

SPACE

a w a r e n e s s

Looking back:

Space scientists' reflections on career influences, paths and choices

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'I stood a few metres from Yuri Gagarin, at the time, the only human to have left planet Earth. This was a mind-boggling experience that shaped my future life.'

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In compiling this report we wish to acknowledge the very important contributions of the survey participants in providing their feedback and reflections. Your efforts have been a tremendous help in providing this view of space science career choices, and offer a valuable contribution to ongoing space science education throughout Europe and beyond. Thank you.



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Executive Summary

As part of the evaluation of the Space Awareness project, a 'retrospective longitudinal' survey was conducted of individuals working and/or studying in space science. The survey built on previous work (e.g. Maltese, Melke, & Wiebke, 2014) and was conducted to gather information into the career paths of these individuals and, importantly, to better understand the influence of various activities, experiences and people on their career-related motivations and choices. This is the first survey to specifically explore the career decisions and influences on people working within space science. Whilst many of the results are broadly in line with wider work involving scientists from a wide range of backgrounds, there are many key findings which will help inform policy and effort in ensuring a strong future workforce within the space sector.

In total, **415 individuals representing over 30 countries** responded to the survey. Respondents were spread fairly evenly from ages 25 to 59 (with fewer in their early 20s or over 60). Approximately twice as many males as females participated in the survey, consistent with the gender imbalance in the field generally.

Interest in space science, and in science generally, began at quite a young age, with 70% reporting being interested in science before the age of 11. Interest in *space* science usually seemed to follow a bit later, with 67.5% saying they were interested in space science by the age of 14. Consistent with other research, **individuals' reported interest in working in science tended to be well established by the early part of secondary school.**

A wide range of activities and experiences were credited as providing the **initial spark** for interest in space science, with reading, stargazing, science fiction programmes/films and space exploration events particularly popular. The survey also explored which activities and experiences were **influential in maintaining interest in space science** at different ages. Two elements appeared relatively consistently as influential across ages: **reading books or magazines and stargazing.** Importantly, both of these **activities can be considered to be relatively low-cost and accessible to many.** There were also a number of notable factors which were reported to maintain interest in space science that demonstrated significant statistical difference with gender and age. In particular **high attainment was important to girls throughout school age** (at ages 6-10, 11-13 and 14-18), whilst **males reported as important computer programming or building** (at ages 14-18 and 18+) and **the space race/moon landings** (at ages 11-13 and 14-18). The pattern reinforces the **importance of providing girls in particular with a range of experiences and activities from early ages.**

In terms of individuals who were influential on the development of interests in space science, **the majority of participants felt that they, themselves, were most responsible for sparking this interest (59.9%), though fathers/male guardians (10.4%) and teachers (9.4%) were also identified as key influencers.** Similar patterns were seen in participants' attributions for who was most responsible for supporting the further development of their interests, although their own initiative as well as the influence of teachers grew as respondents got older, while the influence of parents decreased slightly. There were no gender differences in who respondents felt was most influential in sparking or subsequently encouraging their interests in space science.

Current space scientists were interested in space careers from a young age: over 1/3 of survey respondents' "first job" intentions were related to space science (astronaut/pilot, astrophysicist, astronomer). Likewise, when asked more specifically about their "first job in science" preferences, over 2/3 named a specific space science career. There were no overall gender differences in these preferences, though males were more likely than females to report engineering as the first science job they were interested in.

In reflecting on their paths into space science, respondents provided reasons for their choices related to post-compulsory study. In line with previous research, the majority of respondents (62.2%) reported **enjoyment of the field or subject as the primary reason for selecting the discipline of their first degree**. Relatedly, 18.2% responded that the course or degree provided needed background for their desired career. A substantial proportion of respondents also noted that **attainment (27.7%) or self-confidence in their ability to succeed (23.6%) were influential on their course-related decisions**. Encouragement from teachers (10.1%) and parents (9.4%) also seemed to have some role to play, albeit for fewer individuals. There were no gender differences in reasons respondents gave for the selection of the field/discipline of their first degree.

A slight majority (55.2%) of respondents reported having thought seriously about leaving space science for another field of study or work (with no significant difference by gender). The most frequent reason was poor career prospects (selected by 24.0% of respondents who answered this question). This was followed by career interests/opportunities in other areas (21.8% and of males and 10.4% of females) and concerns around work/life balance (19.5% of females and 8.4% of males). There were also concerns from both males and females around lack of financial support and the competitive environment of space science.

Finally, respondents provided insights into their **career-related priorities for the future**. These primarily revolved around personal motivations, such as interest and self-development/using their skills and talents. Respondents also expressed altruistic motivations, linked to the environment, society and helping others, although these do not seem to be as strong as the desire to make new discoveries. Finally, while job security is important, respondents were less focused on salary expectations – with the majority not rating opportunities to earn high incomes as an important priority. There were no significant gender differences, with the exception of 'developing myself', which was a higher priority for females than males.

It is clear from these findings that initiatives to encourage individuals to consider space-related careers need to begin early (certainly by late primary school), and that girls in particular need to be offered a wide range of potential entry points to inspire their interest. Many initiatives identified as successful are relatively low-cost, and appeal to a wide age-range, such as books and magazines (or their modern, online equivalents) or stargazing experiences. Whilst teachers and parents/carers (especially fathers) have an influence in such decisions, those going into space careers appear to be self-driven, with a wide range of personal, professional and wider societal priorities. In particular it is important to maintain individuals' (especially girls') confidence and self-belief, as well as their interest in the field. Well-designed resources and activities that meet these requirements have the potential to foster lifelong interest in space science and engagement which, in turn, will hopefully encourage more – and more diverse – individuals to pursue careers in the field.

1. Introduction

As part of the evaluation of the Space Awareness project, a 'retrospective longitudinal' survey was conducted of individuals working and/or studying in space science. The survey was conducted to gather information about the career paths of these individuals and, importantly, to better understand the influence of various activities, experiences and individuals on their career-related motivations and choices. It is hoped that such information will provide valuable insights into ways that the interests of children and young people in space science can be nurtured, with the ultimate aim of encouraging more to consider pursuing study and careers in this field.

This report provides a summary of the analyses conducted on the data, which was gathered during 2015-16.

2. Data collection and analysis

2.1 Survey instrument

In developing the survey, the team drew on instruments used in previous research conducted in the United States and internationally (e.g. Maltese & Tai, 2010; Maltese, Melki, & Weibke, 2014). This research explored influences on the development and maintenance of interest in STEM particularly among practicing scientists. In addition to background/demographic questions (e.g. age, gender, nationality and whether they are working or studying), the survey included questions about sources of initial interest in space science (e.g. people, school, out-of-school experiences) and maintenance of that interest. The survey also sought to identify whether interest in space science developed initially or whether it emerged from a broader interest in science. Questions were included relating to parental support for interests in space science and the survey specifically investigated the development of career aspirations in science and space science. Further questions asked about career path, as well as barriers encountered along the way. A copy of the final survey instrument is included in Appendix C.

2.2 Participants

The survey was distributed using a range of routes, primarily via promotion at relevant conferences and seminars (e.g. [EPSC](#), [International Venus Conference](#), [Europlanet workshops](#)), as well as via newsletters and listservs (e.g. [Eurospace](#)). Personal contacts and networks were also utilised. We do not claim that the sample is truly representative, but the numbers responding suggest that the results are likely to capture a range of influences and experiences and thus may be useful in understanding more about the career paths and influences of those working in space science.

Over the duration of the survey (September 2015 through July 2016), responses were gathered from 415 individuals. The age and gender breakdowns of these respondents are demonstrated in Figure 1.

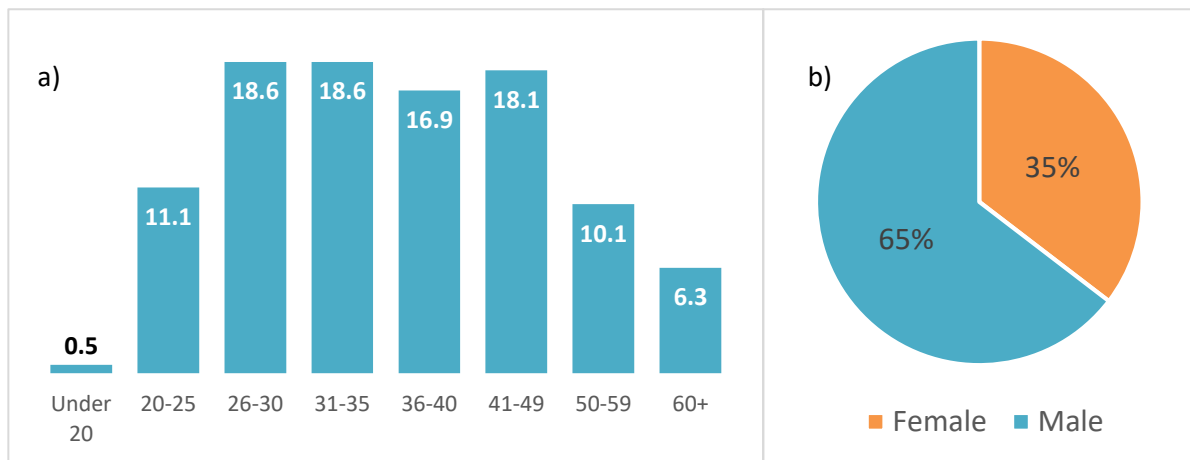


Figure 1 - Respondent demographic breakdowns (%): a) age and b) gender [n=415]

As shown in Figure 1, the responses were fairly evenly mapped across the majority of working-age population categories, with slightly lower levels of contribution from those aged 50 and above. Approximately twice as many males completed the survey as females.

The survey included an optional free-response question about ethnicity. Of the 357 responses, the vast majority indicated a White (and generally European) background. Only 17 respondents specifically indicated a non-White background, primarily South Asian.

Respondents worked in a range of countries, with the highest frequencies of responses from Spain (76), the United Kingdom (58), France (53), Germany (47) and Belgium (24). Nearly half (44.8%) report always having lived in the country in which they currently work/study.

105 respondents (25.3%) replied that they were students, most of whom (68) were doctoral students. (23 were Masters students.) Nearly all students reported space science-related subjects as their main fields of study, including aerospace engineering, astronomy, astrophysics, geology/geophysics, physics, planetary science and space science.

Of the non-student respondents, the vast majority were very highly educated. 242 (78.1%) reported having a doctoral degree and 39 (12.6%) had a Master's degree. Only 2 respondents said they only had a secondary school qualification.

