Using Survey Data to Inform Best Practice of Engagement with New Audiences

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Summary

The main purpose of this article is to discuss how survey findings concerning the audiences for astronomy and space science outreach could help science communicators to foster public interest and participation in space activities among larger audiences. The article draws on findings from a large survey carried out in the UK, based on the responses of 744 respondents attending astronomy and space outreach events. The results of this survey, including interests, preferred means of exploration, beliefs and rationales for exploration, and the relationship with age and gender, could help practitioners reach new audiences who are not often targeted by conventional outreach efforts.

Introduction

Space science and astronomy are recognised by many as being particularly attractive subjects for both students and the general public. Contact with these subjects has a positive effect on students' interest in science and scientific careers, as well as public support for science and technology. As a result, communication of these subjects is regarded as an important activity to be undertaken by individuals, governments and research institutions dealing with space research (e.g., Barstow, 2005; Washington Charter, 2003; BNSC, 2008; Space IGS, 2011; RAS, 2004; Global Exploration Strategy, 2007; National Space Technology, 2011).

The International Astronomical Union Commission 55 developed the Washington Charter in 2003, which highlights principles of action for individuals and organisations involved in astronomical research, stating that they "have a compelling obligation to communicate their results and efforts with the public for the benefit of all".

However, the social scientific literature on these audiences is still relatively limited (Bell & Parker, 2009). Audience characteristics are usually studied in general surveys of public attitudes towards science and technology. The National Science Foundation (NSF), for example, started surveying Americans' opinions on science and technology in 1979, but it was not until 1981 that they introduced questions on attentiveness to space exploration (NSB, 2002, 2010; Miller, 1987). Although undoubtedly a valuable source of information about public interest, knowledge and attentiveness, these surveys do not provide an in-depth characterisation of the public. Practitioners of science communication often stress the lack of quantitative data about their audience, which leaves them to guess the characteristics of the groups that they are meant to be addressing (Entradas, 2011).

A careful analysis of survey data may provide a useful framework for thinking not only about audiences that are already being targeted by practitioners' communication efforts, but also about new audiences to reach and communication strategies to carry out.

The study presented here empirically examines the characteristics of the British audience attending astronomy and space outreach events and focusses on some of those characteristics to discuss how survey findings may assist in understanding audiences and planning outreach strategies.

This study is part of a broader analysis that examines the public support for space exploration (Entradas, Miller & Peters, 2011).

Methods

The study was conducted at two space outreach events in the UK: the Royal Society Summer Exhibition in London and the National Space Centre in Leicester, in the summer of 2008.

Questions designed as indicators of the concepts "beliefs", "attitudes", "rationales for exploration", and "political references" were included in a short questionnaire distributed to visitors to the exhibitions and returned immediately. All questionnaires were anonymous. 744 visitors returned the questionnaires; 249 respondents from the Royal Society and 495 from the National Space Centre. The response rate at the Royal Society Exhibition was 62% and at the National Space Centre was 71%.

The variables discussed here are: socio-demographics such as gender, age and professional activity, means of exploration, rationales for exploration, and beliefs in extraterrestrial life. All variables were measured at the nominal level, except age which was measured at the ordinal level. The relationships between variables were measured using contingency tables, non-parametric tests (χ^2), Cramer's V (for nominal and ordinal variables), and Gamma (for ordinal variables). Relationships between both age and gender with the variables "means of exploration", "rationales for exploration", and "belief in extraterrestrial life" were tested to determine correlations. A significance value of $p = 0.05$ was used to reject/accept the hypotheses about the relationships being tested.

Audience for astronomy and space exploration outreach events

1. Socio-demographic factors

The principal finding that comes out of the data is that the frequency distribution of the socio-demographic factors in both sub-samples — the Royal Society Exhibition and the National Space Centre — were largely the same. Both sub-samples were equally characterised in terms of gender, age and professional activity. This suggests that these characteristics are typical of the audiences who attend astronomy and space exploration outreach events.

Moreover, the distribution of responses to survey questions by respondents at both survey locations was also quite similar ($p > 0.05$). χ^2 was used for each question to test the similarity of distribution of answers in both sub-samples.

This finding indicates that the location did not influence the distribution of answers in the two sub-samples, reinforcing the idea that not only socio-demographic characteristics, but also the other characteristics surveyed, should be typical of audiences for astronomy and space events. Due to the similarity between the two sub-samples ($p > 0.05$), they are not treated separately in the statistical analysis and an aggregated data analysis is presented.

