



Research Article

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Hitting the ‘pause’ button: What does COVID-19 tell us about the future of heritage sounds?

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Abstract: Human existence is accompanied by environmental sounds as by-products of people’s activities and sounds that are intentionally generated to allow human society to function. The resulting soundscapes that surround people’s daily existence are subject to technological, as well as behavioural change. Cultural heritage management has begun to address the question of which sounds and soundscapes should be preserved and maintained as part of humanity’s legacy to future generations. A side-effect of the dramatic social and behavioural change caused by governmental responses to COVID-19 has been a dramatic temporary alteration of urban cultural soundscapes. In this paper we will consider the nature and extent of these and will explore to what extent the COVID-19-induced reality can be employed to project a future of urban cultural soundscapes if no active heritage intervention were to occur.

Keywords: audio heritage; soundscapes; urban sounds; sound loss; COVID-19

1 Introduction

The study of human environmental sound is multi-disciplinary, informed by research ranging from acoustics and urban planning, to landscape ecology and cultural heritage studies. Research has been undertaken in various aspects of sound in the natural and built environment, including negative effects [1–3], positive effects [4, 5], and the absence of sound or quietness [6, 7].

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Research has also investigated the notion of soundscapes in both natural and human environments, with a soundscape being constructed from the totality of sounds within the physical environment, itself an interactive construct between the listener and the sounds themselves [8–10]. Being an anthropocentric concept, the attractiveness of a soundscape, or parts thereof, is largely determined by the listener’s perception of the sound(s) in question, influenced by prior experience and cultural background of the listener, as well as circumstantial context and volume of the sounds themselves [9–14]. Soundscapes have been examined across a multitude of areas of the environment, including indoor urban spaces [15–17], outdoor urban spaces [18–20], transportation systems [21, 22] and in the natural environment [23, 24].

Soundscapes have conventionally been classified into three distinctive features; keynote sounds (omnipresent sounds of a particular place – the everyday behaviour sounds of a society), signal sounds (operational sounds emanating from warning devices or similar) and soundmarks (iconic sounds of a particular place) [25]. The importance and uniqueness of a soundmark is significant when attempting to understand community values towards soundscapes, and the idea has been implemented in a number of soundscape studies worldwide [21, 26–29].

Projects have investigated the hustle and bustle of cityscapes in numerous cities globally, giving plenty of examples of soundscapes created before the period of the COVID-19 pandemic in 2020. Some in-depth examples include: the examination of the soundscape of Indonesian cities, comprising of sounds such as the call of public transport workers, the *Azan*, individually recognisable ambulant vendor calls, incessant beeping of vehicle horns, air traffic sounds, pop music blasting from shopping malls, and singing of public karaoke [30]; the discussion of the symbolic and ideological nature of the relentless honking of car horns in public spaces of Indian cities [31]; and the identification of the major sounds of Istanbul, which combined gives the city its unique busy sonic culture [28].

Hustle and bustle transport sounds have also been investigated and documented within urban environments, although the majority of these undertakings have primari-

ly focussed on transport emanation sounds negatively as a function of noise. Examples include sound emissions from railway traffic [2, 32], aircraft [7, 33], and vehicular traffic [22, 34].

2 Pre-COVID-19 trajectories of sound

Throughout history, technological advancements and changes in societal function have admitted corresponding changes to both sounds generated in the human environment, and the sound-making devices themselves [35]. Devices can be rendered obsolete, policy or legislation may silence activities or devices, and the nature of society may change depending on a myriad of factors such as a variation in age, gender, or cultural background of a community. Conversely, as technologies are improved and societies change, new sounds enter our environment and become part of the soundscape.

Technological changes in transportation methods can be considered the most recognisable, with the entities in question being ubiquitous and commonly used. Such examples include the introduction of electric powered objects (electric cars/planes/trains) in the place of diesel or other combustion powered machines (steam trains/paddle steamers/steam ships/diesel or petrol vehicles), which originally replaced wind driven or animal-powered objects (sailing ships/horse and cart transportation) [36–40]. At each point of change of the trajectory, objects and associated sounds become functionally lost, albeit at a steady but increasing rate of change.

