What makes engagement with (astro)physics outreach significant? Undergraduate students' views and influence of outreach on Higher Education destinations.

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Overview

This briefing summarises key findings from a UK-wide survey of first time (astro)physics undergraduate (UG) students regarding their perceptions of outreach activities they considered significant in influencing their choice of Higher Education Institution (HEI) for study. The briefing highlights geographical patterns of significant outreach and students' current place of study. A comprehensive analysis with full methodology and theoretical framework is being prepared for peer-reviewed publication.

Summary of preliminary findings

1. Over 40% of participants attended at least one outreach event.
2. Just over half of students (56.3%) were retained by the same university that organised the outreach and 43.8% of students were transferred between participating universities. However, participating universities retained a lower, and statistically significant, percentage of female students (female 34.8%, male 64.9%).
3. Talks/lectures and University experiences were the most regularly mentioned types of outreach events mentioned by both female and male students. However, there is a statistically significant gender difference with females mentioning University Experiences as significant outreach less than males (Female 30.0%; Male 70%).
4. Students gave a range of reasons for why they considered an outreach activity significant including it being a positive or interesting experience and supporting the development of their physics identity. However, some students also identified limited access to opportunities.
5. The majority of students (81.6 %, n=84) provided evidence of positive links between outreach and HE destinations. Outreach has validated and influence HE choices but also affect subject interest.

6. Just under 60% of students (57.9%, n=154) reported not engaging with outreach due to lack of awareness of opportunities or having barriers of engagement, especially barriers associated with schools.

The study has explored the link between engagement with outreach opportunities has on young people's HE choices, where students were able access and engage with outreach. It has also highlighted that more needs to be done to understand and mitigate barriers of access to outreach opportunities.

Characteristics of participants

The participants of this survey were 266 (astro)physics students enrolled for the first time in Level 3 and Level 4 (astro)physics programmes in October 2025 at 13 HE institutions (hereafter participating universities – see Appendix A for anonymised details). This represents an estimated sample size of 4.5% of the current UG population, based on HESA data[1]. The gender distribution of the participants (28.2% female, 63.9% male, 3.4% other gender identities, 4.5% not given) is harder to compare with HESA data given that they only publish binary gender information[2]. Data pertaining students of other identities/not given is shown, however not tested for statistical significance due to low numbers. Students entered university via different routes: firm offer, insurance offer and clearing (Table 1)

	Non-Russell Group				**Russell Group**			
	Female	Male	other	Not given	Female	Male	other	Not given
Firm choice	1.5%	3.8%	0.8%	0.0%	17.3%	45.5%	2.3%	3.8%
Insurance choice	0.4%	1.1%	0.0%	0.0%	4.5%	6.8%	0.4%	0.4%
Clearing	1.9%	1.1%	0.0%	0.4%	2.6%	5.6%	0.0%	0.0%
Total	3.8%	6.0%	0.8%	0.4%	24.4%	57.9%	2.6%	4.1%

Table 1: *Gender distribution of students participating in this survey according to their choices of access to HE and the type of current HE institution they are currently enrolled.*

[1] Where on average, 5955 students per year, enrolled for the first time in a physics or astronomy programmes, during the period of 2019 to 2024. (https://www.hesa.ac.uk/data-and-analysis/students/table-52)
[2] Gender distribution in the period of 2019 to 2024 for physics and astrophysics programmes was 27% female and 73% male (https://www.hesa.ac.uk/data-and-analysis/students/whos-in-he/characteristics)

Key Findings (preliminary)

Key findings were supported using appropriate tests for statistical significance and more details of these will be available in a later publication.

Finding 1: Over 40% of participants (n=112) attended outreach activities.

Of the 42.1% of participants (n=112) who attended outreach activities, 32.1% were female (n=36), 60.7% (n=68) were male and 4.5% (n=5) were of other gender identities. 78.6% of these students (n=88) attended outreach organised by Russell Group Universities. Figure 1 shows students' HE mobility patterns between attending significant outreach (on the left) and their current place of study (on the right).

Finding 2: Just over half of students (56.3%) were retained by the same university that organised the outreach and 43.8% of students were transferred between participating universities. However, participating universities retained a lower, and statistically significant, percentage of female students (female 34.8%, male 64.9%).

For participating universities, 56.3% of students (n=63) were "retained "by the same university that organised the outreach activity. 43.8% of students (n= 49) were "transferred" between participating universities (Figure 2).
Participating universities retained a statistically significant lower percentage of female students (34.8%) when compared with male students (64.9%). By contrast, participating universities transfer a higher percentage of female students (65.2%) compared to male students (35.1%).

