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CHARACTERISTICS AND CULTURE OF GEOSCIENCE DEPARTMENTS AS INTERPRETED FROM THEIR WEBSITE PHOTOGRAPHS

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Geoscience department websites are a public representation of the department and discipline. This exploratory study investigated the characteristics and culture communicated about geoscience departments through their website photographs. Outdoor settings dominated in the website photographs. This may give the impression that geoscientists spend most of their time outdoors. Additionally, the outdoors may represent the most appealing aspect of geoscience work. Most people in the photographs were men. Women were more likely to be students than instructors/geoscientists; however, in both student and instructors/geoscientists roles women still were a minority compared to the percentage of men in those roles. Most people in the photographs were white. Thoughtful and deliberate design of the websites is needed to ensure that the websites offer a welcoming image to a diversity of people.

KEY WORDS: *content analysis, geoscience department, website design, signaling theory, diversity, gender, race*

1. INTRODUCTION

Science education is important for maintaining the US technical workforce (Institute of Medicine, National Academy of Sciences, and National Academy of Engineering, 2007). While the total number of bachelor's degrees awarded annually almost tripled during the past 40 years, recent graduation statistics show that the relative percentages of students earning degrees in science and mathematics have slightly declined from about 13% in 1966 to 11% in 2010 (National Science Foundation & National Center for Science and Engineering Statistics, 2013a). More dramatic than the general trend in science, technology, engineering, and medicine (STEM) degree completion, the number of geoscience degree recipients is now almost 30% lower than the

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historic highs of the mid 1980s (National Science Foundation & National Center for Science and Engineering Statistics, 2013a). Despite this decline, the labor market is promising for geoscientists. The Bureau of Labor Statistics predicts that jobs in geoscience will grow by 21% between 2010 and 2020 (Bureau of Labor Statistics, 2013).

Geoscience departments produce graduates who work at the front lines of issues such as energy, mineral resources, climate change, water resources, hazard mitigation, and environmental protection. Because of the broad reach of the geosciences it is important that the practitioners represent the full richness of diversity within the country (Heyman *et al.*, 2004). There is still much work to do to achieve this goal (Heyman *et al.*, 2004; Institute of Medicine, National Academy of Sciences, and National Academy of Engineering, 2007). Geoscience is not yet meeting gender or race parity.

Gender parity among geoscience bachelor degree recipients has stalled at about 40% [Fig. 1(a)] and that percentage has decreased from a high of 42.7% in 2002 to 39.3% in 2010 (National Science Foundation & National Center for Science and Engineering Statistics, 2013a). Progress has been made in understanding the pathways into the geosciences for underrepresented mi-

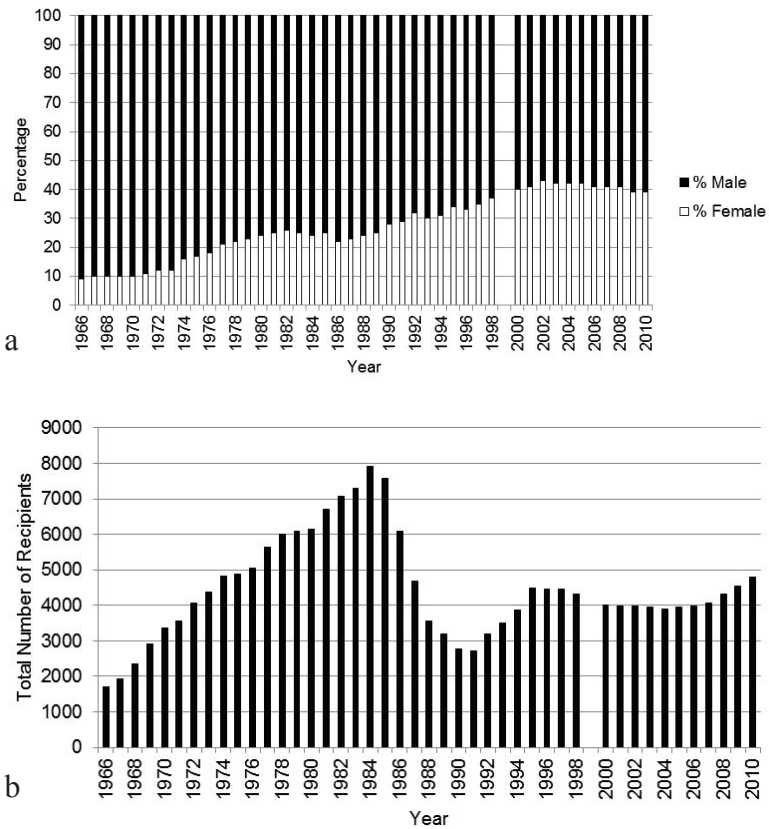

FIG. 1: (a) Percentage of bachelor degrees awarded in geoscience fields to men and women from 1966 to 2010 (National Science Foundation & National Center for Science and Engineering Statistics, 2013a). (b) Number of geoscience bachelor degrees awarded to US citizens and permanent residents in the US from 2001 to 2010 (National Science Foundation & National Center for Science and Engineering Statistics, 2013a). No data were available for 1999.

norities, largely due to the resources provided by Opportunities for Enhancing Diversity in the Geosciences in the NSF Geosciences Directorate and literature emerging from those studies, as reported in a special issue of *Journal of Geoscience Education* (Riggs and Alexander, 2007). Despite efforts to understand the pathways into the geosciences for underrepresented minorities, only small gains have occurred (Fig. 2) (Riggs and Alexander, 2007). It is imperative to investigate recruitment into geosciences to understand how to increase geoscience majors both for the health of geoscience departments and to meet future workforce needs.