Historical obsolescence through technological change can be best seen when one functional item undergoes significant advancement over a period of time, with an excellent example being that of a foghorn – an audible lighthouse. Advancements in technology have allowed the design of foghorns to be developed through a multitude of ways; from gongs, bells and rockets, to electronic reeds, sirens and diaphones, until recently becoming functionally obsolete due to further advancement in navigational practices [35, 41]. Again, sounds associated with any obsolete/decommissioned objects become functionally lost at each step of advancement, taking a by-and-large linear trajectory of technological change.

Regulations and policies imposed by governments worldwide also have potential ramifications on related sounds, including if the regulation affects sound emanation, the allowable use of the device, or the event in which the sounds were traditionally produced. Regulation has

historically been used to control sound emanating from religious buildings, with examples including the restriction of church bell ringing as a result of Turkish regulations in Constantinople in 1453, and Soviet decrees in both Pre-Second World War Russia in 1930 [42] and Post-War Yugoslavia in 1953 [43]. Such controlling measures are usually associated with large scale political ideologies or events, and are developed over an extended time frame of human existence.

In more recent times, restrictions on emanating sound from religious structures have also been implemented. Churches in Australia have been subjected to noise complaints by the surrounding community about their church bell ringing, and have been required to limit the frequency of ringing events, incorporate soundproofing into the bell chamber or undertake other muffling actions [44–46]. Similar government measures have been undertaken to reduce and eliminate the amplitude level of mosque broadcasts within suburban areas in both Indonesia and China [47–49]. Religious buildings have also taken self-regulation of their own sounds, largely in an early defence against any expected animosity from the wider community [50]. Similar trajectories of decreased religious sound emanation may be expected to continue, in correlation with a general increase in secularism in many liberal western societies [51–53].

Government regulation in place to minimise transportation sound is also a driver for the market to undertake technological advancements specifically relating to lowering sound emissions, with research investigating low noise technologies from aircraft [54], trains [55], ships [56] and at airports [57]. It is expected that a similar decrease of sound emanation is to occur with transportation sounds in the future.

These examples shown here highlight that changes to sound emanation and sound emitting devices from the urban environment are largely influenced by technological advancement and societal change. The trajectories of change in the past are by and largely linear, with a similar change over time albeit at a higher rate as modernity increases. Such trends are expected to continue into the future, save for any disruptive technological innovation or large scale political or ideological event.

It is also expected that as sounds continue to transform, existing sounds are rendered practically or functionally obsolete. If any of these potentially lost sounds have value placed on them by society, sound loss could therefore have ramifications for management, and responsibility should be taken to address any problems before the loss of sound takes effect [35].

3 COVID-19 as a cross-sectorial disruptor

The emergence of COVID-19, the coronavirus disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [58], in January 2020, and its rapid development into a global pandemic has been chronicled in the global media. At the time of writing, it is still raging on several continents. While COVID-19 is not a 'Black Swan' event as the emergence of a SARS-like coronavirus was predicted by public health professionals [59], its rapid spread, global reach, intensity and cross-sectorial impact has no predecessor. Even the last pandemic, the influenza ('Spanish flu') epidemic of 1918–1920, while global and severe, cannot serve as a template as the world at that time was not as interconnected, and the economy not as globalised as it is in 2020. At each national level, government reactions to curb or slow the progress of COVID-19 have seen the restriction of international arrivals, the temporary shut-down of non-essential businesses, and the restriction of human movement during periods of lockdown.

Personal and elective international and domestic air travel was either terminated or restricted to repatriation flights [60, 61] with flow-on effects to the tourism industry [61, 62] and the communities and conservation organisations that rely on tourism income [63]. The associated reduction in air cargo volume [64], as well as overall shipping [65, 66] resulted in disruptions to global as well as national supply chains, not only of manufacturing parts [67] and health care materiel [68, 69], but also of food production [70, 71] and food distribution [72, 73], which in part was fuelled by panic buying [61]. In consequence, COVID-19 acted as a disruptor affecting labour markets, in particular expatriate workers [74, 75], with cascading effects on remittances [76], and thus local economies in countries of origin [77].

