

Disruptive AVT workflows in the age of streaming

The Netflix equation

Serenella Massidda

Roehampton University

In the last decade, media industries have witnessed a shift in the way audiovisual content is localised, broadcast, and consumed by multifaceted audiences: from traditional linear TV to subscription video-on-demand (SVOD) services. While this major shift has been well-documented by media studies scholars (Lotz 2014; Lobato 2017a, 2017b; Storstein Spilker and Colbjørnsen 2020), the overall effect it has had on audiovisual translation (AVT) is relatively under-researched within Translation Studies. Hence, this article aims to delve into the current state of the art of AVT within a mediascape dominated by non-linear over-the-top (OTT) platforms. Drawing on the impact that streaming solutions such as Amazon Prime, Disney+, and Netflix have had on the acceleration of AVT workflows worldwide as a way to localise a high volume of content created to reach global audiences, my analysis focuses on their impact on the way subtitling workflows are managed and turnaround times scheduled. This study focuses on the day-of-broadcast (DOB) model, the media release strategy intended to make audiovisual content available ‘now and everywhere’. The disruptive nature of DOB models in localisation workflows is investigated using a case study, the *ad hoc* subtitling workflow devised for Netflix’s *Chelsea*, and analysed using a qualitative research method. The aim is to unveil the practices behind the scenes of the first global talk show subtitled in twenty languages with a turnaround time of only fourteen hours.

Keywords: audiovisual translation, digital technology, internet TV, localisation workflows, Netflix, subtitling, subscription video-on-demand (SVOD)

1. Introduction

This article explores the new mediascape produced by the emergence of online streaming solutions. Drawing on the impact that subscription video-on-demand (SVOD) services have had on the acceleration of AVT workflows worldwide, my analysis, based on documentary analysis, fundamentally qualitative in its nature, focuses on the disruptive force of streaming video content providers that are rapidly growing in popularity. The analytical method employed for the present research was selected as a way to examine pre-existing data and interpret documentary evidence in order to elicit meaning, gain understanding, and ultimately develop empirical and critical knowledge (Bowen 2009) on a topic that has been discussed in the field of Media Studies, yet is still relatively under-researched in Translation Studies. In the last decade, and particularly in 2020, a year characterised by the outbreak of the COVID-19 pandemic, the entertainment and localisation industries have witnessed and undergone ground-breaking transformations that have considerably affected media consumption.

The new digital scenario before our eyes is a world where SVOD giants have knocked out ‘linear TV’, the traditional way of accessing TV content with viewers relying on the broadcaster schedule. The habits of global audiences, forced into strict confinement and lockdown by governments around the world in response to the global emergency, have changed profoundly, accelerating a process that was already in motion before 2020. The traditional concept of linear TV, for which the audience is exposed to a scheduled TV show at the specific time when it is broadcast (Kantar Media 2016), has been progressively replaced by the novel freedom offered by streaming companies that let users decide when and how to consume the titles available on their catalogue: “Combined, these efforts will likely cause the so-far-niche activity of watching live television channels via the Internet into the mainstream” (Luckerson 2016, par. iii). The internet has rapidly emerged to change the nature of many of our everyday activities:

Its growing popularity, in conjunction with the increasing ubiquity of Web-enabled devices and wireless networks, means that the Web now forms an increasingly prevalent part of the broader environmental context in which much of our daily thought and action is situated. (Smart 2014, 326)

In addition, the rise of the ‘day-and-date’ release (Hilderbrand 2010), intended to make audiovisual productions immediately available, poses a major challenge for the delivery of multiple versions of subtitled content in a tight turnaround time. This study will provide insight into pioneering localisation workflows within multicast online streaming platforms by describing the *ad hoc* workflow behind the scenes of Netflix’s *Chelsea* (2016–2017), a talk show subtitled in twenty lan-

guages in around fourteen hours in more than 190 countries around the world. The analysis of the innovative motives and approaches to the workflow required for the near simultaneous global broadcasting of the show sheds light on the new digital landscape generated by SVOD services' new distribution models and marketing tactics driven by user experience (UX) and artificial intelligence (AI) algorithms. This study aims to investigate the impact exerted by new streaming on demand paradigms of current subtitling workflows, and particularly on the localisation workflow created for Netflix's *Chelsea*. The show represents a unique experiment, a precursor of current industry models characterised by tight turnaround times and brand-new technologies integrated in the AVT ecosystem assisting in the acceleration of the overall operations.

In this article, the key factors leading to a second wave of the 'technology turn' in AVT (Chaume 2013; Díaz Cintas 2013) will be identified in an attempt to reshape the boundaries of the new AVT scenario as well as to acknowledge the impact of the coalescing of technical advances in an internet and hyper-audiovisual society. In "The Technology Turn in Subtitling," Díaz Cintas (2013) investigates the relationship between AVT and technological innovations – which determine the very nature of this mode of transfer – and sheds light on the multimodal dimension of human interaction in our times, exemplified by actor Michael Kelly in the teaser trailer of Netflix's *Black Mirror*:

[...] the magnifying glass through which we observe the human condition [...], where the past, present and future all coexist on the same timeline, a reminder that the future is not some distant glimmer, but a bright light shining in your eyes. This is the future we are in right now: where our phones are the first things we touch when we wake up and the last thing we touch before falling asleep. Radiant, seductive screens we so lovingly, endlessly gaze upon.¹

According to Díaz Cintas (2013), the most striking aspect of the phenomenon is the move of subtitling as a mode of transfer to the internet and the impact of this on future AVT practices. Over ten years later, we are able to appreciate and measure the extent to which the technological transformations mentioned above have affected the way AVT is conceived in its conceptual and linguistic dimension, produced in terms of its technical dimension, managed, and globally distributed.

1. Brooker, Charlie. 2016. *Black Mirror*. Netflix. Streamed Oct 21, 2016. YouTube video, 1:35:00. https://www.youtube.com/watch?v=di6emt8_ie8.

2. The Netflix equation

In 2016, Reed Hastings, Netflix CEO and co-founder, delivered a showcase at the Consumer Electronics Show (CES), one of the most influential events for technology executives in Las Vegas, to announce that they had just switched Netflix on in Azerbaijan, India, Indonesia, Nigeria, Poland, Russia, Saudi Arabia, Singapore, South Korea, Turkey, Vietnam, and 130 new countries: “We are witnessing the birth of a global TV network,” he affirmed (Hastings 2016). In his opening keynote speech, Hastings further explained that there’s no more watching TV on a schedule: “You can watch how you want, when you want, and wherever you are in the world” (ibid.). His contribution revolved around the transformation of entertainment in the past 100 years driven by the evolution of technology: from radio to broadcast TV in the 1950s, to cable TV and internet TV in 2008 when the first steps were made to integrate the internet into entertainment devices.

