

Music Loudness Preferences of Middle School and College Students

Duane E. Barrett and Donald A. Hodges
The University of Texas at San Antonio

There is a growing notion in our society that many of us are losing our hearing and that a primary cause may be exposure to loud sounds (Elias, 1991). The *Journal of the American Medical Association* (Noise and Hearing Loss, 1990) reported that of 28 million Americans who experience a hearing loss, approximately 10 million obtained the loss from exposure to loud sounds. Of particular concern are teenagers and others who listen to popular music styles; the contention is that many are listening to rock music at loudness levels that can damage hearing. The effects of high loudness levels may also be exacerbated by the use of headphones (Feldman & Grimes, 1991; Goldstein & Newman, 1994).

While the notion of teenagers listening to rock music at ear-shattering levels fits the popular notion, what research data is available to confirm this stereotype? One of the earliest studies was done by an audiologist, David Lipscomb, who tested the hearing of entering college freshmen in 1969 and found that 60% had a significant hearing loss (cited in Williams, 1992). When this figure was compared to less than 4% of sixth graders who had similar hearing losses, it was evident that something happened in the intervening years to cause hearing damage. Based on interviews, Lipscomb suspected the primary culprit was listening to rock music through headphones.

To put additional research, as well as the current study, in perspective, it may be useful to review the effects of loudness on hearing. For human beings the ratio of softest to loudest detectable sounds is more than a trillion to one (Schroeder, 1993). The upper limit of hearing is determined when the sensation of sound turns to pain. Loudness is commonly measured in decibels (dB) which is a logarithmic scale; 90 dB is 10 times as loud as 80 dB and 100 dB is 100 times as loud as 80 dB.

The Occupational Safety and Health Administration (OSHA) recommends exposure to sounds of no more than 85 dB for 8 hours daily (Occupational Safety and Health Administration, 1981); for reference, a lawnmower is approximately 90 dB, and a jet plane at takeoff is 120 dB. Persons may be at risk who experience repeated exposures to sounds of 90 dB for 8 hours or more daily; however, for each increase of 5 dB above 90 dB, it takes only half as much time for damage to occur. Damage can occur under the following representative conditions: 95 dB for 4 hours, 100 dB for 2 hours, 110 dB in half an hour (Melnick, 1994). The rock group Metallica was measured recently as producing sounds of 113 dB in live performance (Koss, 1993); the concern should be readily apparent.

Damage occurs because overly loud sounds cause hair cells in the cochlea to vibrate so violently that they are damaged (Henderson, Salvi, Boettcher, & Clock, 1994; Nielsen &

Slepecky, 1986). Prolonged exposure flattens outer and inner hair cells, causing them to lose their resilience and die. Once these hair cells are destroyed, they can never be replaced, and hearing loss is permanent. Persons who listen to music at just under “damage limits” may experience a temporary threshold shift, that is a temporary loss of hearing acuity. Their hearing sensitivity may be dampened for a few hours, but generally will recover. When teenagers were given a hearing test at a live rock-music concert, 19 out of 20 experienced significant average threshold shifts (Danenberg, Loos-Cosgrove, & LoVerde, 1987). Of more concern is the fact that 4 of 6 subjects who were retested three days later had only partially recovered to pre-exposure thresholds.

Although one might reasonably speculate that teenagers listen to rock music at harmful levels, there is a paucity of research documenting this. In addition to the Lipscomb study previously cited (Williams, 1992), Kuras and Finday (1974) asked 25 college students to set most comfortable loudness (MCL) levels for rock music samples. They found that 75% of the MCL levels fell between 70-100 dB and that over half the subjects exceeded national damage risk criteria.

No studies have been reported in the literature in the last 20 years that provide data on how loud teenagers prefer to listen to music. Furthermore, there is no evidence to support the supposition that teenagers listen to rock music at a louder level than they do other styles. Finally, no data have been reported to suggest that formal musical training influences the loudness level at which students listen to music. Accordingly, the purpose of this study was to determine whether there were significant differences in the music loudness preferences (MLP) for diverse musical styles among middle school and college students. Answers were sought to the following questions: (1) Are there significant differences in MLP among diverse music styles (chant, classical, jazz, country, rap, and heavy metal) among three subject groups (middle school band students, college music majors, and college nonmusic majors, with each group divided into males and females)? (2) Are there significant differences in MLP among the three subject groups for each of the music styles? (3) Are there significant differences in MLP between males and females for each of the music styles?

