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Immersive and Inclusive Audio

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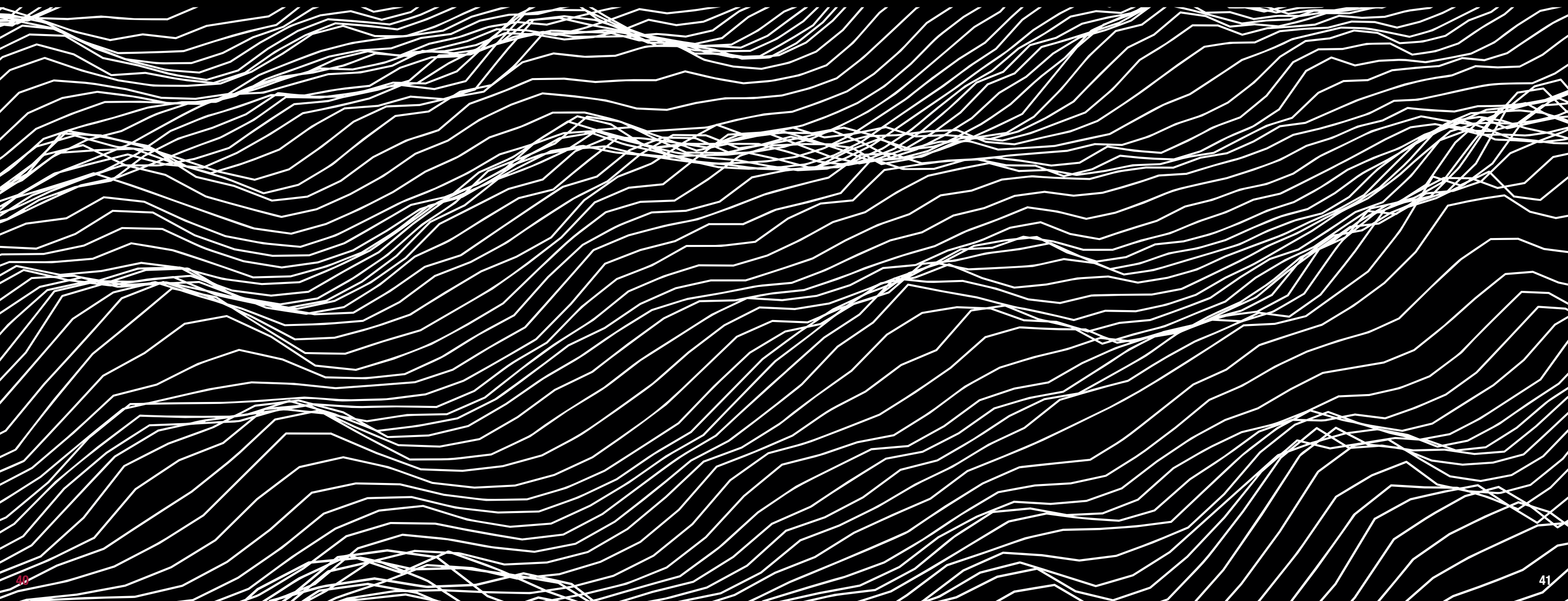
Preface

As the newly appointed President of the Audio Engineering Society (AES) from January 2024, I will be focused on a wide range of activities: from hosting large conventions and conferences to smaller training and development sessions; education initiatives; fostering new membership strategies; supporting our various committees, which include everything from standards and publications to education, Diversity, Equality, and Inclusion (DEI); and making sure our sections across the globe remain energised. Throughout my time in AES leadership, I have primarily focused on immersive audio and inclusion. This year, I am eager to see how the work we do "behind the scenes" is affecting positive and measurable change, particularly at the Audio for Virtual and Augmented Reality conference to be held later this year.

Here is the report I compiled for the Sir Lenny Henry Centre for Media Diversity, having attended the previous AVAR conference in 2022.

Introduction

Immersive audio is a broad term which refers to the technology that allows listeners to perceive sound as coming from "all around" the listener. According to Roginska et al., "Immersive Audio" is a term that has been adopted as the effort to bring "360°" of sound to a wider audience, beginning with Gerzon's "ambisonics" technology (referred to later) and evolving to include virtual reality, augmented reality, and mixed reality gaming today. [Roginska et al., 2017]. The immersive market is forecast to be worth almost 4 billion USD (3.36 bn GBP) by 2030 [JC Market Research, 2022].