Non-student respondents were also asked about the discipline of their highest level of education. The majority of these (261 – 84.2%) were in science, with 39 (12.6%) in engineering. Within science, the most frequent subject area was physics (60.5%). Within engineering, aerospace engineering was most frequently reported.

Of the 155 participants who responded to a question about the broad focus of their current job, 149 (96.1%) reported that their current work was related to space science.

Finally, respondents also reported whether or not they participated in any public engagement or outreach activity as part of their work and 73.6% said they did so. A range

of activities were described (this question was optional), but giving talks or presentations to members of the public (perhaps as part of some sort of science festival or ‘public conference’) or to schoolchildren seemed to be particularly prevalent. The main barriers to participating in more public engagement seemed to be time and family commitments, and language barriers for a few. Nevertheless, there was considerable enthusiasm among respondents for participating in this sort of activity.

2.3 Analysis

The survey data has been stored as an SPSS file and SPSS (v.21) has also been used for analysis. Descriptive statistics were used for an initial summary of the data and then further analyses, primarily utilising Chi-square tests, were employed to further explore patterns of responses to different questions, with a particular focus on gender.

3. Summary of results

This section presents the results of the survey, in particular focusing on respondents’ interest in space and space science (timing, influences, activities/support) and its link to career interests; the career paths taken and, finally, some information about memorable science-related experiences that respondents had along the way.

3.1 Interest in space and space science

Timings

One of the primary purposes of the survey was to trace the development of participants’ interest in science, and space science in particular, over time. Perhaps not surprisingly, over 2/3 of participants (70.4%) reported being interested in science before the age of 11, and even more (84.6%) reported being interested before age 14 (Figure 2).

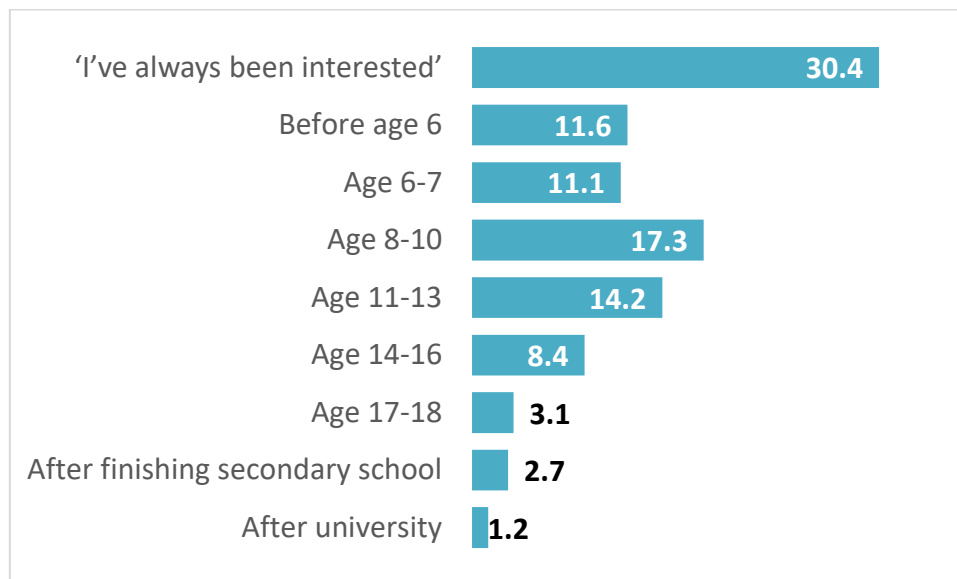


Figure 2 - Age at which first became interested in science [n=415]

In contrast, participants reported first becoming interested in space science in particular at slightly older ages (Figure 3). In this case, slightly over half (52.1%) reported first becoming interested in space science before the age of 11, with approximately 2/3 (67.5%) being interested before age 14. Based on responses to these questions, it would appear that interest in space science emerges out of an interest in science, rather than an interest in space science driving a broader interest in science.

However, this pattern may be due in part to the nature of the question, which required that participants to estimate the age at which they had a specific interest (compared with a more general interest). In addition, respondents were asked an open-ended question about which area of science they recall first being interested in. Of the 374 participants who responded to this question, nearly 2/3 (232 individuals, or 62%) gave an answer that could be categorised as related to space science, with 'astronomy' being particularly popular. In addition, a further 64 (17%) reported interests connected to physics or engineering.

It is also worth noting that this survey was distributed to people currently working within the space sector – so we would expect their level of interest in space science to be high, and it is not surprising that space science interest may have followed more general science interest. Conducting a similar survey with wider science professionals may produce the reverse pattern.

Finally, Chi-square tests revealed no gender differences in terms of age at which participants reported first being interested in science or in space science.

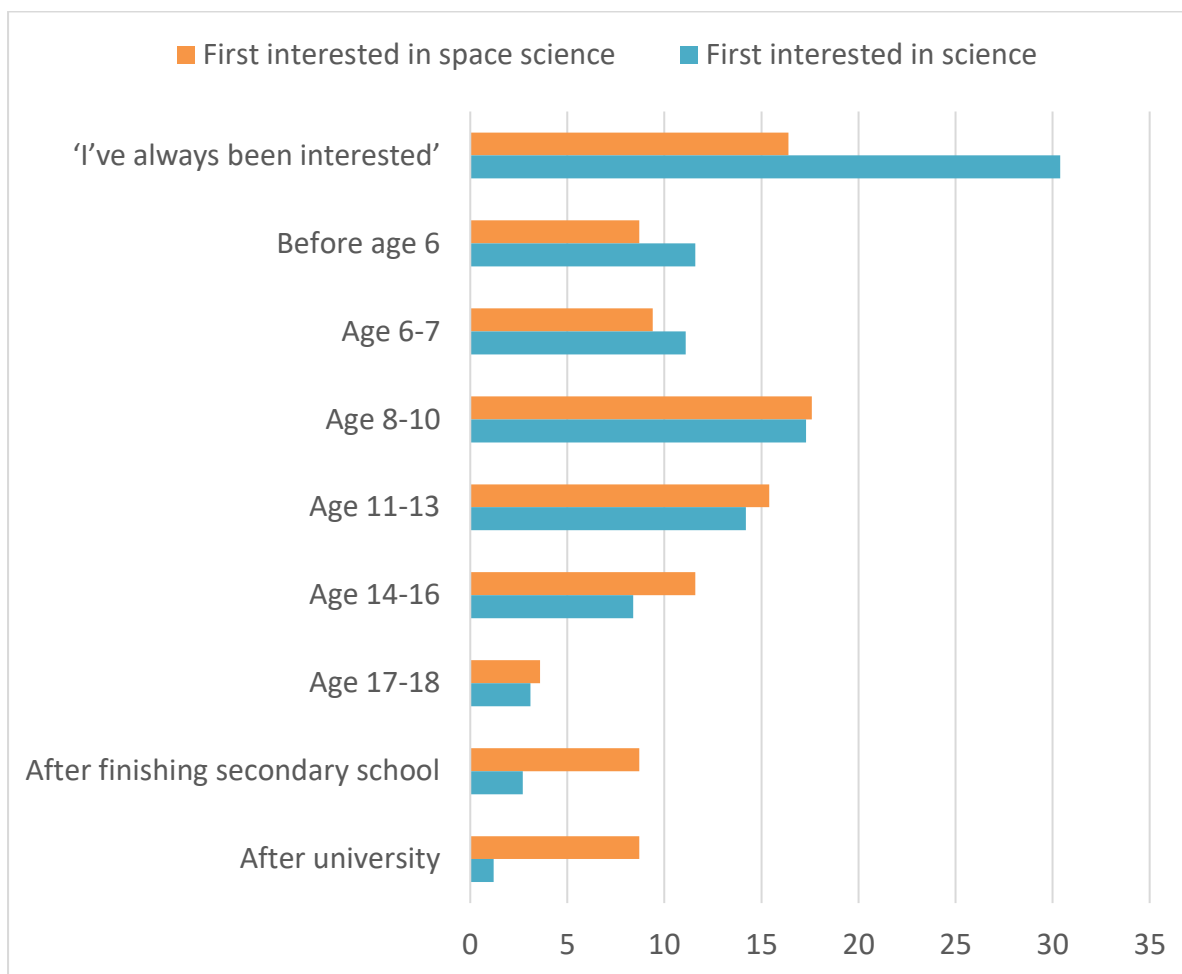


Figure 3 - Comparison of ages at which respondents became interested in science/space science specifically [n=374]

Initial influences

A wide range of activities and experiences were credited as providing that initial spark for respondents' interest in space science. However, a far smaller subset of six experiences, seen in Table 1 below, accounted for nearly 2/3 (62.7%) of the responses.

Response	Frequency	Percent
Books or magazines	131	32.3
Stargazing	32	7.9
Science fiction TV show or movie	30	7.4
Space race/moon landings/shuttle missions	25	6.2
Lessons in school	19	4.7
News reports about space-related discoveries	19	4.7

Table 1 - Experiences/activities that FIRST sparked interest in space science

Interestingly, and perhaps encouragingly, many individuals' interests were first sparked by experiences which could be considered to be relatively low-cost and accessible to many.

In answering the question about what experiences initially sparked interest in space science, respondents were given the opportunity to select additional responses, in the likely event that interest was sparked by more than one type of experience. (In other words, participants initially selected one 'main' influence as reported in Table 1, then optionally selected a series of 'additional' influences.) Responses reflected a generally similar pattern to that seen in Table 1 above. However, a wider range of contributing experiences to that initial spark is seen. More specifically, more than 20% of respondents ticked the following experiences as also contributing to the initial spark of interest in space science:

- Science fiction TV show or movie (28.0%)
- Books or magazines (27.7%)
- Interest in mathematics problems, logic games, or puzzles (25.8%)
- Using a telescope or camera (22.9%)
- News reports about space-related discoveries (22.2%)
- Visit to a museum, science centre or similar place (22.2%)
- Achieving highly in science and related subjects in school (21.7%)
- Home experiments/investigations (20.7%)
- Stargazing (20.0%)

[N.B., a smaller proportion of respondents ticked other activities as also contributing to the initial spark of interest. See Appendix A for full details.]

Analyses also explored the extent to which these experiences differed by gender – that is, whether males and females reported different experiences as first sparking their interest in space science. Although there was an overall gender difference in the pattern of responses¹, this difference was accounted for by contrasting perspectives in only a few activities. Specifically, males were more likely than females to say that board/video games, books/magazines, building/tinkering with objects, or building/programming computers that sparked their initial interest. In contrast, females were more likely than males to report that achieving highly in science or related subjects, or spending time outdoors provided that initial spark. In addition, females were more likely than males to report that there was no specific spark – that they had 'always been interested'.

