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REPRESENTING WOMEN IN STEM IN SCIENCE-BASED FILM AND TELEVISION

Amy C. Chambers

Penny: Oh, wow, a girl scientist.

Leslie: Yep, come for the breasts, stay for the brains.

- 'The Hamburger Postulate', *The Big Bang Theory*

The first woman scientist to appear on the popular science-based sitcom *The Big Bang Theory* (2007-2019) was experimental physicist Leslie Winkle (Sara Gilbert) whose apparently humorous introduction relies on the assumed expectations of both the audience, and their non-scientist mediator Penny (Kaley Cuoco), that a woman scientist is an anomaly. Winkle was not made a series regular and appeared as one of only a small sample of women in the hard sciences, women who were notably defined by their scientific acumen *and* their sexual promiscuity.¹ The physical sciences were left almost entirely up to the men in the show and when women scientist characters were added as regulars, they were both bio-scientists. *The Big Bang Theory* is situated in a history of women scientists' representation which presents them as 'practical, beautiful, anomalous (as women in a male-dominated field), and young' (Szwedky and Pribbernow 2018, p.307).

Historically, women in STEM (science, technology, engineering, mathematics) on screen have been offered limited representation regardless of whether they are biographical or imagined. They are often defined by their male counterparts (mentors, fathers, brothers, lovers)

and framed as ‘sci-candy’ or plain brains rather than fully realized scientists (Attenborough 2011). With broader and more diverse representation of the sciences on screen it may be possible to begin shifting the ‘deeply embedded’ expectations of what science *is* and scientists *are* (and what they look like), which forms part of ‘the institutional fabric of [our] culture’ (O’Keeffe 2013, p.18). Scientists are expected to look like older white men, but fictional media can be utilized to unsettle ideas about ‘who should study, practice, and deploy science and technology’ (Colatrella 2011, p.8). Representation of scientists as experts who do not simply reflect the current biases of science (straight, white, male) in both fiction and non-fiction (Chambers and Thompson 2020), can offer role models and examples of women scientists who are not defined by their gender and race but by their scientific proficiency, thus showing that there is space and a place for everyone in the sciences.

Contemporary examples of science-based films with complex woman scientist characters such as *Hidden Figures* (Melfi 2016), *Black Panther* (Coogler 2018), and *Annihilation* (Garland 2018) offer some alternative approaches to the representation of women’s scientific expertise and role in science-based narratives. *Black Panther*’s Shuri (Letitia Wright) is Wakanda’s chief scientist and technological innovator who, as Carol Azunghi Dralega argues, ‘demonstrates through playful and highly cerebral manifestations what a young, black female (who is not adulterated by colonial and socially constructed Western hegemonic femininity and indeed toxic masculinity) can achieve when presented with opportunity, resources and a conducive environment’(2018, p.463). Notably, Shuri is not an isolated woman with power and ability but rather one of many in a society where women are also dominant in other traditionally male-dominated fields including the military and government. Films like *Black Panther* importantly position women scientists as protagonists within a community of professional agentic women, and as women who can handle and excel in the ‘hard’ sciences including mathematics, engineering and physics. Their plentiful success

shows that increasing the number of women scientists in fictional film and television shows, and having women-led science-based stories, does not constitute a barrier to critical and financial success.

This chapter focuses on the representation of women scientists in contemporary mainstream fiction film and television and considers the different ways in which we might approach the framing and proliferation of women's representation as scientists. When discussing women scientists, it is not possible to categorize discussions within a single film genre. Eva Flicker uses the label 'fiction film with a scientific theme' to indicate films that 'are set in a scientific milieu' (2008, p.242). Here, I will use the shorter-term 'science-based' to indicate a similar concept. Women scientists can be seen across a broad spectrum of genres including, but not limited to, science fiction (e.g. Ellen Ripley [Sigourney Weaver] in the *Alien* franchise), forensic/police procedurals (e.g. Clarissa Mullery [Liz Carr] from *Silent Witness* [1996-]), medical dramas (e.g. Jing-Mei Chen [Ming-Na Wen] in *ER* [1994-2009]), and comedies (e.g. Erin Gilbert [Kristen Wiig] in *Ghostbusters* [2016]). In all of these examples and those to follow, scientific concepts, scientific expertise, and representations of scientific culture, or what David A. Kirby terms 'the systems of science' (2008, p.42), are central to each form of science-based fiction.

