# Considering Gender Effects: STEM Internships at a U.S. National Laboratory

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**ABSTRACT—** ***This study examined Science Technology Engineering and Math (STEM) intern participants' perceptions of their summer internship experiences at an U.S. National Laboratory. An electronic survey with a convenience sample was utilized to investigate the influential parties who encouraged interns to accept internships; the influence of gender; the perceptions of role modeling, networking, and mentoring; and whether respondents' internship experiences were transformational. Results from 80 completed surveys represented interns from all four STEM disciplines. While females reported being more influence by female family members, males were more influenced by male others. Many respondents indicated exposures to networking opportunities during their internships but exposure to female mentor, leadership by female, female role model and female mentor were different between female and male interns. Over one half of respondents agreed their internship included a "transformational experience." This research constitutes an effort to understand the dearth of women entering STEM careers.***

**Keywords—**Internship**,** Science, Technology, Engineering, Math, Gender

## 1. INTRODUCTION

In the U. S. and elsewhere, there continues to be a dearth of females recruited to and retained in STEM (Science, Technology, Engineering and Mathematics) disciplines. "The science and engineering workforce is largely white and male…Women's participation in science and engineering occupations is about half of what it is in the U.S. workforce" [29] (pp. 8). Further, existing STEM workers are growing older and may soon exit the workforce, leaving a gap. Strategies to increase female participation in STEM disciplines must be implemented. "To meet continuing, strong demand, it will be important that every American has an opportunity to achieve in mathematics and science. [Women] remain underrepresented in STEM professions … Alternative and diverse approaches to excellence in education and mentoring create opportunities to tap America's potential" [27] (pp. 2-3).

Many have used the metaphor of a "leaky pipeline" to refer to the loss of females in STEM professions [3] (pp. 17). Some have postulated that females considering the STEM disciplines are initially and greatly influenced, either positively or negatively, by their parents [16, 3]. Some female students have reported their instructors do not necessarily encourage them to enter or remain in STEM disciplines [16, 1]. To increase STEM industry recruits, some have championed internships for females in male-dominated fields [2, 7]. STEM and non-STEM internships have been reported as valuable [8, 17, 22, 12, 21, 22, 35, 36, 42, 47].

The purpose of this study was to examine STEM interns' perceptions of summer internship experiences at a prestigious United States Department of Energy (DOE) National Laboratory. "17 DOE laboratories comprise a preeminent federal research system, providing the Nation with strategic scientific and technological capabilities." [44]. This study also investigated the influences of interns' gender and who encouraged them to apply to, accept, and fulfill their appointments. This research constitutes an effort to understand the dearth of women entering STEM careers, relative to the National Science Foundation's (NSF) key strategies: "to cultivate a world-class, inclusive science and engineering workforce and expand the scientific literacy of all citizens" [27] (pp. 5) and to support the NSF's more recent strategic goal of "Preparing a diverse, globally engaged, technology, engineering, and mathematics (STEM) workforce" [28].

## 1. REVIEW OF LITERATURE

Prior studies have suggested mentoring, networking, leadership, and/or role modeling could give women confidence and help to support future success in STEM [7, 9, 11, 37, 38]. Some have suggested that exposing the successes as well as the challenges of women in male-dominated fields [2, 7]. STEM and non-STEM internships have been reported as valuable [8, 12, 17, 21, 22, 35, 36, 42, 48].

Previously, some programs have attempted to encourage female participation in STEM [13]. Positive work environments, which include role modeling, networking and mentoring, are aimed to assist in retention of female STEM success [16]. But some women do not have access to support. A Bayer Corporation [7] study revealed that African-American women in engineering, cited "no/little access to networking opportunities" (pp. 31).

Some researchers have used surveys to determine which skills were enhanced by internships [21, 25] or used surveys to determine skills needed for successful STEM internships [19] or to assess the relationships between internships and successful job searches [14]. Others interviewed STEM students [43] or surveyed industrial interns [31] to understand the benefits of faculty-mentoring or internships, respectively. Some researchers have called for future research investigations into various aspects of internships [33].

