Vehicle sound emissions, car alarms, and horn honking are the subject of many noise complaints. Auto manufacturers spent years engineering quieter vehicles, and have created cars whose approach is so subtle that they pose a danger to blind pedestrians. But while engine noise has decreased and car alarms are less reactive, horn honking that is linked with remote keyless entry (RKE) technology increasingly contributes to community noise. RKE horn noise has never been the subject of public health inquiry. In scientific literature, discussion of road noise and health does not distinguish noise among separate sources, and tends to measure aggregate ambient noise levels rather than impulsive noise. RKE horn noise violates state traffic laws and some local noise ordinances regarding horn use, but there have been no legislative attempts to address the technology. This raises questions about whether political leaders and policy setters are not exposed to RKE noise or do not discern RKE sounds from traffic noise, and are therefore unaware of it. Using available auto industry data and case studies, this paper will introduce key facts about RKE horn use in the United States and Canada, reviewing new technologies that render noisy counterparts still in use as redundant.
INTRODUCTION

This paper will provide a brief overview of acoustical alert sounds that are used to indicate whether a vehicle is locked or unlocked, and security armed or disarmed, focusing mainly on horn sounds. Data collection began and continues as part of a citizens’ advocacy effort whose goal is to address the use of a horn sound to indicate vehicle lock and security status. The data apply to the United States and Canada.

Horn and chirp sounds have both been used as status indicators with aftermarket car alarms and factory-installed anti-theft systems. Today vehicle remote keyless entry (RKE) systems use alert sounds whether or not an anti-theft system is installed. Car doors can be opened and closed, and anti-theft systems activated by using a key fob either actively or passively, with the key in one’s pocket.

Through the eighties and nineties, chirps were loud and were more commonly used than horn sounds. Softer electronic chirps were developed, and several automakers adopted a short horn honk as a status indicator. Using the horn meant not having to install another sound source. Some systems involve two-stage locking, where the first press of the key fob locks the door, and the second press activates an audible confirmation to assure the driver that the car has been locked. There are varying lengths and sound levels for acoustical alerts, and the technology has never been regulated in the United States or Canada.

Road traffic and community noise studies of non-auditory health effects focus on exposure to sound emissions of moving vehicles, and subjects generally live in buildings facing busy roads [1, 2]. Exposure is often determined using an equation reflecting average noise exposure over time [3]. Acoustical vehicle status signals may be captured within aggregate measurement, but are not a focus of the research.

This author was unable to find mention of acoustical lock alert technology in academic literature. Early chirp sounds are mentioned in a 1994 legal note [4]. A news story published in the Williamsburg Yorktown Daily in 2009 describes the separate attempts of two Virginia residents to address lock alert noise in residential settings [5]. Beyond such rare mentions, and outside of internet forums, noise created by RKE technology is not a part of academic, technical, environmental, legal, or public health discourse.

In addition to information in forums, data gathered through e-mail, telephone, and in-person communication indicate that the technology has a variety of unintended effects. Alert sounds have been reported to disrupt sleep, and can be heard through windows that are closed. The alerts startle and confuse pedestrians, cyclists, and drivers, and they reduce quality of life indoors and outside.

DATA COLLECTION

The internet is a rich source of qualitative data on the effects of exposure to RKE alert sounds, from complaint forums to practical posts intended to answer questions [6, 7, 8]. Such forums are useful for resolving technical problems, finding solace, or even seeking entertainment. Forums are also informative, reflecting a broad range of physical and psychological responses to repeated exposure to vehicle alerts that use an emergency signal.

Through the summer of 2011, the author gathered information about the technology by visiting online forums, and began to search for an environmental group or elected official who was addressing the noise. No group or individual were discovered. Historical data were gathered at first through e-mail and phone interviews with participants in an anti-car alarm campaign that took place in New York City in 2004. The author interviewed a noise researcher; a communications director with the New York City Department of Information Technology and Telecommunications who analyzed data from horn honking complaints; and the community liaison to the only City Council member in New York City to initiate a horn honking sting. Preliminarily, it appeared as if people who reported being bothered by horn honking were not discerning lock alert horn noise from traffic honking.

