Listening back

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Listening Back

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1. THESIS TITLE & ABSTRACT

Thesis Title

Listening Back

Thesis Abstract

Listening Back is a practice-based research project that develops a critical mode of sonic inquiry into a technique of contemporary Web surveillance – the cookie. Following creative sonification practices, cookie data is sonified as a strategy for interrupting the visual surface of the browser interface to sonically draw attention to backend data capture. Theoretical scholarship from surveillance studies proposes that visual panopticism has been superseded by automated technologies of humanly incomprehensible data collection. Scholars such as Mark Andrejevic have observed how the operations of algorithmic surveillance have become post-representational. Listening Back aims to address the post-representational character of Web surveillance by asking: how can artists critically render an online experience of continuous and ubiquitous surveillance?

During this PhD research, I have created the *Listening Back* browser add-on that sonifies Internet cookies in real-time. The add-on has been enacted across both live performance, installation, and personal computer usage. As a sounding Web-based arts practice, it deploys artistic approaches to browser add-ons and creative data sonification that I and others have developed within networked and sounding art fields during the last two decades. Artists such as Adriana Knouf, Allison Burtch and Michael Mandiberg have addressed the opacity and normalisation of the Web browser by creating artistic browser add-ons. These ethico-aesthetic strategies of awareness adopt Web protocols and data mining techniques to re-navigate and expose ordinarily obscured data logics and repurpose the browser as a site for artistic practice. In addition to repurposing and exposing hidden cookie data, sonification aims to situate an embodied listening within the real-time dynamics of Web surveillance and facilitate an engagement across critical analysis and sensing modes of online surveillance.

By providing the opportunity to *listen back*, a human-level connection to real-time data capture is facilitated as a sounding strategy for making the capture of surveillant data online tangible. Listening Back, as a practice based research, contributes a new artistic strategy to creative browser add-ons by engaging an embodied listening experience that deploys time-based and experiential aspects of sound. Listening Back also uses creative sonification to situate online listening at the intersection of the Web, the Web browser and personal computing.

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> In chapter three of my thesis I have drawn from my own conference paper which was published for the 25th International Conference on Auditory Display (ICAD 2019), Northumbria University, June 2019. I am the sole author of this paper and have acknowledged it accordingly in a footnote at the start of chapter three. It is also listed in the bibliography.

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ABSTRACT

Listening Back is a practice-based research project that develops a critical mode of sonic inquiry into a technique of contemporary Web surveillance – the cookie. Following creative sonification practices, cookie data is sonified as a strategy for interrupting the visual surface of the browser interface to sonically draw attention to backend data capture. Theoretical scholarship from surveillance studies proposes that visual panopticism has been largely superseded by automated technologies of humanly incomprehensible data collection. Scholars such as Mark Andrejevic have observed how the operations of algorithmic surveillance have become post-representational. Listening Back aims to address the post-representational character of Web surveillance by asking: how can artists critically render an online experience of continuous and ubiquitous surveillance?

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By providing the opportunity to *listen back*, a human-level connection to real-time data capture is facilitated as an aesthetic sounding strategy for making the capture of surveillant data online tangible. Listening Back, as practice-based research, contributes a new artistic strategy to creative browser add-on practices by engaging an embodied listening experience that deploys time-based and experiential aspects of sound. Listening Back also uses creative sonification to situate online listening as an activity that occurs at the intersection of the network infrastructure, the Web browser, and personal computing.

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Last but certainly not least, I would like to acknowledge the Gadigal people of the Eora Nation as the traditional custodians of the land in which this project was initiated and developed and where I was fortunate to be born.

DOCUMENTATION

This thesis is accompanied by a Web page that provides images and video documentation of artistic practice produced as part of this research in chronological order. In addition, it includes links for installing the *Listening Back* add-on in the Chrome or Firefox browser. The URL link for this documentation Web page and the Web store links for installing the *Listening Back* add-on are provided below.

Throughout this dissertation URL links will be provided in context. When these URL links are clicked they will take the reader directly to the relevant video documentation. This has been designed to avoid having to scroll through the Web page in order to find contextually relevant video documentation. However, all documentation is clearly labelled and identifiable.

Practice Documentation:
http://www.jasmineguffond.com/art/PhD

Chrome Web Store for installing the *Listening Back* add-on in Chrome:
https://chrome.google.com/webstore/detail/listening-back/gdkmphlncmoloepkpifnhneogcliiiah

Mozilla Web Store for installing the *Listening Back* add-on in Firefox:
https://addons.mozilla.org/en-GB/firefox/addon/listening-back/

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INTRODUCTION

According to the most extensive online index of "pre-categorised cookies", in June 2021, 36,816,705 cookies circulated across the World Wide Web and personal computing devices of which one percent were identified as 'strictly necessary'.[1] Notwithstanding this extraordinary scale, the cookie is just one of a plethora of online tracking techniques implemented through the technical protocols and infrastructures of the World Wide Web. By way of HTML and Java Script, the Web browser, vast server infrastructures, and data mining technologies, our personal data is collected, aggregated, compiled, and sold. Such information can include data about our IP address, type of computer or mobile phone, operating system, the plugins we have installed, our searches, our likes, the websites we visit, what we buy, watch, and how long our cursor lingers on a page. Some of the lesser-known online surveillance technologies include Web bugs, audio beacons, Web RTC IP discovery, third-party HTTP requests,[2] and device fingerprinting.[3] The device fingerprinting method identifies users through the combination of their devices' properties such as the ratio of pixels on a computer screen, the plug-ins installed in a browser, battery status, graphic and font rendering, and how machines and browsers process audio.[4] A 2015 measurement study of online tracking technologies across one million of the most visited websites reveals how each and every characteristic of our devices, that is, every technical component and property across hardware and software can and will be repurposed to identify and track us.[5] Yet when I began this practiced-based research I had only ever heard of cookies. Even with the passing of the European General Data Privacy Regulation (GDPR) in May 2018, by which websites are mandated to inform visitors of the tracking technologies embedded in their website, the majority of Web users within the European Union and beyond, remain unaware of the multitude of surveillance technologies monitoring their every online move.[6] Unlike the majority of online surveillance technologies identified above, media attention given to cookies has raised a general awareness of their existence. This was largely initiated by The Internet Engineering Task Force's (IETF) cookie standardisation.[7] The invention of the cookie in 1994 provided a practical means to implement the virtual shopping

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[1] See Cookiepedia, https://cookiepedia.co.uk/, accessed January 13, 2021.

[2] Timothy Libert, "Exposing the Hidden Web: An Analysis of Third-Party HTTP Requests on 1 Million Websites," International Journal of Communication, 2015, 1 – 10.

[3] Steven Englehardt and Arvind Narayanan, "Online Tracking: A 1-Million-Site Measurement and Analysis," in Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security - CCS'16 (the 2016 ACM SIGSAC Conference, Vienna, Austria: ACM Press, 2016), 1388–1401, https://doi.org/10.1145/2976749.2978313, 3.

[4] This subset of tracking techniques is termed canvas, browser, font, audio context, and battery API fingerprinting. Ibid.

[5] Ibid.

[6] See European Commission – Policies, information and services, https://gdpr-info.eu/, accessed June 19, 2021.

[7] David M. Kristol, "HTTP Cookies: Standards, Privacy, and Politics," ArXiv:Cs/0105018, May 9, 2001, http://arxiv.org/abs/cs/0105018.

cart and as a key device in the widespread commercialisation of the Web effected a cultural and commercial paradigm shift. Furthermore, the cookie for the first time enabled a protocol for the automated collection of data online. The IETF is the de facto Internet standards body that began the cookie standardisation process in April 1995, a year after the cookie had been invented and silently released with Netscape's *Navigator* Web browser.[8] Acutely concerned with the tracking potential of the cookie mechanism, the publication of the IETF's specifications in 1996 inspired the first round of media exposure regarding privacy concerns related to cookies and online connectivity in general.[9] Two years after cookies were opaquely introduced into Web browsing, the first article addressing their privacy implications appeared in the Financial Times in February 1996,[10] followed by *Web 'Cookies' May Be Spying On You*, in the San Jose Mercury News.[11] Online commercial surveillance enacted by technologies such as the cookie, has been proven to be inextricably linked with government surveillance, most notably from information contained in the Snowden files. Through 'partnerships' with Internet companies the PRISM document in particular reveals how the U.S. National Security Agency (NSA) piggybacks on the data collection capabilities of corporations such as Google, Facebook, Apple, Yahoo, and Skype through direct access to their servers.[12]

The scope of this research, which I have called Listening Back, is, as a practice-based research, focused on the commercial online context of extractive algorithmic surveillance technologies. Seamlessly embedded in to our everyday Web experiences, their connectivity remains intangible to the surveilled. Third-party cookies in particular have evolved into a dominant mode for advertisers and the commercial data-broker industry to track users across the Web, a mode of data capture termed cross-site tracking.[13] Commercial Web surveillance is the research context for Listening Back and I was intrigued by the everyday situation in which peers, ordinarily highly critical of global capitalism, are heavily reliant on corporate social media and online services: glued to their Instagram feeds and/or dependent on Google products. Global mass surveillance has reached a scale unprecedented in human history, and the very technologies that encourage notions of freedom via the internet are simultaneously implemented for online monitoring.[14]

Across the course of Listening Back, I have developed a critical mode of sonic inquiry into a technique of automated data capture intrinsic to contemporary Web surveillance – the cookie.

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[8] Ibid., 8.
[9] Ibid., 12.
[10] Jackson, T. "This Bug in Your PC is a Smart Cookie." Financial Times, 12 February 1996.
[11] Gomes, L. "Web 'Cookies' May be Spying on You." San Jose Mercury News, 13 February 1996.
[12] Ewen MacAskill and Gabriel Dance, "NSA Files: Decoded. What the Revelations Mean for You," The Guardian, November 1, 2013, https://www.theguardian.com/world/interactive/2013/nov/01/snowden-nsa-files-surveillance-revelations-decoded#section/3, accessed May 22, 2021.
[13] https://www.chromium.org/Home/chromium-privacy/privacy-sandbox, accessed May 27, 2021.
[14] Lyon, D. 2015. Surveillance after Snowden, Polity Press, 21, 55.

Drawing from the creative approaches of artistic browser add-ons and data sonification practices, I have produced the *Listening Back* browser add-on that sonifies Internet cookies in real-time as one browses online. Cookie data is rendered audible as a sounding strategy for interrupting the visual surface of the browser interface and to draw attention to backend data capture in real-time and in situ. The *Listening Back* browser add-on has been artistically deployed across both live performance, installation, and personal computer usage, a practice I also refer to throughout this dissertation as: Listening Back. This rendering sensible creates an alternate sounding of Web spaces in which to critically consider the cookie as a mechanism for ubiquitous, automated data collection. In my artistic practice I aim to foreground the politics of cookies' prevalence and ubiquity, and what these entail for the normalisation of online surveillance. Listening Back aims to creatively address what surveillance studies and postmedia scholarship calls the post-representational character of Web surveillance[15] by asking: how can artists critically render an online experience of continuous and ubiquitous surveillance?

Listening Back as a strategy of sounding involves two manoeuvres. First, cookie data, ordinarily imperceptible to the human sensorium, is translated into sound to provide a tangible presence for otherwise intangible data capture. Implemented through the *Listening Back* browser add-on, the sonification of cookie data provides real-time auditory environments for the second action: to *listen back* to algorithmic surveillance in situ. This sounding strategy for shifting the imperceptible background into the affective foreground is situated within complex commercial, consumer, and political online data extraction networks – and alongside the creative practices of Listening Back, this dissertation is situated across sound and surveillance studies fields. I engage surveillance studies for a critical understanding of contemporary Web surveillance, and sound studies for exploring the potential of sound to register intangible information at a time-based and sensory register.

Throughout this research I bring an understanding of the contemporary Web surveillance context in to direct relation with listening, sounding, and strategies used by creative practitioners. Listening Back sonifies cookie technology artistically through a series of live performances and installation that provide situations for embodied listening to interact with the real-time dynamics of Web browsing. Drawing on online practices of creative browser add-ons, Listening Back is a sounding arts practice that utilises Web technologies and protocols – such as the cookie, browser APIs, HTML and Java Scripts – as materials for the politico-aesthetic goal of sonically exposing automated surveillance infrastructures in situ. In addition to the performative mode of Listening Back, the *Listening Back* browser add-on can be downloaded for personal use through the Mozilla[16]

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[15] Mark Andrejevic, Automated Media (London; New York, NY: Routledge, 2020), 18, 20.
[16] Mozilla Web Store for Installing the *Listening Back* add-on, https://addons.mozilla.org/en-GB/firefox/addon/listening-back/, accessed January 10, 2020.

and Chrome Web stores[17] (see Figures 0.1 and 0.2). By contributing the affecting, time-based, and omni-directional attributes of sound to the field of creative browser add-ons I explore how a sounding arts practice can render real-time processes of post-representational online surveillance tangible for experience, awareness, and discussion during the everyday act of browsing the Web.

Video demonstration of the *Listening Back* add-on:
http://www.jasmineguffond.com/art/PhD#demo

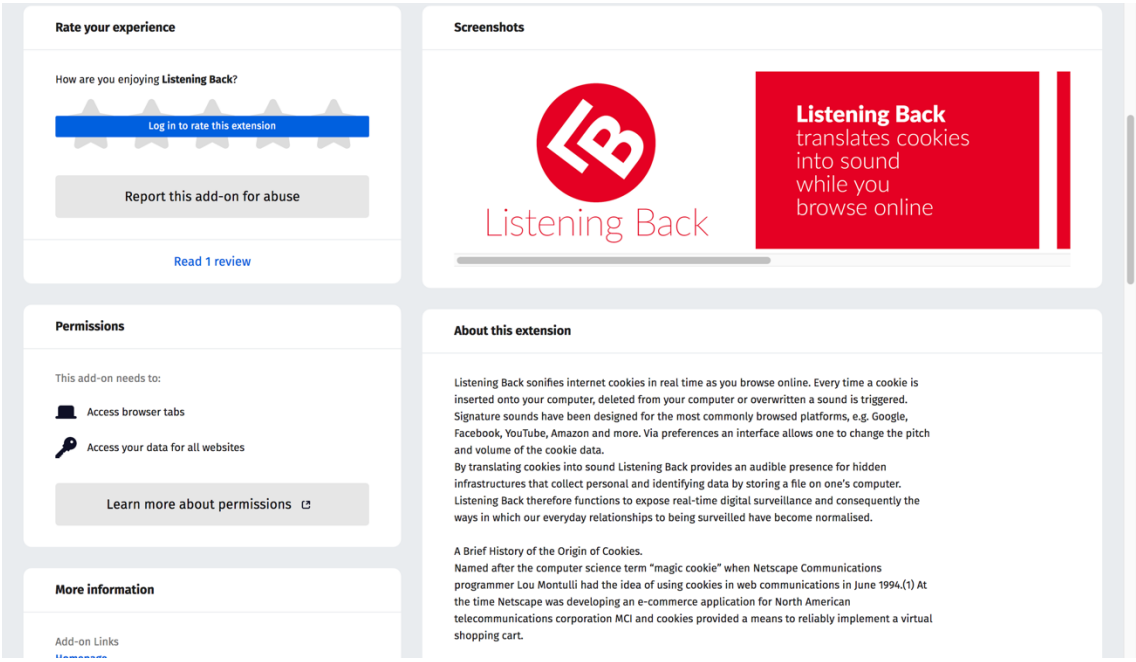

Figure 0.1: Screenshot of the Mozilla Web Store where the *Listening Back* browser add-on is available to download for the Firefox browser.
https://addons.mozilla.org/en-GB/firefox/addon/listening-back/

[17] Chrome Store for Installing the *Listening Back* add-on, https://chrome.google.com/webstore/detail/listening-back/gdkmphlncmoloepkpifnhneogcliiiah, accessed January 10, 2020.

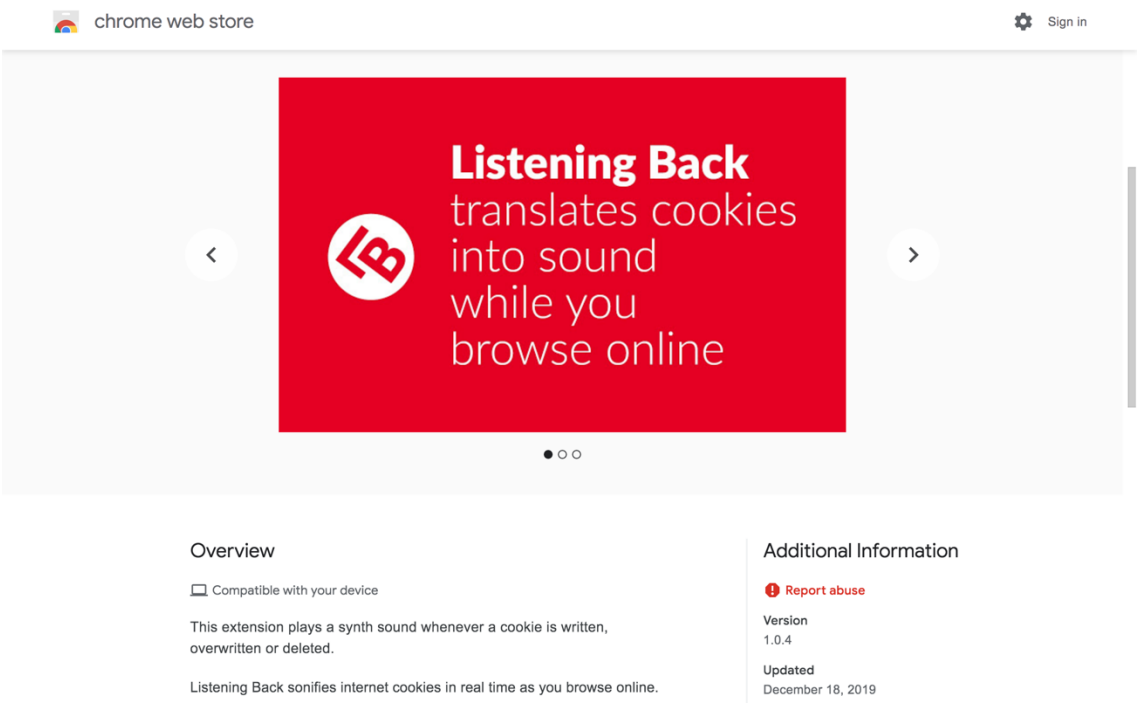

Figure 0.2: Screenshot of the Chrome Web Store where the *Listening Back* browser add-on is available to download for the Chrome browser.
https://chrome.google.com/webstore/detail/listening-back/gdkmphlncmoloepkpifnhneogcliiiah

Automated Web Surveillance in a Post-Representational Context

As evident from the measurement study of online tracking cited previously, multitudinous online tracking mechanisms are ever increasingly affecting our daily experience through the extraction of personal data, which is in turn used to curate news feeds, influence cultural consumption, academic research,[18] consumer purchases and behaviour. Derived from online purchasing, link clicks, and browsing activities, automated techniques of data collection render human activity machine readable with the aim of escalating sales and increasing knowledge. This commercial, extractive industry, dubbed "surveillance capitalism" by Shoshana Zuboff is shrouded in a culture of proprietary secrecy, aided by the complexity and intangibility of its extraction machines.[19] The benefits of online data tracking, returned as convenient forms of personalisation of one's own Web experience, are a proportionately small aspect of the extractive market of converting personal data into sales.[20] Major businesses such as Facebook and Google, while holding a majority of the market share in the extraction and commodification of personal information, are but two players within

[18] "Jake Goldenfein on Google Scholar", *Good Code Podcast,* https://soundcloud.com/chine-labbe/jake-goldenfein-on-google, accessed April 28, 2020.
[19] Shoshana Zuboff, The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power, First edition (New York: PublicAffairs, 2018), 8.
[20] Ibid., 100.

the expanding online data broker industry.[21] Projected for substantial growth from 2020 to 2026,[22] the two hundred billion US dollar industry is comprised of over four thousand data broker companies worldwide, with one of the largest brokers Acxiom, owning twenty-three thousand servers to process data for five hundred million consumers.[23] The magnitude of Acxiom's server infrastructure means that the extraction of data accumulates at scales that exceed human comprehension. Networked algorithmic surveillance has become dependent on automation as it would otherwise be impossible to aggregate and sell data in such extraordinary amounts.[24]

I am concerned throughout this thesis with how to artistically engage with the automated data mining techniques that are employed to search for useful and lucrative patterns – automated systems that bypass human semantic interpretation. This mode of knowledge production founded on computational surveillance techniques of data extraction and mining dates back to the military origins of the internet itself.[25] However with the development in computational power from mainframe computers to everyday software, such techniques have become commonplace business models intrinsic to the economic survival of Internet platforms and the online data broker industry. In addition, increased accessibility to data mining technologies has been taken up by artists as their materials and methods for challenging Web opacity and circumventing online surveillance through creative browser add-ons. As a complement to the data extraction capabilities of Internet cookies and the online surveillance ecosphere more broadly, data mining technologies emerge as a thread throughout this dissertation. Firstly, they are fundamental to Web surveillance's commercial and political context in which Listening Back is enacted. Secondly, they provide an example of the operational logic of algorithmic surveillance, a correlative logic based on statistical models of analysis unlike human modes of interpretation and meaning making. But thirdly, and mostly for my own creative purposes, they have been co-opted by artistic projects as a means to challenge the homogeneity of the Web browser and question its dominant data logics.

Within the Web surveillance context, human sensory modes of surveillance such as eavesdropping or being watched over, have been largely superseded by the non-sensory, extractive capacities of automated algorithmic surveillance. A significant framework for understanding surveillance

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[21] Bharti Thakur and Manish Mann, "Data Mining for Big Data: A Review," *International Journal of Advanced Research in Computer Science and Software Engineering* 4, no. 5 (May 2014): 469–73.
[22] SBWire, "Global Data Broker Market Size, Share, Growth-Opportunities, Trends and Forecast 2020-2026," *Digital Journal*, June 24, 2020, http://www.digitaljournal.com/pr/4722463, accessed December, 12, 2020.
[23] WebFX Team, "What Are Data Brokers – And What Is Your Data Worth? [Infographic]," WebFX, March 16, 2020, https://www.webfx.com/blog/internet/what-are-data-brokers-and-what-is-your-data-worth-infographic/, accessed December 12, 2020.
[24] Mark Andrejevic, "Automating Surveillance," *Surveillance and Society* 17, no. 1/2 (2019): 7–13, 7, 11.
[25] Yasha Levine, *Surveillance Valley. The Secret Military History of the Internet*., 2nd ed. (London, UK: Icon Books Ltd, 2019), 7 – 8, 68 – 69, 75, 174 – 178.

practices was famously contributed by Michel Foucault's theorisation of the Panopticon.[26] However, contemporary theorists such as Mark Andrejevic argue that the gaze mechanism of the Panopticon, highly dependent on a visible symbol for surveillance, has been largely superseded by post-panoptic cultures of invisible, post-representational, automated data capture.[27] Surveillance scholars such as Kevin Haggerty have questioned the relevance of the Panoptic metaphor as a framework through which to examine contemporary digital surveillance.[28] Internet cookies, understood as components of contemporary networked surveillance are positioned within a thematic cluster of 'post-panoptic' surveillance theories[29] that recognise consumer online surveillance as algorithmic, automated, performative, post-representational, and essential to the business models of online platforms.

For a critical understanding of how post-panoptic, automated data capture has contributed to the intangibility of the surveillance apparatus, I engage Andrejevic's notion of operationalism. Andrejevic depicts how the privileging of intangible, automated data capture bypasses a symbolic representation for the surveillance apparatus, becoming post-representational.[30] Drawing on Harun Farocki and Trevor Paglen, Andrejevic further observes how algorithmic surveillance's operational and correlative logics displaces symbolic communication.[31] Machine learning algorithms can scan emails for keywords but they can not tell us what they mean. Hence, the operational logics of data capture and mining technologies produce a correlative knowledge production, and consequently human semantic interpretation and meaning making is displaced by the efficacy of the operation.[32] Listening Back aims to render an intangible post-panoptic surveillance technique sensible through auditory means, and so creatively address the operational logics of automated data capture on which Web surveillance is largely dependent.

I use a human sensory modality – listening – to investigate these post-representational modes of surveillance, and through the auditory practice of Listening Back I explore the tensions between the operation of post-panoptic surveillance and its actual effects. I thereby investigate the potential of sound to reinstate sense-making in the online surveillance context. By translating an intangible, post-panoptic surveillance technology into the human sensible range for immediate perception I

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[26] Michel Foucault, *Discipline and Punish, The Birth of the Prison*, Second Vintage Books Edition, May 1995 (New York, Toronto: Random House, Inc, Random House of Canada, 1995).
[27] Mark Andrejevic, "Automating Surveillance," *Surveillance and Society* 17, no. 1/2 (2019): 7–13, 9 – 10.
[28] Kevin D. Haggerty, "Tear down the Walls: On Demolishing the Panopticon.," in *Theorising Surveillance: The Panopticon and Beyond*, ed. David Lyon (Uffculme, Devon: Willan Publishing., 2006), 23–45, 23.
[29] Maša Galič, Bert-Jaap Koops, and Tjerk Timan, "Bentham, Deleuze and Beyond: An Overview of Surveillance Theories from the Panopticon to Participation", *Philosophy & Technology* 30, no. 1 (March 2017): 9–37, https://doi.org/10.1007/s13347-016-0219-1, 10.
[30] Mark Andrejevic, "Automating Surveillance," *Surveillance and Society* 17, no. 1/2 (2019): 7–13, 7 - 8, 10.
[31] Mark Andrejevic, *Automated Media* (London; New York, NY: Routledge, 2020), 20.
[32] Ibid., 12.

explore sound's potential to provide a space in which the politics of online surveillance operations register. Taking place at the convergence of Web surveillance and sensory perception, Listening Back is a proposition for investigating algorithmic surveillance by providing a new creative approach to experiencing surveillance playing out within the real-time Web browsing experience.

Listening Back as a Mode of Sonic Inquiry

The sounding practice of Listening Back provides sensory access to ordinarily non-sensory data processes. Following creative data sonification practices such as those of artist Andrea Polli and her work *Atmospherics/Weather Works* (2002), I explore the use of sound as an affecting register for signaling data with political, social, and cultural consequences. Through use of the *Listening Back* add-on in my sounding art practice I adopt a "pragmatic aesthetics" evident in creative sonification strategies that aim to communicate information through the experience of sound as both signifier and affecting medium.[33] Through an interplay of aesthetics and functionality, the Listening Back project explores ways to engage listening with a sonic exposition of patterns and flows of algorithmic surveillance. This is enacted through personal use of the *Listening Back* browser add-on and by performatively deploying the add-on in live performance and installation for audiences. The creative sensory rendering of ordinarily post-representational cookie activity performs the function and means to tangibly experience, and through embodied listening, interpret information implicit to cookie data as generated by real-time Web browsing.

To sonically register, that is, to sound out and listen to a cultural, technical, and political situation such as the normalisation of contemporary Web surveillance, introduces the question of what it means to conduct an inquiry via sonic means. As sound studies scholar Johnathan Sterne notes, visual metaphors such as the gaze dominate many strains of western cultural theory.[34] To think through and experience the contemporary Web surveillance context through sound, questions the hegemony of the visual in the Western scholarly tradition. Sound and listening may also be more suited to the characteristics of post-panoptic online surveillance than the unidirectional and visible effects of the gaze. Listening as a means of inquiry has been identified by theorists and practitioners as relational and performative, a mode of sensory perception that takes place within fluctuating and relational, rather than static, dynamics.[35]

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[33] Stephen Barrass, "The Aesthetic Turn in Sonification towards a Social and Cultural Medium," AI & SOCIETY 27, no. 2 (May 2012): 177–81, https://doi.org/10.1007/s00146-011-0335-5, 177.
[34] Jonathan Sterne, ed., The Sound Studies Reader (New York: Routledge, 2012), 3-4.
[35] Janna Holmstedt, "Interspecies Bodies and Watery Sonospheres: Listening in the Lab, the Archives and the Field," *Leonardo Music Journal* 30 (December 2020): 95–98, https://doi.org/10.1162/lmj_a_01099. Brandon LaBelle, *Sonic Agency: Sound and Emergent Forms of Resistance* (Cambridge, MA: The MIT Press, 2018).

To hear is to experience movement over time, as waves of sound propagate from the sound source, causing fluctuations of pressure in a medium such as air. Acoustic vibrations travel and resonate across matter and bodies, such as the human ear where they cause the eardrum to fluctuate in step with the air.[36] Through a nexus of vibration, sound's capacity to link matter within and beyond the human range of audition is proposed by theorists, such as AM Kanngieser, as a means to become aware of registers ordinarily inaccessible to humans and therefore useful for investigations of unseen and non-human phenomena.[37] Rather than being fixed in form, sound's perpetual flux of becoming, a temporal sequence of sensations resonating across bodies and minds, is also proposed by theorists such as Bernd Herzogenrath as a means to question the logic of a separation between experience and reasoning.[38] This potential for critical sonic inquiry is further explored by Annie Goh's proposal for "sounding situated knowledges" which advocates for a material-discursive mode of knowledge production to overcome dualisms such as thinking/sensing, language/matter, epistomology/ontology.[39]

Research into the practical application of the sonification of data with political consequences indicates that an emphasis on linkages between reasoning and sensory experience can extract less evident information than purely visual or discursive modes of analysis.[40] Interactions between cognitive and affective engagement in data sonification is recognised as advancing intuitive and creative means of analysis and has been identified as useful for increasing public literacy and engagement with political issues.[41] Through the sonification of cookie data the practice of Listening Back registers conceptually and experientially to provide strategies for engaging both thinking modalities and embodied, experiential, and affecting ones. The relational functioning of sound is engaged to connect listening bodies to otherwise intangible data flows within the real-time experience of Web browsing. Listening Back offers a material-discursive approach in which the materiality of sound provides an affecting register that connects to ideas about the politics and situated knowledge that cookie data, located within a paradigm of post-representational surveillance, might convey.

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[36] Aden Evens, Sound Ideas. Music, Machines, and Experience, vol. 27, Theory Out of Bounds (Minneapolis, London: University of Minnesota Press, 2005), 1.

[37] Anja Kanngieser, "Geopolitics and the Anthropocene: Five Propositions for Sound," GeoHumanities 1, no. 1 (January 2, 2015): 80–85, https://doi.org/10.1080/2373566X.2015.1075360, 81.

[38] Bernd Herzogenrath, "Sonic Thinking - An Introduction," in *Sonic Thinking: A Media Philosophical Approach, Thinking Media* (New York: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2017), 1–22, 4 – 5.

[39] Annie Goh, "Sounding Situated Knowledges: Echo in Archaeoacoustics," *Parallax* 23, no. 3 (July 3, 2017): 283–304, https://doi.org/10.1080/13534645.2017.1339968, 285, 288 – 289.

[40] Hans Agné, Thomas Sommerer, and David G. Angeler, "Introducing the Sounds of Data to the Study of Politics: A Choir of Global Legitimacy Crises," *New Political Science* 42, no. 3 (July 2, 2020): 272–88, https://doi.org/10.1080/07393148.2020.1809760, 272.

[41] Ibid., 273.

For the purposes of Listening Back, affect refers to an experiential registration of sound as embodied and sensory.[42] As Schrimshaw observes in his analysis of the embodied and affective experience of the sonic figure of immersion, "the use of sound in the arts often seeks to exploit certain affective potentials not immediately evident in other mediums: a felt intimacy where sound resonates within the body and upon the flesh"[43] Mark Bain is one such artist to exploit this resonance through his use of low frequencies that extend to the threshold of the human audible range to include infrasound. Working with the physicality of sound as a means to excite and connect architecture and bodies, Bain's interest lies "in 'connective tissue' between structures and the audience at the show or installation".[44] Through the emission of low, often loud, drones from high wattage speaker stacks a tangible felt force is appreciated as an extreme pressure across and within bodies and ears as they vibrate alongside concrete building structures. This capacity of sound to resonate throughout our entire bodies is harnessed in my creative practice through a range of live performance and installation where the *Listening Back* add-on, in conjunction with subwoofers, is used to create affective experiences. My use of the low-end audible spectrum of sound, although not as extreme as the work of Bain, is intended to produce connections between abstract data flows and human bodies. The physicality of sound as a vibrational force is not central to the concerns of Listening Back however this potential of sound's functioning is employed to enable post-panoptic data capture to be felt as a very real and material force. This embodied experience of quantitative, calculative, data capture processes attempts to render a feeling for being continuously monitored.

De-centering Sound-In-Itself

Listening Back engages the affective, embodying, and experiential affordances of sound, not primarily as an object of study but as a means of creative inquiry. One such approach to sonic inquiry is evident in Julian Henrique's study of embodied knowledge through Jamaican popular music cultures. His notion of "Sonic Bodies" proposes an auditory investigation described as "a mode of Cultural Studies that is itself auditory, as distinct from one that has audition as its object of investigation."[45] By sonifying cookie activity I draw aesthetic attention to specific modes of data capture with the intention to initiate discussion beyond the sound itself. As a sounding art practice that explores the potential of sound to engage a contemporary socio-political context, Listening

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[42] The notion of 'affect' arises across numerous disciplines including queer theory, feminist theory, philosophy, political theory, cultural studies, psychology, biology, neuroscience, and is in itself a field of enquiry that reaches beyond this dissertation.