Nineteen-sixty-six was a key moment in the representation of women scientists on screen with the broadcast of the series *Star Trek* (1966-69) that included the iconic communications officer Uhura (Nichelle Nichols). Uhura is a 'powerful image' of an African-American woman with scientific expertise that had 'a ripple effect that lasted for decades' (O'Keefe 2013, p.19). The show, the character, and the actress became closely aligned with the real-world science institution NASA with Nichols supporting recruitment (focussed on minority engagement and applications) and the public image of NASA alongside other members of the *Star Trek* cast (Penley 1997, pp.18-19).

On 12 September 1992 Mae Jemison became the first black woman astronaut. She began each shift on the space shuttle *Endeavor* as a science specialist with Uhura's famous line 'hailing frequencies open' as a hat-tip to her onscreen inspiration (Carrington 2016, pp.81-84).² Despite Uhura's ground-breaking nature, she remains one of only a handful of images of black women scientists to appear on both film and television. The J.J. Abrams reboot of the *Star Trek* franchise introduced a 'new Uhura' (Zoe Saldana) but she has been 'superfluous' to the films' narratives and 'signals a kind of retrograde for the character' (Mafe 2018, pp.144-45). For Saldana's Uhura science is secondary to her gendered roles, she first appears on screen in *Star Trek* (Abrams, 2009) shot from behind as a desirable body for Kirk (Chris Pine) to admire, and later as a humanizing aspect of Spock's (Zachary Quinto) character as his girlfriend. Despite the missed opportunity of this new Uhura, there have been notable but limited images of women of colour with narrative agency and scientific expertise who are key to the plot rather than simply framed as exceptional or Other.³

Although some people may be inspired by and get information about the sciences from actual scientists including their family, friends, and teachers, for the majority the main source of information comes from media representation rather than direct engagement with scientists (Kitzinger et al. 2008). Research indicates that onscreen portrayals of science and scientists can affect the way people perceive the sciences and those who work in STEM fields (Steinke 2017; Haynes 2017; Haran et al. 2008; Kirby 2008, pp.41-56; Steinke 2010; Pansegrau 2008). By having and increasing the number of women scientists on screen, entertainment media can 'reduce stereotyping of science that can lead to misperceptions about the appropriateness of scientific careers for women' (Steinke 1998, p.143). Where the scientific fields offer a 'dearth' of roles (Steinke 1997, p.410), entertainment can provide aspirational role models by showing that science is an appropriate career for a woman and one that is not automatically beset by harassment and sexism.

A 2018 study conducted by Jocelyn Steinke and Paola Tavaréz identifies how US movies ‘fall short in providing positive, inspirational portrayals’ of women in STEM (2018, p.246). Portrayals typically feature comparatively fewer women and tend towards representations that reify existing misogynistic discourses that define women as either lesser scientists or failed women (‘bad’ wives/mothers). This study uncovered a ratio of almost exactly 2:1 for men and women scientist speaking roles showing that, even in films with women scientists, women are outnumbered and often framed as exceptional ‘superscientists’ (Elena 1997, p.270), rather than being normalized as part of the general workforce. This ratio also aligns with broader studies on women’s speaking parts in Oscar-winning movies produced from 1977-2010 that saw men speaking over women by a ratio of 2.66:1 (Smith et al. 2014). Steinke and Tavaréz conclude that their study ‘[points] to a larger cultural issue related to inclusion and diversity in film portrayals’ (2018, p.259), an issue that is exacerbated at the intersection of science, gender, class, ability, and race/ethnicity.

Studies commissioned and conducted by the Geena Davis Institute on Gender in Media similarly showed that men STEM characters outnumber women at nearly a rate of two to one (62.9 to 37.1 percent) with the majority of those being White (71.2 percent) with fewer represented as Black (16.7 percent), Asian/Asian-American (5.6 percent), Latinx (3.9 percent), or Middle Eastern (1.7 percent) (Davis 2018). Although marginally better than the reality, where only one quarter of scientists in the US are women (Beede et al. 2011), the storyworlds created by the entertainment industry should provide role models that the science industries have yet to manage.

A number of approaches to the study of women of science in entertainment media will be discussed below, beginning with a consideration of how women have been negatively stereotyped or made entirely absent from science-based entertainment media. This leads into a discussion of the idea of historically hidden figures and the ways in which this narrative trope

has been utilized. Scholarship concerning the representation of women scientists has often focussed on analysis of dissemination and reception, but there should also be attention paid to the production processes. Who is writing, directing, advising on, and producing these stories? Why must we consider who is seen to 'speak for science' and how this affects audience perceptions about who holds scientific expertise (LaFollette 1988, p.262)?