An article on the Argonne National Laboratory's (ANL) website, entitled "Science Careers in Search of Women, 2010," reported: "Women continue to be underrepresented in science and technology. Research shows that girls and young women lose interest in subjects and fields of study leading to scientific and technical careers long before they enter college" [6]. In an attempt to counter this trend at the high school level, ANL exposed young women to science and technology career opportunities via a conference at the lab [6]. Other institutions have fostered attempts to recruit women into STEM programs [18, 45, 49].

Towards the goal of reaching equity for women currently in the STEM disciplines, some institutions have established special programs to aid retention [48, 50]. Others have mentored faculty; collected data on faculty appointments, promotions and tenure; enacted "family-friendly policies and practices," and attempted to remove gender bias [34] (pp. 336).

Intended to increase women's participation in STEM disciplines, Institutional Transformational Grants were funded by the NSF [34, 49]. But, according to Surjani and Mouly [41], "with a few notable exceptions, most research into the occupational experiences of women is typically macro-social, and based on large-scale, impersonal, aggregated, and static data" (pp. 1). Therefore, small-scale studies that examine individual's experiences will be valuable additions to the current knowledge base.

### 1.1 Transformational Education

It has been proposed that transformational experiences, such as summer opportunities facilitating student participation in research, may funnel females into STEM [9]. Several researchers have used the term, "transformational" with regard to educational experiences that create profound changes in various settings within and beyond STEM [5, 10, 20, 30, 34, 39]. Retherford [32] stated "transformational learning [helps] the learner in recognizing and discarding previously unexamined beliefs – beliefs that often act as self-imposed limitations and barriers. A transformative learning process that leads to an emancipatory change is one that moves the locus of control in a learner's life from outside to within the learner in order that the learner may freely choose the direction he will take from this point forward" (pp. 11).

The theory of transformational learning was developed by John Mezirow [26]. He explained there are ten phases of a transformational learning experience [24]. Others [23, 24] write that transformational education goes beyond "cognitive enrichment." as it changes attitude and behavior as well. It creates a deep structural alter in thought, feeling and actions [24]. One specific way that transformational learning changes people is that it grows their leadership skills. There is a linkage between transformational education and growth of individual leadership capacities [10]. These indicate that transformational internships could be a crucial part of the educational experience.

According to Kets De Vries and Korotov [23], there are three triangles that influence the transformational process: mental life, conflict, and relationship. The mental life triangle realizes that cognitive and emotional processes need to be taken into consideration in order for there to be any change in behavior. The conflict triangle looks at the source of thoughts and feelings that could potentially prevent change through anxiety. The relationship triangle examines previous experiences that create patterns of response. All of these influence a transformational experience [23].

Some research in STEM disciplines relative to college students' classroom experiences has been conducted [15]. In Sweitzer and King's 1999 book, *The Successful Internship: Transformation and Empowerment,* they explore the individual nature of internship experiences. Villarejo, et al., [46] surveyed previous participants of undergraduate research enrichment programs and determined these experiences had provided "transformations, positioning them for previously unconsidered biomedical research careers. A Bayer Corporation study [7] recommended college internships as a key strategy to ensure women's success in STEM fields. However, no scholarly studies were found which specifically queried current college students regarding their perceptions of "transformational experiences" during STEM internships.

## 2. METHODS

STEM summer internship programs were hosted by a U.S. National Laboratory in the Mid-West with funding from the U.S. Department of Energy and the National Science Foundation. At the end of the internship period, a survey instrument with 18 closed-ended multiple-choice questions and two open-ended questions was administered to interns. A convenience sample of male and female interns, undergraduate and graduate college students, as well as recent graduates of undergraduate programs, was taken for this study.

The researcher met with the internship administrator at the National Laboratory who reviewed and distributed the macro-enabled survey and collected completed surveys. The questionnaire was distributed to 309 interns. Completed questionnaires were automatically routed to the researcher via a specially created email account, ensuring anonymity.