As Lotz (2014, 71) points out, “Netflix has disrupted the long-acclimated sense that television content should be viewed on a television set.” Ultimately, what has changed is the point of view of the observer. If traditional TV audiences were once expected to passively absorb what the black box had to offer, with no control or agency whatsoever on their part, conversely, nowadays the reverse is true: the ‘observer’ decides when (schedule), what (personalised content), and where (anywhere/worldwide) the interaction with multiple screens and devices will happen. From a media localisation industry perspective, the advent of streaming solutions is part of a shift that has been labelled ‘the post-network’ or ‘post-TV era’ (Lotz 2014; Strangelove 2015) where internet TV is conceived as a tool able to empower users and reshape what is possible thanks to the ever-increasing interconnection (Deloitte 2021) facilitated by global internet penetration (reaching 46.1% in 2016) and robust speed, which rose to 2.5 Mbps in March 2014 reaching 6.3 Mbps globally in 2016 (O’Toole 2014), as Hastings (2016) himself reports in his keynote.

Since the COVID-19 outbreak – which forced streaming platforms to release older programmes in new markets and languages (Shevenock 2022) due to the shutting of movie theatres – internet penetration and speeds in Europe have increased exponentially, as well as the number of subscribers at global level (see Figure 1 for more comprehensive data on global streaming services subscriptions 2020–2023). The online usage penetration rate equals 97.4%; that is, 187 million European Union households have access to fixed broadband technologies and 85% to services offering at least 30 Mbps (Eurostat 2022). Overall, the central idea of Hastings’ (2016) contribution is that of globalised audiences unified under the spell of the streaming giant: conveying a sense of ‘unity’ in a Babel where language barriers will be broken down, long distances covered in the blink of an eye, and

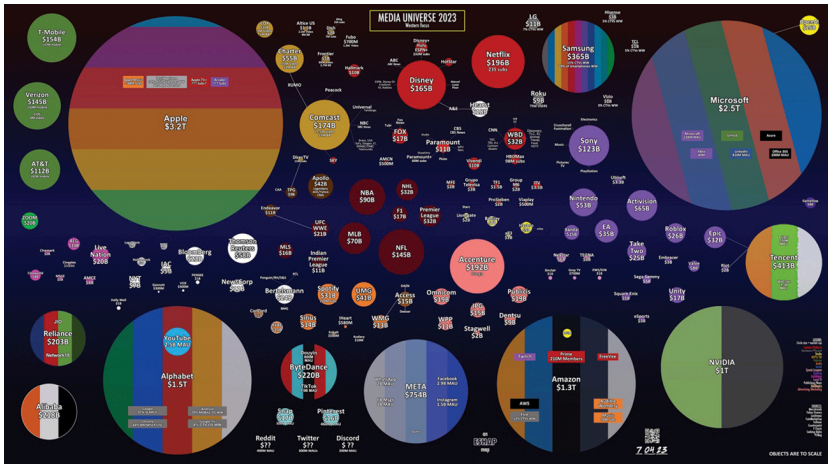


Figure 1. *Media Universe Map* (courtesy of Evan Shapiro 2022–2023)

audiovisual content localised in whatever modern idiom spoken on the face of the earth. Yet, what Hastings (2016) omits to recount is how Netflix managed to break those barriers and successfully expand their reach so widely and quickly.

In 2017, Netflix initiated the *Hermes Netflix Test*² to launch the service in 130 new countries (190 regions globally) and to achieve localisation quality at an increasing scale by rapidly adding new translation talent in a variety of new languages to provide top-notch translations for their new global audiences. In addition, the *Netflix Hermes Test* represented the first online subtitling and translation test (Pedersen 2018) with the aim of measuring professionals' subtitling skills where no standard test was available in the AVT field providing metrics on professionals on a global scale. Netflix managed to find the best professionals relying on the company's Localisation and Media Engineering teams collaborating with renowned academics in the AVT space (Fetner and Sheehan 2017). The test consisted of thousands of timed, randomised questions to test the candidates' comprehension of the English language, their ability to understand and translate idiomatic expressions into their target language and identify linguistic and technical errors in a series of subtitles, and test their overall subtitling proficiency. Once passed, a code (H-number) was issued to the best resources to be identified and the professionals then assigned to Netflix's Preferred Vendors, their trusted language service providers (LSPs), a program recently renamed as Direct Time Text (DTT).³ The operation was advertised so well that only a few weeks after

2. See <https://about.netflix.com/en/news/netflix-is-looking-for-the-best-translators-around-the-globe>.

3. See <http://gvm.netflixstudios.com/>.

its launch thousands of candidates had applied to take the test, reaching almost unmanageable numbers, as reported by *Slator* (Bond 2018). A year later, Netflix issued a statement on its website: “We have reached our capacity for each one of the language tests due to the rapid popularity and response from applicants all over the world. Therefore, we are closing the platform to future testing at this time” (cited in Bond 2018). Allegedly, the project was terminated due to hurdles during the onboarding process, as explained by the Program Manager, Allison Smith at the *Languages and the Media Conference* in 2018:

Netflix aimed to own the full process from subtitler recruitment through to working in our tools, and this started with Hermes. While we learned a lot and did get value from the test, after introspection and analysing our core competencies, we decided vendors were better suited to use their core competencies and add value to the content localisation ecosystem by owning the recruiting, training and onboarding processes. (cited in Bond 2018)

The company admitted that it had been overambitious in its goal, and thus decided to focus on content workflow and development instead, leaving the media localisation management to its Preferred Fulfilment Partners.

Before delving into the intricacies and outcomes of how the *Netflix Hermes* project has affected subtitling ecosystems and professional working patterns in the AVT sector leading to the current ‘global talent crunch’ (Korn Ferry 2018), it is paramount to provide the context that favoured the emergence of these groundbreaking innovations.

3. Evolution of media and localisation industries

The boom in popularity of non-linear over-the-top (OTT) services, along with the explosion of audiovisual serialised productions, have led to a growing demand for media content localisation across the world. In *Netflix Nations: The Geography of Digital Distribution*, Lobato (2019) provides an overview of the evolution of broadcasting technologies from a geolocalised point of view, acknowledging the shift from linear TV to SVOD that has revolutionised the way TV is conceived, localised, consumed, and globally distributed. According to Brown (2017), this shift has led to a huge increase in demand for foreign-language versions of films and TV shows, which has required post-production localisation studios to develop more cost-effective workflows that can process large amounts of audiovisual material simultaneously in multiple languages.