Figure 1: *HE mobility patterns showing percentage of students attending significant outreach at a university (on the left) and their current place of study (on the right). Red flows show students that attended outreach and are currently enrolled in one of the participant institutions of this study. Grey flows show those students who attended outreach organised by non-participating institutions.*

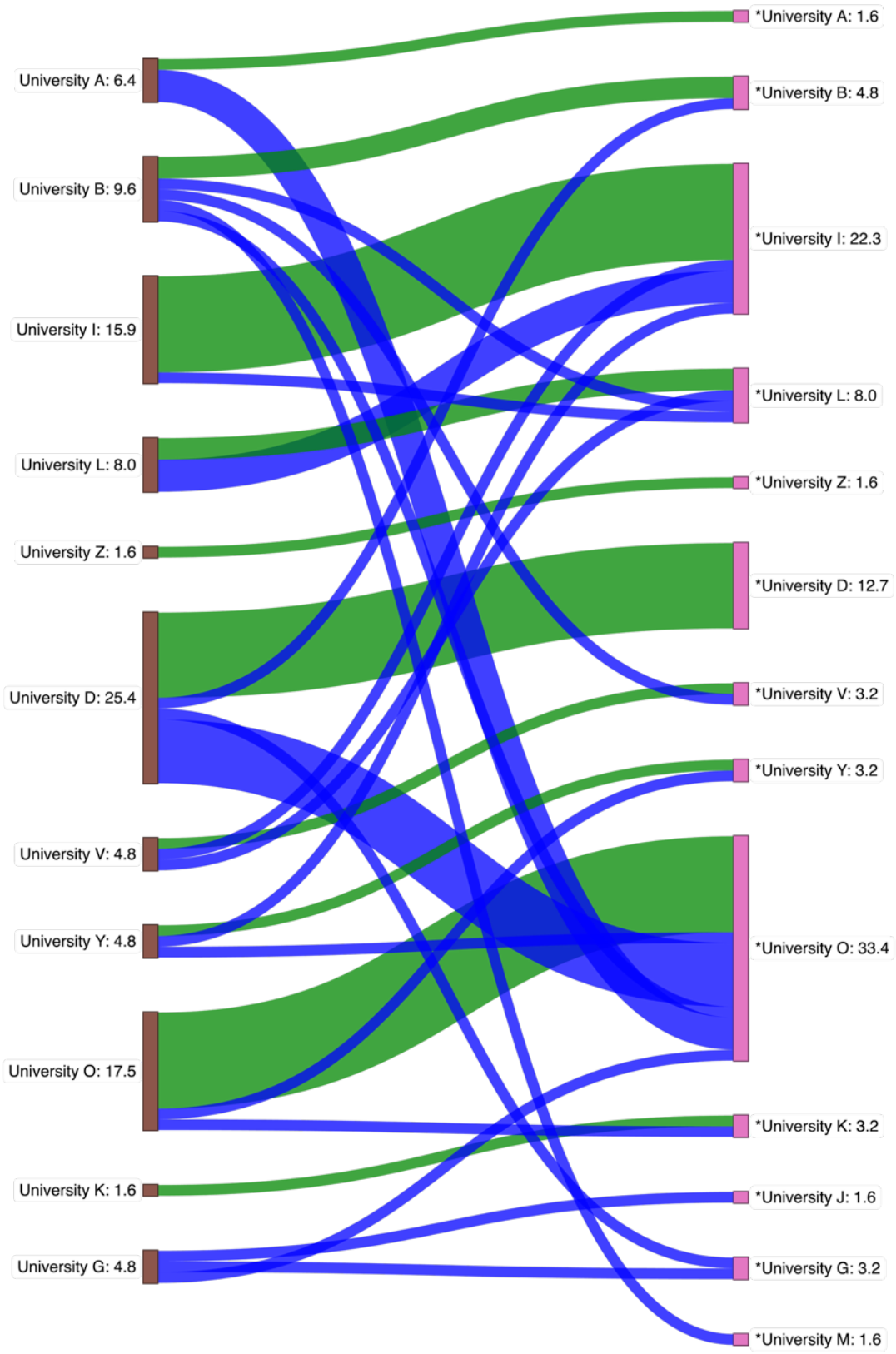

Figure 2: *HE mobility patterns showing percentage of students attending significant outreach (on the left) and their current place of study (on the right) within participating universities. Green flows show students have been retained by participating universities and blue flows students which have transferred between participating universities.*

Finding 3: Talks/lectures and University experiences[3] were the most regularly mentioned types of outreach events mentioned by both female and male students. However, there is a statistically significant gender difference with females mentioning University Experiences as significant outreach less than males (Female 30.0%; Male 70%).