The genre context and broadcast platform of the woman scientist will also be examined as there are more examples of women scientists in serial television than on film. All of this must also be underpinned by a recognition of intersectionality, as improving representation has been generally confined to images of white women who are often straight and able-bodied rather than women of colour, the differently-abled, queer women, and the intersections of these identities. Even when women are offered space in screen fictions, diversity is side-lined as predominately privileged white women represent their gender in the sciences.

Annihilating/Stereotyping the Woman Scientist

Science is political, embedded, and 'fully embodied' into society and thus attempts to improve the number of women pursuing STEM careers (and the retention of those women by the industry) still needs to move beyond what Susan Harding termed the 'just add women' approach to improving diversity (1995, p.55). By failing to address the institutional and structural problems that limit women's participation in scientific cultures – both real and imagined – it is impossible to fully diversify and decolonize the representation and perception of the scientist.

Women are faced with additional challenges that are specific to their gendered experiences and societal expectations. As Roslyn Haynes argues, women are shown to be 'torn between professional aspirations and the gender roles expected by [a] society that [locates]

them firmly in the domestic sphere’ (2017, p.308). In both fiction and reality, women become ‘the “human face” of science while male scientists embody “objective” science and the face of authority and expertise’ (Chimba and Kitzinger 2010, p.617). Women’s stories are tempered with gender specific ‘forms of risks’ including ‘seduction, denigration, criticism of credentials, intimidation, physical violence, manipulation of results, sexist comments, and cultural inequality’ – issues and narrative arcs that are rarely if ever part of stories of men of science (Haynes 2017, p.318). The types of stories that are told about women in the sciences become part of the expectations for women entering the field, an expectation of harassment, bullying, and gaslighting that may result in their contribution being ignored or stolen.

This lack of representation, gendered-focussed representation, and misrepresentation constitutes a form of ‘symbolic annihilation’. As Gerbner and Gross argue, ‘representation in [a] fictional world signifies social existence’ whereas ‘absence means symbolic annihilation’ (1976, p.182). Gaye Tuchman specifically notes that in the media, women are largely invisible and when they are visible, they are marginalized or used as a symbolic representation of gender equality (Tuchman 1978). Both of these scholarly interventions are from the 1970s but still alarmingly prescient as women scientists are seen to repeatedly fall into stereotypical roles and narratives. Women scientists, that are predominately white women, are incorporated in science-based narratives as visual symbols of gender equality and onscreen diversity but their storylines often revolve around men and resolve in romantic/domestic success. Even today, the woman scientist cannot avoid the baggage of societally-constructed notions of femininity/womanhood.

Despite Uhura’s iconic role in *Star Trek*, ethnic-minority women are regularly placed in secondary and background roles if given representation as scientists at all. The prevalence of white women in these positions, although still underrepresented when compared to white men, also tends to lead the promotion and confirmation of ‘white male authority’ (Mafe 2018, p.2). *Hidden Figures* briefly disrupts this trend by dramatizing the history of Black women

computers, programmers, engineers, and mathematicians that had previously been lost to stories of great white men and the overarching institutional narratives of NASA. Although the film received criticism for the prevalence of a fictional male figure (Al Harrison [Kevin Costner]) who acts as a ‘white saviour’ (Page-Kirby 2016; Blay 2017), *Hidden Figures* positively places Black women at the centre of a science-based narrative. This film emerges alongside other contemporary examples of Black representation including *Black Panther*’s Shuri, *Annihilation*’s astrophysicist Josie Radek (Tessa Thompson), and *Star Trek: Discovery*’s (2018-) science officer Michael Burnham (Sonequa Martin-Green). These Black women contribute to this increased visibility and agency, but despite these notable examples it is very ‘rare’ for black women scientists to be seen in science-based fictions (Meyer 2018).

Eva Flicker offers a typology of women scientists on film that sees them ‘subjected to intense simplifications along three basic dimensions: gender, profession, and private life’ (2008, p.246). She argues that ‘the woman scientist tends to differ greatly from her male colleagues in her outer appearance: she is remarkably beautiful and compared with her qualifications, unbelievably young. She has a model’s body... is dressed provocatively and is sometimes “distorted” by wearing glasses’ (2003, p.316). Professional and gendered stereotypes overlap, and women’s representation is often ‘oriented on their deficiency’ of being either ‘not a “real” woman or not a “proper” scientist’ (2003, pp.316-17).