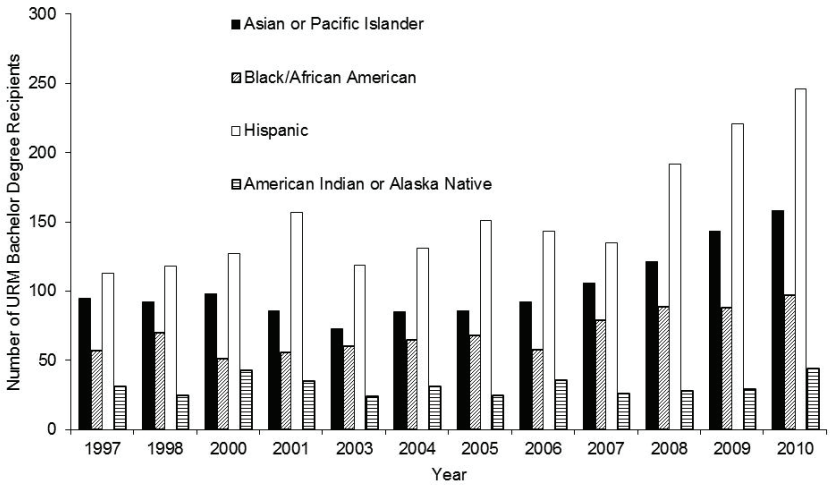

FIG. 2: Number of geoscience bachelor degrees awarded to Asian/Pacific Islanders, American Indian/Alaskan Native, Black, and Hispanic students in the US from 1995 to 2010 (National Science Foundation & National Center for Science and Engineering Statistics, 2013b). Minority geoscience degree data began to be collected in 1995. No data were available for 1999. Asian/Pacific Islander data were not collected until 2000.

Several factors play a role in a student's selection of a geoscience major (Holmes and O'Connell, 2005; Levine *et al.*, 2007; Houlton, 2010). Most of these factors are beyond the reach of a geoscience department. However, one factor that geoscience departments can control is the information communicated about departmental culture and the geoscience discipline via the department website. University websites are an important source of information for prospective college students (Noel-Levitz, Inc. 2010; Geyer and Merker, 2011). Despite this, there is not much published information about the role of departmental websites in students' selection of universities or majors within a university. Our study adds to the literature by investigating the messages conveyed to potential students by geoscience department website photographs about departmental culture and the geoscience discipline.

2. LITERATURE REVIEW

Students use a variety of sources to get information about a major and an academic department (e.g., campus visits, meetings with professors, and conversations with other students) (Rocca and

Washburn, 2005; Bobbitt, 2006). Rocca and Washburn (2005) found that high school students entering college reported that department information describing the degree program information was the source of information that they most used when selecting which college they would attend, but did not address the role of websites in major selection. Bobbitt (2006) found that about 70% of the students in her study said that department websites played an important role in their decision to select an agricultural and natural resources major.

2.1 Websites Represent Department Culture

In addition to serving as an important source of information, websites also play an important role in representing an organization's culture (Braddy *et al.*, 2009). An academic department can be thought of as an organization and its website is one representation of its culture. Department websites have an important role in communicating information to students and other visitors (e.g., prospective faculty, job candidates, and parents) about the climate and culture of the department (Burack and Franks, 2006; Montelone *et al.*, 2006). People make judgments about an organization from website information because they assume that characteristics on the website are characteristic of the organization (Braddy *et al.*, 2003; 2009). A framework for understanding the role of department websites in portraying organizational culture is provided by signaling theory and the attraction selection attrition model (ASAM) (Braddy *et al.*, 2008, 2009). Signaling theory and the ASAM have largely been applied to corporate websites; however, they are applicable and relevant to academic and department websites.

Signaling theory suggests that the information a visitor (e.g., student thinking of selecting a major) receives from a website will influence the visitor's perceptions of an organization (Braddy *et al.*, 2009). The ASAM suggests that if a person interprets from website information that an organization has values and goals that are similar to his or her own, then that person is more likely to be attracted to that organization (Braddy *et al.*, 2009). Similarly, if a person interprets from website information that an organization has values and goals that are different from his or her own, then that person is more likely not to be attracted to that organization. Signaling theory and ASAM may be used as a framework to suggest that a department website can have an important role in communicating information about the departmental culture and nature of geoscience work. This is done by providing expectations for a major, images of what students and faculty members look like, descriptions and images of where and how students and faculty members spend their time, and descriptions and images of how students and faculty members interact with each other (Bobbitt, 2006; Burack and Franks, 2006; Montelone *et al.*, 2006; Braddy *et al.*, 2009).

As signaling theory and ASAM suggest, departmental website visitors will gather information about departments and make interpretations about how the goals and values of the department align with their own. Based on these interpretations, prospective students may make decisions to major or not to major in that discipline. For example, Montelone *et al.* (2006) interviewed STEM graduate students and faculty members to find out what website characteristics make a STEM departmental website welcoming to a visitor, particularly female graduate students and faculty members. The faculty members and graduate students had different ideas about what would make a website welcoming to female students and faculty members. This difference suggests that different types of visitors might find value in different information on a departmental website.

In Montelone *et al.*'s (2006) study, both male and female faculty thought it important that a website depict women in active roles and positions of power, such as department chair. Women

faculty said that if a STEM department did not have a woman in a position of power that departments could make a website more welcoming by "highlighting women faculty members in the department … [and] reporting activities of department and college leaders in promoting women in STEM disciplines" (Montelone *et al.*, 2006, p. 5). However, male and female graduate students had a different perspective than faculty members (Montelone *et al.*, 2006). The graduate students thought that specific highlighting of women faculty on STEM department websites would overemphasize gender issues and create a website that was not welcoming to both genders (Montelone *et al.*, 2006). The graduate students proposed that instead of a STEM website showing images highlighting women faculty that the STEM department websites have written statements describing their support for diversity in general (Montelone *et al.*, 2006).

There is a growing research base on cultural features and information that are displayed on organization websites. However, most of that research has been conducted with corporate or other business websites or university websites in general. This study contributes to a small but growing literature about messages academic departmental websites portray (for example see Montelone *et al.*, 2006; Banning *et al.*, 2007).

