WHO ARE WE MISSING, AND NOW WHAT?

A DEMOGRAPHIC STUDY OF PLANETARIUM VISITORS AND NEXT STEPS FOR THE FIELD

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ABSTRACT

This study collected data from seven planetarium email lists (one per planetarium regional organization in the United States), as well as through a market research survey of residents in each area, to describe and compare those who did and did not visit a planetarium in recent years. The results confirmed broad patterns found in studies of other informal learning institutions, in that planetarium visitors were likely to be affluent, highly educated, and white. Interest in science was reported as moderate to high for visitors and non-visitors alike. Intersectional groups were created to demonstrate how this approach has the potential to hone our understanding of non-visitors in particular. Recommendations are made for ways that planetariums can begin studying visitors more directly moving forward, and ways to expand our results through both additional study and by creating community partnerships to foster welcoming environments for a wide range of community members.

Why is this problem important?

This study was designed to address the lack of data available to describe planetarium visitors and the concurrent increased interest from funders and planetarium staff in understanding and engaging diverse communities. Our specific experience began in 2018 as our team was preparing to apply for a NASA Teams Engaging Affiliated Museums and Informal Institutions (TEAM II) grant. The solicitation for that year (and each year since) requested specific demographic information about the communities that would be reached through the proposed planetariums-focused project, as well as benchmarks related to those groups. The Bell Museum, Minnesota's state natural history museum and planetarium, does not have an internal evaluation team that collects data on visitors; the museum collects some whole-museum visitor data as part of the Collaboration for Ongoing Visitor Experience Studies (COVES), but recognized that data specific to planetarium visitors were not comprehensive and may not have reflected local communities. So, our team looked to the literature to see what others had learned. These efforts also came up short, reinforcing a claim from Immersive Media Entertainment, Research, Science & Arts (IMERSA) that data describing planetarium visitors did not exist (Sumners, 2016). We found plenty of information about other informal science institutions (ISIs, e.g., science centers, zoos, and aquariums), but nothing that focused specifically on planetarium visitors. In response, working with an external research and evaluation partner, we integrated this study into our proposal's evaluation plan, and designed it as a first step to fill the current gap in the literature.

Though the literature is lacking in demographic studies of planetarium visitors, other ISIs have been studied broadly in the United States for decades as part of a national poll called General Social Survey (GSS), with results shared annually as part of the National Science Foundation's (NSF) Science and Engineering Indicators report. These data indicate that visits to ISIs have remained relatively constant over the last several decades (Besley & Hill, 2020). Most Americans attend at least one of the ISIs included in this study each year; approximately six in 10 Americans visited at least one ISI in 2018, the most recent year for which these data are available. The portion of Americans who visit planetariums each year is not studied as part of the GSS, and as far as we are aware, is unknown.

Though planetariums are not included on the list of ISIs studied, some planetariums are embedded within the contexts studied. It is useful to know the prevalence of visitation across other informal science institutions that similarly focus on engaging audiences in science, technology, engineering, and mathematical content outside of the formal classroom. A consistent pattern has emerged in

the types of ISIs visited. Zoos and aquariums top the list of most popular informal science institutions each year; 50% of Americans surveyed in 2018 had visited a zoo or aquarium within the past year. Historically, more Americans have tended to visit a natural history museum each year when compared to those who visit science and technology centers; in 2018, the portion who reported attending natural history museums and those who reported attending a science and technology center was identical (30%). Natural history museums and science and technology centers tend to be the ISIs where planetariums are most likely to be housed.

There are a number of characteristics that are used commonly in studies of visitor behavior, including demographic questions and interest in science. Polling data like those from the GSS have been used to explore the relation between demographic variables and attitudes about science. Results indicate that attitudes about science and engineering in the U.S. tend to be positive overall and have remained relatively constant for decades (Besley & Hill, 2020). Further, those with more education and higher income levels tend to be more positive about science and technology.