In the middle of such exponential growth in digital and media content (DePalma et al. 2016; Statista 2016), professionals working in the AVT field find

themselves in a rapidly changing world where their roles are undergoing enormous changes (Moorkens 2017) due to the increasing integration of AI-powered technologies into traditional subtitling and dubbing workflows. New technologies have changed the professional AVT landscape considerably: automatic speech recognition (ASR), AI-powered auto-caption functionalities, and neural machine translation (NMT) systems have intrinsically altered the nature of the role of professionals in the media industry (Massidda 2022) allowing for the creation of post-editing tasks in each and every step of the subtitling stages (transcription, spotting, and translation) as a way to speed up the process and subtitle more content much faster (Massidda and Sandrelli, forthcoming).

The binge-watching revolution started in the late 1990s when the combination of quality US TV and DVD boxsets made it an irresistible appeal, and a breath of fresh air for viewers around the world. Yet, it is in the last decade, with the new ‘golden age of TV shows’ (Pichard 2011) that many great shows have found their way online: “US productions have shifted from a more traditional approach to a brand-new category of series format, investing large amounts of money in ambitious projects created by famous producers and directors” (Massidda 2015, 114). TV shows are the new cinema: Scorsese depicted the Prohibition era in HBO’s *Boardwalk Empire* (Winter 2010–2014), the Coen brothers directed FX’s TV adaption of *Fargo* (Hawley 2014–2023), while Hulu’s adaption of Margaret Atwood’s *The Handmaid’s Tale* (Miller 2016–2023) was awarded two Golden Globes for Best Drama. It comes as no surprise that in such a flamboyant era, not only linear TV, but also the cinema industry is currently suffering a serious setback. Aside from the most popular streaming services, other SVOD systems are proliferating and gaining ground. Former pay-per-view channels have moved to the streaming club: HBO has a standalone streaming service, HBO Now, FX is now available online, and CBS has a cloud-based service called CBS All Access, just to name a few.

The media localisation industry has undergone a series of transformations (Oliver 2018) that profoundly affected the way AVT workflows are now managed by LSPs worldwide. At the turn of the century, the whole system was merely centralised in its nature, with professional subtitlers working in-house either part-time or full-time within a specific company. Yet, after only a decade, with the ever-increasing volume of audiovisual productions in conjunction with the emergence of SVOD systems and media broadcasting clients’ pressing demands, LSPs were compelled to partly outsource localisation projects to external pools of freelancers, decentralising traditional working models. This scenario is familiar to many professionals, as most LSPs now base their workflows around freelance production networks in a media localisation industry that is “primarily digital, outsourced, and project-driven” (Dunne 2012, 144). The shift from centralised

to decentralised localisation workflows was in no way seamless, as these professionals initially operated in isolation with their own desktop-based subtitling software. In the best-case scenario, they were provided with dongles of the proprietary software to install on their computers – a time-consuming process to download, install, and verify the freelancers’ dongles through a key-code. Yet, normally, subtitlers would own their own software and deal with any technical issues resorting solely on their own resources, also because of the way communications were managed (asynchronous as opposed to real-time). Occasionally, freelancers working for larger LSPs were asked to work on English Master Templates (EMTs), timecoded subtitle files in English meant to be used as the basis for translation into multiple languages (Kapsaskis 2011; Nikolić 2015; Georgakopoulou 2019). Once the use of EMTs started to be systematically incorporated into subtitling workflows for multilingual productions (Georgakopoulou 2006), decentralised workflows began to take shape, streamlining the process, simplifying quality control, and reducing overall costs while expanding the talent pool: “Template files became the cornerstone for the globalisation of the subtitling industry” (Georgakopoulou 2019, 1). Yet, it was the move from desktop- to cloud-based subtitling toolkits that turned workflows into the decentralised ecosystems in use today.

The media localisation sector started witnessing a once in a lifetime revolution due to “the nature of the technology-driven *modus operandi* in place” (Díaz Cintas and Massidda 2019, 265), which revolved around global pools of localisation teams plugged into cloud-based platforms to improve efficiency, speed, and scalability. “Professional cloudsubtitling” (Bolaños García-Escribano, Díaz Cintas, and Massidda 2021) refers to the practice of subtitling on the cloud thanks to the cooperation of subtitlers based in different geographical regions. Cloudsubtitling workflows implement a management system that resembles the traditional chain of subtitling phases employed by subtitling companies, but because these browser-based systems are online they can be accessed anywhere by professionals using their own devices to carry out subtitling and post-production tasks.

The second decade of the new millennium witnessed a progressive “decentralisation of AVT workflows” (19) able to meet the needs of a new media market dominated by streaming services. The first pioneering experiment on decentralised workflows on a large scale was conducted by Netflix in 2016, when it launched *Chelsea*, its first global TV show.

4. Localising content on a global scale

Chelsea was a first for Netflix in many ways. Defined as the first global talk show conceived for internet TV (Wright 2016), it premiered in 2016 in almost 200 countries at the same time. Chelsea Handler, the host of the late-night show, is a popular, eccentric stand-up comedian whose humour is blunt, at times offensive, and culture-bound, “talking about very American stuff on a show designed to play internationally” (Greenberg 2016). Sarcasm and dry humour run consistently throughout the show along with “sticky turns of phrase that might trip up global viewers” (Rodriguez 2016). Unlike traditional linear TV talk shows, *Chelsea* is “a show without boundaries, both geographic and content” (Wright 2016). A show of this nature presented two major challenges for the SVOD giant: making sure *Chelsea*’s peculiar mix of humour and cynicism is not lost in translation with a quick turnaround time, around twelve hours, that “marks the tightest schedule yet for *Netflix*, accustomed to filming scripted series months ahead of time” (Mandell 2016). The strategies implemented to address these challenges and the technological innovations incorporated in the *ad hoc* localisation workflow created for this pioneering enterprise carried out by the company, will be discussed in the following section.

