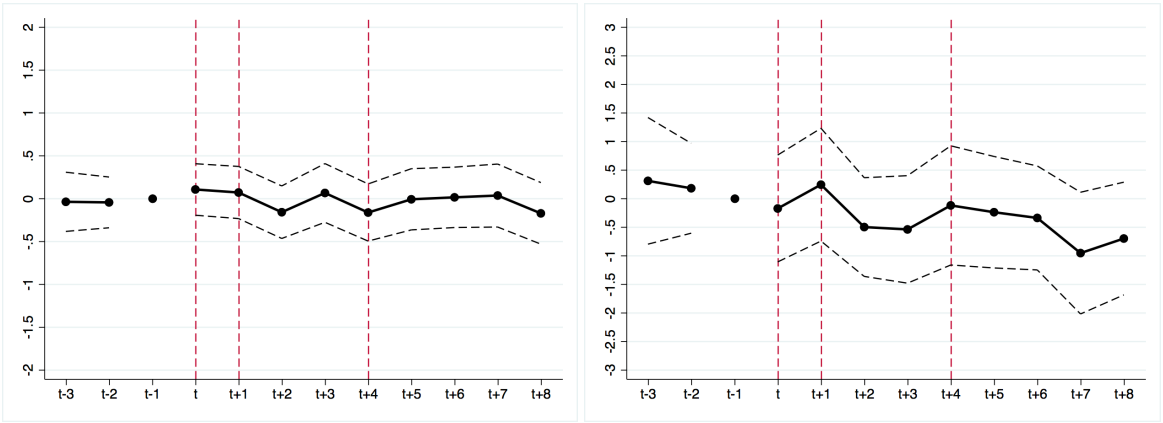

Figure 9. Effect of crime event on the latest hour that female faculty and staff swiped into a facility (conditional on visiting any facility that day), relative to male faculty and staff. Left: Full sample, all facilities. Right: STEM faculty and staff, STEM facilities. The dots are estimated coefficients from our main regressions, interacted with time-since-event (to show how the effect evolves over time). Dashed black lines show 95% confidence intervals. The x-axis shows weeks relative to the events of interest. The y-axis shows the change in the latest hour a facility was visited ("latest hour"). The effect at week t-1 is held at 0, so all estimated effects are relative to what happened during that week. The first red dashed line is when the victim's disappearance was announced, the second red dashed line is when a suspect was arrested, and the third red dashed line is when the victim's remains were found. (These correspond to the events shown in Figures 6 and 7.)

While we show confidence intervals in these plots, we do not have sufficient statistical power to test the effect of each event separately by week – nor does our empirical strategy require that we do so. Our main estimates aggregate and compare all weeks pre- vs. post-event.

Results are largely consistent with our predictions. Column 1 of Table 3 and the graph on the left in Figure 8 show differential effects on the likelihood of any swipe, among all faculty and staff. For this group, there is no difference between men's and women's response to the event until after the victim's remains were found. At that point, there is a clear and sustained decrease in the likelihood that female faculty and staff swipe into any University facility on a given day. This suggests that either (a) some female faculty and staff stopped working in labs or academic buildings afterhours, or (b) they traveled to those locations with another person who swiped in to unlock the door. In either case, this signals a cost to female faculty and staff and a reduced freedom to access University facilities when they might want to work.

Column 3 of Table 3 and the graph on the right in Figure 8 shows analogous results for swiping into a STEM facility specifically, and restricting the sample to those faculty and staff who visited a STEM facility at least once that fall – perhaps a selected sample but closer to the subset of the population that works in STEM. The estimates are noisier due to the smaller sample, but we find no differential effect of the crime events on the likelihood that female STEM faculty/staff access STEM facilities. Since STEM employees need to work in their labs, it may be that no matter how concerned female employees felt, they did not have the option *not* to work on campus the way that non-STEM female faculty and staff did.