Flicker identifies seven categories of women scientists: the old maid, the gruff woman’s libber, the naïve expert, the evil plotter, the daughter or assistant, the lonely heroine, and the clever digital beauty (2008). All of these stereotypes consider the relationship of the woman character to male colleagues and alongside her personal relationships (lover, father, brother). These stereotypes are built from a number of tropes that place traits in opposition including masculinity and femininity, naïvety and intelligence, and good and evil. They often embody

male fantasies and patronisingly frame women as childlike and in need of protection, guidance, and affection.

Flicker updated her stereotypical women scientist taxonomy, first published in 2003, with the addition of ‘the clever digital beauty’ in 2008 reflecting the growing popularity of the hacker or coder character and showing how images of women scientists can and have evolved. These hackers are young and beautiful and often have stories of loss and betrayal concerning male characters. For example, both Skye/Daisy Johnson (Chloe Bennett) from *Agents of S.H.I.E.L.D.* (2014-2020) and Felicity Smoak (Emily Bett Rickards) from *Arrow* (2012-2019) are former hackers recruited into crime-fighting groups. Their expertise is essential to the plots of their respective shows, but they both have backstories that revolve around absent and manipulative fathers and the development of their abilities are inextricably linked to those relationships. These characters also tend to go through glamorous makeovers when they go undercover, Smoak and more recently Nine Ball/Leslie (Rihanna) in *Ocean’s 8* (Ross, 2018) reveal their ‘hidden’ beauty as their capacity to wearing contact lenses and a figure-hugging evening gown become more useful ‘skills’ than their computer science capabilities. Women scientist’s representation has expanded but men continue to be central to their stories and the construction of their expertise.

Female-coded characters are assumed to be emotional, maternal, and benevolent, and in need of a man either professionally or personally. Their agency is ultimately contained by the promise or acquiescence of a heterosexual coupling. For example, Jane Foster (Natalie Portman) in *Thor* (Brannagh 2011) is an astrophysicist whose work is commandeered by the US government, she is shown to be young and naïve about her research and quickly distracted from it in a literal collision with Thor (Chris Hemsworth). She is confirmed as an expert by an older male mentor (Stellan Skarsgård) and saved and swept off her feet by the God of Thunder who also returns some of her research notes to her when her own efforts fail. By perpetuating

stereotypes about women scientists, media producers continue to normalize ideas about traditional binary gender roles and perpetuate a normative ‘cultural imaginary [that] has often struggled to find a place’ for the woman scientist (Palmer and Purse 2019, p.5). They are damaging to all gender identities in their separation of the science entirely from the domestic, and in their promotion of the idea that in order to be a successful scientist you must reject family, home, and hopes of a healthy work-life balance.

Uncovering the Woman Scientist

The phrase ‘hidden figure’ has received renewed popularity, since the release of *Hidden Figures*, as a term to describe the forgotten, ignored, invisible, suppressed and unrecorded labours and histories of those involved in major historical moments (Rowbotham 1973). Some feminist history of science research has focussed on ‘[reclaiming] forgotten women scientists and [restoring] their lost voices’ as via their very presence these uncovered women scientists can disrupt ‘gendered scientific assumptions and practices’ that have long been implicit in the history and knowledge of the sciences (Jordanova 1993, p.474). *Hidden Figures* not only reclaims the contributions of specific women to the Apollo missions but also the input of community of people of colour who worked as researchers and computers at Langley. Attitudes to women and ethnic-minorities in the sciences have been formed across decades of mediations of science by scholars and society (including the media) that have made their contributions seemingly ‘invisible’, thus constituting an ‘ellipsis from official recognition’ (Oreskes 1996, p.91).

There have been a number of contemporary films and TV shows that have focussed on historical/contemporary women scientists including *Hidden Figures*, *The Imitation Game* (Tyldum, 2014), *Chernobyl* (2019), and *Timeless* (2016-2018). Even when real women

scientists are offered representation, they become illustrative of whole groups of women scientists. *The Imitation Game* represents codebreaking as a male endeavour, with Keira Knightly playing the English mathematician Joan Clarke (1917-1996). In the film Clarke is seen as exceptional due to her role as the only woman codebreaker and much of her story is aligned to the characterization and progression of Alan Turing (Benedict Cumberbatch). However, Clarke was actually part of a larger group of women – three quarters of the 10,000 strong workforce – who did calculations at Bletchley Park (Dunlop 2015). Similarly, the focus on Katherine Johnson (Taraji P. Henson) in *Hidden Figures* allows for a tightly narrativized version of events, however it also overshadows the contributions of other women and, interestingly, the men of colour who were involved in the Apollo Missions (Shetterly 2015).⁴ Hidden figures are representative of the experiences of women – and indeed men – who have previously been sublimated in the histories of great white men of science (Chambers 2017, p.14).