3. RESEARCH QUESTIONS

This was an exploratory study to investigate what geoscience department website photographs portray about geoscience departments and the discipline. We focused on geoscience departments because female and non-white (minority) students [Figs. 1(a) and 2] are not at parity with male and white students. Our overarching question was: What messages are presented to visitors of geoscience department websites about diversity (gender and race), roles, and culture from department websites? Our specific research questions were:

1. What types of photographs are portrayed on department websites?
   a. What is the frequency at which each type of photograph is depicted?
2. What are the characteristics of the people portrayed in department website photographs?
   a. What is the relative and absolute frequency with which each gender is depicted?
   b. What is the relative and absolute frequency with which each race is depicted?
   c. What is the relative and absolute frequency with which each role is depicted?
   d. What roles are depicted for men and women?
   e. What are the differences in roles between men and women?
   f. What roles are depicted for various races?
   g. What are the differences in roles between whites and non-whites?
3. What message about geoscience department/geoscience discipline culture might be repre sented by these photographs?

4. METHODOLOGY

An overview of our methodology is provided followed by a more detailed description. Classical content analysis (Krippendorf, 2004; Neuendorf, 2002) provided the general framework for the study. Krippendorf underscores the importance of this methodology: "everything that matters to society and its members has moved content analysis...into the center of how society examines

itself" (Krippendorf, 2004, p. xiv). We examined the visual images of photographs found on geoscience department websites, specifically the home page and field page. We selected photographs on the home pages because they represented the main entry point into departmental websites. We selected photographs on field pages because we were interested in examining the visual images represented on pages that depicted a common activity (i.e., work in the field) for faculty and students.

4.1 Sampling

A list of all US higher education geoscience departments was obtained from the American Geosciences Institute (AGI, previously called the American Geological Institute). AGI defines geoscience as the study of "the composition, structure, and other physical aspects of the earth, including the study of the chemical, physical and mineralogical composition of soils, analysis of atmosphere phenomenon, and study of the distribution, circulation, and physical and chemical properties of underground and surface waters" (American Geological Institute, 2009, p. 3). AGI includes departments that have at least one faculty member teaching geoscience. Some academic institutions have multiple departments in the database. For example, an institution could have a geology department, hydrology department, and soil science department, each listed separately. If multiple departments were present, only the geoscience/geology department was included in this study so that we were comparing images for similar types of departments across the institutions.

A stratified random sampling method was used to select geoscience departments. The database was stratified into three degree-granting categories (i.e., the types of degrees granted at the institutions): associates degree only, bachelors degree only, and multiple degrees (undergraduate and graduate degrees). A stratified sample was used to ensure that adequate information from smaller categories (e.g., associate degree granting only institutions) was included. Within each stratification, we randomly selected 10% of the departments to include in the sample. The sampling resulted in sixty-four departments: ten associate's degree only departments, twenty-two bachelor's degree only departments, and thirty-two multiple degree departments. Of the sixty-four departments, four did not have photographs on their home page (three were multiple degree departments and one was a bachelor's degree only department), hence sixty institutions were included in the home page dataset. Only thirty departments had field pages with photographs, so only thirty institutions (six associate's degree only departments, fifteen bachelor's degree only departments, and nine multiple degree departments) were included in our field page dataset.

4.2. Coding Process

The photographs were coded using template analysis (King, 1998). The template included *a priori* categories of image type, number of persons in photograph, gender, race, and role (Table 1). Subcategories within image type and role were induced by the data and completed the final coding template (Table 1). This coding process used multiple coders and provided the numerical data necessary to calculate and present the results of the study. The strategy of inter-coder reliability (Krippendorff, 2004) was used to measure the reliability of the coding process. This template analysis method was used previously by Banning *et al.* (2007) in a similar study examining mining engineering departmental websites.

All photographs that a visitor would encounter on the geoscience department website home page were captured using a computer screen capture process. If a looping sequence of pho-

tographs was encountered, only the first photograph displayed when the site was visited was captured for analysis. The process of capturing photographs yielded 148 total photographs on the home pages, of which eighty-four photographs contained people.

In addition to coding photographs on geoscience department website home pages, we also captured and coded photographs on pages associated with the geoscience departments that had the term "field" in the link that led to that page. We found the field pages by searching each department's website (including the home page and all associated links) for links containing the word "field." Examples of links found include field school, field course, field studies, and field camp. Once on the field page, we captured and coded all photographs. We also coded all photographs that were one link from the field page. Some field pages had many thousands of photographs within one link from the main field page. These were usually photographs from multiple years. If a field page contained multiple links of photographs from multiple years, then only the photographs from the most recent year were coded. The most recent year was identified through captions on the web page. From the thirty departments with photographs on the field pages, we found 445 photographs, of which 229 photographs contained people.

All photographs were coded by image type (Table 1) and if applicable the number of people in a photograph was recorded. The full coding scheme for home pages and field pages is shown in Table 1.

Each person in a photograph was coded for gender, race as white/non-white, and role, based on visual characteristics and text or labels, if present, associated with the photograph. Because our inferences for race are based on visual inferences, we developed descriptive codes as proxies for race. We adopted the codes "white" and "non-white." We use lowercase letters for the codes in the text as they represent our visual interpretation of race. Our process of visual inference replicates the way visitors to the websites would make inferences about the individuals in the photographs. However, making inferences about an individual's gender, race, and role based on visual appearance can lead to misidentification of the person's true characteristics. It is possible that we misinterpreted an individual's true characteristics. To address this possibility, two researchers coded data and compared their coding to establish reliability.