[43] William Schrimshaw, *Immanence and Immersion. On the Acoustic Condition in Contemporary Art* (New York, London: Bloomsbury Academic, 2017), 57.

[44] Mark Bain, "Tuned City > All Participants > A-z > Bain, Mark (US/NL)," tuned city, 2008, http://www.tunedcity.net/?page_id=29, accessed February 8, 2021.

[45] Julian Henriques, Sonic Bodies: Reggae Sound Systems, Performance Techniques, and Ways of Knowing (New York: Continuum, 2011), XXVI.

Back also recognises Seth Kim-Cohen's premise for a "non-cochlear sonic art". Kim-Cohen advocates for a conceptual sounding art practice, that is, a practice that produces audio works that acknowledge their socio-political and cultural contexts and thereby extend concerns and thematics beyond the medium of sound itself.[46] Or as Douglas Kahn notes, sounds rather than being a destination lead elsewhere and come from "elsewheres".[47] By turning away from the materiality of "sound-in-itself" towards "exigencies out of earshot"[48] Kim-Cohen insists on sound's referential logic and discursive prospects, acknowledging the complexity of "sounds interactions with linguistic, ontological, epistemological, social, and political signification."[49] Schrimshaw further articulates the terrain of sound in contemporary art practices. He maintains that a conceptual focus rejects an "aesthetic sufficiency" understood not as a return to the Conceptualism of the 1960s and 1970s – as is implied by Kim-Cohen's reference to Duchamp's 'non-retinal' conceptual art – but as "a post-conceptualism that decentralizes rather than disavows the aesthetic."[50] Schrimshaw draws on art theorist Peter Osborne's definition firstly, of post-conceptual art practice and secondly, of a post-conceptual approach. "The critical necessity of an anti-aestheticist use of aesthetic materials"[51] is interpreted by Schrimshaw as a de-centering rather than complete rejection of the aesthetic.[52] This aligns with approaches in creative sonification practices including those deployed throughout this Listening Back research project, where sound is employed to affectively and conceptually engage the politics and flows of post-panoptic data capture. A sensory experience through sound that draws attention to the normalised environment of Web surveillance, can function as both a creative sounding work and a platform for a critical, reflexive listening.

Sonic Skills

As a sonic means of imparting information relating to cookie data processes, my sonification practices provide auditory environments for critical and reflexive listening, a mode of inquiry that listens for knowledge. As Henrique notes; "thinking through sound also calls for a practical methodology of listening".[53] Both the sound design and interface for the *Listening Back* add-on aim

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[46] Seth Kim-Cohen, In the Blink of an Ear. Toward a Non-Cochlear Sonic Art. (New York, London: Continuum, 2009).
[47] Douglas Kahn, "Sound Leads Elsewhere," in *The Routledge Companion to Sounding Art*, ed. Marcel Cobussen, Vincent Meelberg, and Barry Truax (New York, NY; Abingdon, Oxon: Routledge, 2017), 41–50, 41.
[48] Seth Kim-Cohen, *In the Blink of an Ear. Toward a Non-Cochlear Sonic Art.* (New York, London: Continuum, 2009), 21.
[49] Ibid., xvii.
[50] William Schrimshaw, *Immanence and Immersion. On the Acoustic Condition in Contemporary Art* (New York, London: Bloomsbury Academic, 2017), 4.
[51] Peter Osborne, *Anywhere or Not at All: Philosophy of Contemporary Art*, First edition, paperback (London; New York: Verso, 2013), 48.
[52] William Schrimshaw, *Immanence and Immersion. On the Acoustic Condition in Contemporary Art* (New York, London: Bloomsbury Academic, 2017), 4.
[53] Julian Henriques, Sonic Bodies: Reggae Sound Systems, Performance Techniques, and Ways of Knowing (New York: Continuum, 2011), xxviii.

to encourage the development of a set of listening skills so that one may either listen to cookies in the background while browsing the Web or engage with a direct focus on cookie data subsets via its interface. The interface, initially developed for playing cookies during live performance, allows for the signaling, silencing, tuning, and volume adjustment of particular cookies. In conjunction with the sound design the interface aims to encourage skillful approaches to listening that might be harnessed for interpreting the sonified cookie data in a more detailed and in-depth manner. As a component to the methods of Listening Back, the development of diagnostic listening skills can also be engaged during live performance or an interactive installation setting where the audience may browse the Web for themselves.

The notion of "sonic skills" has been developed by Karin Bijsterveld in her analysis of historical cases of listening for knowledge, and refers to a range of listening skills and techniques developed in pursuit of specialised study.[54] Bijsterveld's descriptions of embodied and encultured techniques, such as the positioning of the stethoscope on the patient's body or the handling of magnetic tape recorders, continues from Sterne's notion of "audile techniques". Here, listening as a set of historically and culturally informed practices, develops as specialised skills toward instrumental outcomes.[55] Drawing on the concept of sonic skills, I have developed a set of ideas and practices to formulate a critical engagement with cookie activity through listening. By sonically intervening in the technological and socio-political context of real-time data capture, modes of *listening back*, developed across public performance and personal contexts, contribute sound and listening's durational, omni-directional, and affecting attributes to the creative practice of browser add-ons. By providing a sonic addition to the personal and performative modes of Web browsing, the practice of Listening Back provides a supplementary layer of information that extends the sensible register for creative browser add-ons. This enables a situated listening experience in which to reflect and re-consider what it means to browse the Web. Through these practices I produce two primary modes of listening to online data via the *Listening Back* add-on: foreground and background listening. One can either listen peripherally in the background while simultaneously engaging in daily browsing routines or listen attentively as a primary focus. Importantly, users may fluidly switch between both modes. In this way, users of the *Listening Back* add-on have the opportunity to experience a sonic encounter with cookies while browsing and/or further engage with the interface as a tool to guide a listening examination of real time cookie activity.

As a mode of critical listening, to *listen back* also implies that someone or something is already listening and thereby addresses the context in which users are by default opted in to being

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[54] Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5, 63.
[55] Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction (Durham & London, 2003), 93, 96.

continuously 'listened in' on in the online context. To *listen back* is to investigate what it means to be listened in on by automated algorithmic data capture. Sterne's conception of audile techniques helped navigate the professionalisation, industrialisation, and capitalisation of listening during modernity.[56] As a twenty-first century audile technique, computational listening facilitates a post-representational, surveillance (late) capitalisation of listening that is, moreover, an automated, operational, and algorithmic listening. Listening Back thus provides a creative platform from which to continually *listen back* to automated online data extraction as a contemporary mode of ubiquitous, by default always-on, computational listening.

Situated Knowledge Practice

Listening Back draws on Donna Haraway's proposal for "situated knowledges" to the extent that this research has situated an embodied learning within "material-semiotic fields of meaning."[57] Haraway's reflection on objectivity in the sciences promotes the development of knowledge production practices accountable for both political and ontological positions: an onto-ethical positioning.[58] This is presented to contest the idea of an omnipresent, non-locatable, universal authority; the "god trick".[59] A politics of location and positionality is advanced as a means to promote an awareness of power invested in knowledge production processes and to challenge the notion of single and universal truths. To this end, Haraway re-examines the use of vision as a metaphor in Western knowledge practices. In contradiction to "the conquering gaze from nowhere" that claims a cloak of impartiality through "the power to see and not be seen", Haraway proposes an embodied vision that through distinct location takes account for its position.[60] In reclaiming vision as a metaphor Haraway puts forward a version that entails "particular and specific embodiment", proposing "partial perspectives" and "limited location" from complex and contradictory bodies: an embodied metaphor that endorses an acknowledgement of difference.[61] Listening, as already embodied, is engaged by Listening Back as a means to situate listening bodies within the dynamics of Web browsing and algorithmic surveillance. The relational characteristics of sound encourage a politics of positioning that, through listening, at once engage a specific embodiment and its immediate and extended relations. As a means to experience automated data capture and engage its socio-political and cultural implications, the practice of Listening Back situates an embodied listening within the real-time expression of these dynamics.

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[56] Ibid., 93.
[57] Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, no. 3 (Fall 1988): 575–99, 577, 587 - 588.
[58] Ibid., 591.
[59] Ibid., 584, 587.
[60] Ibid., 581.
[61] Ibid., 582, 588 – 589.

Listening, as a tool for an embodied and situated practice, can equally be enacted in multi-sensory settings. Listening Back engages listening within the audio-visual and tactile dynamics of Web browsing and its underlying surveillance, and thereby appreciates listening as one sensory mode of perception amongst many that contribute to knowledge production. By undertaking inquiry through listening, the aim is not to privilege listening and the auditory but to explore what the ear returns to the eye. Salomé Voegelin's notion of a "sonic sensibility" is relevant here as it describes a means of revealing activity below the surface of the visual world, challenging its central position, and hearing other possibilities which ordinarily do not take part in the production of knowledge.[62] Through live performance, sound installation or personal computer usage, the familiarity of the Web browser's graphical interface is interrupted by an atypical soundtrack that functions to reveal hidden tracking infrastructures and challenge the visual organisation of the Web. By bringing intangible, backend data capture processes into the affective foreground a space is provided to re-consider the graphical display of the browser interface as a site of concealment. Through an engagement with the multi-sensory dynamics of Web browsing, the potential for sound and listening to question presumptions and re-examine comprehension about the nature of Web browsing is explored.

Chapter one investigates the context and attributes of cookie monitoring from the perspective of theoretical work undertaken in surveillance studies and media theory. Drawing on surveillance studies literature, the vestige of panopticism is questioned in terms of its relevance for contemporary Web surveillance, dependent as it is on automated, algorithmic data capture. By extending visibility-as-control from the human sense of sight to the invisible act of tracking and capturing data, the operational logics of algorithmic Web surveillance has become post-representational. As a practice, to *listen back* implies that someone or something is already 'listening in', and I consider Web surveillance in terms of Peter Szendy's concept of panacoustic - a non-stop, ubiquitous eavesdropping context.[63] I also explore what a non-human sensory conception of surveillance such as computational listening brings to Web experience. Sharing operational characteristics with the automated surveillance data logics from which it has emerged, I examine a technique of auditory, computational Web tracking, the uBeacon, as an example by which to appreciate attributes of computational listening. Following this, a discussion of a live performance of Listening Back explores the potential of sound to register one of these post-representational surveillance techniques – the cookie. I detail how a public staging of this newer post-panoptic surveillance mechanism enables it to be tangibly experienced and challenged via the creative strategies that I have developed.

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[62] Salomé Voegelin, "Sonic Possible Worlds," *Leonardo Music Journal* 23, no. 23 (December 2013): 89–89, https://doi.org/10.1162/LMJ_a_00168, 3.
[63] Peter Szendy, *All Ears, The Aesthetics of Espionage* (New York: Fordham University Press, 2017), 19.

Chapter two investigates a field of online creative practice that has, over the last two decades, generated strategies for interrupting the Web browser as frontend interface of a backend surveillance infrastructure. Artists such as Adriana Knouf, Allison Burtch, Michael Mandiberg, and Angela Grammatas have addressed the opacity and normalisation of the Web browser and online surveillance by creating artistic browser add-ons. These ethico-aesthetic strategies of awareness adopt Web protocols and data mining techniques to re-navigate and expose ordinarily obscured data logics and repurpose the browser as a site for artistic practice. As historical precursors, I examine alternate art browsers that emerged pre-Web 2.0 through practices coined 'net.art'.[64] By positioning the *Listening Back* browser add-on within this artistic context, I explore through my sonification of cookie data what it is that sound contributes to the online practice of creative browser add-ons. I investigate how different sonic and visual strategies reintroduce narrative, symbolic, poetic, and sense making spaces to contribute to understandings of the effects of proprietary infrastructures and post-panoptic online surveillance. I examine the approach of other browser add-ons, which reconfigure how the Web ordinarily appears on our screens. By way of contrast, by sonically interrupting the browser interface, the graphical display remains intact. I thus explore the potential for sound and listening to reconfigure how we engage with the Web browser, enabling our eyes to re-appreciate and re-consider the function of the browser to make surveillance infrastructures opaque. As a strategy for shifting the imperceptible background into the affective foreground, my sonification explores the potential of a sonic sensibility to reorient the politics of visibility. Looking to other creative sonification practices such as Polli, Mark Hansen, and Ben Ruben, I examine sonification as a metaphorical device and means to communicate thematics inherent to the sonified data. I also examine how the practice of Listening Back engages sound as an affecting medium in which to signal data within a socio-political context. I show how the *Listening Back* browser add-on, deployed and executed across the creative practices of Listening Back, contributes new artistic strategies for creative browser add-ons.

Chapter three investigates what it means to engage sound to think through and experience contemporary data politics. Here, I consider both theoretical approaches to sonic thinking and embodied listening practices. This includes Goh's proposal for sounding situated knowledges – material-discursive strategies that do not separate affect and embodied listening from signification and critical analysis. Rather than positing the sensory experience of sound against cognitive analysis, I suggest that creative inquiry through sound engages across sensory and discursive modes of meaning making. I examine other projects that sonify Web tracking and how, by comparison, the implementation of sonified cookie data as a browser add-on extends the possibilities for the affecting and conceptual engagement of data sonification to every day personal usage. I look at

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[64] Josephine Berry, "The Thematics Of Site-Specific Art On The Net" (Manchester, UK, University of Manchester, 2001), http://www.metamute.org/sites/www.metamute.org/files/thesis_final_0.doc, 38.

historical examples of auditory practices that listen for knowledge in order to formulate modes of listening and sonic skills relevant to the personal and performative usage of *Listening Back*. I then outline the development stage of the *Listening Back* browser add-on and how the process of mapping sound to cookie data led to a practical appreciation of the privacy asymmetries inherent to the Web surveillance context as discussed from the theoretical perspectives outlined in chapter one.

Through the research conducted across the Listening Back project I have developed situated modes of producing and enabling real-time composition driven by user Web browsing and cookie activity. The proprietary environment in which the *Listening Back* add-on is developed through Web protocols such as browser APIs is typically dictated by tech corporations' commercial interests, resulting in a lack of user and programmer agency. Listening Back as a form of critical algorithmic music that engages a real-time online surveillance context, collaborates with the major technology corporations that dominate online surveillance infrastructures through their API's and proprietary technologies. A tension between creative intervention and lack of control over artistic outcomes is articulated through engagement with algorithmic processes and Web protocols as dictated by corporations such as Google, Mozilla, Facebook, and Amazon. The process of creating the *Listening Back* add-on and then performing with it highlights the power relations and privacy asymmetries of the online space. Sonification strategies are therefore situated within complex, technical, commercial, and political networks where cookie data brings these asymmetrical set of relations. By artistically engaging sonification as a 'mediator of the invisible',[65] Listening Back, as a form of practice-based research, aims for dynamically creative outcomes that engage the artistic and poetic realms with the communicative. By rendering cookie data audibly tangible for experience, awareness, and discussion, Listening Back addresses the post-representational character of the cookie as a technique of post-panoptic surveillance and contributes sound and listening to the practice of creative browser-add ons in an aesthetic, embodied experience of Web surveillance.

[65] Kristina Wolfe, "Sonification and the Mysticism of Negation," *Organised Sound* 19, no. 03 (December 2014): 304–9, https://doi.org/10.1017/S1355771814000296.

CHAPTER ONE:
Post-Representational Web Surveillance

Listening Back live performance, Black Box, Sydney, 2017 (see Figure 1.1)
Video documentation: http://www.jasmineguffond.com/art/PhD#browser-duo

In May 2017 at the Black Box venue at UNSW's School of Art & Design in Sydney I performed as a duo with Emily Morandini utilising the *Listening Back* Chrome browser add-on. This was the second live performance to engage the *Listening Back* add-on and I decided to project our laptop screens, greatly enlarged, directly behind us. The first performance at the Sydney Non Objective (SNO) gallery is discussed in chapters two and three as it was formative in grounding the practice of Listening Back in an appreciation of, and engagement with, the multi-sensory dynamics of Web browsing. The SNO performance made me re-consider my initial concept of a purely listening examination of Web surveillance, and so for the Black Box performance I decided to explore the effect of magnifying the Web browser's screen display. As we browsed, a platform was provided to critically interrogate a sonic rendering of cookie activity within the audio-visual dynamics of mundane Web browsing.

During the performance we scrolled through our Facebook streams, clicked the Like button and conversed with each other via the messaging function. I checked my Gmail account, read articles in the Sydney Morning Herald, the Guardian, and Vogue. Meanwhile, Morandini researched Criteo,[66] one of the data brokers inserting numerous third-party cookies onto our laptops, read articles by the ABC's news website, searched for plane tickets, and looked up recipes. In addition, we both went shopping on Amazon. As we performed everyday browsing routines each cookie that was inserted, updated, or deleted from our laptops triggered a sound, which gave a tangible sense of the hidden, extractive relationships intrinsic to navigation of the Web. Within the parameters of a real-time composition, we occasionally accessed the *Listening Back* interface to change the musical key of the cookies. At one point Richard Keys, one of the event organisers, began messaging me on Facebook and sent a photo he had just taken of our performance. This interaction provided a playful exchange with the audience, while a compositional structure unfolded as each website introduced its own sound signature, providing a visual context for the sound. As subsequent tabs were opened and additional websites retrieved, the soundtrack gradually became increasingly layered, evolving into a generally noisier soundscape. As the sounds became denser the contrast between the banal visuals of news websites, the smooth aesthetics of corporation home pages, and the growing cacophony of sound contributed to a palpable paradox. The extraordinary amount of cookie activity generating sound, created a stark contrast to our mundane browsing of the Web.

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[66] Criteo, https://www.criteo.com/, accessed, May 19, 2021.

The familiarity of the visual design of Gmail, Facebook, or Amazon's Web interfaces was interrupted by an atypical soundtrack, at once exposing and repurposing hidden processes of data extraction and situating the audience's listening within the real-time dynamics of contemporary Web surveillance.

This performance of sonified cookie data provides a human-level connection to otherwise intangible data capture. By rendering cookie activity audible the performance sonically highlighted how the Web browser, as interface and gateway to the Web, functions to conceal pervasive, ubiquitous, and omnipresent surveillance infrastructures. Sound provides a tangible presence for data collection processes which resists the intangibility of Web surveillance and challenges what is ordinarily made apparent through screen displays. By providing a means to experience hidden socio-political, extractive infrastructures implicit to Web browsing, a situated listening is engaged as a reflective practice. Implemented by a browser add-on, intangible data capture processes are audibly manifest and the potential of sound in providing an aesthetic space for Web surveillance to sensibly register in real-time and in situ, is explored through a live performance of Web browsing.

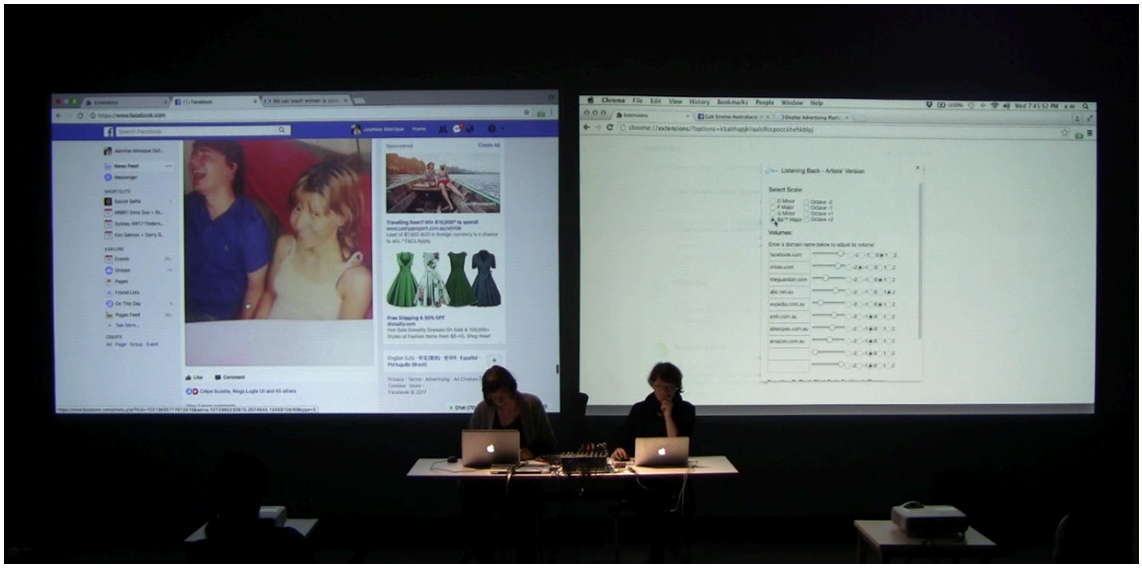

Figure 1.1: Browser Duo: Jasmine Guffond and Emily Morandini performing Listening Back at Black Box, UNSW School of Art & Design, Sydney, 10th May, 2017.

This chapter investigates contemporary Web surveillance in order to appreciate the context in which the creative practice of Listening Back has been enacted through this research. I will be developing an understanding of the attributes of (cookie) data extraction infrastructures drawing on theoretical perspectives. Through the lens of surveillance studies literature I examine how panoptic modes of surveillance, reliant on the human sensory modality of vision and a visual representation of surveillance, have evolved through computational, algorithmic, and database technologies into vast systems of humanly incomprehensible automated data collection. I investigate post-panoptic networked surveillance and how its dependence on intangible, automated,

algorithmic extraction infrastructures critically renders it post-representational, an operational condition that evades human semantic interpretation and scrutiny.

As a listening practice, Listening Back proposes that someone or something is already listening *in*. From this perspective, the second half of this chapter examines what it means to be listened to by automated algorithmic data capture. To *listen back* is to confront Web surveillance as a context that could be understood according to Peter Szendy's concept of panacoustic: that is, a state of ubiquitous, non-stop eavesdropping.[67] As a continuous system of ubiquitous eavesdropping, panacoustism resonates with characteristics of the contemporary online situation in which algorithmic data capture, embedded into everyday technological mediation, is tirelessly and by default always on and (over)collecting. However, an investigation of Web surveillance under the rubric of panacoustism leads to an appreciation of its insufficiency as a metaphor. In an attempt to adequately account for the context of the creative practice I undertake in this research, I explore the potential of a non-human sensory conception of surveillance, such as computational listening. In this vein, and sharing operational characteristics with the automated surveillance data logics from which it has emerged, I examine the uBeacon, a technology that extracts data via an ultrasonic infrastructure that operates above the threshold of human hearing. As an example by which to appreciate characteristics of computational listening, the uBeacon's technique of sonic communication is executed by machines for machines. It therefore exemplifies a mode of operational listening that bypasses human audition, as automated data capture has come to bypass panoptic visual and symbolic regimes.

Post-Panoptic Surveillance

Surveillance studies is an academic field of research that bridges the political and social sciences, cultural and media studies. One of its key proponents, David Lyon, describes it as "dedicated to understanding in context contemporary practices such as monitoring, tracking and identification."[68] A significant framework for understanding surveillance practices was famously contributed by Michel Foucault and his theorisation of the Panopticon.[69] However, post-panoptic surveillance theories have emerged with the evolution of digital technologies and consequently digital and networked surveillance systems. Surveillance scholars such as Kevin Haggerty have subsequently questioned the relevance of the Panoptic metaphor as a framework to examine new modes of

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[67] Peter Szendy, *All Ears, The Aesthetics of Espionage* (New York: Fordham University Press, 2017), X.
[68] Lyon, David. 2015. "The Snowden Stakes: Challenges for Understanding Surveillance Today", *Surveillance and Society,* 13(2), 140.
[69] Michel Foucault, *Discipline and Punish, The Birth of the Prison*, Second Vintage Books Edition, May 1995 (New York, Toronto: Random House, Inc, Random House of Canada, 1995).

contemporary surveillance, arguing that key elements specific to particular socio-technological environments are consequently neglected.[70]

Foucault's well-known theory of disciplinary societies, for which the architectural design of Jeremy Bentham's Panopticon is central, functions foremost due to the illusion of continuous surveillance. Crucial to this perception is a highly specific arrangement of light and space whereby the prisoners cannot see the inspector in the watch tower from their surrounding cells. Since the prisoners cannot see if they are being seen, they could in effect be observed at any time. The invisible omnipresence of the inspector maintains the semblance of the prisoners' perceived permanent visibility, an asymmetrical gaze mechanism that exploits the inmates' uncertainty through optical effect. The spectre of being watched at all times functions due to the efficient use of the watch tower as the visible symbol of surveillance and the primary goal of the panoptic gaze is for prisoners to self-regulate thereby internalising a disciplined behaviour that contributes to their own subjugation, and effects an automatic functioning of power.[71] Particular psychological consequences are incurred via an architectural strategy that expands "perception beyond visible locales" into the imaginary.[72] Mark Andrejevic describes Bentham's efficient engine of reform as a "symbolic efficiency" that warrants the least actual surveillance. In contrast, he points out that contemporary digital surveillance is actually monitoring, according to the comprehensive, always-on, capture-all logic of automated data collection. Rather than the symbol of surveillance functioning as a disciplinary tool, the intangibility of actual algorithmic surveillance enables the ubiquitous capture of undisciplined behaviour.[73] In contrast to the illusion of surveillance offered by the Panopticon, the imperceptibility of automated online data capture technologies empowers networked surveillance. Beyond online activities such as photo sharing, liking, posting or buying a book, platforms are monitoring. Deeply entrenched in everyday communication infrastructures, the spectacle of surveillance has disappeared into the fabric of quotidian life. Furthermore, the creative, active, and performative roles surveillant participants take in offering personal information to online platforms has developed into "a whole way of life".[74] In exchange for the accumulation of Likes and followers or even by simply updating one's online profile, Lyon describes performative modes of surveillance as a development from the disciplinary institution to cultures where surveillance is fun, convenient, and internalised in new ways.[75]

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[70] Kevin D. Haggerty, "Tear down the Walls: On Demolishing the Panopticon.," in *Theorising Surveillance: The Panopticon and Beyond*, ed. David Lyon (Uffculme, Devon: Willan Publishing., 2006), 23–45, 23.
[71] Michel Foucault*, Discipline and Punish, The Birth of the Prison,* Second Vintage Books Edition, May 1995 (New York, Toronto: Random House, Inc, Random House of Canada, 1995)*,* 201.
[72] Jeremy Bentham, The Panopticon Writings. (Ed. M. Božovič). (London: Verso, 1995), 201.
[73] Mark Andrejevic, "Automating Surveillance," *Surveillance and Society* 17, no. 1/2 (2019): 7–13, 9 – 10.
[74] David Lyon, *The Culture of Surveillance. Watching as a Way of Life* (Cambridge, UK; Medford, MA: Polity Press, 2018), 9.
[75] Ibid., 7, 9.

Surveillance Realism

Although not experienced as a prison, breaking free from contemporary surveillance lifestyles is often perceived to be impossible. Symptomatic of the intangible nature of the Web surveillance technologies that are thoroughly entwined into everyday communications, online surveillance is difficult not only to perceive but also is perceived as, difficult to circumvent or avoid. Studies on public opinion regarding digital surveillance expose a general sense of a lack of control[76] and confusion over how information is collected.[77] Symptoms of a "privacy paradox" – a concern for privacy yet little assertion towards privacy-protective behaviour – especially evident online where it has become the norm to provide personal data to websites and mobile apps.[78] In recognition of a climate in which opting out of surveillance networks, deeply entrenched in mundane communication infrastructure, appears unfathomable, Lina Dencik and Jonathan Cable coined the term 'surveillance realism'.[79] Their focus group and interview based research into public understanding of digital surveillance was conducted in the UK post the 2013 Snowden leaks that had unearthed evidence for widespread government mass surveillance programs, particularly, but not uniquely, undertaken by the US and UK government intelligence agencies. As U.S. National Security Agency (NSA) programs such as PRISM revealed, mass surveillance of citizens is at times conducted in collaboration with commercial tech corporations and ISPs (Internet Service Providers).[80]

Dencik and Cable adopt Mark Fisher's notion of "capitalist realism" to refer to the contemporary context of unavoidable, indiscriminate governmental and corporate mass surveillance. Fisher's concept of capitalist realism, written in the wake of the 2008 global financial crisis, describes the perception of capitalism as not just the only viable political-economic system, despite widespread recognition of its fallacies and injustices, but the only coherent one imaginable.[81] Similarly,

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[76] See "Data Protection. Special Eurobarometer Report 431, Summary." (European Commission, March 2015), https://ec.europa.eu/commfrontoffice/publicopinion/archives/eb_special_439_420_en.htm, and also "The General Data Protection Regulation. Special Eurobarometer 487a. Report" (European Commission, June 2019), https://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/ResultDoc/download/DocumentKy/86886. Luke O'Neill, "Majority of Australians Say Online Privacy Beyond Their Control" November 27, 2017. https://www.sydney.edu.au/news-opinion/news/2017/11/27/majority-of-australians-say-online-privacy-beyond-their-control.html, accessed June 15, 2020.

[77] Eszter Hargittai and Alice Marwick, "'What Can I Really Do?' Explaining the Privacy Paradox with Online Apathy," *International Journal of Communication* 10 (2016): 3737–57.

[78] Susan Barnes, "A Privacy Paradox: Social Networking in the United States," *First Monday* 11, no. 9 (September 2006), http://firstmonday.org/issues/issue11_9/barnes/index.html.

[79] Lina Dencik and Johnathan Cable, "The Advent of Surveillance Realism: Public Opinion and Activist Responses to the Snowden Leaks", *The International Journal of Communication*, no. 11 (2017): 763–81.

[80] Ryan Gallagher, "British Spy Chiefs Secretly Begged To Play In NSA's Data Pools", *The Intercept,* April 30, 2014, https://theintercept.com/2014/04/30/gchq-prism-nsa-fisa-unsupervised-access-snowden, accessed November 7, 2020.

[81] Mark Fisher, *Capitalist Realism, Is There No Alternative?* (Hampshire, UK: Zero Books, 2009), 2.

interviews conducted with UK citizens between the ages of nineteen and eighty-four across socio-economic and racial demographics, as well as a focus group with activists from various political affiliations, revealed a social imaginary of resignation and perceived lack of alternatives when negotiating digital mass surveillance.[82] In addition to perceptual factors, the monopolising tendencies of Big Tech surveillance infrastructures facilitates an environment in which consumers, states, government bureaucracies, and public institutions are increasingly dependent on Big Tech's services.[83] Research into the financialisation of corporations such as Amazon, Alphabet, Apple, Microsoft, and Facebook has identified an imperative to dominate through the monopolisation of infrastructure, network effects, platforms and markets, resulting in an unprecedented conglomeration of wealth.[84] Increased opportunities for data extraction, facilitated by the dependency of states, institutions, and individuals on digital services provided by major Internet platforms, contributes to a reinforcing feedback loop, characteristic of a state of surveillance realism.[85] Furthermore, Fisher's conception of capitalist realism as a system of control in which, "subjugation no longer takes the form of a subordination to an extrinsic spectacle, but rather invites us to interact and participate"[86] resonates with contemporary modes of participatory surveillance. Participatory surveillance describes the situation in which users voluntarily give up personal data in exchange for social capital online, and more broadly, the nature in which digital surveillance is embedded in our daily interaction with technologies that continually intersect with surveillance networks. Through everyday technological mediation the all pervasive normalisation of contemporary online surveillance practices is symptomatic of surveillance realism. And as Fisher points out, "an ideological position can never be really successful until it is naturalized."[87]

Persistent Client State Object

The mundane normality of being persistently tracked online is historically, technically, and economically traceable to the invention of the Internet cookie in 1994.[88] At this time the World Wide Web was a stateless infrastructure. 'Stateless' is a computer engineering term used to describe the situation whereby every time a website was visited there was no recall of previous visits, preferences, log in information, or user ID. Without a state mechanism to store records of

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[82] Lina Dencik and Johnathan Cable, "The Advent of Surveillance Realism: Public Opinion and Activist Responses to the Snowden Leaks", *The International Journal of Communication*, no. 11 (2017): 763–81, 765.
[83] Big Tech is a term that refers to multinational corporations that dominate the information and communication technology (ICT) industry and since the World Wide Web have expanded into areas such as media and retail to dominate technology and consumer services more broadly. Rodrigo Fernandez et al., "Engineering Digital Monopolies. The Financialisation of Big Tech", (Amsterdam, The Netherlands: Centre for Research on Multinational Corporations, December 2020), 6.
[84] Ibid., 7, 11, 16 – 17, 46.
[85] Ibid., 48.
[86] Mark Fisher, *Capitalist Realism, Is There No Alternative?* (Hampshire, UK: Zero Books, 2009), 12.
[87] Ibid., 16.
[88] Also referred to as Web, HTML or Browser cookie.

browsing activity, future developments such as online shopping would not have been possible as there was no method for e-tailers to recall actions such as selected items for a virtual shopping basket. Instead, a stateless Web meant that every visit to a website was like the first and any commercial transaction would have to be handled from start to finish on a single page, in a single session.[89] Netscape Communications programmer Lou Montulli was tasked to develop a state mechanism while working on an e-commerce application for north American telecom giant MCI. Montulli named his state mechanism a 'cookie' after a Unix protocol already in use called 'magic cookie', and they provided a means to reliably implement a virtual shopping cart. By providing a state mechanism cookies enabled Web servers to keep track of users' browsing activities and for the first time enabled a protocol for online automated data collection. The invention of cookies contributed to a defining technical, cultural, commercial, and surveillant paradigm shift, transforming the Web from a system of discontinuous visits to cultures of persistent connectivity that enabled continual monitoring.