The television series *Timeless* follows the attempts of white woman history professor (Lucy [Abigail Spencer]), a black male scientist (Rufus [Malcolm Barrett]), and a white male soldier (Wyatt [Matt Lanter]) to stop agents working for Rittenhouse, a mysterious organisation founded in 1778 ‘that wants to control the past, present, and the future’, from travelling back in time and changing history for their members’ benefit. The series uses the time travel format to explore moments in history, key and often hidden figures, and counter-historical narratives (the team are not always successful). The show also recognizes the issues with maintaining history; the US treatment of Black citizens is a recurring theme as the team effectively uphold a system of institutional racism in their pursuit of historical preservation. As Rufus laments: ‘we’re saving rich White guys’ history, a lot of my [black US] history sucks’.

Across the two seasons, *Timeless* includes four women of science as characters: mathematician, Katherine Johnson (Nadine Ellis); actor and inventor, Hedy Lamarr (Alyssa

Sutherland); physicist, Marie Curie (Kim Bubbs); and chemist, Irène Curie (Melissa Farman). ‘Hollywoodland’ (season 2, episode 3) features Hedy Lamarr and explores her invention of the frequency-hopping spread spectrum, a technology that is still used for WIFI and Bluetooth (Barton 2011). *Timeless* uses Lamarr and the way she is often underestimated, and her generally unknown history as an inventor for their story. A similar technique is used with NASA mathematician Katherine Johnson in ‘Space Race’ (season 1, episode 8). In both cases, it is the woman historian’s knowledge of these ‘hidden’ women’s expertise, and their apparent invisibility, that allows them to save the (historical) day.

Praised for its attention to historical detail and accuracy, *Chernobyl* (2019) condenses the work of Soviet scientists into a single fictional nuclear scientist called Ulana Khomyuk (Emily Watson). The Sky/HBO limited series is about the events surrounding the Chernobyl nuclear accident in 1986. Composite characters are a common practice in adaptations and historical dramas, and as with the presentation of science, screenwriters must balance the need for entertainment with accuracy, both scientific and historical (Kirby 2011). But rather than adding another man to the already men-dominated cast the producers actively chose to make this tenacious scientist character a woman.

Chernobyl does not uncover a specific scientist, but it does draw attention to the progressive position of women medics and scientists in the USSR and the involvement of women at senior levels during the Chernobyl disaster (Alexievich 2016). As *Chernobyl*’s writer/producer Craig Mazin remarked when asked about why he thought Khomyuk was an appropriate fictionalized addition: ‘one area where the Soviets were actually more progressive than [the West] was in the area of science and medicine’ with ‘quite a large percentage of female doctors and scientists’ (Holloway 2019). Khomyuk is a moral centre for the show, something which perhaps follows the stereotypical notion of the woman as the ‘human face’ of science but, as Watson notes, she importantly ‘represents the many scientists who worked

fearlessly and put themselves in a lot of danger to help solve the situation’ (Christie 2019). She is a character that may be made more noticeable because many will not expect her to be there. Although an invention for *Chernobyl*, the use of a woman as such an important character should not be diminished; Khomyuk is now a widely-disseminated representation of a woman scientist with the mission to save people from further consequences of man-made disaster.

It is not that women scientists have been ‘written out’ but rather that they ‘have never been written into’ stories about science (Fara 2008, p.19). Films and TV shows like *Hidden Figures* and *Timeless* have begun to offer new screen-specific approaches to visualizing these women’s ‘hidden’ histories as central narratives rather than as addendums to stories of men scientists. One of the first Hollywood feature-length scientist biopics was of a woman scientist, but since the release of *Marie Curie* (1943) there have been four further biopics (1977, 1997, 2014, 2016) made for film and TV of that same woman scientist with 2020 seeing the release of the first woman-written/directed Curie film (*Radioactive*, dir. Marjane Satrapi). These texts contribute to the framing of Curie as *the* exceptional woman of science and an emblematic shorthand for women’s contributions to the sciences. Curie is undoubtedly a significant figure, but she is often ‘where the conversation begins and ends when it comes to women in science’ (Phingbodhipakkiya 2017).⁵ Not only do we need to more stories about exceptional individual women of science, but also narratives that include women experts as part of a diverse team where gender is not simply a defining narrative or character trope.