Respondents	Number of respondents	Total %
Gender		
Male	408	55.5%
Female	327	44.5%
Total	**735**	**100%**
Age		
≤ 15	170	23.2%
16–24	68	9.3%
25–39	208	28.4%
40–54	182	24.8%
55	105	14.3%
Total	**733**	**100%**
Professional activity		
Secondary student	127	18.8%
Undergraduate	36	5.3%
Post-graduate	113	16.7%
Researcher	15	2.2%
Other*	384	56.9%
Total	**675**	**100%**

Table 1. Demographic profile of respondents.

Table 1 shows that a majority of the public attending astronomy and space exploration outreach events were male, that young adults (16–24 years) were the most under-represented and that almost half were either students or had a professional connection to science. The latter is likely to be below the actual percentage as some of the children aged 15 or under, if not yet secondary students, might have considered themselves to fall into the category "others" as no other option was provided.

These data thus suggest that those not being reached by practitioners' communication efforts are more likely to be female, young adults aged 16–24 years, and people who do not have a professional connection to science.

2. Preferred means of exploration

When asked "How do you think we should explore the Solar System?" respondents showed positive support for space exploration with 98% of respondents agreeing that we should explore space. Yet, they held differing views on the preferred means of exploration. While the majority tended to agree with multiple means (55%), 43% had varying opinions on favoured means, with robotic and manned missions ranking higher (16%) than observation from spacecraft (9%) and observation from Earth (6%). Only a small number (2%) thought we should stop exploring space (Figure 1).

A small percentage of respondents (5.3%) ticked more than one response. A separate analysis looked in more detail at this portion of the sample and reflected in this analysis were concerns about manned space missions: a majority (3.5% out of 5.3%) ticked the three answer options that did not involve human exploration.

As one of the main discussions around space exploration, not only in the UK but also elsewhere, is whether it should involve humans, this finding is not surprising. It is to be expected that individuals who did not agree with "all means of exploration" and chose more than one answer would

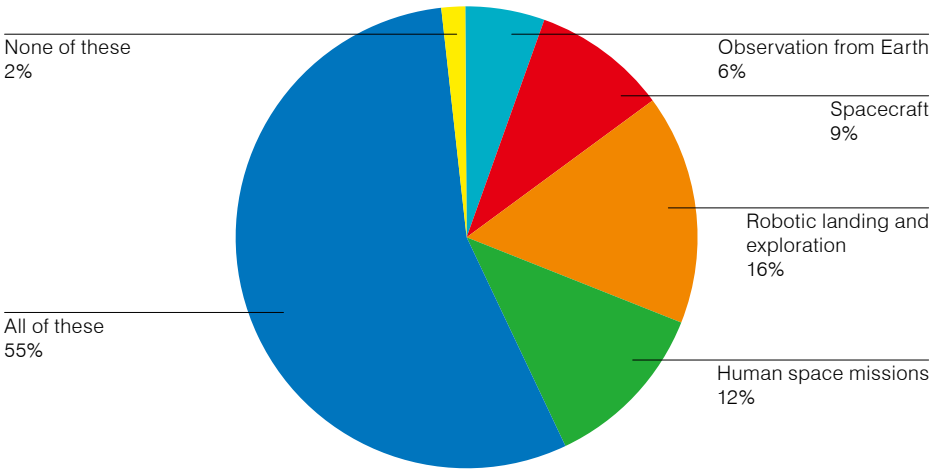

Figure 1. Respondents' preferred means of exploration. (Total number of respondents: n = 725)

be likely to have concerns about human space missions.

Statistical analysis of the relationship between means and demographic factors shows that while spacecraft exploration and manned space missions were more likely to be favoured by men than women, observation from Earth was more likely to be favoured by women than men (Cramer's $V = 0.19$).

The analysis also shows significant relationships between age and means of exploration (Cramer's $V = 0.14$). When compared with older age groups, children aged 15 and younger were the most likely to support human space missions, followed by the group aged 16–24. By contrast, individuals aged older than 55 were more likely to support less "adventurous" means of exploration (Figure 2).