Considering the growing size of the sector alongside its appearance in these different and varied markets, the issues of representation, diversity and inclusion are particularly important for a number of reasons:

- Underrepresented groups (including but not limited to women, gender non-conforming people disabled people, and Black and Global Majority) should have equal access to jobs, and access to the technology with which to craft compelling stories from diverse points of view.

- Sound is experienced subjectively and influenced by culture, therefore diversity is essential in exploring the full potential of the technology and connecting to different audiences.

This paper looks to explore representation in immersive audio by focusing on existing academic literature and reviewing discussions on the issue, exemplified by observations I made at the AES AVAR conference in August 2022. Participation of women and other minorities in this currently growing profession is key towards ensuring stories are being told which reflect the rich tapestry of society.

As an audio professional with over 30 years of experience, including the honour of serving as the President of the Audio Engineering Society, I have a unique perspective in the industry. My research focuses on diversity, equity, and inclusion and immersive audio, and this paper seeks to bring these interests together to examine the issue, and elevate the discussion to ensure that underrepresented voices are part of emerging trends in immersive audio.

Literature review

This research is supported by statistics from various audio related sub-disciplines including music, television and film, and video games. The Annenberg Inclusion Study has shown that only 3.5% of producers for chart-topping songs were women [Hernandez et al., 2022], although that number has increased as of 2024 to 6.5% [Smith et al., 2024]. Participation at AES conferences between 2012 and 2019 shows that no more than 24% of presentations were by women, and of those related to immersive audio no more than 13% [Young et al., 2019]. In the UK, the number of women working in audio for games fell from 16.10% in 2019 to 9.2% in 2021. [Schmidt, 2019 and 2021], and while that same geographic breakdown was not available in 2023, participation by non-males in the industry as a whole fell from 19% to 12%.

In terms of ethnicity, about 25% of game music and sound engineers are non-white, with 2.3% of Black heritage [Schmidt, 2023]; however, it is believed there are no Black people in leadership positions, supported by a statement from Wilbert Roget II. In a panel hosted by the International Game Developers Association (IGDA), he states, "we're in a situation where not only are there not many of us in total, but especially not in senior or leadership positions. I honestly can't think of a single non-white audio leader or director, and only a small handful of non-male ones." [Roget et al., 2020].

Background

If you look at a few select papers from academic conferences related to audio engineering, you will discover the origins of many of the technological innovations we take for granted today. The Institute of Electrical and Electronics Engineers (IEEE) Symposium on Auditory Perspective in 1933 first defined stereo as three channels: left, centre, and right [Fletcher, 1934]. In the late 1960s and early 1970s, Michael Gerzon from the University of Oxford was experimenting with recording sound using height information - after all, sounds come from above us, too. Academic conferences such as AES AVAR can be an indicator of emerging trends as these technologies make their way into the devices we use today.

This could be a home theatre with front, centre, and rear loudspeakers (some systems also allow "height" speakers to be mounted in the ceiling); a cinema where we can

Emma Butt authored an article for Representology that found out of 60 roles in audio post production (dialogue editor, sound effects editor, and dubbing mixer) only one mixed-race person was a member of a post production team, while only three white women out of 60 were involved in audio post production for the highest rated shows on BBC1 and BBC2, and only one white woman was involved for ITV (who worked on two separate productions). Channel 4 had no women, and Channel 5 had one white woman (a re-recording mixer) [Butt, 2020].

Voices of the industry

The report captures industry thinking and practice in respect to diversity through the AES AVAR conference at Seattle, Washington (USA) in August 2022.

Conference Details and Representation

The AVAR conference is a globally representative event, against which the UK's performance as a technology participant and its performance with respect to diversity, equity, and inclusion (DEI) can be compared.

Women at the conference interviewed for this report ranged from emigres to the USA (who came from as far away as Russia and Australia, and who are now working for major media companies) to others based in the United Kingdom and Europe.