The disruption caused by COVID-19 also resulted in a range of environmental side effects, which are perceived to be beneficial, such as reduced air pollution on a local [78], national [79, 80], and global scale [81], reduced recreational fishing pressure [82], and reduced pressures on wildlife [83] with increased sightings of uncommon species in urban [84, 85] as well as near-shore areas [86] and, at least temporarily, reduced pollution of beaches [86]. The reduced human activity also had a flow-through effect on the nature, volume and geographical distribution of human-generated sounds. It manifested itself as a seismically detectable reduction in ground vibration [87–89] and the reduction of boating and shipping noise in coastal marine environments [86, 90]. In the fol-

lowing section we will focus on the effects of COVID-19 on urban soundscapes.

4 Impact of COVID-19 on soundscapes

COVID-19 as a cross-sectorial disruptor affected the sound emissions of a wide range of human activity. Changes to human movement and activity reduced direct and indirect sound emissions, in particular from traffic, factory and recreational sources.

An example is air travel restriction which globally resulted in reduced air traffic [91] and thus also air traffic noise. Greater Sydney and Greater Melbourne, Australia's largest and second-largest cities (pop. 5.312 million and 4.936 million respectively), can serve as examples. In the pre-COVID period, Sydney Airport handled between 770 (weekend) and 1040 (weekdays) aircraft movements per day [92], 2% of which were freight [93]. During lockdown (April 2020), aircraft traffic volume dropped to 30.4% of the previous year's volume for aircraft larger than 136t (mainly overseas flights) and to 8.6% for aircraft between 7t and 136t (mainly domestic flights) [94, 95]. Concomitantly, the noise levels under the flightpaths have dropped to negligible levels, so much so that children noticed and pointed out a passenger plane going overhead which prior to lockdown had been ignored (pers. obs. DHRS). Similarly, road traffic abated but not as dramatically, as travel to work was permitted for people could not work from home or whose presence at the workplace was deemed essential (e.g. emergency staff). During lockdown, vehicular traffic in Sydney dropped to between 52% and 81% (arterial road vs. shopping street) of the previous year's volume (April data) on weekdays and to between 36% and 58% on weekends. The lack of traffic effected the city unrecognisable from its usual busyness, with the silence being palpable and being described as deafening [96]. At the same time, dispatch data of the NSW Police force, show that the level of call outs where sirens were likely to be used (priority 1 & 2 incidents) showed only a minimal drop (81%) compared with 2019 data [97].

Similar downward trends were observed in the Melbourne region. Greater Melbourne aircraft traffic volume in April 2020 dropped to 19.8% of the previous year's volume for aircraft larger than 136t and to 9.6% for aircraft between 7t and 136t [94, 95]. In the Melbourne CBD, vehicular traffic dropped to 55.9% to 66.4% (main roads [137, intersections] vs corridor roads [104, intersections]) of the previous year's volume on weekdays and to 35.5% to 45.3% on



Figure 1: The effects of the lockdown on the main shopping street of a regional community (Albury, NSW, 18 April 2020)

Sundays [98, 99]. Pedestrian traffic in Melbourne dropped during lockdown to 14.6% of the previous year's volume in the CBD (average of 44 locations) and to 34.8% at the Queen Victoria [fresh food] Markets [100].

Such reductions in air, vehicle and pedestrian traffic volumes have occurred in other jurisdictions, which resulted in changes to urban noise volume. The changes to urban soundscapes have been pronounced and have been noted by a number of authors in places as diverse as Los Angeles, New York, Seattle and Washington (all U.S.A.) [101–105]; Paris (France) [106]; New Dehli and Kolakata (India) [107, 108]; Rome (Italy) [109]; Truro, NS (Canada) [110]; Hobart (Australia) [109]; and Kobe (Japan) [111]. Changes in sound levels often varied as a function of urban context: a study in the city of London (UK) showed a reduction in sound level of up to 10.7 dB, with socially active and traffic dominated areas being the most heavily affected (−6.6 dB and −4.5 dB on average respectively), compared with quiet areas (−3.6 dB on average) [112].

