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Effect of a role model-based show on the STEM aspirations of primary school students

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ABSTRACT

A STEM outreach show called 'Who wants to be a Superhero' went into primary schools across England and Wales, delivered live to audiences by professional science communicators. The show was structured around four female STEM role models and two male STEM role models as part of a wider narrative about scientists and engineers being real-life superheroes. The show was found to increase both boys' and girls' aspirations for a STEM career, with a bigger effect seen in the girls. The intervention also increased positive attitudes, and decreased negative attitudes, towards scientists measured through word association given by the audiences pre- and post-show. There was a larger reduction in negative stereotypes from the girls after the show, especially in the 'nerdy' and 'crazy' stereotypes. The show saw an increase in both boys' and girls' perceptions of the 'helpful' nature of science and engineering. It was also found that some students may not want to do a STEM job because of the perceived dangerous nature of the job.

KEYWORDS: role models; attitudes to STEM careers; aspirations; gender equity; primary/elementary school

Effect of a role model-based show on the STEM aspirations of primary school students

INTRODUCTION

Many studies have been carried out over the past century regarding the uptake of STEM careers. Whilst demand for jobs in STEM has increased over time, the number of employment opportunities still outnumbers those pursuing careers in the field, especially in physical sciences and engineering (Big Ideas: The Future of Engineering in Schools, n.d.). Women are significantly under-represented in STEM fields, making up just 29% of the STEM workforce in the UK (More Women to Be Supported Back into STEM Jobs in Government-Backed Training, n.d.). In physics specifically the percent of female undergraduates has risen from 20% in 2012 to 26% in 2022 (Jordan et al., 2025) but in engineering, the figure is just 12% (Zenker, 2023). To combat these gender gaps, many interventions have been attempted, yet these numbers have not changed significantly in the last 10 years.

In IMECHE's 2016 study (Big Ideas: The Future of Engineering in Schools, n.d.), the highest perceived reason for girls' career decisions and the lack of women in engineering was a 'lack of female role models'. Blickenstaff's (2005) literature review categorises explanations for the 'leaky pipeline' in science careers. The absence of women scientists/engineers as role models is listed as one of the most cited reasons for the leaky pipeline. Another study found the influence of role models has a small but significant influence on career choice of 18-25 year old women, above the influence of self-efficacy (Quimby & De Santis, 2006). It was found that a scientist was more likely to be a role model if the students could connect on things like personality and shared interests (Buck et al., 2008).

Attributes of Role Models

Stereotypes about scientists have been a 'hard-to-shift' issue in STEM recruitment since research into this area began. The 'Draw a scientist' (or DAS) test (Chambers, 1983) has been used for decades, and despite a small shift showing more representation of women, the core characteristics used have changed little (Miller et al., 2018). Narrow stereotypes of scientists as white, male and highly intelligent still prevail, and even when positive attributes are recognised (e.g. altruistic), they can be described in a way that 'others' the scientist, showing that they are not seen as 'someone like me' (Shimwell et al., 2023).

In a study on a teacher intervention with primary school students, Shimwell et al (2023) found that by pro-actively using the positive attributes of a different STEM role model each week (e.g., collaborative, curious, passionate) they could change some of the negative associations held about whether students felt they could become a scientist. This could be achieved indirectly without the scientist role model visiting the school. Many of these positive changes were retained a year later, but they found the idea of superior intelligence was a more difficult change to retain long-term.

In the evaluation of the WISE (Women in Science and Engineering) intervention called 'People like me', student characteristics were used to connect girls with case studies of those who have jobs in STEM (Herman et al., 2023). Using this approach

was shown to be effective at changing attitudes to STEM, with 57% of those involved saying they were 'more interested in studying STEM at school' after the event, and those not interested at all dropping from 10% to 4%.

Purpose of Study

From the literature we can see that stereotypes about STEM can be hard to shift but that role models do play an important part of the puzzle in terms of career aspirations. In this case study we propose that role models can be used effectively in an indirect way (through their inclusion in a science show) to change perceptions of, and self-identity with STEM.

Aims

This case study aimed to investigate whether using role models in a science show context improved attitudes to science careers for students aged nine to eleven. The two main objectives of the research were:

1. To explore how watching a live show featuring videos of role models might change the stereotypical views about scientists and engineers among primary school students
2. To explore whether this indirect role-model intervention could change student aspirations to STEM careers
3. To exploring the relationship between the gender of the participants and the gender of the preferred role models/job aspirations

METHODS

Description of the science show intervention

'Who wants to be a Superhero?' is a 60-minute interactive STEM intervention designed for primary school students aged 9-11years old. It was conceived and developed by the social enterprise, Science Made Simple, with support from Women in Science and Engineering (WISE) in Wales and the Welsh Government National Science Academy scheme. The show uses an opening question at the start of the show that asks students who their favourite superhero is and what powers they have. A presenter then connects these answers to our 6 real-life "science heroes" and shows a short video of them talking about their job and their hobbies. Each section of the show then uses active-learning techniques and demonstrations to connect the job of the role model to familiar topics from the school curriculum. The scientists and engineers were chosen to reflect a range of jobs connected to physical sciences and engineering— these being the most gender imbalanced areas of STEM. We also needed to select jobs that would match the themes of the superpowers that students would likely suggest (e.g., flight, super-speed, x-ray vision, etc). This defined the role models we selected. We had hoped to feature 50% male and 50% female role models, but due to the constraints listed above, we ended up with four suitable women and two suitable men. This was justified as a helpful way to address the usual gender balance subtly without pushing the bias too far towards female-only role models which could have alienated the male audience members. The show was always performed to mixed gender audiences. The science heroes, their job and 'superpower', along with the order they are introduced in the show, are summarised in Table 1. The pseudonyms used were not used in the

evaluation itself but have been added during this writing stage to ensure anonymity of the scientists featured.

