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Title: The importance of science fiction and other STEM-related mass media in young people's decisions to enrol in university STEM courses

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Abstract

This paper presents Australian results from the Interests and Recruitment in Science (IRIS) study with respect to the influence of STEM-related mass media, including science fiction, on students' decisions to enrol in university STEM courses. The study found that across the full cohort (N=2999), students tended to attribute far greater influence to science-related documentaries/channels such as Life on Earth and the Discovery Channel, etc. than to science-fiction movies or STEM-related TV dramas. Males were more inclined than females to consider science fiction/fantasy books and films and popular science books/magazines as having been important in their decisions. Students taking physics/astronomy tended to rate the importance of science fiction/fantasy books and films higher than students in other courses. The implications of these results for our understanding of influences on STEM enrolments are discussed.

Goals and objectives

The international Interests and Recruitment in Science (IRIS) study was designed to investigate students' perceptions of the importance of factors from various spheres of influence; family, school, society, etc. on their decisions to take a university STEM course. Among the potential social influences explored are those of STEM-related mass media, including science fiction, documentaries, TV drama and popular science magazines or books. At another level, the study also had the objective of comparing the responses of males and females as well as students in different STEM courses to identify any differences between groups that may inform our understanding of their motivations.

Literature review

The literature reveals several ways in which the influence of science fiction and other STEM-related mass media can potentially influence young people, including their attitudes towards science, their images of scientists and their perceptions of the nature of science. The 1950s and 1960s saw several explorations of the educational potential of science fiction (e.g. Woolever 1951; Gross & Woodburn, 1959; Rosenthal & Jacobson, 1968), though these tended to be speculative rather than empirical. More recently there have been a number of significant research studies into the influence of representations of scientists in mass media (e.g. Chen, 1994; Rosenthal, 2003; 2005; Haste, 2004; Reis & Galvão, 2004), including representations of women and men in science fiction (Steinke, 1997). However, again these studies didn't directly investigate impacts on career aspirations. The most comprehensive is probably Schibeci and Lee (2003) which provides a very useful analysis of fictional representations of scientists and the influence of such images on the public's perceptions of scientists. Recognising a potential link between young people's images of scientists and their career aspirations, the authors called for more research into whether portrayals of scientists in popular culture actually influence career choices among students.

With respect to the influence of science fiction, it would appear that few researchers have subsequently taken up this challenge. A search of peak science education journals reveals a dearth of empirical research investigating the influence of science fiction media or fictional images of scientists on young people's career aspirations. Likewise, science fiction is not found in the index of the Second International Handbook on Science Education (Fraser, Tobin & McRobbie, 2012), though several contributors do mention the role of science documentaries in students' attitudes to science. Apart from other IRIS studies (e.g. Cerinsek, Hribar, Glodez & Dolinsek, 2012) we are aware of no research that has taken a similar tack to our study in surveying students about their retrospective views on the influence on science fiction or non-fiction media on their decisions to take STEM courses. This is perhaps surprising given the results of a 2010 survey of Sigma Xi members asking the question: "Did science fiction influence you?" (Sigma Xi, 2010). While this survey was a poll of the society's members – including many eminent scientists and engineers - rather than an authentic research study, according to the editors "the overwhelming reply was a resounding 'Yes!'"

Methodology

The IRIS project is a large-scale international study of student recruitment, retention and gender equity in university science, technology, engineering and mathematics (STEM) courses. The study was developed by a consortium of European universities and funded by the European Commission's 7th Framework Program (FP7) – Science in Society. The questionnaire was developed by the European IRIS partners and provided to researchers in other countries. Australian IRIS data were collected by a team of researchers in late 2011 (Lyons, Quinn, Rizk, Anderson, Hubber, Kenny, Sparrow, West & Wilson, 2012). The results reported here relate to the responses of 2999 first year students from 30 universities enrolled in ten different STEM courses: physics/astronomy; chemical science; biological science; earth science; engineering; mathematics; IT/computing science; health science; agriculture/environmental science and 'other natural and physical science'. The students were invited to indicate their perception of the importance of a wide range of potential influences, including school-based experiences, influential others and out of school influences, on their decisions. This paper focuses on their responses to the following question:

How important were the following in choosing your course?