These quietening effects of COVID cannot be generalised, however, as exemplified by a case study of a quiet residential area in Kobe (Japan) [113]. Here, little differences were observed, with enforced measures only showing a reduction of around 1–2 dBA, despite some residents reporting a perception of neighbourhood sounds being heard more clearly during this period [111]. This highlights the need to consider culturally conditioned work and leisure habits as well.

The reduction in human activity during the lockdown period led to a drop in the volume of transportation as well as construction sounds in the urban soundscape, which meant that signal sounds created a stronger audible presence than otherwise. This applied to the sirens of emer-

gency vehicles, as for example noted in New York [102, 114]. For some, the increased audible presence of these was perceived as 'unrelenting' and 'nerve-racking,' causing increased levels of anxiety [114]. As one resident put it: "[sirens] are supposed to get your attention amongst distractions. Now the distractions are uncomfortably absent" [Mullens quoted in 114].

Unlike soundscapes that are a by-product of human activity and thus sensitive to changes in that activity (e.g. traffic sounds, emergency vehicle sirens), church bell ringing creates a soundscape that is directly influenced by purposive human action [50]. The COVID lockdown created mixed effects, with some churches ringing more frequently to assert their presence even though regular services were suspended, while others fell silent. This played out to varying degrees, *inter alia* in the U.S.A. [115], the United Kingdom [116], Germany [117] and Australia [118].

In Abu Dhabi, the *Azan*, the Muslim call to prayer broadcast from the minarets of mosques, while adapted from a call to come to prayer (هيا للصلاة) to a call to pray at home (عسست في بيوتكم), has not changed in frequency of occurrence [119]. In Canada, the *Azan*, was for the first time publicly broadcast from many urban mosques during Ramadan 1441 (i.e. 2020). As this coincided with the pandemic-induced reduction in ambient transportation and construction sounds, the audible reality the novel soundmark was much more pronounced, which inevitably led to (in part Islamophobic) noise complaints [120].

The development of COVID soundscapes was not solely subtractive, however. Novel soundmarks also emerged during the pandemic, such as the weekly (in some countries daily) clap for essential and medical (front-line) workers in numerous countries, such as Austria [121], France [106], Germany [122], Ireland [123], Portugal [124], Spain [125], the United Kingdom [126] and the USA [127, 128]. In addition there were musical flash mobs, such as people *impromptu* singing and playing from balconies in Siena (Italy) [129] as well as organised nationwide events in Italy [130], and the playing of instruments, utensils, bells and conch shells in many states of India during a 14 hour self-imposed curfew [131]. Such ephemeral auditory events may have potential short- or long-term sociological effects on both local and national populations, and, while outside of the scope of this paper, the nature and effect of these temporary soundmarks warrants future research.

5 Conceptualising post-COVID-19 trajectories

The COVID-19 pandemic has demonstrated how a stochastic disruptive event can dramatically alter community soundscapes. The critical question is to what extent the event engendered permanent change and to what degree the communities snapped or slid back to pre-pandemic conditions once the stringent lockdown conditions were lifted. During the height of the lockdown, frequent calls were made to consider systemic change to urban traffic systems and general designs of urban spaces [132, 133]. It is yet too early to determine what lessons urban planners will extract from the pandemic, and to what extent these lessons will actually be incorporated into future urban design. It is not too early, however, to consider the effects of the lifting of lockdown conditions on urban soundscapes.

Returning to the previous cited cases of Sydney and Melbourne, the data for June 2020 are illustrative of the extent of snap-back of traffic towards pre-COVID conditions. While some restrictions on the size of gatherings remained, general travel, as well as a return to work was permitted. This is well reflected in the vehicle traffic data, which in Sydney had risen back to 78%–95% (arterial road vs. shopping street) on weekdays and to 73%–87% on weekends [134], as well as in the police siren call-outs which returned to 95% of 2019 levels [97]. Vehicle traffic in Melbourne had increased back to between 78.3% and 96.8% (main roads vs corridor roads) of the previous year's volume on weekdays and between 49.4% and 62.7% on weekends [98, 135]. These changes are a reflection of straight snap-back to a pre-COVID era once personal restrictions were removed. While the soundscapes associated with urban transportation and associated activity show little change during the work week, they remain diminished on Sundays, indicating a reluctance of people to immediately re-embrace pre-pandemic conditions except where required (e.g. return to work). This interpretation is underlined by the Melbourne pedestrian traffic data, which only recorded a moderate rise back to 39.3% of the previous year's volume in the CBD (average of 44 locations) and to 52.8% at the Queen Victoria [fresh food] Markets [100].