Table 1. *Role models used in the show and samples of the comments they include in their videos for context*

Role model pseudonym (gender)*	Job (simple summary of job given on questionnaire)	Superpower (related to narrative of the show)	Relevant comments about themselves, or reasons given for choosing their job
Harriet (f)	Astronomer (studies stars)	X-Ray vision	Chose astronomy because she didn't know what to do and teacher gave her a book about space which got her curious
Lola (f)	Civil engineer (builds bridges)	Strength	Enjoyed maths and physics at school. Talks about roads and bridges (in hard hat)
Hannah (f)	Medical engineer (keeps people safe)	Saving lives	Chose subject because good at art and design at school and wanted to make things that keep people safe
Libby (f)	Environmental scientist (helps the environment)	Saving the planet	Talks about a bus running on waste and sewage (the poo bus!) Makes a link to preventing animals becoming endangered
Evan (m)	Electronic engineer (builds lasers)	Lasers	Wanted to do something practical, plays with circuits. Systems fly on drones and go into space
Rory (m)	Aeronautical engineer (improves aeroplanes)	Flight	Did work experience with engineers, grew up with pilots in the family – learning to fly. Passion for planes. Doing what I love as a job is great

**Pseudonyms are used to protect identity of individual scientists*

Data Collection

The theory underpinning this case study stems from Bourdieu's concept of habitus within his broader theory of social reproduction. Habitus is a complex system of dispositions, attitudes, and behaviours that are guided through socialisation. More specifically, we have drawn on Archer et al.'s (2015) extension of this theory into 'science capital' as the identity young people have in science is related to what they perceive to be normal, possible, and desirable for people like them (Archer et al., 2015.

A mixed methods approach was taken with a sequential explanatory design (Creswell & Plano Clarke, 2018). This involved implementing a quantitative phase of data collection first to gain an overview of the participants' perspectives on careers in science. This was followed by a qualitative phase that delved into the quantitative results and sought to provide explanations and understanding of the patterns in the data.

The pre-intervention survey was developed using questions to assess the aspirations to STEM and the level of science capital students have (e.g., Would you like a job in science and engineering when you are older? Do you know anyone in your life who is a scientist of engineer?). The post-intervention (post-show) survey had additional questions to assess which role model was perceived as most like them and which role model had the job they would most like to do. Surveys were issued to students before and immediately after the show and completed individually in a class setting. The questionnaire responses were compiled using SPSS software and MS Excel for quantitative analysis.

Surveys also asked students to choose 3 words they would use to describe a person working in STEM both before and after the intervention. These were categorised into positive, negative and neutral words using an inductive approach in NVivo. They were firstly categorized by synonyms, and then by the attitude: overly positive, negative; neutral. Positive words were "Creative, pioneering, caring, helpful, important, hardworking, amazing" and synonyms. Negative were "Crazy, evil, cunning, nerdy, lonely, confusing, messy" and synonyms. Neutral words could be seen in both a positive and negative way, and these were "clever, curious, educated, danger, strong, brave, careful" and their synonyms. These results were then analysed to see whether the intervention had changed the frequency of words used.

A few weeks after the show, four mixed-sex focus groups of between 5 and 8 students each from two different schools were held. The person conducting the interviews was the lead author and not the person who had presented the show as it was felt that could have biased the responses due to social desirability bias (Bispo Júnior, 2022).The focus groups were designed to be semi-structured. The audio of these focus groups was recorded, transcribed, and coded using NVivo software, with specific focus on attitudes towards scientists, responses to the role models, and awareness of science and gender stereotypes.

The students who responded to the survey represented around 7% of the total audiences reached. 24 students were involved in the focus groups which represents

about 6% of the students who completed surveys. The full list of questions used at each stage of the data collection are included in the Appendices of this article.

