Noise and Stress in Primary and Secondary School Children: Noise Reduction and Increased Concentration Ability Through a Short but Regular Exercise and Relaxation Program

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The present study examined whether a short but regularly used program of relaxation, applied to Primary and Secondary school children, could (a) reduce noise levels (in decibels), (b) reduce pupils’ experienced stress levels, and (c) increase the pupils’ ability to concentrate, as measured by teachers’ estimates. Noise levels in 5 classrooms (84 participants) were measured using sound monitors, before and after a 4-week long relaxation program, as well as when no relaxation training was provided. The results indicated that levels of noise were reduced significantly after the relaxation treatment. The results indicated no significant reduction of stress levels in the classes, but ability to concentrate increased among the pupils.

Introduction

The type A versus type B personality distinction regarding risk for stress has been applied to children (Elkind, 1984; Evans, Allen, Tafalla & O’Meara, 1996). One difference compared to adults is that children require an awareness of stress mechanisms in order to resist negative stress in their daily lives (Ellneby, 2000). Veninga and Spradley (1981) demonstrated that ‘burn-out’ might afflict children. A maladaptive school environment, that is a school that often causes stress, is usually a school with an overproduction of noise (Kadesjö, 1997). Levels of noise in school and in childcare have increased due to larger group sizes and newer teaching methods that...
allow more children to speak simultaneously. Additionally, noise from computers and ventilation appliances contribute to constant levels of background noise in the classroom (Sylwander, 1999). Recent findings show that noise not only causes undue stress to children but also inhibits intellectual and language development (Maxwell & Evans, 1999). Children exposed to noisy environments are influenced psychologically: for example showing increased blood pressure, alimentary canal disturbances and other somatic problems, when exposed to constant noise levels of 95–125 decibels (dB) (Maxwell & Evans, 1999). Motivation, concentration, and attention are negatively influenced at constant levels of 22–78 dB (Maxwell & Evans, 1999). Disruptive effects upon language comprehension courses were noted at noise levels of 65–70 dB (Jiang, 1997; Maxwell & Evans, 1999), that is lower and middle school children could understand only 71% of the language content since consonant sounds were masked.

One consequence of too much noise is that younger children have problems following a theme that allows them, amongst other things, to draw conclusions. In research studies, this is shown through reference to ‘signal-to-noise-ratio’ (SNR) measurements. The SNR is the difference between the level of signals and the level of background noise; a typical signal is the level of teacher’s voice (Soli & Sullivan, 1997). It was found that children needed to reach the age of 15 years to be able to compensate for the periodic loss of spoken messages. One interesting aspect of these studies is that the youngest children (4–5 years) that had been exposed to noisy environments developed a better ability to ignore noises than those exposed to environments less noisy. However, by the time school-attending age had been reached this ability had generally disappeared. Children from noisy environments learned to tune out auditory stimuli but in a nondiscriminatory way and tuned out important cues (Maxwell & Evans, 1999), an observation suggesting that the ability was not necessarily to the children’s advantage in that they may have learned to ‘turn a deaf ear.’

Australian studies have indicated that more pupils present significant hearing problems today than 25 years ago. For example, 15% of the total number of pupils show more noticeable hearing problems (Massie, Byrne, Theodorus, Smaldino, & McPherson, 1997). Furthermore, it was reported that the constant level of noise in most classrooms was often 60–63 dB. Australian maximum levels have been set at 40–45 dB (AS 2107–1967, Australian Design Standard) which is similar to North American recommendations for noise levels from external sources. These figures may be compared with teachers’ speech with noise levels estimated for low voice at 50–65 dB and for loud voice at 78 dB (Maxwell & Evans, 1999).

The increasing demands upon intellectual quality and mental performance are difficult to meet in noisy environments; the school environment has been developed to facilitate the particularly demanding task of learning. Thus, a minimum of noisy disturbance must be sought (Andersen, 2000). Studies from both Germany and the UK make the same indications (Airey, MacKenzie, & Craik, 1998; Schick, Klatte, & Meis, 2000).
Our experience gained from enquiries and visits to schools during teacher training proves that both teachers and schoolchildren suffer from the noise they in parts cause themselves in classrooms and corridors. Measurements taken in Berlin revealed as much as 76 dB over a period of eight hours in a first-year primary school class. In comparison, the regulation governing places of work provides a limit of 55 dB where, in the main, intellectual work is carried out. (Schick et al., 2000, p. 541)

Airey et al. (1998) presented a large study on the influence of stress upon school children and teachers in 60 English primary schools. The pupils’ ways of communicating in the classroom were examined. Noise levels of up to 100 dB were registered and attempts were made to reduce this by altering the rooms’ acoustic silencing ability.