4.1 The technology behind Netflix’s *Chelsea*

What is important is needed yesterday, all *Chelsea* show jobs are due thirty years ago. (Wong et al. 2016)

On 11 May 2016, Netflix launched *Chelsea*, a late-night TV show that streamed on Wednesday, Thursday, and Friday for a total of ninety thirty-minute episodes aired simultaneously in 190 countries, around thirty-four hours after being taped (Rodriguez 2016). The quotation opening this section is an attempt to oversimplify a titanic effort hidden behind a set of figures. The first season of *Chelsea* was aired three days (in a row) per week, for thirty weeks (from May to December 2016), while for each episode around twenty subtitled versions were produced in eight to twelve hours thanks to a technology-driven clockwork able to manage and closely monitor the worldwide translation task force behind the scenes. Díaz Cintas’ (2013) definition of our era as the “Technology Turn in Subtitling” reached its acme with decentralised cloud-based systems and video streaming technologies. As a way to elucidate how Netflix managed to premier the first global talk show with a lightning-fast turnaround time for subtitles, insight into the latest developments of video streaming encoding techniques and cloud-based architectures will be provided.

Netflix has long worked to reduce the time required to prepare features and TV shows to be streamed globally. As explained by Wong et al. (2016) in *Netflix Technology Blog*:

Historically there was not as much pressure on encode times. Our system was optimized for throughput and robustness, paying less attention to speed. In the last few years, we had worked to reduce the ingest and encode time to about 2.5 hours. This met the demands of our most stringent use cases like the Day-After-broadcast delivery of *Breaking Bad*.

Yet, the audacious approach employed for *Chelsea* by the SVOD giant posed a formidable challenge: beating the 2.5-hour record by reducing the ingest and encode time for each episode even further to have each thirty-minute episode encoded in real-time in around thirty minutes, roughly the same runtime of the source. Therefore, the day-of-broadcast (DOB) model of delivery devised for *Chelsea* called for a series of enhancements and techniques enabling Netflix engineers to encode “in the fast lane” (ibid.). Over the last few years, their main efforts were devoted to the development of a robust and scalable cloud-based system able to handle an ever-growing amount of data.

According to Wong et al. (ibid.), to support the acceleration of new media localisation systems at Netflix, two main streaming processes, video ingestion and encoding, paved the way for *Chelsea*'s dream to come true. It is through real-time video ingestion that the audiovisual data is imported as the source emits it; while it is through video encoding that the same data is converted into a variety of formats that are available for playback. However, a set of new procedures based on the concept of ‘parallelism’, enhanced these processes even further for *Chelsea*. ‘Parallel encoding’ is a procedure by which a title is broken up into thirty-second chunks processed in parallel on different machines, a system that allows for lower latency⁴ and can downscale the overall encoding time. ‘Automated parallel inspection’, on the other hand, is focused on data quality assurance by monitoring and ensuring high quality video streams. The data ingested, or ‘mezzanine file’ (ibid.), is inspected to detect wrong frame rate conversion, metadata, picture corruption, and so on. Once again, the encoded video file is sliced into chunks, thus enabling parallel automated inspections.

Having briefly elucidated how Netflix has ensured such quick encoding workflows, in the following section I investigate the subtitling workflow devised for *Chelsea*.

4. The delay between the instant a frame is captured and the instant the frame is played.

4.2 Subtitling in the fast lane

From May to December 2016, every week, more than 200 professional subtitlers located around the globe were engaged in an unprecedented worldwide operation: localising *Chelsea*, the first global talk show conceived for the internet, in around fourteen hours. This is certainly not the first attempt made by Netflix to accelerate localisation processes. In 2011, as a way to catch up on prior seasons, the full seasons of three popular TV shows became available for ‘binge-viewing’: *Mad Men* (Weiner 2007–2015, seasons 1–4), *Breaking Bad* (Gilligan 2008–2013, seasons 1–3), and *The Walking Dead* (Kirkman, Moore, and Adlard 2010–2021, season 1). Yet, it was only in 2013 that Netflix finally kicked off the binge-watching era of TV consumption, which was to become a well-known trademark of the company. Netflix raised the stakes on binge-viewing, turning it from a way to watch previous seasons of popular TV shows, into a way to watch recent seasons of new programmes, all at once. Netflix flouted TV industry convention by releasing all the episodes of the first season of *House of Cards*. In homage to the novelty introduced by the company, in 2015 the term ‘binge-watching’ was named the *Collins* dictionary word of the year and was defined as follows: “To watch a large number of television programmes (especially all the shows from one series) in succession” (BBC News 2015).

According to Tracy Wright, Director of Content Operations, the streaming service vetted a pool of 5000 linguists to find the best subtitlers on the market “who knew how to take American comedy that is edgy and often profanity-laced and translate it to another language while preserving cultural relevancy and tone” (Wright 2016). For the first time, Netflix started to test and hire subtitlers directly (Porzucki 2016); around 5000 initially, then narrowed down to 2000, in order to localise and perform the quality control checks. At the end of this process, around 200 professionals were hired to cover the twenty language pairs in which the show was released:

It had them translate clips from Handler’s Uganda Be Kidding Me stand-up special and *Netflix* originals including *Orange is the New Black* and *House of Cards*, to see how well they interpreted ‘vulgarity, slang, US-centric political terms and idioms’ into their respective languages. (Rodriguez 2016)

By employing highly sophisticated respeaking technology, the company’s localisation team managed to “build a workflow that allows to create and share one EMT with subtitlers from Mecca, Saudi Arabia to Sao Paulo, Brazil” (Wright 2016). Netflix’s subtitlers were able to rely on a live English transcript of the show created by a team of respeakers during the taping of *Chelsea*, “which [...] means that someone [repeats] all of Handler’s jokes in real time, but with perfect pronunciation, which

then gets automatically transcribed by a computer” (Roettgers 2016) by employing ASR technologies. Upon completion, the transcript, which would undergo human post-editing and would then become an official EMT of the episode, was immediately distributed and shared on the same night with the pool of expert subtitlers located around the world, thus optimising the workflow, and allowing them to deliver the final subtitled version the following morning. The live transcription of the dialogue was also simultaneously live streamed to a team of cultural experts able to identify tricky expressions, cultural references, or US public figures to provide subtitlers with relevant information and allow them to research ahead of time for maximum efficiency:

References such as “Edumacate Me”, the DMV, Xanax, Snapchat, Huggie Jeans and play on words like ‘Chelsea Grammar’ and ‘anyways’ aren’t globally understood, so flagging these in the template ensures that we give enough context to get the most locally relevant translation to achieve the desired impact. (Wright 2016)

Despite the efforts to localise the first season of *Chelsea* in a tight turnaround time, the approach devised for the second season, broadcast in 2017 in an hour-long, once-a-week format, went back to traditional media localisation approaches in terms of turnaround times and workflow. The reasons behind this U-turn are unknown, due to Netflix’s confidentiality and secrecy, an attitude which is, to some degree, rather understandable. One might assume that it could be due to potential flaws in the linguistic and technical quality of the translation output, as some scholars and mainstream media outlets have lamented a progressive decrease in Netflix’s subtitling quality (Blair 2021; Kuscu-Ozbudak 2022).