1. Science fiction or fantasy books/films;
2. Popular science books and magazines;
3. Popular science television or radio programmes/channels (e.g. Discovery Channel, Life on Earth, Mythbusters, Dr Karl, Catalyst, Crocodile Hunter, etc.);
4. Films or drama on television (e.g. CSI, Numb3rs, Grey's Anatomy, Stargate, etc.).

Students rated each item on a five point Likert-like scale from 'very important' to 'not important'. The frequencies of students' ratings of these five points were analysed by crosstabulation and chi-squared contingency table tests. This procedure was likewise used to establish whether there were any significant sex or Field of Education differences in responses to each item. A significance level of 0.001 was adopted for tests across the whole cohort. For tests across smaller categories of respondents – for example, males and females within a particular STEM field, results up to the $p < .005$ level are reported as strongly suggestive of a relationship between the relevant variables. Cramer's V was used as a measure of effect size to determine whether any significant differences were meaningful. Details of the methodology can be found in our IRIS report (<http://www.une.edu.au/simerr>).

Results

Figure 1 summarises respondents' ratings of the importance of STEM-related mass media on their decisions.

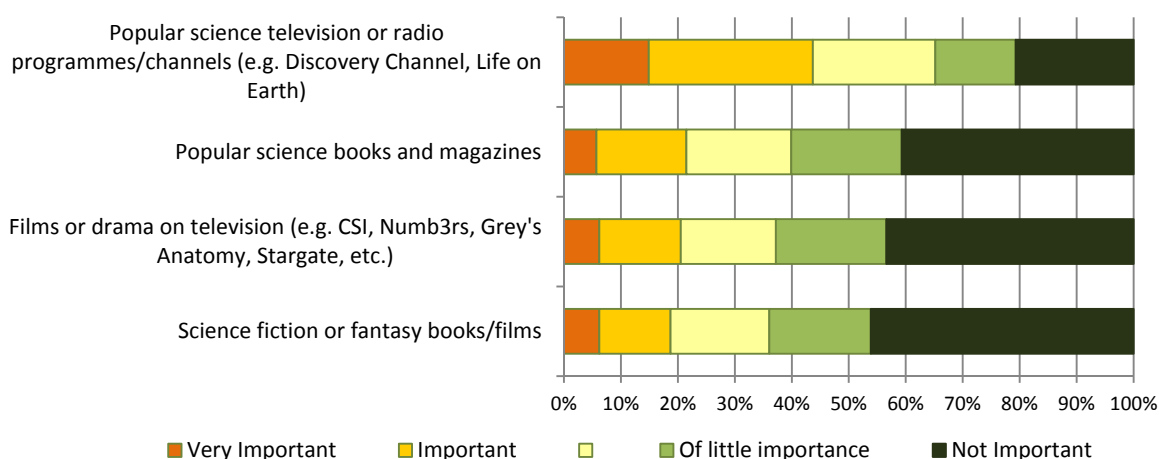


Figure 1. Percentage breakdown of students' responses to items relating to the importance of STEM-related mass media in their decisions.

Popular television and radio science programs/channels were considered the most influential, with around 44% of respondents regarding these as important or very important. This was more than twice the percentage of those rating the other three media categories as important. Around 22% of respondents considered popular books and magazines to have been important in their decisions, while a similar percentage rated TV drama shows as important. Science fiction or fantasy books and films were regarded by only 19% of respondents as

having been important in their decisions, and by 64% as having been of little or no importance. By way of comparison, non-media influences such as personal interest, clear feedback from teachers, lessons showing practical applications, and personal encouragement from teachers were rated as important or very important by 86%, 73%, 68% and 62% of respondents respectively (Lyons et al., 2012).

Sex differences in perceptions of the importance of science media

Potential sex differences in ratings on these items were explored by chi-squared analysis of the rating frequencies. Two types of media were rated as very important in course choice significantly more often by males: science fiction or fantasy books/films ($\chi^2(4) = 75.46$; $p < 0.001$; ASR = 5.2, Cramer's V = 0.159); and popular science books and magazines ($\chi^2(4) = 54.91$; $p < 0.001$; ASR = 5.0, Cramer's V = 0.136). Some indication of these sex differences can be gained from the plotting of mean ratings in Figure 2. However, it should be recognised that our conclusions are based on the chi-square analyses of rating frequencies rather than the means depicted in this figure, which is included here as a visual cue.