This profile also applies to visitors and participants in the context of museums and science centers (Dawson, 2014b; Falk & Needham, 2010; Feinstein, 2017), citizen science projects (Martin, 2017; Pandya, 2012), science festivals (Kennedy et al., 2018; Nielsen et al., 2019), public science events (Kato-Nitta et al., 2017), consumption of science media (Dawson, 2017, 2018), and out of school activities such as maker spaces and science clubs (Dawson, 2017). This trend is considered the result of deeper historical and societal prejudices that have (re)produced inequities in participation over time (Dawson, 2014a, 2019; Feinstein, 2017; Garibay & Teasdale, 2019). A recent poll confirmed perceptions of these prejudices. The majority of both the African Americans and Native Americans who participated in a recent poll believe that systemic racism is present in natural history museums (Culture Track, 2021). Further, approximately half of Americans (55%) want arts and culture organizations (including museums) to change to better serve and welcome their communities.

In his essay on equity and science museums, Feinstein (2017) challenged science museums to "reimagine museum science in the image of the underserved and invest in new programs that are grounded in the cultures and concerns of the very people who currently avoid science museums (p. 536)." Garibay and Teasdale (2019) note that efforts to broaden participation in informal learning contexts often focus on encouraging participation of historically marginalized groups without acknowledging or addressing the systemic factors that created those inequities. They highlight the role that evaluation can play in guiding the informal learning community toward the use of inclusive practices. Similarly, Dawson (2014a) and Feinstein (2017) shared a call to action for researchers to work with practitioners to study and understand equity challenges in informal learning spaces. The results and discussion for this study are presented with these goals in mind, and with a specific focus on the next steps that planetarium staff might take to begin learning from and with community members.

In this study, we set out to answer the following research questions:

RQ1: What is the demographic makeup of both planetarium visitors and those who do not visit planetariums?

RQ2: What additional patterns emerge among planetarium visitors and non-visitors when viewed through the intersectional lens of race and gender?

The second research question in our study requires additional explanation. Intersectionality is the idea that human characteristics such as race and/or ethnicity, gender, socioeconomic status, education, age, etc. are not mutually exclusive within a person, but rather work in concert with (and sometimes against) one another and should be treated as such (Crenshaw, 2017). To date, we are aware of only one study in the ISI field that has studied visitors using intersectional groups (Dawson et. al., 2020). The current study explores planetarium visitors and non-visitors through both traditional descriptive analysis and a descriptive analysis of intersectional groups.

The distinction between a descriptive analysis of intersectional groups and an intersectional study is nuanced and important. The advice provided in the contemporary literature regarding intersectional studies is to be intentional when conducting this type of research by planning for this kind of analysis from the beginning and oversampling from key groups of interest (Christoffersen, 2017). Furthermore, it is recommended that research subjects help design the study and determine how data will be collected, analyzed, and reported (Christoffersen, 2017; Collins, 2015). Over the past 10–15 years, analysis has moved from an additive approach (race/ethnicity + gender + socioeconomic status), which assumes mutual exclusivity among these characteristics, to a truly intersectional approach (race/ethnicity x gender x socioeconomic status), using interaction terms as part of a statistical analysis to compare groups (Bowleg, 2008; Christoffersen, 2017). Our decision to investigate intersectional groups was post hoc and thus we did not follow the practices specified above. Because this was not part of our planning process, in this paper we present the demographics of planetarium visitors and non-visitors as viewed through descriptive analyses only. As such, the purpose of our analysis is to demonstrate the importance of exploring data in intersectional ways, and not to highlight definitive trends among those who visit planetariums and those who do not.

METHOD

This study consisted of an online survey that was administered to email lists from seven planetariums, as well as data that were collected

via market research-style survey for each geographic area. Data were collected for this study during the first year of the COVID-19 pandemic, and thus our study design was dictated by the availability of staff to support this effort and capacity of partner planetariums to participate. Our original study design included surveying visitors from 30 planetariums who had just been part of a live show or event. Due to the pandemic, we modified this design to include one planetarium within each regional planetarium organization in the United States, as well as a market research survey from the local area. This study was reviewed by the University of Minnesota's Institutional Review Board and was determined not to qualify as human subjects research (STUDY00011770).