In November of 2011, the author decided to use a participatory action research model, and launched an online petition on the web site Change.org. Titled “Auto Industry: Eliminate horn honking from convenience-based technologies” and addressed to automakers, industry regulatory agencies, and trade associations, the petition received only 164 signatures and the author closed it six months later. Receiving e-mails and other referrals as a
result of the petition, the author compiled further data through e-mail, letters, and phone interviews with more than fifty people. The author also reached out to a small number of people whose contact information was provided in online forums and interviewed those people. Interviews were loosely structured and questions were focused on effects on work, sleep, and quality of life related to exposure to RKE horn noise, and methods people had used to address the issue. The author created and maintains a web site that serves as a clearinghouse with information for people who want to contact automakers and industry leaders.

Data about the technology were collected through observation, followed by accessing vehicle owner manuals; calling auto manufacturers’ customer service lines; writing to auto manufacturers; speaking with service managers and mechanics; calling car dealerships; and visiting dealerships. Observation of RKE sound often matched the data in owner manuals, but occasionally it did not. Technology that is demonstrated at dealerships reflects the most accurate current alert method, but not all dealership staff have knowledge of the history of each car’s alert modality.

A limitation of data collection was that it was not possible to take sound measurements in a controlled setting. Some random, unscientific decibel measurements were taken on urban streets in New York City and Montreal, resulting in measurements ranging from approximately 58 dB(A) to 87 dB(A). Both horn and chirp RKE alerts fell on high and low ends and all along the range. Typically RKE horn sounds are not as loud as a honking horn.

**ALER**T **MODALITIES**

This paper reflects current available data where data collection is ongoing. An attempt was made to include data for Big Seven automakers that have used the horn modality for lock alert within the past six years through year end 2012, and data are included for additional automakers whose information was consistent and verifiable. Attempts were also made to determine which vehicles would continue to use a horn sound in 2013. The Big Seven include Chrysler, Ford, General Motors, Toyota, Nissan, Honda, and Hyundai. Kia is a subsidiary of Hyundai and attempts were made to obtain data about Kia vehicles.

With Chrysler, Ford, General Motors, and Honda, which all use horn sounds, street observation was consistent with owner manual data, and usage for the period 2007 through year end 2012 was confirmed during dealership visits, customer service calls, or both. All of these brands continue to use horn sounds in 2013. Mitsubishi and Mazda used horn sounds from 2007 through 2012 and continue to do so in 2013.

Customer service staff for one automaker stated that while the horn modality applies to 2013 vehicles that have left the factory, information about future changes in modality are proprietary and could not be shared. This can be assumed for every 2013 model for every brand.

Every Nissan model except Rogue has used a horn sound during the period 2007 through 2012. Rogue has featured an electronic chirp and will continue to do so in 2013. According to Nissan Consumer Affairs, the Altima and Maxima models began to use an electronic chirp beginning in 2013. Every Infiniti model has used a horn sound during the period 2007 through 2012, and will continue to do so in 2013.

It has not been possible so far to obtain consistent data for Hyundai, Kia, or Mercedes-Benz. With Hyundai, street observation reflected a transition from horn use to use of an electronic chirp. What is certain is that twelve of fourteen 2013 Hyundai models use an electronic chirp, while Accent and Tucson use a horn sound.

Volkswagen used a horn sound from 2007 through 2012 and continues to do so. Audi transitioned from a horn sound to a chirp, but the time frame has not been confirmed for every model.

Among car brands reviewed, only Land Rover has never used an acoustical alert, having always used flashing lights for lock and security confirmation. Jaguar used flashing lights as confirmation during the years 2007 through 2012 and continues to do so. Jaguar vehicles emit a horn sound for alert when there has been an error in locking.