One important factor for optimal learning is the size of the classrooms. These are usually unsuitable for uses other than formal teaching, being too small and having few possibilities for working in alternative ways without disturbance (Elkind, 1984). The use of computers and other new techniques has consequences both for teaching and teaching methods. These innovations to the current school curriculum require too an altered teacher role (Sjöquist & Pettersson, 1998). Teachers function increasingly as ‘guides’ or ‘organizers’ rather than in the traditional role of the ‘one-with-the-knowledge’, with the result that pupils maintain a dialogue in the learning process, thereby contributing to the number of voices in a classroom. Thus, the teaching environment requires a radical architectural design shift if worsening adverse consequences for school performances are to be avoided (Kadesjö, 1997).

The purpose of the present study was to examine whether a simple, yet regularly applied, program of relaxation could (a) reduce noise levels (in decibels) in several classes, (b) reduce pupils’ experienced stress levels, and (c) increase the pupils’ ability to concentrate, as measured by teachers’ estimates.

**Methods**

**Participants**

The investigation was carried out at a primary and secondary school (Liljenäs school, Grums, Värmland, Sweden). Ninety-five persons participated of whom 88 were pupils (40 boys and 48 girls) and 7 were teachers (2 male and 5 female). The mean age of the pupils was 11.31 years ($SD = 1.09$) and that of the teachers was 42.14 years ($SD = 13.91$). At the start of the investigation, the participants were required to assess, on a 5-point scale, how it felt to work at school. The results indicated that 73.5% experienced school work as ‘good’ or ‘quite good’, whereas 12.2% responded that it was ‘bad’ or ‘very bad’, 14.3% that it was ‘very good’. Statistical analysis applying Mann-Whitney U-tests did not show any significant differences with regard to Gender ($p = 0.296$) or between those who had participated in the relaxation program and those who had not ($p = 0.827$), but did with regard to pupils/teachers ($U = 22, p < 0.001$). Further analysis indicated that the pupils experienced work in
school as ‘quite good’ to ‘good’ ($M = 3.74$, $SD = 0.83$), whereas the teachers experienced work in school as ‘bad’ ($M = 2.29$, $SD = 0.49$).

Design

Noise levels in five classrooms (84 participants) were measured using sound monitors, before and after a 4-week relaxation program. For comparison, noise levels were measured in a different room also (11 participants) wherein no relaxation training was provided. Noise levels were examined according to a before/after design. Only pupils from the middle school were studied, together with the teachers, for an analysis of subjective assessment of noise levels and other factors. This arrangement allowed a better comparison with the class that was not provided with relaxation training. For the subjective scaling (questionnaires distributed before and after treatment) a split-plot design was used with pupils’ and teachers’ estimates of different aspects as the Within-subjects factors and with a Control group (9 participants from the 5th and 6th year classes) and an Experimental group (40 participants from the 4th, 5th, and 6th year classes) as Between-subject factor.

Instruments

(a) Noise monitor. The measuring equipment was a noise monitor, YF-20 Sound Level Meter (YFE Yu Fong), with registration areas of 35–80 dB and 80–120 dB, respectively. The equipment was calibrated and the batteries tested prior to each occasion.

(b) Questionnaires. Two questionnaires for pupils were developed: one presented prior to and one after treatment. The questionnaires consisted of 10 items concerning, for example, experienced noise and stress levels. Respective questionnaires were developed for the teachers.

(c) Relaxation Program. The program included three different groups of stretch exercises that were performed repeatedly in short series. These exercises are directed primarily at muscle groups in the upper part of the body: arms, shoulders, neck, chest, and back, and consist of episodes of effort and rest (e.g., with arms stretched forward, press a book with both hands). The program was terminated with relaxation exercises (Setterlind & Larsson, 1993), with the pupils sitting in their chairs (e.g., with eyes closed, silently counting inhalations). Total time for completion of the program was 5–10 minutes.