Method

Subjects who participated in this study were 40 middle school (Grades 6-8) band students (MS), 40 college music majors (CM), and 40 college nonmusic majors (CN). Each group comprised equal numbers of males and females. The college nonmusic major students were enrolled in a music appreciation course; those who volunteered to participate had had less than five years of formal instruction in music.

A representative sample of six diverse music styles was selected; these included: classical (CL)—*Eine Kleine Nachtmusik* by Mozart; country-western (CW)—*The Thunder Rolls* performed by Garth Brooks; chant (CH)—*Puer Natus Est Nobis* performed by Benedictine Monks of Santo Domingo de Silos; rap (RP)—*Jump* performed by Kriss Kross; jazz (JZ)—*Improvisation* performed by John Coltrane; heavy metal (HM)—*Skin O' My Teeth* performed by Megadeth.

The following equipment was used to prepare a Music Loudness Setting To Decibel Conversion Chart and to play the music for the subjects: Pioneer PD-M430 multi-play compact disc player, Pioneer SA-1520 stereo amplifier, Pioneer VSP-333 AV surround processing amplifier, Koss HV/PRO digital stereo headphones, Realistic-1033 Sound Level Meter.

The sound level meter was used to identify the decibel (dB) level of each music selection for each of the 30 settings of the loudness knob on the stereo amplifier. For example, a setting of 6 on the loudness knob produced the following dB levels: CL = 78 dB, CW = 68 dB, CH = 85 dB,

RP = 81 dB, JZ = 88 dB, and HM = 97 dB. Decibel levels were calculated by holding the sound level meter approximately one inch away from one of the ear pieces of the headphone and marking down the dB level for each setting of the loudness knob on the CD player. Two other strategies were used to confirm these readings. Method 2 consisted of holding the two ear pieces against each other with the sound level meter inserted between them. For Method 3 a Styrofoam piece (representing the side of the head) was prepared with a small hole. The sound level meter was inserted into the hole; one ear piece was placed against the outside of the Styrofoam piece and the other ear piece was blocked off with a piece of cardboard. Similar readings were obtained for all three methods. Still, these dB levels must be taken as approximations because the dynamic levels of these (or any) pieces of music are constantly changing. The dB level used for the conversion chart approximated the general loudness over the first 30-40 seconds of the selection.

Each subject was tested individually. Seated comfortably with headphones on, subjects were placed where they could not see the stereo amplifier controls. Each selection was started with the loudness setting so that the music was just barely audible. As the music started the experimenter very slowly increased the loudness level. Subjects indicated they wanted the loudness increased or decreased by pointing a finger upward or downward. When the loudness was at the preferred level, they indicated by a “stop” motion with the hand. The loudness knob setting was marked on a chart and later converted to a dB level using the conversion chart.

Results

Question 1: Were there significant differences in music loudness preferences (MLP) among musical styles? One-Way Analyses of Variance (ANOVA) for each of the six subgroups all indicated significant differences in mean MLP among music styles, $F(5,114) \geq 8.47, p < .001$. Generally speaking, subjects preferred to listen to different music styles at different loudness levels. In Table 1, the mean MLP for each subgroup and for each music style is given in dB.

Table 1

Mean Decibel (dB) Levels Indicated as Music Loudness Preferences by Six Different Subject Groups for each of Six Music Styles

Group	Music Style					
	Country	Classical	Chant	Rap	Jazz	Heavy Metal
Middle School Males	74.5	75.6	78.2	82.9	88.8	94.7
Middle School Females	73.2	77.6	77.6	78.9	84.7	91.1
College Music Males	73.2	78.0	78.2	79.9	86.6	96.5
College Music Females	68.8	71.0	73.0	76.5	83.6	96.6
College Nonmusic Males	65.7	65.7	69.2	69.3	74.0	84.1
College Nonmusic Females	67.5	70.0	73.3	75.5	80.4	84.9

Note. One-way comparisons of music styles within each subject group are significant for all groups, $F(5,114) \geq 8.47, p < .001$.

With few exceptions, subjects preferred to listen to the classical, country-western, chant, and rap selections at the same loudness levels. The jazz and heavy metal selections were preferred at louder levels. The heavy metal example was always preferred at the loudest level (MLP = 84.5-96.6 dB), the jazz example was next loudest in preferred listening level (77.2-88.8 dB). To determine more specifically which differences were statistically significant, the Newman-Keuls Multiple Comparison Procedure was used as a subsequent analysis for each significant F -test. With few exceptions, there were no significant MLP differences among the country-western (65.7-74.5 dB), classical (65.7-78.0 dB), chant (69.2-79.9 dB), and rap (69.3-82.9 dB) selections.