Smart uses flashing lights in cars that are sold without an optional anti-theft system, and those cars sold with an alarm use an electronic chirp for security status alert. Volvo, BMW, Mini Cooper, Lexus, and Acura have only used an electronic chirp in factory installed models. Toyota vehicles began transitioning from a horn sound to an electronic chirp in 2001. Subaru vehicles used a horn sound for two years, and have used a chirp since 2003.
ESTIMATED POTENTIAL HORN USE

According to US Census statistics, as of 2009 there were 134,880,000 registered automobiles [9], and Transport Canada reported 20 million light vehicles at year end 2011, for an approximate total of 154,880,000 [10]. The Polk auto data firm reported that as of July 2011, the average age of US passenger cars and light trucks has reached 10.8 years [11]. Additional quantitative data are based on auto sales data tracker Good Car Bad Car [12] using six years of sales statistics for each car, and only including cars whose modality of alert sound was able to be confirmed.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>General Motors</td>
<td>16,160,392</td>
<td>1,726,518</td>
</tr>
<tr>
<td>Ford Motor Company</td>
<td>12,228,264</td>
<td>1,479,602</td>
</tr>
<tr>
<td>Chrysler Group</td>
<td>8,567,286</td>
<td>1,298,626</td>
</tr>
<tr>
<td>Honda</td>
<td>7,088,189</td>
<td>788,216</td>
</tr>
<tr>
<td>Nissan</td>
<td>5,345,960</td>
<td>415,684</td>
</tr>
<tr>
<td>Mazda</td>
<td>1,524,491</td>
<td>464,791</td>
</tr>
<tr>
<td>Volkswagen</td>
<td>1,687,519</td>
<td>274,118</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td>472,729</td>
<td>114,870</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>53,074,830</strong></td>
<td><strong>6,562,425</strong></td>
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<tr>
<th>Year</th>
<th>US Total Sales</th>
<th>Canada Total Sales</th>
</tr>
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<tbody>
<tr>
<td>2007</td>
<td>16,154,064</td>
<td>1,653,771</td>
</tr>
<tr>
<td>2008</td>
<td>13,245,718</td>
<td>1,640,020</td>
</tr>
<tr>
<td>2009</td>
<td>10,431,510</td>
<td>1,461,639</td>
</tr>
<tr>
<td>2010</td>
<td>11,589,844</td>
<td>1,558,487</td>
</tr>
<tr>
<td>2011</td>
<td>12,778,885</td>
<td>1,587,429</td>
</tr>
<tr>
<td>2012</td>
<td>14,492,398</td>
<td>1,677,990</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>78,692,419</strong></td>
<td><strong>9,579,336</strong></td>
</tr>
</tbody>
</table>

A six-year range with only vehicles whose use of a horn sound could be absolutely verified was chosen in order to avoid bias toward overestimation. Among the 88,271,755 cars sold in the US and Canada during the years 2007 through 2012, 59,637,255, or 67% of this number, are capable of emitting a horn sound to reflect lock status if the driver chooses to use the feature. Among the remaining 32% of cars, most are capable of emitting chirp or horn sounds of varying sound levels, styles, and duration.

The 88,271,755 cars sold in the United States and Canada during the years 2007 through 2012 represent approximately 57% of the 154,880,000 vehicles on the road according to the most recent statistics. Little can be verified about the remaining 43% of vehicles sold prior to 2007. Since alert sounds have been used for door lock and security arming for more than a quarter of a century, any number of the remaining 66,608,245 vehicles may feature an audible alert, with or without RKE capability.

These are just raw numbers, and don’t give us any idea of distribution or the number of car owners who use sound or who opt not to use sound. What the numbers do reflect is that a lot of cars are capable of emitting noise to confirm that people have locked them – and a lot of that noise is horn noise. There is so much noise that we will never be able to reduce or control. But this noise is optional – automakers choose to make it available, and some people choose to use it.
LEGAL CONSIDERATIONS

There are various legal considerations around the issue of horn use for non-emergency situations. In approximately eighty percent of United States driver manuals, which reflect state driving regulations, horn use is either restricted to warning of imminent danger, or to use in driving situations related to safety [13].