Instrument

The online survey captured planetarium attendance and related behaviors (see Appendix A) to understand more about the characteristics of those who visit planetariums and those who do not. Survey items were modeled from existing, similar efforts that were designed to gather data from across multiple informal learning institutions. Demographic items were modeled after those from the COVES survey *(http://www.understandingvisitors.org/about/resources),* unless otherwise noted. Gender was collected based on four categories: male, female, another category, and prefer not to say. Due to sample size limitations, for the purposes of gender-based analyses, only those who selected male or female were included.

Race/ethnicity was captured via eight categories: *American Indian/Alaska Native, Asian, Black or African American, Hispanic or Latino, Native Hawaiian/Pacific Islander, White, prefer not to say*, and *other*. Participants who selected a combination of two or more race options were assigned to a More than One Race category, with one exception. There are multiple perspectives on how to recode race and ethnicity data. For the purposes of this study, we followed the conventions that prioritize Hispanic ethnicity when selected in combination with one race (Itzigsohn & Dore-Cabral, 2000; Padilla, 1984). Those who chose one race and Hispanic were assigned to Hispanic. Those who chose two races or more and Hispanic were assigned to the *More Than One Race* category. Due to sample size limitations for some groups, only those who selected Asian, Black or African American, Hispanic or Latino and White were included in analyses that explored race and ethnicity.

Education was reported using eight categories: *some high school, high school degree, some college, college degree, some graduate work, graduate degree, prefer not to say*, and *other*. Household income was collected based on income before the pandemic, using eleven categories: *under $25,000; $25,000–49,999; $50,000–74,999; $75,000–99,999; $100,000–149,999; $150,000–199,999; $200,000–249,000; $250,000–300,000; more than $300,000, don't know*, and *prefer not to say*.

Participants reported whether they had visited the planetarium and other ISIs in 2019, 2020, in neither year, or in both years. In addition to planetarium visits, participants shared whether they had visited the categories of ISIs included in the GSS: *a zoo or aquarium; a science or technology museum; or a natural history museum*. An additional item, *art museum or gallery*, was also included. For analysis, responses were collapsed into visitors (those who had visited during at least one year) and non-visitors (those who had not visited in either year).

Interest in science was modeled after an existing item (Robertson Evia & Peterman, 2020); participants responded to *How would you rate your interest in science?* using an 11-point scale from 0–10 (*no interest–extreme interest*).

Survey Sample

Planetarium Email List Participants

The seven planetarium partners for this study included the home institution for a subset of the authors, and six planetariums that were recruited to be part of the project by working with us to survey their email lists of members and/or visitors. As noted earlier, one planetarium was included from each regional planetarium organization in the United States.

A total of 38 planetariums were invited to participate between February and October 2021. Eligible partners included permanent planetariums that were either a standalone institution or part of a university system that offers shows to the public on a regular weekly schedule (except for COVID-related closures). In addition, eligible partners had to have access to an email list of members, visitors, or a combination of both that could be used for this study. Once invited, planetariums were included in the study on a first-come, first-served basis until one partner had been recruited from each region. COVID-related staffing shortages were the primary reason that potential partners were unable to participate.

To be part of the study, all partners agreed to work with us to gather survey data from visitors or members on their email list. Email lists were created by the planetarium staff and compiled through registration processes or through membership or donor programs. Some lists were updated regularly while others were a compilation of email addresses collected over the years. Partners were given the option to administer a pre-programmed survey themselves or to provide their email list to researchers for distribution. Three partners chose the first option and four chose the latter. All data were collected in Survey Monkey; the survey invitation language, reminder schedule, and survey distribution plan were identical for all partners. All surveys were active for two weeks.

A total of 16,419 participants successfully received an invitation to complete the survey. A total of 1,811 complete surveys were collected, for a response rate of 11%. Partial responses stored by the survey system were not used. Pew Research typically surveys about 5,000 people to gather what they consider to be a representative sample of the US population of 330 million people; though we would have liked a higher portion of respondents from those invited, we believe our response rate is sufficient. The number of respondents from partner sites ranged from 91 to 528.