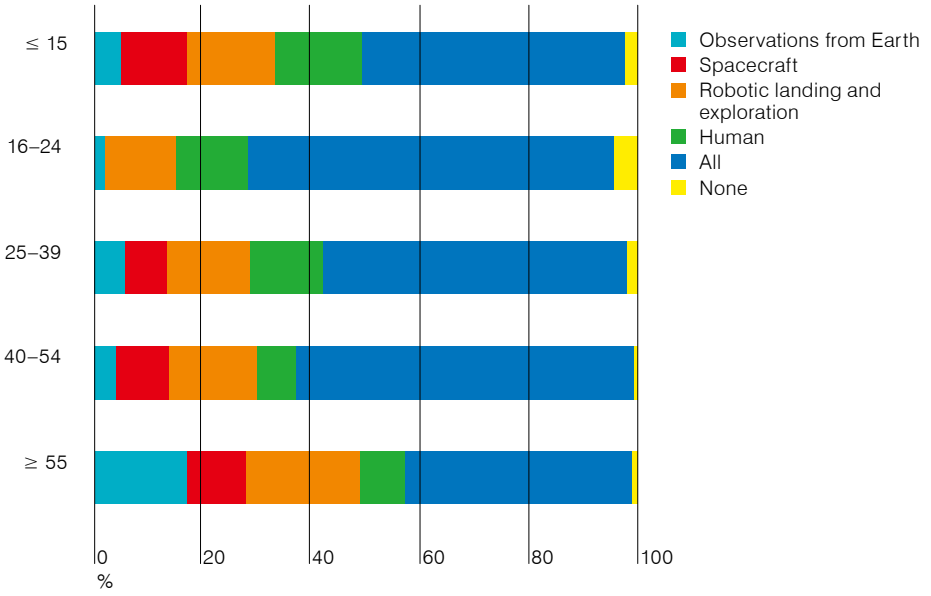

Figure 2. Preferred means of exploration by respondents' age. (Total number of respondents: n = 725)
Note: A sum of the response "all of these" with each of the four preferred means of space exploration would read as: 71% agreed with robotic landing and exploration; 67% agreed with human space missions; 64% observation from spacecraft; and 61% observations from Earth.

3. Rationales for exploration

When asked about rationales for exploration, the most common response was "generating new scientific knowledge and advancing human culture" (69%). "Inspiring new generations" was the second most common reason (16%), while "creating international cooperation" (3%), "engaging British society in the full excitement of space exploration" (6%), and "returning value to the UK economy" (6%) did not appear to be strong preferences for the justification of space exploration. This seems to suggest that people think of space exploration as a science whose aim is to generate new knowledge about the Universe, rather than thinking about the practical applications of technologies derived from space exploration. Applications that have included mobile phones, GPS, and weather forecasting.

This suggests a lack of awareness of the benefits that space exploration can bring to our lives, and is supported by other information in the data regarding respondents' attitudes towards value for money.

Respondents were asked to what extent they agreed with the statement "Space exploration is good value for money" using a five-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree). Just over a quarter of respondents agreed with the statement (31%), a similar number disagreed with the statement (28%), and almost half of respondents were ambivalent (41%).

Associations were not found between respondents' demographics and rationales for exploration ($p > 0.05$). This is not at all surprising as the great majority of respondents mentioned the same reason to explore space.

4. Beliefs in life beyond Earth

4.1. Is there life out there?

When asked "Do you think life has ever existed on other planets in the Solar System?" the majority of respondents said they believe that life has existed elsewhere in the Solar System (63%), either as primitive (47%) or higher forms (16%). However, around a quarter of the respondents said "don't know" (24%). A further 12% did not believe that other planets in the Solar System have held life (Figure 3).

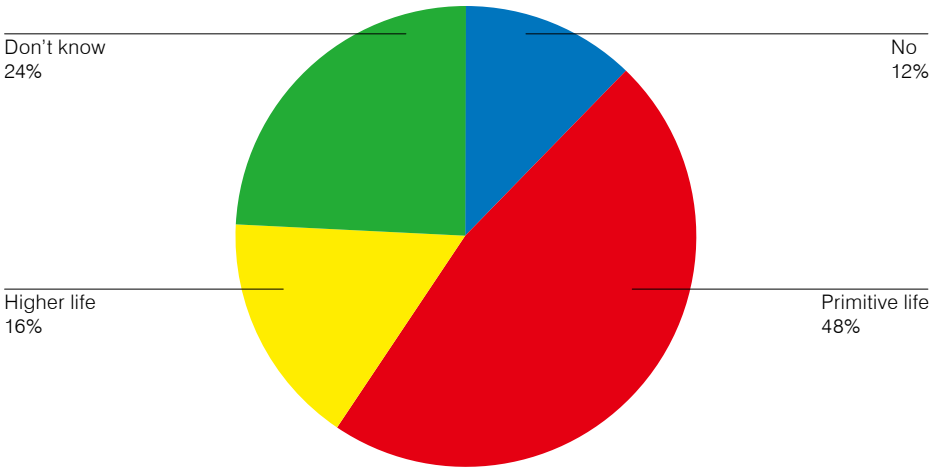

Figure 3. Respondents' belief in the existence of life on other planets in our Solar System.
(Total number of respondents n = 718)