Students were asked to categorise the type of event they chose as significant. Talk/Lectures were the most mentioned type of event (female 50.0%; male 38.2%). (Table 2).

		Gender		
Type of event	**Prevalence (n=112)**	**Female**	**Male**	**Other/not given**
Talk/lecture	42.9%	50.0%	38.2%	50.0%
University experience	17.9%	16.7%	20.6%	0.0%
Hands-on activity/workshop	11.6%	2.8%	16.2%	12.5%
Masterclass	8.0%	5.6%	8.8%	12.5%
Multi-part programme	8.0%	16.7%	4.4%	0.0%
Open day	3.6%	2.8%	2.9%	12.5%
Festival	2.7%	5.6%	1.5%	0.0%
Planetarium show	2.7%	0.0%	2.9%	12.5%
Observatory tours	2.7%	0.0%	4.4%	0.0%
Total	100%	100%	100%	100%

Table 2: *Distribution of mentions of each type of event per gender.*

Overall, there was a statistically significant difference in the percentage of female students choosing University Experience compared to males (female: 30.0%, n=6; male: 70.0%, n=14).

Finding 4: Students gave a range of reasons for why they considered an outreach activity significant including it being a positive or interesting experience and supporting the development of their physics identity. However, some students also identified limited access to opportunities.

[3] "University experience" covers activities such as work experience and summer schools.

Students were asked "*Why have you chosen this event as the most significant?" and "Tell us a bit more about the details of this event.".* The responses from 179 students were analysed thematically and 13 themes identified. Different types of events were related to different themes (Table 3). This preliminary analysis of themes shows a strong alignment with the Situated Expectancy-Value Theory (Eccles & Wigfield, 2024), a psychological model developed to explain motivated achievement-related choices.

Event type	Most common themes for this type of event	Indicative response
Talk/Lecture	**1. Positive or interesting experience** 2. Limited access to outreach 3. Development of physics identity	**Positive or interesting experience:** *"It was very interesting and engaging as it was about a subject that I was familiar with …"*
University Experiences	**1. Limited access to outreach** 2. Help with application and access to HE 3. Time investment	**Limited access to outreach:** *"It is the only event I have attended …"*
Hands-on activity/Workshop	1. Limited access to outreach 2. Positive or interesting experience **3. Familiarisation with learning environments**	**Familiarisation with learning environments:** *"It helped me learn more about the school I would be studying at …"*
Masterclass	1. Positive or interesting experience **2. Validation of choices** 3. Tools to study at university	**Validation of choices:** *"It confirmed my decision to pursue Physics at University"*
Multi-part programme	**1. Development of physics identity** 2. Time investment 3. Help with application and access to HE	**Development of physics identity:** *'…made me see physics as a subject I could study and was interested on it's own without using it as a route to somewhere else…"*
Others: open days, festivals, planetarium shows and observatory tours	1. Familiarisation with learning environments **2. Tools to study at university** 3. Positive or interesting experience	**Tools to study at university:** *"I've learned to operate a large telescope using the software to point the telescope at planets in our solar system"*

Table 3: *The three most popular themes for each type of event type and some indicative responses included in the theme highlighted in bold text.*

A small number of students (9%, n=10) have mentioned the value of *interactions with significant people* as evidenced by the following responses: *"I for instance went on a tour with the STEM outreach officer Erin and was shown one of the most advanced driving simulators in the world" or "Showed me the people at the uni were truly passionate about what they were doing".*

Finding 5: The majority of students (81.6%, n=84) provided evidence of positive links between outreach and HE destinations. Outreach has validated and influence choices but also affect interest in (astro)physics.

Open responses from 103 students to the question **"***In what way, if any, has this event influenced your Higher Education choices?"* were thematically analysed to identify themes related to 'domains of influence'. Six different domains of influence have been constructed from students' responses. A preliminary analysis of these patterns shows their alignment with student decision making processes to access tertiary education (el Nemar et al, 2020), meaning that engagement with significant outreach could occurs at various stages of HE decision making process. Table 4 provides a definition and prevalence of the different domains of influence.