Question 2: Were there significant differences in MLP among the three subject groups for each of the music styles? One-Way ANOVAs performed within each music style indicated that there were significant differences between subject groups (MS, CM, and CN) in each of the comparisons, $F(2,117) \geq 4.72, p < .01$. Within each style of music, the three subject groups preferred to listen at different loudness levels. In Table 2, the mean MLP for each subject group is given in dB.

For each music style, college nonmusic majors preferred to listen at the softest levels and, with one exception (chant), middle school students preferred the loudest levels. Loudness preferences for college nonmusic majors were significantly lower than the other two groups for all styles except country-western and rap. There were no significant differences in loudness preferences between college music majors and middle school band students, except for rap music. Perhaps this indicates some effects of music study.

Question 3: Were there significant differences in MLP between males and females for each of the music styles? One-Way ANOVAs performed for each music style indicated that there were significant differences for each comparison, $F(5,114) \geq 2.99, p < .01$. Males and females preferred to listen to music at somewhat different loudness levels.

Table 2

Mean Decibel (dB) Levels Indicated as Music Loudness Preferences by Three Different Subject Groups for each of Six Music Styles

Group	Music Style					
	Country	Classical	Chant	Rap	Jazz	Heavy Metal
College Nonmusic Majors	67.8	66.6	72.3	71.3	77.2	84.5
College Music Majors	71.0	75.5	78.2	74.6	85.1	91.6
Middle School Students	73.8	76.6	77.9	80.9	86.8	92.9

Note. One-way comparisons of subject groups within each music style are significant for all styles, $F(2,117) \geq 4.72, p < .01$.

Although each of the one-way ANOVAs was significant, closer inspection of the differences between means reveals that there are many more similarities than differences. Some patterns are noticeable. College nonmusic major males had the lowest MLP for each style. Middle school males and college music major males each had three of the highest MLPs. Females tended to obtain the second-, third-, and fourth-highest means, with middle school females always the highest of the females. If one makes gender comparisons within groups, the following results are evident: for middle school students, males always had higher MLPs than their female counterparts, and these differences were significant for four of the six music styles. College music major males always had higher MLPs than college music major females, but only two of the six comparisons were significantly different. College nonmusic major males always had *lower* MLPs than their counterparts, but only two of the six comparisons were significant.

Discussion

The purpose of this study was to determine whether there were significant differences in the music loudness preferences (MLP) for diverse musical styles among middle school and college students. Subjects indicated the loudness level at which they preferred to listen to selections of six diverse musical styles. Loudness knob settings on a stereo amplifier were converted to dB readings by means of a sound level meter. Data were analyzed for significant differences among the six musical styles, among the three groups, and between males and females.

Three broad conclusions can be drawn from the results of this study. First, subjects in all three groups preferred to listen to music styles at different loudness levels. Generally, heavy metal and jazz selections were listened to at significantly louder levels than were the other four styles. Furthermore, these two styles were the only ones that exceeded the OSHA safety levels of 85 dB (HM means ranged from 84.5-96.6 dB and JZ from 77.2-88.8 dB). It would be inappropriate on the basis of these data to make a claim that listening to heavy metal or jazz music is harmful to hearing. Obviously, individual MLPs vary, and the amount of time spent listening at levels higher than 85 dB is an important factor; however, with regard to educating music listeners on the potential dangers of listening to music at loud levels, those who prefer heavy metal and jazz music may be at greater risk.

Second, college nonmusic majors preferred to listen to music at significantly lower loudness levels than the two groups of musicians. It would be interesting to explore further the notion that music training increases the preferred loudness level. If such a relationship does indeed exist, perhaps it is related to the degree to which a person likes music; the greater the liking, the greater the loudness level. In a somewhat related study, Hoover and Cullari (1992) found that nonmusicians were more accurate than musicians in estimating the loudness of 6 out of 10 different music styles. Both groups were most accurate with styles that were most familiar. An alternative explanation worth pursuing might be that musicians have already experienced hearing losses such that they prefer the music louder.

Once again, some concern should be registered about MLPs for jazz and heavy metal music. College music students and middle school band students exceeded 85 dB, with mean MLPs for jazz and heavy metal music of 85.05 and 86.8 dB. All three groups approached or exceeded this level for heavy metal music. Furthermore, it should be noted that 12 of the 40 middle school students had an MLP over 100 dB. The highest registered MLP was 120 dB; at that level, it would take repeated exposures of only 7.5 minutes for permanent damage to occur.