Market Research Participants

To help ensure that the sample included an adequate number of non-visitors, responses from 100 participants were purchased from SurveyMonkey Audience. This system functions like a market research survey. In addition to state-specific data, survey parameters matched the gender of respondents to that of the local area. One planetarium is located in a city that is within the boundaries of two states. The panel for that location was split between those two states, 50 from one state and 50 from the other.

In most cases, the market research survey was initiated on the same day as the data collection with planetarium email lists. In almost all cases, the market research data were collected in less than 24 hours. A total of 672 complete responses were submitted through SurveyMonkey Audience. The number of respondents from each state ranged from 90 to 119.

Description of Participants

Table 1 provides a demographic description of all survey participants, by recruitment strategy. More women than men completed the survey through the email lists, while a relatively even number of men and women were recruited to complete the survey through SurveyMonkey Audience. Most respondents, from both groups, were white; there was more racial/ethnic diversity among market research respondents compared to planetarium email lists. Even so, among market research participants, Asian, Native Hawaiian/ Pacific Islander, and white participants responded at similar rates when compared to the national U.S. Census (2021) data, while the four remaining racial/ethnic groups were underrepresented in the sample.

With regards to income level, those recruited through the planetarium email lists were from higher income levels when compared to those recruited through SurveyMonkey Audience. The income levels of both groups were elevated when compared to the national U.S. Census data (see Table A2, United States Census, 2020a).

More than three-quarters of those recruited through planetarium email lists had a college degree or higher, compared to approximately half of those recruited through SurveyMonkey Audience. There was more diversity in education level among market research respondents, though this group reported higher education levels than the national U.S. Census data (see All Races, United States Census, 2020b).

Engagement patterns varied widely across the email list and market research samples. Perhaps not surprisingly, most email list participants reported they had visited the planetarium. This portion is well above what we might infer for the population based on the data available about other ISIs through the GSS. Far fewer market research participants had visited a planetarium. Email list participants were also more likely to visit other ISIs when compared to those in the market research sample. The overall pattern of visitation across ISIs by market research respondents is similar to that reported nationally (Besley & Hill, 2020).

Analysis

Demographic items are presented below using descriptive statistics. The data presented in Table 1 demonstrate that the survey sample is quite imbalanced across key demographic categories. The vast majority of the sample identified with the following categories: female, white, moderate to high income, and at least a college degree. To control for this imbalance, portions were calculated based on each demographic category of interest rather than for the sample as a whole. T-tests were used to explore group differences related to QI, when sample sizes allowed. Statistical analyses were not used to explore intersectional comparisons; instead, we used a conservative approach and present these results descriptively as they relate to planetarium visitors and non-visitors.

RESULTS

Demographic Description of Planetarium Visitors and Non-Visitors

RQ1 addresses the basic demographics of planetarium visitors and non-visitors. Here, we present the results for both groups. In an effort to highlight the most useful information for planetarium leaders, we focus broadly on the most frequent behavior within each group. Just over half (52%) of all respondents visited their local planetarium in either 2019 or 2020, and thus were considered visitors for the purpose of this analysis. Men and women were equally likely to be visitors (and non-visitors); 52% of those in each group indicated they had visited a planetarium.

Table 2 presents the portion of non-visitors as opposed to visitors for the remaining items measured, and by the specific features for each demographic item. There were few differences based on race/ethnicity categories between visitors and non-visitors. Asian, Hispanic, and Black respondents were slightly more likely to be non-visitors, with just over half reporting they had not visited a planetarium (54% - 60% across these groups). White respondents were slightly more likely to be visitors, with just over half reporting that they had visited a planetarium.

With regard to income and education level, the results from our analysis replicate those from research on other informal learning contexts (Dawson, 2014b; Dawson, 2017; Falk & Needham, 2010; Feinstein, 2017; Kennedy et al., 2018; Kato-Nitta et al., 2017; Martin, 2017; Nielsen et al., 2019; Pandya, 2012). Respondents from the lower income levels on the scale were more likely to be non-visitors, with over half of the respondents in each of the three lowest income categories reporting that they had not visited a planetarium. Respondents who reported an annual income of $75K or higher were more likely to be visitors, with more than half reporting that they had visited a planetarium within the survey period.