Technically termed 'persistent client state object',[90] the Internet cookie's namesake, the 'magic cookie', can be traced to a 1979 Unix programmer's manual.[91] As a Unix protocol the magic cookie refers to an opaque identifier sent back and forth between different pieces of software.[92] The magic cookie remains unchanged as it is passed around, and its opacity renders it unreadable by any program except its author. Similarly, the Internet cookie is defined by its opacity and predominant inscrutability. Functioning as a reference number or ID that travels between Web servers, Web browsers, and personal computers, the Internet cookie allows Web servers to identify users without disclosing what and how much information is being collected. The information collected is therefore at the discretion of the Web server making it difficult to examine a cookie's value or what it represents.[93] Inherent to the technical protocol of a cookie, is an opacity that contributes to a "privacy asymmetry" that aligns knowledge and power with the tech corporations and data broker industry that programme the automated data capture systems and maintain the vast data mining infrastructures.[94]

This critical power dynamic is intrinsic to the Web surveillance context in which users are mostly unaware of how or what data is collected. The online situation is further complicated by the fact

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[89] See 'Giving Web a Memory …', NY Times, https://www.nytimes.com/2001/09/04/business/giving-web-a-memory-cost-its-users-privacy.html, accessed May 26, 2018.
[90] See 'Persistent client states', https://patents.google.com/patent/US5774670A/en, accessed May 27, 2018.
[91] "Unix Time-Sharing System: Unix Programmers Manual, Seventh Edition, Volume 1" (Bell Telephone Laboratories, Incorporated, January 1979).
[92] David M. Kristol, "HTTP Cookies: Standards, Privacy, and Politics," *ArXiv:Cs/0105018*, May 9, 2001, http://arxiv.org/abs/cs/0105018, 4.
[93] Ibid., 5.
[94] Matthew Crain, "The Limits of Transparency: Data Brokers and Commodification," *New Media & Society* 20, no. 1 (January 2018): 88–104, https://doi.org/10.1177/1461444816657096.

that even if users are able to access their personal data, they might not have the tools, such as data mining techniques, for making sense of their own data.[95] Big Tech companies benefit from these largely insurmountable information asymmetries,[96] as disparities in resources such as software, processing power, and analytical expertise are characteristic of the commercial and proprietary cultures in which the cookie was invented and released. In September 1994 the first publicly available version of the Netscape *Navigator* browser supported cookies, although it was largely unknown.[97] The following commercial release in 1995 continued to introduce cookies silently as a default setting. The Internet Explorer browser followed suit with cookies integrated into version two in October 1995. From the outset, online automated data collection was shrouded in a culture of proprietary secrecy and inherent technical illegibility as is characteristic of post-panoptic modes of commercial surveillance.

Eight years after the cookie was invented, studies into user control of its operations, such as the potential to opt-out of cookie tracking mechanisms or minimise their monitoring effects, revealed that exerting privacy rights on the Web significantly hinders convenience.[98] Scholars such as Wendy Chun have identified the paradoxical coupling of freedom to browse the Web at one's convenience, and control via intrinsic tracking mechanisms embedded into the very protocols that enable online browsing.[99] Resonating with Gilles Deleuze's influential depiction of control societies,[100] these control technologies transcend the gaze mechanism of the Panopticon through invisible, automated tracking mechanisms.[101] Outwardly benign yet intrusive systems of automated data collection, initially introduced by the cookie mechanism, have prospered into cultures of permanent connectivity, a situation in which users are by default opted-in to automated data capture. The promise of convenience through continual online connectivity, integral to daily life, coincides with increasingly comprehensive data collection.[102] Post-panoptic surveillance, no longer dependent on a subject's response to a representation of surveillance, bypasses subjectification completely,[103] resulting in users having little awareness and control over intangible, automated, algorithmic surveillance, and thus potentially eradicating a space for human judgement.

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[95] Germán Llorca-Abad, and Lorena Cano-Orón, "How Social Networks and Data Brokers Trade with Private Data," Research Gate, December 2016, 85–103, 89. Also Mark Andrejevic, "The Big Data Divide," International Journal of Communication 8 (2014): 1673–89 1675.
[96] Rodrigo Fernandez et al., "Engineering Digital Monopolies. The Financialisation of Big Tech" (Amsterdam, The Netherlands: Centre for Research on Multinational Corporations, December 2020), 11.
[97] Ibid., 9.
[98] Greg Elmer, ed., Critical Perspectives on the Internet (Lanham, Boulder, New York, Oxford: Rowman & Littlefield Publishers, INC., 2002), 51.
[99] Wendy Hui Kyong Chun, *Control and Freedom: Power and Paranoia in the Age of Fiber Optics* (Cambridge, Massachusetts, London, England: MIT Press, 2006).
[100] Gilles Deleuze, "Postscript on the Societies of Control," *October* 59, no. Winter, 1992 (1992): 3–7.
[101] Ibid., 12.
[102] Mark Andrejevic, *Automated Media* (London; New York, NY: Routledge, 2020), 7.
[103] Mark Andrejevic, Automated Media (London; New York, NY: Routledge, 2020), 75.

Post-Representational Control Technologies

Insidious and imperceptible control technologies, enacted through permanent online connectivity and the automated collection of data were forecast by Deleuze's theory of control societies. Deleuze revised Foucault's architectural panoptic model with modulating control mechanisms intrinsic to the distributed computer networks of information economies. His concept of modulation emphasised the technique by which contemporary populations are monitored and controlled through computer networks that fluctuate at the speed of an electronic signal across and beyond physical space. Power is embedded wherever personal data-capture is woven into the fabric of everyday life and the individuals of disciplinary societies have evolved into 'dividuals', that is the masses have become samples, data, and markets.[104] By reconfiguring human behaviour into machine readable data, automated data collection and mining infrastructures compile data profiles with the aim to develop strategies of governance, economic gain, and control.[105] Furthermore, data profiles refer back to particular individuals yet defy a purely representational form as extractive surveillance processes intersect with the individual, reterritorialising it into data flows.[106] Similarly, the computational interaction between the cookie protocol, personal computer, Web browser, and Web server operates across machines and technical protocols in ways that are largely non-representational. We understand that the cookie is doing things, but often not what they mean. Instead of utilising the panoptic power of the visible symbol, post-panoptic surveillance technologies act by privileging intangible, machinic, automated intervention.[107] In this sense, automated data collection technologies are post-representational: they are machinic operations that bypass symbolic representation and remain predominantly, humanly incomprehensible.

Jenna Burrell's investigation into the opacity of machine learning algorithms is relevant here as it reveals contributing factors to the intelligibility of automated algorithmic operations that Web surveillance is dependent on.[108] Burrell takes algorithmic opacity as a starting point for her investigation into how machine learning algorithms function to evade human interpretation due to differences between machinic, post-representational operations and human modes of knowledge production. Using hand-writing recognition algorithms as an example for machine learning, Burrell diagrams a basic algorithmic classification neural network as movement from input node to hidden layer node and finally output node. A value or weight is associated with each connection between nodes and the optimal values are what the algorithm learns. As an image recognition task, it is

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[104] Gilles Deleuze, "Postscript on the Societies of Control," *October* 59, no. Winter, 1992 (n.d.): 3–7, 5.
[105] Kevin D. Haggerty, Richard V. Ericson, "The Surveillant Assemblage", *British Journal of Sociology* 51, no. 4 (December 1, 2000): 605–22, https://doi.org/10.1080/00071310020015280, 613.
[106] Ibid., 611.
[107] Mark Andrejevic, "Automating Surveillance," *Surveillance and Society* 17, no. 1/2 (2019): 7–13, 8, 10.
[108] Jenna Burrell, "How the Machine 'Thinks': Understanding Opacity in Machine Learning Algorithms," *Big Data & Society* 3, no. 1 (January 5, 2016): 205395171562251, https://doi.org/10.1177/2053951715622512.

possible to visualise the optimised weights in the hidden layer node of the machine's 'subconscious', thereby observing how a neural network recognises or 'sees' a handwritten number.[109] A matrix of indecipherable pixels that correspond to weighted grey-scale values are unintelligible to human recognition, focused as it is on, lines and circular shapes that typically contribute to the perception of handwritten digits.[110] Burrell's second example, an email spam filter, reveals a correlative mode of learning as a list of spam identifying key words are matched to email content. As Burrell observes, "there is no posited semiotic relationship between the words and no meaning in the messages extracted, nor is there an attempt in the algorithm at narrative analysis."[111] Instead, machine learning builds its own classification and decision making without regard for human modes of comprehension. According to Burrell's research, machine optimisations based on training data accrued from automated data collection, do not accord with human semantic interpretations but rather escape human comprehension entirely, even for those with specialised training.[112]

Similarly, Andrejevic describes how the methods by which machines communicate between each other, their operability, their machine language, is critically different from human language due to its post-representational functioning. In the context of surveillance paradigms, the invisibility of the medium of automated data capture mechanisms no longer acts upon the subject through an intermediate sphere of meaning, the symbol of surveillance, but rather intervenes and effects directly, bypassing a visible representation for the surveillance apparatus. According to computational communication between machines, the space between sign and referent has disappeared. In symbolic communication there exists a distance between things and words which provides a space for sense, interpretation, and meaning making. Symbolic or 'natural' language provides room for, "interpretation, politics, and judgment, precisely because of its gaps, its incompleteness."[113]

Can the closure of the symbolic space of representation, the sense making gap vital to human comprehension, be unfastened through sound? Considering the post-representational, algorithmic, Web surveillance context, it is through my Listening Back practice that I ask the question: can sound as an aesthetic device for creating a tangible register for algorithmic data capture offer a reopening of the symbolic space for reflection, sense making, meaning, politics, affect?

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[109] Ibid., 6.
[110] Ibid., 7.
[111] Ibid., 8.
[112] Ibid., 10.
[113] Mark Andrejevic, *Automated Media* (London; New York, NY: Routledge, 2020), 109.

http://www.jasmineguffond.com/art/PhD#browser-duo

Returning to the Black Box (UNSW Sydney) performance where the *Listening Back* browser add-on was used to create an audible presence for cookie activity, two distinct issues emerged from the audience interaction and response to the sonic performance of cookie data and Web browsing. Firstly, a close friend had seen her own Facebook post projected large in the intimate yet public space of the small, darkened venue. She explained that she had felt self-conscious and exposed while seeing her post projected large for everyone to see. She had the realisation that when she is posting from the privacy of her home or simply engaged one on one with her online device, the function of posting feels like a private and even intimate act. That – in spite of an awareness that the post is not only for her Facebook friends to see, but also information stored on Facebook servers, and from which personal data is extracted, compiled, aggregated and sold to third-party brokers – it nonetheless feels like a private action. In contrast, when her Facebook post was projected and enlarged before an audience she felt uncomfortably exposed. By publicly staging the surveillance medium, the affordances of the post-panoptic surveillance apparatus were tangibly experienced and its invisibility challenged. The performance exemplified a disconnect between how one feels during the act of posting and the actuality of privacy transgressions.

Secondly, a playful atmosphere was generated through audience interaction in the form of laughter, photo taking, and Facebook message exchanges. It highlighted how playful and fun browsing the Web can be and how the browser itself is a pleasurable interface. This exemplified a disconnect between the experience of the frontend graphical browser and the socio-political implications of backend monitoring infrastructures such as cookies: a disjuncture that will be further examined through the practices of creative browser add-ons in chapter two. As networked power manifests intangibly through algorithmic surveillance, monitoring technologies such as cookies are largely obscured from the user, making these systems difficult to approach, analyse, and understand. Operating behind the Web's graphical surface, the opacity of the Web browser contributes to the post-representational condition of post-panoptic surveillance. A performance utilising the *Listening Back* add-on counters this predicament by interrupting the browser's graphical display to provide a sonic tangibility for backend algorithmic surveillance. While not providing a complete representation of the post-representable, Listening Back questions what can be seen, and senses something else by offering the possibility for experiencing data extraction processes as they unfold in real time. By engaging a situated listening within the durational, multi-sensory dynamics of Web browsing, listening performs an interpretation of the effects of the online surveillance apparatus. An auditory tangibility challenges the disappearance of the visible symbol of surveillance, and the practice of Listening Back thereby provides a creative, tactical counterforce to the intangibility of post-panoptic Web surveillance.

Panacoustism

By providing an audible register for cookie activity, to listen back is to listen to these algorithmic data capture processes 'listening'. The practice of Listening Back, which implies that someone or something is already listening, thereby addresses a contemporary online context that could be considered panacoustic. Szendy develops the concept of panacoustic by pointing to Jeremy Bentham's plan for the Panopticon to include an ancillary system of acoustic surveillance. This was intended for prisoners to not only be constantly watched but also constantly overheard.[114] Bentham's architecture of acoustic surveillance is envisioned as a network of pipes between the prisoners' cells and the central tower:

> a small tin tube might reach from each cell to the inspector's lodge… By means of this implement, the slightest whisper of the one might be heard by the other.[115]

Applying the panacoustic model of continual, intrusive, and ubiquitous eavesdropping as a means to reflect on the nature of listening, Szendy identifies a surplus which he defines as a "non-stop overhearing."[116] Translated from his own neologism "surecoute" which literally translates into English as "overlisten", Szendy expands the English concept of overhearing to encompass excessive modes of listening.[117] Furthermore, Szendy describes how in a "post-Snowdenian" world, where the exposition of programs such as PRISM and Xkeyscore reveal the extent to which citizens are mass surveilled by ubiquitous computer networks, listening as a sense has dissolved into a, "generalized indexation and machinic auscultation of communication flows."[118] However, he insists that the paradigm of auditory, pre-digital espionage remains a better fit for comprehending the contemporary surveillance context: "it is as if there were more and more ears – only ears, everywhere – even though there are no real ears anymore.[119]

The concept of panacoustic surveillance is therefore at once a useful and ill-fitting metaphor for the online surveillance context dependent on automated data capture. As Szendy observes, "in the face of this simultaneously omnipresent and evasive actuality", the notion of ears everywhere, aids in depicting the affordance and effects of algorithmic surveillance that otherwise remain largely intangible. However, while panacoustism depicts the effects of online surveillance it sidesteps how such processes occur. This manifests as problematic when algorithmic surveillance emerges within

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[114] Peter Szendy, "1787: Bentham, Mozart," ed. Dalibor Davidovic and Ksenija Stevanovic, *Archipelagos of Sound. Music and Its History within the Imperial World Order*, 2005, 8–20, 11-13.
[115] Jeremy Bentham, *The Panopticon Writings* (Ed. M. Božovič). (London: Verso, 1995), 7.
[116] Peter Szendy, "1787: Bentham, Mozart," ed. Dalibor Davidovic and Ksenija Stevanovic, *Archipelagos of Sound. Music and Its History within the Imperial World Order.*, 2005, 8–20, 20
[117] Peter Szendy, *All Ears, The Aesthetics of Espionage* (New York: Fordham University Press, 2017), IX.
[118] Ibid., X.
[119] Ibid., IX – X.

contested spheres of political and social power, as evident in a joint hearing of the U.S. Senate's commerce and judiciary committees in April 2018. Here, Facebook founder and CEO Mark Zuckerberg was questioned by senator Gary Peters, "Yes or no, does Facebook use audio obtained from mobile devices to enrich personal information about users?" To which Zuckerberg confidently answered, "No!".[120] Zuckerberg's two day testimony occurred in the wake of the Cambridge Analytica data breach. Personal data had been acquired from eighty-seven million Facebook users via a personality quiz application called 'thisismydigitallife'.[121] The application provided permission to access users' Facebook profiles, including their extended friend networks. Status updates, Likes, and even personal messages were harvested, analysed, and correlated to build psychological profiles of U.S. voters on behalf of Cambridge Analytica's client, Donald Trump's 2016 election campaign.

Prior research at Cambridge University's Psychometrics Centre had proven the value and effectiveness of mapping Facebook Likes to personality traits in order to determine and predict users' behaviour.[122] The personality quiz, developed by Cambridge quantitative psychologist Aleksandr Kogan, was outsourced by Cambridge Analytica to datamine Facebook profiles and influence U.S. voters via micro-targeting techniques.[123] When former Cambridge Analytica employee Christopher Wylie exposed the political consulting firm's use of unwittingly obtained Facebook data to influence a U.S. presidential election, a data breach scandal ensued.[124] As a result, Zuckerberg was questioned before congress regarding Facebook's data practices. Sitting before the House Energy and Commerce Committee, Zuckerberg was not only able to negate Senator Peter's question but furthermore sidestep the fact that Facebook does not need to use microphones to listen.[125] Instead, Facebook is able to gather personal data through 'Like' buttons embedded in

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[120] Sarah Jeong, "Zuckerberg Shoots down Conspiracy Theory That Facebook Taps Your Microphone," *The Verge*, April 10, 2018, https://www.theverge.com/2018/4/10/17221478/zuckerberg-facebook-senate-listening-tapping-microphone, accessed December 17, 2018.

[121] Metcalf, Jacob, "Facebook may stop the data leaks, but it's too late: Cambridge Analytica's models live on." *MIT Technology Review,* April 9, 2019, https://www.technologyreview.com/s/610801/facebook-may-stop-the-data-leaks-but-its-too-late-cambridge-analyticas-models-live-on/, accessed February 13, 2019.

[122] Granville, Kevin, "Facebook and Cambridge Analytica: What You Need to Know as Fallout Widens", *The New York Times,* March 19, 2018, https://www.nytimes.com/2018/03/19/technology/facebook-cambridge-analytica-explained.html, accessed February 5, 2019.

[123] Micro-targeting is a marketing strategy that uses data generated by social media profiles and online activity to create highly specific advertisements to narrowly-targeted groups.

[124] Rosenberg, Matthew, Confessore, Nicholas, Cadwalladr, Carole, "How Trump Consultants Exploited the Facebook Data of Millions", *The New York Times,* March 17, 2018, https://www.nytimes.com/2018/03/17/us/politics/cambridge-analytica-trump-campaign.html?module=inline, accessed February 2, 2019.

[125] However, Facebook has patents that involve the use of microphones for monitoring. Solon, Olivia, "Facebook patents systems that use your mic to monitor TV habits" https://www.theguardian.com/technology/2018/jun/28/facebook-patent-phone-mic-listening-tv-shows, accessed December 18, 2019.

websites across the entire Web.[126] Whether or not you are logged in or even have a Facebook account, any website containing the thumbs up Like icon will insert an individual cookie onto your computer that enables Facebook to receive your IP address, location, browser details, and more.[127] This technical infrastructure enables an extraordinary amount of websites to feed data back to Facebook, ranking them as second only to Google in the online tracking ecosystem.[128] Senator Peter's inquiry, symptomatic of misconceptions regarding computational listening as a mode of digital surveillance, was framed by Zuckerberg as a "conspiracy theory that gets passed around, that we listen to what's going on your microphone".[129]

Computational Listening

While framing around a human sense modality can provide a means to understanding the affordances and effects of online monitoring technologies, listening in these situations takes on an algorithmic form that enables tech developers to bypass regulation and public response to what is considered invasive practice. When tracking technologies contribute to an exercise of power and emerge as a political problem it becomes vital to understand, experience, and scrutinise at least some aspects of their technological nature. How then do we critically interrogate computational surveillance cultures without solely resorting to modes of perception reliant on human sensory modalities? Do we need new qualifications of aspects of perception such as 'computational listening' to assist with an investigation into how surveillance functions in online environments? Cultures of incessant, computational listening that have emerged from the online surveillance logics of comprehensive, automated data capture bear little if any resemblance to the biological processes of human audition. In actuality, online surveillance equates to the extraction, management, selling and ultimately, control of data. These algorithmic processes often bypass the human ear entirely via automated, machinic intervention, an operational mode of communication by machines for machines.

Stefan Maier's research into Google's WaveNet speech synthesizer, developed through applied machine listening techniques, is useful in demonstrating the characteristics of computational

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[126] Gebhardt, Gennie, Williams, Jamie, "Facebook Doesn't Need To Listen Through Your Microphone To Serve You Creepy Ads", *Electronic Frontier Foundation,* April 13, 2018, https://www.eff.org/deeplinks/2018/04/facebook-doesnt-need-listen-through-your-microphone-serve-you-creepy-ads, accessed December 17, 2018.

[127] Phillips, Gavin, "Facebook Is Tracking You! Here's How To Stop It", MUO, July 26, 2017. https://www.makeuseof.com/tag/facebook-tracking-stop/, accessed December 28, 2018.

[128] Steven Englehardt and Arvind Narayanan, "Online Tracking: A 1-Million-Site Measurement and Analysis," in Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security - CCS'16 (the 2016 ACM SIGSAC Conference, Vienna, Austria: ACM Press, 2016), 1388–1401, https://doi.org/10.1145/2976749.2978313.

[129] Jeong, Sarah, "Zuckerberg shoots down conspiracy theory that Facebook taps your microphone", The Verge, April 10, 2018. https://www.theverge.com/2018/4/10/17221478/zuckerberg-facebook-senate-listening-tapping-microphone, accessed December 17, 2018.

listening. Similar to Burrell's investigation of machine learning algorithms, which were found to develop their own systems of categorising, sorting, and decision making without regard for human interpretation, the WaveNet speech synthesizer, minus a human to converse with, produces a unique speech output unlike any known language.[130] This behavioural by-product demonstrates a learning and listening unlike human modes of meaning making, comprehension, communication, or audition. Maier and Burrell's research indicates that abstract statistical learning models crucial to the development of technologies such as the WaveNet speech synthesizer, do not necessarily correspond to modes of knowledge production held by their human developers and users. When WaveNet is removed from its intended utility to synthesise humanly recognisable speech, its unintentional speech follows statistical abstraction unhinged from the parameters of human comprehension, and consequently without regard for human meaning making or cognition. Rather than seeking to understand, the WaveNet's irregular fashion of "stuttering and jerking phonemes" simply acts.[131] Just as Burrell's visualisation of the hidden layer of algorithmic classification reveals humanly incomprehensible operational logics, the WaveNet example provides an audible, and moreover through sound, a demonstration over time of ordinarily incomprehensible logics pertaining to computational listening and machine learning more broadly. Rather than human modes of sense making, WaveNet is defined by operational logics, described by Maier as "a class of listening relations unique to specific technologies."[132]

The notion of machinic modes of communication as primarily an operative rather than human centric sense making activity, is elucidated by Andrejevic, who draws from Trevor Paglen by way of Harun Farocki. The concept of "operative images" was initially proposed by Farocki as a result of his investigation into the way machines see, in particular the "filming bombs" used in war.[133] These projectiles would film their trajectories while homing in on their targets. Farocki argues that images taken by these machines from a position and at a speed that a human cannot normally occupy, are technical representations of the operative and do not represent an object but are rather part of an operation.[134] A decade later Paglen's research into the contemporary context for operational images and machine vision, discovered that such images had become invisible. Machines were no longer bothering to make operational images humanly comprehensible since "meat-eyes are far too inefficient to see what's going on anyway."[135] As Andrejevic observes, "at work here is an anesthetics of disappearance" whereby the operational image has collapsed into a post-

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[130] For an audio example listen to "Knowing What to Say", https://deepmind.com/blog/article/wavenet-generative-model-raw-audio, accessed May 20, 2021.
[131] Stefan Maier, "WaveNet: On Machine and Machinic Listening," *Technosphere Magazine, HKW*, December 23, 2018, https://technosphere-magazine.hkw.de/p/1-WaveNet-On-Machine-and-Machinic-Listening-a2mD8xYCxtsLqoaAnTGUbn, accessed November 10, 2020.
[132] Ibid.
[133] Harun Farocki, "Phantom Images," trans. Brian Poole, *Public* 29, 2003, 12–22, 2.
[134] Ibid., 4, 6.
[135] Trevor Paglan, "Operational Images," *E-Flux Journal* 59 (November 2014): 1–3, 3.

representational, post-aesthetic operationalism.[136] As James Parker suggests, the characteristics of machine vision and the notion of operative images are useful and relevant frameworks for thinking about machine listening as an emergent field of knowledge-power, data extraction, capital accumulation, automation, and control.[137] An example of operational listening is evident in Ultrasonic Beacons, a Web based surveillance technology that functions via ultrasonic frequencies to perform a correlative listening.

Ultrasonic Beacons

Ultrasonic Beacons (uBeacons) are a networked surveillance technology that perform a sonic mode of communication executed as an operational logic by machines for machines. Ultrasonic refers to the frequency range above the human hearing spectrum, and this panacoustic network is evoked by granting apps permission to access the microphone on personal smart devices. The enabled microphone picks up high frequency signals known as beacons that emanate from shops, sport stadiums, television advertisements and websites.[138] The ultrasonic beacons transport encrypted data such as time and location over an audio signal within the near ultrasound spectrum of 18 – 20 kHz. As a post-panoptic surveillance technology the uBeacons' infrastructure remains intangible to the surveilled yet enables what the industry terms; ultrasonic cross device tracking (uXDT), that is, the ability to link multiple devices such as phone, laptop, and television for profile building.[139] The uXDT technology transmits an ultrasonic beacon embedded in a television or radio advertisement, an advertisement delivered via a Web browser, or a video, movie, or song on platforms such as YouTube.[140] Through such content the uBeacon is accessed and its ultrasonic signal played through the devices' speakers, inaudible to the human ear.

Devices such as smartphones using uXDT-enabled apps are persistently listening out for these ultrasonic smart tones. When the app hears the signal, it submits it back to the service provider of the advertising network with details such as IP address, geolocation data, telephone number, SIM card code, viewed content, and which devices co-occupy a space. This data is added to a user's

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[136] Mark Andrejevic, Automated Media (London; New York, NY: Routledge, 2020), 108.
[137] Jasmine Guffond, "Computational Listening W/ Jasmine Guffond," Internet Radio, *Computational Listening W/ Jasmine Guffond* (Bristol, UK: Noods, September 21, 2020), https://noodsradio.com/shows/computational-listening-with-jasmine-guffond-21st-september-20, accessed October 11, 2020.
[138] Newman, Lily Hay, "Hundreds of Apps Can Listen For Marketing 'Beacons' You Can't Hear", *Wired*, 02.05.2017 https://www.wired.com/2017/05/hundreds-apps-can-listen-beacons-cant-hear/, accessed April 8, 2019.
[139] Mavroudis, Vasilios, Maggi, Federico, *Talking Behind Your Back. On The Privacy and Security of the Ultrasound Tracking Ecosystem.* 33C3, 29/12/2016 https://media.ccc.de/v/33c3-8336-talking_behind_your_back, accessed April 9, 2019.
[140] Bradbury, Danny, "Tor Users At Risk Of Being Unmasked By Ultrasound Tracking", *Naked Security*, 13 January, 2017, https://nakedsecurity.sophos.com/2017/01/13/tor-users-at-risk-of-being-unmasked-by-ultrasound-tracking/, accessed April 8, 2019.

profile to push targeted advertisements back to users' devices. By providing a sonic communication network across various devices, the uBeacons operate according to programmed protocols rather than a communication of humanly comprehensible transmissions. When listening cultures are detached from human ears they become not only inaudible but moreover indecipherable to users. And as Paglen's research into machine vision reveals, a machine, rather than following human sensing will sense "according to the forms of power that have been encoded into it."[141] In the case of uBeacons, data is extracted via sounding and listening technologies for the purposes of correlating digital profiles with targeted advertisements. As a sonic means of extracting and mining data the uBeacon's panacoustic network enacts a *correlative listening*. Hence, computational listening facilitates an auditory regime without the need for human semantic comprehension. However, economic value is extracted by advertisers via data mining techniques that sonically mine user behaviour to correlate how many people have watched a particular advertisement as well as to steadily monitor channel switching. This auditory monitoring infrastructure is employed for audience measurement analytics and, symptomatic of post-panoptic surveillance techniques, without the need for conscious participation by audiences.[142]

As background research for the *Listening Back* browser add-on and its artistic deployment for the practice of Listening Back, this chapter has examined the operational logics of Web surveillance and the cookie mechanism specifically. As a technique for post-panoptic, automated data capture the logics and operations of the cookie evade human scrutiny with the potential to displace human decision making. As evidenced from a live performance, the practice of Listening Back attempts to reinstate a space for the operations of automated data capture to become sensory through sound and thereby tangibly experienced in real-time. Within the multi-sensory dynamics of Web browsing, a situated listening is engaged to reflect on the real-time characteristics of automated data capture's comprehensive, continuous, and ubiquitous operations. By *listening back* to automated data capture, a counter mode of eavesdropping, or sousveillance as an aesthetic strategy of awareness is implemented. As a means to invert surveillance, the practice of Listening Back during live performance engages the audience in not just a *listening back* to the operations of data capture but also an observation of projected social media feeds including (un)private messaging and email correspondence. Through the staging of Web browsing as a live performance, the performative mode of Listening Back exemplifies the ways in which we also survey each other online. By

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[141] Trevor Paglen, 2017 CAST Symposium BEING MATERIAL: Lisa Parks and Trevor Paglen, INVISIBLE, YouTube, 2017, https://www.youtube.com/watch?v=SmHeSEE24sk, accessed May 15, 2021.

[142] Ubeacons are further implemented for the study of offline user behaviour. Termed 'proximity marketing', supermarkets and sports stadiums install speakers to emit ultrasonic signals for the purposes of communicating with user's portable smart devices. Through supermarket or sports fan apps containing the uXDT framework, movements are tracked at sporting events and through supermarket aisles. Daniel Arp et al., "Privacy Threats through Ultrasonic Side Channels on Mobile Devices," in 2017 IEEE European Symposium on Security and Privacy (EuroS&P) (2017 IEEE European Symposium on Security and Privacy (EuroS&P), Paris, France: IEEE, 2017), 35–47, https://doi.org/10.1109/EuroSP.2017.33.

interrupting the opacity of the Web browser across both performative contexts and personal usage, I provide a tactile approach through sound and listening that counters the aesthetic disappearance of the surveillance apparatus. The next chapter examines creative browser add-ons by artists that also interrupt the browser interface but use visual tactics or data obfuscation rather than sound.

CHAPTER TWO:
Creative Strategies for Interrupting the Interface

This chapter investigates a field of online creative practice that has, over the last two decades, generated strategies for interrupting the Web browser as frontend interface of a backend surveillance infrastructure. As discussed in chapter one, the opacity of the Web browser functions to conceal the distributed networks of algorithmic surveillance technologies. Often taking the form of automated data extraction, the aggregation, management, sale, and ultimately control of data has developed into a fundamental business model for online platforms. With tech corporations and the data broker industry collecting data at scales that exceed human comprehension, the industry is dependent on the computational technique of data mining, that is, discovering patterns amongst vast troves of data and rendering them humanly comprehensible. Pattern recognition – an ever expanding industry that Shoshana Zuboff terms behavioural future markets,[143] Mark Andrejevic the "database era,"[144] and Matteo Pasquinelli the "metadata society"[145] – is essential to the online surveillance economy and aids in the prediction of future behaviours, more sales, and the accumulation of knowledge.[146] In direct relation to the networked cultures of data mining, Anna Munster coined the term "data undermining" to describe an ethico-aesthetic strategy in contemporary artistic projects for making alternate data relations perceptible for understanding the complexity of networked data flows and the normalisation of online user behaviour.[147] Following from this, I argue in this chapter that these contemporary artistic strategies adopt three approaches for intervening at the site of the web browser: tackling the (aesthetic) opacity of the browser; generating data noise as a mode of counter-obfuscation; and repositioning sound and listening as newer artistic strategies within online monitoring environments of automated data collection. As historical precursors to these creative add-ons I examine alternate art browsers that emerged in the pre-Web 2.0 practices of net.art.

This is followed by an investigation into a number of tactical interruptions that repurpose the Web browser as a site of artistic practice, including Adriana Knouf's *MAICGregator* (2009),[148] Allison

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[143] Shoshana Zuboff, The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power, First edition (New York: PublicAffairs, 2018), 8.
[144] Mark Andrejevic, Automated Media (London; New York, NY: Routledge, 2020), 81.
[145] Matteo Pasquinelli, "Metadata Society," in Posthuman Glossary, Theory (London, Oxford, New Delhi, New York, Sydney: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2018), 253–56, 253.
[146] Anna Munster, An Aesthesia of Networks. Conjunctive Experience in Art and Technology, Technologies of Lived Abstraction Ser. (Cambridge, Massachusetts, London, England: MIT Press, 2013), 12.
[147] Ibid.
[148] *Maicgregator* add-on documentation website, http://maicgregator.org/, accessed June 6, 2017.