Domain of influence	Sample response	Prevalence (n=103)
Validation of choices - responses has a positive tone and mostly focus on validation of choices or choosing one specific programme or university.	*Convinced me to apply for physics rather than a related subject*	33.0%
Subject interest - responses has positive or neutral tone. They mostly focus on influence of interest in (astro)physics with little evidence of influence on HE choices	*Influenced my interest in astrophysics*	28.2%
Enabling choices - Responses have a positive tone. They mostly focus on encouragement to make choices; however, evidence is not fully explored.	*Made me pursue physics at university*	19.4%
No influence- Responses are neutral and brief	*Not really*	10.7%
No because decision has been made – Responses have a neutral or positive tone. They focus on no influence because decision to study certain programmes or enrolling in certain universities has been made.	*Not massively, already wanted to do physics*	7.8%
Yes - Responses are neutral and brief	*yes*	1.0%

Table 4: *The six different domains of influence of outreach, constructed from students' responses which includes a sample and prevalence of domain of influence amongst responses.*

Overall, the most mentioned domain of influence relates with validation of HE choices to access specific programmes or institutions. This theme was more frequently mentioned by male responses (23 of 63), when compared with female

responses (6 of 33). Over a third of female responses (12 of 33) focussed on influence of outreach had in their interest in (astro)physics.[4]

Finding 6: ***Just under 60% of students (57.9%, n=154) reported not engaging with outreach due to lack of awareness of opportunities or having barriers of engagement, especially barriers associated with schools.***

Just under 60% of students (57.9%, n=154) reported not engaging with outreach (female 25.3%, male 66.2%, other gender identities 2.6%). Students were asked "*Tell us why you didn't attend any physics outreach event organised by a physics department of a university?".* Responses to this question were thematically analysed and eight themes were identified (Table 5).

Theme	Sample response	Prevalence (n=184)
Unawareness	*"I wasn't aware of them"*	25.5%
Barriers of engagement	*"None close enough to me"*	17.4%
School as barrier of engagement	*"No such events were advertised by my sixth form"*	15.8%
Limited opportunities	*"Did not get the opportunity to"*	13.0%
Active disinterest	*"Couldn't be asked"*	9.8%
Not useful for education plan	*"I didn't want to do physics"*	8.7%
Other opportunities	*"I attended other physics events by non-university providers"*	4.9%
Misc	*"no"*	4.9%

Table 5: *The seven different themes associated with the lack of engagement with outreach. Table includes a sample response and prevalence of theme amongst responses.*

Lack of awareness of opportunities and barriers of engagement, especially those linked with school are the most mentioned themes given by participants (both in female and male responses) as to why they have not engaged with outreach events.

[4] Analysis of thematic responses is not aimed at generating data for statistical testing but rather focus on exploration of the meaning of patterns and participant experiences.

References

Eccles, J. S., & Wigfield, A. (2024). The development, testing, and refinement of Eccles, Wigfield, and colleagues situated expectancy-value model of achievement performance and choice. *Educational Psychology Review*, *36*(2), 51.

El Nemar, S., Vrontis, D., & Thrassou, A. (2020). An innovative stakeholder framework for the student-choice decision making process. *Journal of Business Research*, *119*, 339-353.

Appendix A - Universities per type and region

University code	Type	Region	University code	Type	Region
University A	Russell Group	London	**University K**	Non-Russell Group	South East England
University AA	Non-Russell Group	North West England	**University L**	Non-Russell Group	North East England
University AB	Non-Russell Group	Wales	**University N**	Non-Russell Group	East Midlands
University AC	Russell Group	South West England	**University O**	Russell Group	West Midlands
University AD	Non-Russell Group	West Midlands	**University P**	Non-Russell Group	South East England
University AE	Russell Group	West Midlands	**University Q**	Non-Russell Group	West Midlands
University AF	Russell Group	South East England	**University R**	Russell Group	Northern Ireland
University B	Russell Group	Yorkshire and the Humber	**University S**	Non-Russell Group	Yorkshire and the Humber
University C	Russell Group	London	**University T**	Non-Russell Group	South East England
University D	Russell Group	South East England	**University U**	Russell Group	South West England
University E	Russell Group	Yorkshire and the Humber	**University V**	Russell Group	North East England
University F	Russell Group	North West	**University Y**	Russell Group	Wales
University G	Russell Group	London	**University Z**	Non-Russell Group	South East England