A similar pattern was found for education level. Respondents with less education were more likely to be non-visitors, with over half of the respondents in each of the three lower education level categories reporting that they had not visited a planetarium. Respondents who reported having a

		PLANETARIUM EMAIL LISTS (N=1,519)	MARKET RESEARCH PARTICIPANTS (N=672)
Gender	Binary female	70%	59%
	Binary male	28%	41%
	Another category	<1%	–
	Prefer not to say	1%	<1%
Race/Ethnicity	American Indian or Alaska Native	<1%	<1%
	Asian or Asian American	2%	6%
	Black or African American	2%	7%
	Hispanic or Latino/a/x	5%	7%
	Native Hawaiian or Pacific Islander	1%	<1%
	White	81%	72%
	Other	1%	<1%
	More than one race	<1%	1%
	Prefer not to say	4%	1%
Income Level	Under $25,000	2%	14%
	$25,000–$49,999	6%	19%
	$50,000–$74,999	15%	24%
	$75,000–$149,999	37%	26%
	$150,000–$199,999	14%	6%
	$200,000–$249,999	6%	3%
	$250,000–$300,000	3%	1%
	More than $300,000	4%	1%
	Don't know	<1%	2%
	Prefer not to say	13%	3%
Education Level	Some high school	–	3%
	High school degree	1%	17%
	Some college	9%	25%
	College degree	33%	28%
	Some graduate work	8%	6%
	Graduate degree	47%	21%
	Other	1%	1%
	Prefer not to say	<1%	1%
ISI Engagement in 2019 or 2020	Visited planetarium	68%	18%
	Visited art museum or gallery	69%	44%
	Visited natural history museum	68%	38%
	Visited science or technology museum	72%	36%
	Visited zoo or aquarium	80%	57%

Table 1. Demographic sample description, based on recruitment strategy

college degree and those who reported an education level above a college degree were each more likely to be visitors, with more than half reporting that they had visited a planetarium.

Interestingly, both visitors and non-visitors reported being interested in science. The average interest of non-visitors was 7.41 on the 11-point scale (n=1,049; SD=2.31), while the average interest of visitors was statistically significantly higher at 8.25 (n=1,154; SD=1.68), $t(1900) = 9.67$, $p < .0001$. While attitudes were higher for visitors, it is important to note that the average ratings for both groups were in the upper range on the scale. The ratings for both groups are similar to those reported by those who were classified as science hobbyists or enthusiasts in a recent study that used a similar methodology to study science festival visitors (Robertson Evia & Peterman, 2020). The average ratings are well above those who were classified as uninterested as part of this same study.

This finding suggests that non-visitors are probably not staying away from planetariums due to a lack of interest in the content on offer. Lack of financial resources might keep some potential visitors away, particularly since those from lower income brackets are more likely to be non-visitors. Even so, a task force from the Center for the Advancement of Informal Science Education (CAISE, 2018) has warned that simply providing free admission or other "access only" strategies burdens non-dominant groups and is not enough to overcome the systemic barriers that might prevent broader visitation and participation. Additional information is needed to understand the specific science interests of those from lower income groups and lower education levels, and why they do not pursue those interests at a planetarium.

Intersectional Description of Planetarium Visitors and Non-Visitors

In this section we focus on eight intersectional groups - males and females within four races or ethnicities. This intersection of variables was chosen

VARIABLE	FEATURES	N*	NON-VISITORS	VISITORS
Race/ethnicity	Asian or Asian American	75	**60%**	40%
	Hispanic or Latina/o/x	124	**56%**	44%
	Black or African American	85	**54%**	46%
	White	1728	**46%**	54%
Income	Under $25,000	121	**79%**	21%
	$25,000 - $49,999	220	**64%**	36%
	$50,000 - $74,999	386	**53%**	47%
	$75,000 - $149,999	733	**44%**	56%
	$150,000 - $199,999	247	**35%**	65%
	$200,000 - $249,999	113	**36%**	64%
	$250,000 - $300,000	49	**37%**	63%
	More than $300,000	77	**30%**	70%
Education	Some high school	17	**76%**	24%
	High school degree	141	**78%**	22%
	Some college	303	63%	37%
	College degree	690	**46%**	54%
	Some graduate work	159	**49%**	51%
	Graduate degree	852	**37%**	63%