Burtch's *Internet Illuminator* (2014)[149] and Michael Mandiberg's *Oil Standard* (2005)[150] and *Real Costs* (2007).[151] These projects adopt Web protocols and data mining techniques to transfigure browser aesthetics and reveal hidden networks of economic and political power. In addition, I examine data obfuscation as a tactical strategy for circumventing online surveillance as produced by a range of browser add-ons from *TrackMeNot* (2006)[152] to *Noiszy*, (2018).[153] Finally, in relation to these online practices I elaborate on Listening Back as an aesthetic strategy for interrupting the web browser while leaving its graphical display intact. By sonically highlighting how the Web browser functions to conceal pervasive, ubiquitous, and omnipresent tracking infrastructures, I explore the potential for sound and listening to challenge the visual organisation of the browser and the intangibility of post-panoptic Web surveillance. As a sonic tactic, *Listening Back* engages the human capacity to listen peripherally while simultaneously engaging in other activities, notably Web browsing. This allows for real-time automated data capture to be audibly experienced during the everyday act of browsing. Through creative sonification practices by artists such as Andrea Polli, I examine sonification as a metaphorical device and a means to communicate thematics inherent to the sonified data. The *Listening Back* browser add-on contributes sound's time-based durational, omnidirectional, and affecting attributes to the practice of creative browser add-ons. Furthermore, sound as a signifier for data with socio-political consequences also provides a material-discursive approach to knowledge production that engages cognitive and sensory modes of analysis.

Radical Disruption of Seamless Web Topology

When CEO of Google, Eric Schmidt spoke as part of Google's lecture series Google Zeitgeist, he envisioned a Web that is both ubiquitous and indiscernible:

> In the future, people will spend less time trying to get technology to work.... because it will just be seamless. It will just be there. The Web will be everything, and it will also be nothing. It will be like electricity.[154]

Schmidt's projection for a seamless Web elucidates an ubiquitous normality and mundane totalization of networks, making it function smoothly for the economic imperatives that drive

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[149] *Internet Illuminator* add-on documentation website, https://allisonburtch.github.io/plugin/, accessed January 11, 2020.
[150] *Oil Standard* add-on documentation website, http://www.mandiberg.com/oil-standard-2/, accessed June 4, 2020.
[151] *Real Costs* add-on documentation website, http://therealcosts.com/, accessed June 6, 2017.
[152] Mozilla Web store, *Track Me Not* add-on, https://addons.mozilla.org/en-US/firefox/addon/trackmenot/, accessed July 27, 2020.
[153] *Noiszy* add-on documentation website, https://noiszy.com/, accessed June 3, 2020.
[154] Schmidt also reveals the development of a pill (recently approved by the FDA) that when swallowed turns into a machine that observes the body for medical purposes.
(https://www.youtube.com/watch?v=kUHF43xjMJM), accessed May 25, 2020.

platform monopolies such as Google.[155] From engineering and design perspectives, as Christian Ulrik Anderson and Soren Pro Pold's research indicates, the goal for computing devices is to blend into our environments via "transparent design".[156] Interfaces that allow for flawless encounters between human and machine facilitate the disappearance of any difference between them.[157] The Web browser, optimised to be user-friendly and offer uninterrupted functionality, is bundled seamlessly with our everyday computing devices and smart media. The practice of making art at the intersection of the browser interface and the World Wide Web, challenges this seamlessness by proposing alternative aesthetic strategies. This mode of artistic practice emerged in the late 1990s, when electronic and net.artists such as London collective I /O / D,[158] Mindflux[159] and Dutch/Belgium duo JODI[160] were producing art works in the form of alternative browsers or works that functioned to completely disrupt the graphical display of the commercial browser interface. As the interface that marks the point where technology becomes apparent to the user, the Web browser maintains a visual presence for the Internet and World Wide Web and by the mid-1990s were already bundled with operating systems. Built upon a distributed infrastructure of cables, servers, satellites, and coded protocol that dates back to the invention of packet switching during the 1950s cold war era,[161] the Web browser is crucial as a site of engagement that conceals the algorithmic processes intrinsic to the Web's functionality. Earlier versions of 'line mode' browsers were not capable of displaying images simultaneously with text: to view a picture, one had to open a new window.

Mosaic, the first graphical browser to become available across Macintosh and Windows operating systems and thereby markedly contribute to what became known as the Internet revolution, was celebrated for providing a pleasurable mode of access to the Web that allowed the complex methods of extracting information to be hidden from sight.[162] By the mid-1990s the browser market was dominated by two commercially available browsers: Netscape's *Navigator* and Microsoft's *Internet Explorer*. This was the commercial and cultural context in which these artists

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[155] Naomi Klein, "Screen New Deal. Under Cover of Mass Death, Andrew Cuomo Calls in the Billionaires to Build a High-Tech Dystopia," The Intercept, May 8, 2020, https://theintercept.com/2020/05/08/andrew-cuomo-eric-schmidt-coronavirus-tech-shock-doctrine/, accessed May 20, 2020.
[156] Christian Ulrik Andersen and Søren Bro Pold, eds., *Interface Criticism. Aesthetics Beyond Buttons*, Humanities Series 1 (Aarhus, Denmark: Aarhus University Press, 2011), 8.
[157] Nicholas Gane and David Beer, "New Media", English ed, *The Key Concepts*, 1747-6550 (Oxford; New York: Berg, 2008), 53.
[158] Josephine Bosma, *Nettitudes. Let's Talk Net Art, Studies in Network Cultures* (Rotterdam: NAi Publishers, n.d.), 31.
[159] Belinda Barnet, "Storming the Interface: Mindvirus, I/O/D and Deceptive Interaction.," I / O / D, 1998, https://bak.spc.org/iod/Aus%20interview.html, accessed December 15, 2020.
[160] Tilman Baumgärtel, *Net.Art 2.0 New Materials towards Net Art* (Verlag für moderne Kunst Nürnberg, 2001), 33 – 34.
[161] Alexander R. Galloway, *Protocol: How Control Exists after Decentralization* (Cambridge, Mass.: MIT Press, 2004), 5.
[162] Gary Wolfe, "The (Second Phase of the) Revolution Has Begun," *Wired*, January 10, 1994, https://www.wired.com/1994/10/mosaic/, accessed May 25, 2018.

chose to challenge the homogeneity of browser design by exploring the myriad possibilities for representing information on the Web. As I / O / D's Matthew Fuller explains, "on connecting to a URL, HTML appears to the user's computer as a stream of data. This data could be formatted for use in any of a wide variety of configurations."[163]

By drawing attention to the pre-programmed, visual grammar of Web interaction, experimental Web browsers such as I / O / D's *Web Stalker* (1998), JODI's *Wrongbrowser* (2000) and Mindflux's "electronic magazine" *Mindvirus* (1998), presented jarringly different methods for representing the indexing of information, often working at the threshold of functionality.[164] For example in navigating *Mindvirus0294*:

> the reader is given the option at one point of pressing 'restart' for fear of strange interfaces and alternative paradigms. The only problem is that the familiar 'restart' button begins to blink and skid across the screen in the most user-unfriendly fashion, with your trigger-happy finger in hot pursuit.[165]

Mindvirus produces a disruptive experience of computer navigation that destabilises the relationship between the technology and user by jarring them out of their familiar computer gestures. By producing an interface that consists of anti-functional interactions, *Mindvirus* questioned the development and adoption of limited, universalised operating environments such as the 'office' desktop with its files and trash can. By exploring interaction and design possibilities beyond the networked computer's intended design, a critique of the universal machine performatively unfolds on the site of the personal computer. Furthermore, as Fuller points out, the action of throwing files into the trash is in actuality the instruction for the deletion of data and thereby masks the fact that data is not sitting in a wastepaper basket but on a backup disk.[166] Computer operations, "radically obscured" by misapplied metaphors and visual icons are questioned through "user abuse" and the "ironic dysfunctionality" of speculative design practices.[167] According to Tilman Baumgaertel, JODI's *Wrongbrowser* is the most radical version of this approach as strategies of rupture create an estrangement effect whereby websites were barely recognisable.[168] The repurposing of browser and HTML protocols, including their grammar and structure, the texture

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[163] Matthew Fuller, "A Means of Mutation: Notes on I/O/D 4 The Web Stalker," in *Readme! Ascii Culture and the Revenge of Knowledge* - Filtered by Nettime, ed. Josephine Bosma and et al. (Brooklyn, New York: Autonomedia, 1999), 37–45, 38.
[164] Belinda Barnet, "Storming the Interface: Mindvirus, I/O/D and Deceptive Interaction.," *I / O / D*, 1998, https://bak.spc.org/iod/Aus%20interview.html.
[165] Ibid.
[166] Matthew Fuller, "A Means of Mutation: Notes on I/O/D 4 The Web Stalker," in *Readme! Ascii Culture and the Revenge of Knowledge* - Filtered by Nettime, ed. Josephine Bosma and et al. (Brooklyn, New York: Autonomedia, 1999), 37–45, 40.
[167] Ibid., 39 – 40, 43.
[168] Tilman Baumgärtel*, Net.Art 2.0 New Materials towards Net Art* (Verlag für moderne Kunst Nürnberg, 2001)*,* 34.

of code, its shape and colour, produces the aesthetic for "a series of abstract compositions, while frustrating the user's sense of interactivity."[169] I / O / D's "art browser" *Web Stalker* takes the approach of turning the entire screen black and leaving the user to navigate the cursor by drawing a window for each function they want to employ.[170] For a subsequent version of *Web Stalker* the opening screen is also black but on touching the mouse the user effects sounds and with slight movements introduces new bass loops and electronic "bleeps". As Belinda Barnet describes:

> After a while, she discerns that the key navigational organ is the ear: she must re-adjust her perceptions to a sound-based interface. The initial reaction is one of bewilderment. (Am I controlling these noises or are they pre-programmed? Is this how I 'access' the information?)[171]

By incorporating sound as a surprise element in a novel, listening navigation of the interface, the *Web Stalker* browser encourages the user to explore the boundaries of technological interaction and reflect upon how standardised browsers navigate us, by directing our gaze and hand gestures towards a smooth and uniform consumption of information. Here, sound is implemented to question the normalisation of Web browsing, an approach that will be later explored through the *Listening Back* add-on which also adopts sound as a means to question the normalisation, not just of Web browsing, but of being surveilled while browsing the Web. The aim of dis-articulating the standardised Web browser, "a finely-wrought behavioural map", is according to Fuller and Simon Pope a means to encourage a reflective awareness of design conventions and, through speculative software, open up the possibilities for treating the Web as a space for reinvention.[172]

The projects *Mindvirus*, *Web Stalker*, and *Wrongbrowser* are primarily engaged with the materiality and graphic design of the Web browser, from the perspective of its code, technical protocols, and data. They did not take up the Internet's physical infrastructure such as its fibre optic cables, satellites, and data centres.[173] A primary focus on the browser as the object and material for these art works has been dubbed "Web formalism".[174] Critiqued for its self-referentiality, net.art has been aligned with modernist art practices' formal and medium specific focus.[175] However, by subverting Web browsing logics from the commercial orientation of Web browsers as this progressed during the

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[169] Alexander R Galloway, "Jodi's Infrastructure," *E-Flux Journal*, no. 74 (June 2016), https://www.e-flux.com/journal/74/59810/jodi-s-infrastructure/.
[170] Josephine Berry, "The Thematics Of Site-Specific Art On The Net" (Manchester, UK, University of Manchester, 2001), http://www.metamute.org/sites/www.metamute.org/files/thesis_final_0.doc, 59
[171] Belinda Barnet, "Storming the Interface: Mindvirus, I/O/D and Deceptive Interaction.," I / O / D, 1998, https://bak.spc.org/iod/Aus%20interview.html, accessed November 25, 2020.
[172] Ibid.
[173] Matthew Fuller, "A Means of Mutation: Notes on I/O/D 4 The Web Stalker," in *Readme! Ascii Culture and the Revenge of Knowledge* - Filtered by Nettime, ed. Josephine Bosma and et al. (Brooklyn, New York: Autonomedia, 1999), 38.
[174] Tilman Baumgärtel, *Net.Art 2.0 New Materials towards Net Art* (Verlag für moderne Kunst Nürnberg, 2001), 17, 31, 37.
[175] Ibid., 28 – 31.

same period, a resistance to its normalisation is also implied. As we shall see, the creative browser add-ons that emerged with Web 2.0, similarly interrupt the seamlessness of Web browser design but with subtle transfigurations of the graphical interface. Instead of being primarily concerned with the Web itself they engage its interface to reveal alternate information that exposes the commercialized Web to its financial, political, and surveillant networks of power. They thereby engage the browser as a site for politco-aesthetic practice, that while challenging aesthetic conventions also inquires beyond the Web's browser design.

Front and Backend Divisions

The Web is designed according to a distinction between front- and backend use and development. This topology engages varying levels of user, developer, and systems administrator interactions. Front- and backend are software engineering terms that reference the software and hardware infrastructures that support the functionality and usability of the web. The backend is broadly understood as referring to server-side relations that encompass the underlying technical systems that sustain a Web platform or application. This consists of multi-layers of systems, networks, and machines that communicate via suites of protocols enacted via automation and standards.[176] An aspect of this automation is algorithmic processes, which, as revealed through Jenna Burrel's research are, in the broadest engineering sense, a set of computer implementable instructions that transform input data into a desired output. Here, a programmatic series of steps organise and act on data to achieve a specified outcome. Both algorithm and dataset possess embedded values from protocols that privilege both an optimization of a narrow task and what is to be included in a dataset. These embedded values are further implicated in socio-technical assemblages that reach beyond the technical to encompass engineers, programmers, and users.[177] As Jamie "Skye" Bianco observes, algorithms present themselves to the user in the way information is returned to the screen, sorted by the Google page rank algorithm, purchase recommendations from Amazon, social media news streams, status updates, or add placement in the Gmail sidebar.[178] Including and beyond such examples, automated algorithmic processes, driven by monumental data collections, are increasingly making consequential decisions in our lives.[179] Rob Kitchin describes these modes

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[176] Douglas Comer, *Computer Networks and Internets*, 5th ed (Upper Saddle River, N.J: Pearson/Prentice Hall, 2009). p. 637–81. Shay, W. (1999). Understanding Data Communications and Networks. Pacific Grove, CA: Brooks Cole, 20-23.

[177] Tarleton Gillespie, "Algorithm," *Culture Digitally*, June 25, 2014, http://culturedigitally.org/2014/06/algorithm-draft-digitalkeyword/.

[178] Jamie "Skye" Bianco, "Algorithm," in *Posthuman Glossary, Theory* (London, Oxford, New Delhi, New York, Sydney: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2018), 23–26, 23 – 24.

[179] Rob Kitchin, "Thinking Critically about and Researching Algorithms," Information, Communication & Society 20, no. 1 (January 2, 2017): 14–29, https://doi.org/10.1080/1369118X.2016.1154087, 15.
Julia Velkova and Anne Kaun, "Algorithmic Resistance: Media Practices and the Politics of Repair," *Information, Communication & Society*, August 26, 2019, 1–18, https://doi.org/10.1080/1369118X.2019.1657162, 2.

of algorithmic governance as a means to "automate the disciplining and controlling of societies and to increase the efficiency of capital accumulation."[180] In this newer webscape, creative browser add-ons developed by artists and cultural producers, explore the extent and ways that algorithmic authority,[181] governance, and power can be strategically and tactically engaged.

If the backend encompasses largely inscrutable algorithmic processes embedded in complex systems of software, hardware, and technical protocols, the frontend is where information is materialised, accessed, and navigated by the user. Although the front and backend are distinct, a website's functionality relies on their constant information exchange. Rather than being strictly split, their interdependency enables these domains to operate seamlessly together. The frontend functions through an interface the user perceives and engages with as the Web browser. The interface as such has a history that pre-dates the Web and digital technologies.[182] First recognised in the field of fluid dynamics, a physics and engineering sub-discipline that describes the flow between liquids and gases.[183] Here, the interface occupies the threshold of transformation from one state to another.[184] Since the early twentieth century the notion of interface has primarily been concerned with interactions between humans and machines. The human-machine interface is a site from which technological processes are managed and operated, from the control of machinery to computer games.[185] The concept 'interface' used within computer and information science disciplines has migrated into media studies and the humanities more broadly. In this context its meaning encompasses social, cultural, and political aspects creating a complex relation between technical descriptor and metaphorical trope.[186] An interface is often considered as a bridge between two separate entities, a mediator or translator that navigates the boundaries between different objects and systems.[187] Resonating with its original conception in fluid dynamics, Alexander Galloway defines interfaces as processes rather than objects. Conceived as thresholds that mediate zones of interaction between different realities, Galloway recognises interfaces as effects in themselves, as

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David Beer, "Power through the Algorithm? Participatory Web Cultures and the Technological Unconscious," *New Media & Society* 11, no. 6 (September 2009): 985–1002, https://doi.org/10.1177/1461444809336551.

[180] Rob Kitchin, "Thinking Critically about and Researching Algorithms," Information, Communication & Society 20, no. 1 (January 2, 2017): 14–29, https://doi.org/10.1080/1369118X.2016.1154087, 15.

[181] Caitlin Lustig and Bonnie Nardi, "Algorithmic Authority: The Case of Bitcoin," in *2015 48th Hawaii International Conference on System Sciences* (2015 48th Hawaii International Conference on System Sciences (HICSS), HI, USA: IEEE, 2015), 743–52, https://doi.org/10.1109/HICSS.2015.95.

[182] Branden Hookway, *Interface* (Cambridge, Massachusetts: The MIT Press, 2014), 1.

[183] John D. Anderson, "Brief History of the Early Development of Theoretical and Experimental Fluid Dynamics," in *Encyclopedia of Aerospace Engineering*, ed. Richard Blockley and Wei Shyy (Chichester, UK: John Wiley & Sons, Ltd, 2010), eae001, https://doi.org/10.1002/9780470686652.eae001, 2.

[184] Branden Hookway*, Interface* (Cambridge, Massachusetts: The MIT Press, 2014)*,* 5 – 6.

[185] Ibid., 6. Christian Ulrik Andersen and Søren Bro Pold, eds., *Interface Criticism. Aesthetics Beyond Buttons.*, Humanities Series 1 (Aarhus, Denmark: Aarhus University Press, 2011)*,* 8.

[186] Nicholas Gane and David Beer, "New Media", English ed, *The Key Concepts*, 1747-6550 (Oxford; New York: Berg, 2008)*,* 2, 9, 15 -16, 21.

[187] Benjamin H. Bratton, The Stack: On Software and Sovereignty (MIT Press, n.d.), 220. Nicholas Gane and David Beer, "New Media", English ed, *The Key Concepts*, 1747-6550 (Oxford; New York: Berg, 2008)*,* 54.

well as the effects of other things and thus they "tell the story of the larger forces that engender them."[188]

For the purposes of this research I am specifically concerned with the Web browser as an opaque mechanism operating as a site of both access and concealment in its functioning as interface to the World Wide Web. Now convergent with platforms like Google or Microsoft, the Web browser does not sit neutrally between the user and technology and can no longer simply be the object of design interventions as it largely was by earlier net.art. As we shall see in the next section, Firefox add-ons such as Adriana Knouf's *MAICGregator* (2009) reveal hidden funding infrastructure and financial networks, which tertiary educational institutions – seemingly neutral in their Web presence – are nonetheless embroiled. By inserting alternative information into the graphical display of official university websites, *MAICGregator* shows how the web browser interface connects the user not just technically to networks but to networked culture and its political economy. The *MAICGregator* add-on re-purposes the Web browser as a site in which we can learn something about what the Web's generalised opacity obscures.

Web Opacity

Relevant to Web opacity, scholarly critiques of algorithmic opacity identify three predominant factors: proprietary protection, an intentional means of maintaining trade secrecy and competitive advantages that additionally functions to confound regulation and manipulate consumers; and code illegibility. The third, as discussed in chapter one, is the discrepancy between large scale computing, automated algorithmic post-representational operations, and human scale reasoning and methods of semantic interpretation.[189] The very scale of computational networks can function to not only confound users but also programmers who must contend with complex multi-component backend infrastructures built by teams working on discreet elements within integrated networks. Under such systems, code audits typically require hours, even days, to unravel millions of lines of code.[190]

The proprietary secretiveness of technical operations, and consequently the business practices of Internet corporations, is analysed by Frank Pasquale through the metaphor of the black box.[191] Pasquale confirms that even when processes are revealed their technical complexity often belies the idea of transparency that motivated the unhinging of the black box in the first place. Rather than

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[188] Alexander R Galloway, *The Interface Effect* (Cambridge, Massachusetts: Polity Press, 2012), VII.
[189] Burrell, "How the Machine 'Thinks'",3-4. Frank Pasquale, The Black Box Society: The Secret Algorithms That Control Money and Information (Cambridge: Harvard University Press, 2015), 2.
[190] Lucas D. Introna, "Algorithms, Governance, and Governmentality: On Governing Academic Writing," *Sage Publications, Science, Technology & Human Values*, 41, no. 1 (January 2016): 17–49, https://doi.org/1 0. 1 1 77/0 1 622439 1 5587360, 25.
[191] Frank Pasquale, The Black Box Society: The Secret Algorithms That Control Money and Information (Cambridge: Harvard University Press, 2015).

providing clear and insightful evidence necessary for accountability, as is often the aim of transparency goals, disclosure approximates an empty gesture.[192] Instead, subsequent black boxes are revealed and multiply as the boundary of the black box is continually renegotiated through illegible programming protocols. Furthermore, due to on-going updates and technical development, to look under the lid of networked computational systems would provide only a limited snap shot of their functionality.[193] As Mike Ananny and Kate Crawford suggest, "to ask to 'look inside the black box' is perhaps too limited a demand and ultimately an ill-fitting metaphor for the complexities of contemporary algorithmic systems."[194] Rather than looking inside systems, they propose to look across, as such systems do not contain complexity within but rather enact it across distributed networks of human and non-human actors.[195] For such socio-technical assemblages key knowledge lies not internally but relationally.[196]

MAICGregator and *Internet Illuminator*

Precisely by mining relations across databases for otherwise obscured connections of networked power, creative browser add-ons engage technologies across the backend web infrastructure. Munster has described the emergence during the 1990s of specific techniques for querying what new data could be derived from the multiplication of stores of networked data. Such techniques involved data mining, and as discussed in chapter one, contributed to a new correlative mode of meaning making, by finding patterns in data and rendering them comprehensible to humans.[197] According to Pasquinelli, the establishment of big data as a source of cognitive and political capital marks the birth of the metadata society, as it is the 'meta' of the data that is interpreted for patterns and trends and therefore what renders the data as valuable.[198] As addressed in chapter one, these correlative modes of knowledge making favour always-on data capture, enabled by the growth of continual, online, networked interactivity.[199] Artists such as Knouf and Burtch co-opt such systems of data base management, which typically curate the information that appears on our screens. By adopting Web protocols and data mining techniques as the grounds for artistic practice, their approaches contrast with the common purposing of such technologies that typically estrange the user from their inner workings: hidden behind the browser interface. Not completely unlike

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[192] Ibid., 16.
[193] Mike Ananny and Kate Crawford, "Seeing without Knowing: Limitations of the Transparency Ideal and Its Application to Algorithmic Accountability," New Media & Society 20, no. 3 (March 2018): 973–89, https://doi.org/10.1177/1461444816676645, 982.
[194] Ibid., 982.
[195] Ibid., 974.
[196] Ibid., 984.
[197] Anna Munster, *An Aesthesia of Networks. Conjunctive Experience in Art and Technology.*, Technologies of Lived Abstraction Ser. (Cambridge, Massachusetts, London, England: MIT Press, 2013), 81.
[198] Matteo Pasquinelli, "Metadata Society," in *Posthuman Glossary, Theory* (London, Oxford, New Delhi, New York, Sydney: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2018), 253–56, 253.
[199] Mark Andrejevic, *Automated Media* (London; New York, NY: Routledge, 2020), 106.

net.artist's use of the medium's technologies, the artistic usage of technical protocols and ordinarily invisible metadata challenges the culture of proprietary code and furthermore becomes the artwork itself.[200] Through their own automated searching, compiling, and aggregation of data across publicly available networked databases, the Firefox add-ons, *MAICGregator* and *Internet Illuminator*, resurface obscured networks of financial and political power. By adopting data mining techniques, these artists produce alternate knowledge and creatively engage with the very same technologies through which data control has developed into a core competency for internet platforms' economic survival.[201]

The *MAICGregator* add-on's automated scouring of government funding databases, private news sources, private press releases, and public information about trustees, reveal hidden data logics concerning financial relationships between the military, colleges, and universities, that is, the military-academic-industrial complex (MAIC). The newly aggregated information is then automatically inserted onto academic websites by the add-on. The re-configuration of the technologies that ordinarily contribute to the visual politics of the browser's graphical display and thereby, as Knouf states, to contemporary knowledge techniques, "not only generates a different knowledge base but also forms a proposal for a 'radical cartography' of knowledge production."[202] Situated within the dynamics of the territory of its study, the *MAICGregator* add-on's process enacts a situated knowledge production, an onto-ethico approach that will be further investigated in chapter three as it relates to situated listening practices.

Documentation of before (Figure 2.1) and after (Figure 2.2) screenshots of the University of Southern California's (USC) homepage, depicts the *MAICGregator* add-on in operation.[203] USC's welcome message has been replaced with the headline, "Current Alternative News".[204] Below, a list of hyperlinks have been automatically inserted, and when clicked, further lists of research grants from the Department of Defence or press releases related to commercial sponsorship arrangements are revealed. A reorganisation of the interface's display politics uncovers deeply embedded political and economic connections to expose financial dynamics that underpin the

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[200] Geoff Cox, "Means-End of Software," in *Interface Criticism. Aesthetics Beyond Buttons*, ed. Christian Ulrik Andersen and Søren Bro Pold, Humanities Series 1 (Aarhus, Denmark: Aarhus University Press, 2011), 145–59, 146.

[201] Tim O'Reilly, founder of the industry Web 2.0 summit, broadly defines Web 2.0 according to a shift from Netscape (Web 1.0) to Google (Web 2.0) and a transformation in business model from software licensing to database management: "the value of the software is proportional to the scale and dynamism of the data it helps to manage." https://www.oreilly.com/pub/a/web2/archive/what-is-web-20.html, accessed November 2, 2018.

[202] Anna Munster, *An Aesthesia of Networks. Conjunctive Experience in Art and Technology,* Technologies of Lived Abstraction Ser. (Cambridge, Massachusetts, London, England: MIT Press, 2013), 90.

[203] *Maicgregator* add-on documentation website, http://maicgregator.org/docs/screenshots, accessed April 15, 2021.

[204] *Maicgregator* add-on documentation website, http://maicgregator.org/static/images/MAICgregatorScreenshotInjected.png, accessed November 30, 2020.

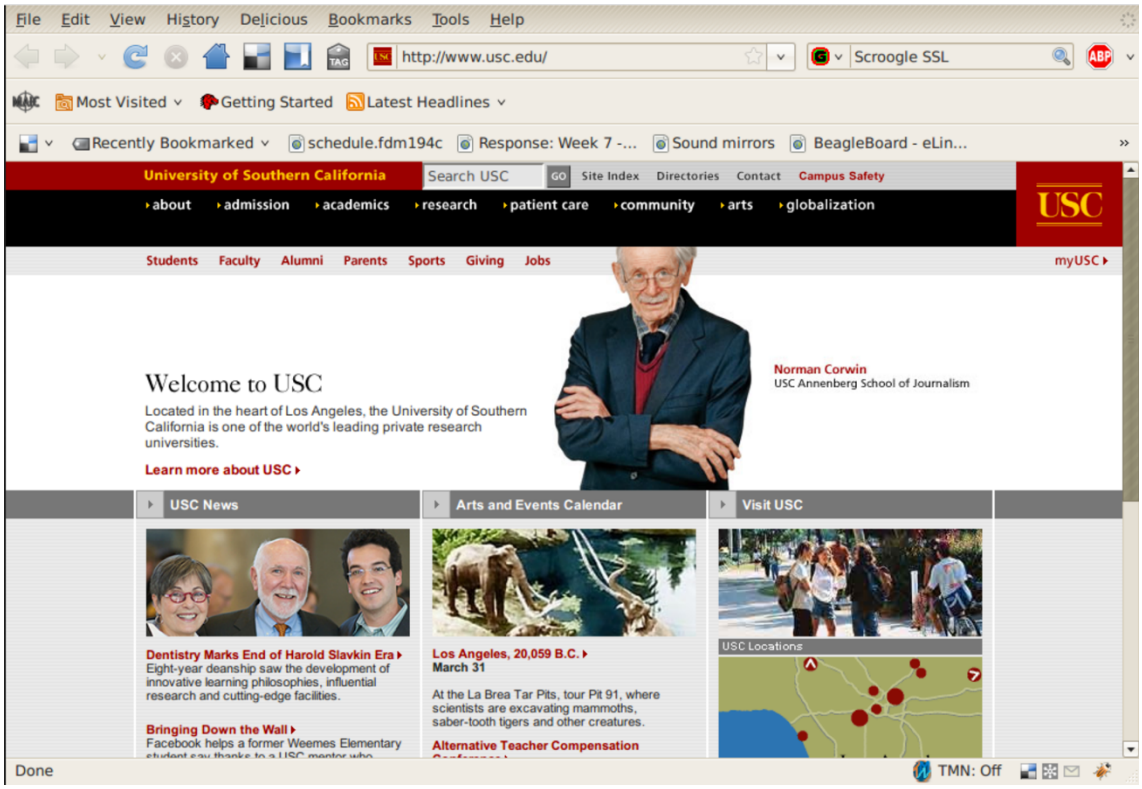

Figure 2.1: University of California Homepage
http://maicgregator.org/static/images/MAICgregatorScreenshotNormal.png.

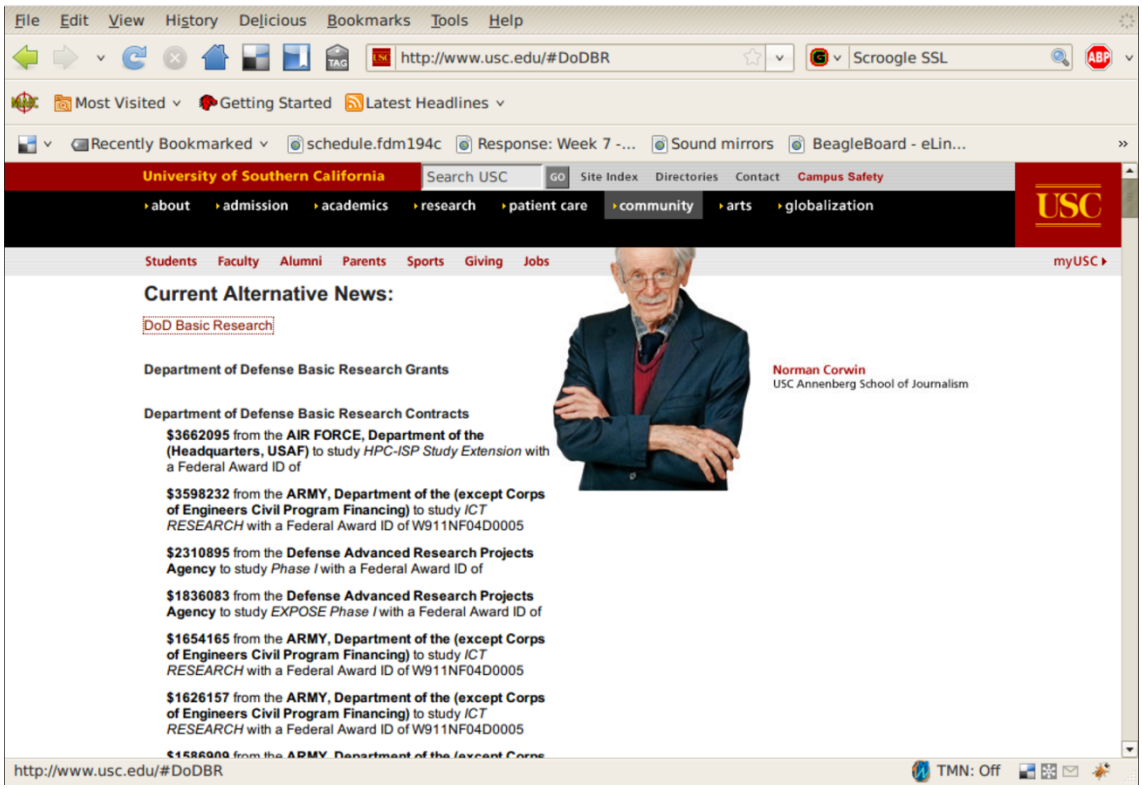

Figure 2.2: University of California Homepage injected with MAICgregated data to expose Department of Defense funding for the university
http://maicgregator.org/static/images/MAICgregatorScreenshotDoD.png.

production of academic knowledge. Notably, a photo of the director of USC's school of journalism Norman Corwin remains, now floating absurdly within the homepage's new layout.[205] His prior position of authority, firmly poised above the university's achievements, has been 'undesigned' and become unhinged, ironically reminding us of the role of journalism in exposing critical information.