Genre and the Woman Scientist

The genre in which the woman scientist appears can also influence how their expertise is received. In some instances, when science is represented within a narrative by a woman it becomes less powerful. Holly Hassel (2008) identifies a woman scientist trope that emerges in

the action genre of the 1990s and early 2000s: ‘the babe scientist’. The babe scientist is a co-protagonist to the action hero, but she is overly ‘invested in the science at the expense of “intuition”’ (Hassel 2008, p.190). She of course aligns to the young, thin, and beautiful stereotype, but needs to be re-educated by the man protagonist ‘in the ways of the human spirit’ rather than the rational sciences (Hassel 2008, p.192).

In *I, Robot* (2004) Susan Calvin (Bridget Moynahan) has to be ‘converted’ from her attachment to the scientific method to follow her emotions. It is only once she rejects science and trusts in the (ultimately proven) paranoia of the protagonist – Del Spooner (Will Smith) – that she is able to help save the world from the rise of the robots that she helped to create. In opposition to the majority representations of women scientists, the action movie woman scientist’s emotional detachment is gendered as weak. Her rational adherence to the systems science makes her less powerful in comparison to the man action hero who is driven by his emotion and desire. Intuition and feelings are privileged in the non-scientist action hero, but in other genres that have leading men scientists their dominance attributed to their emotional detachment.

Men, women, and their gendered expectations are aligned to particular fields. In a focus group study by Rashel Li and Lindy Orthia analysing gender in *The Big Bang Theory*, participants agreed that women and men scientists are presented as having equal scientific expertise in the comedy show. But they expressed frustration at the fact that the women are aligned with the ‘soft’ biosciences and the men with the ‘hard’ sciences of engineering and physics (Li and Orthia 2016). *The Big Bang Theory* is unusual in its incorporation of women scientists, but these women are undermined by the ‘goals [of the comedy format] to entertain while reinforcing the status quo’ (McIntosh 2014, p.196). The recurring women scientists of the show – Amy Farrah Fowler (Mayim Bialik) and Bernadette Rostenkowski-Wolowitz (Melissa Rauch) – are ‘caught between their function as supporting characters for the male

leads, and the potential to depict women as working scientists' (Weitekamp 2015, p.89). They are initially stereotyped and primarily played for laughs as part of the comedy format, with Fowler initially introduced as a punchline to a gag about Sheldon (Jim Parsons) using internet dating. Women in the series are 'always a woman first and only a scientist second' and even when they are shown to be more successful (publications, awards, grants) they must navigate the fragile egos of the men on the show (Archer 2015, p.48). Despite the radical potential for '[exploring] ways of reshaping science to include women' in the less restrictive comedy genre frame, *The Big Bang Theory* as a central/culturally pervasive example instead resorts to stereotypes and 'jokes' about women to reinforce male dominance (Jowett 2007, p.32).

The incorporation and speculative discussions of science do not only belong within science fiction but to a broad range of science-based fictions. Although a recent upsurge in fictional women scientists have been aligned to science fiction (specifically astronauts) (Lovell 2019), it would not be possible to discuss a long-running medical drama like *Grey's Anatomy* (2005-) as science fiction, despite the series' engagement with new medical science and technology and their imagined uses and consequences. Although medical reality television has tended to focus more on male physicians, women are better represented in fictional medical dramas (Jain and Slater 2013). They are featured most frequently 'as doctors or medical examiners'(Weitekamp 2015, p.79), and the ensemble casts that often surround them can act to reduce the "burden of representation" which could typecast an individual woman as a "representation" of all women' in the sciences (Haran et al. 2008, p.ii). Untethered by the restrictions of reality, large ensemble-cast medical dramas have space for diversity, as television productions can be more responsive to audience tastes, cultural trends, and changes in the visibility and acceptance of marginalized groups.

Television series provide more intersectional spaces for women scientists to exist in, to a extent due to the platform's inherent opportunities for writers/producers to develop, drop,

and introduce characters over a long-term serial narrative. Women scientist characters on television series also have the potential to significantly impact viewers, especially given the weekly appearances over the course of a season or more. Forensic anthropologist, Temperance ‘Bones’ Brennan (Emily Deschanel) is the titular character in the 12-season series *Bones* (2005-2017) and she is featured as part of a diverse team of scientists in terms of gender, race, and sexuality. As Lauren Archer argues ‘this repetition creates opportunities for viewers to develop a deeper understanding of and identification’ with more diverse scientist characters – an image of science that they may not usually come into contact with (2015, p.31).