The survey instrument queried respondents about any encouragement they had received towards accepting their internship offers. This encouragement would have happened well prior to interns arriving at the internship site. Respondents were additionally questioned about their perceptions of influences during their onsite internship experiences. The survey also contained demographic questions regarding age, gender, and race.

The data collected from this survey were descriptively analyzed using a statistical analysis program using SPSS to categorize the characteristics of respondents. Frequency counts and percentages were calculated. To compare the gender differences in influences on an acceptance of internship, exposures and influences during internship, and transformational experience, Chi-Square tests were conducted.

## 3. RESULTS

### 3.1 Characteristics of Respondents

Eighty usable surveys were returned for a return rate of 25.89%. All four of the STEM disciplines were represented by the respondents (See Table 1). Over one third of the respondents (29, 36.25%) indicated their internship was in "engineering;" almost one third (24, 30.0%) selected "technology"; over one quarter (21, 26.25%) chose "science"; and two respondents (2.5%) indicated "math". Four interns (5%) did not report a STEM area affiliation.

Table 1. Characteristics of Participants

| STEM categories | | | | | |
|---|---|---|---|---|---|
| Technology | Science | Engineering | Math | System | Total |
| 24 (30.0%) | 21 (26.3%) | 29 (36.3%) | 2 (2.5%) | 4 (5%) | 80 |
| **Gender** | | | | | |
| Female | Male | Not Identified | Total | | |
| 31 (38.8%) | 47 (58.8%) | 2 (2.5%) | 80 | | |
| **Age** | | | | | |
| 17 | 18 - 22 | 23 - 30 | 31 - 40 | 41-50 | 51+ | Total |
| 3 (3.8%) | 45 (56.3%) | 28 (35.0%) | 3 (3.8%) | 0 (0%) | 1 (1.3%) | 80 |
| **Race** | | | | | | |
| African American | Asian American | Caucasian American | Hispanic American | Other | Not Identified | Total |
| 8 (10.0%) | 6 (7.5%) | 47 (58.8%) | 6 (7.5%) | 9 (11.3%) | 4 (5.0%) | 80 |

Respondents were mostly males (47, 58.75%); fewer were females (31, 38.75%). This composition approximated the distribution of males and females interns at the National Lab. Two respondents declined to report gender (2.5%). Respondents' age varied: three (3.75%) were 17 years old or under; 45 (56.25%) were 18–22 years old; 28 (35.0%) were 23–30 years old; three (3.75%) were 31–40 years old; none (0%) were 41–50 years old; and one was 51 years old or over (1.25%).

A majority of respondents reported race as Caucasian American (47, 58.75%) and remaining respondents were: African American (8, 10.0%); Asian American (6, 7.5%); Hispanic/Latino/Latina American (6, 7.5%) or "Other" (9, 11.25%). A small number (4, 5.0 %) did not report race.

### 3.2 Influences on Acceptance of Internships

Respondents were queried regarding internship acceptance influences. Multiple responses were provided and respondents could choose all applicable. In response to "**Who encouraged you to accept your Summer internship?**"

the following familial choices were offered: "mother", "father", "stepmother", "stepfather", "sister", "brother", "grandmother", "grandfather", "aunt", "uncle", "female cousin" and "male cousin". Approximately two thirds of respondents (52, 65%) selected "mother". However, when one considers gender, well over four fifths of *female* respondents (26, 83.87%), but approximately one half (26, 55.32%) of *male* respondents, chose "mother". Over one half of respondents (45, 56.25%) answered "father". However, while over one-half of *female* respondents (25, 53.19%) chose "father", less than one half of *male* respondents (20, 42.55%) selected "father".

Additional family member choices yielded far less responses: "stepmother" (3, 3.8%); "stepfather" (3, 3.8%); "grandmother" (10, 12.5%); "grandfather" (5, 6.3%); "aunt" (7, 8.8%); "uncle" (6, 7.5%); "sister" (10, 12.5%); "brother" (4, 5.0%); "female cousin" (2, 2.5%), and "male cousin" (3, 3.8%).

The original response categories: "mother," "stepmother," "sister," "grandmother," "aunt," and "*female* cousin" were collapsed into "*female* family member". The corresponding *male* categories were similarly collapsed into "*male* family member".