In one of the Virginia cases [5], a retired military officer living in Richmond filed a petition with the State Police requesting a new procedure that would address RKE horn use whenever vehicle owners had their cars inspected. Titled “Restoring the proper use of automobile horns solely as a warning device,” the petition requested that in order to pass inspection, cars would have to have their lock alert sounds set to silent. The petition was rejected, with Department of State Police countering that the proposed requirement would result in an economic burden and other hardships and complications associated with implementing the suggested practice.

The other Virginia resident attended a City Council work session to ask that RKE horn sounds be excluded from a list of exceptions to a recently passed noise ordinance in the city of Williamsburg. As it turned out, RKE horn sounds were not on the list of exceptions to the ordinance. If the sound level of the horn was higher than 55 decibels at night, that could be grounds for a citation.

Two people told the author about their experiences living in gated or deed restricted communities. A resident in a quiet gated community on the west coast of Florida had been noticing short horn sounds for a year or so that seemed out of place. Then an announcement appeared in her community’s newsletter. A new by-law restricted use of horn alerts, but did not mention electronic chirps. Residents welcomed the restriction, people complied, and peace was restored. On the east coast of Florida, a man who had carefully searched for a retirement community found one where he was told residents were restricted from using horn lock alerts. But in his case, there were residents who were not compliant, and he found himself frequently awakened on a regular basis by vehicles that parked close to his condominium.

RELATED TECHNOLOGIES AND QUIETER OPTIONS

Horn lock alerts are a sensitive topic among noisy car features. Many people cannot understand how automakers could conceive of using an emergency indicator to confirm car locking. Car owners who use the technology appreciate the sense of assurance provided. Anecdotally, when asked if they would accept a softer chirp sound, people the author has spoken with have said that what matters is that there is a sound, and they don’t care what the sound is. At dealerships, when asked if buyers express a preference for one modality over another, sales staff said that buyers are interested in specific cars, and they will accept whichever feature the car happens to have.

A 2010 article demonstrates that electric (EV) and hybrid vehicles (HEV) are not significantly quieter than newer generation standard internal combustion engine (ICE) vehicles [14]. The authors oppose adding artificial sound to EVs and HEVs, and warn of a potential “cacophony of alerting sounds.” But a cacophony of alerting sounds has already arrived in the United States and Canada. With or without artificial noise added to EVs and HEVs, there exists an ever expanding repertoire of new noisy car features, some of which use horn sounds.

Car Finder is offered by several brands either through the key fob or by using a smart phone app. When the feature is used with the key fob, pressing the icon on the fob will cause emission of a horn sound with a lower decibel level than that of the lock alert sound. A quieter option is to use GPS functionality with a smart phone car finder app that locates the car without using noise. Alternately, one might simply remember where one parked.

Panic Alarm emits thirty seconds of sound that resembles car alarm noise, including horn honking and a siren. This feature is intended to be used when approaching one’s car and finding someone trying to break into the car. Panic Alarm is also used to find a car in a parking lot in the same way Car Finder and RKE horn sounds are used.

Backup beeping is a technology that has been a topic of much debate. Now some late model cars have begun to feature rear-view cameras, which are silent, and which may be more effective than backup beeping. It is possible
that rear-view cameras may be mandated as a standard feature in all new cars in the United States. Motion sensors at the rear of a car are another quiet alternative to backup beeping

Recently Nissan began featuring Easy-Fill Tire Alert as standard in all 2013 models, a technology that had been introduced in LEAF and Quest the year before [15]. When a car’s tire pressure monitoring system indicates that a tire needs air, the driver can find a service station and begin the process of filling the tire. But instead of having to guess when the tire is full, or alternate filling it with air and measuring air pressure, this technology will honk the car’s horn when the tire is filled to the appropriate pressure. Guidance rather than guessing seem like a good idea for people who are intimidated by filling tires with air. But surely a soft chime could accomplish the same thing. Or better still, a tire pressure monitoring system that is so accurate one can simply read it and know that the tire is properly filled. Discordant aggressive multiple horn honks at a service station could cause confusion.