Columns 2 and 4 of Table 3 and Figure 9, then, show the differential effects of this crime event on the latest hour that someone swiped into a locked facility on a given day, conditional on swiping into at least one facility. Again, we consider effects for the full faculty and staff population (Table 3 column 2, left graph in Figure 9), and for the STEM faculty and staff population (Table 3 column 4, right graph in Figure 9). Column 2 and the graph on the left in Figure 8 show no differential effect on the time of the

latest swipe, among the full faculty and staff. Recall from column 1 that there was a decrease in the likelihood that women swiped into *any* locked facilities (relative to men) after the victim's remains were found; these additional results show that, conditional on swiping in somewhere, there was no differential change in the time at which they entered. That is, the margin on which most female faculty changed their behavior was whether (not when) to access campus facilities.

Column 4 and the graph on the right in Figure 9 show differential effects on the time of the latest swipe for the subsample of STEM faculty and staff. They show a decline in the latest hour that women swiped into STEM facilities (again conditional on swiping in at least once, and relative to men), beginning after the arrest of the assailant and continuing after the victim's remains were found. Recall that column 3 showed no differential change (relative to men) in the likelihood that female STEM faculty and staff swiped into any locked facility; this graph shows that they began entering those facilities earlier. This is consistent with the notion that—because female STEM faculty and staff do not have the ability to avoid working in their offices and labs—they changed their behavior to avoid working there late at night.

General Discussion

Women in academia face a chilly and sometimes hostile climate. Opportunity gaps—from funding opportunities to social networks—are central to this experience. In the present work, we document yet another opportunity gap for women; specifically, we document women's safety concerns and how these concerns might restrict on-campus work, especially afterhours. Our correlational data suggest that women are more concerned about their safety than are men, and that these concerns are associated with reduced on-campus workhours afterhours. Our experimental data were generally consistent with this; increasing men's safety concerns decreased their willingness to use the library that week, even if campus were better lit. That said, we were unable to manipulate women's safety concerns, perhaps because women are socialized to be concerned about their safety, making their

concerns difficult to manipulate in an experimental setting. For this reason, we turned to real-world data. We analyzed swipe access data across an entire semester. We found that a major crime event, one which made safety concerns more salient for women, reduced the likelihood that women worked on-campus afterhours, and reduced the likelihood that STEM women worked on-campus later at night. Taken together, these data provide initial evidence that physical safety matters and can undermine women's work.

This work complements previous work on gender gaps in academia, including work on identity threat and safety. Extant research has shown that women in academia and in STEM especially face identity threat; they worry they will be treated negatively or devalued because of their gender (e.g., Murphy et al., 2007). Identity safety—knowing that one's identity is not a barrier to inclusion or success—is essential for women's entry, persistence, and success in male-dominated domains (Walton et al., 2015). The present work suggests that physical safety is also important. Indeed, we would argue that women must feel physically safe before they can experience identity safety.

Limitations of the work provide avenues for future work. One limitation is our weak experimental evidence. Future work will need to extend these findings, ideally by testing interventions. Doing so would have dual advantages. It would address women's safety concerns, which they report in clear and unambiguous terms. It would also provide better experimental tests of our results. Another limitation is our relatively narrow focus on work afterhours. Future work might document other ways in which safety concerns produce opportunity gaps. We can imagine, for example, that safety concerns undermine psychological safety and sense of belonging at one's institution; presumably, feeling "at home" at an institution requires feeling safe at that institution.

If we want women to fully engage, then, we must make it safe for them to do their work, a sentiment powerfully echoed in renowned scientist Hope Jahren's memoir (Jahren, 2016). She writes, "[Science is] threatened by the fact that it's not safe for so many of us. Period. It's just not safe. And I

believe that until we can believe it to be safe, we don't have any business making a hypocritical show of recruiting the very people who are the least safe." What we have documented here is that many women (and some men) indeed do not feel safe at work and, as a result, do not engage in the way they want to engage. They do not work the hours they say they want to and would work. And although there is some debate over "safe spaces" in higher education, we suspect most people would agree that everyone ought to be and feel physically safe on campus so they can do their best work. Our work, then, points to an important and politically feasible solution to better support women in doing their best work: physical safety.

References

Altman, I., & Low, S. (1992). *Human behavior and environments: Advances in theory and research.* Volume 12: Place attachment. New York: Plenum Press.