In addition to asking about the experiences that sparked interest in space science, respondents were also asked **who** was most responsible for sparking this interest. As reflected in Figure 4, the majority of participants felt that they, themselves, were most responsible for sparking this interest, followed by much smaller proportions who identified fathers/male guardians and teachers as key influencers. Interestingly, there was no gender difference in terms of who respondents felt was most responsible for sparking their interest in space science ($p = .814$).

¹ $\chi^2(24)=61.164, p < .001$

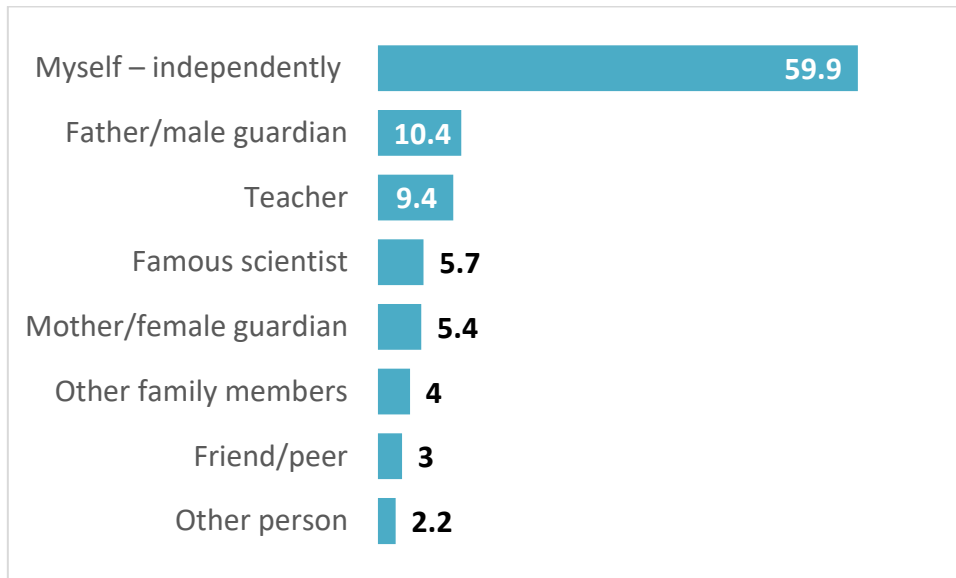


Figure 4 - WHO was most responsible for sparking interest in space science [n=404]

Maintenance of interest

Respondents were also asked about how their interest in space science was maintained after the initial spark and who helped support it at various ages. The results are presented in Table 2 & Figure 5², below. [Table 2 includes the main factors - see the Appendix for the complete list.]

In looking at Figure 5 and Table 2, some age-related trends are apparent. For instance, doing home experiments peaked in the 11-13 age range, and the influence of achieving highly in science seemed to increase over time, as did the desire to make new discoveries. Chi-square tests also confirmed that the following factors increased in importance with age:

- Career interest
- Desire to make a difference to society
- Achieving highly in science and related subjects
- Lessons or classes in school
- Research experience

In addition, websites related to space, and lab or research centre visits also became more important in maintaining interest with age, but overall, they represented a very small proportion of respondents. Conversely, the role of planetarium visits, building and tinkering and playing outdoors also decreased over time (although again, they represented a very small proportion of respondents).

² Due to the complicated nature of these data, both numeric and graphical representations have been provided, though they refer to the same information.

Response	Ages 6-10	Ages 11-13	Ages 14-18	Over 18
'I was not interested at this point'	18.1	9.4	5.1	1.0
Books or magazines	24.3	31.8	33.0	26.5
Career interest	1.4	4.3	12.0	31.6
Desire to make a difference to society	1.4	3.4	7.2	15.9
Desire to make new discoveries	5.8	9.6	15.2	27.2
Achieving highly in related science subjects or courses	4.1	10.4	20.7	21.2
Home experiments/investigations	8.9	14.0	8.4	3.4
Interest in mathematics/logic games/puzzles	8.7	16.6	20.5	16.4
Interest/passion for the field generally	11.1	17.8	25.1	28.7
Lessons or classes in school (or university) about space science	1.4	4.3	10.4	23.1
News reports about discoveries in space science	7.5	14.5	21.0	23.6
Research experience	0.5	1.2	2.7	26.5
Science fiction TV show or movie	9.4	16.9	20.2	16.6
Space race/moon landings/shuttle missions	9.2	12.3	15.2	16.1
Stargazing	9.6	15.9	16.4	16.9
Using telescopes or cameras	4.8	10.6	16.6	17.1

Table 2 - Factors considered important in maintaining interest in space science (%)

While not surprising, these patterns are indicative of the increasing importance of attainment in order to progress in science, as well as of increasing alignment between motivations (e.g. to make new discoveries) and the possibilities offered by the field. It is also noteworthy that generally, greater proportions of respondents agreed that particular experiences had a supporting influence at older ages than at younger, which is consistent with the way in which the proportions responding 'I was not interested at this time' decreased across older age categories.

Finally, some experiences seem to be regarded as motivational consistently over time (e.g. books/magazines). In contrast, other activities or experiences were so low that they were excluded from Table 2 and Figure 5 for the sake of brevity (e.g. board or video games; computer programming or building; economic necessity/opportunities; expectations of others that they would pursue a degree/career in science; clubs inside or outside of school related to space science; competitions; spending time outdoors; visits to planetariums, science centres/museums or laboratories/research centres; websites related to space. See Appendix B for full details.) In the main, however, responses to this question paint an informative picture of the kinds of activities that influenced interest in space science at various ages.

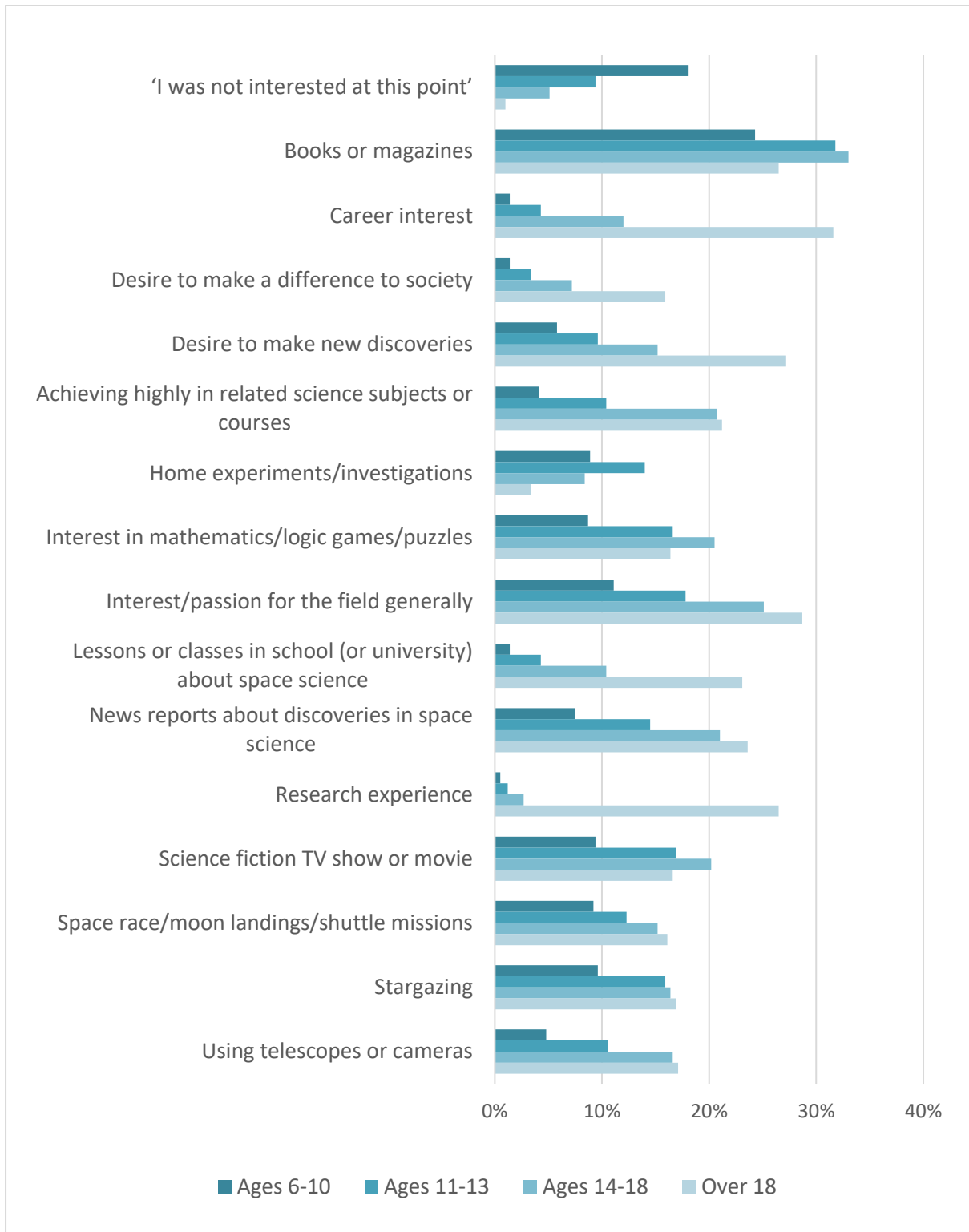


Figure 5 - Factors considered important in maintaining interest in space science (%)

Analyses also explored gender differences in the maintenance of interest at various ages and showed few differences overall, but Table 3 reflects the activities where there was a gender difference at particular ages. Activities listed under 'females' are those that females rated as more important than males at those ages and activities listed under 'males' are those that males rated more important than females at those ages.

	Females	Males
Ages 6-10	<ul style="list-style-type: none"> • Achieving highly in science-related courses • Home experiments/investigations • Interest in maths problems/puzzles/logic • Playing/spending time outdoors • Stargazing • Visiting planetarium or similar • Visiting science museum, science centre or similar 	
Ages 11-13	<ul style="list-style-type: none"> • Achieving highly in science-related courses • Interest in helping the environment • Interest in maths problems/puzzles/logic 	<ul style="list-style-type: none"> • Space race/moon landings
Ages 14-18	<ul style="list-style-type: none"> • Achieving highly in science-related courses • Clubs at school related to space science • Economic necessity 	<ul style="list-style-type: none"> • Board or video games • Computer programming or building • Space race/moon landings
Over 18	<ul style="list-style-type: none"> • Desire to make a difference to society • Expectations of others that I pursue a science degree or career • Research experience • Volunteer experience 	<ul style="list-style-type: none"> • Computer programming or building

Table 3 - Gender differences in factors which maintained interest in space science at various ages

Looking across these categories, it is somewhat striking that there is a large number of activities that were more important for females than males at a young age (6-10). While it is not possible to generalise (due to the relatively small numbers, and because respondents were able to select different numbers of responses), the pattern does reinforce the importance of providing girls in particular with a range of experiences and activities at an early age.