Anti-theft systems are now optional with many cars. Their usefulness has always been questionable, but now more than ever, when vehicle immobilizers and stolen vehicle recovery technology can control a stolen car’s speed. With the capability of smart phone integration with many vehicles, it should be possible for a car owner to be notified when theft is attempted. Historically, many false alarms have been caused by car owners who forget to disarm the alarm, and that is still the case today. Completely eliminating anti-theft systems might result in owners purchasing after-market alarms.

**CASE STUDIES**

Three brief case studies are based on interviews and e-mail communication this author conducted. Use of initials rather than names was requested. It is not easy to approach a neighbor about a noise issue. When one approaches a neighbor to ask to eliminate a sound the neighbor’s car emits, resistance and retaliation may be encountered. But people can and do take the chance. Many online forum thread begin with a question about eliminating the horn sound or swapping it for a chirp, with frequent mentions of people not wanting to disturb their neighbors. There are also online videos that demonstrate how to disable RKE horn noise [16, 17].

**A Residential Neighborhood in Montreal, Canada**

PR is a small business owner and editor living and working in the Ahuntsic borough of Montreal with his wife CD, a journalist. The couple have four grown children living on their own. Ahuntsic features private homes, condominiums, and town homes with some cars parked in garages and carports, but most parked on the streets. Housing is dense, and many residents live in attached or semi-attached dwellings.

PR became aware of remote keyless entry confirmation sounds approximately five years ago. PR and CD have attempted to address the noise by distributing flyers which are left on windshields, requesting that car owners lower the decibel level of their audible alert sound to comply with a World Health Organization night noise guidelines of 40 decibels [18] or not use an audible alert, due to the close proximity of homes to parked cars. PR also created the web site www.hornfree.org to provide education and information to car owners and people affected by the noise, with web site versions in French and English. PR also wrote to 16 Canadian automakers.

When CD was undergoing chemotherapy for cancer, it was difficult to rest during the day because horn sounds would carry into the house from the street. Additionally, a neighbor would park her car in a space that was eight feet from the living room and eighteen feet from the bedroom. The neighbor used the horn for audible alert late at night when she would make several trips back and forth to the house from her car. PR spoke with the neighbor, a doctor who was friendly and sympathetic, but who had difficulty giving up the assurance of the audible report. Ultimately, she was able to do so. This neighbor has continued to lock her car silently, but she is now dating a man who drives a car with an electronic chirp that is loud enough to awaken PR if the car is close enough to the house.

At least five neighbors have given up using an audible alert as a result of the flyer campaign. One neighbor continues to use a horn lock alert, and a commuter who parks in front of PR’s home continues to use the horn lock alert even after receiving four flyers.
Summers in Rural Indiana and Winters in Cape Canaveral, Florida

KG is a “snowbird” who spends spring and summer in Indiana, and fall and winter in Cape Canaveral, Florida. His home in Indiana is far enough from the next house that he would not know if his neighbor used a horn sound to confirm vehicle security. But in Florida, KG lives in a five-story condominium with parking space in close proximity to the building, and horn and chirp sounds have increased over the past several years at his Florida residence.

Retired from General Motors, KG worked as a laboratory technician in an automotive electronics engineering and manufacturing facility, and is a lifelong car buff, easily able to work with most vehicles’ computers and owner manuals. Some cars are more difficult to work with, and may need to be taken to a dealership to adjust the alert settings. Most new cars feature adjustment by following a sequence using various operator controls, in some cases running the sequence using the key fob.

KG has approached some of his Florida neighbors and asked if they would like him to turn off the audible lock alert. One neighbor declined to have the audible feature turned off, but others took him up on the offer. KG admits that he would not feel comfortable approaching neighbors whom he does not know, but he plans to place an article in the condominium’s newsletter addressing the issue.