* Total of non-visitors and visitors

Table 2: Basic demographics of planetarium non-visitors and visitors

for two reasons. First, it includes primary demographic characteristics that are often prioritized when trying to broaden informal learning audiences. Second, the sample sizes for these intersectional groups ($n \geq 20$) provided a reasonable point from which to demonstrate the importance of beginning to consider intersectionality as a means of gaining a better understanding of visitors and non-visitors.

RQ2 focuses on planetarium visitors and non-visitors who are members of race × gender intersectional groups. Here, we present the demographic results for these groups with a focus on the unique patterns that emerge when looking at intersectional, rather than traditional, demographic groups. While the data in Table 2 are useful for beginning to articulate non-visitors broadly, they do not help narrow down to specific community members who are non-visitors. Table 3 shows the portion of visitors and non-visitors from intersectional groups by combining gender and race/ethnicity. This more nuanced view of the data reveals additional variability that allows us to consider who is missing among planetarium visitors.

Looking at the data from this perspective reveals that there are five groups who were more likely to be non-visitors, with at least half reporting they had not visited a planetarium. When comparing visitors and non-visitors within each intersectional group, Asian men were the most likely to identify as non-visitors; Asian women also identified as non-visitors, with slightly more than half reporting that they had not visited a planetarium. Black men were more likely to identify as non-visitors than visitors; just over half of Black women also identified as non-visitors. Most Hispanic women identified as non-visitors, while approximately half of Hispanic men identified as visitors. White men and white women were similarly likely to identify as visitors, with just over half reporting that they had visited a planetarium.

The combination of gender and race/ethnicity presented here begins to identify specific groups of community members that planetariums might partner with to learn more about non-visitors. For example, the planetariums in our sample might want to understand more about why Asian men do not visit planetariums. Similarly, they might want to learn more about why Hispanic men are more likely to choose to visit than Hispanic women.

These intersectional groups also help uncover nuances in science interest. Table 4 shows the average interest ratings for each intersectional group, for non-visitors and visitors. As with the overall results, in almost every case, the average interest rating for non-visitors was lower than that for visitors who share the same intersectional gender-racial/ethnic identity. Asian males were the only group for whom non-visitors reported stronger attitudes toward science than visitors.

The results also show some notable differences across groups. Black male non-visitors reported the lowest interest rating, followed by Black female non-visitors; interest in science among these groups was noticeably lower than other groups in the sample. All other groups reported science interest in the upper ranges of the scale. White male visitors reported the highest interest ratings overall, followed by Black male visitors, and Hispanic female visitors.

INTERSECTIONAL GROUP	N*	NON-VISITORS	VISITORS
Asian or Asian American male	27	**74%**	26%
Hispanic female or Latina	79	**61%**	39%
Black or African American male	20	**60%**	40%
Asian or Asian American female	47	**53%**	47%
Black or African American female	64	**52%**	48%
Hispanic male or Latino	44	**48%**	52%
White female	1156	**47%**	53%
White male	555	**46%**	54%

** Total of non-visitors and visitors*

Table 3: Intersectional demographics of non-visitors and visitors: Gender and race/ethnicity

INTERSECTIONAL GROUP	N	INTEREST IN SCIENCE*
Asian or Asian American male	**20**	**8.45**
	7	7.29
Hispanic male or Latino	**21**	**8.14**
	23	8.52
White male	**254**	**7.74**
	300	8.84
Asian or Asian American female	**25**	7.64
	22	8.14
Hispanic female or Latina	**48**	**7.54**
	31	8.58
White female	**538**	**7.18**
	618	8.11
Black or African American female	**33**	**6.45**
	31	8.03
Black or African American male	**12**	**5.17**
	8	8.75

*Interest is an average rating on a scale from 0 to 10.