Their perspectives were useful for framing existing data and helping to get a picture of where the immersive audio industry as a whole stands in terms of DEI.
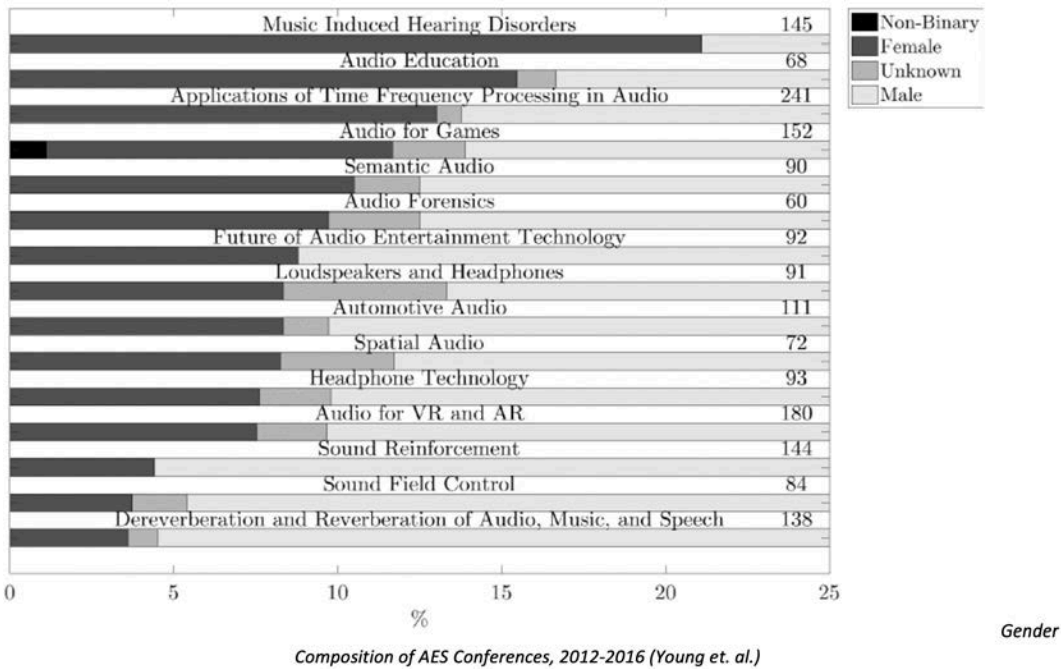
Academic and industry research institutions from all over the world came to the conference, including attendees from the UK

experience sounds moving behind us and above us; a virtual reality (VR) headset with head-tracking capabilities that make it possible for you to turn your head and see from where sounds are coming; or "spatial audio" that you can hear through your earbuds on certain music streaming platforms.

Buzzwords like spatial audio, head-tracking and head related transfer functions were discussed as engineers presented their latest findings, mostly to do with how to convincingly reproduce sound from all directions in real and virtual environments.

In my notebook I jotted down my observations in the margins. How many women were in attendance? How many people of colour1? The reason I wanted to document these numbers is because when representation is low, the data might be pointing to certain symptoms. For example, Amandine Pras and her colleagues at the University of Lethbridge embarked on a study to "capture important demographic information about the audio industry and recording producers/ engineers' experiences of discrimination in the studio." [Audio Engineering Society, 2019]. Their study, published in the Journal of the Audio Engineering Society found that when compared to STEM (Science, Technology, Engineering, and Math) fields, recording studio workplaces score 33% worse on the silencing and marginalisation of women,

representing the University of Southampton, the University of Surrey, and the University of York, and the BBC, among others.

1. As someone who identifies as African-American, I prefer the term "people of colour" to acronyms like BAME (Black, Asian, and Minority Ethnic)

Composition of AES Conferences, 2012-2016 (Young et. al.)

	Male	Female	Other / Non-binary
USA	82.3%	13.7%	3.9%
UK	90.8%	9.2%	0%
Rest of World	89%	10.9%	0%

GameSoundCon Game Audio Industry Survey (2021)

33% worse on gender-related workplace microaggressions, and 24% worse on sexual objectification" [Pras et al., 2021].