Andersen, S. M., Chen, S., & Carter, C. (2000). Fundamental human needs: Making social cognition relevant. *Psychological inquiry*, *11*(4), 269-275.

Barefoot, J. (2009, November 4). *UMW will install 33 streetlights*. The Blue & Gray Press at The University of Mary Washington. https://blueandgraypress.com/2009/11/04/umw-will-install-33-streetlights/

Berdahl, J. L. (2007). Harassment based on sex: Protecting social status in the context of gender hierarchy. Academy of Management Review, 32(2), 641-658.

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: how stereotypical cues impact gender participation in computer science. *Journal of personality and social psychology*, *97*(6), 1045

Chulef, A. S., Read, S. J., & Walsh, D. A. (2001). A hierarchical taxonomy of human goals. *Motivation and Emotion*, *25*(3), 191-232.

Clancy, K. B., Nelson, R. G., Rutherford, J. N., & Hinde, K. (2014). Survey of academic field experiences (SAFE): Trainees report harassment and assault. PloS one, 9(7), e102172.

Committee on Equity, Diversity, and Professional Conduct. (2019). Report: Committee on Equity, Diversity, and Professional Conduct. https://pubs.aeaweb.org/doi/pdfplus/10.1257/pandp.109.709

Committee on Maximizing the Potential of Women in Academic Science and Engineering (US). (2007). *Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering*. Washington, DC: National Academies Press.

Currle, D. H. (1994). Women's safety on campus: Challenging the university as gendered space. *Humanity & Society*, *18*(3), 24-48.

Daily Free Press Admin. (2008, August 20). *Students and faculty concerned about safety.* The Daily Free Press at Boston University. https://dailyfreepress.com/blog/2008/03/27/bupd-concerned-about-faculty-safety/

Day, K. (1994). Conceptualizing women's fear of sexual assault on campus: A review of causes and recommendations for change. *Environment and Behavior*, *26*(6), 742-765.

Deci, E. L., & Ryan, R. M. (2000). The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological inquiry*, *11*(4), 227-268.

Fairchild, K. (2010). Context effects on women's perceptions of stranger harassment. Sexuality & Culture, 14(3), 191-216.

Fairchild, K. (2015). "But Look at What she was Wearing!": Victim Blaming and Street Harassment. In Gender, Sex, and Politics (pp. 22-32). Routledge.

Fairchild, A. L., Holyfield, L. J., & Byington, C. L. (2018). National Academies of Sciences, Engineering, and Medicine report on sexual harassment: making the case for fundamental institutional change. Jama, 320(9), 873-874.

Fairchild, K., & Rudman, L. A. (2008). Everyday stranger harassment and women's objectification. Social Justice Research, 21(3), 338-357.

Fletcher, P. C., & Bryden, P. J. (2007). Preliminary Examination of Safety Issues on a University Campus: Personal Safety Practices, Beliefs & Attitudes of Female Faculty & Staff. *College student journal*, *41*(4).

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.

Hyde, J. S. (2005). The gender similarities hypothesis. *American psychologist*, *60*(6), 581

Inzlicht, M., & Ben-Zeev, T. (2003). Do High-Achieving Female Students Underperform in Private? The Implications of Threatening Environments on Intellectual Processing. *Journal of educational psychology*, *95*(4), 796.

Jahren, H. *Lab Girl* (2016). Knopf Doubleday Publishing Group.

Kadel R. P., & Kip K. E. (2012). A SAS Macro to Compute Effect Size (Cohen's d) and its Confidence Interval from Raw Survey Data. Proceedings of the annual Southeastern SAS Users Group Conference.

Kenrick, D. T., Griskevicius, V., Neuberg, S. L., & Schaller, M. (2010). Renovating the pyramid of needs: Contemporary extensions built upon ancient foundations. *Perspectives on psychological science*, *5*(3), 292-314.

Koltko-Rivera, M. E. (2006). Rediscovering the later version of Maslow's hierarchy of needs: Self-transcendence and opportunities for theory, research, and unification. *Review of general psychology*, *10*(4), 302-317.

Leslie, S.-J., Cimpian, A., Meyer, M., Freeland E. (2015). Women are underrepresented in disciplines that emphasize brilliance as the key to success. *Science,* 347, 262–265

Maslow, A. (1954). *Motivation and personality*. New York: Harper & Row.