Although there is ‘not a plethora of examples’, television has allowed ‘for more ambiguity regarding who is [and can be] the hero’ with more opportunities for women characters to develop (Mafe 2018, p.141, p.125). Films generally have extremely long production scales and offer only one entity on which producers will be judged (critically and financially). Broadcast television, conversely, has a different development and dissemination process that affects how and where intersectional representations of women may appear and develop. TV producers are commissioned to make pilot episodes before a full series is ordered, which means that potentially ‘risky’ characters can be tested on audiences prior to a full financial commitment. Internet-distributed content offers ‘new models of television, with their appeals to ever more niche and activated users’ giving media producers the potential to incorporate more gender and race diversity and queer representation (Goddard and Hogg 2018, p.472).

Streaming services have also offered space to present images of queer women scientists. For example, Netflix’s *Sense8* (2015-2018), created by transgender sisters Lana and Lilly Wachowski with J. Michael Straczynski, includes Nomi Marks (Jamie Clayton) who is a hacker, and a proud lesbian transgender woman. *Star Trek: Discovery*, produced for CBS Access/Netflix incorporates a queer woman engineer into its second season, but Jett Reno’s

(Tig Notaro) ‘queerness is not hidden [or] revealed’ it is simply there (Chambers 2020, p.274). Similarly, *Orphan Black*’s biologist Cosima Niehaus (Tatiana Maslany) is one of two queer clones on the show, and one of several women scientists including her girlfriend (Delphine Cormier [Évelyne Brochu]). Their sexuality is important for character definition but does not propel their narrative arcs. Netflix has the broadcast rights to *Orphan Black* in the UK and Ireland, and the service also became the international distributor for the women scientist-led movie *Annihilation* after distributors chose not to give the film an international theatrical release (Sims 2018). The film premiered on the service alongside original and distributed films and serial shows that offer representation that is often restricted or denied by traditional dissemination methods.

Gender, Media Production, and Representing Women Scientists

Campaigns intended to encourage and improve women’s participation in the sciences are reflected and embedded in the media produced (Merrick 2012, p.752). So, just as it is vital to consider the institutional and structural problems that limit women’s participation in scientific cultures, when analysing women scientists’ fictional representation we need to be aware of the issues of surrounding women working in the media industries. Women-led (both onscreen and in terms of production) entertainment media is burdened with the expectation ‘to disrupt, overcome, and dismantle systemic marginalization in a traditionally masculine cinematic space’ (Donoghue 2019, p.4). The entertainment media industry is a male-dominated field; in 2018 women accounted for only eight percent of directors, sixteen percent of writers, and twenty-six percent of producers working on the top 250 films released that year (Lauzen 2019, p.1). A 2017-18 study of prime-time television showed that women constitute seventeen percent of directors, twenty-five percent of writers, and forty percent of producers (Lauzen

2018, p.4). Although the statistics show that women are better represented in television production, they are still a long way off achieving parity.

Feminist and women's science fiction literature emerged visibly in the 1960s onwards, and these flourishing and often utopian imaginings of the future 'coincided with (and were invigorated by) the women's liberation movements, which included significantly increased opportunities for women in science and engineering education and careers' (Merrick 2012, p.753). As Jane Donawerth observes, science fiction literature written by women tends to feature more women scientists and suggests that women writers are more likely to include a variety of women characters (1997, p.4). However, much of the science-based fiction that is adapted tends to be based upon men-written texts, and then directed and often written/adapted by men too. A large proportion of the media texts under consideration in this chapter are indeed predominately written and directed by men. Women rarely feature in the processes of production as writers, producers, directors, or even as science consultants.

Scientists can be involved behind-the-scenes of science-based film and television as science advisors. In this role they can consult with media producers to support the development of science-based narratives and storyworlds. It is an opportunity to take a more 'speculative approach to science' and provide 'extrapolative speculations about scientific phenomena' as well as to advise on the representation of realistic science and scientific practice (Kirby 2011, p.36). But as with the media and science industries, women science advisors are in the minority. The major 'labcoats in Hollywood' associated with popular science-based films and television series are male (Kirby 2011, p.36), including Jack Horner for *Jurassic Park* (Spielberg, 1993), David Saltzberg for *The Big Bang Theory*, Kip Thorne for *Interstellar* (Nolan, 2014), and Adam Rutherford for *Annihilation*. There are women working as science advisors – Anne Simon for *The X-Files* (1993-2002, 2016-2018), Jessica Coons for *Arrival* (Villeneuve, 2016), Cady Coleman for *Gravity* (Cuarón, 2013), and Cosima Herter for *Orphan Black* – but they

are harder to uncover and confirm. All of these women-advised productions feature central woman scientist characters – Dana Scully (Gillian Anderson), Louise Banks (Amy Adams), Ryan Stone (Sandra Bullock) and Cosima Niehaus – whose scientific expertise is central to the stories and structure of each text. Women scientist’s expertise is vital for creating entertainment media that not only pictures but also engages with the complexities of women’s experiences in the male-dominated sciences and a world that is designed to accommodate men.