Table 4: Intersectional interest in science ratings of **non-visitors** and visitors: Gender and race/ethnicity

The combination of results in Tables 3 and 4 provides additional insight for planetariums to consider. For example, Asian males are the most likely to report being non-visitors (based on the results in Table 3) and they are also the group of non-visitors that reports the highest interest in science (based on the results in Table 4). It is interesting that Asian male non-visitors reported higher interest than Asian male visitors, though perhaps this is simply due to the small sample size of the latter group.

Black males are more likely to be non-visitors than visitors based on the results in Table 3, and the results in Table 4 show a striking difference of more than three points on the scale in the science interest ratings across Black male visitors and non-visitors. Black male visitors reported the second highest science interest rating of any intersectional group, and Black male non-visitors reported the lowest science interest of any intersectional group. A similar pattern was found for Hispanic females and for Black females, though the differences were not quite as pronounced in these cases as they were for Black males.

Each of these patterns deserves further study and consideration in local context. The results shared here are not intended to signify national trends in visitation. Instead, they are meant to serve as a demonstration of the additional nuance that can be gleaned about visitors if the field begins to conduct intersectional descriptive analyses or formal studies. Some planetarium leaders might think they recognize local trends in the results shared here. These kinds of results can provide an ideal entry point for participatory conversations with local community members who might be interested in sharing their perspectives about whether they would expect to see a similar pattern of results for their local area, and why similar patterns might or might not exist among local visitors and non-visitors. In other cases, planetarium leaders may be inspired to gather data from their own communities to understand intersectional participation from local members.

DISCUSSION

This study was conducted to fill a gap in the field (Sumners, 2016) by providing demographic information about planetarium visitors. Our results are based on a sample that included those who were on an existing planetarium email lists and those from a market research-style sample. Approximately half of those surveyed overall reported that they had visited a planetarium in 2019 or 2020, though the portion of those who visited was quite different across our email list and market research samples. Respondents from planetarium email lists had previously been in direct contact with the planetarium, and thus can be considered predisposed toward visiting a planetarium; the 68% of respondents from this group who visited a planetarium in 2019 or 2020 is likely to be a greater portion than that found in the local population overall. Far fewer respondents from the market research sample reported attending a planetarium in these years (18%). Given that 2020 was the first year of the COVID-19 pandemic and that almost all planetariums were closed for a portion of the year, this number is likely an underestimate of the overall population who visits planetariums.

Traditional, demographic studies of other informal learning opportunities have been available for some time and have helped establish a shared pattern of visitor characteristics that begins to identify the communities who are missing from these institutions (Dawson, 2019; Falk & Needham, 2010; Nielsen et al., 2019; Pandya, 2012). We intentionally chose to focus on

non-visitors as part of our analysis. Studies of non-visitors are less common across the field. The results from this study indicated that non-visitors report an interest in science overall, and thus it not likely to be the science content itself that is keeping potential visitors away. Recent research indicates that the American public would like to see cultural institutions become more welcoming and involve community members more directly in their program planning (Culture Tracks, 2021). Studies of non-visitors are critical if the ISI field (including planetariums) strive to become welcoming to a greater portion of the public.

We believe that the descriptive analyses hint at the value of conducting intersectional studies of ISI visitors in the future, and planetarium visitors in particular, as a way to help narrow the focus on community members who are not visiting the planetarium. All groups reported at least some interest in science, which seems a positive starting point for planetariums that are interested in attracting non-visitors. The specific patterns across gender, race/ethnicity, and science interest offer much to consider and establish a context for additional study. The majority of our sample consisted of those who were already on planetarium email lists; these non-visitors might be particularly interesting partners for planetariums that are interested in learning more about why community members do not visit.