Over two-thirds (54, 67.5%) of respondents agreed a "*female* family member" had encouraged them to accept internships (See Table 2). Regarding "*male* family members," over one half (44, 55.0%) agreed they had been encouraged by this group.

Table 2. Influence on Acceptance of Internship

| | Female Interns (N=31) | | Male Interns (N=47) | | Not Identified (N=2) | Total Interns (N=80) | | $\chi 2$ (Chi-square) | *p* |
|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | n | % | | |
| Influence on acceptance-female family member | 27 | 87.1 | 26 | 55.3 | 1 | 54 | 67.5 | **8.661*** | **.003** |
| Influence on acceptance-male family member | 18 | 58.1 | 26 | 55.3 | 0 | 44 | 55 | .057 | .811 |
| Influence on acceptance-female others | 18 | 58.1 | 20 | 42.6 | 2 | 40 | 50 | 1.799 | .180 |
| Influence on acceptance-male others | 19 | 61.3 | 31 | 66.0 | 2 | 52 | 65 | .177 | .674 |

*significant at $\alpha<.05$

When one considers gender, over four fifths (27, 87.09%) of *females* indicated "*female* family members" had encouraged them and over half (18, 58.1%) of *females* agreed "*male* family members" provided encouragement. Over half (26, 55.3%) of *males* indicated "*female* family members" had encouraged them and over one half (26, 55.3%) reported "*male* family members" provided encouragement.

Also, in response to "**Who encouraged you to accept your Summer internship?**", non-familial choices were offered: "*female* teacher", "*male* teacher", "*female* friend", "*male* friend", "*female* mentor", "*male* mentor", "*female* classmate", "*male* classmate", "*female* significant other", "*male* significant other", "previous participant - *male* intern", "previous participant - *female* intern", "*female* supervisor", "*male* supervisor", "*female* counselor", "*male* counselor", "*female* coach" , "*male coach*", and "other". Almost one third of respondents (26, 32.5%) responded "*male* teacher," and almost one quarter (18, 22.5%) responded "*female* teacher." Approximately one quarter indicated "*female* friend" (22, 27.5%) or "*male* friend" (20, 25%); less than one fifth selected *male* mentor (13, 16.4%), and only a few selected *female* mentor (4, 5%). Less than one fifth selected "*male* classmate" (15, 18.8%) or "*female* classmate" (13, 16.3%); approximately one tenth chose "*male* significant other" (7, 8.8%) or "*female* significant other" (9, 11.3%)." Over one tenth selected "previous participant-*male* intern" (9, 11.3%) and only a few chose "previous participant-*female* intern" (3, 3.8%). A small number (4, 5%) responded "*female* supervisor;" over one tenth (10, 12.5%) selected "*male* supervisor." A few chose "*male* counselor" (2, 2.5%), and a few more chose "*female* counselor" (6, 7.5%). Only one respondent (1.3%) chose "*male* coach", while none (0, 0%) indicated "*female* coach."

The original *female* survey response categories: "*female* teacher", "*female* friend", "*female* mentor", "*female* classmate", "*female* significant other", "previous participant - *male* intern", "*female* supervisor", "*female* counselor", "*female* coach" were collapsed into one category: "*female* other". The corresponding *male* categories were similarly collapsed into "*male* other".

"*Female* others" were reported to have encouraged internship acceptance by 40 (50.0%) of respondents. Almost two-thirds (52, 65.0%) indicated "male others" had influenced them to accept internships. However, when one considers gender, over one half (18, 58.1%) of females indicated "female others" had encouraged them and over one half of

females (19, 61.3%) indicated "male others" had encouraged them. Almost one-half (20, 42.6%) of males indicated "female others" had encouraged them and two thirds (31, 66.0%) of males reported "male others" had encouraged them.