In this way, a visual poetics unfolds that differentiates the MAICGregator add-on from traditional data science techniques. Data mining algorithms have been repurposed and the newly aggregated information is inserted into a re-designed university website. Situated within its context of critique, the distribution of information unfolds contextually to provide an alternative visual and informational narrative, typically absent from data mining techniques of correlative knowledge production. As discussed in chapter one, the logic of operation displaces the aesthetics of symbolic representation and yet here it has been reinstated. Unlike the ironic dysfunctionality of the pre-Web 2.0 projects of O/C/D, Mindflux and JODI, *MAICGregator* extends the browser interface into a site of hyper-functionality, surpassing the intended purpose of official university websites. These abnormal, extra functionalities facilitate aesthetic strategies of awareness, which, as Munster states, render "disjunctions between the proprietary of the web site/space itself and the data being displayed".[206] As she argues, an aesthetic, tactile mode of knowledge production opens up the possibility for alternate socio-political spaces. As Andrejevic has observed, the collapse of representation into operationalism makes it harder for humans to "see" how decisions are being made and thus discern the reasons for their consequences.[207] *MAICGregator* challenges the operational logic by reinstating a representational one and thereby re-opening a symbolic space for human sense making.

By asking who funds tertiary institutions, *MAICGregator* critically addresses interface effects by which information and knowledge are concealed beneath the Web's frontend design. By extending the data logistics of the browser, Knouf re-negotiates its functionality as a locus of both access and concealment. Similarly, Allison Burtch's Firefox add-on, *Internet Illuminator*, questions the pre-programmed and highly curated Web interface by exposing concealed data logics pertaining to corporate and political power structures. Burtch used Wikipedia lists, corporate watchdog resources, and the LittleSis API to access accumulations of financial power across networks.[208] The LittleSis API is a Web developer tool that provides a database compiled by media organisations of people

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[205] *Maicgregator* add-on documentation website, http://maicgregator.org/static/images/MAICgregatorScreenshotDoD.png, accessed April 15, 2021.
[206] Anna Munster, *An Aesthesia of Networks. Conjunctive Experience in Art and Technology,* Technologies of Lived Abstraction Ser. (Cambridge, Massachusetts, London, England: MIT Press, 2013), 91- 92.
[207] Mark Andrejevic, *Automated Media* (London; New York, NY: Routledge, 2020), 20.
[208] Littlesis database, https://littlesis.org/lists, accessed January 13, 2020.

and associations in order of rank, power, wealth, or influence. Burtch's aim was to "increase the spread of information about political and corporate relationships without making people go to one place for the data."[209] Instead, Internet Illuminator distributes knowledge about how a particular brand, person, or corporation is owned, sponsored, or acquired, within the mobile space of the Web browser, thereby situating knowledge within the context and process of its making. If a person, company, or CEO shows up in an article, the add-on appends additional information about that figure in the html.[210] Burtch explains this is in order to "highlight the interconnections of the ruling class" and clarify "the corporate and political power structures of the 1%"[211] What is ordinarily visible within the graphical interface of the browser is challenged through a redistribution of aesthetics, a modification of the aesthetico-political field of possibility. Through the aggregation and examination of a mesh of data relationships Internet Illuminator creatively repurposes data-mining techniques and Web APIs to make hidden knowledge contextually apparent.

Operating within the framework of programming and software technologies such as Web API's and data mining techniques, both these browser add-ons creatively collaborate with Web protocols, and in order to continue functioning, must evolve and adapt; that is, update in tandem with APIs and developer codes and protocols. Unfortunately, the *Internet Illuminator* add-on has ceased to function and there is also no visual documentation of it. As forms of resistance to browser opacity these artistic projects are often challenged by the discrepancy between access to resources (processing power, storage capacity, connectivity, time) among artists and technologists compared to the corporations who dominate the programming environments in which such artistic projects take place. Knouf has officially retired *MAICGregator* as she claims maintaining it would be a full-time job. In addition, one of the key database resources, USASpending.gov,[212] was threatened with shut down by the US Federal Government. As a primary resource for the mining of Defence Department grants and contracts, it had been essential to *MAICGregator*'s interrogation of the interconnectedness of military funding and tertiary institutions.[213] Artists that utilise Web technologies to produce works online navigate a calculated conformity that manages to elude total assimilation because, as Manuel Castells observed regarding network societies, "actors will have to play their strategies within the rules of the network".[214] Some earlier net.artists had already taken this in to account – Joan Heemskerk from JODI takes the approach of poetically incorporating degradation, where the inevitable trait of the constant upgrading of Web technologies turns into "a

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[209] *Internet Illuminator* github, https://allisonburtch.github.io/plugin/, accessed January 11, 2020.
[210] Unfortunately there is no visual documentation of how the *Internet Illuminator* add-on displayed the newly aggregated information.
[211] *Internet Illuminator* github, https://allisonburtch.github.io/plugin/, accessed January 13, 2020.
[212] USASpending.gov, accessed December 2, 2020.
[213] *Maicgregator* add-on documentation website, http://maicgregator.org/, accessed June 6, 2017.
[214] Manuel Castells, "Materials for an Exploratory Theory of the Network Society1," *The British Journal of Sociology* 51, no. 1 (January 2000): 5–24, https://doi.org/10.1111/j.1468-4446.2000.00005.x, 16.

kind of ongoing performance".[215] Julia Velkova and Anne Kaun derive a conception of tactical "algorithmic resistance" that locates the possibilities for resistance within the platforms in which algorithms are embedded. Here, artists utilise the logic of the algorithm to produce different and unintended outcomes. Creative tactics produce resistance through alternative use within the cracks of proprietary power.[216] By interrupting the functionality of the browser interface, even temporarily, the *MAICGregator* and *Internet Illuminator* add-ons were able to reimagine Web space through both a compliance and repurposing of its technologies, thereby addressing the algorithmic governance embedded in these very protocols. Although deploying specific technical expertise in their re-navigation of data relations, their tactical disruption of quotidian browsing routines represents everyday online practices of resistance.

Oil Standard and *Real Costs*

Artist Michael Mandiberg executes another approach to aesthetically intervening in the browser's opacity. His Firefox add-ons, *Oil Standard* (2005)[217] and *Real Costs* (2007),[218] manage to elude mundane algorithmic power by inserting alternative information into the browser interface at specific points of consumer decision making. *Oil Standard*, restored in 2018 for the Chrome Browser,[219] converts the cost of consumable items on e-commerce websites into their equivalent value in barrels of crude oil. (see Figures 2.3 and 2.4).

By reinserting these prices in oil-coloured brown, and adopting the font type of the original price, an elegant and subtle de-familiarisation of Web space is initiated. Comparable to *MAICGregator* and *Internet Illuminator* the defacing of the Web browser engages the visual and representational politics of its screen display and repurposes it to become a site of exposure. Mandiberg's *Real Costs* add-on similarly inserts CO2 emissions data into travel related e-commerce sites in the form of a red bar graph.[220] Both the *Oil Standard* and *Real Costs* add-ons employ a method known as eco-visualisation.

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[215] Josephine Bosma, *Nettitudes. Let's Talk Net Art*, Studies in Network Cultures (Rotterdam: NAi Publishers, 2011), 37.
[216] Julia Velkova and Anne Kaun, "Algorithmic Resistance: Media Practices and the Politics of Repair," *Information, Communication & Society*, August 26, 2019, 1–18, https://doi.org/10.1080/1369118X.2019.1657162, 2-3.
[217] *Oil Standard* add-on documentation website http://www.mandiberg.com/oil-standard-2/, accessed June 4, 2020.
[218] *Real Costs* add-on documentation website http://therealcosts.com/, accessed June 6, 2017.
[219] Chrome Web store for *Oil Standard,* https://chrome.google.com/webstore/detail/oil-standard/ibllhgohamhimfbfjpcikfmgkhpiegan?hl=en-GB, accessed November 30, 2020.
[220] *Real Costs* add-on documentation website, https://therealcosts.com/screenshots.html, accessed April 15, 2021.

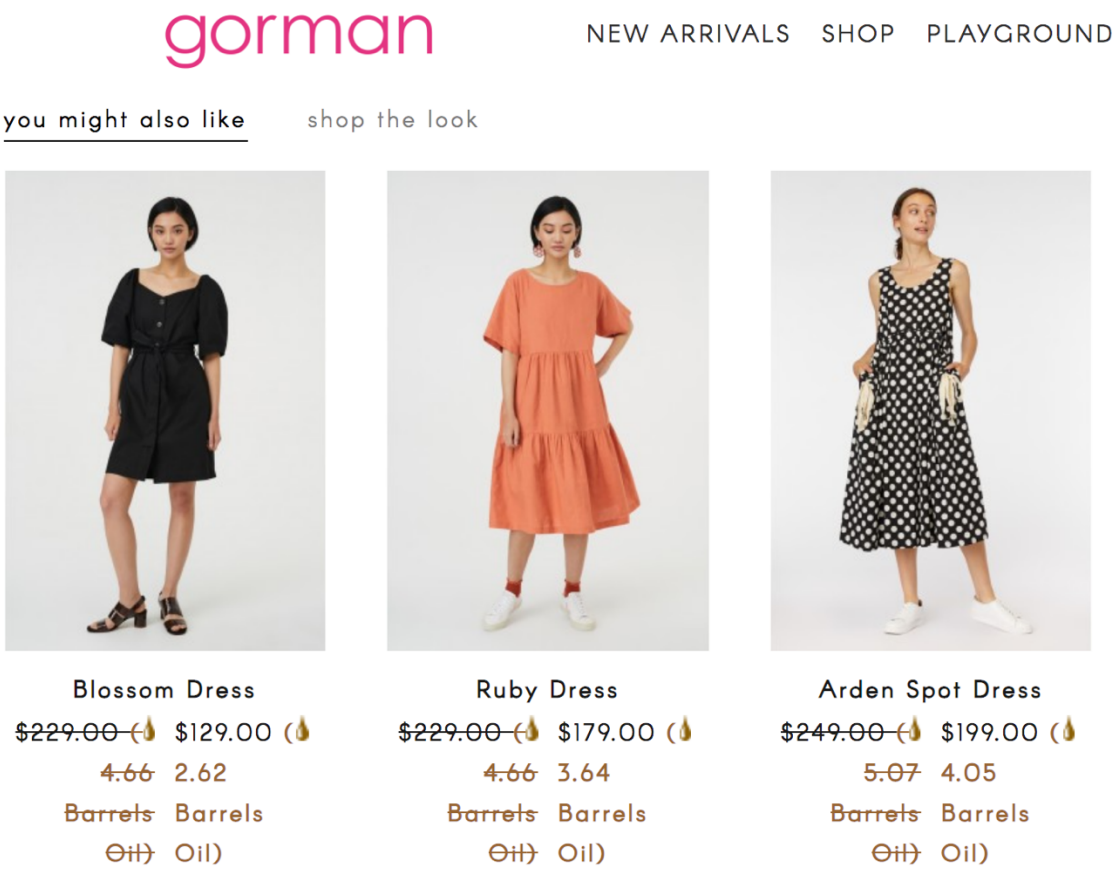

Figure 2.3: *Oil Standard* add-on installed on the Chrome Browser: Gorman website.

This artistic practice creates custom software driven artworks that translate environmental data into accessible visual narratives with the aim of promoting stewardship. By dynamically representing environmental data, eco-visualisation engages with modes of information representation to make data comprehensible to audiences outside of the domain of climate science.[221] The *Oil Standard* add-on automatically recalculates the price of consumer goods into crude oil in real time so that as the cost of oil fluctuates, e-commerce web pages are dynamically effected. This provides a reminder and space to reflect on the influence of oil markets on everyday consumer exchanges and the sustainability of fossil fuel industries more broadly. One could speculate that its title refers to the Standard Oil company of John D. Rockefeller which was eventually regulated due to its monopoly of the oil industry during the late 1800s drawing a connection between the history of the so-called "Robber Barons" and the monopolising of infrastructures and markets by 'Big Tech'.[222]

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[221] Tiffany Holmes, "Eco-Visualization: Promoting Environmental Stewardship in the Museum," Journal of Museum Education 32, no. 3 (September 2007): 273–83, https://doi.org/10.1080/10598650.2007.11510577, 273.

[222] Rodrigo Fernandez et al., "Engineering Digital Monopolies. The Financialisation of Big Tech" (Amsterdam, The Netherlands: Centre for Research on Multinational Corporations, December 2020), 12.

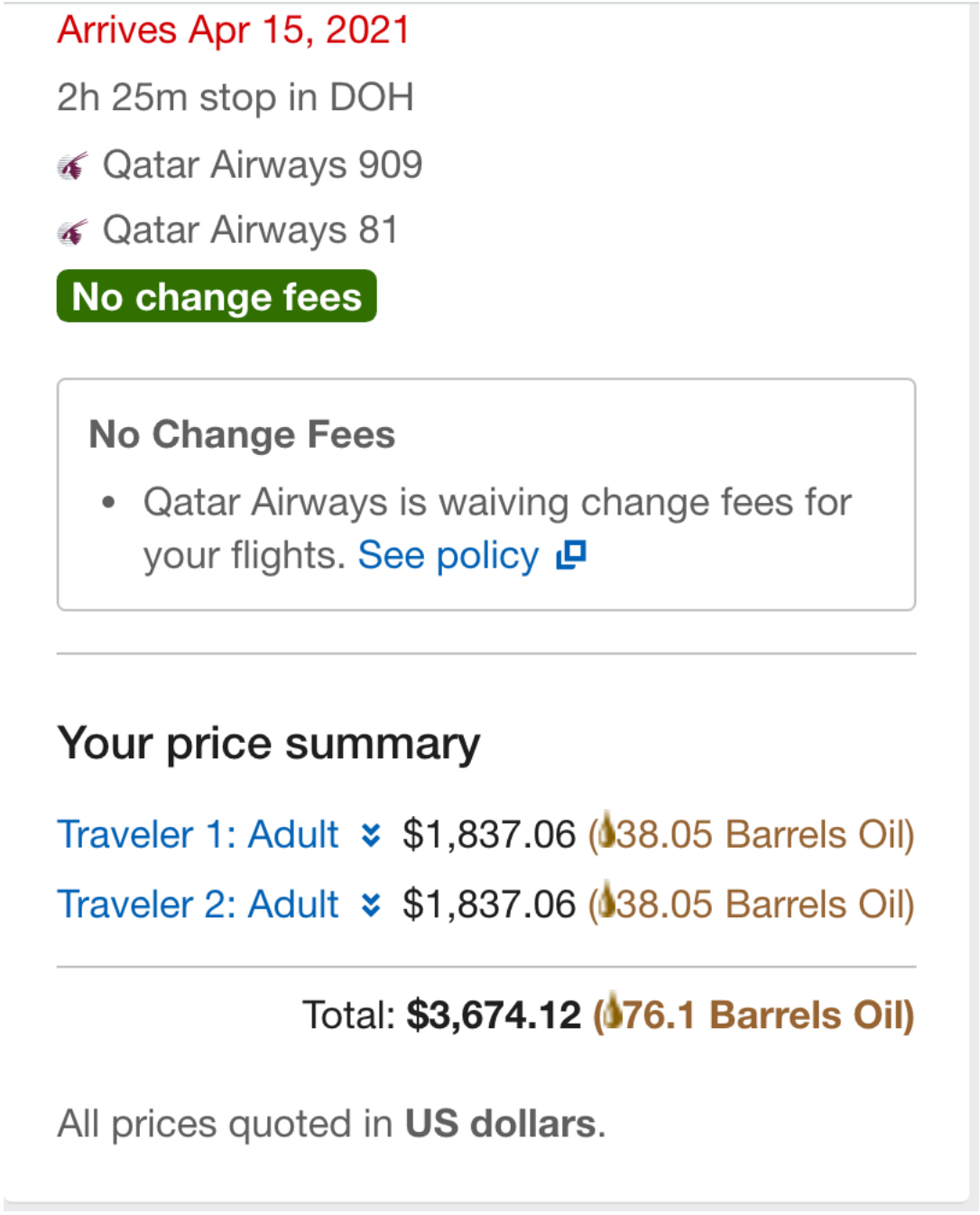

Figure 2.4: *Oil Standard* add-on installed on the Chrome Browser: Qatar website.

Similarly dynamic in its presentation of information, *Real Costs* calculates CO2 emissions in real time. Based on travel geo co-ordinates, the aim is to contrast and compare emissions produced by air, bus, or train travel so that consumers can incorporate the production of CO2 emissions into travel logistics and make informed consumer decisions. Mandiberg utilises the potential of the interface to influence consumer decisions by interjecting alternate, supplementary information at the point of purchase. With the intent of encouraging engaged and informed decision making, Mandiberg's objective is to increase awareness of the environmental impact of travel choices and hopefully encourage a sense of individual agency at the point where travel decisions are made. By

interrupting the usual procedure for e-shopping, that is, the direct consumption of goods online, *Real Costs* and *Oil Standard* encourage a moment of considered reflection. This technique momentarily breaks the Web's economic dynamics, which require the least possible friction for commodity and financial exchange.[223]

Obfuscation

The formerly discussed creative browser add-ons utilise data-mining techniques across public databases and Web APIs to resurface ordinarily invisible data logics pertaining to hidden networks of power. Through a subtle transformation of the aesthetics of the browser interface, the political, cultural and commercial domain of the Web as originating with the invention of the cookie as a state mechanism that enabled online shopping and the automated collection of data, is repurposed into a site of artistic practice and illumination. Obfuscation is another method for tactically intervening in the Web browser's functionality and its infrastructure for monitoring and surveying engagement and interaction. It challenges the dynamics of online visibility by covering the digital tracks of personal Web browsing in excessive, misleading data. Rather than trying to block or avoid tracking mechanisms, obfuscation pertains to a logic that insists that such tactics are impossible or at best ineffective. By acknowledging that whatever we do online is inevitably tracked, and believing that erasing or hiding from data collection is fruitless, obfuscation is indicative of a state of surveillance realism.

Again, harnessing Firefox and Chrome add-on functionality for engaging the Web browser and its social, political, and cultural effects, *Noiszy* (2018)[224] was developed by digital analytics consultant Angela Grammatas. Gammatas was motivated by a 2017 US Congress bill in which Internet Service Providers (ISPs) are permitted to harvest and share their customers' browsing histories, app usage history and other private information without consent. The bill was a repeal of regulations proposed by the US Federal Communications Commission that would have required ISPs to obtain customer consent before selling personal data to companies such as advertisers.[225] Web users are by default opted-in to being tracked by major tech corporations and lesser known data brokers such as Acxion, Experian, and ChoicePoint, who clandestinely collect information about millions of people

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[223] Manuel Castells, The Rise of the Network Society., 2nd ed., vol. Vol. 1, *The Information Age: Economy, Society and Culture* (Oxford: Wiley-Blackwell, 2010), 453-454.

[224] Chrome Web store for *Noiszy* add-on, https://chrome.google.com/webstore/detail/noiszy/immakaidhkcddagdjmedphlnamlcdcbg, accessed December 12, 2020.

[225] Jon Brodkin, "For Sale: Your Private Browsing History." Ars Technica, March 28, 2017, https://arstechnica.com/tech-policy/2017/03/for-sale-your-private-browsing-history/, accessed July 24, 2020.

and resell it to a range of clients.[226] ISPs, motivated to capitalise on the expanding data broker industry, felt disadvantaged by a market dominated by Google and Facebook who face less strict opt-out and consent regulation. In reaction to the online ecosphere in which users are by default opted-in to continual, extractive monitoring, the *Noisy* add-on employs the method of obfuscation to contaminate one's Web browsing history with additional, extraneous, and irrelevant site visits. By automatically browsing a list of websites, approved by the user, *Noisy* generates excessive data in order to produce misleading digital footprints. The *Noisy* interface enables the user to select from a default list of news related web sites for the add-on to randomly navigate in the background.[227] The option to manually add additional URLs to the list is also provided. With the aim of simulating actual browsing behaviour, *Noisy* waits approximately one minute before moving on to a new site. By clicking the start button one can observe the browser gradually move across different sites as *Noisy* generates data trails, linked to one's IP Address. With the panacoustic tagline, "They're Listening. Make Some Noise," *Noisy* recognises the climate in which our Web browsing is embedded in an environment of non-stop comprehensive data extraction and claims to provide a campaign of misinformation aimed at outsmarting the filter bubble; a phenomenon by which our personal data is also used to curate, personalise, and thus bias the information that appears on our screens.[228] The excessive data created by automatic irrelevant web browsing counter-deploys extractive data capture technologies, with the intention of shrouding one's data traces in a cloud of noise. As discussed previously, the online culture of surveillance is fundamentally characterised by privacy and power asymmetries.[229] *Noisy* claims to resist this situation by "making ourselves harder to analyze – both individually, and collectively." Moreover it claims to "take back the power of our data" by creating a form of digital camouflage that makes data collected from habitual Web browsing increasingly difficult for the algorithm to understand and use for marketing and manipulation.[230] *Noisy* thereby promotes user agency within power asymmetries wrought by online surveillance, tactically repurposing the very tools used by the data broker industry.

Noisy is not the only project to adopt data obfuscation. Steve Smith's *ISP Data Pollution* (2017)[231] project similarly generates irrelevant web browsing by crawling for links via random word searches, *RuinMyHistory* (2017)[232] opens a popup window that cycles through different websites, while Daniel

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[226] Matthew Crain, "The Limits of Transparency: Data Brokers and Commodification," New Media & Society 20, no. 1 (January 2018): 88–104, https://doi.org/10.1177/1461444816657096, 88.
[227] *Noisy* add-on documentation website, https://noiszy.com/noiszys-algorithm/, accessed December 3, 2020.
[228]Eli Pariser, *The Filter Bubble. What the Internet Is Hiding From You* (New York: The Penguin Press, 2011).
[229] Matthew Crain, "The Limits of Transparency: Data Brokers and Commodification," *New Media & Society* 20, no. 1 (January 2018): 88–104, https://doi.org/10.1177/1461444816657096, 89.
[230] https://chrome.google.com/webstore/detail/noiszy/immakaidhkcddagdjmedphlnamlcdcbg, accessed December 1, 2020.
[231] *ISP Data Pollution* github, https://github.com/essandess/isp-data-pollution, accessed July 24, 2020.
[232] *Ruin My History* github, https://github.com/FascinatedBox/RuinMyHistory, accessed July 24, 2020.

C. Howe and Helen Nissenbaum's Firefox and Chrome add-on *TrackMeNot* (2006)[233] randomises search queries. *TrackMeNot* is focused explicitly on obscuring personal browsing data collected by search engines. Its creators refer to it as an "artware browser add-on" that hides actual web searches in a cloud of phantom queries, in plain view.[234] Nissenbaum describes obfuscation as a philosophical approach, stating "we can't stop you from tracking us, we tried that."[235] By periodically issuing randomised search-queries to search engines such as AOL, Yahoo!, Google, and Bing, the *TrackMeNot* add-on claims to increase the difficulty of aggregating such data into profiles that identify users. The authors understand the tactic as an "immediate solution" that provides a form of user agency in a context where legislation, although potentially effective, is time consuming as it "would require orchestrated efforts by many parties."[236]

As a form of resistance to online extractive modes of automated, algorithmic surveillance it is questionable if obfuscation practices are effective in obscuring one's actual browsing activity. The tools of contemporary metadata search are extremely good at finding patterns even amongst data surrounded by noise, as this is precisely what big data analysis systems are trained to do: search for patterns. *TrackMeNot* within its logic of periodic, random search-queries also incorporates a mechanism to evolve a unique client profile over time, by parsing results of its searches for seemingly logical future query terms.[237] *TrackMeNot* thereby generates data profile impersonations while incorporating a time-based element to confuse and confound the very same automated data tracking and aggregating systems, in a tactic of ongoing obfuscation.

The *Listening Back* Browser Add-On

The browser add-ons discussed thus far either interrupt the opacity of the web browser or endeavour to circumvent online surveillance through automated, interventionist tactics that repurpose the very tools used to curate the information that appears in the graphical interface or track users across the Web. These approaches either subtly transfigure the aesthetics of the Web browser or attempt to confuse automated data tracking systems through data obfuscation. They co-opt Web protocols such as data mining techniques, browser APIs, and public databases to critically traverse the networked systems that operate beneath the surface of the browser interface. In addition, they utilise strategies to challenge and resist mundane algorithmic power at specific points where such power operates.

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[233] Chrome Web store for *TrackMeNot* add-on, https://addons.mozilla.org/en-US/firefox/addon/trackmenot/, accessed July 27, 2020.
[234] *TrackMeNot* documentation website, http://trackmenot.io/, accessed December 2, 2020.
[235] "Helen Nissenbaum on Post-Consent Privacy", *The Good Code* Podcast, https://soundcloud.com/chine-labbe/helen-nissenbaum-on-post, accessed October 29, 2020.
[236] *TrackMeNot* add-on documentation website, http://trackmenot.io/, accessed December 02, 2020.
[237] Ibid.

My own custom-made browser add-on, *Listening Back*, interrupts the visual surface of the web browser via a different tactic: sound. By sonifying data generated by Internet cookies the graphical display for the Web browser remains intact. Rather than disrupting the visual representation for the World Wide Web, the experience of routine browsing is disrupted through sound, and a listening investigation as an aesthetic strategy is facilitated. Comparable to the obfuscation add-ons discussed earlier, the *Listening Back* add-on, deployed by individual users and for live performance and installation, addresses the surveillant state that is the online ecosphere. However, rather than proposing a strategy of circumvention I provide the opportunity to *listen back* to some of the data collection infrastructures that underlie everyday Web browsing. Obfuscation tactics advocate user agency within an online context of privacy asymmetries and Listening Back addresses this environment by providing a platform for users to *listen back* to the machines listening to them. By specifically sonifying cookie activity, machine listening equates to an online data capture mechanism invented to facilitate the tracking of user's browsing activities. The practice of Listening Back to ubiquitous, opaque tracking mechanisms that typically evade our sensible understanding or experience of web browsing, enables new and alternate comprehensions of the act of Web browsing. The sonic exposition of algorithmic surveillance highlights a disconnect between underlying data capture processes and the the Web browser's visual display. Furthermore, it offers another approach to experiencing how surveillance itself is situated. Sound is employed as a strategy for shifting the imperceptible background into the affective foreground thereby exploring the potential of what Salomé Voegelin terms a 'sonic sensibility' to reorient the politics of visibility.[238] Through the sonification of real-time cookie data the *Listening Back* add-on situates an embodied listening within the multi-sensory dynamics of Web surveillance and thereby recognises Donna Haraway's proposal for situated knowledges, an approach to the production of knowledge that will be further investigated in chapter three.

Pragmatic Aesthetics

Listening Back aims to strike a balance between interrupting an otherwise seamless browsing experience and allowing that routine activity to continue. What appears on screen demands attention, which leaves room for sound to simultaneously provide a space to render the presence of more opaque data capture processes. Sara Bly first hypothesised the value of sound in presenting digital information in 1982. By identifying the limits of graphical modes of representation, Bly demonstrated how sound can also be used to communicate information from a computer to a

[238] Salomé Voegelin, "Sonic Possible Worlds," Leonardo Music Journal 23, no. 23 (December 2013): 89–89, https://doi.org/10.1162/LMJ_a_00168, 3.

human.[239] Recognised as a keystone proposition for sonification, subsequent research has been conducted into which contexts sound is effective for communicating information.[240] By questioning the traditional hierarchisation of the senses with vision privileged over sound, sonification practices value listening as a method of understanding and interpretation, and consequently research has also been conducted into the human process of decoding sound. For instance, the study known as "auditory scene analysis", has discovered that the human aural perceptual apparatus is adept in discerning individual sounds amongst complex layers of multifarious sound.[241] Additionally, humans are capable of recognizing patterns or anomalies without necessarily devoting full attention to the listening task at hand.[242] This has proven useful for the continuous monitoring of computer network traffic, a situation in which sonification has been practically implemented. Here listening enhances situational awareness and allows for system engineers to simultaneously attend to other tasks. Network security specialists also use audition to monitor anomalies and detect intrusion without needing to watch a screen continuously.[243] Similarly, listening is ideal for the real-time monitoring of ambient surveillance data, an engagement with an elaborate continuum of overlapping sonic forms. An analysis of modes of listening relevant to the use of the *Listening Back* add-on will be covered in chapter three. However, paramount is the human auditory ability to monitor peripherally,[244] as it is critical to listen to the cookie continuum while simultaneously browsing the Web. This enables the user to engage and experience online tracking during routine Web browsing, thereby situating listening within the ontological, social, and political nexus of Web surveillance. Sound is used as an aesthetic device to provide experiential access to otherwise intangible post-panoptic surveillance infrastructures directly within the socio-technical environments in which these data capture processes occur. It thereby facilitates an alternate Web

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[239] Sarah Bly, 1982. "Presenting Information in Sound." *Conference on Human Factors in Computing Systems*, Gaithersburg, Maryland, 15-17.

[240] Bregman, A. S. 1990. *Auditory Scene Analysis: The Perceptual Organization of Sound*. Cambridge, MA: MIT Press. Gaver, W. W. 1993. "What in the world do we hear? An ecological approach to auditory event perception." *Ecological Psychoogy*, 5(1), 1-29. Walker, B. N., & Kramer, G. 2004. "Ecological psychoacoustics and auditory displays: Hearing, grouping, and meaning making." In J. Neuhoff (Ed.), *Ecological psychoacoustics,* New York: Academic Press, 150-175.Tuuri, K. & Eerola, T. 2012. "Formulating a Revised Taxonomy for Modes of Listening." Journal of New Music Research 41(2), 137-152. Vickers, P. 2012. "Ways of Listening and Modes of Being: Electroacoustic Auditory Display." Journal of Sonic Studies 2(1), Leiden University Press.

[241] Hermann, T. 2002. *Sonification for Exploratory Data Analysis*, Dissertation zur Erlangung des akademischen Grades Doktor der Naturwissenschaften der Technischen Fakult at der Universit, Bielefeld, 53.

[242] Ibid., 55.

[243] Mohamed Debashi and Paul Vickers, "Sonification of Network Traffic Flow for Monitoring and Situational Awareness," ed. Richard Mankin, *PLOS ONE* 13, no. 4 (April 19, 2018): e0195948, https://doi.org/10.1371/journal.pone.0195948.

[244] Brown, M.L., Newsome, S.L., & Gilbert, E.P. 1989 "An experiment into the use of auditory cues to reduce visual workload." *Proceedings of the ACM CHI 89 Human Factors in Computering Systems Conference* CHI 89: 339-346. Fitch, W.T., & Kramer, G. 1994. "Sonifying the body electric: Superiority of an auditory over a visual display in a complex, multivariate system." In Dramer, G (Ed.), *Auditory Display: Sonification, Audification, and Auditroy Interfaces,* 307-326. Vickers, P. 2011. "Sonification and Process Monitoring." In Hermann, T., Hunt, A. and Neuhoff, J. G. (eds), *The Sonification Handbook*. Berlin: Logos Publishing House, 455–92.

space to critically consider both the cookie as a mechanism for automated data collection, and the politics its prevalence and ubiquity entails for the normalisation of online surveillance.

Sonification as a signifier or metaphorical device is valued by scientific communities as a means of communication with non-specialist audiences.[245] Alexandra Supper's research into its use within the domains of astrophysics, geoscience, particle physics, and genetics, identifies a trend towards adopting sonification as a means to popularise scientific research through primarily metaphorical sonic strategies.[246] The use of sonification as a symbolic and signaling tactic is also utilised by artists such as Andrea Polli, whose intent is similarly to communicate to a public unfamiliar with scientific discourse.[247] Exploring the aesthetic, educational, and political potential of sonifying environmental data, Polli engages in interdisciplinary crossovers between science and art. Her work includes live performance and interactive sound installations such as *Atmospherics/Weather Works* (2002), a sixteen-channel installation that sonifies storms and other meteorological events generated directly from data produced by a highly detailed and physically accurate simulation of the weather.[248] As an ethical gesture, Polli believes it is essential that the public have a greater understanding of science, especially regarding complex issues like climate change. By communicating environmental debates to a non-scientific audience, Polli states that she is motivated to develop strategies for the interpretation of data through sound "that has both narrative and emotional content because I believe an emotional connection with data can increase the human understanding and appreciation of the forces at work behind the data."[249] Polli's aim through creative data sonification strategies to emphasise narrative and emotional connections and thereby increase understandings related to the sonified data aligns with Stephen Barrass' argument for sonification practices to harness sound as a "naturally affective, aesthetic and cultural medium" and in doing so effect an aesthetic turn in sonification research.[250] Such naturally affective practices, elaborates Barrass, are driven by a pragmatic aesthetics, which strive for a co-habitation of aesthetics and functionality aimed at listening enjoyment as well as providing useful information about the world.[251]

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[245] Alexandra Supper, "Sublime Frequencies: The Construction of Sublime Listening Experiences in the Sonification of Scientific Data," Social Studies of Science 44, no. 1 (February 2014): 34–58, https://doi.org/10.1177/0306312713496875, 44, 37.
[246] Ibid., 34.
[247] Polli, A, (09 Aug 2016), "Soundwalking, Sonification, and Activism" from: *The Routledge Companion to Sounding Art Routledge*.
[248] Andrea Polli's artist website, http://www.andreapolli.com/studio/atmospherics/, accessed November 10, 2014.
[249] Sterne, J & Akiyama, M. 2012. "The recording that never wanted to be heard and other stories of sonification", *The Oxford Handbook of Sound Studies*, Ed. Trevor Pinch and Karin Bijsterveld, 553 – 554
[250] Stephen Barrass, "The Aesthetic Turn in Sonification towards a Social and Cultural Medium," AI & SOCIETY 27, no. 2 (May 2012): 177–81, https://doi.org/10.1007/s00146-011-0335-5, 177.
[251] Ibid.