Air travel can serve as a proxy to consider longer-term external influences. International air travel remained severely restricted due to an ongoing ban on overseas travel [136], and domestic travel remained depressed due a lack of inter-state tourism, resulting in a much slower recovery for this sector. In Sydney (Melbourne), movements of very large aircraft ($\geq 136t$) were at 17.9% (23.4%) of 2019 values, while those for other commercial aircraft (7t–136t)

were at 8.6% (12.6%) of 2019 values [137, 138], 10% of which were freight (data FlightRadar 24).

Considering pedestrian traffic on Sundays as a proportion of the average daily traffic on weekdays provides an insight into human behaviour and resulting soundscapes. During lockdown in April 2020 that proportion was 70.9% in the CBD, contrasting with 76.5% (71.7%) in the pre-pandemic period April (June) 2019 [100]. The relative importance of largely non-work foot traffic dropped by less than 10 basis points, reflecting movement restrictions (but movement for exercise was permitted). This needs to be contrasted with a 89.8% value in the immediate post-lockdown period (June 2020) showing that, while the overall pedestrian usage was less than in the pre-pandemic period (see above), people availed themselves of the newly re-found ability to move freely on their days off work.

As expected, the novel soundmarks that emerged during the lockdown period proved to be ephemeral. The musical flash mobs are gone as is the weekly clap for frontline workers. The latter ended some eight weeks after it started, with not only the founder (in the UK) calling for its end (on 22 May) [139] but also some of the 'beneficiaries' of the events decrying it as meaningless and self-serving allowing those clapping to assuage their guilt and fears [140]. Churches gradually reverted their bell ringing patterns to pre-COVID conditions, but the recovery has been uneven and subject to local conditions [118].

In conceptualising post-COVID trends of soundscapes, we need to take into account numerous possibilities that may ultimately lead to the termination of restrictions and/or lockdowns in any given country, combined with governmental and public responses in each of these circumstances. It is possible that with the large number of vaccine candidates currently nearing middle or final stage trials, global production of a COVID-19 vaccine may transpire in the short to middle term [141]. If this was to occur, it would be expected that human activities (with associated sounds and resultant soundscapes) would undergo a snap-back process, in a manner similar to the above data for Sydney and Melbourne. Since with a successful vaccine, imposed restrictions would be lifted and physical distancing requirements be no longer required, it is conceivable that work, vehicular travel and social engagements would return to pre-COVID times. While domestic air travel is likely to return to near pre-pandemic levels, international travel may be inhibited until such time that vaccination reaches saturation levels on a multi-lateral if not global scale. However, the speed of such a recovery might be slowed due to COVID-induced economic depression [142], social anxiety [143] as well as future workplace restructures, such as the increased potential to work from home using digital

technologies [144]. Furthermore, with some countries installing infrastructure to support active transport such as walking and cycling, a ‘recovery’ to past soundscapes may be further impacted [145].

However, it is entirely possible that no successful (or limited) vaccine is generated, or that the uptake of the vaccine is too low to ensure herd immunity [146]. In such a case, there are three possible resolutions for society: continue with current restrictions; lift restrictions with re-imposed restrictions as conditionally required; or lift/remove all restrictions and accept what ramifications this may entail. As each of these choices would directly affect human activities, resultant soundscapes in a future world are strongly contingent on government choices and imbued regulations and controls.