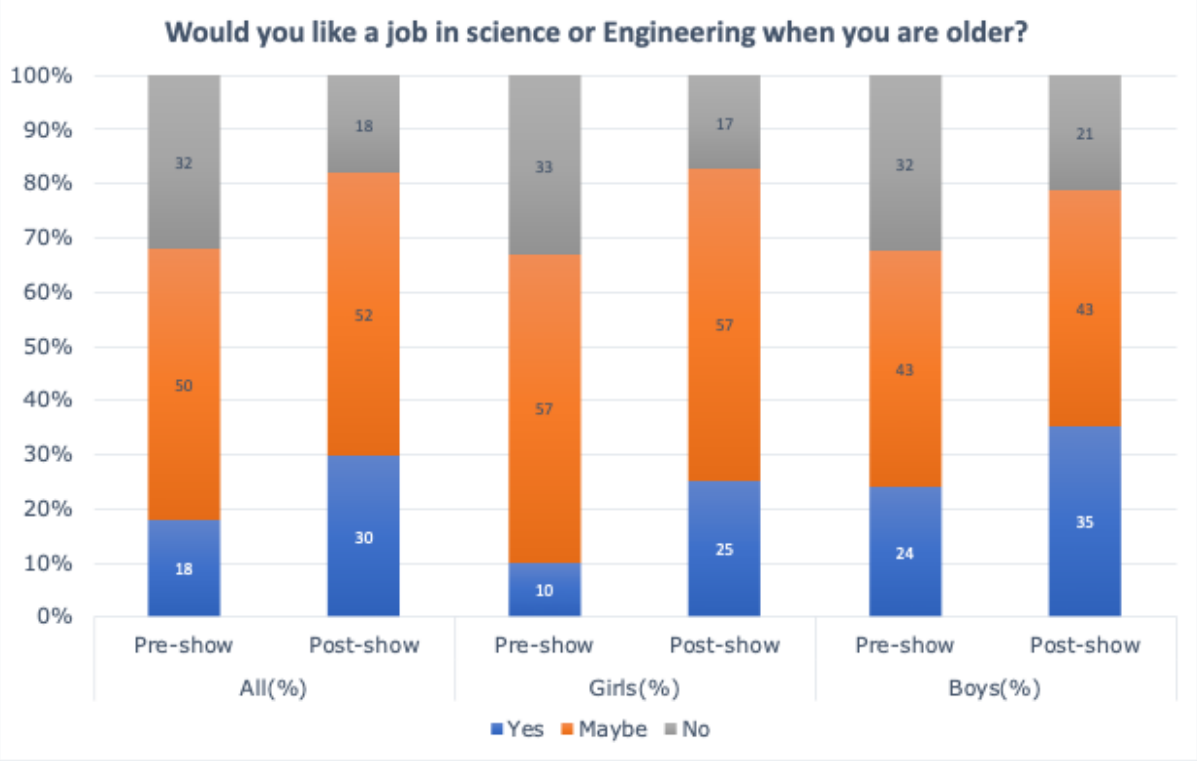
RESULTS AND DISCUSSION

In line with Archer et al.'s concept of identity in science and what is normal for 'people like me', we explored the extent to which the pupils felt they had something in common with the role models. The total number of respondents to the questionnaire was 363, all of whom were between nine and eleven. Respondents included 191 boys, 157 girls, and 15 students who did not endorse a specific gender. With questions connected to gender we did not analyse students who selected the 'unspecified' category in our results due to too few responses. The focus groups were conducted in two randomly selected schools with a total of 25 students. The focus groups lasted between twenty to forty minutes each and these resulted in a total recording time of 102 minutes.

STEM Job Aspirations pre- and post-intervention

Participants were asked both before and after the show if they 'would like a job in science or engineering when you are older?' and could respond with 'yes', 'no', or 'maybe'. Responses are summarised in Figure 1.

Figure 1. *Results before and after show for question; "Would you like a job using science or engineering when you are older?" Data collected from the questionnaires*



Approximately 18% of all participants indicated they would like a career in science and engineering before the show. This is comparable to the benchmark data from ASPIRES which puts the figure of those wanting a STEM career at age 10 at about

17% (DeWitt & Archer, 2015). It is apparent that before the show, the proportion of boys and girls that said 'no' were comparable, however more boys answered a definite 'yes' than girls, with more girls saying 'maybe'.

A chi-square test was computed to explore the difference between pupils' career aspirations before and after the show. Cramer's V was used to measure effect size. Overall, the show had a statistically significant positive effect on students' STEM career aspirations with a small effect size ($\chi^2(4) = 108.99$, $p = <0.001$, $\varphi c = 0.393$). Before the show, only 18% of the 363 students said 'yes' to the question 'Would you like a job using science or engineering when you are older?'. After the show, this rose by 12 percentage points to 30%. Those who said they did not want a job in STEM also dropped from 32% ($n = 117$) to 19% ($n = 67$); a drop of 13 percentage points.

Looking in more detail at how the responses changed after the show, 14% moved from saying 'no' to 'yes' and 49% moved from saying 'no' to 'maybe'. Of those who said 'maybe' in pre-test, 25% changed to say 'yes' in the post-test, and 12% changed to say 'no' (Figures 2a and 2b).

When looking at results according to gender, of the 61 boys who responded 'no' in the pre-test, 16% said 'yes' and 46% said 'maybe' in the post-test'. These differences were statistically significant with a small effect size ($\chi^2(4) = 54.64$, $p = <0.001$, $\varphi c = 0.378$). Alternatively, for girls, of those who responded 'no' in the pre-test, 10% said 'yes' in the post-test and 53% said 'maybe'. Of those who said 'maybe', 24% said 'yes' in the post-test. Again, these changes were statistically significant ($\chi^2(4) = 49.86$, $p = <0.001$, $\varphi c = 0.402$). These results are summarised in Table 2.

Table 2. *Showing movement on opinion on jobs in science before and after the show from questionnaire data*

Pre-	Post-	All	Males	Females
Stayed the same across occasion		202 (57.4%)	104 (55.3%)	91 (59.1%)
No	No	43 (37.4%)	23 (37.7%)	19 (37.3%)
	Maybe	56 (48.7%)	28 (45.9%)	27 (52.9%)
	Yes	16 (13.9%)	10 (16.4%)	5 (9.8%)
Maybe	Maybe	110 (63.2%)	46 (56.8%)	59 (67.8%)
	No	21 (12.1%)	14 (17.3%)	7 (8.0%)
	Yes	43 (24.7%)	21 (25.9%)	21 (24.1%)
Yes	Yes	49 (77.8%)	35 (76.1%)	13 (81.3%)
	Maybe	11 (31.7%)	8 (17.4%)	3 (18.8%)
	No	3 (4.8%)	3 (6.5%)	0 (0.0%)

Figure 2a. *Showing girls' changes of opinion on wanting a job in science and engineering before and after the show*

