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Sound Levels Emitted by Children's Toys

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ABSTRACT: In keeping with an increased national awareness of nonoccupational sources of noise and their potential hazards to hearing, this study examines the possible hazards related to sound levels emitted by children's toys. The sound levels emitted by a random sampling of toys designated for use by children aged 6 months to 5+ years were measured at several distances. Results suggest that the levels emitted may be a potential contributing factor to school-age high-frequency hearing loss. Although more extensive research is required, a combination of public education, manufacturer's participation, and governmental guidelines may be beneficial in preventing damage to children's hearing from these devices.

Throughout the last three decades, considerable research and governmental attention has been paid to the negative effects of occupational noise exposure, giving rise to mandates and regulations for the primary purpose of protecting and conserving the hearing of employees within the workplace. The danger of noise-induced hearing loss (NIHL) in the work environment is now a familiar topic among employers and employees, environmentalists, health and safety regulation boards, and lawmakers, and has culminated in restrictions imposed by the United States Occupational Safety and Health Administration (OSHA) regarding levels and length of exposures (1983). In general, these restrictions require that employers protect the hearing of employees who are exposed to noise exceeding an 8-hour time-weighted average of 85 dBA.

Although the Environmental Protection Agency (EPA) reported in 1974 that 34 million Americans were exposed to nonoccupational noise that is capable of inducing hearing loss, the issue and potential hazards of nonoccupational noise exposure has only recently come to the forefront. Because our society has rapidly created a more noisy environment, hearing health has become a major issue in more than just the workplace. Recreational use of power tools, personal stereos, high-volume music, and firearms all become potentially dangerous to hearing if they are not used with hearing protection and/or according to directions. Clark (1991) noted that OSHA's regulations fail to consider an employee's exposure to noise during nonworking hours, and that this may be an important issue.

Although most nonoccupational NIHL research has focused on adults, this study will focus on sources of noise exposure for young children. Specifically, many toys are exceedingly noisy and may pose a potential danger to hearing. Clearly, the potential damage to hearing that is presented by impulse sounds and explosions as can result from cap guns and firecrackers is logical, intuitive, and well-documented. A study by Gupta and Vishwakarma (1989) investigated the effects of toy weapons and firecrackers as a source of hearing loss in 9- to 15-year-olds. They found sensorineural hearing loss in 2.5% of their target population, and strongly advocated a judicious approach in the manufacturing and use of toy weapons and firecrackers.

But what of toys that are less obviously noisy? The sound emitted by a toy may not be harmful to a child's hearing if used appropriately, that is, at some distance away from the ear, yet many children will not use toys in this way, particularly if there are no restrictions to placing the ear closer to the sound source. For example, McMillan and Kileny (1994) found that a 39-month-old child suffered a permanent, 30 dB sensorineural hearing loss after blowing a bicycle horn several times near his left ear. The bicycle horn produced a 143 dB peak SPL, yet there were no warnings on the packaging of the horn regarding sound levels or risk of

hearing loss. Further, no restrictive physical guards were in place to limit the potential proximity to the ear.

And what of toys that are even more innocuous still, for example, infants' squeaking toys? Axelsson and Jerson (1985) measured the sound output of a number of toys including squeaking and moving toys, toy weapons, and firecrackers. They concluded that many of these toys, including the squeaking toys if used close to the ear, posed a substantial risk to hearing, and that there were no acceptable reasons for the dangerously high levels.

The potential dangers of noisy toys has also been brought to the public's attention by advocacy groups (e.g., The Canadian Hearing Society, 1991) and consumer magazines (e.g., Debrovner, 1995), and to the government's attention largely through its own initiatives (for a review, see Kirkwood, 1992). Despite this attention, regulations pertaining directly to the sound levels of toys remain scarce. The scope of toy safety regulations in general varies considerably country to country, with perhaps the most comprehensive coverage coming from the Hazardous Products Act (Consumer and Corporate Affairs Canada, 1996) in Canada. These regulations apply to "toys, equipment and other products for use by a child in learning or play" and state that the sound emitted by toys should not exceed 100 decibels. The United States's Child Protection and Toy Safety Act (United States Congress, 1984) does not specifically address hazardous sound levels. Given this much attention by scientists, the public, and at least some governments, perhaps the potential dangers that are presented by loud toys are no longer a threat to children's hearing.

The study described here will examine this question and attempt to establish the sound levels that are emitted by a variety of toys at several distances from the sound source. By these means, we hope to determine if any of the toys measured exceed a dangerous sound level, and at what distance the hazards are present. Further, we will assess the potential risk to the user, given the intended age ranges for the toys and an analysis of the toy packaging for precautionary labeling that could warn buyers of potential harm to the hearing of the user.