The normalization of women’s expertise both on and behind the camera is essential to improving the image of the woman scientist and shifting cultural perceptions about who can be a scientist and what kind of life a woman scientist can have. This, like attempts to improve women’s participation in the sciences, cannot just be about adding more women but thinking about why so few women are incorporated into these stories in the first place. A lack of women in media production affects the number of women-led fictions, therefore we must consider who is permitted/invited to write and produce science-based stories and how the perspectives of those not represented in the reality of the sciences might be more actively and accurately incorporated.

Conclusions: From Symbolic Annihilation to Normalization

The notion of the exemplary and exceptional woman scientist is a major issue when discussing their representation. Successful women scientists are seen as phenomena rather than a normal part of the scientific community, and they continue to be side-lined in the fictional (and indeed real) world of men-dominated science. Studies on the representation of women in STEM have shown that the images presented reinforce stereotypes and position women scientists in a state of conflict between their personal and professional lives, with few represented as mothers and/or happily married (Haran et al. 2008; Steinke 2005; Lovell 2019; Jain and Slater 2013).

Normalizing women of STEM is central to changing broader attitudes about what and who a scientist is, attitudes that need to be altered across lines of gender, race, class, sexuality, and ability. By involving a diverse range of women in STEM as advisors and collaborators, the representation of women can move from being token figures and anomalies to being regular and entirely expected leading figures in science-based narratives on either the big or the small screen. By making women more visible in stories about science, both fictional and factual, the inspiring images of science that can and are being produced can be associated with women who are not only represented as smart anomalous individuals but as part of a network of diverse and complex professional women.

The ‘explicit’ rejection and mockery of women’s scientific expertise may be lessening, but the ‘subtle ways’ of making those who are not white, straight, able-bodied men, ‘feel like outsiders’ shows that, as Patricia Fara argues, ‘modern discrimination is elusive, insidious, and stubbornly hard to eradicate’ (2018, p.285). This is achieved through refusing and failing to incorporate women and ethnic-minority voices and faces into the visual and academic cultures of science including: the deficit of portraits of women in institutions; the absence of women’s scholarship in student reading and scholarly reference lists; and the lack of representation on screen as both fictional and factual figures. By not being able to see themselves in the ways in which science is mediated and embedded into contemporary culture, those who are under-/not represented can feel like the STEM industries are not a place for them. Improving, increasing, and diversifying media representation is only one way of affecting change, but it is an important part of the/a long-term project to change the sciences in a way that stops constraining people by their race, sexuality, class, ability, and gender identity.

Notes

¹ Alongside Leslie, who is presented as sexually confident and occasionally manipulative, the show only offers one other non-biosciences woman scientist: Elizabeth Plimpton (Judy Greer) is a cosmological physicist but her academic prowess is undermined by her voracious sexual appetite.

² Jemison also appeared in the 150th episode of *Star Trek: Next Generation* as Lt. Palmer. She was the first real astronaut to appear in the series.

³ Other examples of fictional black women in STEM include: haematologist Karen Jenson (N’bushe Wright) in *Blade* (1998), medic-in-training Martha Jones (Freema Agyeman) in *Doctor Who* (2007-2010), astronaut Molly Woods (Halle Berry) in *Extant* (2014-2015), inventor/engineer Shuri in *Black Panther*, astrophysicist Josie Radek (Tessa Thompson) in *Annihilation*, astronaut/engineer Ava Hamilton (Gugu Mbatha-Raw) in *The Cloverfield Paradox* (2018), and engineer Naomi Nagata (Dominique Tipper) in *The Expanse* (2015-).

⁴ Margot Shetterly, author of *Hidden Figures*, is the daughter of Robert B. Lee III who was a black research scientist at NASA-Langley Research Center. The film adaptation focusses on the work of black women at Langley and does not present any images of the black men despite their inclusion in the source history.

⁵ The *Beyond Curie* design project celebrates brilliant women scientists who have not received the recognition they deserve.

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