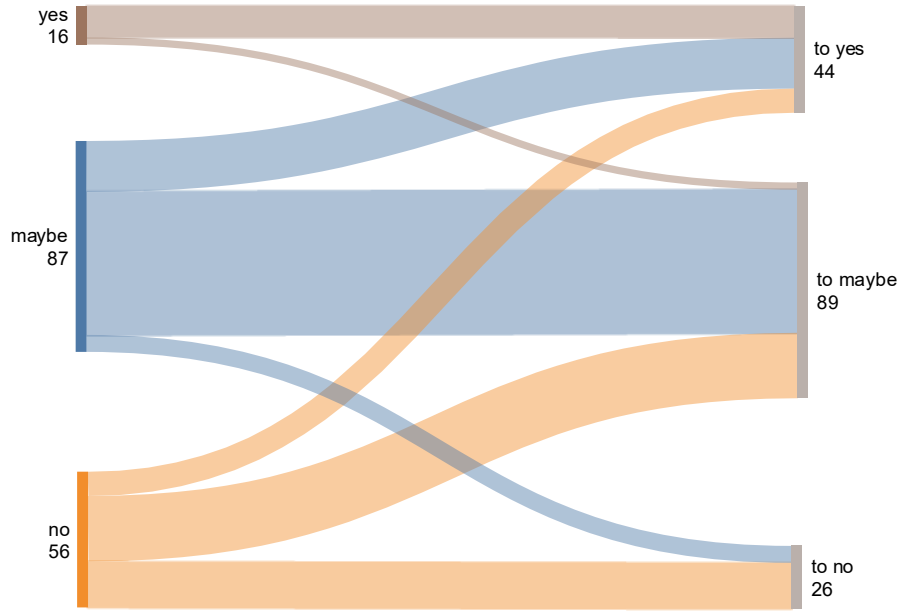
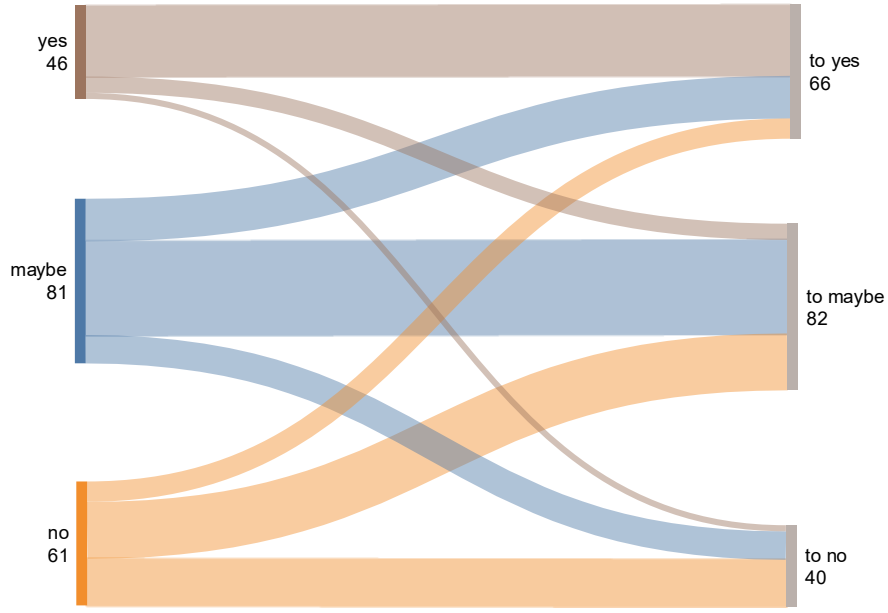


Figure 2b. *Showing boys' changes of opinion on wanting a job in science and engineering before and after the show*



Slightly more girls maintained their initial view after experiencing the show: approximately 60% compared to 55% of boys. As is apparent from Figures 2a and 2b, the most common change among participants' views was from a 'no' to a 'maybe'. The greatest change was seen among girls with nearly 53% (*n* = 27; Table 2) making this change. Across both genders the group that least frequently showed a change of mind were those who said 'yes' before the show and stuck to 'yes' after the show.

Reasons Given for Wanting/Not Wanting a Job in Science or Engineering

The results from the career aspirations questions were explored further through the follow-up open question included in the survey: 'Why do you think that [about having job in science]?' Answers were categorised into altruistic motives, enjoyment, aptitude, taking after family, danger and miscellaneous/other. The main reason for wanting to do a science job was the perceived enjoyment. It was also the main reason for not wanting to do a science job (i.e., the respondent had a preference or enjoyment for another subject or viewed science as boring). This supports previous research that suggests enjoyment of a subject is correlated with wanting a job in that area (Caleon & Subramaniam, 2008).

These justifications were also explored in the focus groups where a key reason that arose for not wanting to pursue a science job was a perception of danger (which came up equally from boys and girls). For example, from the focus group in one school the conversation showed a shared view of the dangers and how they could put people off. Please note in the following excerpt, I = interviewer, B= boy, G = girl.

> ***I:*** *yeah, okay, why do you think people might not want a job in science, what do you think puts people off?*
>
> ***G:*** *you can get like very badly injured*
>
> ***B:*** *…they're afraid of getting electrocuted or shocked or something*
>
> ***I:*** *so there's a danger element in the job do you think?*
>
> ***G:*** *science could be like really dangerous,*
>
> ***G:*** *I would think that some of those things put people off cos with science it can be really dangerous, very very dangerous … when Evan does the lasers that could blow something up and with all the rest of them, especially these two, when they're building things, they could build something and then it could fall straight down on them*

Despite the prevalence of danger discussions in focus groups, this did not come up as a significant answer in the survey data, so it is not possible to make a general conclusion about whether this aspect of concern is a salient issue for boys and girls generally or if it may be perceived differently across genders. The subject arose as the interviewer probed further about why a job in STEM would not be appealing,

but it was not the first thing that came to mind in the students answering the questionnaire.