In the case of *Chelsea*, translating comedy in the fast lane represents an added challenge and a difficult target to attain within the allotted time; however, the specific analysis of the translation of humour and general quality of the subtitled versions of *Chelsea* is beyond the scope of this paper. The motives behind the shift of format, technologies, and media localisation workflow for the second season of *Chelsea* might well be connected to the talk show parting ways with its showrunner and executive producer, Bill Wolff (Birnbaum 2016), yet the real reasons remain unknown.

5. The global talent crunch: Disruptive forces at work

The talent crunch, an imminent skilled labour shortage affecting both developed and developing economies could ultimately shift the global balance of economic power by 2030 if left unaddressed. (Korn Ferry 2018)

The media localisation industry is currently facing a serious challenge represented by the small pool of skilled professionals available in the AVT sector working for a multitude of LSPs worldwide. The talent shortage dilemma was first noted in the news in connection with the fast-growing global demand for content: “Given the way the market is growing, there are already capacity shortages, and this is likely to get worse in the short term” (Estopace 2017). Yet, it was only at the end of 2021 that the subtitling talent crunch was formally acknowledged and took centre stage when an article in *The Guardian* titled “Where Have All the Translators Gone?” was published (Bryant 2021). The article reveals the reality of the media localisation industry in the age of streaming: the rates offered to subtitlers are on average below minimum wage, making it “unsustainable as a single source of income” (ibid.), leaving professionals feeling they are being taken advantage of. As a result, the most experienced subtitlers are leaving the AVT sector for better translation jobs or have already exited the localisation market altogether. This is the unfortunate result of a profit-based business model that has had a dramatic impact on experts working in the AVT sector.

According to Pym et al. (2012) and Moorkens (2020), the majority of professional translators worldwide work on a freelance basis. The professional isolation of freelancers has made it difficult for them to organise collectively, a fact that has given the largest language service conglomerates more overall control on those professionals plugged into their proprietary web-based platforms: “The combination of subdivision of tasks and the integration of technology built on previously gathered data and serviced via the cloud massively complicates translation workflows, necessitating a host of new roles” (Moorkens 2020, 20), such as machine translation post editing (MTPE) tasks applied to media localisation processes.

In 2021, *Squid Game*, the most watched TV series of all time which “clocked over 1.6 billion viewing hours” (Shevenock 2022), triggered a heated debate for its subtitling inaccuracies (Groskop 2021). Netflix was heavily criticised for the alleged use of NMT technologies in the localisation process, as ATRAE (2021), the organisation representing Spanish audiovisual translators explained to ATAV (atav.pt), the association for Portuguese professionals and AVTE (avteurope.eu), the European federation of national associations for media translators. ATRAE verified how a multinational language service conglomerate utilised NMT systems, further compromising the already precarious subtitling profession: *Squid Game* represents the first Netflix title to use post-editing processes. Nevertheless, the debate on *Squid Game* and how these technological transformations have progressively affected the overall quality of media localisation workflows in the age of streaming has revealed a widespread, uncritical appreciation of the complexity of subtitling. In addition, it has awakened global audiences to the reality of the media localisation industry in our times by bringing to the fore a set of issues to

be urgently addressed at corporate level by LSPs. Accordingly, AVTE published the *Machine Translation Manifesto* (2021), an executive summary with recommended guidelines for AI-powered human translation as well as best practices for the long-term sustainability of the media localisation industry in general, the subtitling profession, and the promotion of better working conditions.

In March 2022, at the sixth annual *Content Workflow Management Forum* held in London by MESA, which gathers the most important media localisation and broadcasting providers in the world, the conversation revolved around the same concerns: AI, MTPE, and the AVT talent crunch. VP of talent management and business development at *ZOO Digital*, Mazin Al-Jumaili, emphasised that rather than the amount of resources available, the main concerns for LSPs are the increasingly tighter turnaround times of localisation workflows caused by the sheer volume of content to be localised (MESA 2022). As a result, broadcasting companies require LSPs to manage a subtitling project in a third of the amount of time once available. According to Max Deryagin, AVTE academic liaison, invited to the event, some initiatives are already in place in the AVT industry to counteract the talent shortage: some companies are raising their rates or either providing a monthly flat fee to attract and retain talent. AVTE acknowledged that professionals in the field are systematically rejecting low rates, exacerbating the talent crunch (ibid.). Jorge Díaz Cintas (UCL), representing the academic sector at the event, confirmed that the alleged mismatch between university training and industry requirements is a reality, particularly in those territories where AVT practices are not integrated in translation programmes at BA or MA level, as opposed to the more widespread courses on literary and specialised translation. In addition, according to Díaz Cintas, academic institutions worldwide should be more prepared to train future generations of AVT professionals. To respond to market demands effectively, universities should not only teach students how to become skilled subtitlers, but also how to hone a set of extra skills, either technical or conceptual, such as EMT creation, project management, and other related tasks able to ensure a seamless and robust AVT workflow, thus improving the entire localisation ecosystem (ibid.).

Several initiatives to counteract the talent crunch were presented at the *Content Workflow Management Forum*. As a way to bridge the gap between university training and industry needs, *ZOO Digital* have recently launched its own academy (*ZOO Academy 2022*) and believes that by providing industry-leading dubbing and subtitling technology to academic institutions for free, it will equip and empower future generations. Another initiative comes from *The Pool*, a directory for AVT professionals and LSPs that announced that it will soon be providing the *AVT Pro Certification* (AVTpro 2023), the first subtitling accreditation able

to identify the best professionals in the field, supported by a board of academics, professional associations, and all the main stakeholders in the industry.

Furthermore, data projections reveal that \$230 billion will be invested in media localisation content in 2022 (Pennington 2022), which guarantees that the volume of content produced will continue to grow for at least the next five years. On the other hand, the diversified media localisation content created in an increasing number of language pairs might require even tighter turnaround times on the part of LSPs, further disrupting localisation workflows at global level.

6. Conclusions

The fertile ground that has favoured the emergence of disruptive AVT workflows in the age of streaming, namely the epochal shift from traditional linear TV to SVOD services, was outlined in this article. The revolution powered by streaming giants, in turn, has played a fundamental role in the forced acceleration of AVT workflows worldwide, due to the vast amount of content produced by these services in terms of new TV series formats and ambitious media productions led by famous producers and directors, as well as the need to reach out to as many regions in the world as possible. By 2017, Netflix was available in over 190 countries, and in 2018 around “73 million of its 130 million subscribers [were] outside the U.S.” (Brennan 2018). Since then, the streaming giant has reached 222 million total subscribers globally (Silberling 2022).