METHODS

The devices tested were a random sampling of toys or accessories that are manufactured for use by children. A total of 22 toys was tested in this sample, encompassing 29 different emitted sounds. The recommended ages for use of the toys ranged from 6 months through 5 years and over. Six toys were specifically recommended for children under the age of 3 years, and included musical, windup, and talking and/or singing toys. Another six toys were specifically recommended for children age 3 years and older, and included toy weapons, robots, toy phones, trains, and toy power tools. Ten toys had no recommended age range stated on the packaging or the product packaging was not available.

All sound measurements were made using a Quest 1800 Precision Integrated Sound Level Meter equipped with the Model OB-300 combination 1/3-1/1 Octave Filter Set (Quest Technologies, Inc., Oconomowoc, WI 53066) All measurements were made using the A-weighting filter network and the fast response mode (125 ms time constant). Measurements were made in a room with reverberation characteristics that were similar to those that might occur in a typical room where a child would play with or be exposed to these toys. The measurements approximated two distances that a child might potentially hold the toy from his or her ear. The sound emitting source of each device was placed as near the microphone as possible while not touching it for five measurements in order to simulate an "as close as possible" listening condition, and 15 in away from the microphone for five additional measurements in order to replicate an "arm's length" listening condition. Final data are expressed as the averages of these measurements. The measurement times were as long as necessary for an accurate reading (typically between 1 and 5 s), but varied with the sound duration of the item.

RESULTS

Results are displayed in Table 1. The average sound levels of the various toys were 106.8 dB measured at a point nearest the sound source, and 90.55 dB measured at 15 in away from the sound source. The extreme near field values ranged from 79.4 dB to 125.3 dB, with a toy recommended by the manufacturer as appropriate for children as young as 6 months old yielding the highest measured level. Values measured at what may be considered a more "typical use" distance of 15 in ranged from 60.9 dB to 109.6 dB, with a toy train yielding the highest levels. By recommended age levels, the six toys recommended for use by as young as 3 years averaged 103.3 dB for the near field measures and the six toys recommended for older than 3 years averaged 104.9 dB.

DISCUSSION

According to Hellstrom, Dengerink, and Axelsson (1992), the hearing protection regulations of Sweden for adults state that no person be exposed to sound levels that are greater than 115 dBA at any time. Applying these standards to the toys measured in this study indicates that nine of the devices tested (33%) would exceed these values. In addition, 20 of the devices (66%) would exceed legal limits as set forth by Canada. The duration of the sounds emitted from the toys was typically 1–10 s, thus, none of the toys tested can be considered as emitting impulse noises, for which higher levels might be permissible. Although the sound durations noted are reasonably short, it is safe to assume that children playing with these toys are likely to activate the sounds more than once during a play session.

None of the packaging accompanying any of these toys contained any labeling regarding potentially hazardous noise levels, and only one label (rescue car) warned that adult supervision was required. In addition, no labeling

Table 1. Average sound levels in dBA at near 0 in and 15 in from device. Included are approximate durations in seconds of a single exposure, intended age ranges, and a description of the emitted sounds.

Toy	*Sound*	*Age*	*Duration (s)*	*dBA @ 0"*	*dBA @ 15"*
music horn[1]	organ style	6m+	2	101.3	87.0
	ratchet		1	125.3	105.3
plastic bear[2]	ratchet/bell	n/a	1+	115.3	105.4
Talking 1st Words[3]	spoken words	n/a	2	101.0	87.9
See & Say[4]	spoken words	6m-5y	4	105.5	93.9
plastic train	choo-choo	n/a	2+	120.0	103.6
	siren		2+	118.8	109.6
	traintrack		2+	115.3	97.6
toy phone	touchtone	3y+	1+	121.2	91.8
	tone series		5	120.3	89.4
fire truck	sirens	n/a	3+	103.6	84.8
robot[5]	computer speech	n/a	3+	96.3	81.4
dump truck[6]	speech	n/a	2+	113.2	87.5
	horn		4+	109.1	88.1
	motor		4+	108.4	83.7
large robot[7]	machine sound	n/a	5+	121.9	96.4
squeeze toy[8]	dolphin sound	n/a	1	79.4	60.9
tape recorder[9]	speech	n/a	1+	98.1	88.5
rescue car[10]	speech	18m+	3	95.5	77.1
police car[11]	siren	19m+	4	95.3	78.5
farm tractor[12]	speech	3y+	2	96.9	76.8
see & say piano[13]	piano sound	9-36m	4	99.0	87.4
toy Uzi[14]	gun sound	5y+	4+	102.5	94.7
toy M-16[15]	gun sound	5y+	4+	110.6	99.1
air wrench	ratchet sound	4y+	3+	110.7	99.6
talking hi-chair[16]	speech	n/a	2	98.1	85.4
singing baby[17]	speech	2y+	8	101.2	94.6
toy pager[18]	speech	3y+	2	92.2	81.2
bicycle horn	horn sound	n/a	1	119.6	109.0