4.3 Establishment of Inter-Coder Reliability

Three department websites from each degree-granting categories were chosen randomly to establish inter-coder reliability and all photographs on the main page and within one click off the main page were used. A total of 405 photographs were found on the pages associated with the three departments. Two independent coders (a White female geoscientist and qualitative education researcher and a White male environmental psychologist and qualitative education researcher) were selected from the research team to code the data. They were chosen based on their diversity of academic background (geology versus psychology), experience with qualitative coding (both were experienced qualitative researchers), and geographical proximity (both were able to meet face to face to reach consensus of coding issues). The two coders recorded 2395 coding decisions. A coding decision refers to every time a coder coded some aspect of the photograph. Agreements were recorded for 2324 of the decisions, producing an inter-coder agreement of 97.04%. Within the categorical structure of the coding (image type, number of people, gender, race, and role) the percent agreement ranged from 99.79% for the number of people to 94.57% for the role. The overall inter-coder reliability and the inter-coder reliability for each coding category exceeded the typical standard for inter-coder reliability, which is 80% (Neuendorf, 2002).

TABLE 1: Coding categories and definitions

Category	Subcategory value	Definition
Image type	0	No photograph present on home page
	1	Photograph depicted outside setting and no person was present in the photograph
	2	Photograph depicted outside setting and person was present in the photograph
	3	Photograph depicted inside setting (e.g., laboratory, classroom, office) and no person was present in the photograph
	4	Photograph depicted inside setting (e.g., laboratory, classroom, office) and person was present in the photograph
	5	Unknown, unable to determine if photograph depicted an outside or inside location, person may be present or not present
	6	Photograph depicted outside setting and had a large group, which made it impossible to identify the characteristics of individuals. For example, a photograph depicted a group of 50 individuals who were too distant or small to be able to identify their characteristics.
	7	Photograph depicted inside setting and had a large group, which made it impossible to identify the characteristics of individuals. For example, a photograph depicted a group of 50 individuals who were too distant or small to be able to identify their characteristics.
# of People in photograph	Number value	Number of people depicted in each photograph. Value varied based on number of people in photograph.
Gender	0	Male
	1	Female
	2	Unknown, unable to determine gender

TABLE 1: continued

Category	Subcategory value	Definition
Race	0	White
	1	Non-white
	2	Unknown, unable to determine race
Role	0	Student, a person was coded as a student based on information in labels or captions on the webpage, if present, by making an interpretation of the role based on the situational relationships between people in the photograph, or by an interpretation of role based on age. For example, if there is an older person standing at the head of a room and younger people sitting at desks, then the people sitting at desks were interpreted to be students. All people who looked to be college age were coded as students unless there was information (e.g., a caption) that stated otherwise.
	1	Instructor/researcher/geoscientist, an individual was coded as an instructor, researcher, or geoscientist based on information in labels or captions on the webpage, if present, by making an interpretation of the role based on the situational relationships between people in the photograph, or by an interpretation of role based on age. For example, if there is an older person standing at the front of a room and younger people sitting at desks, then the person standing at the front of the room was assumed to be a student. All people who looked older than college age and who were conducting geoscience work were coded into this category unless there was information (e.g., a caption) that stated otherwise.
	2	Staff or administrative personnel; an individual was coded into this category using labels or captions on the webpage.
	3	Other, a person in a role unaffiliated with geoscience academic or industry related activities or role. For example, if a photo depicted tourists inside a museum, then those people were coded as other.
	4	Unknown, unable to determine the role of an individual

Even though inter-coder reliability was high, the coders reviewed areas where there was disagreement. Disagreements were due to the coders having different interpretations of the definition of the codes. For example, the image type category was not clearly defined and during a review of coding to establish inter-coder reliability, we realized that the definition needed clarification. The codes were better defined to ensure that the coders had similar interpretations. After the calculation of inter-coder reliability and revision of code definitions, the two coders met to reach consensus on the coding for the three sites. The two coders revised coding to reach 100% consensus for the data from the three sites. The coding from the consensus process was included in the data set for analysis.

4.4 Quantitative Content Analysis of Categories

After the photographs were coded, quantitative content analysis was conducted. Following a procedure established by Banning *et al.* (2007), counts, frequency, relative frequency, and relative likelihood were calculated for each department to investigate research questions 1 and 2.

Relative frequency is the percentage of occurrences within a particular gender or race group categorized into each role category. Relative likelihood is a measure of between-gender differences and between-race group differences. Specifically, relative likelihood is the ratio of the gender-specific and race-group-specific relative frequencies for each role category. Table 2 provides an example of these calculations. The count of men in each role is divided by the total number of men to yield within-male relative frequency. The same is done for women. Then, each male relative frequency is divided by each female relative frequency to yield a relative likelihood for each role.

TABLE 2: Example of relative frequency and likelihood calculations

Gender	**Role**		**Total**
	Student	**Instructor**	
Male count	94	23	117
Within-male relative frequency (male role count/male total count) (%)	80.3%	19.7%	100.0%
Female count	70	9	79
Within-female relative frequency (female role count/female total count) (%)	88.6%	11.4%	100.0%
Relative likelihood (male relative frequency/female relative frequency)	0.9	1.7	—

First the total number of images with and without people was calculated. Then the occurrence of men and women in each role was determined and the total number of occurrences of white and non-white people holding each role was determined. Next, each gender's relative frequency in each role and each race group's relative frequency in each role were calculated. Finally, between-gender patterns and between-race patterns were investigated by calculating relative likelihood statistics. All relative likelihood statistics are comparisons of men to women (i.e., values for men in numerator, values for women in denominator) and non-white to white (i.e., values for non-white in numerator, values for white in denominator). Relative likelihoods less

than one indicate that a higher proportion of women or a higher proportion of white people held a particular role. Relative likelihoods greater than one indicate a higher proportion of men or non-white people held a particular role. All computed relative frequency and likelihood statistics are reported with rounding to one decimal place.

5. RESULTS

Of the 64 geoscience departments in the sample, 60 had photographs on their home pages and 30 had photographs on their field pages (Table 3). There were 148 home page photographs and 445 field page photographs for a total of 593 photographs. Of the 593 photographs, 313 photographs contained people. There were 1004 individuals or groups identified and coded in the 313 photographs.