The statistical analysis shows rather interesting relationships between people's belief in the existence of life beyond Earth and gender and age. Females were less likely than males to believe in the existence of life on planets other than Earth. In contrast, males were more likely to believe in the existence of higher forms of life on other planets than females ($p = 0.003$). Regarding age, respondents older than 55 were the least likely to think that life has existed outside Earth, when compared with other age groups. And, of the 16% who believed in the existence of higher forms of life, the majority were younger than 16 years old. Those aged between 40–54 years old were the strongest believers in the existence of primitive life.

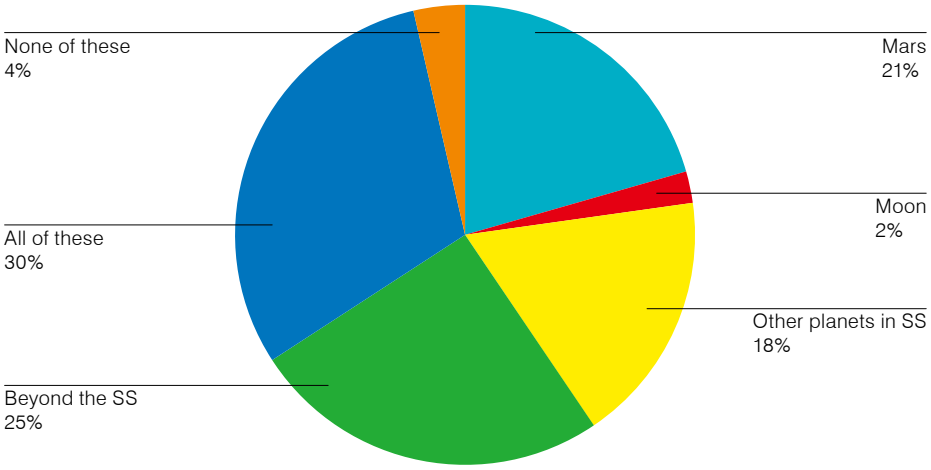

Figure 4. Respondents' preferred targets for exploring for traces of life. (Total number of respondents n = 739) *Note: A sum of the response "all of these" with each of the four preferred targets for exploration for any traces of life would read as: 52% agreed with exploration on Mars; 33% agreed with exploration on the Moon; 49% agreed with exploration on other planets in the Solar System (SS); and 56% agreed with exploration beyond the Solar System.*

4.2. Where to look for life beyond Earth

Regarding targets for exploration of extraterrestrial life, when asked "Where do you think we should explore for any traces of life?" — Mars; Moon; other planets in the Solar System; beyond the Solar System; all or none of these, the most common response was "all of these" (chosen by almost a third of the respondents — 31%), and there was a strong expectation of the existence of life beyond the Solar System (25%), on Mars (21%) and other planets in the Solar System (18%). The Moon was almost disregarded as a possible host to life (2%) (Figure 4).

The younger age groups were more likely to believe that life exists on Mars than older age groups ($p = 0.001$). In fact, the younger age groups appeared to be more excited about looking for life on more distant targets than older age groups, who preferred exploring the Solar System (Figure 5).