As with initial interests in space science, the survey also explored who was most responsible for supporting individuals' interests at various ages (Figure 6).

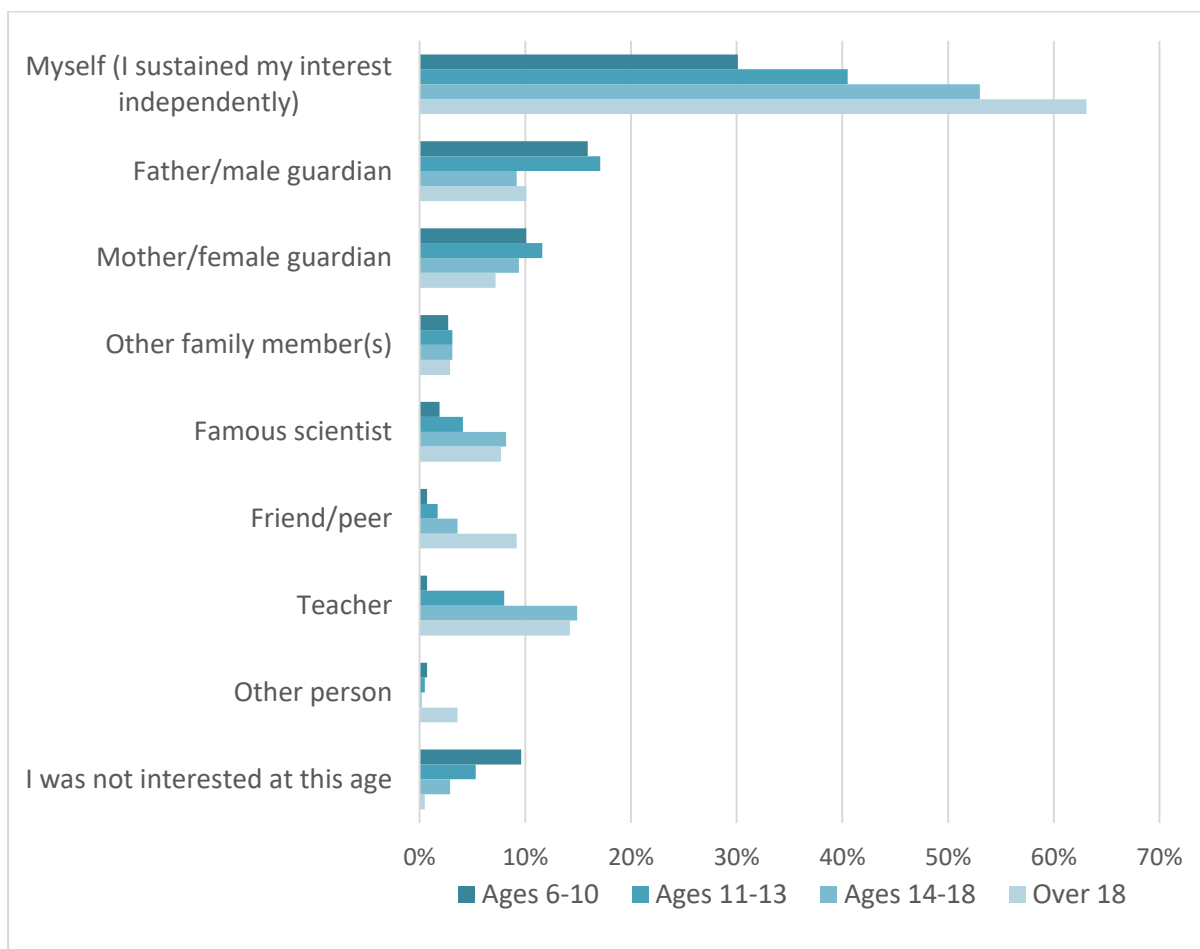


Figure 6 - Who was most responsible for supporting interests in space science

Consistent with the data about who sparked initial interests, self-sustaining interest was by far the most frequent reason given. In addition – though not surprisingly – individuals’ own initiative in nurturing their interests increased noticeably over time. Parents also appeared to have an influence, particularly fathers – though again, as would be expected, this influence decreased as respondents got older, while the influence of teachers grew stronger. There were no gender differences in who respondents felt was most supportive of their interests in space science.

Due to the prevalence of parental influence on the development of individuals’ interests and aspirations (even if not always explicitly acknowledged/recognised as such by individuals) (c.f., Archer & DeWitt, 2017; Maltese, Melki, & Wiebke, 2014; Maltese & Tai, 2010; Sonnert, 2009) additional questions were asked exploring the extent to which respondents felt their parents supported their science interests, as well as their non-science interests. On the whole, it was felt that parents were slightly more supportive of science interests than of non-science interests, though they were perceived to be quite supportive of both, as reflected in Figure 7 below.

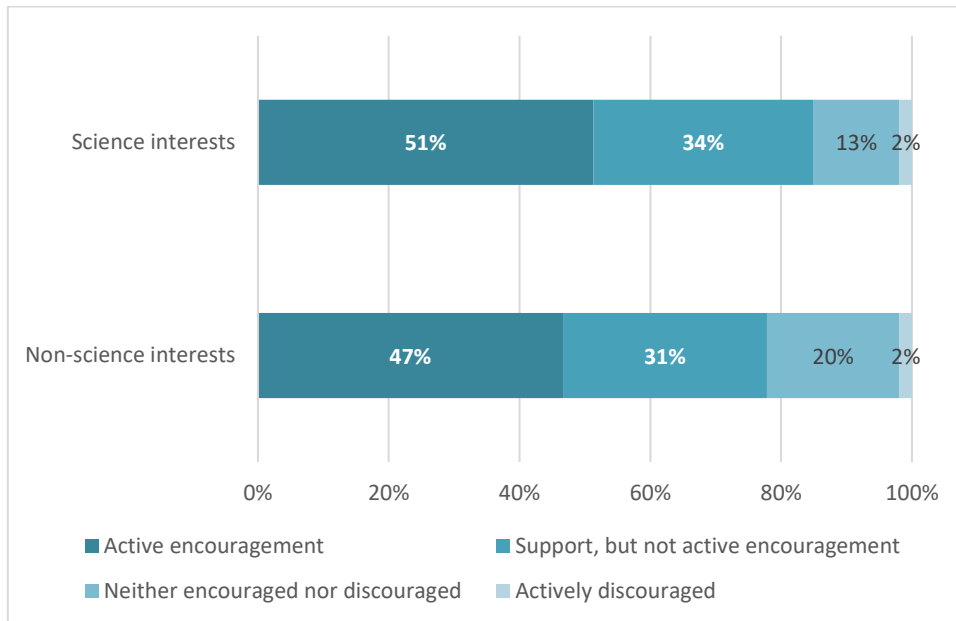


Figure 7 - Perceived parental support for interests

3.2 Career path

The survey explored the development of respondents' interests in careers, particularly related to science and space science, as well as the choices and paths they had actually taken.

Development of career interests

Thinking back to childhood, respondents reported having been interested in a range of careers, including teacher, doctor, and train driver. However, the majority of careers respondents recall first having been interested in were connected with science. Indeed, the top two response categories, and over 1/3 (36.4%) altogether were related to space science in particular. The top seven responses to this question about careers ('What is the first job you remember wanting as a career?'), accounting for nearly 2/3 of the survey participants, were:

- Astronaut/pilot (18.1%)
- Astrophysicist (9.3%)
- Scientist – other (9.3%)
- Astronomer (9.0%)
- Engineer (5.9%)
- Researcher (5.1%)
- Doctor (4.5%)

Chi-square analyses were used to explore this question by gender and although this was significant overall³, there were no gender differences on the most popular responses. That is, the proportion of respondents reporting that the first job they were interested in was an astronaut/pilot, astronomer, doctor and so forth did not differ significantly by gender.

Respondents were also asked specifically about what kinds of jobs *in science* they were initially interested in (*When you first thought about a career in SCIENCE, what job did you want?*) Although there was some shift (e.g. away from astronaut/pilot) compared to responses to the first question (about initial career interests – in or outside of science) the overall pattern of interest was quite similar:

- Astronomer (18.3%)
- Astrophysicist (18.3%)
- Researcher (13.1%)
- Astronaut/pilot (9.5%)
- Space scientist (9.3%)
- Scientist – other (9.3%)
- Engineer (8.7%)

A Chi-square test on the responses to this question (specifically about careers in science) reflected no gender difference overall. At the level of individual career types the proportion of males and females reporting that being an engineer was the first job in science they were interested in did differ significantly, with males being more likely than females to report engineering as the first science job they were interested in.

The survey also enquired at what ages respondents recall becoming interested in particular careers, the results of which are presented in Figure 8 below.

Consistent with previous research (e.g. Tai et al., 2006), it appears that amongst our respondents, individuals' interest in working in science developed fairly young (by the early part of secondary school). Interestingly, although the majority of respondents chose jobs related to science as the job they were first interested in, they reported being specifically interested in a science career a bit later. Moreover, what is clearer is that interest in careers in space science appeared to emerge noticeably later than interest in general science careers amongst this cohort. Chi-square analyses confirm that this pattern was significant overall⁴.