One possible reason that the same results were not observed in the questionnaire data could be because the question was phrased a little differently. In the focus group students were asked specifically to say, 'What puts other people off science?' as opposed to the more personal question; 'Why do you think that [you might not like a job in science]?' This could suggest that thinking of what puts others off encourages more honest answers compared to answering for yourself only.

Similarity to a role model vs aspiration to their job

By asking audiences which role model they felt had something in common with them, and then which role model had the job they would most enjoy, we wanted to see if we could evidence any pattern between the two as suggested in previous research (Gladstone & Cimpian, 2021). As our audiences only 'meet' the role models via facilitated videos, we felt it would be interesting to check any effect from using 'indirect' role models. The results of this analysis are presented in Table 3.

Table 3. *Heat map of the percentage of responses to which role model has something in common, and the job most liked (by gender)*

Which superhero has...	something in common with you? %		job you would most like? %	
	Boys	Girls	Boys	Girls
Harriet (astronomer)	9.9	20.9	9.7	30.9
Lola (civil engineer)	12.2	6.8	9.7	4
Hannah (medical engineer)	1.1	15.5	5.9	22.8
Libby (environmental scientist)	13.8	39.9	8.6	24.2
Evan (electronics engineer)	33.1	10.1	42.5	11.4
Rory (flight engineer)	29.8	6.8	23.7	6.7

Note: *Green = most frequent, red = least frequent*

For the girls, the environmental scientist (female) was most frequently stated as the person who had something in common with them, and the astronomer (female) had the job most girls said they would like. The civil engineer (female) was least frequently stated by girls as having anything in common with them and was also selected as the least desirable job (equal with the flight engineer).

Although the environmental scientist was the person most girls felt they had something in common with, her job was not chosen as the most desirable. This could be a surprising result as it does not reflect the altruistic desire the girls had

for saving the planet. However, on reflection, this discrepancy could be connected to the fact that the specific job the role model was doing involved working on a bus powered by poo! This could have put some girls off what would usually have been an inspiring job due to the disgust factor.

For the boys, the electronics engineer (male) had the most in common with them and the most desirable job. The astronomer (female) had the least in common. The medical engineer (female) was selected as having the least desirable job.

When comparing responses to these two questions overall, we found that 197 (58.3%) of participants indicated that the superhero they had the most in common with was also the superhero with the job they would most like to have. This confirms the findings of other research about the importance of the similarity of role models (or peer models) to the student (Johnson & Burns, 2023). The implications of this finding are that if STEM role models can be encouraged to be more relatable (by talking about their interests and attributes beyond just their work) then more students may aspire to choose a similar career to them.

We then explored the gender of the superheroes that participants felt they had most in common with and who had the most desirable job. Looking at the gender of participants, 63% (n = 114) of boys felt they had most in common with a male role model and 86% (n = 123) of girls felt they had most in common with a female role model. This association was significant with a small effect size ($\chi^2(1) = 70.89$, p = <0.001, $\varphi c = 0.464$). Similarly, 66% (n = 122) of boys most wanted the job of a male role model, and 82% (n = 122) of girls most wanted the job of a female role model. This association was also significant with a small effect size ($\chi^2(1) = 74.42$, p = <0.001, $\varphi c = 0.476$).

Reasons Students Gave for Choosing Specific Role-Models

We used the data from the post-show questionnaire to explore how altruism and enjoyment factors related to the choice of role model (Table 4). Many more girls than boys chose altruistic reasons to justify their choice of role model. Most boys gave reasons related to enjoyment. The most frequently stated factor for girls on choosing a role model was also the perceived enjoyment of their job, but the proportion who mentioned altruistic similarities (to the person) was much higher than for boys and was almost equivalent to the enjoyment when explaining why they would like the role model's job.