The approach of a pragmatic aesthetics is apparent in creative sonification strategies that aim to communicate information through the experience of sound as a signifier for data with particular social, cultural, or political implications. Another example is statistician Mark Hansen and media artist Ben Ruben's Listening Post (2001) which sonifies Web data to convey a sense of the online communication environment.[252] Capitalising on the networked, data mining potential for almost every online human activity to be rendered digital, the real-time output of data from public online discussions, chat rooms, and bulletin boards is sonified to provoke a sensory experience of the vastness of such interactions.[253] By creating meaningful experiential encounters with dynamic data streams the intention is to support both practical monitoring platforms and sound art installations, an interdisciplinary approach that, like Polli, engages a science-art crossover.[254] Polli's sonification works distribute knowledge through auditory means with the aim to provide platforms of engagement around issues critical to climate change. Similar to Mandiberg's intention for his eco-visualisation add-ons, through an aesthetic reconfiguration of data, Polli aims to facilitate understandings for people to make informed decisions. By engaging the reflective agency of listening and its potential to offer alternative experiential perspectives and comprehensions, her work engages a symbolic mode of sonic communication. Not unlike the ways in which creative browser add-ons re-connect otherwise obscured data relations, Polli takes the position that media artists reshape and reorder information. Data sonification is an interpretative process which she recognises as necessitating a simplification of the data. Aesthetic, practical, reductive decisions are made which impact the symbolic topologies of her sonification projects aimed at creating "a kind of data soundscape that uses qualities of the real world soundscape to convey information." For Polli this mirrors the fact that numerical data is in itself a simplification because, as she argues, it is impossible to collect data on everything that is happening in an environment.[255]

In contrast to Polli's understanding of the limits of data collection, post-panoptic surveillance aims to capture all available data through the non-stop comprehensive extraction and processing of information at incomprehensible scales.[256] The reductive process of navigating which and how much data to sonify is relevant to the process of mapping sound to cookie data, which I will elaborate in chapter three. Translating at least some features of vast, incomprehensible data capture networks into sound, provides an immediately tangible and sensible mode for registering

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[252] Mark Hansen and Ben Rubin, "Babble Online: Applying Statistics and Design to Sonify the Internet," in *Proceedings of the 2001 International Conference on Auditory Display* (International Conference on Auditory Display, Espoo, Finland, 2001), 10–15, 13.
[253] Mitchell Whitelaw, "Hearing Pure Data. Aesthetics and Ideals of Data-Sound," in *Unsorted*, ed. Arie Altena (Sonic Arts Press / De Balie, 2004), 45–52, 5 – 6.
[254] Mark Hansen and Ben Rubin, "Babble Online: Applying Statistics and Design to Sonify the Internet," in *Proceedings of the 2001 International Conference on Auditory Display* (International Conference on Auditory Display, Espoo, Finland, 2001), 10–15, 10.
[255] Andrea Polli, EAR ROOM | re-sounding dialogues across the globe, February 1, 2010, https://www.icad.org/Proceedings/2004/Polli2004.pdf, accessed November 15, 2020.
[256] Mark Andrejevic, "Automating Surveillance," *Surveillance and Society* 17, no. 1/2 (2019): 7–13, 11.

algorithmic surveillance. *Listening Back* facilitates a human-level connection to humanly immeasurable systems which enables experiential insights into the nature of their prevalence, continuity, and consistency. Rather than simply expose hidden information with social and political consequences – as enacted by the browser add-ons discussed earlier – rendering algorithmic processes tangible through sound creates experiential environments for exploring the effects and affects of online surveillance. As a sounding practice, Listening Back provides an opening for listening, feeling, and reflecting on the ways in which algorithmic surveillance intersects with our daily browsing experience. By providing the opportunity to *listen back* to some of the data capture processes that underlie our Web experience, sound is situated as a tactical medium and deployed as a counterforce to the asymmetric power dynamics inherent to online surveillance cultures.

Listening as a Method for Experiencing Time Based Media Operability

Sound, as a signifying medium, shares temporal characteristics with algorithmic processes that comprise online data extraction technologies. Both sound and algorithms are processes that transpire over time. Neither are fixed in form but rather constantly unfold in multifarious ways. As previously discussed, algorithms operate via specific steps in unfolding modes of automatic calculation, deploying continuous strings of actions that have complex temporal flows. Shintaro Miyazaki identifies the operability of algorithms as time based and, furthermore, stresses that they are part of rhythmic procedures with measurable, temporal effects. By interweaving the concepts of algorithm and rhythm, Miyazaki coined the term algorhythm as a media archaeological concept that reveals media epistemic aspects of current computational culture and its history.[257] Miyazaki investigates a history of listening to machines that pre-dates the popularisation of the term algorithm in the early 1960s.

Early mainframe computers such as UNIVAC-I, BINAC and the PASCAL computer developed by Philips Electronics, had alongside visual interfaces, auditory ones installed which amplified the circuitry of mainframe computers enabling engineers to listen to their operation.[258] Through a mediated listening operators where able to diagnose and debug, an example of listening for knowledge that will be further covered in chapter three.[259] The practice of listening in to the operations of computers focuses on the processes of computation itself, and according to Shintaro, provides an epistemic model of machines that make time itself logically controllable.[260] Listening is

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[257] Miyazaki Shintaro, "Algorhythmics: Understanding Micro-Temporality in Computational Cultures," *A Journal of Software Studies Computational Culture,* no. 2 (September 28, 2012): 1–20, 2.
[258] Ibid., 5.
[259] Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5, 13.
[260] Miyazaki Shintaro, "Algorhythmics: Understanding Micro-Temporality in Computational Cultures," *A Journal of Software Studies Computational Culture,* no. 2 (September 28, 2012): 1–20,10.

critical to the implementation of the concept of algorhythmics, which emphasises the micro-temporal zones of mediated technical environments such as information storage, transmission, and processing.[261] Listening in this context enables a methodology for experiencing time based media operability. The practice of Listening Back similarly engages the act of listening as a method for experiencing media operations over time, specifically algorithmic processes of data capture. However, rather than amplify pre-existing sound as in the historical cases of engineers listening to computers, Listening Back employs sound referentially to draw aesthetic attention to specific tracking algorithms that would otherwise be silent. Sound, as a continual process of qualitative and quantitative transformation in which waves of pressure known as acoustic vibrations propagate over time from the sound source through a medium such as air, shares temporal characteristics with algorithms and is therefore suitable for representing the real-time unfolding of the online surveillance continuum. The sonification of real-time algorithmic processes provides a procedural model for the practice of Listening Back to engage the ways in which algorithmic surveillance intersects routine Web browsing over time.

Embodied Listening

The experiential time-based characteristics of sound not only provide access to post-panoptic surveillance technologies over time but also inform our understanding of these processes through the sensory embodied practice of listening. Marie Thompson and Ian Biddle's investigation into the ways in which sound affects, through the phenomena of protest music, is useful for appreciating sound's affective potential. During 2010 to 2011 in the UK, demonstrations and protests occurred in response to public spending cuts and increased university fees.[262] It became apparent that music without overt political content directly expressed through lyrics, was nevertheless politically mobilising.[263] When British grime MC Tempa T was questioned about the use of his music during the protests he explained, "it's not about the content, it's about the energy and the aura." Biddle and Thompson interpret the words 'energy' and 'aura' to mean affect. Affect describes the phenomenon in which rather than politically motivating through lyrics, the music mobilised bodies through affective transmission.[264] For Biddle and Thompson, drawing from Patricia Clough, affect refers broadly to a relationship between bodies, organic and inorganic, and the immediacy of fluctuations of feeling that shape the experiential yet may pre-empt or evade conscious knowing.[265] A multitude of approaches to understanding affect exists across a range of disciplines including

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[261] Ibid., 2.
[262] Marie Thompson and Ian Biddle, Sound, Music, Affect. Theorizing Sonic Experience (London, New Delhi, New York, Sydney: Bloomsbury, n.d.), 1.
[263] Ibid., 2 – 4.
[264] Ibid., 5.
[265] Patricia T. Clough, "The Affective Turn: Political Economy, Biomedia and Bodies," *Theory, Culture & Society* 25, no. 1 (January 2008): 1–22, https://doi.org/10.1177/0263276407085156.

queer theory, feminist theory, philosophy, political theory, cultural studies, psychology, biology, and neuroscience, which are beyond the scope of this dissertation. Furthermore, as Paul Jasen reasons, "affect is never reducible to language and something of it always escapes us."[266] For the practice of Listening Back, however, affect refers to an experiential appreciation of sound in embodied and sensing terms. It provides a framework for engaging the arguably immeasurable[267] "material-energetic tendencies" of sonic experience.[268]

I capitalise upon sound's embodied affects during performance or installation when sound is transmitted through speakers capable of emitting frequencies at the low end of the human hearing spectrum. Sound's capacity to be experienced in an embodied way is especially apparent through low frequencies where, as Steve Goodman writes, "bass is not just heard but is felt."[269] However, sound's ability to propagate throughout our entire human body – as our bones conduct sound towards the inner ear – is not restricted to low end frequencies. Goodman describes this as an "affective tonality" immersed in a wider field of power, as is relevant to his research into sonic warfare.[270] For Listening Back, the sonic nexus engages bodies and matter in relations to otherwise intangible post-panoptic surveillance networks. Stressing these embodied sensing moments, sound affects in a way that provides for more than a purely discursive experience and understanding of automated data collection. As Holger Schultze observes, the human corporeal character of auditory experience encompasses a "bodily felt sense", where our bodies are "primary and very material receivers, amplifiers and interpreters of sound."[271]

Although emphasised when Listening Back is performed over multi-channel full-range sound systems for installation in a gallery setting or live performance at a concert venue, affective, embodied listening also occurs over headphones or computer speakers in the context of personal usage. Listening across all these contexts occurs at the intersection of the browser and the Web where ordinarily obscured data flows are tangibly experienced within their socio-technical environments. Sound here challenges what is apparent by providing access to infrastructures that remain otherwise hidden beneath the visual organisation of the Web, and therefore do not take equal part in the production of knowledge and understanding. Hence, sound questions

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[266] Paul C. Jasen, *Low End Theory: Bass, Bodies and the Materiality of Sonic Experience*, Bloomsbury Music (New York: Bloomsbury Academic, 2016), 12.
[267] Paricia Ticineto Clough, *The User Unconscious: On Affect, Media, and Measure* (Minneapolis: University of Minnesota Press, 2018), XI.
[268] Paul C. Jasen, *Low End Theory: Bass, Bodies and the Materiality of Sonic Experience,* Bloomsbury Music (New York: Bloomsbury Academic, 2016), 11.
[269] Steve Goodman, *Sonic Warfare. Sound, Affect, and the Ecology of Fear*, Technologies of Lived Abstraction 3 (Cambridge, Massachusetts, London, England: The MIT Press, 2010), 24.
[270] Ibid., 190.
[271] Holger Schultze, "How To Think Sonically? On the Generativity of the Flesh," in *Sonic Thinking: A Media Philosophical Approach* (New York: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2017), 217–42, 220, 227.

presumptions regarding routine Web browsing and enables a re-examination of previous comprehensions that encourages other kinds of thinking. As Janna Holmstedt suggests, the act of embodied listening implicitly questions the notion of a divide between sensory bodily experience and cognition, and with reference to Michel Serres' writing, insists that the body is not separate from the production of knowledge.[272] The act of listening as a mode of critical sonic inquiry that inherently questions dualisms such as mind/body, cognition/sensing, ontology/epistemology, will be elaborated in chapter three were I explore the notion of sonic thinking and sounding situated knowledges.

I now turn to a discussion of how Listening Back has worked in an affective way through an installation setting. The first exhibition that utilised the *Listening Back* browser add-on took place at Sydney Non Objective (SNO) gallery in Sydney, Australia during April 2017 (see Figures 2.5, 2.6 and 2.7). Entitled *The Web Never Forgets*, the exhibition utilised two iMacs, seven small speakers, one subwoofer, and the *Listening Back* Chrome browser add-on. The seven small cube shaped speakers were placed on stands around the circumference of the room and a single subwoofer (a speaker designed to transmit low audio frequencies, usually between 20 – 200Hz) was positioned on the floor in a corner of the room. The affective and vibrational force of sound, most evident at the low end of human audition, is where sound noticeably affects change in a body, and for the transmission of low frequencies a subwoofer is essential. In the middle of the space two iMacs sat on a table. The two chairs, positioned on either side of the table encouraged visitors to sit before the iMac and browse the Web for themselves. Due to their small cube design, the loud speakers appeared to be looking down upon visitors, as they hovered on stands around the edges of the room. These emitted an immersive sound experience that gave life to the ubiquitous and continuous nature of the contemporary online surveillance continuum. Streams of data were generated by websites that produce regular ongoing cookie activity including news sites such as theguardian.com that are dependent, at least in part, on advertising revenues generated by data collection, and flight search engines such as expedia.com whose business models are similarly dependent on data extraction.

Sound's potential to be experienced in an embodied way provides a sensible and affective experience of cookie activity and the immersive experience of the installation was intended as an enveloping and embodied experience, although not in the sense that Julian Henriques suggests when describing Jamaican dancehall sessions as "sonic dominance"; an "intensive, immersive, visceral experience" steeped in high amplitude low frequencies and heavy bass.[273] The low-end

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[272] Janna Holmstedt, "Interspecies Bodies and Watery Sonospheres: Listening in the Lab, the Archives and the Field," *Leonardo Music Journal* 30 (December 2020): 95–98, https://doi.org/10.1162/lmj_a_01099, 97.
[273] Julian Henriques, Sonic Bodies: Reggae Sound Systems, Performance Techniques, and Ways of Knowing (New York: Continuum, 2011), 13.

physicality of sound was not intended to dominate the installation experience but rather contribute to an experience of post-representational algorithmic surveillance as a felt, material force which in turn invokes an embodied and affective relationship to Web surveillance. The experience of being tangibly immersed in ubiquitous data capture was achieved in combination with the visual effect of surrounding the gallery visitors with speakers, along with the projection of the iMac desktop and cookie developer log on the walls of the gallery space. The cookie logs are provided for developers when the Chrome browser is in 'developer mode'. It manifests as lines of code that scroll automatically, often too fast to read, as vast quantities of cookies were activated by websites loaded onto browser tabs. One of the cookie log projections was positioned on top of the generic Mac OS desktop screen saver, nestled between the backdrop of an alpine mountain range and pink sky. Not completely dissimilar to net.artists' use of the materials of the Web and networked computers, the everyday materials and visual aesthetics of computer desktop environments were exhibited. However, rather than radically disrupting the standard visual experience, I chose instead to maintain the generic and universal aesthetics that have become ubiquitous in part due to Apple's market dominance. The extension of the computer screen onto the gallery walls complimented and contributed to the immersive sound installation, providing a visual, enveloping context for the atypical soundscape produced by hidden data processes inherent to everyday Web browsing.

Figure 2.5: Jasmine Guffond, *The Web Never Forgets*, 2017. Installation view, Sydney Non Contemporary (SNO). 2 x Imac, 7 x 4" Speakers, 1 x Subwoofer, *Listening Back* Chrome browser add-on, WiFi.

Figure 2.6: Jasmine Guffond, *The Web Never Forgets*, 2017. Installation view, SNO.

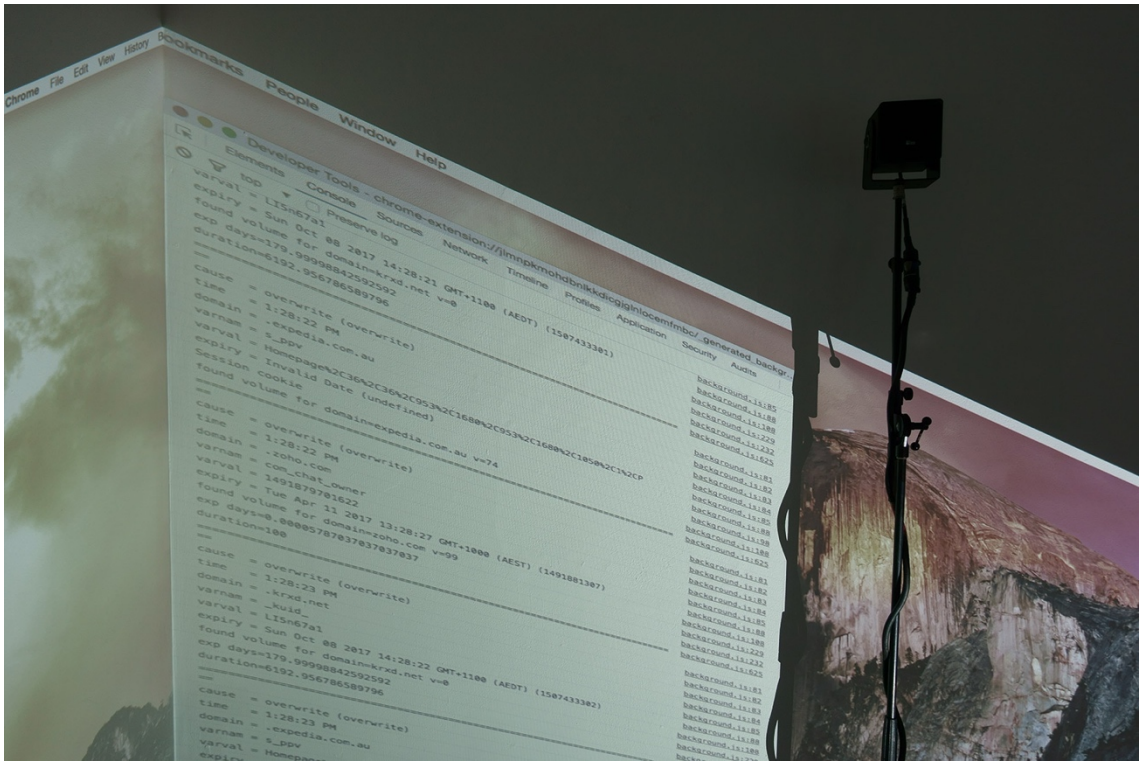

Figure 2.7: Jasmine Guffond, *The Web Never Forgets*, 2017. Installation view, SNO.

Algorithmic processes intrinsic to online surveillance remain sensibly abstracted from us. When we experience them it is through secondary representations and enactments, such as the Web browser or software interfaces. It is typically only when the seamlessness of our Web experience is interrupted, that the very material processes that support and determine the Web come to the fore. Sound as a signifier provides an audible presence for these backend algorithmic processes. As Brandon LaBelle suggests, sound is a dynamic link between our concrete realities and more immaterial forces.[274] Sound tangibly connects us to the hidden layer of algorithmic operability that as previously discussed operates beyond human comprehension.

In installation or live performance, such as at SNO gallery, the research project undertaken as Listening Back, engages the immersive and affective potentials of sound to produce enveloping, tangible, and bodily felt encounters with abstract data flows. I argue that these practices for *listening back* engage these immersive and affective sonic attributes as a means to produce sensory experiences for ubiquitous, pervasive, non-stop, always-on data capture. Sound as a signifier for cookie data simultaneously engages a symbolic, semantic, and critical thinking. Rather than positing the sensory experience of sound at odds with cognitive analysis, I suggest that an inquiry through sound engages across both sensory and discursive modes of meaning making. The *Listening Back* add-on and its creative deployment of sonification strategies across artistic, performative, and personal contexts, contributes sound's experiential attributes – affecting, omni-directional, and durational – to the artistic practices of producing browser add-ons. In the following chapter, I will further examine modes of sonic inquiry by asking what it means to use sound to think through and experience contemporary data politics.

[274] Brandon LaBelle, *Lecture on Shared Space*, Room Tone, Errant Bodies Press, Audio Issues, Vol. 7, 2016, 93.

CHAPTER THREE:[275]

The Practice of Listening Back

As a mode of critical sonic inquiry sound registers conceptually and experientially thereby providing strategies for overcoming dualistic notions of discursive, thinking modalities as distinct from embodied, experiential and affecting ones. By asking what it means to engage sound to think through and experience contemporary data politics, I examine theoretical approaches to sonic thinking, embodied listening practices and sonified Web tracking projects which explore the potential of sonic modes of inquiry to situate listening across sensory and critical modes of experiential analysis. This is followed by historical cases of listening for knowledge which provide examples of modes of listening pertinent to the development of sonic skills and their application to listening to otherwise intangible surveillance data. I detail the development process of mapping sound to cookie data and how this preliminary research led to a practical appreciation of the privacy asymmetries inherent to the Web surveillance context as discussed from theoretical perspectives in chapter one.

Listening as a Situated Knowledge Practice

In an essay written in 1988 Haraway reflects upon objectivity in relation to the production of knowledge with the goal to move beyond merely identifying bias in science, and towards developing practices of knowledge production accountable for their political and ontological situatedness. As an onto-ethico approach to knowledge production, she argues for "politics and epistemologies of location, positioning, and situating, where partiality and not universality is the condition of being heard to make rational knowledge claims."[276] Other practices of listening inquiry that identify with Haraway's situated knowledges, such as Janna Holmstedt's study of interspecies communication[277] or Freya Zinovieff and Gabriela Aceves Sepúlveda's "listening geopolitics",[278] engage the sensory practice of embodied listening. Haraway, however, elaborated on situatedness in knowledge production through a re-examination of the metaphor of vision, already in use in Western knowledge practices. In contradiction to "the conquering gaze from nowhere" that claims a cloak

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[275] Some of the material in this chapter has been drawn from my own conference paper which has been acknowledged and detailed in the 'Inclusion of Publications Statement' for this thesis. Jasmine Guffond, "Listening Back", *The 25th International Conference on Audio Display* (ICAD 2019, Northumbria University, 2019), 1 – 4.

[276] Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, no. 3 (Fall 1988): 575–99, 589.

[277] Janna Holmstedt, "Interspecies Bodies and Watery Sonospheres: Listening in the Lab, the Archives and the Field," *Leonardo Music Journal* 30 (December 2020): 95–98, https://doi.org/10.1162/lmj_a_01099.

[278] Freya Zinovieff and Gabriela Aceves Sepúlveda, "Listening Geopolitics and the Anthropocene Contact Zones of the Bali and Georgia Strait," *Leonardo Music Journal* 30 (December 2020): 114–18, https://doi.org/10.1162/lmj_a_01103, 116.

of impartiality through "the power to see and not be seen," she advocates for an embodied vision that through specific location takes account of its ontological and political positioning, and furthermore recognises "partial perspectives".[279] "Limited location" from complex and contradictory bodies is recommended to further a "responsibility for difference in material-semiotic fields of meaning."[280] The vision metaphor is further applied to expand upon politics of positionality in situated knowledges, leading to the question: "what other sensory powers do we wish to cultivate besides vision?"[281] How then might listening as a sensory mode of inquiry contribute to situated knowledge practices?

Janna Holmstedt's research into a study of human-dolphin communication, claims an auditory, listening methodology as a situated knowledge practice located within the real-time dynamics of the environment of its study and, furthermore, as an embodied learning practice. Her analysis of an archive of lab recordings of human-dolphin language experiments is in itself an exercise in listening for knowledge as well as a study of an historical, audition based scientific research method.[282] Historical examples of listening for knowledge will be further explored in this chapter as a mode of inquiry. As we shall see, these learned practices contributed to the professionalisation of listening in the nineteenth century and the development of "sonic skills".[283] For Holmstedt, the act of listening as a mode of inquiry inherently questions Western, reductive, ocularcentric, and cartographic scientific methods by offering a "sonospheric modality of reason, which is relational, performative, situated, generative, mulitisensorial and impossible to quantify or reduce to basic components."[284] Rather than approach study with the aim to master and control, for Holmstedt, listening opens up to a receptivity and performativity within fluctuating and relational, rather than static, dynamics.

Furthermore, through an understanding of the ontology of bodies in relation to sound, for which "being in sound is always already a being-outside", Holmstedt identifies listening as a fluid, relational, and embodied process that situates, positions, and connects, thus exemplifying what an embodied learning could be as sound vibrates in and beyond the ear, towards and through bodies.[285] According to the relational characteristics of sound, listening connects phenomena,

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[279] Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, no. 3 (Fall 1988): 575–99, 581.
[280] Ibid., 588.
[281] Ibid., 587.
[282] Janna Holmstedt, "Interspecies Bodies and Watery Sonospheres: Listening in the Lab, the Archives and the Field," Leonardo Music Journal 30 (December 2020): 95–98, https://doi.org/10.1162/lmj_a_01099.
[283] Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5.
[284] Janna Holmstedt, "Interspecies Bodies and Watery Sonospheres: Listening in the Lab, the Archives and the Field," Leonardo Music Journal 30 (December 2020): 95–98, https://doi.org/10.1162/lmj_a_01099, 95 – 96.
[285] Ibid., 96 – 97.

bodies, events, and minds through a vibrational paradigm. One could argue that the functioning of acoustics endorses a politics of positioning that at once engages specific embodiment and its immediate and extended relations, thereby exemplifying Haraway's notion of embodied vision: specifically located and concurrently accountable for its positioning within a broader network. However, as Annie Goh points out, accountability is not a given nor necessarily inherent to embodied listening and sounding practices. With reference to Jean-Luc Nancy's analysis of a listening centred on the body and yet from an unaccounted, "traditional masculinist subjectivity", Goh observes a tendency in sound studies to emphasise embodiedness without a situatedness.[286] I would argue that the relational functioning of sound, and the embodied nature of listening, both provide a useful sonic metaphor for the purpose of emphasising how bodies are situated, and how a situated knowledge practice such as Haraway intends, could be equally embodied and situated.

Listening, as an already embodied mode of perception, engages with the relational characteristics of sound to connect bodies and phenomena, such as the human listening body to the dynamics of real-time post-panoptic data capture. As a sensory mode of engagement, a situated, embodied listening experiences the flows, patterns, and interruptions of real-time data capture across sensing and critical modes of experiential analysis. This is in distinction to any perceived dualities between the notion of an embodied and subjective sounding experience, and a critically distant, objective thinking associated with visual modes of perception, as have been notably critiqued by Jonathan Sterne's "audio-visual litany".[287] This potential for critical inquiry through sound to question divisions between mind/body or cognitive/sensing modes of analysis, is further examined in the following section which explores Goh's notion of "sounding situated knowledges" and what it means to use sound to think through contemporary data politics.

Sonic Thinking, Sonic Inquiry

The scholarly field of sound studies is interdisciplinary with important foci being sound and listening across cultural and historical contexts.[288] A prominent aspect of sound studies is to rethink history and culture through the lens of sound thereby contributing perspectives to the potential of sonic modes of inquiry. This is a strategy that inherently questions visually-based approaches to knowledge production that have historically dominated Western theory, research, and analysis. Partly attributed to the increased circulation of print in the fifteenth century which facilitated the comparison, analysis, and study of written and graphic material, the notion of 'eye witnessing' and

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[286] Annie Goh, "Sounding Situated Knowledges: Echo in Archaeoacoustics," *Parallax 23*, no. 3 (July 3, 2017): 283–304, https://doi.org/10.1080/13534645.2017.1339968, 289.
[287] Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Durham & London, 2003). p. 15.
[288] Michael Bull, ed., *The Routledge Companion to Sound Studies* (London; New York: Routledge, 2019), xvii.

visually based academic and scientific study became primary modes of knowledge production.[289] To think across a critical combination of phenomena, events, or histories through the medium of sound generates potential for new and alternate positions. To listen, is to invite radically alternative perspectives, invoking a different politics of inquiry. As Sterne states, there is "more than one map for a territory,"[290] and as previously discussed, a listening mode of inquiry provides a means to emphasise receptivity, performativity, and embodied learning due to sound's fluid, affecting, and relational dynamics.[291]

To investigate a contemporary cultural, technical, and political situation through sound – such as hearing the phenomenon of online surveillance – introduces the question: what does it mean to think with and through the medium of sound. Sterne defines this as a mode of thinking "conjecturally about sound and culture", that is, to use "sound to ask big questions".[292] Bernd Herzogenrath has similarly proposed sonic thinking as a form of interdisciplinary artistic research that equally engages art practices, philosophy, and science as heterogeneous forms of thinking, researching, and doing: a "mediaphilosophical" practice in which (sound) artists think with and through the materiality of their (sounding) medium.[293] Sounding arts, a term used to broadly define artistic applications of sound, is such a creative practice wherein the concerns and thematics of the artworks often extend beyond the medium of sound itself.[294] Consequently, no single discipline such as sound studies, musicology, acoustics, or visual art theory is able to entirely engage the thematics addressed by creative sound practices.[295]

Besides being a form of interdisciplinary artistic practice, sonic thinking has been described as a means to reinstate listening in western thought;[296] engage listening as a research practice; or simply to listen.[297] The temporal dimension of sound as a phenomenon that unfolds over time, is also

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[289] Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5, 9.
[290] Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction (Durham & London, 2003), 3.
[291] Janna Holmstedt, "Interspecies Bodies and Watery Sonospheres: Listening in the Lab, the Archives and the Field," Leonardo Music Journal 30 (December 2020): 95–98, https://doi.org/10.1162/lmj_a_01099, 95 – 96.
[292] Jonathan Sterne, "Sonic Imaginations," in The Sound Studies Reader, ed. Jonathan Sterne (New York: Routledge, 2012), 1–17, 3.
[293] Bernd Herzogenrath, "Sonic Thinking - An Introduction," in Sonic Thinking: A Media Philosophical Approach, Thinking Media (New York: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2017), 1–22, 3.
[294] Marcel Cobussen, The Routledge Companion to Sounding Art, 1st ed. (New York, NY; Abingdon, Oxon: Routledge, 2016. | 2016 |: Routledge, 2016), https://doi.org/10.4324/9781315770567, 2.
[295] Ibid., 5.
[296] Brandon LaBelle, Background Noise: Perspectives on Sound Art, Second edition (New York: Bloomsbury Academic, 2015), 13.
[297] Holger Schultze, "How To Think Sonically? On the Generativity of the Flesh," in Sonic Thinking: A Media Philosophical Approach (New York: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2017), 217–42, 219.

summoned by sound studies researchers such as Herzogenrath and Holge Schultze to exemplify a (sonic) philosophy that is process oriented. That is, a processual thinking that, not unlike the propagation of sound, transmits a flow of "contingent actualizations of virtual potentiality".[298] Rather than being fixed in form, sound's perpetual flux of becoming – a temporal sequence of sensations resonating across and through material bodies in an interconnected manner – is proposed as a model to question the logic of a separation between experience and reasoning.[299] Schultze in particular draws on William James and then Michel Serres to transcend traditional, reductive, language based modes of comprehension peculiar to logocentric discourses, describing sonic thinking as an emphasis on the experiential and generative aspects of listening and sounding in situ.[300] The appreciation of sound and listening as characteristically time-based, generative, relational and whereby reason and sensory experience overlap, relates back to Holmstedt's emphasis on a 'sonospheric modality of reason' as relational, performative, situated, and generative, and to Goh's notion of 'sounding situated knowledges'.