Planetarium leaders should consider our results in relation to their local context, and as a springboard for additional work. At a minimum, planetariums should invest in regular demographic data collection of visitors using a consistent set of items across programs, events, and members. Based on our experience recruiting partners, few planetariums collect demographic information regularly and in consistent ways across these contexts. The COVES demographic questions used for this study provide a set of vetted items that will work well for planetariums interested in taking this step (*http://www.understandingvisitors.org/about/resources*); because the data collected from these questions are used by science museums across the U.S., they have the added benefit of providing comparison data as well. The planetarium field should also consider investing in formal intersectional studies of visitors and non-visitors.

The results from this study were also intended to be a starting point for planetarium leaders who are interested in creating inclusive environments for community members, a stated commitment of the International Planetarium Society (IPS 2022). For those interested in helping to change the face of planetariums, the recent landscape study from the Cultural Competence Learning Institute provides a range of entry points (Garibay & Olson, 2020). Their study was designed to include four broad categories that measured museums' efforts related to diversity, equity, access, and inclusion (DEAI). Four dimensions were considered foundational, in that they focused on whether the museum has an explicit mission or values statement related to DEAI, and the extent to which museum leaders and boards foreground DEAI in their decision-making efforts, including those related to funding. Two dimensions were related to staffing and vendor selection, and the extent to which the museum makes decisions, from recruitment to hiring to promotion, that strive to reflect the composition of the local community.

Two dimensions are related to public-facing programs, and Gariby and Olson note that local community groups should be partners in designing engagement programs, services, and products provided. The final category focuses on using data and evaluation to guide decisions related to the other dimensions. The combination of these latter categories provides the most direct connection to the findings from the current study. Our findings identify both a broad challenge facing the field, as well as specific communities of non-visitors who might be ideal partners with whom to begin building relationships. Planetarium staff are likely to know which intersectional groups from their own communities do not visit. Garibay and Teasdale (2019) recommend strengthening informal science education by privileging the voices of those from communities who are not from dominant groups, and by collaborating with those community members to identify project outcomes. This goal might be achieved by hosting listening sessions with community members from non-dominant groups to learn their impressions of the local planetarium, or by forming a community advisory group that includes multiple group members from relevant and non-dominant groups who can help inform decision-making at the planetarium moving forward.

If the planetarium staff does not include those from non-dominant groups, planetarium leaders should consider whether and how it would be more beneficial to work with external partners to begin this work. Hinojosa et al. (2021) suggest the value of working with a trusted liaison who shares cultural identity with focal communities to first develop outreach initiatives that meet audiences where they are. Recent research provides specific areas that Americans would like to see improved across museum and cultural institutions (Culture Tracks, 2021). These include "amplify access & new works (70% of those surveyed), embrace equity & inclusion (56%), become places of belonging and welcome (53%), and deepen community rootedness (46%)." Scholars have also suggested that change across the field must be based on fostering empathetic museums; a maturity model exists to guide informal learning institutions that are interested in using empathy to guide internal changes that promote integrating community voice and engagement (Jennings et al., 2019).

Recommendations for creating authentic community partnerships to support more inclusive experiences in museums are not new (see Garibay & Huerta Migus, 2014, for a summary of recommendations from others, and a framework for creating inclusive museums). Even so, the COVID-19 pandemic and heightened awareness of systemic racism have necessitated a field-wide reset as we consider

whether and how to become antiracist organizations moving forward. Leaders such as the Oregon Museum of Science and Industry have already taken steps in this direction and serve as models for other informal learning institutions (see *https://xplane.com/ a-powerful-way-to-get-traction-on-your-dei-, https://xplane.com/a-powerful-way-to-get-traction-on-your-dei-initiative/nitiative/* for their Equity Action Framework). As planetariums consider how to define a "new normal," it is our hope that the gaps identified here are seen as opportunities to begin to develop reciprocal and meaningful relationships with local neighborhoods and community groups to create more inclusive learning environments for the future.

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(Continued on pg. 62)

in order to remind people to make sure they were wearing them for the main presentation.

Would I work on another documentary? Absolutely. Would I do so again with another tiger team, including the same people? Likewise. It was, after all, a project that I could really sink my teeth into!

Who are we Missing... (con't.)

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