Table 4. *Altruism and enjoyment by gender as reasons for choosing role models*

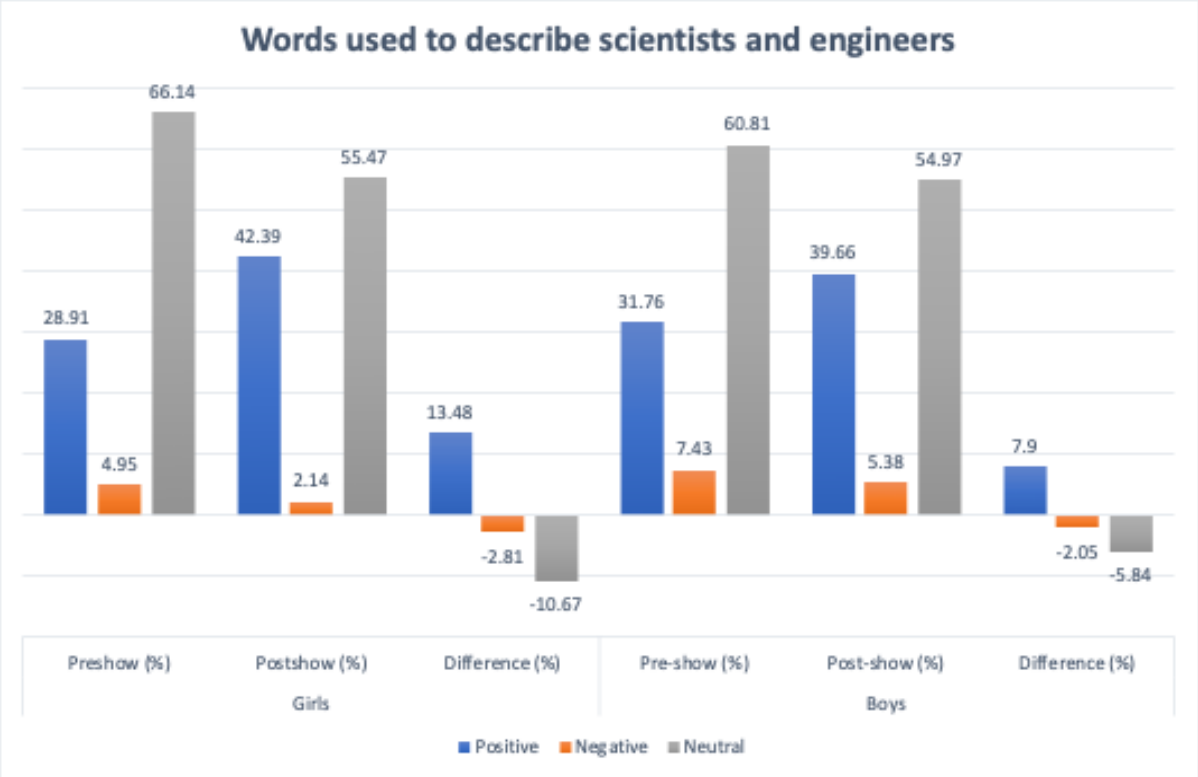
	What did you have in common [with the superhero]?		**Why did you like their job?**	
Answers linked to…	Boys (%)	Girls (%)	Boys (%)	Girls (%)
Altruism	7	29	9	43
Enjoyment	64	46	66	45

Attitudes to Scientists Based on Words Chosen

Before and after the show, students provided three words to describe scientists and engineers. The results are shown in Figure 3. There was a clear increase in positive words used, and a reduction in negative words from before the show to after the show. Both genders showed an increase in the actual number (and proportion) of positive words used after the show suggesting a shift in attitude about what scientists and engineers are like. There was a larger increase in the positive words from girls, but boys were more likely to give more 'extreme' views, where girls were more likely to be 'neutral'.

The implication of this finding is that role models have the potential to showcase to young people a more diverse range of people with a variety of attributes. This can then shift the image of what scientists are like for young people as they relate to the positive attributes they have seen and aspire to the more positive stereotypes that they may feel they share.

Figure 3. *Words used to describe scientists pre- and post-show (by gender)*



Analysis of Specific Words Used to Describe Scientists

There was a decrease seen in the 'crazy', 'nerdy', and 'evil' stereotypes after the show. In the questionnaire response data from before the show, roughly 5% of both boys and girls used these stereotypical words. After the show, there was a reduction in this perception for both boys and girls, but girls' negative stereotypical attitudes to scientists decreased more than boys' attitudes. A summary of these comparisons are presented in Table 5. Students' awareness of both gender

stereotypes and 'nerdy' stereotypes was also apparent in the focus groups. In response to the question, 'What puts people off a job in science?' students observed that other people thought it was nerdy, even if they themselves did not hold this view.

Table 5. *Changes in specific descriptive words used before and after the show by gender*

	Girls			**Boys**		
Word groupings	Pre-show (%)	Post-show (%)	Difference (%)	Pre-show (%)	Post-show (%)	Difference (%)
'Clever' 'Talented' 'Intelligent'	47.69	39.87	-7.82	43.63	39.55	-4.08
'Awesome' 'Cool' 'inspiring'	10.12	21.51	+11.39	11.49	18.36	+6.87
'Hardworking' 'Ambitious' 'Focussed'	6.30	5.91	-0.39	6.56	7.10	+0.54
'Creative' 'Designers' 'Pioneers'	7.76	6.92	-0.84	6.08	4.87	-1.21
'Dangerous' 'Brave' 'Strong'	4.39	3.65	-0.74	5.89	3.75	-2.14
'Helpful' 'Important'	2.92	5.79	+2.87	4.44	6.80	+2.36
'Nerdy' 'Crazy' 'Evil'	4.27	1.76	-2.51	4.82	3.55	-1.27

The 'Clever' Stereotype

The largest proportion of words used (both before and after the show) to describe scientists implied a certain type of person, someone 'talented' or 'clever', as shown in Table 5. Although there was some reduction in this stereotype, it was still the most common word listed. Girls originally had more of this view, but the reduction in the proportion of these words was greater for girls than for boys. It can be concluded that the show reduced the 'clever' perception of scientists for girls and

boys. While boys' perception of scientist's cleverness reduced, they were influenced less than girls by the show.

The Altruistic View of STEM

Words like 'helpful' and 'important' (and their synonyms) as a part of the three words to describe scientists were counted, as shown in Table 5. Although girls showed a larger increase in the 'helpful' perception, a higher proportion of boys' responses reflected this view of scientists. Overall, the show did increase the 'helpful' perception of science, for both boys and girls, although there was a larger change in girls' responses from a lower starting point.