Taking up Haraway's use of a sonic metaphor to push for situated knowledges "tuned to resonance, not to dichotomy", Goh advocates a material-discursive mode of knowledge production to overcome dualisms that occur in particular positions taken up in sound studies, notably in Christoph Cox's notion of a sonic materialism which pits sound as independent from the mind.[301] Against this dualism, Goh proposes the acoustic and mythical figure of the echo to exemplify positionality, complex entanglement, and difference,[302] arguing for a new materialism to underpin sounding situated knowledges, a materialism that "attends to matter without denigrating the role of language or signification".[303] In order to provoke a sensory and cognitive engagement, listening is appreciated by practitioners and theorists as a mode of inquiry that affords a continuity between sensing and thinking, a movement between experience and reflection, where "thought and sensation merge".[304]

Auditory modes of inquiry, such as those deployed in Listening Back*,* vary from other visual or discursive modes of knowledge production. Research into the sonification of data with political

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[298] Bernd Herzogenrath, "Sonic Thinking - An Introduction," in *Sonic Thinking: A Media Philosophical Approach*, Thinking Media (New York: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2017), 1–22, 4, 6.
[299] Ibid., 4, 5, 232.
[300] Holger Schultze, "How to Think Sonically? On the Generativity of the Flesh," in *Sonic Thinking: A Media Philosophical Approach* (New York: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2017), 217–42, 233.
[301] Annie Goh, "Sounding Situated Knowledges: Echo in Archaeoacoustics," *Parallax 23*, no. 3 (July 3, 2017): 283–304, https://doi.org/10.1080/13534645.2017.1339968, 292.
[302] Ibid., 295 – 296.
[303] Ibid., 292.
[304] Holger Schultze, "How to Think Sonically? On the Generativity of the Flesh," in *Sonic Thinking: A Media Philosophical Approach* (New York: Bloomsbury Academic, an imprint of Bloomsbury Publishing, Inc, 2017), 217–42*,* 230, 231.

consequences indicates that an emphasis on linkages between cognitive reasoning and an affective sensory experience can extract meanings that are less evident in purely visual or discursive modes of analysis.[305] Furthermore, the interaction between cognitive and affective engagement in data sonification has been recognised for its potential to encourage intuitive and creative means of analysis identified as useful for increasing public literacy and engagement with political issues.[306]

Sonifying Web Tracking

As a means of raising user awareness and engagement with online third-party tracking, the projects *Soundbeam* (2014) and *Surfing in Sound* (2019) sonify Web tracking scripts in real-time. Observing a general lack of knowledge or sense of how many third parties are invisibly tracking us, the producers of *Soundbeam*, Charles Celeste et al., sonify information produced by the Firefox add-on *Lightbeam* which graphically maps every site a user's data is sent to while browsing.[307] As the graph of interconnected networks between trackers and websites exponentially expands, this data is sonified via Open Sound Control (OSC) messaging for live audio-visual performance.[308] Elements of the aggregated data, such as URLs, are projected for the audience to "voyeuristically experience the activities of governments and advertisers" aimed at increasing the "clarity of the piece".[309] Presented at the international conference for New Interfaces for Musical Expression (NIME), Celeste et al., are interested in exploring the musical potential of *Soundbeam* for live collective performance while engaging issues relevant to data surveillance exchanges between users, governments, and Web corporations. Here, sound is considered to provide a "stronger sense" of these activities by providing a real-time awareness of third-party tracking.[310]

Similarly, *Surfing in Sound* by Otto Lutz et al. offers a sonification-based approach to raising awareness, understood as a general consciousness of the prevalence of Web tracking.[311] Extending the possibilities of existing approaches, specifically *Soundbeam*, *Surfing in Sound* creates its own "framework for live web tracking analysis and conversion to OSC events" across any network connection, browser, and various apps and devices.[312] Similar to creative browser add-ons, Web

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[305] Hans Agné, Thomas Sommerer, and David G. Angeler, "Introducing the Sounds of Data to the Study of Politics: A Choir of Global Legitimacy Crises," New Political Science 42, no. 3 (July 2, 2020): 272–88, https://doi.org/10.1080/07393148.2020.1809760, 272.
[306] Ibid., 273.
[307] Mozilla Web store for the *Lightbeam* add-on, https://addons.mozilla.org/en-US/firefox/addon/lightbeam-3-0/, accessed May 7, 2021.
[308] Charles Celeste et al., "Soundbeam: A Platform for Sonifying Web Tracking," in *Proceedings of the International Conference on New Interfaces for Musical Expression*, 2014, 496–98, 497.
[309] Ibid., 497 – 498.
[310] Ibid.
[311] Otto Hans-Martin Lutz et al., "Surfing in Sound: Sonification of Hidden Web Tracking," *The 25th International Conference on Auditory Display,* Northumbria University, UK, June 2019, 1 – 4, 1.
[312] Ibid., 1, 3.

protocols are re-deployed to expose hidden data operations. The network protocol analyser TShark configures lists of Web tracker's IP addresses sent via OSC for translation into sound.[313] The aim is to not only provide awareness of the prevalence of Web tracking but also highlight the concentration of a few corporations accessing user's data across the majority of websites. With the intention to encourage discussion concerning the dominance of an online tracking "oligopoly" a whispered recording of the name of each of the top ten online trackers is generated.[314] Lutz intends for Surfing in Sound to be a short-term rather than durational intervention that explores the potential of sound as an emotional trigger to hopefully encourage action. An initial user study with twelve participants between the ages of twenty-three and thirty-six in a class-room setting supports their hypothesis that sonification of third-party online monitoring contributed to an increased awareness of Web tracking.[315]

Listening Back extends the possibilities of these sonified Web tracking projects through its implementation as a browser add-on which facilitates personal usage during the everyday act of Web browsing. As Beate Ochsner observes, "she made her tool available for everybody using popular browsers such as Chrome or Firefox."[316] This availability enables the potential of both cognitive and affective engagement in data sonification to increase public literacy with political issues, not only in public settings but at a personal and intimate level. The possibility to experience the persistent flows of Web tracking in private settings such as one's own home enacts another experience of real-time, invasive, privacy transgressions. During a public performance of Listening Back*,* the audience observes Web browsing navigated by performers choices, pre-determined according to sound aesthetics generated by particular sites, or sites that have personal relevance to individual performers. Through personal usage the listener is sonically immersed in their Web browsing decisions, free to navigate their own listening investigation via personal computing devices. The sonic interruption of everyday browsing routines effects an individual experience of being continually and ubiquitously tracked by a post-panoptic surveillance technique. Furthermore, through the *Listening Back* interface, initially developed for live performance, users are able to individually adapt settings for long-term usage and diagnostic and exploratory listening. These modes of listening will be further discussed in the next section.

Listening for Knowledge

For *Soundbeam*, *Surfing the Sound*, and the Listening Back project, sound provides an experiential encounter with otherwise intangible algorithmic surveillance as a means to reflect upon the

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313 Ibid., 2.
314 Ibid.
315 Ibid., 4, 3.
316 Beate Ochsner, "Sonification of Web Tracking, Jasmine Guffond: Listening Back," Sound Studies, February 22, 2021, 1–4, https://doi.org/10.1080/20551940.2021.1875292, 2.

contemporary concerns of Web surveillance, in particular its prevalence and consistency. The materiality of sound itself is not the central conceptual focus for these Web tracking sonification projects, rather, sound is engaged as an aesthetic device to affectively and conceptually engage the politics and flows of third-party Web tracking scripts and cookie data. As a strategy in creative sonification works, Stephen Barrass' notion of a 'pragmatic aesthetics' discussed in chapter two, suggests an approach that critically de-centres the aesthetic without completely rejecting it.[317] The interplay of aesthetics and functionality is executed through the aestheticisation of ordinarily non-aesthetic cookie data which performs the function and means to tangibly access, experience, and interpret information implicit to the cookie data. Barry Truax defines this as 'acoustic communication': creative sound practices that map audio to real world data in order to "direct the listener's attention back to an understanding of some facet of that world."[318] As a sonic means of imparting information relating to cookie data processes, sonification provides auditory environments for critical and reflexive listening, a mode of inquiry that listens for knowledge.

With the development of sound technologies, opportunities to systematically listen for knowledge grew. For example, early experiments in audification, the process of translating waveforms of data into the audible human hearing range, became possible in the 1870s.[319] In the following century audification was standardised to include the Geiger counter as well as methods for distinguishing earthquakes from subterranean nuclear explosions.[320] Karin Bijsterveld's research into the histories of listening for knowledge provides numerous historical and contemporary cases across science, medicine, the military, and engineering. These include listening to cells vibrating, solar winds, glaciers, computers, cars, and the invention of the stethoscope in 1816. Across these examples Bijsterveld identifies a set of "sonic skills", that is, the development of a range of listening skills and techniques for making, recording, storing, and retrieving sound in pursuit of specialised study.[321] Bijsterveld's descriptions of embodied and encultured techniques, such as the positioning of the stethoscope on the patient's body, or the handling of magnetic tape recorders, continues from Sterne's notion of "audile techniques", that is, listening as a set of historically and culturally informed practices, developed as specialised skills toward instrumental outcomes.[322]

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[317] Ibid.

[318] Truax, B. 2012. "Sound, Listening and Place: The Aesthetic Dilemma", *Organised Sound* 17(3), 196.

[319] Dombois, F, "The 'Muscle Telephone': The Undiscovered Start of Audification in the 1870s." In *Sounds of Science - Schall im Labor (1800 - 1930)*, ed. J. Kursell, Workshop Sounds of Science, Max- Planck-Institut für Wissenschaftsgeschichte Berlin, 2006, Berlin: Max-Planck-Institut für Wissenschaftsgeschichte, 2008, 43.

[320] Volmar A. 2013. "Listening to the cold war: The nuclear test ban negotiations, seismology, and psychoacoustics, 1958–1963." *Osiris* 28: 80–102.

[321] Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5, 63.

[322] Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Durham & London, 2003), 93, 96.

The value of developing specialised and learned listening skills is evident in the history of auditory practices that evolved around physician René Laennec's invention of the stethoscope.[323] "Mediate auscultation", the term Laennec gave for listening through the medium of the stethoscope occurred at a turning point in Western medical knowledge providing an historical case for when listening is taken up by scientific inquiry and contributes to modern knowledge making and the professionalisation of listening.[324] In addition to developing a listening medium, mediate auscultation as a means of producing diagnostic knowledge required Laennec to carefully codify lung sounds as indicators of pathological states.[325] Alongside the lexicon of internal body sounds, the practice of mediate auscultation was a learned process that required practice to perfect.[326] Hospital training was therefore crucial for acquiring and developing the necessary skills for diagnostic listening.[327] The development of a diagnostic mode of listening to the body coincided with a growing practice of dissecting bodies in eighteenth century Western medicine. Autopsies were conducted in hospitals to observe visual alterations, marks left by disease under the skin, which were instrumental in developing new theories of disease.[328] This visual and tactile mode of observation led to an auditory practice on living bodies. Listening enabled a method for crossing the visual frontier of the human body. Drawing on the concept and practice of diagnostic listening, along with an understanding that socio-political and cultural contexts inform listening constructs, I have developed a set of conceptual and practical apparatus such as the *Listening Back* interface, to formulate a critical engagement with cookie activity through listening.

Listening Back Interface

Similar to mediate auscultation, the *Listening Back* add-on provides a mediating instrument to intensify focus and direct listening beyond the visual surface of the browser interface to invisible post-panoptic surveillance processes. This encourages the development of sonic skills in navigating a listening examination of cookie activity during the act of Web browsing. However, rather than listening out for submerged sounds data is sonified to provide a platform from which to *listen back* to intangible algorithmic surveillance. Through personal computer usage the sonification of cookie

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[323] Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5,, 11 – 12.
[324] Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction (Durham & London, 2003), 93.
[325] Jens Lachmund, "Making Sense of Sound: Auscultation and Lung Sound Codification in Nineteenth-Century French and German Medicine," Science, Technology, & Human Values 24, no. 4 (Autumn 1999): 419–50, 424.
[326] Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction (Durham & London, 2003), 93. 103.
[327] Karin Bijsterveld, Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5, 11 – 12.
[328] Jens Lachmund, "Making Sense of Sound: Auscultation and Lung Sound Codification in Nineteenth-Century French and German Medicine," Science, Technology, & Human Values 24, no. 4 (Autumn 1999): 419–50, 423.

data interrupts routine browsing as an aesthetic strategy to position the listener within the ontological nexus of the real-time activity of online data capture and facilitate a reflective space to re-consider what it means to browse the Web. Through personal usage one may experience a sonic encounter with cookies while browsing or further engage with the medium of the interface as a tool to guide a listening examination of real time cookie activity.

As an instrument that enables the development of sonic skills across live performance or personal usage, I initially designed the *Listening Back* interface to allow performers to change the key, the octave, and the volume of individual cookies. Through a collaborative process with different performers, this performative mode of my Listening Back practice explored the add-on as a musical instrument for performing real-time cookie activity while contributing to an exploratory research process that influenced the development of the interface. During the development phase, the add-on was trialed in rehearsals with a Browser Ensemble that consisted of creative practitioners Trevor Brown, Emily Morandini, Gail Priest, and myself. My own practice as an experimental electronic music composer who has performed live and produced records over the last twenty years informs the sound aesthetic of the *Listening Back* add-on and its deployment across live performance and installation, as do practical considerations elaborated on later in this chapter. The experience and personal practices of the members of the Browser Ensemble are situated across instrumental music performance, improvisation, composition, and experimental sonic arts.

From the outset the aim was to create an instrument for live performance that provided for musical manipulations and a means to impart information inherent to the sonic unfolding of real-time cookie activity. In developing a set of musical sonic skills for the playing of cookies, the involvement of sound and music practitioners during the development phase enabled their experience to influence the design of the interface as a performance tool as well as contributing approaches to 'playing' the Web. It was decided to choose four scales that are, according to Western tuning systems, in tune with each other. Previous experience with earlier sonification projects has indicated that dissonance can have the effect of disrupting in a way that makes audiences disengage or users simply turn the sound off.[329] Moreover, when working with real-time data the results tend to occur unpredictably, a phenomenon that is particularly evident with cookie data as the online surveillance ecosphere is perpetually expanding, transforming, and mutating beyond one's capacity to fully monitor and adapt. As an indeterminate composition, Listening Back is driven by real-time post-panoptic surveillance processes, and it thus benefits from a simple harmonic structure that aids listeners in deciphering the complexity of simultaneous and unpredictable layers of sonic information. In order to encourage the sonic skill of deciphering individual cookies from the

[329] Documentation of creative android app that sonifies Wi-Fi and GPS in real-time. http://jasmineguffond.com/art/Anywhere+All+The+Time, accessed April, 12, 2019.

layered, complex, and multitudinous online cookiesphere, the cookie sounds incorporate varying degrees of differing complex textures to provide discernible sonic difference between various cookies.

Sonification research has proven that human aural perception notices difference in timbre more effectively than differences in pitch.[330]. With this in mind, I produced various identifying sounds for particular cookies, and by making them audibly discernible hoped to encourage the development of diagnostic listening skills in the browser add-on users and for audiences attending a live performance. In addition to changing musical keys, the interface enables users to decipher between first and third-party cookies as well as between cookies specific to particular Web domains. This functionality is activated through volume sliders that allow for the turning up or silencing of individual data sets (see Figure 3.1). During the process of mapping sound to cookie data I came to understand the significance of the difference between first and third-party cookies and the prevalence of major trackers such as, though not exclusively, Google and Facebook. To highlight predominant networks of surveillance, I designed specific signature sounds for the major online platforms: Google, Facebook, Amazon, YouTube, Expedia and some of the third-party advertising cookies that are prevalent across many websites, such as krxd.net.[331]

Max Breedon is the programmer I collaborated with during the development stage of this project, and he suggested using the timbre.js library as the most practical method for generating Web audio.[332] Hence, sounds were designed using digital waveform synthesis: sine, saw, or triangle waves, white noise, alongside a range of sound effects such as equalisation, delay, phasor, flanger, and reverb that can all be employed together in various combinations. As previously discussed, the humanly incomprehensible scale of post-panoptic online surveillance can only be rendered sensible in part. Considering the extraordinary amount of individual cookies circulating the Web and personal computing devices it was impossible to design a sound for each one. Hence, a sound called 'pluck' from the timbre.js library was selected as the generic cookie sound. The goal was to provide a sense that something else is taking place beneath the visual surface of the browser interface through a creative and pragmatic sound design that is both communicative and listenable over time. Pluck's sound, reminiscent to that of a single guitar string being plucked, was suitable as a sound that is played continuously by numerous cookies. The note of each generic cookie is generated

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330 Stephen A. Brewster, Peter C. Wright, and Alistair D. N. Edwards, "An Evaluation of Earcons for Use in Auditory Human-Computer Interfaces," in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '93 (the SIGCHI conference, Amsterdam, The Netherlands: ACM Press, 1993), 222–27, https://doi.org/10.1145/169059.169179, 226 – 227.

331 Krxd.net is hosted by the Krux Advertising company and has been found on eight thousand, six hundred and thirty-two websites for targeting and advertising purposes. https://cookiepedia.co.uk/host/.krxd.net, https://webcookies.org/cookie/domain/krxd.net/182, accessed May 3, 2020.

332 Timbre.js github, http://mohayonao.github.io/timbre.js/, accessed March 5, 2017.

from a number produced by a hash of the cookie's domain name. In this way, the pluck sound is subtly varied to provide an impression of a complex ecosphere of millions of cookies.

Throughout this research-led practice I have received varied feedback regarding *Listening Back*'s sonic aesthetic, including from peers who have asked "why did you make the cookies so beautiful?" or "I found them fun, but then I'm a tech cynic". There were also reviews from differing sources such as a data security magazine which proclaimed "listening to Web cookies can be very interesting, even though they are not particularly musical",[333] and an art blog which found that, "the plug-on [sic] for chrome and firefox translates data generated from cookies into (rather unpleasant) sound".[334] A degree of surprise or disquiet regarding the disclosure of ubiquitous hidden cookie surveillance may also play into the aesthetic response to a performance, installation, or personal usage. As an article in *The Irish Times* states, "if you enjoy the wobbly psychedelic synth of Boards of Canada you might like listening to the onslaught of cookies but if, like me, you have both AdBlock and Privacy Badger installed on your browser then you will begin to worry about how many of these third-party cookies they are managing to catch and block."[335]

The possibility to engage diagnostic listening skills with *Listening Back* extends to first and third-party cookies: predominant data subsets that carry particular privacy implications. The primary operational difference is identified by their host, which is the domain name of the site that, via the browser, inserts cookies onto computers. A first-party cookie is a cookie with the same domain name as the website one is currently visiting, and a third-party cookie is any cookie with a domain name other than the website one has currently loaded. First-party cookies are only inserted or read by the website while one is visiting it and normally are not employed to monitor activity across different websites. Third-party cookies, on the other hand, are implemented by numerous, divergent websites and function as an effective method for tracking users across the Web. Typically inserted onto personal computers via advertising banners, scripts, or tags added to a web page, they enable data brokers to track users across different sites, gather information, and aggregate behavioural profiles to sell on to strategic partners such as advertisers. My aim was to encourage users to develop the listening ability to decipher between first and third-party cookies by providing a timbral

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[333] Alex Perekalin, "Why You Should Try Listening to Your Cookies. Listen to Your Cookies with the Listening Back Browser Extension to Understand the Real Scale of Web Tracking.," *Kaspersky Daily*, March 2, 2020, https://www.kaspersky.com/blog/36c3-listening-back/33859/, accessed March 2, 2020.

[334] Regine, "Global Control, Macho Technology and the Krampus. Notes from the RIXC Open Fields Conference.," *We Make Money Not Art* (blog), September 28, 2018, https://we-make-money-not-art.com/global-control-macho-technology-and-the-krampus-notes-from-the-rixc-open-fields-conference/, accessed November 15, 2018.

[335] Marie Boran, "Listen to the Cookies Following You around on the Web. Web Log: Chrome and Firefox Plugin Reveals Level at Which Cookies Are Tracking Us Online.," *The Irish Times*, accessed January 15, 2021, https://www.irishtimes.com/business/technology/listen-to-the-cookies-following-you-around-on-the-web-1.4191500, accessed January 15, 2021.

based sounding difference and, furthermore, through the interface guide a diagnostic listening. Hence, the interface is designed to enable users to select and isolate first and third-party cookies through sliders that allow for volume adjustment or the silencing of these individual data sub-sets.

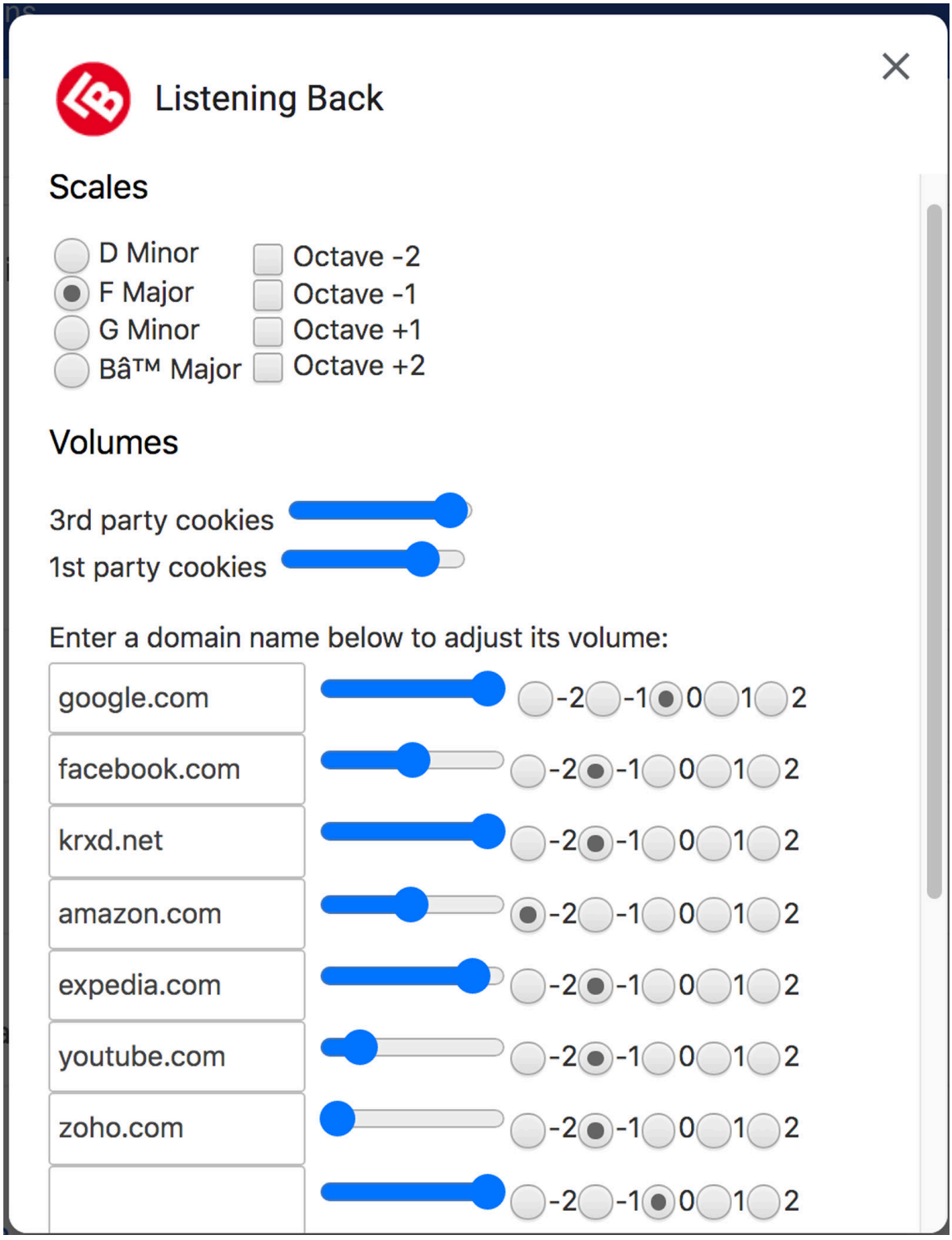

Figure 3.1: *Listening Back* interface, Chrome browser.

Figure 3.2: *Listening Back* interface, Chrome browser.

By encouraging the listening skill of deciphering between first and third-party cookies, and the ability via the interface to isolate these individual data sets, attention is drawn to the prevalence of third-party cookies through an engaged, diagnostic listening in conjunction with the interface. Users are by default opted-in to being tracked by cookies although every Web browser provides an option to block third-party cookies. This setting is usually buried under layers of sub-menus in the preference settings dependent on the browser platform. Due to this inaccessibility, in addition to providing the means to sonically identify the prevalence of third-party cookies across various and divergent websites, I included instructions for how to block third-party cookies in the interface, so that as an option it is more apparent and provides a tactic to address, at least temporarily, online privacy asymmetries.

To further engage the sonic skill of differentiating between first and third-party cookies and enable a reflective space to consider their prevalence, I have harnessed this audible difference as a performance effect. During lecture performances I have demonstrated the blocking of third-party cookies in the Web browser settings at UNSW galleries in Sydney and Ian Potter Museum at Melbourne University for the *Eavesdropping* public program initiated by Liquid Architecture and Melbourne Law School in August 2018,(Figure 3.3) the *Web Audio* Conference in Berlin, September 2018, at the Q-o2 residency in Brussels, January 2019 (Figure 3.4) and the *International Conference for Auditory Display*, Newcastle, UK, June 2019. The silence that immediately followed the selection to block third-party cookies, a sonic vacuum after the consistent sound of cookie activity, was particularly effective in conveying the sense of how many third-party cookies are by default tracking users across the Web.

Figure 3.3: Browser Duo: Julie Burleigh and Jasmine Guffond, Eavesdropping Public Program, Ian Potter Gallery, Melbourne University, 11th August, 2018.

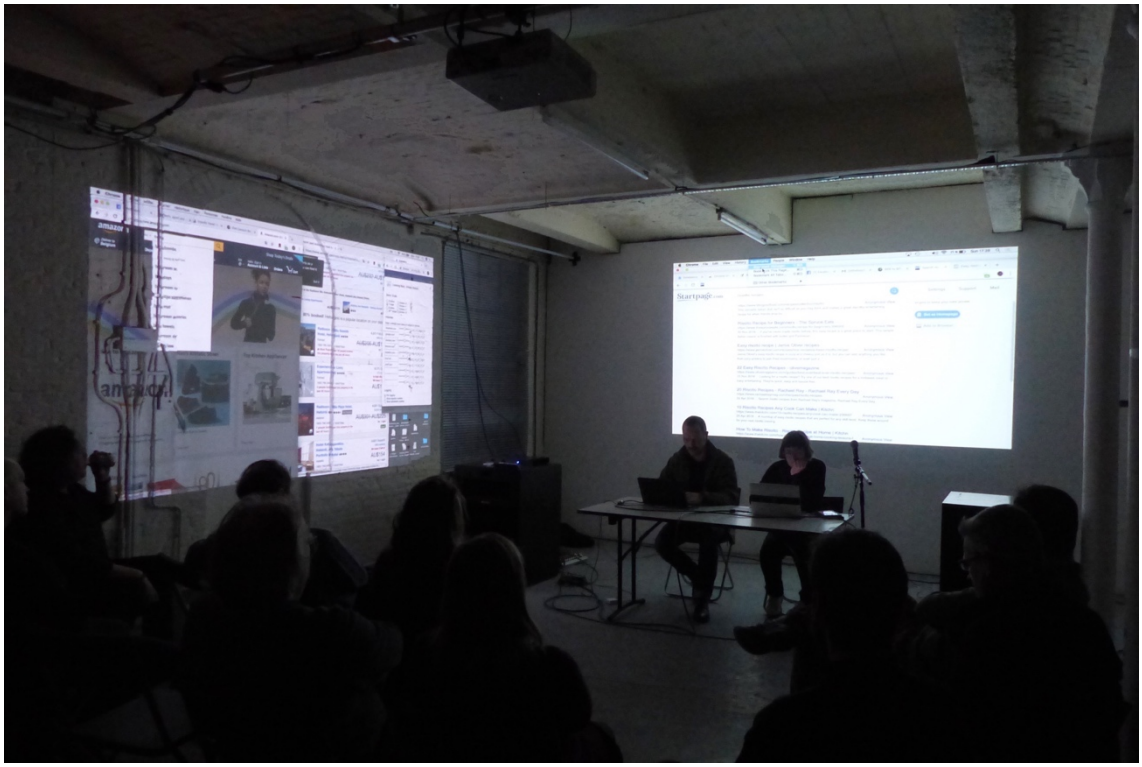

Figure 3.4: Browser Duo: Frederic Alstadt, Jasmine Guffond, Qo2, Brussels, 13th January, 2019.

Modes of Listening

Varying modes of listening, such as the diagnostic listening previously discussed in relation to first and third-party cookies, are possible for the practice of *listening back* to real-time cookie activity. Both *Listening Back*'s sound design and interface aim to encourage the development of a set of sonic skills so that one may either listen to cookies in the background while browsing the Web or engage with a direct focus on cookie data subsets via its interface. Hence, the practice of *listening back* enables one to switch between modes of listening, a practice that Bijsterveld found to be an essential sonic skill in the auditory knowledge-making practices of scientists, engineers, and doctors.[336] By engaging sound as a means of inquiry that exploits 'the ever-openness of the ear',[337] users of the *Listening Back* add-on can either listen peripherally while simultaneously engaging in daily browsing routines, or listen attentively as a primary focus. To *listen back* therefore functions broadly across two predominant modes of listening: foreground and background.

A notion of background listening is defined by Truax, who identifies categories of listening according to different levels of attention. For Truax background listening refers to a passive listening in comparison to "listening-in-readiness" which is more active and "listening-in-search" which is more active still.[338] The notion of distinct modes of active and passive listening and hearing, had been defined by French physician Matthieu-François-Régis Buisson in 1802. Within the cultural context of medical, auditory practices of auscultation, Buisson distinguished between a passive audition and an active auscultation, a difference on which the words to hear and to listen are based.[339] Sterne notes that the physiological construct of hearing was accompanied by a practical-social formulation of listening.[340] This indicates that the construction of distinct modes of hearing and listening, as sets of determinate possibilities, emerged from a specific cultural and historical context and furthermore served the practical needs of the social and medical environment of Parisian hospitals in the early nineteenth century. Sterne continues to argue that the physiological notion of hearing as defined by Buisson, is not entirely passive but more accurately, receptive. This receptive quality was identified earlier by Holmstedt concerning a listening that facilitates an approach to learning not aimed at mastering and controlling but rather at a mode of reception to fluctuating and relational dynamics. A receptive mode of background *listening back* will be further elaborated, but first Bijsterveld's categorisation of specialised modes of listening – monitory,

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[336] Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5, 65.
[337] Kim-Cohen, S. 2009, *In the Blink of an Ear, Toward a Non-Cochlear Sonic Art*, New York & London: Continuum, XVIII.
[338] Barry Truax, *Acoustic Communication*, Communication and Information Science (Norwood, N.J: Ablex Pub. Corp, 1984), 17 – 24.
[339] Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Durham & London, 2003), 93, 100.
[340] Ibid.

diagnostic, and exploratory – provide a useful framework for further unpacking modes of *listening back*.[341]

Bijsterveld defines exploratory listening as actively listening out for new phenomena, a notion developed by Susan Douglas for the practice of radio hams trying to discover distant stations, or when ornithologists listen out for unusual or exotic bird songs, guided by their ears on field trips.[342] Exploratory listening in the context of *Listening Back* is a mode of browsing the web with the explicit intent of hearing how particular websites sound. A curious exploration of web pages specifically for the purpose of discovering what different sites might sound like according to the cookie activity they generate. Exploratory listening however, is not distinct from other listening modes defined by Bijsterveld. An exploratory mode of listening could simultaneously engage a diagnostic listening that aims to decipher recurring sonic patterns as they relate to particular cookies across different sites. A diagnostic mode of listening that enabled physicians to distinguish between healthy and unhealthy internal body sounds allows personal usage of the *Listening Back* add-on, or audiences in public contexts, to differentiate between cookies by Google, Facebook, YouTube, Amazon, flight search engines, prevalent data brokers, and first and third-party cookies. As discussed previously, from the multifarious stream of cookies inserted onto personal computers by the data broker industry, some of the key major tech corporations have been mapped to discernible signatory sounds. This provides a means to listen back to their real-time data collection and track their prevalence across various websites as a counter-tactic that aims to address privacy asymmetries inherent to the online surveillance ecosphere. This is particularly notable regarding the two main actors: Google and Facebook. The Google analytics cookie, the most prevalent cookie to be embedded across the Web and personal computing devices, is heard to be emanating from numerous websites beyond the google.com domain. Similarly Facebook, the second largest data collector in the online tracking ecosphere, can be heard across multiple sites.[343]

The third mode of listening identified by Bijsterveld is monitory listening. Monitory listening relates to what sonification researchers term peripheral listening, that is the monitoring of information in the background, while simultaneously attending to another task. The electrocardiogram (ECG) machines used in hospitals to monitor patients' heartbeats are a primary example of peripheral or monitory listening as is the continuous monitory listening by systems engineers to computer networks mentioned in chapter two. As sonification researchers claim, this is

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[341] Karin Bijsterveld*, Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5*,* 18.
[342] Ibid., 68.
[343] Steven Englehardt and Arvind Narayanan, "Online Tracking: A 1-Million-Site Measurement and Analysis," in *Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security - CCS'16* (the 2016 ACM SIGSAC Conference, Vienna, Austria: ACM Press, 2016), 1388–1401, https://doi.org/10.1145/2976749.2978313, 8.

when sound and listening offer an advantage to visual modes of representation and in particular for *Listening Back*, the ability to browse the Web, write an email, or buy a book while monitoring cookie activity is essential to the situated listening practice of experiencing post-panoptic surveillance in context.[344] For personal usage of the *Listening Back* add-on I define peripheral listening as a receptive mode of background listening to modulating cookie activity. For example, as I write this dissertation the Firefox browser is permanently open in the background and my computer permanently connected to the Web. Numerous tabs are open allowing for multiple websites to be loaded. Although Facebook is not one of these sites, each day I hear the sound of the Facebook cookie. A receptive mode of peripheral listening, in combination with a diagnostic listening, provides a sonic awareness that at least one of the websites is providing the means for Facebook to continually track me. The Facebook cookie, otherwise intangible, has been sonified to produce an aesthetic presence which presents a chilling reminder that although I am not logged into a Facebook account, the corporation persists in collecting personal data from what feels to be the privacy of my living room. This sonic alert disrupts and challenges the disappearance of the surveillance apparatus.