I would have preferred to have access to a demographic breakdown of attendance, since no one can tell simply by looking at someone how that person might identify in terms of race and gender. However, the conference organisers did not capture this data for presenters or attendees. Nonetheless, in 2018 the AVAR committee acknowledged a lack of representation in that year's event and pledged to make changes by asking the AES Board of Governors to set aside proceeds from that convention to invite future guests from a more diverse pool of speakers [AES AVAR Committee, 2018]. As of 2022, the committee seems to be making inroads with esteemed keynote speakers Anastasia Devana, founder of Hear XR; and Dr. Veronique Larcher, director

of Sennheiser's AMBEO Immersive Audio programme. The third keynote was by Karlheinz Brandenburg, CEO of Brandenburg Labs.

During casual conversations I had with individual women, some noted the slight improvement in the number of women attending AES AVAR. Although this was encouraging for some, I also sensed a resigned shrug from others. Altogether, there were around 250 people in attendance, not including online attendees. Including two of the keynote speakers, I counted 20 women, most of whom were there to present a paper, poster, workshop, or panel.

Besides myself, there was one other woman of colour; Dr. Kyla McMullen of the University of Florida, who spoke about the results of her study, "3D Audio to Augment the Museum Experience." I also noticed 10 men who might fit the description of "person of colour". If my tally was applied to the industry as a

whole, it could mean the conference was representative of the corresponding data: 8% women, and 4% people of colour.

In fact, there is data to support these *prima facie* observations. In an effort to address the lack of data regarding attendance at conferences, author Kat Young and her colleagues did a deep dive into the data to quantify the number of women and non-binary individuals presenting at AES conferences [Young et al., 2018]. They found that women presenters consistently totalled fewer than 25% of all the papers, presentations, and workshops.

Further, they categorised their findings by topic. As shown in the graph below, "Spatial Audio", "Immersive and Interactive Audio", and "Audio for VR and AR" were among the topics with lowest representation – consistently below 10%. Audio for Games is just over 10%.[8]

Game Sound

My informal tally at AES AVAR, together with the data from Young et al. (2018) is also backed up by data in other industries. In the field of sound for video games, Brian Schmidt and his colleagues at GameSoundCon.com found in 2021 that 9.2% of game sound engineers in the UK are women, compared with 13.7% in the USA. That number for women in the UK was down from 16% in 2019, and down from 19% to 12% when looking at non-males in the industry worldwide in 2023 [Schmidt, 2023].

Immersive Audio for Film, Television, and Music

Another place where we can find participation data is in directories of certified professionals. On their website, Avid (manufacturer of Pro Tools software) lists the individuals who have earned certification as an "Avid Certified Professional Pro Tools | Dolby Atmos" (https://www.avid.com/learning/ind-a-certified-professional). Worldwide, in 2021 there were 89 engineers listed (Avid lists engineers who pass the certification, it is not clear if anyone has opted not be listed), only 6 of whom were women. In the UK, there were 10 engineers listed,

only one of whom is a woman (it happens to be the author).

Looking at Grammy award winners in the immersive sound category, there is an interesting trend. There are three credits in the category: "immersive mix engineer", "immersive mastering engineer", and "immersive producer". Of 16 winning immersive mix engineers, Leslie Ann Jones, Elaine Martone and Ulrike Schwarz are the only women represented. Of winning immersive mastering engineers, one woman, Darcy Proper, has won 4 times.

The UK group "2 Percent Rising" (founded by mastering engineer Katie Tavini) took their name from the Annenberg statistic. In the four years since that study was published, things have slightly improved; 2.8% of producers were women in 2021 [Smith et al., 2021], and 6.5% in 2023 [Smith et al., 2024].

Social Media Spaces

Participation in social media groups is a way for professionals and students to network and learn more about many different technologies, including immersive audio. In the Dolby Music Mixing Professionals group, I looked at the profiles of 1,500 members visible to me and

found that of its 2,205 members, only 2% are female [Gaston-Bird et al., 2021]. Furthermore, less than one percent of profiles were people who appeared to be Black. One of the group's admins confirmed my findings about the representation of women by sharing the demographic data from the group (race and ethnicity data is unavailable).