TABLE 3: Number of departments with photographs and number of photographs with people

Category	Home	Field	Total
Number of departments with photographs	60[1]	30[1]	60[1]
Number of photographs	148	445	593
Number of photographs with people	84	229	313
Number of individuals or groups coded	267	737	1004

[1]There were 64 departments in the sample. Sixty of the 64 departments had home page photographs. Thirty of the 64 departments had photographs on field pages.

5.1. What Types of Photographs Are Portrayed on Department Websites?

Photographs were grouped into two categories: photographs depicting outdoor settings and photographs depicting indoor settings. Over 80% of the photographs on the home page and over 90% of the photographs on field pages depicted outdoor settings (Table 4).

TABLE 4: General types of photographs depicted

Category	Home		Field		Total	
	Count	Percent	Count	Percent	Count	Percent
Total outside	121	81.8	413	92.8	534	90.1
Total inside	25	16.9	32	7.2	57	9.6
Unknown	2	1.3	0	0.0	2	0.3
Total	148	100.0	445	100.0	593	100.0

Outside photographs with people were the most common photograph type on home page sites and the second most common photograph type on field page sites (Table 5). People in the photographs were posed for the photograph, participating in instructional activities (e.g., listening to a lecture on a field trip for a course), or conducting geoscience work (e.g., examining rocks).

TABLE 5: Specific types of photographs depicted. Counts represent photographs.

Photograph type	Home			Field		
	Count	Percent	Percent within outside or inside	Count	Percent	Percent within outside or inside
Outside photographs						
No person	57	38.5	47.1	214	48.1	51.8
With person	64	43.2	52.9	169	38.0	40.9
Large group unable to identify characteristics	0	0.0	0.0	30	6.7	7.3
Total outside	121	81.8	100.0	413	92.8	100.0
Inside photographs						
No person	5	3.4	20.0	2	0.4	6.3
With person	19	12.8	76.0	30	6.7	93.8
Large group unable to identify characteristics	1	0.7	4.0	0	0.0	0.0
Total inside	25	16.9	100.0	32	7.2	100.0
Unknown if inside or outside	2	1.4	100	0	0.0	0.0
Total	148	100.0		445	100.0	

Outside photographs without people were the most common photograph type on field page sites and the second most common photograph type of home page sites (Table 5). These photographs showed scenes of either general landscapes or of geologic features of interest.

Thirty photographs depicted large groups of people outdoors. These photographs were more common on field site pages and usually involved instructional activities or conducting geoscience work. Individual characteristics (e.g., gender, race, and role) of most people in these images could not be determined because the people were too distant or their features were obscured (e.g., they were facing away from the camera and wore hats and jackets that obscured their physical features).

Photographs with people were the most common type of inside photograph. People were typically in office or classroom settings. Three indoor photographs depicted people working in laboratory settings.

5.2. What Are the Characteristics of the People Portrayed in Department Websites Photographs?

We only present results for individuals for whom we could code gender, race, and role. Gender could be determined for 196 individuals depicted on home pages and 671 individuals on field pages. Gender could not be determined for 71 individuals on home pages and 66 individuals on field pages. These individuals were removed from our analyses. Race and/or role could not be

determined in 67 home page and 35 field page individuals. These individuals were also removed from our analyses.

Men made up about 60% of people portrayed on home pages and field pages (Table 6). Whites make up over 90% of people portrayed on home pages and field pages (Table 7). Students also dominate the images, making up 84% and 87% of home and field pages, respectively (Table 8).

TABLE 6: Gender of people depicted in photographs. Counts represent individuals depicted in photographs.

Gender	Home		Field	
	Count	Percent	Count	Percent
Male	117	59.7	404	60.2
Female	79	40.3	267	39.8
Total	196	100	671	100

TABLE 7: Race of people depicted in photographs. Counts represent individuals depicted in photographs.

Race	Home		Field	
	Count	Percent	Count	Percent
White	190	95.0	653	93.0
Non-white	10	5.0	49	7.0
Total	200	100.0	702	100.0

TABLE 8: Role of people depicted in photographs. Counts represent individuals depicted in photographs.

Role	Home		Field	
	Count	Percent	Count	Percent
Student	164	83.7	582	86.7
Instructor	32	16.3	41	6.1
Staff	0	0.0	0	0.0
Other	0	0.0	48	7.2
Total	196	100.0	671	100.0

5.3. Portrayal of Gender by Role

Counts, percentages, within-gender relative frequencies, and relative likelihoods of each role category held by people depicted in the photographs are presented in Tables 9, 10, and 11, and Fig. 3. The counts represent the total number of occurrences of female and male individuals holding a particular role. All relative likelihood statistics presented here are comparisons of men to women. In Tables 10 and 11, the relative frequencies are within-gender percentages (calculated across the

TABLE 9: Count and percentage of male and female individuals for each role

Role	Home				Field			
	Male		Female		Male		Female	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Student	94	57.7	70	42.7	335	57.6	247	42.4
Instructor	23	71.9	9	28.1	35	85.4	6	14.6
Staff	0	0	0	0	0	0	0	0
Other	0	0	0	0	34	70.8	14	29.2
Total gender	117	59.7	79	40.3	404	60.2	267	39.8

TABLE 10: Relative frequency and likelihood for role by gender on home pages

Gender	Role		Total
	Student	Instructor	
Male count	94	23	117
Within male relative frequency (%)	80.3%	19.7%	100.0%
Female count	70	9	79
Within female relative frequency (%)	88.6%	11.4%	100.0%
Relative likelihood (male relative frequency/female relative frequency)	0.9	1.7	—

TABLE 11: Relative frequency and likelihood for role by gender on field pages

Gender	Role				Total
	Student	Instructor	Staff	Other	
Male count	335	35	0	34	404
Within male relative frequency (%)	82.9%	8.7%	0	8.4%	100.0%
Female count	247	6	0	14	267
Within female relative frequency (%)	92.5%	2.3%	0.0%	5.2%	100.0%
Relative likelihood (male relative frequency/female relative frequency)	0.9	3.9	0.0	1.6	—

row); therefore, the sum of the relative frequencies for a particular role category (i.e., the sum of each column percentages) does not equal 100%. Only the within-gender relative frequencies (i.e., the sum of the percentages across the rows in the tables) should sum to 100%.