[1–18] See Appendix.

advised parents regarding what safe distance from the ear or head the toy should be held.

Toy safety is always of particular concern with younger children (3 years old and younger) because they are more prone to use toys in an inappropriate manner. Warnings regarding choking hazards, for example, are readily apparent. It seems logical that this age group would also be at greatest risk for sound exposure at the measured near-field distance. However, average measures in this study of toys recommended for this age group are over 100 dB and within 2 dB of the average level for toys recommended for older children.

Even toys considered harmless enough for 6-month-olds (e.g., "See & Say" in Table 1) emit sounds that are in excess of 105 dB when the sound source is extremely close. And, as can be seen from the results presented here, proximity to the ear is a matter of great importance when considering possible hearing damage. With regard to this issue, even the Canadian regulations fall short, in that sound levels for toys are to be measured "at the distance that the product ordinarily would be from the ear of the child using it," and not as close as possible to the sound source. Our inquiries to representatives of U.S. toy manufacturers indicated that issues of toy safety of this sort in this country are predominantly self-regulated within the industry.

Should we really be all that concerned about the occasional noise exposure children subject themselves to when using some toys? A recent study by Clark, Govett, and Goldstein (1997) suggests that this may be only a small part of the overall noise exposure picture for children. By having children wear sound-measuring devices to school, they investigated typical noise exposures for children through the course of a typical school day. Expecting certain situations to be noisy (e.g., recess, lunchroom, etc.), they were surprised to find that the average 24-hour exposure was near 90 dB. If these average levels were found in industry, federal law would require exposed workers to wear hearing protection! Further, Peppard and Peppard (1992) found evidence of NIHL in children as young as 9 years of age through a school screening program in Georgia. Further research is needed to determine the long-term effects of this noise exposure on children's hearing. This research should also be extended to include pre-schoolers to determine the extent and likelihood of inappropriate use of toys with regard to sound exposure.

The current results suggest that sound exposure from children's toys may well be a contributing factor to school-age high-frequency hearing loss. Axelsson and Jerson (1985) concluded that they could find no compelling reason for toys to be dangerously loud, and we must concur. A combination of manufacturer's awareness, inclusion of

physical restraints distancing the ear from the sound source, and written warnings for increased parental guidance may help prevent this damage from occurring. A public education campaign that focuses strongly on the hearing of young children may also be beneficial. Federal guidelines regarding safe noise levels, measurement, monitoring, and advisory labeling of toys could be established to aid manufacturers and consumers in the appropriate selection and use of toys.

ACKNOWLEDGMENTS

The author would like to acknowledge and thank Robyn Sutton for her considerable contribution of work and effort to this study in its execution and the manuscript preparation. I would also like to thank Johanna McCoy and Barbara Nissen for their work on researching this project; Susan Main and Marshal Chasin of the Canadian Hearing Society for their help with noise regulations in Canada; and two anonymous reviewers for their helpful suggestions to an earlier manuscript.

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APPENDIX. PRODUCT DETAILS FOR THE TOYS USED IN THIS STUDY

[1] Playskool "Rockin Radio," item #5417, 1992.
[2] Redbox yellow plastic teddy bear, item #23096, 1989.
[3] V-Tech "Talking First Words."
[4] Mattell "See n Say Mother Goose Says," item #260IT2, 1989.
[5] Bandai.
[6] SLM, Inc. "Big Rigs Construction."
[7] Marchon large robot, 1994.
[8] Seaworld fuzzy squeeze puppet.
[9] Kidsound Quality Toys tape player/recorder, 1990.
[10] Funrise "Rescue Team," item #02312.
[11] Buddy L "Police Car."
[12] Buddy L "Big Bruiser Farm Tractor."
[13] Mattell "See n Say Piano."
[14] Daisy Toy "uzi."
[15] Daisy Toy "M-16."
[16] "Love my Dolly High Chair."
[17] Eugene Co. "Talk and Sing Baby."
[18] Hope Inc. "Talking Morpher."