Hidden Figures: Perspectives of Women Working in the Industry

Although only 44 of the members of the Atmos group are women, there are other women's-only groups dealing with immersive technology. For example, the group Women in AR/VR boasts 11,000 members. However, engagement in the group is quite low. When I tried to poll how many women worked in sound, I received the following answers:

- "I only work in audio for VR/AR": 3 votes

- "I work with audio and image": 6 votes (including two men)

One respondent shared an explanation of why engagement might be low. In a separate survey, I asked, "what does participation feel like in mixed gender versus gender-exclusive spaces?"

She offered the following:

"The spatial sound and immersive audio community is already small. When you limit yourself to creating a women-only space within that community you severely limit the ability to have the conversations necessary to promote and advance the technologies and the art form. If the few women that have the knowledge to really share and enhance a community are too busy to fully maintain the community I find these communities fall apart pretty fast due to lack of engagement."

- Survey respondent

. . . told me about their experiences with other scholars who approach their male colleagues to ask questions, rather than directing the questions to them, demonstrating a common microaggression: being dismissed or overlooked because they are women.

In order to dig deeper, I went back to my field notes from the AES AVAR conference and to interviews I held with women enrolled in immersive audio workshops (which I taught) to find more perspectives.

"It took me four years to be taken seriously," said one of the AVAR presenters about her experience as a woman working in the field of audio for augmented reality. Another woman admitted she felt intimidated by the amount of higher level of mathematics present in some immersive audio research, referring to herself as a "just a designer". Yet she is very involved in mentoring and runs a Discord server to teach people about sound design for Unity, a software programme used for designing video games.

Both McMullen (an author of a website featuring young African Americans in STEM) and another AVAR presenter told me about their experiences with other scholars who approach their male colleagues to ask questions, rather than directing the questions to them, demonstrating a common microaggression: being dismissed or overlooked because they are women.

Recommendations

Dr. McMullen does not shy away from conversations about equity, being empowered by her tenure appointment to speak about pipeline initiatives. Such efforts need to be led by the right people with the right experience with DEI, she says. "We are reinventing the wheel when we don't even have a car."

Other women are taking charge of building the "vehicles" for access to the technology by starting networking mentoring programmes. In the UK, the

Yorkshire Sound Women's Network, 2 Percent Rising, Saffron Sound, and the Omnii Collective are examples of groups working to shift the balance of women in music technology and audio engineering.

The Black Sound Society was founded as a support network for sound technicians and post sound mixers in film and television. Mama Youth provides training for young people from underrepresented backgrounds to enable them to succeed in the media industry.

The recommendations for overcoming barriers to entry include:

- Establishing employee network groups (also known as Affinity groups, and Feminist audio collectives as catalogued by Dobson [n.d.])
- Scholarships
- Certification and upskilling
- Continued unconscious bias training
- Building social capital by uplifting role models, creating mentorship opportunities, and networking as described by Laird [2016].

Conclusion: Informing policy and practice

Dr. Amandine Pras and her colleagues at the University of Lethbridge encountered a response in their study of microaggressions in the studio. "Look at that famous engineer who is a woman/ transgender person/ racial minority: they did just fine," they recounted. I have also encountered similar sentiments about my

presence in immersive audio. "You're different Leslie, you're hungry" I have been told or, "You're like a unicorn," since encountering a Black woman doing re-recording mixing is rare. However, Pras's team envisions a future in which underrepresented groups can thrive "without having to be absolutely exceptional." [Pras et al., 2021]

In order to investigate the concerns of women and minorities who seek to work in immersive sound, I have since started an initiative called "Immersive and Inclusive", which provides both online and in-person immersive audio training in a safe space. Over a few months, 121 applicants have sought funding to attend the training, over 30 scholarships have been awarded for Pro Tools User certifications, and another 5 women have received Avid Pro Tools | Dolby Atmos certificates from our programme, including 2 from the UK. The myth that women are "just not interested" is unfounded. In fact, our students are determined enough to complete 24 non-consecutive hours of intense training to earn a certificate which provides them with a sense of pride and accomplishment. The results of that study were published as part of my doctoral dissertation [Gaston-Bird, 2024].

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