

# How Can Science Communication Research Facilitate the Communication of Astronomy with the Public?

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Science communication exists as both an area of research and practice. One of the greatest values of science communication research is to produce evidence that can be used to inform the communication of science with society. In this article, we use findings from a large survey on visitors at astronomy and space exploration events in the UK to discuss engagement of broader audiences in astronomy. In particular, we examine visitors' policy preferences and attitudes towards space exploration, and the relation of these with gender to discuss involvement of groups less likely to attend astronomy informal learning places including female audiences.

## 1. Introduction

Science communication exists as both an area of research and practice. One of the greatest values of science communication research is to produce evidence that can be used to inform the communication of science with society. In this article, we use findings from a large survey on visitors at astronomy and space exploration events in the UK to discuss engagement of broader audiences in astronomy. Drawing on visitors' attitudes towards space exploration and space policy preferences including their preferred means of space exploration and funding for space activities, and the relation of these with gender, we discuss how science communication research in 'audiences for astronomy and space exploration' can help astronomy communicators and other key players in public engagement with astronomy to better understand their actual audiences and to address new ones.

## 2. Visits to Informal Learning Places

Previous research that has examined how people learn about science and what sources of scientific information they use has shown that museums and science centres are important places for scientific learning. For example, a study conducted in Los Angeles in 2000, asked people to self report their interest in various areas of science, their levels of knowledge in that/those areas, their sources of information, and why they were interested in scientific topics (curiosity vs interest). Using a representative sample ( $N = 1007$ ), 'museums and zoos' were reported as a source of information they relied upon 'some or a lot' for learning about science and technology [1]. The study highlighted the important role of museums in people's access to science, which according to the authors, mostly rely on free-choice learning (including books, newspapers, museums, etc.).

Numbers are striking when we look at annual attendance figures for planetariums around the world (figures include visits at school shows, public shows, concerts, laser shows, etc., all together). In January 2015, 109,399,015 people

visited the 4,111 planetariums around the world. And, both attendance and number of planetariums have increased in the last decade. In 1995, 75,374,791 people visited the 2,613 planetariums around the world<sup>1</sup>.

Nevertheless, without stretching the accuracy of the overall attendance estimate at planetariums (data is dispersed and do not allow for direct comparison), when compared with attendance at other cultural institutions such as public libraries, art museums and zoos/aquariums, attendance at science/technology museums (including planetariums) ranks lower in many countries. For example, the latest available comparable data shows that while 60% Americans (2012), 34% Europeans (2005) and 46% Japanese visited a “public library”, 25% Americans, 16% Europeans and 12% Japanese visited a “science and technology museum” [2]. Understanding visitors’ characteristics at astronomy informal learning places can be useful for practitioners of communication and other key players in engagement to address a less supportive public including female audiences as we will seek to show.

### 3. Key-Concepts in Survey Questions

Six questions on beliefs, attitudes, rationales for exploration, and political preferences, as well as socio-demographic factors were asked to visitors at two locations in the United Kingdom in 2008: the National Space Centre in Leicester and the Royal Society Summer Exhibition in London (Table 1). Postcards were distributed to visitors and returned immediately before they left the locations. 744 visitors returned the postcards for a response rate of 71% and 62% respectively (700 and 500 postcards were distributed at the National Space Centre and the Royal Society Summer Exhibition respectively).

### 4. Analysis

This analysis is part of a broader study that examines how *rationales for exploration*, *belief in extraterrestrial life*, *age* and *gender* (independent variables), relate to *public support for space exploration* (dependent variables) [3 & 4]. *Public support for space exploration* is a measurement of two principal measures: (a) *attitude towards space exploration* (given by five attitude items ‘risk’, ‘UK positioning’, ‘value for money’ and ‘priority’, Q5B Table 1) and (b) *space policy preferences* (given by preferred *means of exploration* and *government spending*, Q1 and Q6 Table 1).

In the analysis presented here, we specifically focus on examining the interrelationship between attitude item ‘value for money’ (‘Space exploration is good value for money’) and space policy preferences, and gender effects. We present the analysis in two steps. *Step 1* looks at the relationships between attitude item ‘value for money’ and space policy preferences (means of exploration and government spending) (Figs. 3 and 4); and *step 2* looks at gender effects, in particular how gender varies with policy preferences for space exploration. Relationships were explored by crosstabulating the individual attitude item ‘value for money’ with space policy preferences (Step 1) and gender with attitude item ‘value for money’ and policy preferences. Before presenting the results of our two-step analysis, we describe the respondents’ socio-demographic characteristics (Table 2), preferred means of exploration (Table 3), preferred government funding for space activities (Table 4), and attitudes towards space exploration (Fig. 1).