Men made up the majority of roles on both home pages and field page (Table 9). There was a lower percentage of men in the student role than there was for the instructor role. Tables 10 and 11 show the relative likelihoods for role by gender on home page and field pages. Women are

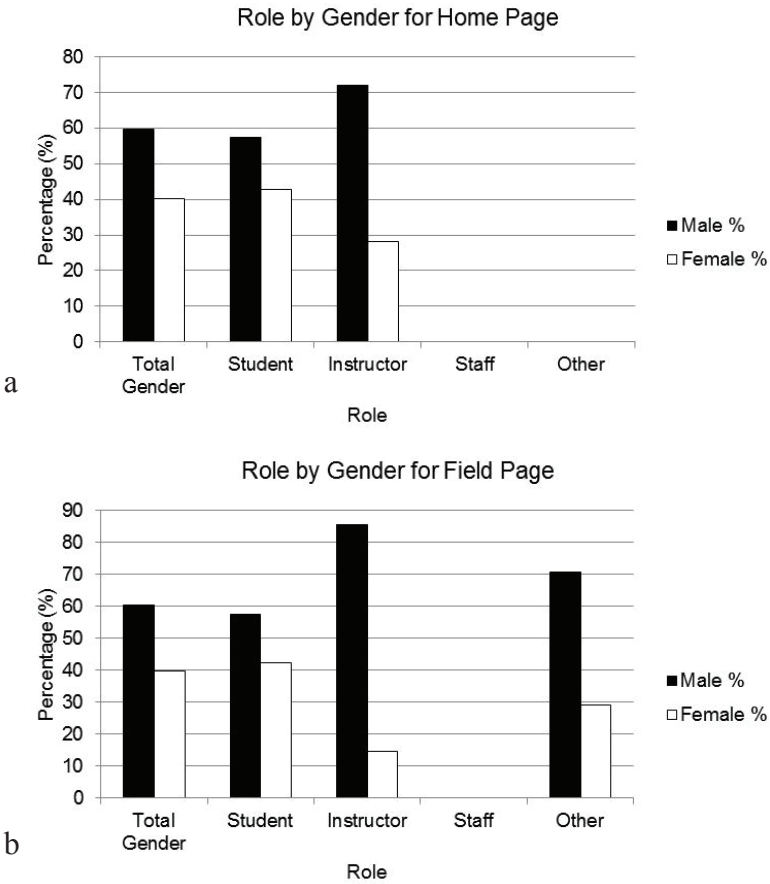

FIG. 3: Percentage of male and female individuals in each role on home pages (a) and on field pages (b)

slightly more likely to be depicted as students than are men (relative likelihood less than one). Men were much more likely than women to be portrayed as instructors on the home page and field pages, 70% and 290% more likely, respectively (relative likelihood greater than one). Men were also more likely than women to be depicted in the staff and other roles on field page sites.

5.4. Race by Role

Counts, percentages, within-race relative frequencies, and relative likelihoods of each role category held by people depicted in the photographs are presented in Tables 12, 13, and 14 and Fig. 4. In Tables 13 and 14, the relative frequencies are within-race percentages (calculated across the row); therefore, the sum of the relative frequencies for a particular role category (i.e., the sum of each column percentages) does not equal 100%. Only the within-race relative frequencies (i.e., the sum of the percentages across the rows in the tables) should sum to 100%. The counts represent the total number of occurrences of white and non-white individuals holding a particular role. All relative likelihood statistics presented here are comparisons of non-white to white.

TABLE 12: Count and percentage of white and non-white individuals for each role

Role	Home				Field			
	White		Non-white		White		Non-white	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Student	156	95.5	8	4.9	579	94.3	35	5.7
Instructor	34	94.4	2	5.6	40	100	0	0
Staff	0	0	0	0	0	0	0	0
Other	0	0	0	0	34	70.8	14	29.2
Total	190	95.0	10	5.0	653	93.0	49	24.5

TABLE 13: Relative frequency and likelihood for role by race on home pages

Race	Role		Total
	Student	Instructor	
Non-white count	8	2	10
Within non-white relative frequency (%)	80.0%	20.0%	100.0%
White count	156	34	190
Within white relative frequency (%)	82.1%	17.8%	100.0%
Relative likelihood (non-white relative frequency/white relative frequency)	1.0	1.1	

TABLE 14: Relative frequency and likelihood for role by race on field pages

Race	Role				Total
	Student	Instructor	Staff	Other	
Non-white count	35	0	0	14	49
Within non-white relative frequency (%)	71.4%	0.0%	0.0%	28.6%	100.0%
White count	579	40	0	34	653
Within white relative frequency (%)	88.7%	6.1%	0%	5.2%	100.0%
Relative likelihood (non-white relative frequency/white relative frequency)	0.8	0	0	5.5	