Procedure

The teachers for each of the classes were informed about the organization and purpose of the investigation. The school authorities gave permission and approved investigation. All the participating teachers were required to prepare and train
themselves in the relaxation program and were given an opportunity for questions and clarifications. No information was given to the pupils about the investigation or its purpose. Each teacher completed the relaxation program just as if this was one of the official disciplines in the educational syllabus.

Registrations of noise measurements (see Instruments) were taken from neighboring localities (group-rooms) while the actual noise monitor was placed on top of a cover in the classroom where the measurements were done. Noise measures were carried out on three occasions before treatment (relaxation) and on three occasions after treatment. On each occasion measures were taken over 40 minutes (approximately the length of each lesson period) and 11 points of measure with 4-minute intervals were applied. Measurements were taken against a point in the center of the room and were all carried out by the Experimenter. The criterion for the point of measure was the lesson should not be directed and not in any way be influenced by ‘orders’. The teachers were to maintain their usual supportive role in the classroom while the pupils worked by themselves, either singly, in couples or in groups. Other criteria were that the measures were taken on a random schedule, that could not be influenced by the Experimenter and only one measure per week was taken in the classroom involved. Consequently, noise measures were taken over 3 weeks prior to treatment and over 3 weeks after treatment.

All the participating classes (with the exception of the control class) carried out the same relaxation program (see Instruments) over 4 weeks. Relaxation episodes occurred twice daily: immediately following the morning break (09.50 hours) and after the lunch break (11.40 and 12.00 hours, respectively). The program took 5–10 minutes and consisted of a combination of stretching exercises and relaxation exercises that terminated every episode. The pupils carried out the program while sitting behind their benches. No other materials or equipment were necessary.

Results

Data Summation

In order to facilitate statistical analysis, the possibility of summatıng the different measurement points and measurement occasions before and after treatment, respectively, was examined. A stepwise regression was performed with 33 collected measurement points from the three measurement occasions before treatment. At step 1, there was a highly significant value on Multiple R \( F(1,4) = 63.95, p = 0.001, R = 0.97 \), which allowed the 33 measurement points before treatment to be summated to the mean value. Similarly, regression analysis was performed on the 33 measurement points after treatment. Once again, at step 1 there was a highly significant value on Multiple R \( F(1,4) = 120.51, p < 0.001, R = 0.98 \), which allowed the 33 measurement points after treatment to be summated to a mean value.
Noise Registration Before and After Treatment

Classes Receiving Relaxation (5 Groups)

Wilcoxon’s Matched-Pairs Test indicated a significant difference between noise levels (dB) before and after treatment ($Z = -2.02, p = 0.043$). Further analysis indicated that the noise levels in the five classrooms had been reduced from 63.24 dB ($SD = 6.60$) to 50.50 dB ($SD = 4.38$).

Class Not Receiving Relaxation (1 Group)

Since only one group was involved, no significance testing could be performed; however, descriptive analysis indicated that there was no reduction of noise levels (before: $M = 72.91$; after: $M = 74.61$).

Experience of Noise and Stress

Experience of Noise

Both pupils and teachers made estimates of noise levels in the classroom before and after treatment on a 7-point scale whereby 1 defined ‘little noise’ and 7 defined ‘very noisy’. Split-plot ANOVA, applying Noise (before, after) as Within-Subject Factor and Group (Control, Experimental) as Between-Subject-Factor, did not indicate any significant effect for Noise ($p = 0.687$), nor any Noise x Group interaction effect ($p = 0.459$), but a significant Group effect [$F(1,47) = 14.91, p < 0.001$]. Further analysis indicated the control group had a higher score on experienced noise level both before ($M = 5.33, SD = 1.87$) and after ($M = 5.44, SD = 1.51$) treatment in comparison with the Experimental group (before: $M = 3.38, SD = 1.76$; after: $M = 3.00, SD = 1.83$). Table 1 presents the means and standard deviations for subjective experience of noise.