<sup>1</sup>Estimated numbers based on visitors’ attendance at 10% of the world’s domes (not singular institutions) regardless of dome size) (Loch Ness Productions database, 2015) Accessed on 29-11-2015: <https://www.lochnessproductions.com/reference/attendance/attendance.html>

**Table 1** Operationalization of key-concepts, indicators and variable name to survey questions.

Concepts	Indicators	Variable name
Beliefs	(Q3B) Do you think life has ever existed on other planets in our Solar System?	<i>Belief in extraterrestrial life</i>
Attitudes towards space exploration	(Q5B) To what extent do you agree or disagree with the following statements · Space exploration is very risky · It is important that the UK is at the forefront of space activity · Space exploration is good value for money · Space exploration is much less important than solving problems on Earth	<i>Attitude ‘risk’</i> <i>Attitude ‘UK positioning’</i> <i>Attitude ‘value for money’</i> <i>Attitude ‘priority’</i>
Rationales for exploration	(Q2B) What do you think is the MOST important reason to explore the Solar System?	<i>Rationales for exploration</i>
Political preferences	(Q1) Do you think we should explore the Solar System with (Q6) How much of the national budget should be spent on space exploration?	<i>Preferred means</i> <i>Government spending</i>

**Table 2** Socio-demographic profile of respondents

	<i>n</i>	%
<b><u>Gender</u></b>		
Male	408	55.5%
Female	327	44.5%
Total	735	100%
<b><u>Age</u></b>		
≤ 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%
<b><u>Professional Activity</u></b>		
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%

5. Respondents’ Socio-Demographic Profile

As Table 2 shows, a majority of visitors attending space exploration outreach events was male (55.5%,  $n = 408$  males; and 44.5% females,  $n = 327$ ). 23% of the

surveyed visitors were children (younger than 16 years), 9% were young adults (16-24 years), 29% were between 25-39 years, 24% between 40-45 years, and 14% were 55 years old or above. 43% were either students or had a professional connection to science. This percentage might be slightly higher as some of the children aged 15 or under, if not a secondary student yet might have considered themselves under “other” as no other option was provided.

6. Space Policy Preferences

When asked about means of exploration they thought should be used to explore the Solar System, visitors showed considerable enthusiasm with 98% agreeing that the Solar System should be explored with over 55% preferring multiple means (“all of these”) i.e. “observation from Earth”, “observation from spacecraft”, “robotic landing and exploration”, and “human space missions”. 43% had varying opinions on favoured means, with robotic and manned missions ranking higher than observation from spacecraft and observation from Earth (see Table 3). The remaining 2% showed disagreement with the exploration of outer space.

Table 3 Preferred means of space exploration

Question (Q1) Do you think we should explore the Solar System with		
	Responses ( $n = 725$ )	Percentage (%)
Observation from Earth	43	6
Observation from Spacecraft	72	9
Robotic landing and Exploration	125	16
Human space missions	91	12
All of these	426	55
None of these	13	2

Table 4 Preferred government funding for space activities

Question (Q6) How much of the national budget should be spent on space exploration?		
	Responses ( $n = 710$ )	Percentage (%)
None: Private Money	62	9
Less than 0.04%*	81	11
Between 0.04 and 0.5%	250	35
More than 0.5%	108	15
Don't know	209	29

\* Government budget spent on space activities in 2008 (0.04% GDP)

As Table 4 shows, even though there was a general feeling that government should fund space activities, about a half of the respondents (50%) agreed that the current government budget should be maintained or increased, while 11% agreed that the UK was spending too much and 9% that space activities should be funded by private bodies.

7. Attitudes towards Space Exploration

As Fig.1 shows, more than 8 in 10 (86%) visitors perceived space exploration as very risky, and only 4% opposed to this idea. Visitors shared the same opinion concerning the importance of space exploration if compared with solving problems on Earth – 42% agreed with the statement “space exploration is less important

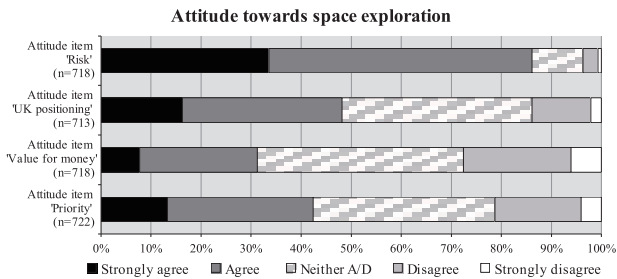


Fig. 1 Attitude toward space exploration

than solving problems on Earth” while 21% disagreed. When considering “value for money”, fewer more than a quarter agreed that space is good value for money (31%), but another quarter did not (28%). Moreover, almost half of respondents were “ambivalent” regarding this issue (41%). For the importance of “UK positioning”, half of the respondents agreed with the statement “it is important for the UK to be at the forefront of space exploration”. The opposite feeling was held by a 14% who disagreed, and 38% did not express a clear opinion (neither agreed nor disagreed).

8. Step 1: Relationship between Attitude Item ‘Value for Money’ and Space Policy Preferences

Visitors who agreed that space exploration is good value for money were more likely to agree that more money should be spent on space exploration and to agree with more complex means of exploration such as robotic and human space missions (Fig. 2 and Fig. 3). By contrast, visitors who agreed that the current budget should be decreased ( $< 0.04$  GDP) were more likely to disagree that space exploration is good value for money.

Perceived benefit (“good value for money”) strongly influenced the level of support for a costly space program ( $p < 0.001$ ). But here the levels of agreement and disagreement were almost equally high (as Fig. 2 shows). This shows that the respondents’ different views on the benefit of space exploration influence their personal level of support for a costly space policy.

