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A LONG-TERM STUDY ON HIGH LEVEL MUSIC EXPOSITION AND HEARING EFFECTS IN ADOLESCENTS

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ABSTRACT
Interdisciplinary long-term study, developed according to international standards, on hearing effects in adolescents by high level music exposition and its relation with physical and psychosocial variables. Two groups −boys and girls- are examined along four years, from 14 to 17 years old. The study focus on: a) changes both, in hearing threshold, applying conventional and extended high frequency audiometry, as well as, in recreational activities; b) sound inmission levels measurements in discotheques and by using walkman in everyday life. The early results of the two first years of study are shown.

1 - INTRODUCTION

Sources of noise exposure outside the workplaces that are potentially damaging have been the topic of many studies [1]. In occupational noise environments there are regulations concerning sound levels, ear protection, etc. In non occupational settings, no such legislation or organizations are responsible for checking on hearing or sound levels. There is a widespread lack of knowledge about harmful sounds and their effects on hearing and the well being of that exposed [2].

There are numerous sources of non-occupational noise. According to exploratory studies, in Argentina, one of the most common for young people is exposure to high level music in discotheques or through personal listening devices and, sometimes, attending to popular concerts. About the possible harmful hearing effects of music, some authors consider that loud pop or rock music clearly contains a risk for noise-induced hearing loss (NIHL), meanwhile, others consider that the hearing loss cannot be attributed to that kind of music in non-professional listeners [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12]. According to recent studies, the extended high frequency audiometry could inform about hearing sensibility and to be an early predictor of hearing loss by noise [13], [14], [15], [16], [17], [18], [19], [20], [21].

We are carrying out an interdisciplinary long-term study, during four years, with two groups of adolescents -boys and girls-, on hearing effects of high level music exposition and its relation with psychosocial variables. It is developed taking into account international standards. The study focus on changes both, in hearing threshold, applying conventional and extended high frequency audiometry, as well as, in recreational activities, along the four years. Besides, sound inmission levels of those adolescents, during

the attendance to discotheques, as well as, by the use of walkman, are measured. The results of the two first years of the study are presented.

2 - METHOD

Subjects: All the pupils attending the third year of high school level during 1998 of two -different schools - one for males, another for females. Both groups are examined along four years from 14 to 17 years old. In the first year -1998 - the number of subjects were 102 boys and 71 girls. In the second year - 1999 - the number of boys was strongly reduced to 72 due to changes in the general Study Plan in their school, and the number of girls, was 64.

Hearing study: environment, equipment and procedure

a) **Audiometer booths**: Two audiometer booths were specially built fulfilling the requirements of ISO 8253-1 (1989) and IRAM 4028-1 (1997) standards with regard to the interior noise. Each one was installed in a quite place of the corresponding school.

b) **Audiometers**: Two Madsen audiometers Orbiter 922 for conventional and extended high frequency range −one for each school- according to IEC 60645-1, 60645-4 and IRAM 4075. They are calibrated three times by year in the conventional and extended high frequency (EHF) ranges according to ISO 389 and ISO 389-5. In EHF was corrected following PTB Document Test Report (future ISO 389-7).

c) **Earphones**: Circumaural earphones Senheiser HDA 200 for both conventional and extended high frequency range −one for each school. The headband force measured (9,92N and 10,3N fulfils the specifications of ISO/TR 389-5 standard (10,0N ± 1,0N).

d) **Procedure**: The audiological study is performed yearly in each school, during the same months of the year, by very good trained audiometricians who determine the threshold of each subject in conventional and in extended high frequency ranges, according to ISO 8253-1 and IRAM 4028-1 (bracketing method). The audiometer attenuator steps for the test signal are of 2 dB. When the threshold in one or more frequencies is doubtful, the hearing test is repeated after a week. Before each audiometer test, an individual otoscopy examination is carried out and a "hearing state" questionnaire is applied. Each subject is tested yearly by the same audiometrician.

Psychosocial study: tests and procedure

a) **Tests performed**:

Recreational Activities Questionnaire (RAQ) [20] for knowing in detail
the exposition to noisy activities and music.

- Scale about Attitude Towards High Level Music (ATHLM) [22].
- Differential Semantic Scales (DSS) [23], to evaluate different situations related with music.
- Millon Adolescent Personality Inventory (MAPI) [21], [24] for knowing personality traits and its relation with types of recreational activities.

b) **Procedure**:

The psychosocial tests are performed in small groups, no more than 10 subjects, and strictly controlled. The RAQ is applied yearly at the same month of the year, in order to know changes in such activities along the four years. Both types of scales, ATHLM and DSS, are performed in the first year of the study −at 14 years old- and in the last year −at 17 years old-, in order to know differences of attitude between both ages. The MAPI will be performed in the third year of the study −2000-, at 16 years old.