Chi-Square tests were conducted to compare the gender differences in influences on an acceptance of internship. The percentage of participants that were influenced by female family member ($\chi^2$ (1, N=80) = 8.661, $p$ = .003) differed by gender. One the other hand, the percentage of participants that were influenced by male family member ($\chi^2$ (1, N=80) = .057, $p$ = .811), female non-family member ($\chi^2$ (1, N=80) = 1.799, $p$ = .180), and "male non-family member" ($\chi^2$ (1, N=80) = .177, $p$ = .674) did not differ by gender.

### 3.3 Exposures and Influences During Internships

Respondents were asked questions regarding *exposures* and *influence during* their internships. Multiple responses were provided and respondents could choose all that applied. In response to the question, **"On either a formal or informal basis, to which of the following have you been exposed during your Summer Internship?**" When one considers gender of the *mentors*, almost one third (26, 32.5%) of the intern respondents agreed they had been exposed to mentoring by *females* (See Table 3). Conversely, almost two-thirds (51, 63.8%) of the intern respondents agreed they had been exposed to mentoring by *males.*

Table 3. Exposure & Influence During Internship

| | Female Intern (N=31) | | Male Intern (N=47) | | Not Identified (N=2) | Total Interns (N=80) | | $\chi^2$ (Chi-square) | *p* |
|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | n | % | | |
| Exposure to female mentor | 16 | 51.6 | 9 | 19.1 | 1 | 26 | 32.6 | **9.039*** | .003 |
| Exposure to male mentor | 18 | 58.1 | 32 | 68.1 | 1 | 51 | 63.7 | .815 | .376 |
| Exposure to networking with female | 26 | 83.9 | 26 | 55.3 | 1 | 53 | 66.3 | 6.852 | .009 |
| Exposure to networking with male | 23 | 74.2 | 34 | 72.3 | 1 | 58 | 72.5 | .33 | .857 |
| Exposure to leadership by females | 21 | 67.5 | 8 | 17.0 | 1 | 30 | 37.5 | **20.575*** | .000 |
| Exposure to leadership by males | 22 | 71.0 | 26 | 55.3 | 1 | 49 | 61.3 | 1.933 | .164 |
| Exposure to female role model | 18 | 58.1 | 9 | 19.1 | 0 | 27 | 33.8 | **12.499*** | .000 |
| Exposure to male role model | 14 | 45.2 | 24 | 51.1 | 0 | 38 | 47.5 | .260 | .610 |
| Positive influence-female mentor | 11 | 35.5 | 4 | 8.5 | 1 | 16 | 20 | **8.750*** | .003 |
| Positive influence-male mentor | 13 | 41.9 | 21 | 44.7 | 0 | 34 | 42.5 | .057 | .811 |

*significant at $\alpha$<.05

Considering gender of respondents, over one half (16, 51.6%) of *female* intern respondents agreed that they had been exposed to a *"female* mentor", and over one half (18, 58.1%) of *female* interns agreed they were exposed to a *"male* mentor." Conversely, less than one quarter (19, 19.1%) of *males* agreed that they had been exposed to a "*female* mentor," and over two-thirds (32, 68.1%) of *male* interns agreed that they had been exposed to a "*male* mentor."

Respondents were asked "**On either a formal or informal basis, to which of the following have you been exposed during your Summer Internship? – Networking**," approximately two thirds of total intern respondents agreed they had been exposed to "networking" with both *females* (53, 66.3%) and *males* (58, 72.5%).

When one considers gender, over four fifths (26, 83.9%) of the *female* interns indicated they had networked with *females*, and almost three quarters (23, 74.2%) of the *female* interns agreed they had networked with *males*. Over one half (26, 55.3%) of the *male* interns indicated they had networked with *females*, and almost three quarters (34, 72.3%) of the *male* interns reported networking with *males*.

In response to "**On either a formal or informal basis, to which of the following have you been exposed during your Summer Internship? – Leadership by females,"** over one third (30, 37.5%) of respondents selected "leadership by *females*". Conversely, in response to "**On either a formal or informal basis, to which of the following have you**

**been exposed during your Summer Internship? –**"**Leadership by *males***", almost two thirds (49, 61.3%) selected "leadership by *males".*

When one considers the gender of the intern respondents, two-thirds (21, 67.5%) of the *female* interns indicated they had been exposed to leadership by *females*, and almost three quarters (22, 71.0%) agreed they had experienced leadership by *males*. Less than one fifth (8, 17.0%) of the *male* interns indicated they had experienced leadership by *females*, yet over one half (26, 55.3%) agreed they had experienced leadership by *males*.