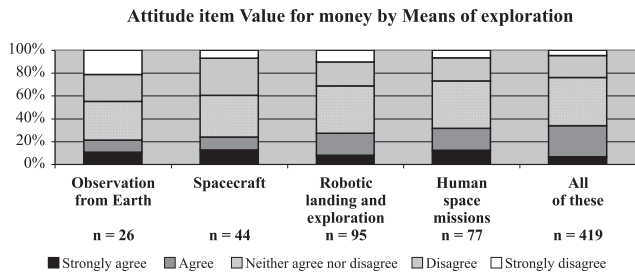
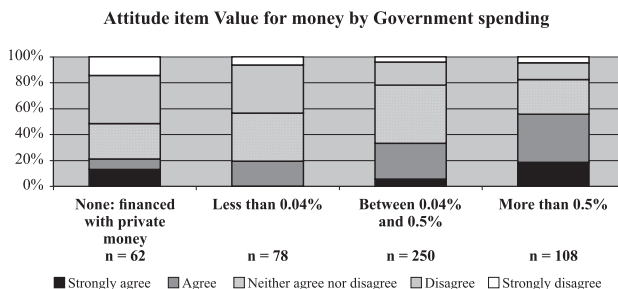


Fig. 2 Relationship between attitude item ‘value for money’ and preferred means of exploration

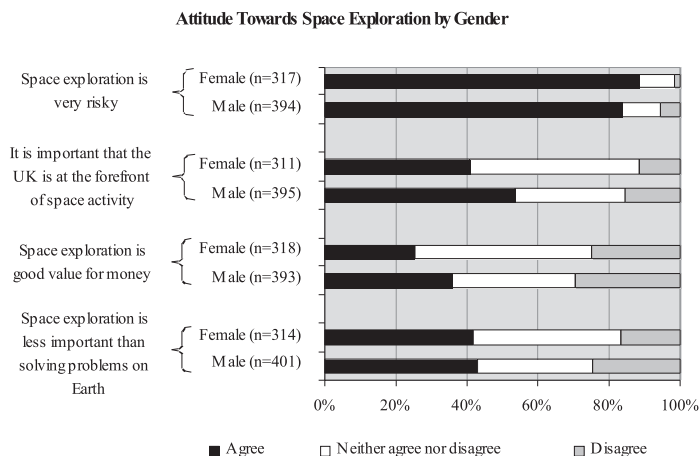


**Fig. 3** Relationship between attitude item ‘value for money’ and support for government spending

## 9. Step 2: Gender Effects

The analysis shows that support for space exploration – attitude toward space exploration and space policy preferences – varied with gender: Men had a more positive attitude than women, wanted more government spending on space activities and preferred more complex exploration means such as manned space flights and robotic landing and exploration ( $p < 0.05$ ).

As Fig. 4 shows, the attitude items ‘UK positioning’ and ‘value for money’ showed the largest gender difference (Cramer’s  $V = 0.20$  and  $0.18$ , respectively), while the attitude items ‘risk’ and ‘priority’ did not significantly differed with gender. Male respondents thus were more likely than female respondents to consider it important for the UK to be at the forefront of space activities and that space exploration is good value for money. Consistently, women were more likely than men to agree that solving problems on Earth was more important than exploring space.



**Fig. 4** Gender differences in attitude items towards space exploration.

## 10. Discussion

The main purpose of this article is to discuss how surveys of ‘audiences for astronomy and space exploration’ could benefit the role of informal learning places and science communicators in stimulating public interest and participation in space issues amongst larger audiences. Given the locations at which the survey data were collected, this sample cannot provide a representative view of the general UK public at large. But it does provide important information about the audiences for space exploration as a group.

Based on the analysis of the characteristics of visitors at two astronomy and space outreach events in the UK, we would like to bring two considerations to the discussion. Firstly, the more visitors valued space exploration, the more they tended to support it – i.e. those more likely to support more adventurous and expensive means of exploration such as human missions and robotic landing (in opposition to observation from Earth and spacecraft) were also more likely to support higher government spending in space activities. However, only 30% of the respondents surveyed believed that space exploration is good value for money. This suggests a lack of knowledge of the benefits of space research.

Secondly, our gender analysis shows that females have a limited attendance at space outreach events, are less likely to support more complex and expensive means of exploration and are more likely to agree with lower spending on space research activities. They are also more likely than men to agree that solving problems on Earth should be priority and that space exploration is not a good value for money. Discussing the benefits of space exploration to overall quality of life and to society at large, in particular with female audiences, rather than concentrating on immediate economic returns may be something practitioners (and decision makers) may want to emphasize in their communication efforts. Finally, astronomy informal learning places could be thought of by science communication practitioners as ideal places to attract a less interested audience: When people visit science-related informal learning institutions they are quite likely to be in groups or accompanied by family members or friends [5]. Thus, these places appear to be excellent opportunities to reach a less attentive public that just happens to be in the “right” social setting, but which otherwise would be very difficult to reach through other means.

## References

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