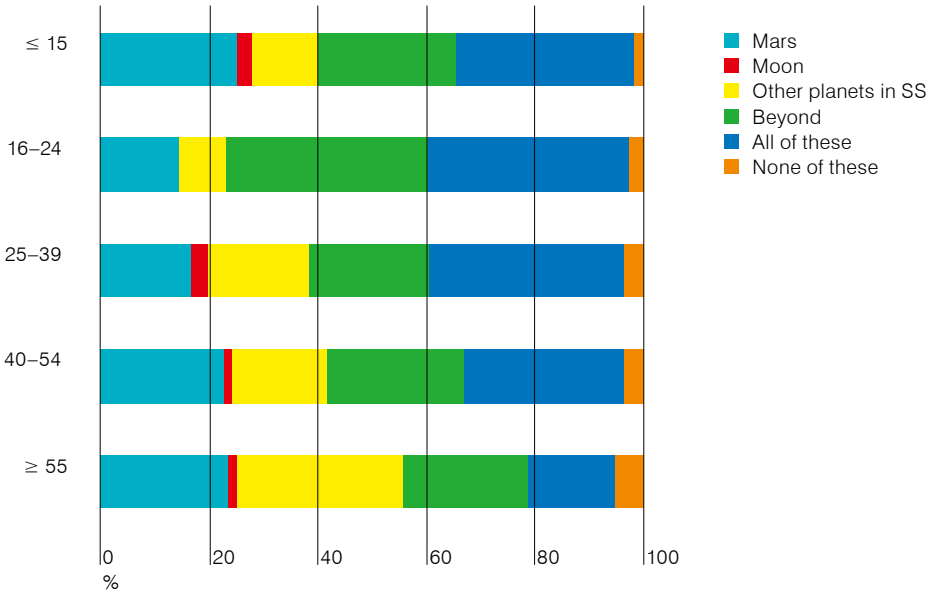

Figure 5. Respondents' preferred targets for exploring for traces of life by age.

Discussion: Reaching new audiences for astronomy and space

The main purpose of this article is to discuss how surveys of audiences for astronomy and space could benefit the role of science communicators in stimulating public interest and participation in space activities amongst larger audiences. This discussion is based on a UK survey of 744 respondents attending astronomy and space outreach events, as well as other studies, including previous detailed analysis of these data. Drawing on analysis of responses from this group and the relation of these responses with age and gender factors, practitioners could reach new audiences who have not been targeted by their outreach efforts.

The main findings presented here show that the group most certainly interested in space and astronomy is mainly composed of male adults aged 25–54 years whose professional occupation relates somehow to science. As for the other characteristics of respondents, a majority of them reported to believe that life may exist, or may have existed outside Earth (63%) in either primitive (37%) or higher forms (16%). In addition, audiences showed a strong positive attitude towards exploring space beyond the Solar System (56%), on Mars (52%) and on other planets in the Solar System (49%).

The audiences that have been less well reached by practitioners' communication efforts are likely to be female young adults, aged 16–24, who do not have a professional link to science.

In particular, the poor attendance of young adults seems to be of particular concern. The absence of this age group at outreach events, combined with their limited awareness of astronomy and space-related issues (Ottavianelli & Good, 2002; Saftwat et al., 2006), shows a younger stratum of people with whom it is critical to engage. It might be of particular interest to attract this cohort since ESA and NASA's long-term space programmes, the Aurora Programme and the Vision for Space Exploration (VSE), respectively, have ambitious aims that call for human exploration of the Solar System and will certainly require support from these individuals. Moreover, reaching younger age groups means recruiting more students for scientific careers and combating the decline in the number of young people studying science and engineering subjects (PISA, 2009; Barstow, 2005).

The survey shows that members of the younger age groups express excitement about manned space missions and reported themselves as believing in the existence of life on other planets. These groups appeared to be particularly supportive of the exploration of life on Mars and beyond our Solar System. The belief that life may exist on other planets seems to be connected with supporting space exploration (Entradas et al., 2011) making it reasonable to argue that communicating the goals of ESA's Aurora Programme, which has the search for signs of extant or fossil life on Mars as a key driver, might attract new audiences to space events. This idea is supported by the strong public expectations of the existence of life on Mars (52% of respondents agreeing that we should explore Mars for any traces of life).

Another important result shown by the survey is the limited attendance of a female audience when compared to males, as well as a female lack of interest in and support for more "adventurous" means of exploration. While these differences in gender are not surprising, concerns about reaching female audiences are shared among practitioners (Entradas, 2011). Many state that such differences are due to the way in which formal education and science communication is pitched. Practitioners may want to think about more attractive ways of communicating to females, which could be based on females' beliefs, interests and attitudes towards space and astronomy as shown here. For instance the survey suggests that a way of reaching new audiences might be through communicating the more tangible technological benefits of space exploration.

Deep analysis of these data (Entradas, Miller & Peters, 2011), shows that the more the public valued space exploration science, the more they tended to support higher levels of government spending on space activities. However, as the results here show, only 30% of the respondents surveyed believed that space exploration is good value for money, suggesting a deficit in public knowledge of the benefits that might come from space research. Therefore, it is reasonable to argue that discussing and communicating the benefits of space exploration to overall quality of life, and to society at large, rather than concentrating on immediate economic returns, may contribute to attracting the more "difficult" audiences.

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Biography

Marta Entradas is a postdoctoral researcher in science communication at Lisbon University Institute, and a visiting scholar at the London School of Economics and Cornell University. Her research interests lie in science communication, public understanding of science and public attitudes towards science and technology.