Sound as a signifier that transmits omni-directionally, facilitates a sonic alarm that represents a rupture to privacy even when I am not directly engaged in Web browsing. Rather than constituting a passive activity, the situated practice of background listening is more precisely a monitory mode in which listening is not the primary or singular task at hand and thereby enables an engagement with not only the real-time context of Web surveillance but the immediate physical environment in which Web connectivity takes place. Rather than requiring a fixation on the screen, as a visual mode of inquiry would demand, I can listen to Web surveillance as I turn from my laptop and engage my position in the familiar private setting of my home. Sound signals how data capture processes cross physical boundaries and affect beyond direct engagement with Web connectivity. Once a familiarity with particular cookie sounds is developed it is possible to engage a diagnostic listening across monitory and exploratory modes. Hence, modes of listening are not discreet but rather like sound itself, a modulating and fluid slippage between modes of engagement.

Sterne's conception of audile techniques navigated modernity and with it the professionalisation, industrialisation, and capitalisation of listening.[345] In addition to the perceptual modes of listening engagement, to listen back, as discussed in chapter one, is a practice of listening to continual non-

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[344] Bradley S Mauney and Bruce N Walker, "Creating Functional and Livable Soundscapes for Peripheral Monitoring of Dynamic Data," 2004, 5., 1. Kay Tislar et al., "Examining the Learnability of Auditory Displays: Music, Earcons, Spearcons, and Lyricons," in *Proceedings of the 24th International Conference on Auditory Display - ICAD 2018* (The 24th International Conference on Auditory Display, Houghton, Michigan: The International Community for Auditory Display, 2018), 197–202, https://doi.org/10.21785/icad2018.029., 197.

[345] Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Durham & London, 2003), 93.

stop algorithmic data capture processes listening in. These modes of computational listening are themselves a twenty-first century audile technique, one characterised by a surveillance (late)capitalisation of listening, that is, an automated, operational and algorithmic listening. The affordances and effects of the contemporary online surveillance state, similar to the omni-directionality of sound, is omni-directional in its ubiquity. Unlike the eye which can close, the ever openness of the ear as a multi-directional mode of perception provides an appropriate sense for appreciating the non-stop ability of machines to ubiquitously survey our online activity at all times. *Listening Back* intervenes in this technological context of ubiquitous data capture mechanisms embedded into varied cultures of everyday online technological mediation. It provides a platform to continually *listen back* to automated online data extraction as a contemporary mode of ubiquitous, by default always-on, computational listening. To *listen back* addresses the privacy asymmetry inherent to online surveillance by providing a means to perceive and *listen back* to the ubiquity of computational modes of listening.

To *listen back* is furthermore a situated mode of listening to data extraction within the real-time multi-sensory dynamics of Web browsing, and it maintains a relationship to the visual character of the Web. Returning to the first performance of Listening Back at SNO, it was here that I appreciated the visual presence and dynamic of the Web browsing experience. As previously discussed, I had invited three sound and music practitioners to perform with me as the Browser Ensemble. We sat huddled in the middle of the room, each with a computer, and the audience was free to walk around the room and look at our screens (see Figure 3.5). The experience of staging and performing everyday taken for granted Web browsing, for the first time helped me to understand the importance of engaging not just the listening modality but also the visual. I realised that the World Wide Web had a strong visual presence that was integral to the Web browsing experience. As Bijsterveld notes listening does not take place in isolation from the other senses[346] and following the first performance of Listening Back, my initial concept for a purely listening mode of examination was re-considered. Listening Back acknowledges interconnections with sensory modalities beyond discreet listening, and in particular as relevant to the dynamics of the Web browsing context. It engages not only sound and listening but also visual, textual, and haptic modalities experienced through the graphical browser interface, the touch of fingers on the keyboard, or the movement of the curser across the screen as messages are typed and hyperlinks clicked. As Bijsterveld argues, rather than isolating listening from other modes of perception, knowledge dynamics can be substantially deepened by attending to the ways listening informs knowledge-making processes.[347] Listening Back's use of sound to tangibly register and disclose hidden data capture engages in dynamic, performative and cross-modal interactions.

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[346] Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering* (1920s-Present) (London: Palgrave Macmillan UK, 2019), https://doi.org/10.1057/978-1-137-59829-5, 4 – 5, 14.
[347] Ibid., 62.

Video Documentation: http://www.jasmineguffond.com/art/PhD#SNO

Figure 3.5: Browser Ensemble, Trevor Brown, Jasmine Guffond, Emily Morandini, Gail Priest, SNO, Sydney, 20th April, 2017.

The Browser API

As a situated listening practice that navigates particular modes of listening, its instrument, the *Listening Back* browser add-on, has not unlike mediate auscultation, emerged from specific social, technical, and political environments. It is therefore determined by certain technical protocols, practical considerations, and cultural factors particular to the political and commercial context of post-panoptic Web surveillance. These include the parameters of the cookie data, Browser API's, online power asymmetries, limited access to data, Web browser opacity, proprietary secrecy, computing and processing power, the size of speakers on computers, and the humanly incomprehensible and ever evolving scale of online data capture infrastructures. As previously discussed, regarding the magnitude of networked data collection it is only possible to sonify a portion of its vast infrastructures. This is largely determined by the Browser API, a Web protocol critical to the *Listening Back* add-on and its deployment across artistic and personal listening contexts.

A Web API is a programming interface for a Web server or browser that predetermines the objects, actions, data, or protocol third-party developers may access in order to execute the development of a third-party application. Functioning as a gateway the browser API determines what cookie data

the *Listening Back* add-on can access. As Andrea Polli found regarding her sonification work in chapter two, as a translation process data sonification is a reductive procedure that necessitates a simplification of the data. The representational form of the data sets used is not a simple analog, but rather a process of translation techniques that are inherently reductional, indexical, and symbolic topologies. For *Listening Back*, this is first determined by the browser API and therefore the data Google or Mozilla allow third-party developers access to. This includes each time a cookie is inserted onto the user's computer, deleted from the user's computer, or overwritten, but other information such as when a cookie is read by the Web browser and the Web server are excluded. The limited cookie data set accessible for sonification is indicative of the proprietary control inherent to the political, technical, and commercial online surveillance context. It makes apparent privacy asymmetries intrinsic to the situation in which Web developers are provided with limited access to data in contrast with the capture-all logic of data extraction practiced by the data broker industry and Big Tech.

Breedon found a way to circumvent the browser API and access otherwise inaccessible data, such as how often a cookie is read by the Web browser and the Web server. Combining the data generated by cookies read resulted in an increase of at least double the amount of cookie data generated during a web page load. As there is already an extraordinary amount of data generated by cookies inserted, deleted, or overwritten, and I intended for the add-on to be available through the Chrome and Mozilla Web stores, I decided to exclusively use the data officially made available by the browser API. From the outset it became clear that the data I have access to is determined by major tech corporations and furthermore that there is a monopoly on distribution infrastructure, such as the Web stores for add-ons or Web browsers themselves.

The Web browser environment – while providing for more than the two commercial browsers we saw during the 1990s when the cookie was invented and net.art practices emerged – is dominated by Google's Chrome browser. As the world's most popular browser, Chrome serves as a critical gateway to the Web and provides Google with rampant opportunities for the extraction of data and control over online services, applications, and Web developers through its APIs and the Chrome store.[348] As the most widely used browser, I initially developed the *Listening Back* add-on for Chrome, and later made it available for Firefox. Besides Firefox being the browser that I regularly use, until *Listening Back* was available for Firefox, privacy activists interested in the add-on's educational potential to raise awareness, refused to use it with Chrome.

During the development phase I frequently accessed the cookie log provided by the Chrome browser via its API. It is a text that displays in real time which cookies are being inserted, deleted,

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[348] Fernandez et al., "The Financialisation of Big Tech." p. 46.

or overwritten on the user's computer. It provides the domain name of the cookie, its variable value, time stamp, and duration. This text was an important reference when trying to understand and decipher the cookiesphere, and it ranges from difficult to impossible to interpret[349] (see Figures 3.5 and 3.6). The cookie log's inherent inscrutability drew attention to the fact that certain technical processes are hidden or obscured, even from tech savvy programmers. As discussed in chapter two in relation to the black box as a metaphor for Web opacity, it is evident from the developer's cookie log that peering under the lid of the browser is too simple a gesture for deciphering the complexity of Web protocols. Rather than providing clarity and accountability, disclosure perpetuates technical bewilderment. It became evident within the technical protocols of the Web that algorithmic methods of online data extraction are well kept business secrets for major tech corporations and the online data broker industry. As previously elaborated, trade secrecy functions to confound programmers as well as users and constitutes a power that is normalised through its embeddedness in everyday technical mediation.

In addition to the access and legibility politics for cookie data, a further practical, technical and cultural limitation driven by Web protocols and the browser's design politics determined the development of the *Listening Back* add-on. As browser add-ons were never intended to process large quantities of sound, during the development phase certain websites were crashing the browser due to the sheer amount of cookie activity. I therefore had to limit the amount of cookies that can trigger sound at any one time to forty three. However, a Web browser is capable of sending substantially more cookies from the Web server to the user. This is indicated by the Internet Engineering Task Force's cookie implementation considerations and limits.[350]

Practical user agent implementations have limits on the number and size of cookies that they can store. General-use user agents SHOULD provide each of the following minimum capabilities:

- At least 4096 bytes per cookie (as measured by the sum of the length of the cookie's name, value, and attributes).
- At least 50 cookies per domain.
- At least 3000 cookies total.

[349] For instance, whatever information is collected on the user would probably be revealed by deciphering the 'varval'. However, this code is untranslatable to anyone but the programmer of the cookie.

[350] Barth, A. 2011, "HTTP State Management Mechanism" *Internet Engineering Task Force, Requests for Comments 6265*, https://tools.ietf.org/html/rfc6265, accessed March 28, 2019.

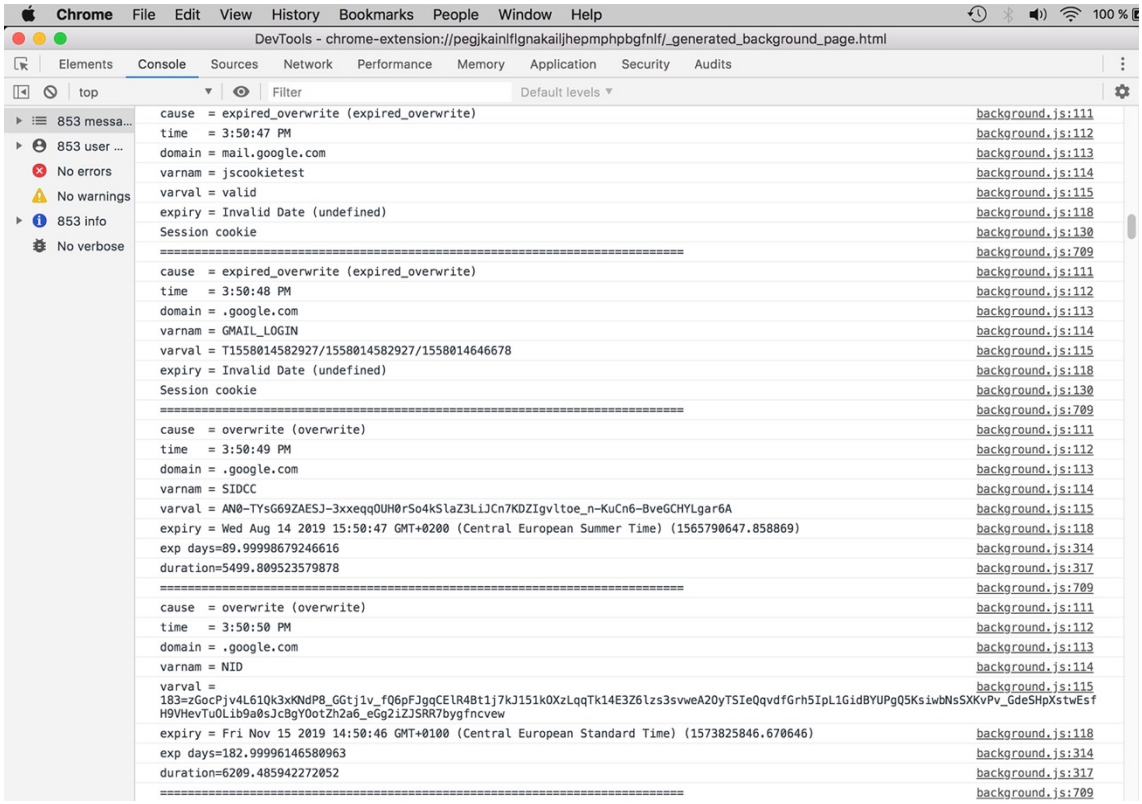

Figure 3.6: Chrome Developer Cookie Log.

Although I have limited the amount of cookies that can simultaneously trigger a sound, from fifty per domain to just forty-three in total, at times a digital almost distorted stuttering sound effect can be heard. It is an indicator that the computer is reaching the limits of its processing power and sounds very much like its teetering on the edge of collapse. I decided to allow for this 'on the threshold of malfunctioning' sound effect as an aesthetic reminder of the impact tracking scripts have on Web sites energy consumption, that is, the impact of their materiality. Rather than floating in infinite cyber space or in clouds, computers, the World Wide Web, and tracking technologies are defined by processing power, storage capacity, and network speeds. A sonic encounter with CPU limitations signals the material restrictions of computation and moreover the effect that tracking scripts have on network processing and ultimately, the environment.[351]

[351] Research into the energy consumption of the Web revealed that between 2010 and 2018 global IP traffic increased more than ten-fold and global data centre storage capacity by a factor of twenty-five. The world's largest data centres require the equivalent amount of electricity as it would take to power 80,000 U.S. households. Eric Masanat and Nuoa Lei, "How Much Energy Do Data Centers Really Use?" (Energy Innovation Policy and Technology LLC, March 17, 2020), https://energyinnovation.org/2020/03/17/how-much-energy-do-data-centers-really-use/. Within this context of extreme energy expenditure advertising and tracking scripts contribute to more than fifty percent of the Internet's energy consumption. Kevin Lozano, "Can the Internet Survive Climate Change? How a warming world is sparking calls for a greener web" *The New Republic*, 18 December, 2019, https://newrepublic.com/article/155993/can-internet-survive-climate-change, accessed May 4, 2020.

Performance Mode

In addition to shifting modes of listening during personal computer usage, a performative mode of Listening Back is explored through live performance. Here, the instrument of the add-on, developed within the cultural, political, and technical constraints of Web protocols, is explored as a means to engage a performative intersection between its potential as a musical instrument and as an audile technique for a live listening engagement with issues critical to post-panoptic online surveillance. Sonic skills are developed by performers who have spent time practicing with the *Listening Back* add-on in order to gain familiarity with the sounds of various websites. This set of performative sonic skills navigates a tension between a creative playing of cookies and a certain lack of creative agency due to *Listening Back*'s collaboration with Web protocols as dictated by corporations such as Google, Mozilla, Facebook, or Amazon. The process of creating the *Listening Back* add-on and then performing with it highlights the power relations and privacy asymmetries of the online space. Sonification strategies executed by performers are situated within complex, technical, commercial, and political networks where cookie data brings these asymmetrical sets of relations, as I will further elaborate later.

As a performance tactic that aims to discursively and sensibly highlight aspects of the cookie as a post-panoptic surveillance mechanism, one approach was the development of lecture-performances. This was first initiated at UNSW Galleries, Sydney (see Figure 3.7) followed by Ian Potter gallery at Melbourne University. Both performances were for the public program for Liquid Architecture and Melbourne Law School's Eavesdropping exhibition at Ian Potter Museum of Art in August 2018. At UNSW Galleries I performed as a duo with musician Lucy Phelan and at Ian Potter with artist Julie Burleigh. During a lecture-performance the duo formation permits me to present the project by speaking directly to the audience while the other performer browses. After a verbal introduction I join in browsing. This effectively communicated ideas related to cookies, Web surveillance, and the use of sound as critical mode of inquiry, while simultaneously experiencing cookie activity sonically and Web browsing visually, thereby contributing a sonification-based approach that aimed to be both communicative, informational, poetic, and musical.

Figure 3.7: Browser Duo: Jasmine Guffond and Lucy Phelan Eavesdropping Public Program, UNSW Galleries, Sydney, 2nd August, 2018.

I continued with the lecture performance format at the Web Audio Conference in Berlin in September 2018 with sound artist and researcher Jacob Eriksen as co-performer. As a compositional approach we determined a musical narrative by pre-selecting an order for Web sites to be accessed according to how they triggered sound via the add-on. News sites were selected for steady rhythms and Amazon and flight search engines for extreme amounts of cookie activity that contributed to impactful, tangible system overload. Eriksen contributed the idea of continually messaging each other via Facebook during the performance. Our banal chit chat provided a textual, performative, even entertaining narrative that functioned to engage the audience in another distinct way.

Firstly, humour was generated due to the performers constantly communicating via Facebook although in extreme proximity to each other, an unintentional satire for how our everyday communication is ever increasingly mediated by technology. Secondly, a couple of audience members commented that they could easily recognise themselves and identify with the process of messaging via a mainstream social media platform. Similar to responses from the Black Box performance, but with a larger international audience of strangers, the performative staging of the act of messaging provided a palpable contrast between what typically feels like a private communication and the experience of observing it performed in public. As a mode of *listening back* this performance tactic added to the sonic experience of real-time cookie activity by tangibly amplifying the un-private dynamics of using such Web platforms for personal communication. By engaging compositional techniques developed as performers who had spent time practicing with the *Listening Back* add-on, the addition of performance tactics such as Facebook messaging,

enhanced the continual soundtrack of cookie activity and the sonic registration of how monitored such online communication practices actually are.

Video Documentation: http://www.jasmineguffond.com/art/PhD#WAC

Listening Back fulfills the structural concept for indeterminate music composition as the musical structure is not strictly determined by a composer, but rather by personal browsing routines which generate variating cookie activity. Structure and outcomes are accordingly difficult if not impossible to control as cookie activity will differ, even when loading the same Web page as the commercial industry of the online tracking environment determines the fluctuating distribution of cookie activity. For instance, it became apparent that the allocation of third-party tracking cookies differs over time. The Guardian had been hosting krxd.net third party cookies when I began developing this project in 2017, and in 2020 the krxd.net cookie had disappeared from the Guardian news website. In this way the data broker industry is a co-composer, as are Google and Mozilla who determine what cookie data I have access to through their browser APIs. This reflects a general lack of user and also programmer agency in online environments. Employing the cookie mechanism as co-composer highlights characteristics of an environment in which the data broker industry and major tech corporations are co-composing online experience through the extraction, collection, aggregation, and sale of personal data which is in turn used to curate our news feeds, access to information, and cultural experience. Listening Back enables a real-time engagement with characteristics of the politics of Web surveillance through the act of Web browsing which is at once a performative and compositional gesture in collaboration with Web surveillance algorithms as we shall see with the Browser Ensemble performance at EAVESDROP festival in Berlin, November, 2017.

The Browser Ensemble EAVESDROP Festival, Berlin, 2017

Video Documentation: http://www.jasmineguffond.com/art/PhD#eavesdropfestival

The need to be adaptive during live performance with real-time cookie algorithms extends to human collaboration. As part of my artistic research I collaborated with various performers as each brought a new aesthetic approach and engagement with the performance of Listening Back. A Browser Ensemble consisting of Jessica Ekomane, Felicity Mangan, and myself performed at EAVESDROP Festival in Berlin in 2017 and again at Hangar in Barcelona in 2018 (see Figure 3.8).

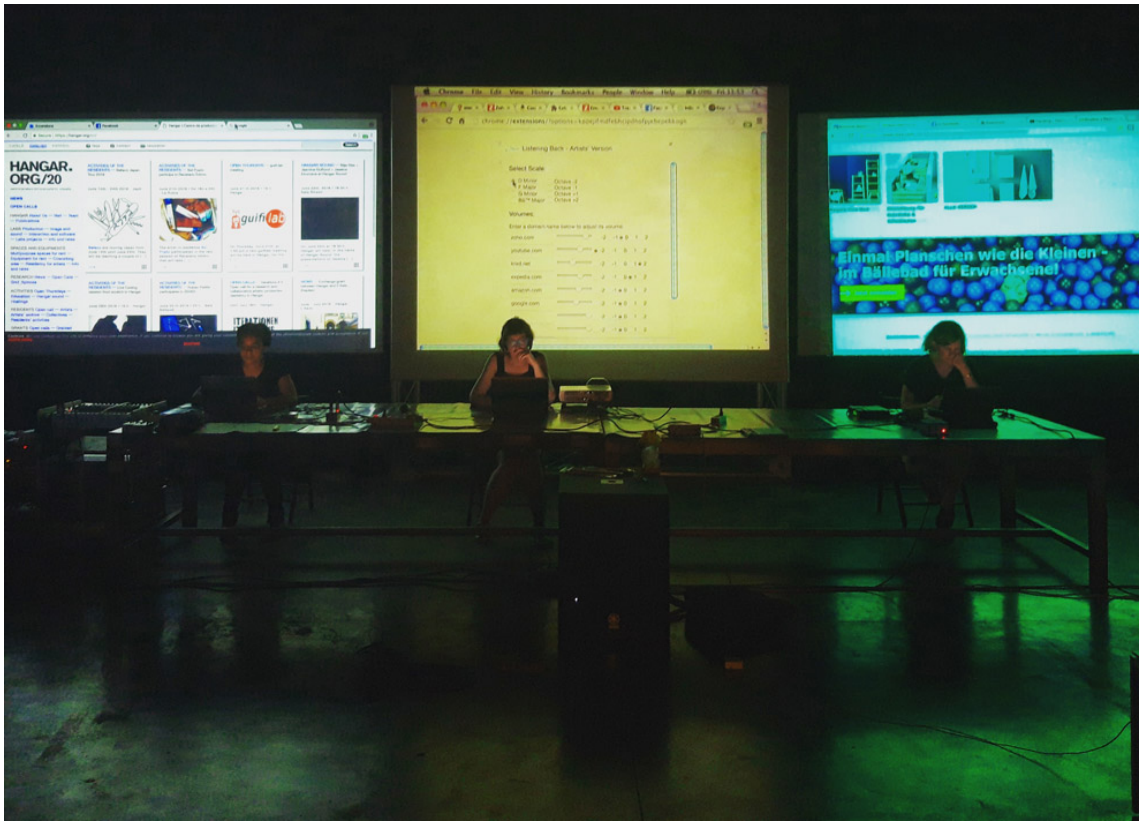

Figure 3.8: Browser Trio: Jessica Ekomane, Jasmine Guffond, Felicity Mangan. Hangar, Barcelona, 22nd June, 2018.

Three people simultaneously browsing generates a large quantity of cookie activity capable of producing an extremely dense and multi-layered sound. I therefore adopted the approach of accessing websites with little cookie activity in contrast to the websites Ekomane and Mangan chose to visit. This provided a visual poetics between the contrasting interfaces of non-commercial websites such as Wikileaks and corporations such as Facebook or Ikea. For the performance at EAVESDROP festival, Ekomane and Mangan were generating sounds by browsing Facebook, Ikea, YouTube, as well as shopping and ordering a pizza. Meanwhile, I was reading the Wikileaks website as well as checking Gmail, Facebook, and the Guardian. We had a four-speaker system that surrounded the audience and we sat in the middle of the room. Our laptop screens were projected onto the walls of the venue. Although I was consciously choosing to load websites with minimal cookie activity, due to the noise making tendencies of Ekomane and Mangan's personal practices as well as their browsing choices the concert unfolded as an onslaught of noise. In this way each and every live performance varied thematically and sonically according to individual performers. A general response was for audience members to be surprised at just how many cookies are continually tracking us. Although there is a general awareness of cookies, due to these processes being intangible the effect of making them audibly present highlights how disconnected one is from being continually surveilled while browsing online. This addresses a politics of sensibility-

formation and a hopefulness that by highlighting data with political consequences, aesthetic strategies of awareness will affect a new attentiveness, understanding, knowledge, and even change.

This chapter has examined the practice of Listening Back as a sonic Web based art practice that situates an embodied listening within the real-time ontological and socio-political context of Web surveillance. The *Listening Back* add-on is artistically deployed across personal computer usage and live performance or installation and its interface enables users to engage various modes of listening attentiveness to real-time cookie data while affording performers musical options for playing cookies. By providing the opportunity to develop sonic skills in a listening navigation of data collection processes, the *Listening Back* add-on extends the possibilities for sonified Web tracking projects by enabling personal usage and customisation of sonified data sets. The process of mapping sound to real-time cookie activity during the initial research phase of the add-on development provided a practical appreciation for the lack of user and programmer agency intrinsic to the commercial online surveillant context, technically dictated by proprietary Web protocols such as browser APIs. As a mode of critical sonic inquiry, to *listen back* is to engage across sensing and critical modes of experiential analysis. Sound's affecting, omni-directional, and durational attributes are engaged to render real-time cookie activity sensible. By sonically signaling their situatedness within the Web browsing context, alternate Web spaces are facilitated to consider the politics of being continually tracked while browsing the Web. By contributing sounds affecting and time-based attributes to the practice of creative browser add-ons, *Listening Back* extends their aesthetic register for a unique appreciation of Web surveillance's ubiquitous prevalence.

CONCLUSION:
Post Third-Party Cookies

In 2019 Google announced "privacy sandbox" – a proposal to program a more private Web, and since then, Google has announced its intention to block third-party cookies in the Chrome browser by January 2022.[352] Through initiatives such as the Federated Learning of Cohorts (FLoC), the aim is to develop alternatives to third-party cookies so that advertisers can track consumers in a way that Google argues would be more private. As a new online tracking technique, FLoC employs machine learning to group people with similar interests and demographics by enabling a browser to collect data which is then purposed to assign individuals to a cohort.[353] Instead of personal data typically provided by the third-party cookie to advertisers, Google's cookieless method categorises groups of at least one thousand people, an obfuscation tactic that proposes to hide users within a crowd of similar interests. However, FLoC is deeply flawed – aside from the third-party cookie, it does not remove other forms of tracking and analysis but rather adds to them, rendering users potentially easier to identify.[354] The question is not whether to track user activity, but rather how to present an automated tracking technology as being somehow more private. Rolled out with Chrome 89 in March 2021,[355] the FLoC initiative is an indicator that the Web surveillance context in which my Listening Back research has taken place, is continually evolving. Driven by the commercial imperatives of Big Tech, as was made apparent during the research and development phase of the *Listening Back* add-on, the Web tracking ecosphere is complex, largely controlled by proprietary protocols, and subject to ongoing change.

In chapter one of this thesis I drew upon surveillance studies and postmedia theory to show how Web surveillance, largely dependent on automated data capture, has become post-representational. This operational condition renders the ever-changing infrastructure of online surveillance difficult to engage with and comprehend, as these algorithmic processes often bypass human, semantic modes of comprehension. Over the course of this practice-based research I have addressed the post-representational character of Web surveillance through the development of creative sounding strategies for rendering the continual and ubiquitous flux of the ever evolving cookiesphere,

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[352] Bennett Cyphers, "Don't Play in Google's Privacy Sandbox," *Electronic Frontier Foundation*, August 30, 2019, https://www.eff.org/deeplinks/2019/08/dont-play-googles-privacy-sandbox-1, accessed May 26, 2021.
[353] Kate Kaye, "Life Beyond the Cookie. Publishers like The Guardian Become Conscientious FLoC Objectors, as The New York Times and Others Open to Testing the Controversial Tech.," Digiday, April 26, 2021, https://digiday.com/media/publishers-like-the-guardian-become-conscientious-floc-objectors-as-the-new-york-times-and-others-are-open-to-testing-the-controversial-tech/, accessed May 27, 2021.
[354] Zak Doffman, "Why You Should Avoid Google Chrome's New FLoC Tracking," May 1, 2021, https://www.forbes.com/sites/zakdoffman/2021/05/01/stop-using-google-chrome-on-your-iphone-android-macbook-and-pc/?sh=aedc09a539b3, accessed May 26, 2021.
[355] Frederic Lardinois, "Google Starts Trialing Its FLoC Cookie Alternative in Chrome," *Tech Crunch*, March 30, 2021, https://techcrunch.com/2021/03/30/google-starts-trialling-its-floc-cookie-alternative-in-chrome/, accessed May 27, 2021.

sensible for human experience. Through the artistic deployment of the *Listening Back* browser add-on across live performance, installation, and personal computer usage, I have shown how sound's time-based experiential attributes effectively render a real-time experience of the flows, patterns, and repetitions of the ubiquitous flux of cookie activity.

The first performance of Listening Back at Sydney Non Objective (SNO) in April 2017, was formative in orienting my creative practice in an appreciation of, and engagement with, the multi-sensory dynamics of Web browsing. Through further live performances across, gallery, music venue, and conference contexts, I developed creative strategies for engaging an embodied listening within the multi-sensory dynamics of Web browsing and the sonic exposition of its underlying surveillant networks. In live performances with the browser ensemble, trio, or duos, the act of Web browsing was amplified and enlarged via video projections and multi-channel sound systems as a means to increase appreciations of the ubiquity and pervasiveness of Web surveillance. These enveloping sensory environments facilitated alternate Web spaces to consider the normalisation of Web surveillance through critical and bodily felt encounters with abstract data flows. Similarly, for the gallery installation at SNO, an immersive Web browsing environment was produced to increase human connections to cookie data and offer a more considered and exploratory engagement through the possibility of interaction. Through personal usage of the *Listening Back* add-on, the listener is sonically situated within the surveillant networks of their own browsing. The possibility to experience the persistent flows of Web tracking in private settings from personal devices affords another experience of real-time, invasive, cookie activity. In these intimate situations the sonic interruption of everyday browsing, effects an individual experience of being continually and ubiquitously tracked by the ever-evolving cookiesphere.

At the Black Box performance in May 2017, we incorporated the projection of our laptop screen displays for the first time. The magnification of the graphical browser interface helped me appreciate its functioning as a pleasurable means of accessing the Web and simultaneously as a site that concealed algorithmic processes of post-panoptic Web surveillance. In chapter two I examined how differing creative strategies interrupt the opacity of the browser interface to reintroduce narrative, symbolic, poetic, and sense making Web spaces for facilitating new understandings of the effects of proprietary infrastructures and online surveillance. Through comparative analysis to these ethico-aesthetic, visual, and data obfuscation tactics the practice of Listening Back explored what the experiential attributes of sound can bring to the artistic online practice of browser add-ons and the experience of Web surveillance. Through the installation at SNO and my artistic work discussed in this thesis I would argue that sound's time-based and affecting characteristics contribute an embodied experience and procedural method for engaging real-time post-panoptic surveillance in situ. In addition, I have identified and employed strategies in creative data sonification practices that utilise sound as an affecting medium for signaling data with socio-political consequences. A sonic

mode of inquiry, such as undertaken by Listening Back, I argue, engages both sensing and critical modes of experiential analysis.

Finally, drawing on the concept of sonic skills, I have demonstrated the development of a set of ideas and practices to formulate a critical engagement with cookie activity through listening. In performative contexts we explored the potential of *Listening Back* as a musical instrument and means to performatively disclose the hidden ecosphere of everyday endemic Web surveillance, exemplified by cookie activity. In combination with a developing understanding of cookie categories, the *Listening Back* interface was further expanded to encourage a diagnostic listening to real-time cookie data subsets. This mode of engagement provided by a browser add-on extends the accessibility of other sonified Web tracking projects and the affecting and conceptual engagement with cookies to everyday personal usage. Key findings highlight how sound's durational and omni-directional functioning registers online surveillance as occurring spatially, temporally, and ubiquitously, thereby extending the sensory, spatial, and temporal effects of sound to the practice of creative browser add-ons and the experience of a real-time post-panoptic surveillance technique.

Listening Back proposes the creative potential of sound to provide a supplementary layer of sensory information to advance experiential engagement with post-representational Web surveillance through its aesthetic disclosure during the everyday act of browsing the Web. Considering the ever evolving online tracking ecosphere, the artistic practice of *listening back* to cookies is an open-ended proposal that could be further developed to include the sonification of other and newer tracking scripts. To this end I plan to make the source code available in the tradition of open source coding practices. To make the source code open invites anyone with the inclination and programming skills to develop their own adaptations for the add-on as well as build upon and evolve its artistic and functional potential for other contexts and usage. As a critical mode of sonic inquiry developed throughout this doctoral candidature, Listening Back offers a proposition for investigating algorithmic Web surveillance by providing a new creative sounding approach to experiencing how the operations of post-representational Web surveillance are continually and ubiquitously taking place.

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