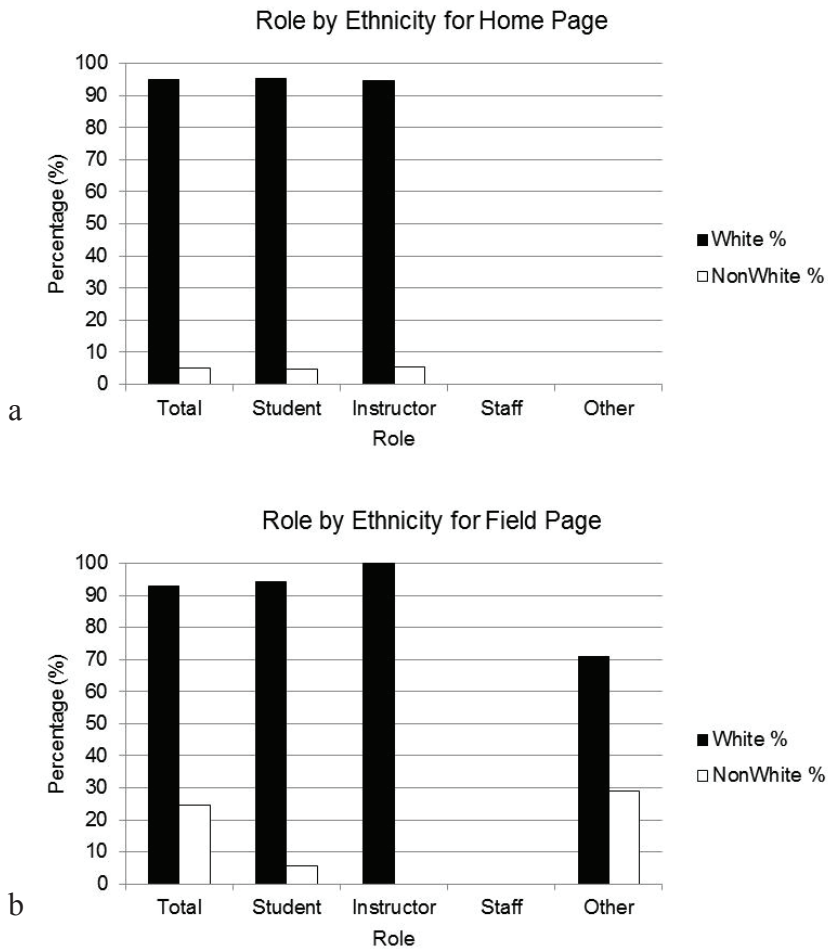

FIG. 4: Percentage of white and non-white individuals in each role on home pages (a) and on field pages (b)

Table 12 and Fig. 4 show that white people make up a majority of all people depicted in all roles. Tables 13 and 14 show the relative likelihoods for role by race on home page and field pages. With a relative likelihood of 1.0 for students and 1.1 for instructors, non-whites were nearly as likely as whites to be students and instructors in the photographs on the home pages. Whites were about 24% more likely to be students than non-whites on the field pages. No non-white instructors or staff members were portrayed in field page photographs.

Non-whites were 450% more likely to be in the role of other in field pages than were whites. Captions associated with the photographs helped explain the high relatively likelihood that non-whites were in the role of other. The photographs with non-whites coded in the role of other depicted field experiences in a foreign country where the local population was non-white. The photographs showed excursions to local museums in which the people coded as other were local, non-white visitors to the museums.

6. DISCUSSION

6.1 What Types of Photographs Are Portrayed on Department Websites?

Over 80% of photographs both on home pages and field pages depict outdoor settings. About 55% of photographs showing people on home pages and about 62% of photographs showing people on field pages are also set outdoors. Out of the twenty-five photographs from the home pages showing inside settings and thirty photographs from the field pages showing inside settings, only three photographs from home pages depicted geoscientists working in laboratories. We could not locate research data or research studies that describe what percentage of time geoscientists work outdoors. However, the American Geoscience Institute states that geoscientists spend most of their days working in the office (American Geological Institute, 1997). Therefore, based solely on the frequency of images depicting outdoor settings, the website photographs represent an inaccurate image of how most geoscientists spend most of their time. The consequences of depicting mostly outdoor settings and people mostly outdoors on geoscience websites is unknown and may depend on how visitors interpret the images.

Visitors to departmental websites may interpret the information and images on the websites to represent the culture of the organization (Burack and Franks, 2006; Montelone *et al.*, 2006; Braddy *et al.*, 2009). One possible message communicated by the photographs is that students and faculty in a geoscience department spend most of their time outdoors. If people interpret the images to represent the culture, as suggested by Braddy *et al.* (2009), then this interpretation would be inaccurate as few geoscientists spend 80% of their time working outdoors. Another possible interpretation is that the photographs show the most interesting and enjoyable aspect of the work done by students in the program or geoscientists in their profession. There are other possible interpretations that can be made about the photographs. We found no published research to suggest how visitors to geoscience department websites might interpret the fact that most photographs depict outdoor settings.

The representation of mostly outdoor photographs may encourage some students who enjoy outdoor work to major in the geosciences if they interpret the geoscience discipline to include outdoor work. For example, Holmes and O'Connell (2005) identified love of the outdoors as one of three dominant factors that attract someone to major in the geosciences. Alternatively, students who do not enjoy the outdoors or working outdoors may find a geoscience department or the discipline less inviting if the culture represented in photographs strongly emphasizes outdoor work.

Whitney *et al.* (2005) surveyed high school and college students about their interests in outdoor activities and about their interest in geoscience careers. They found that Caucasian students reported a statistically higher interest level in outdoor activities and a statistically higher interest level in doing a science experiment in an outdoor setting than an indoor setting than the reported interest by African American, Latino, and Asian students. Whitney *et al.* (2005) speculate that Caucasian students may be more attracted to a geoscience major than other ethnic groups because of their interest in outdoor activities. Therefore, the depiction of outdoor images on geoscience department websites might help recruit Caucasian students to the geosciences, but limit the interest of minority groups who have a lower interest in outdoor activities.

One indication of the minimal attraction of underrepresented minorities to the outdoors is the low visitation rates to national parks. A 1997 Yellowstone National Park visitor survey found that only 1.5% of the visitors were African-Americans and only 1% were Hispanic (Wilkinson, 1999). A 2002 survey of visitors to Florida's Everglades National Park and California's Sequoia and King

Canyon National Parks, both states with large Hispanic and/or Asian populations, found that only 10% of the visitors were non-white (Kelly, 2006). Adams *et al.* (2006) found that <15% of Hispanic youth had participated in outdoor activities such as backpacking, bird watching, and fishing.