Third, middle school males generally prefer to listen to music louder than do middle school females, but there were fewer differences between college males and females. One intriguing result was that, although middle school and college music major males always listened to music louder than their female counterparts, college nonmusic major males always preferred to listen to music softer than college nonmusic major females. Perhaps these males were simply less interested in listening to music than the females.

Two factors must be considered in interpreting the results of this study. One has already been noted, and that is that the dB levels obtained in the conversion chart are approximations; however, even if relationships among different dB levels were used rather than absolute values, the conclusions of this study would not be changed.

A second factor is more problematic. It has been demonstrated that a person's liking for a given music style affects loudness preference; the more subjects like a music style, the louder they prefer it (Cullari & Semanchick, 1989; Fucci et al., 1993). During the current study, it was possible to discern this relationship in that those who disliked rap music, for example, displayed that dislike visibly and immediately wanted the music turned down. Those who really liked heavy metal, however, wanted it "cranked up." To the degree that the subjects in this study represent "typical" middle school band students and college music and nonmusic majors, these data may represent a norm. Listeners who have intensely stronger likes or dislikes may be expected to register different MLPs; however, since a like/dislike survey was not given to these subjects, such a contention remains conjecture.

Even with the potential limitations of this study, there is sufficient evidence to warrant efforts on the part of music educators to inform students and their parents about possible risk factors in listening to any music at loud levels. Because this effect is exacerbated with headphones, especially smaller ones that are inserted into the ear canal, parents may unwittingly increase the risk factor when they have their children listen to music on headphones so that they, the parents, won't be bothered. Students who listen to music many hours a day, or who prefer jazz or heavy metal music may be most at risk. Research that would further clarify relationships between music listening habits and loudness levels is clearly warranted.

References

- Cullari, S. & Semanchick, O. (1989). Music preferences and perception of loudness. *Perceptual & Motor Skills*, 68, 186.

- Danenberg, M., Loos-Cosgrove, M., & LoVerde, M. (1987). Temporary hearing loss and rock music. *Language, Speech & Hearing Services in the Schools, 18*, 267-274.
- Elias, M. (1991, 22 March). Loud music beats away at kids' eardrums. *USA Today*. Section D, p. 1.
- Feldman, A., & Grimes, J. (1991). Audiology. In J. Ballenger (Ed.), *Diseases of the nose, throat, ear, head, and neck, 14th ed.* (pp. 1029-1052). Philadelphia: Lea & Febiger.
- Fucci, D., Harris, D., Petrosino, L., & Banks, M. (1993). The effect of preference for rock music on magnitude-estimation scaling behavior in young adults. *Perceptual & Motor Skills, 76*, 1171-1176.
- Goldstein, B. & Newman, C. (1994). Clinical masking: A decision-making process. In J. Katz (Ed.), *Handbook of clinical audiology, 4th ed.* (pp. 109-131). Baltimore, MD: Williams & Wilkins.
- Koss, M. (1993). Why noise fun is no laughing matter. *Nation's Business, 81*(2), 57.
- Henderson, D., Salvi, R., Boettcher, F., & Clock, A. (1994). Neurophysiologic correlates of sensory-neural hearing loss. In J. Katz (Ed.), *Handbook of clinical audiology, 4th ed.* (pp. 37-55). Baltimore, MD: Williams & Wilkins.
- Hoover, D. & Cullari, S. (1992). Perception of loudness and musical preference: Comparison of musicians and nonmusicians. *Perceptual and Motor Skills, 74*, 1149-1150.
- Kuras, J., & Finday, R. (1974). Listening patterns of self-identified rock music listeners to rock music presented via earphones. *Journal of Auditory Research, 14*, 51-56.
- Melnick, W. (1994). Industrial hearing conservation. In J. Katz (Ed.), *Handbook of clinical audiology, 4th ed.* (pp. 534-552). Baltimore, MD: Williams & Wilkins.
- Nielsen, D., & Slepecky, N. (1986). Stereocilia. In R. Altschler, R. Bobbin, & D. Hoffman (Eds.), *Neurobiology of hearing: The cochlea* (pp. 23-46). New York, NY: Raven Press.
- Noise and hearing loss. (1990). *JAMA: Journal of the American Medical Association, 263*:23, 3185-3190.
- Occupational Safety and Health Administration. (1981). Occupational noise exposure. Hearing conservation amendment. *Federal Register, Part III*. Department of Labor, 39, 37773-37778.
- Schroeder, M. (1993). Listening with two ears. *Music Perception, 10*, 255-280.
- Williams, R. (1992). On the teen scene: Enjoy, protect the best ears of your life. *FDA Consumer, 26*(4), 25-27.