In response to "**On either a formal or informal basis, to which of the following have you been exposed during your Summer Internship – Role Models?**" approximately one third of respondents selected "*female* role models" (27, 33.8%). Conversely, almost one half (38, 47.5%) selected "*male* role models".

When one considers the gender of the intern respondents, more than one half (18, 58.1%) of the *female* interns indicated they had been exposed to *female* role models, and (14, 45.2%) agreed they had been exposed to *male* role models. However, less than one fifth (9, 19.1%) of the *male* interns indicated they had exposed to *female* role models, and, in contrast, over one half (24, 51.1%) agreed they had been exposed to *male* role models.

In response to the question "**Who has positively influenced you during your Summer Internship? – Mentor**" one fifth of intern respondents (16, 20%) selected *"female* mentor". Almost one half of intern respondents (34, 42.5%) selected "male mentor".

When one considers the gender of the interns, over one third (11, 35.5%) of *females* indicated they had been positively influenced by "*female* mentors", but only a few *male* respondents (4, 8.5%) reported they had been positively influenced by *"female* mentors". Also, almost one half of *male* respondents (21, 44.7%) indicated they were positively influenced by *male* mentors, and almost one half of *female* respondents (13, 41.9%) indicated they had been positively influenced by "*male* mentors".

Chi-Square was conducted to compare the gender differences in exposures and influences during internship. The percentage of participants that were exposed during internship to mentoring by female ($c^2$ (1, N=80) = 9.039, $p$ = .003), networking with females ($c^2$ (1, N=80) = 6.852, $p$ = .009), leadership by females ($c^2$ (1, N=80) = 20.575, $p$ = .000), and female role models ($c^2$ (1, N=80) = 12.499, $p$ = .000) differed by gender. However, the percentage of participants that were exposed during internship to mentoring by male ($c^2$ (1, N=80) = 0.815, $p$ = .376), networking with males ($c^2$ (1, N=80) = 0.33, $p$ = .857), leadership by males ($c^2$ (1, N=80) = 1.933, $p$ = .164), and male role models ($c^2$ (1, N=80) = 0.260, $p$ = .610) did not differ by gender.

In terms of positive influence during internship, the percentage of participants that were influenced by female mentor ($c^2$ (1, N=80) = 8.750, $p$ = .003) differed by gender. One the other hand, the percentage of participants that were influenced by male mentor ($c^2$ (1, N=80) = 0.057, $p$ = .811) did not differ by gender.

## 3.4 Transformational Experience

In response to "**Do you feel that you have had a "transformational experience" during your Summer Internship?**" over one half of all respondents (57, 71.3%) agreed they had a "transformational experience " (see Table 4). Twenty-three (28.8%) did not agree. When one considers gender, a higher percentage of *females*, over three quarters, (26, 83.87%) reported a transformational experience than did *males*, almost two thirds of whom agreed (30, 63.8%).

Table 4. Transformational Experience

| | Female Interns (N=31) | | Male Interns (N=47) | | Not Identified (N=2) | Total Interns (N=80) | | $\chi 2$ (Chi-square) | *p* |
|---|---|---|---|---|---|---|---|---|---|
| Transformational Experience | n | % | n | % | n | n | % | 3.705 | .054 |
| | 26 | 83.9 | 30 | 63.8 | 1 | 57 | 71.3 | | |

*significant at $\alpha$<.05

To compare the gender differences in transformational experience, Chi-Square test was conducted. The percentage of participants that have had a transformational experience during internship did not differ by gender ($c^2$ (1, N=80) = 3.705, $p$ = .054).