CONCLUSIONS

The role model-based science show 'Who wants to be a superhero?' was shown to provide positive and diverse messages about the kinds of people who work in science and engineering. The use of role models in the show reduced the stereotypes about 'nerdy' and 'crazy' scientists, and perceptions that scientists and engineers are 'clever'. This change was larger for girls than boys, though girls began with a higher proportion using these words in their descriptions. In the focus groups, it was clear that students were aware of both 'nerdy' and gender stereotypes of people working in STEM, yet their personal views tended not to be stereotypical. The show achieved a small increase in perceptions of the 'helpful' nature of science. However, the main reason for choosing a STEM career and identifying with a scientist, among both boys and girls was a shared interest or perceived enjoyment of the job.

Recent research (Davenport & Padwick, 2025) has shown that between the ages of 7 and 11 girls decrease their STEM aspirations, whilst boys increase theirs. This reinforces the importance of (effective) STEM role models at a younger age to ensure aspirations in girls are not lost.

As this case study used role models in an indirect way (through showing videos facilitated by a presenter rather than in person), the findings suggest that this could be an effective way to scale-up role model interventions in a sustainable and effective way. This could be an important implication for practitioners who can't use real role models in person but can still communicate their attributes using effective video clips interpreted by a live presenter.

A key finding from the focus groups showed that students may be put off a job in STEM because of its dangerous nature, as opposed to it being difficult or unattainable. Practitioners should be careful when balancing the choice of role model jobs shown in case what they think are 'exciting' jobs blur into jobs that can appear dangerous to students.

This case study has helped to confirm the importance of role models in any intervention talking about their personal interests and passions and explicitly contradict the negative stereotypes (such as scientists all being super-intelligent and nerdy). It is also important for role models to have a diversity of backgrounds and interests to make it more likely that each member of the audience will find someone that they resonate with. These findings reinforce that students need to

see someone they relate to (whether by gender similarity or hobby/passion), and someone who shows that they enjoy their job to make it more likely that students may change their views on whether a job in science or engineering is for 'people like them'.

ENDNOTES

Statement on conflict of interest: The lead researcher/author (Wendy Sadler) is also the founding Director and owner of Science Made Simple, who are creators of the science show; "Who wants to be a superhero?". A potential conflict of interest could exist that there would be a bias in only reporting positive results to reflect well on the work of the organisation. This will be mitigated by the co-authors having access to the full dataset and conducting analysis on this data independently of the lead author. As an academic who also sits on the School Physics Ethics committee, the lead author has completed the required researcher integrity training as required for their academic role. Any other staff handling data were instructed to enter all data regardless of responses given and are also made aware of the importance of research integrity that needs to be complied with for this process.

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REFERENCES

Archer, L., Dawson, E., DeWitt, J., Seakins, A., & Wong, B. (2015). "Science capital": A conceptual, methodological, and empirical argument for extending bourdieusian notions of capital beyond the arts. *Journal of Research in Science Teaching, 52*(7), 922–948. https://doi.org/10.1002/tea.21227

Institute of Mechanical Engineers (IMechE 2016) Big Ideas: The future of engineering in schools. (n.d.). Retrieved 21 March 2025, from https://www.imeche.org/policy-and-press/reports/detail/big-ideas-report-the-future-of-engineering-in-schools

Bispo Júnior, J. P. (2022). Social desirability bias in qualitative health research. *Revista De Saude Publica, 56*, 2-4. https://doi.org/10.11606/s1518-8787.2022056004164

Buck, G. A., Clark, V. L. P., Leslie-Pelecky, D., Lu, Y., & Cerda-Lizarraga, P. (2008). Examining the cognitive processes used by adolescent girls and women scientists in identifying science role models: A feminist approach. *Science Education, 92*(4), 688–707. https://doi 10.1002/sce.20257

Caleon, I. S., & Subramaniam, R. (2008). Attitudes towards science of intellectually gifted and mainstream upper primary students in Singapore. *Journal of Research in Science Teaching, 45*(8), 940–954. https://doi.org/10.1002/tea.20250

Chambers, D. W. (1983). Stereotypic images of the scientist: The draw-a-scientist test. *Science Education, 67*(2), 255–265. https://doi.org/10.1002/sce.3730670213

Creswell, J. W. & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (Third edition). SAGE Publications.

Davenport, C., & Padwick, A. (2025). Making their minds up: Flux and stability in young children's career aspirations in North East England. *Humanities and Social Sciences Communications, 12*(1), Article 1038. https://doi.org/10.1057/s41599-025-05364-z

DeWitt, J., & Archer, L. (2015). Who aspires to a science career? A comparison of survey responses from primary and secondary school students. *International Journal of Science Education, 37*(13), 2170–2192. https://doi.org/10.1080/09500693.2015.1071899

Gladstone, J. R., & Cimpian, A. (2021). Which role models are effective for which students? A systematic review and four recommendations for maximizing the effectiveness of role models in STEM. *International Journal of STEM Education, 8*(1), Article 59. https://doi.org/10.1186/s40594-021-00315-x

Herman, C., Kendall-Nicholas, J., & Sadler, W. (2023). *People like me—Encouraging girls to see themselves in STEM careers*. AIP Conference Proceedings, Article 3040(1). https://doi.org/10.1063/5.0176062

Johnson, M. L., & Burns, E. (2023). Characteristics of effective models for classroom demonstrations. *Theory Into Practice, 62*(3), 207–218. https://doi.org/10.1080/00405841.2023.2226552

Jordan, S., Bakewell, S., Campbell, H. J., Coltman, J., Sadler, W., & Setty, C. (2025). Women in physics in the United Kingdom: A review of recent policy and initiatives (No. arXiv:2509.06825). *arXiv*. https://doi.org/10.48550/arXiv.2509.0682