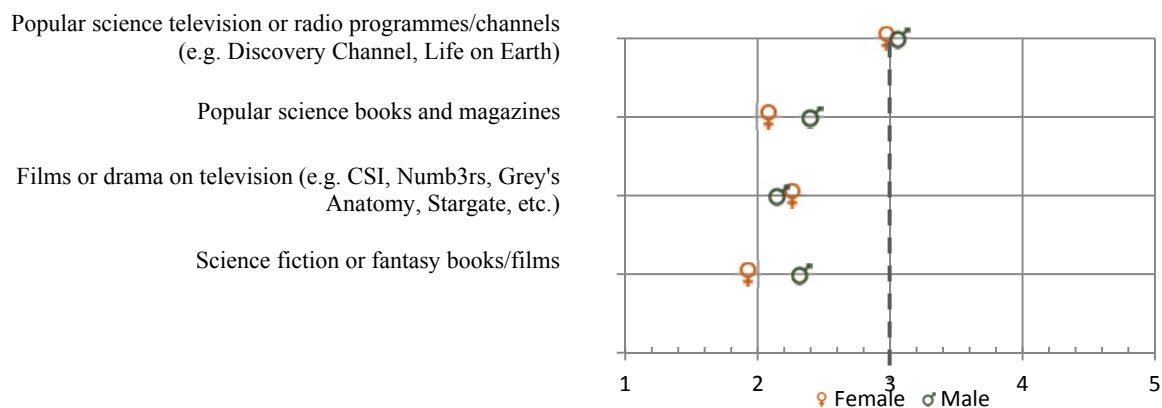


Figure 2. Mean ratings of males and females on items relating to the importance of STEM-related media in their decisions

Given the predominance of females in some STEM fields and males in others, crosstabulations were also conducted for females in each field and for males in each field. These revealed that significantly more females enrolled in physics/astronomy than expected rated science fiction/fantasy media as very important ($\chi^2(20) = 59.057$; $p < 0.001$; ASR = 3.4, Cramer's V = 0.117), while significantly fewer rated it as not important (ASR = -3.4). In contrast, significantly more females enrolled in health courses rated this type of media as not important in their decision (ASR = 3.8). The effect size was small. The overall sex difference in ratings of the importance of popular science books and magazines is strongly attributable to females enrolled in Health, who were more inclined than other females to rate this item as not important ($\chi^2(20) = 41.976$; $p < 0.003$; ASR = 3.4, Cramer's V = 0.098). Analyses were also conducted to investigate whether females choosing traditionally male-dominated STEM courses (physics/astronomy; engineering; IT) rated these items differently to those in female-dominated STEM courses (biological science; health; other natural and physical sciences). This crosstabulation revealed a higher than expected number of those choosing female-dominated courses rating popular science TV programs/ channels as very important ($\chi^2(4) = 23.706$; $p < 0.001$; ASR = 3.5, Cramer's V = 0.148). The effect size was small.

Ratings of the importance of STEM-related media by students in different STEM courses

Following the general trend in Figure 1, students in nine of the ten STEM course categories tended to rate popular science TV programs/ channels as more important than other media types (IT students were the exception, rating this as of equal importance to science-fiction/fantasy media). Crosstabulations and chi-squared tests indicated that significantly more physics/astronomy students than expected rated science fiction/fantasy books or films as very important ($\chi^2(36) = 173.69$; $p < 0.001$; Cramer's V = 0.121, ASR = 6.7), while significantly fewer than expected rating these as not important (ASR = -4.8). In contrast, significantly more Health students ($\chi^2(36) = 173.69$; $p < 0.001$; Cramer's V = 0.121, ASR = 5.1) and Agriculture/environmental studies students ($\chi^2(36) = 173.69$; $p < 0.001$; Cramer's V = 0.121, ASR = 5.1) than expected rated these as not important. Significantly more Biological sciences students than expected rated popular science programs/channels as very important ($\chi^2(36) = 153.14$; $p < 0.001$; Cramer's V = 0.113, ASR = 3.6), while significantly fewer rated them as not important (ASR = -4.6). Some indication of these differences can

be gained from the plotting of mean ratings in Figure 3. Again, it should be recognised that our conclusions are based on the chi-square analyses of rating frequencies rather than the means depicted in this figure.