## 3.5 Open-Ended Comments

The survey offered two open-ended questions asking for more information. An open-ended question asked respondents, "**Did you have a transformational experience during your Summer Internship?**" While one respondent expressed that she had a transformation experience, many *female* respondents said that they had a great experience, but "transformational" was too strong of a word. Many *female* respondents indicated that this experience showed them that

this was a field of study they would like to pursue, while some indicated that it revealed that a research career was not for them.

Most *males* expressed that it was not a transformational experience. However, many *males* indicated that the internship exposed them to some "great opportunities" and that they "learned a lot".

The other open-ended question asked respondents, "**Is there anything else that you would like to tell us about your Summer Internship?**" The responses from *females* indicated that the internship was a great educational experience and that it left a profound impact on their educational and career choices. The *male* respondents expressed that it was an enriching experience that enhanced their abilities and they would recommend it to others.

"Leadership*"* was specifically mentioned by only one *female* respondent but not by *males*. "Mentoring" was mentioned by both genders. The term, "supervisor", was used by two *female* respondents, and the term, "advisor", was used by one *male*. "Networking", was not used by any respondents. However, germane activities, such as engaging in positive interactions, attending meetings, and learning about job opportunities, were reported by both genders and other related terms e.g. "career," "job," and "profession," were used. Both academic and professional career intentions were in evidence. "Role modeling*"* was not mentioned by either gender of respondents but "learning from people" was reported by one *female*.

## 4 DISCUSSION AND CONCLUSIONS

This research gathered data regarding internship perceptions at a National Laboratory and contributes to our general understanding of the impacts of STEM internships for both genders. This study specifically allowed interns the opportunity to reflect on their recent internships and how their experiences may influence their STEM futures. Overall, the results suggest the respondents at the studied site found their internships valuable. In general, *female* perceptions differed from their *male* counterparts, although all interns underwent a common application process, shared the same orientation sessions, and were employed with their cohorts at a common site. Interestingly, mothers were seen as the most influential familial agent towards internship acceptance by both *female* and *male respondents*, with a much stronger maternal influence perceived by the *females* than the *males*. The interns' fathers were the second most influential person across all interns' acceptance of their internships with a stronger influence by the fathers over the *females* than the *males*. While female reported being more influence by female family members, males were more influenced by male others. *Female* family members reportedly exerted more influence over *female* interns than over *males*.

Overall, respondents indicated more exposure to "*male* role models" than "*female* role models". *Male* respondents reported more leadership by *males* than *females*. Interestingly, *female* interns indicated identical percentages of leadership by role models of both genders. Exposure to *female* mentor, leadership by *female*, *female* role model and *female* mentor were different between *female* and *male* interns.

Finally and importantly, although over one half of all respondents reported a transformational experience during their internships, a higher percentage of *female* interns reported occurrences of transformational experiences than did their *male* counterparts. STEM internships offerings may lead to an increased number of *females* in STEM careers in the future. However, it should be noted the results regarding transformational experience by gender were not found to be statistically significant. STEM internships can provide transformational experiences benefitting both genders.

As part of orientation, interns attended seminars. Two of the nine seminars were presented by *female* scientists. Additional opportunities to meet *female* scientists and to read about them on the lab's website and newsletter were available during the internships. The exposure of f*emale* interns to successful *female* STEM leaders had been anticipated to be transformative. Exposure to *female* mentor, leadership by *female*, *female* role model and *female* mentor were different between *female* and *male* interns. The anticipated transformative experience occurred for the majority of *female* interns. One may speculate *female* intern respondents' perceptions of transformational experiences were influenced by their first exposures to a STEM culture and their first immersion experience in a STEM community with *female*. Further, the transformations the *females* reported may be due to pride, fulfillment and independence provided to them by their first paid jobs, the summer internships. Conversely, *male* respondents may have been previously exposed to STEM environments through other internships, technical jobs, science fairs, etc. Although previous researchers have indicated that leaders, role models, and mentors for *females* are important for STEM careers, this study suggests that perhaps equally or even more important for *females* are early exposures to paid work in lab environments.

This study's relatively small, non-random sample, focused temporal scope, and single site limit the ability to generalize from the results. Future research based on this study can be conducted with larger samples and different types of internships.

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## 6 DISCLAIMER

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