³ $\chi^2(27)=50.514, p < .01$

⁴ $\chi^2(14)=343.984, p < .0001$

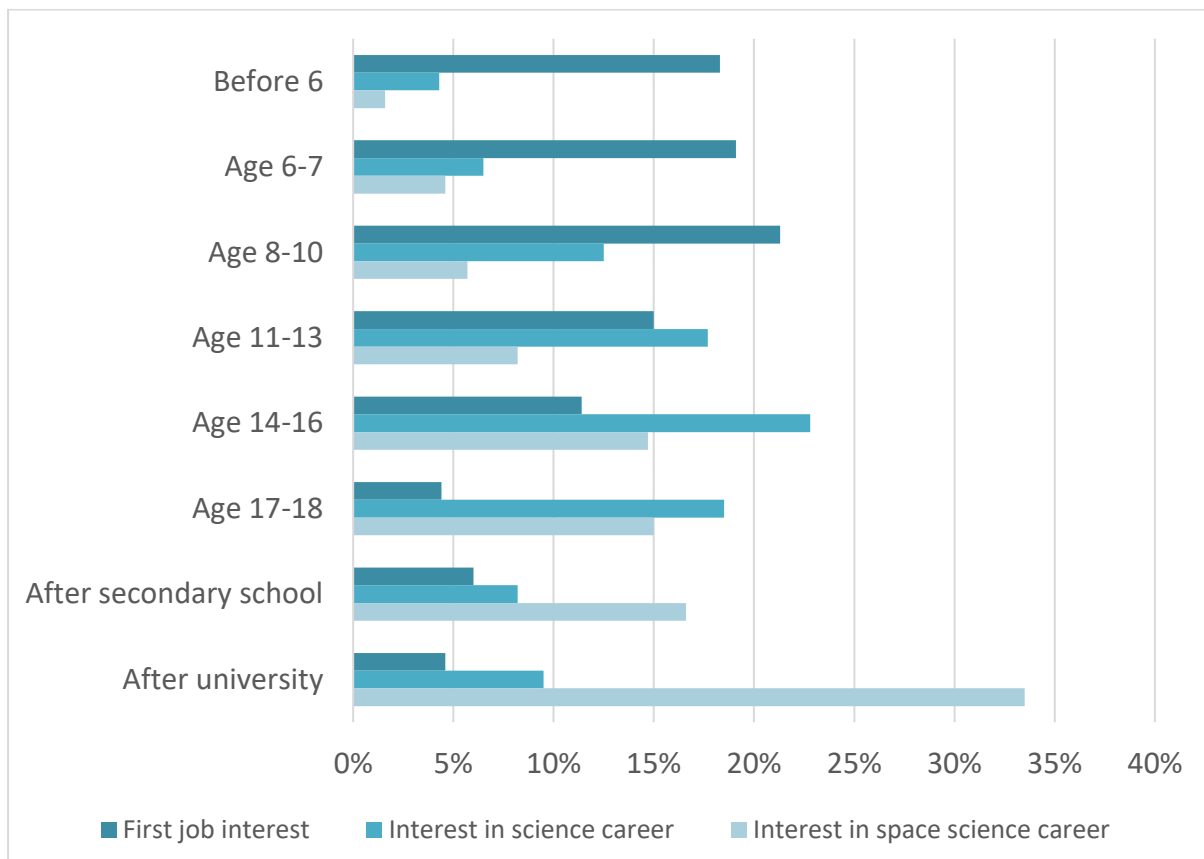


Figure 8 - Age of emerging career interests

Choices and priorities

Although it is a reasonable assumption that individuals' choices related to post-compulsory study and careers are related to their interest in those areas, previous research (e.g. Archer & DeWitt, 2017; Vidal Rodiero, 2007) has shown that other factors also have an influence, albeit smaller. The majority of our respondents (62.2%) reported enjoyment of the field/subject as the primary reason for selecting the field/discipline of their first degree. Additionally, a sizeable minority (18.2%) responded that the course provided background for a desired career, which can also be considered as related to interest (in a particular career). Fewer than 4% selected any of the remaining options (e.g. self-confidence in the field, attainment, parental or teacher encouragement, employment prospects) as the *primary* reason underpinning their choice.

However, individuals could also note *additional* reasons for their degree choice (in addition to the *primary* reasons just discussed), which reflects a slightly broader picture. In particular, a substantial proportion of respondents noted that attainment (27.7%) or self-confidence in their ability to succeed (23.6%) were also influential on their decisions. Encouragement from teachers (10.1%) and parents (9.4%) also seemed to have some role to play, albeit for fewer individuals. There were no gender difference in reasons respondents gave for the selection of the field/discipline of their first degree (whether the primary reason or additional reasons).

In addition to retrospective justifications for choice of study, the survey also looked forwards, exploring respondents' priorities for the future, which gives a picture of their perceptions of the field of space science. The importance individuals placed on various future priorities for their career paths are summarised in Figure 9 below.

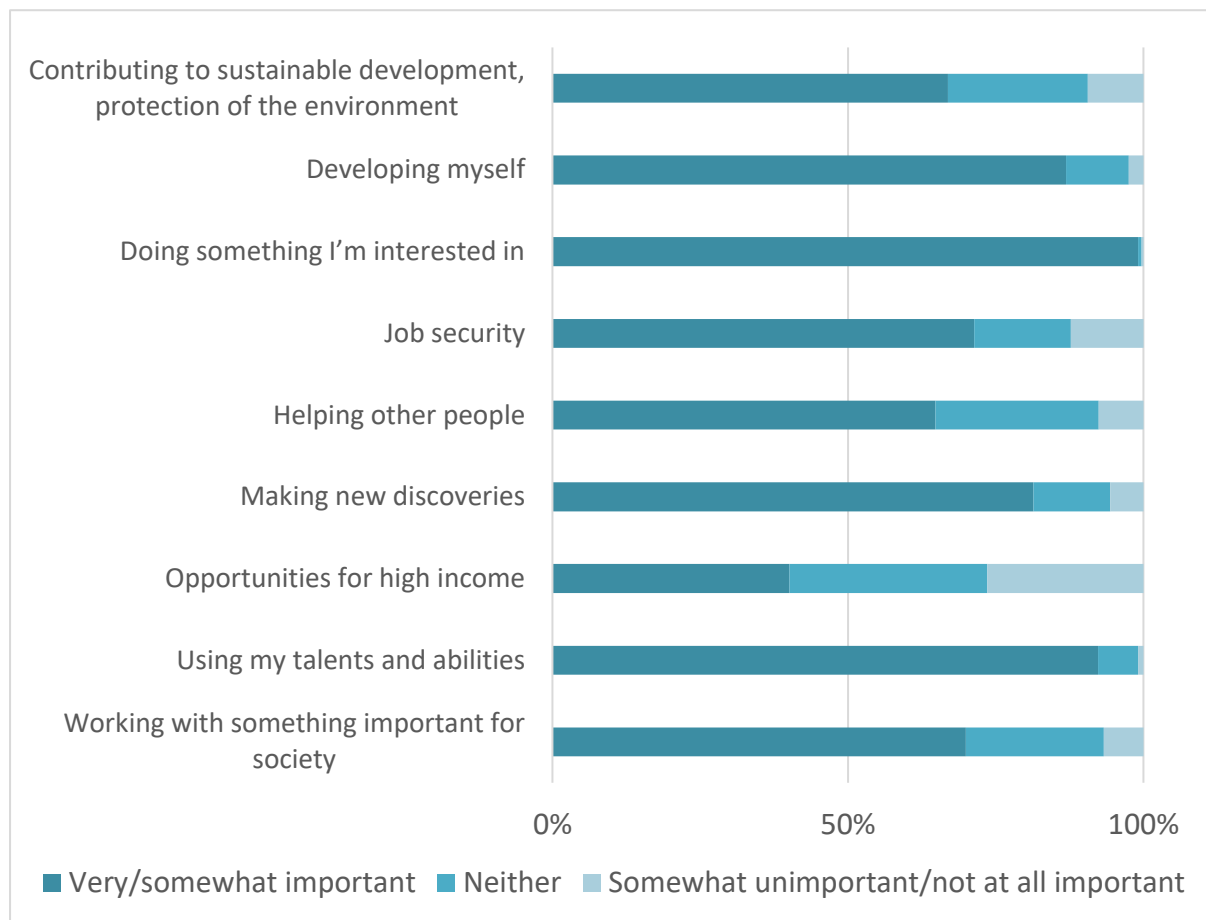


Figure 9 - Priorities for future career choices

In alignment with reasons for degree choices – or reasons for entering into the field in the first place – it seems that respondents' priorities for the future also revolve around personal motivations, such as interest and self-development/using their skills and talents. Respondents also expressed altruistic motivations, linked to the environment, society and helping others, although these do not seem to be as strong as the desire to make new discoveries. Finally, while job security is important, respondents were less focused on salary expectations – with the majority not rating opportunities to earn high incomes as an important priority. Chi-square analyses confirmed these patterns⁵, reflecting that interest, using their talents and abilities, self-development and making new discoveries are important drivers for career-related choices by current space scientists. In contrast, opportunities for high income would seem to be less of a motivating factor.

⁵ $\chi^2(16) = 541.233, p < .0001$

Analyses also explored gender differences in these priorities. Somewhat surprisingly, there were no significant differences, with the exception of 'developing myself', which was a higher priority for females than males⁶.

Despite these priorities, a slight majority (55.2%) of respondents reported having thought seriously about leaving space science for another field of study or work. Of these, the most frequent response was poor career prospects (selected by 24.0% of respondents who answered this question). This was followed by career interests/opportunities in other areas and concerns around work/life balance. There were also concerns around lack of financial support and the competitive environment of space science.

There were no gender differences in whether respondents had considered leaving space science, with 58.1% of female respondents and 53.5% of male respondents affirming that they had seriously considered leaving the field. Moreover, a Chi-square analysis of gendered patterns in the reasons for considering leaving was also not significant⁷. However, comparing the proportions of males and females who ticked each reason as their primary reason for considering leaving revealed a couple of differences, namely, females were more likely to consider leaving due to concerns about work-life balance (19.5% of females and 8.4% of males selected this as their primary reason for considering leaving). Additionally, males were more likely to consider leaving a career in space science due to interest/opportunities in other areas. (21.8% of males and 10.4% of females selected this as their primary reason to consider leaving.)⁸

3.3 Memorable experiences

It is clear from the data thus far that interest in space science – and in science broadly – is something that develops over time, under the influence of others as well as individuals' own enjoyment and initiative. While interest development is incremental, and choices related to careers are influenced by a myriad of interlocking factors, persistence in science can also be influenced by key experiences that are highly salient to individuals. Thus, the survey also enquired about respondents' most memorable science experiences and their impact on their persistence in the field. Of the 342 participants who responded to this question, 26.9% said their most memorable experience was school-related, while the majority reported it as being related to educational (35.1%) or non-educational (31.9%) experiences outside of school. These responses did not differ by gender.

⁶ $t(355) = 3.347, p < .05$

⁷ $p = .199$

⁸ It is worth noting, however, that there could be further gender differences in reasons individuals consider leaving – or leave – the field of space science. Recall that only respondents who agreed they had thought seriously about leaving answered this question, so the sample size was quite small ($n=202$). Moreover, respondents could only select a single reason, so the numbers responding to many of the choices were too small to allow for statistical comparisons. Finally, the sample did not include individuals who had already left the field.

Additionally, nearly 1/3 (29.5%) said that a teacher or faculty member was the person most associated with this experience, while 15.3% reported a parent or guardian playing this role. However, 27.7% reported it as being 'personal and independent of other individuals', perhaps reflective of the way in which respondents throughout the survey frequently described their interest and pursuit of space science as self-motivated. Overall, differences by gender in terms of who was most associated with the memorable experience approached significance⁹, with the only difference being around the association of a famous scientist with the most memorable experience. Specifically, 12.6% of males and 5.6% of females reported that a famous scientist was associated with their most memorable experience.