My analysis has therefore focused on the disruptive impact of video streaming providers on the way AVT workflows are currently conducted and turnaround times planned and managed. In order to fully appreciate the considerable influence exerted by SVOD innovations on the media localisation industry, an analysis of the various transformations LSPs have undergone in the last two decades of the new millennium has been provided, underlining the focal point represented by the slow shift from centralised to decentralised cloud-based workflows conducted online. The focus of this study has been on the presentation of a case study on the disruptive workflows created for Netflix’s *Chelsea* (2016), which exemplifies the new media localisation trends at work and describes the technological complexity of localising a global talk show in multiple languages in an exceptionally tight turnaround time. Firstly, the technological challenges posed by Netflix’s encode times were investigated, unveiling how the fourth industrial revolution (Schwab 2017), characterised by swift transformations to industry, society, and technology, has played a crucial role in the advent and spread of streaming solutions. Subsequently, an in-depth analysis of *Chelsea*’s novel localisation processes was provided, highlighting its experimental nature and extreme complexity: the

workflow devised for *Chelsea* perfectly illustrates the underlying mechanisms of the video-on-demand and large-scale content delivery solutions currently shaping the media localisation industry.

It is remarkable how deceptively simple the Netflix equation is: harnessing the power of digital technology to give consumers what they want (everything), when they want it (now), and wherever they are (globally). It can be acknowledged how the first season of Netflix's *Chelsea* was indeed conceived as a pilot project able to produce a proof of concept for the feasibility of encoding and localising "in the fast lane" (Wong et al. 2016). According to Greenberg (2016), "*Chelsea* is ultimately the chance to test out how all of this works – the translating, the encoding, the humour, the globe-trotting, the disrupting – for a rapidly approaching future." The direct consequences of this proof of concept are in the hands of the entertainment and media localisation industries desperately striving to experiment, research, and adapt to change in order to conceive the perfect workflow able to manage this delicate and complicated system in the fastest way possible.

The technological pathway seems the only way through for many LSPs: the implementation of translation memory tools (TMs), ASR and NMT's technologies into media localisation workflows are the very latest trends in this sense, as described in Section 5 devoted to the impact on the professional dimension. Yet, while the AVT industry has benefitted a great deal from technological advancements, the downside is the complete lack of control and loss of agency on the part of professionals who will become human post-editors of machine-translated audiovisual content, as explained in the *Machine Translation Manifesto* released by AVTE (2021). In this document, AVTE has given voice to its concerns: the use of MT systems, as it affirms, "requires insight, expertise and careful planning" (3). It also laments the lack of engagement and involvement of subtitlers in the design, development, and overall decision-making processes regarding MT solutions applied to AVT workflows on the part of LSPs.

This article has also explained how the *Squid Game* debate has shed light on the delicate issue of subtitling quality in the age of streaming: the talent crunch has revealed the need to give value to the expertise of skilled subtitlers and reconsider the overall localisation system in place. The ethical aspects of the disruptive impact of localisation workflows in the age of streaming, a topic that has been addressed by various scholars in connection to machine translation practices (Koskinen and Pokorn 2020; Moorkens and Rocchi 2021; Moorkens 2022), represent a crucial issue that needs to be addressed for the future sustainability of the media and broadcasting industry. The pressure is now on the large language service conglomerates to produce a better price model for freelance resources in order to retain talent and counteract the global shortage of AVT professionals.



Therefore, further studies are needed in order to monitor and investigate the profound changes outlined in this study.

References








TV series

- Gilligan, Vince. 2008–2013. *Breaking Bad*. AMC.
- Hawley, Noah. 2014–2023. *Fargo*. FX
- Kirkman, Robert, Tony Moore, and Charlie Adlard. 2010–2021. *The Walking Dead*. AMC.
- Miller, Bruce. 2016–2023. *The Handmaids Tale*. Hulu.
- Netflix. 2016–2017. *Chelsea*. Netflix.
- Weiner, Matthew. 2007–2015. *Mad Men*. AMC.
- Winter, Terence. 2010–2014. *Boardwalk Empire*. HBO.



Works cited

- ATRAE. 2021. “Comunicado sobre la posesición [Statement on post-editing]”. October 13, 2021. <https://atrae.org/comunicado-sobre-la-posedicion/>
- AVTpro. 2023. “Certifications.” <https://avtpro.oona.net/the-avtpro-certifications/>
- AVTE. 2021. “Machine Translation Manifesto”. https://avteurope.eu/wp-content/uploads/2022/10/Machine-Translation-Manifesto_ENG.pdf
- BBC News. 2015. “Binge-watch is Collins’ Dictionary’s Word of the Year.” November 5, 2015. www.bbc.co.uk/news/entertainment-arts-34723515
- Birnbaum, Debra. 2016. “Bill Wolff Exits ‘Chelsea’ Talk Show as Executive Producer.” *Variety*, May 27, 2016. <http://variety.com/2016/tv/news/bill-wolff-chelsea-handler-netflix-1201784870/>
- Blair, Gavin J. 2021. “Why Are Netflix’s Subtitles So Bad?” *The Hollywood Reporter*, November 5, 2021. <https://www.hollywoodreporter.com/business/business-news/why-are-netflix-subtitles-so-bad-1235043051/>
-  Bolaños García-Escribano, Alejandro, Jorge Díaz Cintas, and Serenella Massidda. 2021. “Subtitlers on the Cloud: The Use of Professional Web-Based Systems in Subtitling Practice and Training.” *Revista Tradumàtica: Tecnologies de la Traducció* 19: 1–21.
- Bond, Esther. 2018. “Why Netflix Shut Down Its Translation Portal Hermes.” *Slator*, October 19, 2018. <https://slator.com/why-netflix-shut-down-its-translation-portal-hermes/>
-  Bowen, Glenn A. 2009. “Document Analysis as a Qualitative Research Method.” *Qualitative Research Journal* 9 (2): 27–40.
- Brennan, Louis. 2018. “How Netflix Expanded to 190 Countries in 7 Years.” *Harvard Business Review*, October 12, 2018. <https://hbr.org/2018/10/how-netflix-expanded-to-190-countries-in-7-years>
- Brown, Will. 2017. “The Top Audio, Video & Multimedia Localization Trends of 2017.” *JBI Studios*, December 27, 2017. <https://jbilocalization.com/the-top-audio-video-multimedia-localization-trends-of-2017/>