May, D. C., Rader, N. E., & Goodrum, S. (2010). A gendered assessment of the ''threat of victimization'': Examining gender differences in fear of crime, perceived risk, avoidance, and defensive behaviors. *Criminal justice review*, *35*(2), 159-182.

Miyake, A., Kost-Smith, L. E., Finkelstein, N. D., Pollock, S. J., Cohen, G. L., & Ito, T. A. (2010). Reducing the gender achievement gap in college science: A classroom study of values affirmation. *Science*, *330*(6008), 1234-1237.

Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological science*, *18*(10), 879-885.

National Science Foundation, National Center for Science and Engineering Statistics, Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017 (Special Report). Available at https://www.nsf.gov/statistics/2017/nsf17310/static/downloads/nsf17310-digest.pdf. Accessed 20 August 2019.

Nelson, R. G., Rutherford, J. N., Hinde, K., & Clancy, K. B. (2017). Signaling safety: Characterizing fieldwork experiences and their implications for career trajectories. American Anthropologist, 119(4), 710-722.

Nosek, B. A., Smyth, F. L., Sriram, N., Lindner, N. M., Devos, T., Ayala, A., ... & Kesebir, S. (2009). National differences in gender–science stereotypes predict national sex differences in science and math achievement. *Proceedings of the National Academy of Sciences*, *106*(26), 10593-10597.

Park, L. E., Young, A. F., Troisi, J. D., & Pinkus, R. T. (2011). Effects of everyday romantic goal pursuit on women's attitudes toward math and science. *Personality and Social Psychology Bulletin*, *37*(9), 1259-1273.

Pronin, E., Steele, C. M., & Ross, L. (2004). Identity bifurcation in response to stereotype threat: Women and mathematics. *Journal of Experimental Social Psychology*, *40*(2), 152-168.

Rodier, D.N. (1995, September 22). *Students and faculty concerned about safety*. Daily Collegian at The Pennsylvania State University. https://www.collegian.psu.edu/archives/article_12baf332-9767-5a32-af44-f55d61d6415f.html

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of experimental social psychology*, *35*(1), 4-28.

SPSP Task Force on Sexual Harassment. (2019). SPSP Sexual Harassment Survey Results. https://spsp.org/sites/default/files/SPSP-2018-SH-Survey-Results.pdf

Steele, C. M., Spencer, S. J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In *Advances in experimental social psychology* (Vol. 34, pp. 379-440). Academic Press.

Steinpreis, R. E., Anders, K. A., & Ritzke, D. (1999). The impact of gender on the review of the curricula vitae of job applicants and tenure candidates: A national empirical study. *Sex roles, 41(7),* 509-528.

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the tide: Using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of personality and social psychology*, *100*(2), 255

Tay, L., & Diener, E. (2011). Needs and subjective well-being around the world. *Journal of personality and social psychology*, *101*(2), 354.

Tuan, Y.-F. (1974). *Topophilia*. Englewood Cliffs, NJ: Prentice-Hall.

Tuan, Y.-F. (1977). *Space and place: The perspectives of experience.* Minneapolis: University of Minnesota Press.

Valian, V. (1999). The cognitive bases of gender bias. *Brook. L. Rev.*, *65*, 1037.

Wahba, M. A., & Bridwell, L. G. (1976). Maslow reconsidered: A review of research on the need hierarchy theory. *Organizational behavior and human performance*, *15*(2), 212-240.

Walby, S. (2006). In-depth study on all forms of violence against women: Report of the Secretary General. United Nations Division for the Advancement of Women. https://openaccess.city.ac.uk/id/eprint/21682/1/

Walton, G. M., Murphy, M. C., & Ryan, A. M. (2015). Stereotype threat in organizations: Implications for equity and performance. Annual Review of Organizational Psychology and Organizational Behavior, 2(1), 523-550.

Witteman, H. O., Hendricks, M., Straus, S., & Tannenbaum, C. (2019). Are gender gaps due to evaluations of the applicant or the science? A natural experiment at a national funding agency. *The Lancet, 393(10171),* 531-540.