Perhaps not surprisingly, the vast majority (90.9%) rated their most memorable experience as having a positive impact on their persistence in science, with 42.1% agreeing it was a major reason they wanted to pursue science. Responses to this question did not differ by gender.

Over 80 individuals were willing to share this memorable experience with us, and these responses highlight a range of experiences. We cannot make generalisations because not all respondents provided details about their memorable experience, but those that were provided highlight the memorability of experiences related to pop culture (television and film), reading/books, teachers, stargazing/looking through telescopes, visits (e.g. to planetariums or even universities), extracurricular clubs in school, astronomical events (e.g. eclipses) or space exploration events (e.g. moon landings). It is also noteworthy that many of these experiences also involved family members. For instance:

My dad and I went to the London Planetarium and it was the most magical thing I had ever seen.

Doing experiments with my brother.

A number of respondents also described what might be categorised as involving content that was particularly memorable:

Understanding that our atoms were made in a star.

A number of responses were also quite personal and poignant:

I stood a few metres from Yuri Gagarin, at the time, the only human to have left planet Earth. This was a mind-boggling experience that shaped my future life.

A teacher at my school offered a weekly astronomy course (in his free time!) where we either went out to the next field to observe planets, galaxies, etc., or had 'lectures' during bad weather about everything in the universe we were interested in. I did study mathematics first but came back to astronomy because I enjoyed the topic that much in school!

I saw Saturn and its rings through a telescope in my back garden aged about 15. I had been lent the telescope and set it up myself over many evenings. It was truly inspirational.

⁹ $\chi^2(6) = 12.236, p = .057$

Some memories also reflected the way in which negative experiences could act as a motivation for more positive or determined action, which highlights the complex way in which experiences can interweave to shape the development of interests and career pathways.

There are actually two experiences: one teacher (early on) had sparked my interest in the sciences and supported me throughout school to pursue this. Another teacher was spending huge efforts on making my life difficult and convincing me that women were not suited for natural sciences. Funnily both made me more determined to pursue that interest.

Stargate was a TV show broadcasted from 1997 to 2007, thus I've been watching it over a long period, which included my adolescence. During this time, I guess a child/teenager is quite sensitive to any forms of input, and I chose this TV show to become my favorite ever. Of course it is science fiction, but it covers a range of issues related to space science, e.g., exoplanets, life on other planets, space travel, evolution of humanity, politics etc. which really attracted me. It might sound stupid, but I can even imagine, if I hadn't watched this show, I might not be where I am now, due to parental expectations and the fact that there is almost no overlap of this field with school. I actually wished, my parents had given me more attention and seen my passion as a real one. I might not have struggled that much in the beginning after secondary school (Though I had good grades, I thought I couldn't do it, not enough self-esteem).

Overall, the responses highlight both the range of experiences that can influence interest in space science, as well as the key role of teachers and family members, in both positive and negative directions.

3.4 Acknowledged limitations

As with any survey, there were unavoidable limitations which should be borne in mind when interpreting the findings.

- As noted previously, we do not claim that this sample is representative, due to the way in which participants were recruited (primarily via mailing lists/listservs and conferences). In addition, because participation was voluntary, participants were likely those with the time and interest in sharing their experiences. Nonetheless, broadly speaking we have no reason to believe that the sample participating in the survey differed from the broader population of space scientists in any systematic way.
- When considering influences on and timings of the development of interests in space science, generalisations and conclusions are limited by the fact that nearly all of the participants are working or studying in fields related to space science. It is possible that early experiences of space science could act as a spark for interests that then translated into pursuit of study or careers in other STEM areas. However, individuals whose responses could help address that question did not form part of our sample.
- When considering the timing of the development of interests in space science, it is important to recall that participants have the benefit of hindsight, meaning that various experiences and influences (particularly from childhood) may be recalled or interpreted in a different light by the time they are adults. However, this form of bias affects any sort of retrospective survey and should operate in comparable ways.

- As with any survey, responses (and memories) are situated and contextualised in a particular time and place. For instance, technological advances mean that many of the influences mentioned by older respondents may no longer be directly applicable and, likewise, factors influencing the interests of current students may not have existed when some respondents were young (and thus would not be reflected in their answers).

Despite these limitations, the number of respondents, as well as the range of their experiences within space science, suggests that a range of experiences and career trajectories have likely been captured. Thus, we argue that the survey can be useful in providing insight into influences and pathways in space science.

4. Conclusions

The analyses contained in this report aimed to explore the influence of various activities, experiences and individuals on the career-related motivations and choices of individuals working or studying in space science. The responses of the 415 participants (individuals working or studying in areas related to space science) provided some useful insights, particularly into the kinds of experiences that seem to have sparked and maintained interest in space science as they progressed towards further study and into work.

For many, interest in science emerged at very young ages – and nearly always by age 13. Although interest in space science seemed to appear slightly later, for most it happens by the time they are only part-way through secondary school. In addition, interest in science careers, and in careers related to space science in particular, emerged for many respondents at quite young ages. These patterns, while not unexpected, reinforce the importance of working with younger children (e.g. primary school level), to spark interest in space science.

The survey also explored the maintenance of interest over time and highlighted the variety of influences and individuals involved in this process. At the same time, some activities emerged as important for many participants – for instance, almost 1/3 of participants credited books and magazines as important in sparking their interest in space science and nearly as many noted their role in maintaining that interest. Activities such as stargazing were also cited by many as impacting the development of interest in space science. Another influence that was apparent throughout our data was that of space science ‘events’ (e.g. moon landing, shuttle missions) on the development of interest. This pattern also suggests that such events – or news items about discoveries and advances – may be good levers to spark or maintain interest. Online experiences (e.g. websites) appeared to be less influential on our respondents. However, given that the majority of our respondents were over 30 (with much if not all of their childhood pre-internet) and given the current pervasiveness of the internet, reading online may be quite an important route to sparking and maintaining interest in space science among current schoolchildren.

An important thread that runs through many of these experiences and activities (and could also be applied to online engagement today) is their relatively low-cost and accessible nature. Moreover, many respondents asserted that they were independently responsible for sparking and maintaining their own interest in the topic. This perception reinforces the importance of providing resources that are easily accessible to children and young people as individuals, rather than focusing purely on mediated interactions (where the involvement

of an external adult is required). At the same time, the role of parents and teachers in supporting the development of interest in space science is also clear, suggesting that resources for use in family environments as well as in the classroom would be beneficial.

Despite unequal gender balance in space science as a field, gender differences in the survey data were quite minimal. The main area in which any differences were found concerned the kinds of experiences that had sparked and then maintained interest in space science. These differences only appeared in a few activities, with males reporting games, reading, tinkering and computers being more influential, while females were more likely to report being influenced by achieving highly, and spending time outdoors. In addition, a larger number of activities seem to have been central to the maintenance of interest among females, compared with males. Together, this highlights the importance of providing a range of opportunities to engage with space science and avoiding the assumption that a single type of activity or experience will necessarily be engaging for boys and girls alike.

There were also no gender differences in the age at which interest in space science emerged and only minimal differences in priorities for career choices (with more females than males prioritising 'developing myself') or reasons for considering leaving the field. Whilst perhaps surprising, this pattern of minimal gender differences echoes that of research conducted with individuals working in other areas of physical science (Maltese et al., 2014). It also may be due to the fact that respondents had already chosen to study or work in space science – so females who felt that space science was not for them, or who had otherwise been discouraged from following that path for gender-related reasons, were not represented in the survey sample.

Despite the limitations of the sample, the congruence of the findings with previous research suggests that the implications of the work for nurturing interest in space science are likely to be valid and provide a good starting point for resource development. It is clear from these findings that initiatives to encourage individuals to consider space-related careers need to begin early (certainly by late primary school), and that girls in particular need to be offered a wide range of potential entry points to inspire their interest. Many initiatives identified as successful are relatively low-cost, and appeal to a wide age-range, such as books and magazines (or their modern, online equivalents) or stargazing experiences. Whilst teachers and parents/carers (especially fathers) have an influence in such decisions, those going into space careers appear to be self-driven, with a wide range of personal, professional and wider societal priorities. In particular it is important to maintain individuals' (especially girls') confidence and self-belief, as well as their interest in the field. Well-designed resources and activities that meet these requirements have the potential to foster lifelong interest in space science and engagement which, in turn, will hopefully encourage more – and more diverse – individuals to pursue careers in the field.

5. References

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Appendix A

Experiences/activities that ALSO sparked initial interest in space science

Response	Frequency	Percent
Science fiction TV show or movie	116	28.0
Books or magazines	115	27.7
Interest in maths problems/logic games/puzzles	107	25.8
Using a telescope or camera	95	22.9
News reports about space-related discoveries	92	22.2
Visit to a museum, science centre or similar place	92	22.2
Achieving highly in science and related subjects in school	90	21.7
Home experiments/investigations (microscope, chemistry kit)	86	20.7
Stargazing	83	20.0
Visit to a planetarium or similar place	81	19.5
Space race/moon landings/shuttle missions	72	17.3
Lessons in school	69	16.6
Building/tinkering/taking apart mechanical obj or electronics	58	14.0
Playing or spending time outdoors	41	9.9
Computer programming or building	40	9.6
Other TV show or movie	37	8.9
Visit to a laboratory, research centre or similar	35	8.4
Board or video games	34	8.2
No specific event – always interested	23	5.5
Club OUTSIDE of school related to science (including space sci)	22	5.3
Website related to space science	19	4.6
Expectations of others (to pursue career in this area)	16	3.9
(Other)	15	3.6
Club at school related to science (incl space science)	15	3.6
Science fairs or competitions	11	2.7
Volunteer experience	6	1.4

Appendix B

Factors important in maintaining interest in space science (complete list)