6 What COVID-19 can tell us about the future of heritage sounds?

There are specific sounds, soundmarks and soundscapes that contribute to the cultural heritage of many localities and communities [147]. Such heritage soundscapes may also include internal acoustic environments of historical buildings [148], open-air sites of archaeological interest [149], and sounds associated with the fabric of historic memorials and locations [150]. From a heritage management perspective the diminishment or loss of these needs to be managed [35]. While standards have been developed to define soundscapes and their documentation [10, 151], heritage legislation and associated instruments on an international [152] and national level [153] have struggled to include auditory heritage in their management framework. While expressions of human communication through spoken words (language) and song are deemed to be heritage and thus formally collected and documented [154, 155], the preservation of sounds that are at risk of extinction due to technological obsolescence, societal disinterest or legal restrictions poses conceptual and managerial challenges to the heritage profession [35].

Cultural heritage management is based on an understanding of individual and community values [156, 157], whereby knowledge of context is an important factor [153]. This holds true for the understanding of heritage soundscapes as well [158]. Cultural heritage management, as a discipline, requires hindsight to be able to adequately assess the significance of the presence or loss of practices and places [159, 160]. In most cases a certain passage of time has to have occurred for the cultural and historic context to develop until the significance can be assessed, be-

cause an instant realisation of significance is rare [161]. COVID-19, with its rapid global spread, its cross-sectorial impact and the reaction by various governments to curb the spread of the virus, brought about, in heritage terms, instant change of conditions. This presents a unique opportunity to consider implications on sound heritage.

It is too early to determine how pre-COVID-19 sounds and soundscapes may change over the longer term, as this is dependent on the success of health measures and future government imposed regulations. The changes that have occurred with respect to sound may indeed return to their former levels, or they may diminish with the progression of time. However, the COVID-19 pandemic does provide us with a snapshot of the degree of sound change as of today compared with the situation at the outset of the pandemic, and presents itself as a possible indicator of what the future may ‘sound’ like, if sounds widely produced today were not emanated in future times.

As noted in the introduction, changes to urban environmental sound emanation and associated sound emitting devices are heavily influenced through imposed restrictions and regulations for sound control, and through obsolescence due to technological advancement and societal change. Despite the (so-far) short term period of soundscape change during the current COVID-19 pandemic, this period can provide us with plausible future soundscape scenarios if restrictive sound controls were to be implemented, such as short-term curfews or longer-term or permanent restrictions on religious, construction, or traffic sounds. With the ever-growing pursuit of individual preference over a collective society in many countries, such events are entirely possible and plausible, as they have been seen in localised areas before [162–164]. Whilst quiet areas are known to be perceived as pleasant and generally attractive to people [165, 166], research has only begun to investigate and document enforced silence, and the resultant lack of valued or appreciated environmental sounds. Some of these sounds have heritage potential [50, 105, 167], and their loss, if potentially permanent, needs to be formally assessed and documented [35]. These are, in particular, sounds that are faced with a reduced presence, or are even at risk of extinction, due to technological obsolescence such as factory sirens or foghorns [41]; due to societal disinterest, such as church bells [50]; public pressure [168] or legal restrictions.

In other situations, ambient traffic and construction sounds form familiar background soundscapes creating an unexpected level of sound ‘comfort’ that, once removed, made signal sounds, such as emergency vehicle sirens, more pronounced, thereby inducing, in some instances, anxiety [102, 114]. If such sounds and soundscapes are im-

portant, then silence becomes at least an emotional, if not mental health, issue. Therefore, imposed sound loss, resulting from pandemic-associated human activity restrictions, allows us to appreciate that sounds currently minimised or terminated could be recognised as having potential heritage attributed to them.

Importantly, the sound loss experienced during this pandemic gives us the opportunity in many situations to see rare baseline sound data of numerous urban areas—cities stripped bare of many human generated sounds [96]. While research has shown incredible diversity of sound levels and soundscape intensities between pre- and through-pandemic periods [105, 112, 118], and past work has detailed descriptors and perception of soundscapes [169], it is important now to conceptualise and undertake social science research into the values placed on sounds lost from the urban environment as a result of the pandemic. As countries are now experiencing a second wave of infections, and several countries are considering, or implementing, community- or even country-wide lockdowns, soundscape studies as defined by international standards [151], coupled with qualitative studies of attitudes towards lockdown conditions and soundscapes are indicated. Such research will enable soundscapes in a post-COVID-19 world to accurately support community values towards sound.

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