- Bryant, Miranda. 2021. "Where Have All the Translators Gone?" *The Guardian*, November 14, 2021. <https://www.theguardian.com/tv-and-radio/2021/nov/14/where-have-all-the-translators-gone>
-  Chaume, Frederic. 2013. "The Turn of Audiovisual Translation, New Audiences and New Technologies." *Translation Spaces* 2 (1): 105–123.
- Deloitte. 2021. "Broadband for All: Charting a Path to Economic Growth." April 2021. <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/process-and-operations/us-charting-a-path-to-economic-growth.pdf>
- DePalma, Don, Hélène Pielmeier, George Stewart, and Scott Henderson. 2016. *The Language Services Market: 2016*. Boston: Common Sense Advisory.
-  Díaz Cintas, Jorge, and Serenella Massidda. 2019. "Technological Advances in Audiovisual Translation." In *The Routledge Handbook of Translation and Technology*, edited by Minako O'Hagan, 255–270. Abingdon: Routledge.
- Díaz Cintas, Jorge. 2013. "The Technology Turn in Subtitling." In *Translation and Meaning: Part 9*, edited by Marcel Thelen and Barbara Lewandowska-Tomaszczyk, 119–132. Maastricht: Zuyd University of Applied Sciences.
-  Dunne, Keiran. 2012. "The Industrialization of Translation: Causes, Consequences and Challenges." *Translation Spaces* 1, 143–168.
- Estopace, Eden. 2107. "Talent Crunch Hits Media Localization as Amazon, Netflix Accelerate Market Growth." *Slator*, July 17, 2017. <https://slator.com/talent-crunch-hits-media-localization-as-amazon-netflix-accelerate-market-growth/>
- Eurostat. 2022. "Increase in High-speed Internet Coverage in 2021." August 22, 2022. [https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220822-1#:~:text=In%202021%2C%20the%20European%20Commission,VHCN\)%20connections%20acro ss%20the%20EU](https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220822-1#:~:text=In%202021%2C%20the%20European%20Commission,VHCN)%20connections%20acro ss%20the%20EU)
- Fetner, Chris, and Denny Sheehan. 2017. "Netflix is Looking for the Best Translators Around the Globe." *Netflix*, March 30, 2017. <https://about.netflix.com/en/news/netflix-is-looking-for-the-best-translators-around-the-globe>
-  Georgakopoulou, Panayota. 2019. "Template Files: The Holy Grail of Subtitling." In *Quality in Media Accessibility*, edited by Gian Maria Greco and Anna Jankowska, special issue of *Journal of Audiovisual Translation* 2 (2): 137–160.
- Georgakopoulou, Panayota. 2006. "Subtitling and Globalisation." In *Audiovisual Translation*, edited by Jorge Díaz Cintas, special issue of *JoSTrans* 6: 115–120.
- Greenberg, Julia. 2016. "Netflix's Global Dreams Depend on Chelsea Handler." *Wired*, May 11, 2016. <http://www.wired.com/2016/05/netflixs-plan-conquer-world-depends-chelsea-handler>
- Groskop, Viv. 2021. "Lost in Translation? The One-Inch Truth About Netflix's Subtitle Problem." *The Guardian*, October 14, 2021. <https://www.theguardian.com/tv-and-radio/2021/oct/14/squid-game-netflix-translations-subtitle-problem>
- Hastings, Reed. "Netflix CES 2016 Keynote Speech." *Netflix*, YouTube. www.youtube.com/watch?v=5TR-NRpkW9I
-  Hilderbrand, Lucas. 2010. "The Art of Distribution: Video on Demand." *Film Quarterly* 64 (2): 24–28.

- Kantar Media. 2016. "Linear Vs. Non-Linear Viewing: A Qualitative Investigation Exploring Viewers' Behaviour and Attitudes Towards Using Different TV Platforms and Services Providers." https://www.ofcom.org.uk/__data/assets/pdf_file/0029/68816/km_report.pdf
- Kapsaskis, Dionysios. 2011. "Professional Identity and Training of Translators in the Context of Globalisation: The Example of Subtitling." In *Translator Training, Consecutive Interpreting, Localisation*, edited by Michail Sachinis, special issue of *JoSTrans* 16: 162–184.
- Korn Ferry. 2018. "Future of Work: The Global Talent Crunch Report". <https://www.kornferry.com/content/dam/kornferry/docs/pdfs/KF-Future-of-Work-Talent-Crunch-Report.pdf>
-  Koskinen, Kaisa, and Nike K. Pokorn, eds. 2020. *The Routledge Handbook of Translation and Ethics*. Abingdon: Routledge.
-  Kuscü-Ozbudak, Seda. 2022. "The Role of Subtitling on Netflix: An Audience Study." In *Latest Trends in Audiovisual Translation*, edited by Roberto A. Valdeón, special issue of *Perspectives: Studies in Translation Theory and Practice* 30 (3): 537–551.
- Lobato, Ramon. 2019. *Netflix Nations: The Geography of Digital Distribution*. New York: New York University Press.
-  Lobato, Ramon. 2017a. "Rethinking International TV Flows Research in The Age of Netflix." *Television & New Media* 19 (3): 241–256.
-  Lobato, Ramon. 2017b. "Streaming Services and the Changing Global Geography of Television." In *Handbook on Geographies of Technology*, edited by Barney Warf, 178–192. Cheltenham: Edward Elgar Publishing.
- Lotz, Amanda D. 2014. *The Television Will Be Revolutionized*. 2nd ed. New York: New York University Press.
- Luckerson, Victor. 2016. "How You Watch TV Is About to Change Forever." *Time*, May 6, 2016. <http://time.com/4320941/online-television-tv-netflix-hulu/>
- Mandell, Andrea. 2016. "Go Behind the Scenes of 'Chelsea.'" *USA Today*, May 10, 2016. <https://eu.usatoday.com/story/life/tv/2016/05/10/go-behind-scenes-chelsea/84148162/>
- Massidda, Serenella, and Sandrelli, Annalisa. Forthcoming. "¡Sub! Localisation Workflows (th)at Work." In *Translation and Translanguaging in Multilingual Contexts*, edited by Jorge Díaz-Cintas, Alessandra Rizzo, and Cinzia Spinzi. Amsterdam: John Benjamins.
-  Massidda, Serenella. 2022. "The Symbiotic Match of AVT & Tech Industry State-of-the-Art and Way Forward." *Rhesis: International Journal of Linguistics, Philology and Literature* 13 (1): 21–35.
-  Massidda, Serenella. 2015. *Audiovisual Translation in the Digital Age: The Italian Fansubbing Phenomenon*. Basingstoke: Palgrave MacMillan.
- MESA. 2022. "6th Annual Content Workflow Management Forum." <https://www.mesaonline.org/conferences/content-workflow-management-forum-2022/?cpage=presentations>
- Moorkens, Joss. 2022. "Ethics and Machine Translation." In *Machine Translation for Everyone: Empowering Users in The Age of Artificial Intelligence*, edited by Dorothy Kenny, 121–140. Berlin: Language Science Press.
- Moorkens, Joss, and Marta Rocchi. 2021. "Ethics in the Translation Industry." In *The Routledge Handbook of Translation and Ethics* edited by Kaisa Koskinen and Nike K. Pokorn, 320–364. Abingdon: Routledge.
-  Moorkens, Joss. 2020. "A Tiny Cog in a Large Machine': Digital Taylorism in the Translation Industry." *Translation Spaces* 9 (1): 12–34.