Response	Ages 6-10	Ages 11-13	Ages 14-18	Over 18
'I was not interested at this point'	18.1%	9.4%	5.1%	1.0%
Board or video games	2.7%	4.3%	7.0%	6.3%
Books or magazines	24.3%	31.8%	33.0%	26.5%
Building/tinkering	6.3%	10.4%	10.8%	9.2%
Career interest	1.4%	4.3%	12.0%	31.6%
Club at school rel to space sci	0.2%	1.7%	5.1%	1.9%
Club outside of school rel to space sci	1.2%	2.7%	6.0%	5.8%
Computer programming or building	1.7%	3.6%	8.2%	13.3%
Desire to make a difference to society	1.4%	3.4%	7.2%	15.9%
Desire to make new discoveries	5.8%	9.6%	15.2%	27.2%
Economic necessity/opportunities	0.2%	0.2%	1.0%	6.0%
Expectations of others	0.5%	1.4%	3.9%	4.1%
Achieving highly in related science subjects or courses	4.1%	10.4%	20.7%	21.2%
Home experiments/investigations	8.9%	14.0%	8.4%	3.4%
Interest in helping the environment	1.0%	2.7%	4.3%	8.0%
Interest in mathematics/logic games/puzzles	8.7%	16.6%	20.5%	16.4%
Interest/passion for the field generally	11.1%	17.8%	25.1%	28.7%
Lessons or classes in school (or university) about space science	1.4%	4.3%	10.4%	23.1%
Maths or science competitions	0.2%	3.4%	7.7%	2.7%
News reports about discoveries in space science	7.5%	14.5%	21.0%	23.6%
Playing/spending time outdoors	8.2%	8.7%	6.0%	5.1%
Research experience	0.5%	1.2%	2.7%	26.5%
Science fiction TV show or movie	9.4%	16.9%	20.2%	16.6%
Other TV show or movie	6.3%	7.5%	8.0%	6.7%
Space race/moon landings/shuttle missions	9.2%	12.3%	15.2%	16.1%
Stargazing	9.6%	15.9%	16.4%	16.9%
Using telescopes or cameras	4.8%	10.6%	16.6%	17.1%
Visiting planetarium or similar	8.2%	10.6%	12.5%	13.3%
Visiting museum, science centre or similar	7.5%	12.5%	13.0%	16.9%
Visiting lab, research similar or similar	2.2%	2.4%	6.0%	18.3%
Volunteer experience	0.2%	0.7%	2.2%	7.5%
Website related to space science	0.7%	1.7%	6.7%	11.6%
Other	1.0%	1.2%	1.2%	2.4%

Appendix C

The following pages contain the final version of the survey questions distributed to the respondents.



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Scientist survey Feb 2016

Welcome!

Q1: In order to begin the survey, please agree to the following items by ticking the boxes next to each one.

- I understand that I can stop responding to this survey at any time, without giving a reason.
- I understand that my responses will be confidential and I will not be identifiable in any reports or publications arising from this research.
- I understand that providing my contact information is optional.
- I understand that any contact information provided will be seen by the research team only and will not be used for any purpose other than in the unlikely event that I need to be contacted to follow up on specific responses.

Your Background

This section asks some basic background questions about you and your education. Such information can be extremely useful in communicating to current students about people who study or work in space science.

Q2: What is your age?

- under 20
- 20-25
- 26-30
- 31-35
- 36-40
- 41-49
- 50-59
- 60+

Q3: I am...

- Female
- Male
- Prefer not to answer

Q4: How would you describe your ethnicity?

Q5: In which country do you currently work?

- Austria
- Belgium
- Bulgaria
- Croatia
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Netherlands
- Norway
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden
- United Kingdom
- Other

If 'Other' please specify here

Q6: Have you always lived in this country?

Yes No

If 'no' then what country did you mostly grow up in?

Q7: Are you currently a student?

Yes No

Your current studies

This section asks questions about the course you are currently studying.

Note: if you have answered/chosen item [2] in question 7, skip the following question

Q8: What is the level of your current course?

Technical qualification Degree level (undergraduate) Masters
 Doctorate Other

If 'Other' please specify here

Note: if you have answered/chosen item [2] in question 7, skip the following question

Q9: What is your main subject area of study?

Previous Education

This section asks about your previous education (i.e. please do not include information about any current studies here).

Note: if you have answered/chosen item [1] in question 7, skip the following question

Q10: What is your highest level of previous education?

- High school
- University degree
- Master's degree
- Doctoral degree
- Technical qualification
- Master's level - started work but did not complete
- Doctoral level - started work but did not complete
- Other

If 'Other' please specify here

Note: if you have answered/chosen item [1] in question 7, skip the following question

Q11: Was your highest level of education in a science or engineering related subject/discipline?

- Science
- Engineering
- Neither

Note: if you have answered/chosen item [1] in question 7, skip the following question

Q12: How related is your current job to the subject matter of your highest academic degree?

- Not related
- Minimally related
- Moderately related
- Closely related
- N/A

Science Discipline

Note: if you have answered/chosen item [1] in question 7, skip the following question

Note: if you have answered/chosen item [3] in question 11, skip the following question

Note: if you have answered/chosen item [2] in question 11, skip the following question

Q13: Please identify the science discipline most closely associated with your highest level of education:

- Biology/life science
- Chemistry
- Earth science/geology
- Environmental science
- Physics
- Other: please specify

If you have chosen "other", please specify:

Engineering Discipline

Note: if you have answered/chosen item [1] in question 7, skip the following question
Note: if you have answered/chosen item [3] in question 11, skip the following question
Note: if you have answered/chosen item [1] in question 11, skip the following question

Q14: Please identify the engineering discipline most closely associated with your highest level of education:

- | | | | |
|----------------------------------|---------------------------------|----------------------------------|---|
| <input type="radio"/> Aerospace | <input type="radio"/> Chemical | <input type="radio"/> Civil | <input type="radio"/> Electrical |
| <input type="radio"/> Industrial | <input type="radio"/> Materials | <input type="radio"/> Mechanical | <input type="radio"/> Other (please specify): |

If you have chosen "other", please specify:

Other Discipline

Note: if you have answered/chosen item [1] in question 7, skip the following question
Note: if you have answered/chosen item [1] in question 11, skip the following question
Note: if you have answered/chosen item [2] in question 11, skip the following question

Q15: Please identify the field of study of your highest level of education:

Sparking your interest in science

This section focuses on how you **initially** became interested in science generally, and space science specifically, and who helped to encourage that initial interest.

Q16: Approximately when do you remember first becoming interested in SCIENCE?

- | | | |
|---|--|--|
| <input type="radio"/> I've always been interested | <input type="radio"/> Before age 6 | <input type="radio"/> Age 6-7 |
| <input type="radio"/> Age 8-10 | <input type="radio"/> Age 11-13 | <input type="radio"/> Age 14-16 |
| <input type="radio"/> Age 17-18 | <input type="radio"/> After finishing secondary school | <input type="radio"/> After university |

Q17: What area(s) of science do you remember first being interested in?

Q18: Approximately when do you remember first becoming interested in SPACE SCIENCE?

- | | | |
|---|--|--|
| <input type="radio"/> I've always been interested | <input type="radio"/> Before age 6 | <input type="radio"/> Age 6-7 |
| <input type="radio"/> Age 8-10 | <input type="radio"/> Age 11-13 | <input type="radio"/> Age 14-16 |
| <input type="radio"/> Age 17-18 | <input type="radio"/> After finishing secondary school | <input type="radio"/> After university |

Q19: What type of experience or activity FIRST sparked your interest in SPACE SCIENCE? If you have more than one answer, please select up to four additional activities under the column marked 'ADDITIONAL'.

	FIRST	ADDITIONAL
Board or video games	<input type="radio"/>	<input type="checkbox"/>
Books or magazines	<input type="radio"/>	<input type="checkbox"/>
Building/tinkering/taking apart mechanical objects or electronics	<input type="radio"/>	<input type="checkbox"/>
Club at school related to science (including space science)	<input type="radio"/>	<input type="checkbox"/>
Club OUTSIDE of school related to science (including space science)	<input type="radio"/>	<input type="checkbox"/>
Computer programming or building	<input type="radio"/>	<input type="checkbox"/>
Expectations of others for you to pursue a degree or career in this area	<input type="radio"/>	<input type="checkbox"/>
Achieving highly in science and related subjects in school	<input type="radio"/>	<input type="checkbox"/>
Home experiments/investigations (with microscope, chemistry kit, etc.)	<input type="radio"/>	<input type="checkbox"/>
Interest in mathematics problems/logic games/puzzles	<input type="radio"/>	<input type="checkbox"/>
Lessons in school	<input type="radio"/>	<input type="checkbox"/>
News reports about space-related discoveries	<input type="radio"/>	<input type="checkbox"/>

Playing or spending time outdoors	<input type="radio"/>	<input type="checkbox"/>
Science fair or competition	<input type="radio"/>	<input type="checkbox"/>
Science fiction TV show or movie (e.g. Star Trek)	<input type="radio"/>	<input type="checkbox"/>
Other TV show or movie	<input type="radio"/>	<input type="checkbox"/>
Space race/moon landings/shuttle missions	<input type="radio"/>	<input type="checkbox"/>
Stargazing	<input type="radio"/>	<input type="checkbox"/>
Using a telescopes or camera	<input type="radio"/>	<input type="checkbox"/>
Visit to a planetarium or similar place	<input type="radio"/>	<input type="checkbox"/>
Visit to a museum, science centre or similar place	<input type="radio"/>	<input type="checkbox"/>
Visit to a laboratory, research centre or similar (e.g. CERN, observatory)	<input type="radio"/>	<input type="checkbox"/>
Volunteer experience	<input type="radio"/>	<input type="checkbox"/>
Website related to space science	<input type="radio"/>	<input type="checkbox"/>
No specific event – I remember ALWAYS being interested	<input type="radio"/>	<input type="checkbox"/>
Other (please specify in the box below)	<input type="radio"/>	<input type="checkbox"/>

If 'Other' please specify here

Q20: Who was MOST responsible for sparking your initial interest in SPACE SCIENCE? If there was more than one person, please indicate this in the column labelled 'ADDITIONAL';.

	MOST RESPONSIBLE	ADDITIONAL
Myself - I grew interested in space science independently	<input type="radio"/>	<input type="checkbox"/>
Father/male guardian	<input type="radio"/>	<input type="checkbox"/>
Mother/female guardian	<input type="radio"/>	<input type="checkbox"/>
Other family members (Please specify below)	<input type="radio"/>	<input type="checkbox"/>
Famous scientist or science personality (Please name below)	<input type="radio"/>	<input type="checkbox"/>
Friend/peer	<input type="radio"/>	<input type="checkbox"/>
Teacher	<input type="radio"/>	<input type="checkbox"/>
Other person (Please specify below)	<input type="radio"/>	<input type="checkbox"/>

If 'Other' please specify here

Q21: If you remember any specifics about the event or experience that first sparked your interest in SPACE SCIENCE, please tell us more about it in the box below.

Maintaining your interest in science

This section asks questions about how your interest in space science was **maintained** and who helped support that interest.

Q22: Which of the following were the most important factors in maintaining your interest in SPACE SCIENCE beyond the experience that initially interested you?