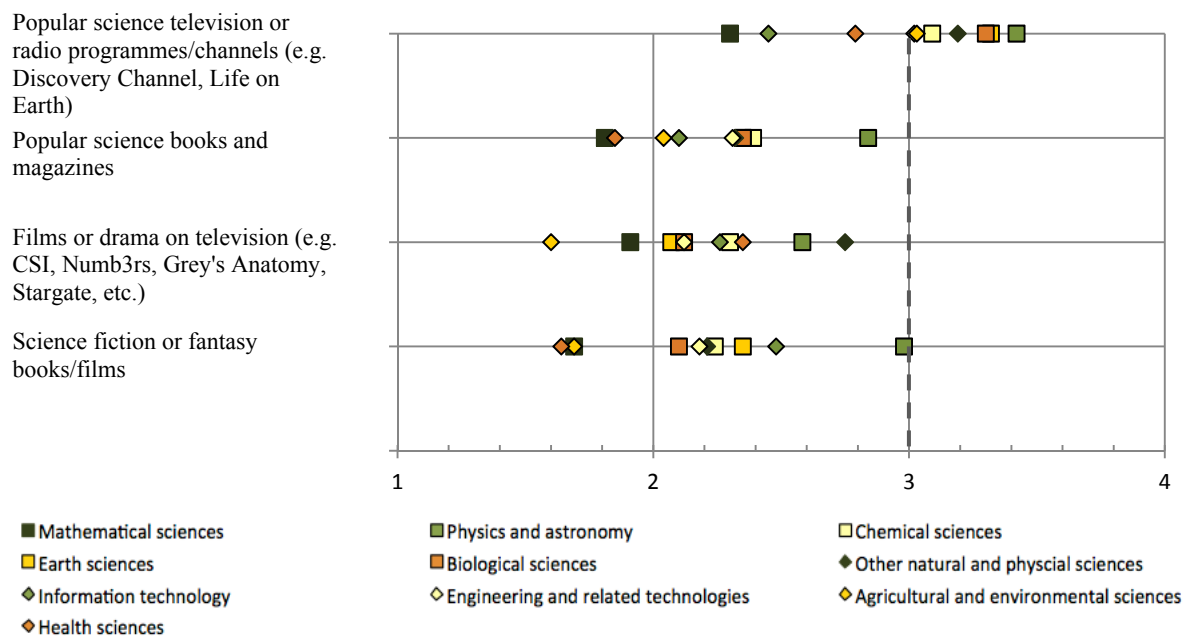


Figure 3. Mean ratings by respondents in different STEM courses on items relating to the importance of STEM-related media in their decisions.

Conclusions and significance of the study

As identified earlier, very little research has been published with respect to the importance attributed by students to science fiction and other STEM-related mass media in their decisions to choose STEM courses. This part of our IRIS study makes three contributions to our understanding. First, Australian students tend to consider documentary science programs as having been more important in their decisions to take STEM courses than science fiction or STEM-related drama programs. This appears to be the case for students in all STEM courses except IT. The finding that compared to other types of media, these documentary programs /channels were considered important or very important by nearly twice as many students suggests that this they are either twice as effective at influencing students to take STEM courses, or perhaps more frequently viewed than other types. Further research is required to determine which explanation is more likely.

Second, it would appear that male STEM students attribute greater influence than females to two forms of STEM-related media: popular books/magazines and science fiction/fantasy books and films. Given that some STEM courses are dominated by males and others by females, this raised the question of whether the differences were more closely associated with sex or STEM course. While this is difficult to tease out, some indication can be taken from the case of physics/astronomy students and science fiction/fantasy media, where the significant associations with sex found in the overall cohort were also found among females. This suggests that regardless of sex, students attracted to physics/astronomy attribute more importance to science fiction/fantasy media than those choosing other STEM fields.

A third contribution of this study was to highlight differences and similarities in the level of importance attributed to various STEM-related media by students in different STEM fields. While this analysis confirmed the importance of popular science documentaries for all STEM students, it also demonstrated the importance attributed to science fiction/fantasy media by physics/astronomy students. While perhaps not so surprising, this result nonetheless provides an evidential base for those seeking innovative strategies to arrest the declines in participation in this field reported in many countries.

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