O'Connell and Holmes (2011) recommended that geoscience departments show images of laboratories associated with the geosciences to help recruit students who may not be attracted to outdoor work. More work is needed to determine how visitors interpret the representation of mostly outdoor photographs on geoscience department websites. Additionally, more research is needed to identify how those interpretations affect student recruitment and retention.

6.2. What Are the Characteristics of the People Portrayed in Department Websites Photographs?

All individuals on home and field pages were students, instructors/geoscientists, or other (see Table 1 for definitions of the roles and how they were coded). No people in staff roles were portrayed on the home and field pages (see Table 1 for definitions of staff role and how it was coded). The home page and field page photographs depicted men making up the majority of people in all roles and depicted white individuals making up the majority of people in all roles. The percentage of men and women in student roles in the photographs is similar to the percentage of men and women receiving geoscience degrees nationally (Fig. 1, National Science Foundation & National Center for Science and Engineering Statistics, 2013a).

Women made up 28% of instructors on the home pages and 15% of instructors on field pages. Women make up about 17% of tenure and non-tenure track faculty positions of all ranks across the country (American Geological Institute, 2009). Women in instructor roles on home pages were portrayed at a higher percentage than the percentage that they make up in the instructor role in the geoscience academic population. However, women in the instructor roles on field pages were portrayed at a lower percentage than the percentage that they make up in the instructor role in the geoscience academic population. It is possible that the departments chose to highlight their female instructors on their home pages, which may explain why women made up a higher percentage of instructor roles on the home pages than they do in the general academic geoscience faculty population.

The percentage of white and non-white people portrayed in student roles on the websites is similar to the distribution in the national data for student roles. About 5% of students on the home and field pages were non-white. Between 1997 and 2010, the percentage of underrepresented minority students rose from 5% to 8% of geoscience undergraduate degrees (Fig. 2). This number includes white Hispanics, but not African, Caribbean, or Asian students. This study was unable to distinguish between different non-white individuals.

No non-white faculty members were portrayed on field pages and were 6% of faculty members portrayed on home pages. It is difficult to compare the portrayal of non-white faculty members with published literature. The American Geosciences Institute tracks many demographic characteristics of the geoscience workforce; however, it does not record ethnicity and race for academic faculty. The National Science Foundation surveys faculty about their demographic characteristics. Unfortunately, in the NSF data, geosciences are aggregated with the physical and related sciences, so the percentage of underrepresented minority geoscience faculty cannot be determined. However, NSF reports that about 22% of physical science and related sciences faculty members of all ranks are non-white (National Science Foundation & National Center for Science and Engineering Statistics, 2013b).

According to signaling theory, a viewer's perception of a department may be influenced by the images on department websites (Braddy *et al.*, 2009). Sagebiel and Dahmen (2006) analyzed European engineering department websites and found that the majority of people were men. They suggested that the lack of women depicted on engineering websites could discourage women from pursuing engineering degrees. Burack and Franks (2006) and Montelone *et al.* (2006) found that a lack of women and minorities depicted on websites may send an unwelcoming message to women and minorities. Based on the findings from other studies, the geoscience department website images of people in this study could send the message that geoscience departments are welcoming to men and white people and less welcoming or indifferent to women and non-white people.

7. RECOMMENDATIONS

Geoscience department websites can be an important venue for communicating information about departments and discipline characteristics and culture. Rocca and Washburn (2005) recommend "that accurate, quality information be provided to students through departmental, college, and university websites" (p. 36) because they found that students use information on department websites when making decisions in college selection. Student visitors to geoscience department websites may make judgments about departmental and disciplinary characteristics and culture based on the information provided on the websites. Based on how students interpret the information on geoscience websites, some students may enroll in geoscience courses and pursue a geoscience degree. However, other students may make interpretations based on the website photographs that lead them to pursue a non-geoscience degree.

We recommend that geoscience departments conduct a self-study to evaluate their websites and examine the potential messages their websites photographs portray about their department and the discipline. Our coding process and categories may serve as a useful model for departments to analyze the characteristics of what is portrayed on their website.

During the self-study, departments should determine what types of settings are shown in their website photographs (outdoor vs. indoor) and decide what settings they think should be shown. Departments should also determine the gender, race, and roles of the people depicted in photographs on their websites and determine if the representations are an accurate portrayal of the people in their department. Although Banning *et al.* (2007) advise caution when determining the characteristics a department wants to communicate on a website; it may be possible to include a broad range of activities without misrepresenting the characteristics and culture in a department. A broader representation might help departments create an online culture that is an initial step toward increasing the diversity of the geoscience workforce.

8. FUTURE RESEARCH

This study serves as a preliminary investigation of the types of photographs and the characteristics of the people portrayed on geoscience department websites. We explored the possible messages communicated by these photographs. Research by Braddy *et al.* (2003, 2006, 2008, and 2009), Burack and Franks (2006), Montelone *et al.* (2006), Bobbitt (2006), and others suggest that all information, not just photographs, portrays information about the characteristics and cul-

ture of an organization. Departments should evaluate their websites holistically for the messages communicated not just by photographs, but also by text, and navigation systems. A geoscience department website serves as the visible, public representative to the department and discipline. Thoughtful and deliberate design of the website may ensure that the department and discipline are welcoming to a range of people.

Future research should also be conducted to determine how department faculty members, students, potential faculty job applicants, and other visitors interpret the messages in the photographs. This research should also investigate how these interpretations affect recruitment and retention in the departments. Based on the findings from this future research, departments will have a better understanding of how visitors interpret photographs. This will help departments better plan what types of photographs to post on their websites to communicate their program and culture to visitors.

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