Please indicate the MOST IMPORTANT factor in each age range:

	Ages 6-10	Ages 11-13	Ages 14-18	Over 18
I was not interested at this point	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Board or video games	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Books or magazines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Building/tinkering/taking apart mechanical objects or electronics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Career interest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Club at school related to space science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Club OUTSIDE of school related to space science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computer programming or building	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Desire to make a difference to society	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Desire to make new discoveries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economic necessity/opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Expectations of others for you to pursue a degree or career in science (including space science)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Achieving highly in related science subjects or courses (including space science)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Home experiments/investigations (with microscope, chemistry kit, etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interest in helping the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interest in mathematics problems/logic games/puzzles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Interest/passion for the field generally	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lessons or classes in school (or university) about space science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mathematics or science competitions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
News reports about discoveries in space science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Playing or spending time outdoors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Research experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Science fiction TV show or movie (e.g. Star Trek)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other TV show or movie	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Space race/moon landings/shuttle missions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stargazing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using telescopes or cameras	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visiting a planetarium or similar place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visiting a museum, science centre or similar place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visiting a laboratory, research centre or similar (e.g. CERN, observatory)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Volunteer experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Website related to space	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If 'Other' please specify here

Q23: Who do you feel was MOST responsible for supporting/advancing your interest in SPACE SCIENCE beyond the event that sparked your initial interest?

	Age 6-10	Age 11-13	Age 14-18	Over 18
Myself - I sustained my interest in space science independently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Father/male guardian	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mother/female guardian	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other family member(s) (Please specify below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Famous scientist or science personality (Please name below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Friend/peer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teacher	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other person (Please specify below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was not interested at this age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If 'Other' please specify here

Q24: How supportive were your parents/guardians of your SCIENCE interests while you were growing up?

- They actively encouraged my interest
- They supported but did not actively encourage my interest
- They neither encouraged nor discouraged my interest
- They actively discouraged my interest

Q25: How supportive were your parents/guardians of any NON-SCIENCE interests you had while growing up?

- They actively encouraged my interest
- They supported but did not actively encourage my interest
- They neither encouraged nor discouraged my interest
- They actively discouraged my interest

Early career interests and decisions

This section explores your early career interests and your motivations relating to your first degree or post-secondary qualification.

Q26: Thinking back to when others used to ask you “What do you want to be when you grow up?” – what is the first job you remember wanting as a career?

- | | |
|--|---|
| <input type="radio"/> Accountant | <input type="radio"/> Actor/Director |
| <input type="radio"/> Architect | <input type="radio"/> Artist/Designer |
| <input type="radio"/> Astronaut/Pilot | <input type="radio"/> Astronomer |
| <input type="radio"/> Astrophysicist | <input type="radio"/> Author/Writer |
| <input type="radio"/> Banker | <input type="radio"/> Business executive |
| <input type="radio"/> Computer programmer/Game designer | <input type="radio"/> Cosmologist |
| <input type="radio"/> Doctor | <input type="radio"/> Engineer |
| <input type="radio"/> Entertainer/Musician/Dancer/Singer | <input type="radio"/> Farmer |
| <input type="radio"/> Firefighter/Police officer | <input type="radio"/> Government official |
| <input type="radio"/> Journalist | <input type="radio"/> Lawyer |
| <input type="radio"/> Mathematician | <input type="radio"/> Military |
| <input type="radio"/> Nurse | <input type="radio"/> Priest/minister/clergy |
| <input type="radio"/> Researcher | <input type="radio"/> Space scientist |
| <input type="radio"/> Scientist - other | <input type="radio"/> Sports professional |
| <input type="radio"/> Stockbroker/Finance | <input type="radio"/> Teacher - Primary |
| <input type="radio"/> Teacher - Secondary | <input type="radio"/> Teacher/lecturer - University |
| <input type="radio"/> Veterinarian | <input type="radio"/> Other (please specify below) |

If 'Other' please specify here

Q27: When do you remember first becoming interested in this career?

- | | | |
|--|--|---------------------------------|
| <input type="radio"/> Before age 6 | <input type="radio"/> Age 6-7 | <input type="radio"/> Age 8-10 |
| <input type="radio"/> Age 11-13 | <input type="radio"/> Age 14-16 | <input type="radio"/> Age 17-18 |
| <input type="radio"/> After finishing secondary school | <input type="radio"/> After university | |

Q28: And when you first thought about a career in SCIENCE, what job did you want? (Your answer may be the same as the similar previous question.)

- | | |
|---|-------------------------------------|
| <input type="radio"/> Astronaut/Pilot | <input type="radio"/> Astronomer |
| <input type="radio"/> Astrophysicist | <input type="radio"/> Author/Writer |
| <input type="radio"/> Computer programmer/Game designer | <input type="radio"/> Cosmologist |
| <input type="radio"/> Doctor | <input type="radio"/> Engineer |
| <input type="radio"/> Journalist | <input type="radio"/> Mathematician |
| <input type="radio"/> Nurse | <input type="radio"/> Researcher |

- Space scientist
- Teacher - Primary
- Teacher/lecturer - University
- Scientist - other (Please specify below)
- Teacher - Secondary
- Other (Please specify below)

If 'Other' please specify here

Q29: When do you remember first thinking of pursuing a career in SCIENCE?

- Before age 6
- Age 11-13
- After finishing secondary school
- Age 6-7
- Age 14-16
- After university
- Age 8-10
- Age 17-18

Q30: When do you remember first thinking of pursuing a job related to SPACE SCIENCE in particular?

- Before age 6
- Age 11-13
- After finishing secondary school
- Age 6-7
- Age 14-16
- After university
- Age 8-10
- Age 17-18

Q31: What was the MAIN reason you selected the field/discipline for your first degree? If you have more than one answer, please select up to four additional reasons under the column marked 'ADDITIONAL'.

	MAIN	ADDITIONAL
I enjoyed the field/discipline more than others.	<input type="radio"/>	<input type="checkbox"/>
I knew what career I wanted and the course provided the background preparation for that career.	<input type="radio"/>	<input type="checkbox"/>
I was confident in my ability to succeed in my selected field.	<input type="radio"/>	<input type="checkbox"/>
I had attained well in subjects in school related to my selected field.	<input type="radio"/>	<input type="checkbox"/>
My parents strongly encouraged me to pursue my selected field.	<input type="radio"/>	<input type="checkbox"/>

My teachers in school encouraged me to pursue my selected field.	<input type="radio"/>	<input type="checkbox"/>
Work in my selected field could make a difference to society.	<input type="radio"/>	<input type="checkbox"/>
Work in my selected field could make a difference to the environment.	<input type="radio"/>	<input type="checkbox"/>
Work in my selected field had many practical applications.	<input type="radio"/>	<input type="checkbox"/>
The likelihood of finding employment with a degree in my selected field was strong.	<input type="radio"/>	<input type="checkbox"/>
The potential for earning a high salary with a degree in my selected field was strong.	<input type="radio"/>	<input type="checkbox"/>
Other (Please specify below)	<input type="radio"/>	<input type="checkbox"/>

If 'Other' please specify here

Your career path

We are interested in hearing about the path you took to your current job. This information is very helpful to inspire young people who might be interested in work in this field.

Q32: Is your current job related to space science?

- Yes No

Q33: Since leaving school, how many jobs have you had BEFORE your current job?

- 0 - This is my first job
 1
 2
 3
 4
 5
 More than 5

Q34: Please name up to five of your previous jobs here, starting with the most recent:

Q35: Regarding your priorities for the future, how important are the following things to you?

	Not at all important	Somewhat unimportant	Neither important nor unimportant	Somewhat important	Very important
Contributing to sustainable development and protection of the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Developing myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Doing something I am interested in	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Getting a secure job	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helping other people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Making new discoveries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunities to earn a high income	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using my talents and abilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working with something that is important for society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q36: Was there a point in time when you thought seriously about leaving SPACE SCIENCE to pursue education or work in another field?

- Yes No

Your reasons to consider leaving space science

This section briefly explores your reasons for considering leaving a career in **space science**.

Note: if you have answered/chosen item [2] in question 36, skip the following question

Q37: Which of the following was the PRIMARY reason for you to consider leaving a career in space science?

- Career interest/opportunities in other areas
- Competitive environment in space science
- Concerns about work/life balance
- Difficulty of courses
- Extensive time required
- Influence of family
- Influence of teacher
- Issues related to family planning
- Lack of academic support
- Lack of ethnic diversity among people working in this field
- Lack of emotional support
- Lack of financial support
- Loss of interest
- Lower salary compared with other fields
- Poor career prospects
- Poor grades
- Poor teaching
- Research experience
- Volunteer/work experience
- Work in the field is dominated by men
- Influence of other person (Not a teacher or family member)
- Other (Please describe below)

If 'Other' please specify here

Note: if you have answered/chosen item [2] in question 36, skip the following question

Q38: If there are any details about this experience that you are willing to share, please include them here.

Your most memorable science experience

For the next few questions, please think about the single most memorable experience – positive or negative – you had in SCIENCE prior to the completion of your first post-secondary qualification. Please consider all experiences including school-based (e.g. lessons, competitions, school trips) and non-school based (e.g. family holidays, television) experiences.

Q39: How would you classify your most memorable experience?

- Related to school
- Related to educational experiences outside of school
- Related to non-educational experiences outside of school
- Other (Please specify below)

If 'Other' please specify here

Q40: Who do you consider to be the person most associated with this experience?

- This experience was personal and independent of other individuals
- Parent/guardian
- Other family members (Please specify below)
- Medical professional (e.g. doctor, nurse)
- Famous scientist or science personality
- Friend
- Teacher/faculty member
- Other individual (Please specify below)

If 'Other' please specify here

Q41: How would you rate this experience in terms of its impact on your persistence in science?

- Strongly negative (it was a major reason why I did not want to pursue science)
- Negative
- Neither positive nor negative
- Positive

Strongly positive (it was a major reason why I wanted to pursue science)

Q42: If there are any details about your most memorable experience that you are willing to share, please include them here.

Sharing your interest

We would like to find out whether or not you do any public engagement or outreach (e.g. to school children, families or others outside of your job) about your work. This information will be very helpful in supporting such efforts across the field.

Q43: Do you participate in any public engagement or outreach activity about your work?

Yes No

If 'Yes', please tell us about the activities that you do. If 'No' please tell us what barriers prevent you from getting involved in outreach?

Follow-up information

Q44: If you would be willing to be contacted for a follow-up conversation, please supply your details below. (Please note, this is optional and declining will not affect you in any way. Details will be held securely and will only be accessible to the research team. This information will also be held separately from your data and will not be used to identify you in any report or publication arising from this research.)

Name	<input type="text"/>
Institution	<input type="text"/>
E-mail address	<input type="text"/>
Other contact info (e.g. telephone)	<input type="text"/>