Measurements of real sound inmission levels

- In discotheques

Measurements in situ are performed in the discotheques more visited by the adolescents involved in the study, using two methods:

a) Personal dosimeter Brüel & Kjaer, 4436.

b) A system developed ad hoc made up of a chain of portable instruments composed by high quality Norsonic condenser microphone 1220, preamplifier 3336 and Sony digital tape recorder TCD-D8, all of them, previously calibrated in laboratory and then mounted in a fashion small knapsack. The recorded signals are analyzed in laboratory using another chain of instruments: real time analyzer 2144, sound level meter 2231 with statistical analysis module BZ 7115 and signal generator 1049, all of them from Brüel & Kjaer.

- With walkman

A system made up by Head and Torso Simulator Brüel & Kjaer 4128 in accordance with IEC 60959, fitted with two occluded ear simulator as described in IEC 60711 was developed for measuring the real sound levels in the ear of the adolescents when they use walkman. The measurement technique is used taking as reference the draft ISO/CD 11904-2.

3 - RESULTS

According to the hearing threshold (HT) in the first year of the study, the adolescents were classified in three groups, as follows:

Group A: (250 to 2000) Hz, HT $\leq$ 16 dB.....(3000 to 16000) Hz, HT $\leq$ 26 dB.

Group B: (250 to 2000) Hz, HT $>$ 16 dB $\leq$ 30 dB... (3000 to 16000) Hz, HT $>$ 26 dB $\leq$ 40 dB.

Group C: (250 to 2000) Hz, HT $>$ 30 dB.....(3000 to 16000) Hz, HT $>$ 40 dB.

The subjects classified in the first year, remain in the same group till the end of the study. In order to compare the results between the two years of study, only the subjects who have remained in the same school were considered for the statistic process.

Only the results of the most significant variables of the Group A (60 boys and 50 girls in the second year of the study) are shown below:

****Recreational activities**: "Exposition to Music" (EM) is the variable where the most important change between the two years of study was observed:

Boys: First year: *low* EM: 63,3% − *middle* EM: 33,3% − *high* EM: 3,3%

Second year: *low* EM: 30,0% − *middle* EM: 53,3% − *high* EM: 16,7 %

McNemar Test: p<0,0001

Girls: First year: *low* EM: 64,0% − *middle* EM: 32,0% − *high* EM: 4,0%

Second year: *low* EM: 18,0% − *middle* EM: 58,0% − *high* EM: 24,0%

McNemar Test: p<0,0001

"Discotheques attendance" (DA) is the most important variable in relation to EM:

Boys: First year: *no* DA: 23,3% − *low* DA: 18,3% − *middle* DA: 50,0% − *high* DA: 8,3%

Second year: *no* DA: 16,7% − *low* DA: 18,3% − *middle* DA: 46,7% − *high* DA: 18,3%

McNemar Test: p<0,004

Girls: First year: *no* DA: 28,0% − *low* DA: 16,0% − *middle* DA: 44,0% − *high* DA: 12,0%

Second year: *no* DA: 6,0% − *low* DA: 8,0% − *middle* DA: 46,0% − *high* DA: 40,0%

McNemar Test: p<0,0001

** **HT**: Comparison between the two years of study.

(a) **(b)**

Figure 1: Comparison of HT −right and left ears- between first and second year of the study (a) boys (b) girls.

Significant HT shift in the second year of the study (Test t) in the following frequencies:

a) **male group**: *right ear* [6000 (p<0,03), 9000 (p<0,0001), 10000 (p<0,001), 11200 (p<0,10), 14000 (p<0,0001) and 16000 (p<0,003)] Hz; *left ear* [1000 (p<0,04), 9000 (p<0,0001), 10000 (p<0,001), 11200 (p<0,007), 14000 and 16000 (p<0,0001)] Hz. b) **female group**: *right ear*, only [6000 (p<0,001) and 10000 (p<0,002)] Hz; *left ear* [250 (p<0,01), 6000 (p>0,0001), 8000 (p<0,03), 10000 (p<0,005), 14000 (p<0,004) and 16000 (p<0,02)] Hz.

** **Relation between DA and HT** in the second year of the study:

(a) **(b)**

Figure 2: HT of both ears according to the categories of AD in the second year of the study (a) boys (b) girls.

The boys with the "highest attendance level" have higher HT than the rest (Anova test) in [6000 and 9000 (p<0,02), 10000 (p<0,03), 11200 and 16000 (p<0,08)] Hz. In the female group, the difference is significant only in [6000 (p<0,01) and 8000 (p<0,03)] Hz.

** **Sound inmission levels in two recreational activities**:

(a) **(b)**

Figure 3: Sound inmission levels in two recreational activities (a) in the most visited discotheque (b) by using walkman.

4 - CONCLUSION

In the second year of study, the results show:
- **Hearing**: significant HT shift, mainly in the high frequencies, and more emphasized in the male group than in the female.
- **Recreational activities**: EM significantly increased in both groups. DA is the most important recreational activity, especially in the female group where a high percentage of girls have "high attendance" to such places.
- Relation between HT and DA level: High level DA in the male group is related with higher HT, mainly in the most of high frequencies, meanwhile in the female group, only in two middle frequencies.
- **Sound inmission**: The measurements in disco, as well as, by using walkman are showing high and dangerous doses of music inmission levels.
At present, a tendency in the behavior of the variables considered can be observed. Two years more of study will let us confirm or no such tendency.

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