Miller, D. I., Nolla, K. M., Eagly, A. H., & Uttal, D. H. (2018). The Development of children's gender-science stereotypes: A Meta-analysis of 5 decades of U.S. draw-a-scientist studies. *Child Development, 89*(6), 1943–1955. https://doi.org/10.1111/cdev.13039

UK Government (2023) *More women to be supported back into STEM jobs in Government-backed training*. (n.d.). GOV.UK. Retrieved 15 August 2025, from https://www.gov.uk/government/news/more-women-to-be-supported-back-into-stem-jobs-in-government-backed-training

Quimby, J. L., & De Santis, A. M. (2006). The influence of role models on women's career choices. *The Career Development Quarterly, 54*(4), 297–306. https://doi.org/10.1002/j.2161-0045.2006.tb00195.x

Shimwell, J., DeWitt, J., Davenport, C., Padwick, A., Sanderson, J., & Strachan, R. (2023) Scientist of the week: evaluating effects of a teacher led STEM intervention to reduce stereotypical views of scientists in young children. *Research in Science & Technological Education, 41*(2), 423-443. https://doi.org/10.1080/02635143.2021.1941840

Zenker, A. (2023, August 30) *Women in STEM Statistics: Progress and Challenges. Stem Women*. https://www.stemwomen.com/women-in-stem-statistics-progress-and-challenges

Appendices

Appendix 1.
Summary of questions asked in the pre- and post-show questionnaire, *n*= 383 (191 boys, 157 girls, 15 students who did not endorse a specific gender).

Table A1. *Summary of questionnaire questions asked pre- and post-show*

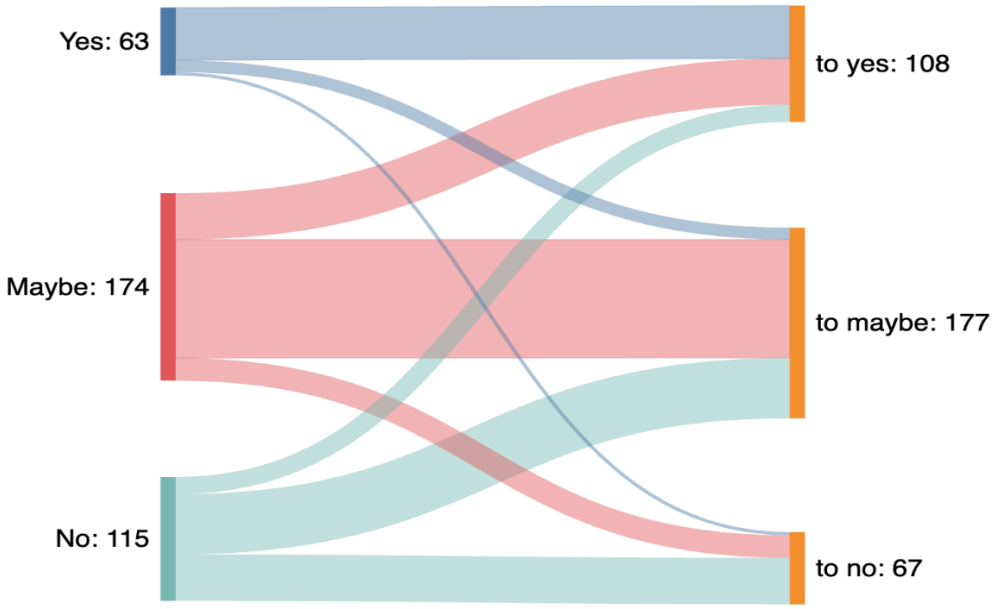
Pre-show questionnaire	Post-show questionnaire
Age	Post Q1: Did you enjoy the show? (Yes/Sort of/Maybe)
Gender	Post Q2: What did you like/not like about the show?
Pre Q1: Would you like a job in science and engineering when you are older? (Yes/Maybe/No)	Post Q3: Would you like a job in science and engineering when you are older? (Yes/Maybe/No)
	Post Q4: Tell us why you think that?
Pre Q2: Tell us 3 words that you think best describe a person who is a scientist or an engineer	Post Q5: Tell us 3 words that you think best describe a person who is a scientist or an engineer
Pre Q3a: Do you know anyone in your life who is a scientist or an engineer? (Yes/No)	Post Q6: Which real-life superhero from the videos had something in common with you? What do you have in common?
Pre Q3b: If so, who are they (eg Mum, Dad, friend etc?)	Post Q7: Which real-life superhero from the videos had the job you would most like? What did you like about that job?
Pre Q3c: What is their job?	

Appendix 2.
Summary of questions used with focus groups (please note, not all questions were asked of all groups as shown below)

1. What can you remember about the show? (All four focus groups)
2. What can you remember about their [the superheroes'] jobs? (two of four focus groups)
3. Would you like to do any of these jobs? (All four focus groups)
4. Was there anything you would have liked to ask them [the superheroes]?
5. Diamond activity: most and least like a scientist (Three of four focus groups)
6. Diamond activity: most and least like yourself
7. What would attract you to a job in science?
8. What puts people off a job in science?
9. Do you think boys and girls should have different types of jobs?
10. Do you know anyone in science or engineering?

Appendix 3.

Figure A1. *Sankey diagram of all changes of opinion pre- and post-show (not divided by gender)*



Appendix 4.

Table A2. *15 attributes used in the role model research (Shimwell et al, 2023)*

Collaborative	**Hard-working**	**Organised**
Committed	**Imaginative**	**Passionate**
Communicator	**Logical**	**Patient**
Creative	**Observant**	**Resilient**
Curious	**Open-minded**	**Self-motivated**