- doi Moorkens, Joss. 2017. "Under Pressure: Translation in Times of Austerity." In *Translation Economics and the Economics of Translation*, edited by Łucja Biel and Vilemini Sosoni, special issue of *Perspectives: Studies in Translation Theory and Practice* 25 (3): 464–477.
- doi Nikolić, Kristijan. 2015. "The Pros and Cons of Using Templates in Subtitling." In *Audiovisual Translation in a Global Context: Mapping an Ever-Changing Landscape*, edited by Rocío Baños Piñero and Jorge Díaz Cintas, 192–202. New York: Palgrave Macmillan.
- O'Toole, James. 2014. "Netflix Speeds Surge for Comcast Users Following Connection Deal." *CNN Money*, April 15, 2014. <https://money.cnn.com/2014/04/14/technology/netflix-comcast/index.html>
- doi Oliver, John J. 2018. "Strategic Transformations in The Media." *Journal of Media Business Studies* 15 (4): 278–299.
- doi Pedersen, Jan. 2018. "From Old Tricks to Netflix: How Local are Interlingual Subtitling Norms for Streamed Television?" *Journal of Audiovisual Translation* 1 (1): 81–100.
- Pennington, Adrian. 2022. "Looks Like \$230 Billion Will Be Spent on Content in 2022." *NAB Amplify*, March 20, 2022. <https://amplify.nabshow.com/articles/230-billion-will-be-spent-on-content-in-2022/>
- Pichard, A. 2011. *Le Nouvel Age d'or des séries américaines* [The golden age of US TV shows]. Paris: Editions Le Manuscrit.
- Porzucki, Nina. 2016. "Netflix Figured Out How to Translate a Talk Show into 20 Languages in Just 24 hours." *PRI The World in Words*, September 26, 2016. www.pri.org/stories/2016-09-14/film-was-once-solution-tower-babel
- Pym, Anthony, François Grin, Claudio Sfreddo, and Andy L. J. Chan. 2012. "The Status of the Translation Profession in the European Union. (DGT/2011/TST)." Luxembourg: European Commission. https://termcoord.eu/wp-content/uploads/2013/08/The_status_of_the_translation_profession_in_the_European_Union.pdf
- Rodriguez, Ashley. 2016. "Lost in Translation: Netflix Built a Massive Worldwide Operation to Make Chelsea Handler's Dirty Jokes Land Globally." *Quartz Media*, May 18, 2016. <https://qz.com/686598/netflix-has-a-massive-worldwide-operation-to-make-chelsea-handlers-dirty-jokes-land-globally/>
- Roettgers, Janko. 2016. "The Technology Behind Netflix's 'Chelsea' Talk Show." *Variety*, May 17, 2016. <http://variety.com/2016/digital/news/netflix-chelsea-encoding-ui-translation-1201776469/>
- Shapiro, Evan. 2020–2023. *Media Universe Map*. <https://eshap.substack.com/p/media-universe-maps-2020-2023>
- Shevenock, Sarah. 2022. "The International Content Boom Has Made Subtitlers and Dubbers the Lifeblood of Streaming." *Morning Consult*, April 25, 2015. <https://morningconsult.com/2022/04/25/subtitles-dubbing-streaming/>
- Schwab, Klaus. 2017. *The Fourth Industrial Revolution*. London: Penguin.
- Silberling, Amanda. 2022. "Netflix Had Its Lowest Year of Subscriber Growth Since 2015." *TechCrunch+*, January 21, 2022. <https://techcrunch.com/2022/01/20/netflix-q4-2021-results-subscriber-numbers/>
- Smart, Paul R. 2014. "Embodiment, Cognition and the World Wide Web." In *The Routledge Handbook of Embodied Cognition*, edited by Lawrence Shapiro, 336–334. New York: Routledge.

- Statista. 2016. “Market Size of the Global Language Services Industry from 2009 to 2019 with a Projection until 2022.” <http://www.statista.com/statistics/257656/size-of-the-global-language-services-market/>
-  Storstein Spilker, Hendrik, and Terje Colbjørnsen. 2020. “The Dimensions of Streaming: Toward a Typology of an Evolving Concept.” *Media, Culture & Society* 42 (7–8): 1210–1225.
-  Strangelove, Michael. 2015. *Post-TV: Piracy, Cord-Cutting, and the Future of Television*. Toronto: University of Toronto Press.
- Wright, Tracy. 2016. “Delivering a Global Talk Show: The Innovation Behind *Chelsea*.” *Netflix*, May 18, 2017. <https://media.netflix.com/en/company-blog/delivering-a-global-talk-show-the-innovation-behind-chelsea>
- Wong, Rick, Zhan Chen, Anne Aaron, Megha Manohara, and Darrell Denlinger. 2016. “*Chelsea*: Encoding in the Fast Lane 2016.” *Netflix Technology Blog*, July 18, 2016. <https://medium.com/netflix-techblog/chelsea-encoding-in-the-fast-lane-5coe7064053a>
- ZOO Academy. 2022. “ZOO Academy.” www.zoodigital.com/about/zoo-academy/

Address for correspondence

Serenella Massidda
 Roehampton University
 366 Upper Richmond Road
 SW15 6TS LONDON
 United Kingdom
 s.massidda@ucl.ac.uk
 <https://orcid.org/0000-0002-4418-6279>

Publication history

Date received: 1 September 2021
 Date accepted: 26 July 2023
 Published online: 24 August 2023