A Residential Neighborhood in Ontario

JL and his wife live in Orangeville, a residential neighborhood with detached private homes. Each home has a garage and a driveway. The neighborhood features a by-law restricting overnight street parking during the winter, but car owners are able to fit from two to four cars in many driveways. JL is a semi-retired photographer, and his wife NL, works as an office manager. They own two cars, and they disabled the audible lock alert feature as soon as they purchased the cars.

The couple began to notice lock alert horn noise in 2003 when they moved to Orangeville. In 2008, JL approached the neighbor living beside them, asking if the neighbor’s family would consider refraining from using an audible alert sound due to the proximity of the cars to others’ homes. The family owns multiple cars, and the children arrive home late at night, using the horn lock alert regardless of the hour. In response to the request, the neighbor and his family members began honking their car horns whenever they saw JL outside. The retaliatory behavior continues, and JL does not respond or even acknowledge their presence when he is outside.

The high incidence of alert horn sounds along with the retaliatory horn noise have made it difficult to sleep with open windows or enjoy outdoor activities such as gardening. It is possible to sleep with the windows closed, but occasionally a horn sound can be heard if a car is close enough to the home.

There are local noise laws in the municipality where JL lives, but the law would be difficult to enforce for a complaint based on horn honking. It would be easier to enforce the law with a noise violation involving continuous sound, such as a loud party. It would be difficult to capture an impulsive noise of short duration, as doing so would involve the police having to sit in a car waiting to hear a horn honk. JL is also reluctant to submit a formal complaint because of negative stereotypes about people who complain about noise. He has an acquaintance who is an elected official, but he has hesitated to raise the matter because of the perception that “there are always more important issues” that make noise seem trivial by comparison.

JL and his wife own a cottage on Lake Huron where each home occupies approximately an acre of land. They enjoy good relationships with their neighbors at the lakefront property, none of whom are users of audible vehicle alert technology. Some of the lakefront friends have had similar experiences at their primary residences, and share a sense of frustration and incredulity that the technology has become a part of modern life.
DISCUSSION

The acoustical challenge created by short horn sounds and high-decibel electronic chirps to indicate vehicle lock status is not going to be solved by building walls or installing better windows. Such measures will help affected people to restore the possibility of a better night’s sleep, but will not have any effect once the window is open or during the many outdoor activities that are interrupted in one way or another by lock alerts.

If every automaker currently using a horn sound for lock and security confirmation were to switch to visual alert or a quiet electronic chirp, within ten to fifteen years there would be marked improvement in community noise in cities, on quiet side streets, in towns, and suburbs, and even in parking lots. If automakers were to standardize a low-decibel, non-irritating electronic sound as an optional lock alert feature, with a visual cue as the default when the car is sold, the soundscape would improve still more.

There is little need for government intervention, or new laws to accomplish a revision and standardization among vehicle alert sounds currently used. Eliminating horn use would bring all auto models into compliance with existing state driving regulations in the United States, and with certain municipal noise codes in the United States and Canada, by limiting horn use to appropriate situations. A self-regulating initiative would demonstrate the auto industry’s commitment to a public health standard that is chosen rather than mandated. It would also bring automakers in line with their stated environmental and social responsibility missions.

CONCLUSION

Horn sounds used for purposes other than emergencies and signaling while driving violate driving regulations in the United States, and violate noise codes throughout the United States and Canada. Addressing noise pollution is consistent with most automakers’ stated environmental and social policies.

If nothing is done to eliminate some lock alert sounds and reduce others in the United States and Canada, there is no evidence to suggest that use of the technology will decrease. With the life span of cars increasing, with nearly every new car leaving the factory with some sort of audible alert, and with the prospect of EVs and HEVs contributing still more sound, the potential exists for higher levels of community noise and increased noise-related annoyance in a broad range of settings.

ACKNOWLEDGMENTS

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REFERENCES