Experience of Stress

Both pupils and teachers made estimates of noise levels in the classroom before and after treatment on a 7-point scale whereby 1 defined ‘little stress’ and 7 defined ‘very stressful’. Split-plot ANOVA, applying Noise (before, after) as Within-Subject Factor and Group (Control, Experimental) as Between-Subject-Factor, did not indicate any significant effect for Stress ($p = 0.474$) or Group ($p = 0.107$), nor any Noise x Group interaction effect ($p = 0.584$). Table 1 presents the means and standard deviations for subjective experience of stress.

Pupils’ Experience of the Relaxation Program

Responses to the question: ‘how do you think the relaxation program has worked?’, indicated that 41.2% of the Experimental group pupils considered it as ‘quite good’, 32.4% as ‘good’, and 20.6% as ‘very good’, whereas 5.9% indicated it as ‘bad’.
Teachers’ Perceptions About the Pupils

Before treatment, the teachers received a 9-point scale (whereby 1 corresponds to ‘bad’, 5 to ‘normal’ and 9 to ‘good’) in order to express how they experienced the pupils’ average ability to concentrate. After treatment, the teachers had to respond to the scale once more. The results indicated that the teachers considered that pupils showed a lesser ability to concentrate before treatment compared to what they considered normal (\(M = 3.57, SD = 1.40\)), whereas the average ability of the pupils was considered to be normal after treatment (\(M = 5.29, SD = 1.25\)). Statistical analysis applying the Wilcoxon Matched-Pairs Test indicated that the difference between before and after was significant (\(Z = -1.84, p = 0.046\)). In order to control for the extent to which compliance with the relaxation program was maintained, a question regarding that was posed: four out of seven teachers responded ‘complied with completely’ and three responded ‘complied with almost completely.’

Discussion and Conclusion

The present study indicated that levels of noise, measured in dB, were reduced significantly following a short but regular relaxation program implemented during a 4-week period. The result indicated no significant reduction of stress levels in the classes, but ability to concentrate increased among the pupils.

One explanation for the reduction of noise level in the present study may be explained by the point at which the relaxation program occurred in the daily curriculum since this time ‘bridged’ a critical period in the school day, namely when the school day shifted from the break (free activity) to lessons (concentration upon school work). The initial period following the break is important as the ‘ceiling’ noise level at that time sets the threshold to be maintained for working. In the present study, pupils were helped, through the relaxation program, to attain concentration again after the tensions of playing soccer or other ball games in the compound. No significant difference upon the experience of noise before and after treatment was observed for the Experimental group. A difficulty is present in the
estimation procedure, namely that one may detach oneself such that one does not ‘hear’ the noise level (Maxwell & Evans, 1999). Later, when one repeats the estimation procedure following correction measures, a completely different comprehension is obtained. Thus, this may mean that on the second occasion the ‘noise level is discovered’ and one responds with a higher level even though sound measurements may indicate the converse. The noise levels measured in this study adhere closely to those from North American classroom studies regarding the width of variation of the sound curves and the sound intensity measured in dB (Bradley, 1997). German, British, and Australian studies point in the same direction regarding noise levels in the classroom (Schick, Klatte, & Meiss, 2000).

Assigning words and values to experienced stress complicates the process of estimating stress so that an awareness of stress mechanisms is required (Ellneby, 2000). This may explain why there was no evidence of reduced stress in the pupils. Another explanation may involve the pupils’ ability to resist stress through sport and playground activity, a de-stress process (Elkind, 1984; Ellneby, 2000; Jönsson, 1999). If so, then more attention should be given to breaks and ‘meditation rooms’ (Jönsson, 1999). Levels of concentration were found to have increased in the pupils of this study following relaxation treatment; it has been documented that the relaxation techniques ‘sharpen the senses’ and furthermore facilitate a faster restoration following stress (Lindberg & Lindberg, 1990; Setterlind & Larsson, 1993). The present findings underline the utility of a short but regular period of relaxation in reducing noise level but increasing concentration levels.

The schools’ in many respects obsolete organization is experienced as unsatisfactory by many students, often causing a dissatisfactory and unpleasant school day (Andersson, 1999). Nevertheless, the results of this investigation generally indicate that the pupils experienced their work environment as more positive than the teachers did. Probably, the pupils did not have any other environment as a comparison. Teachers have colleagues in other schools and county councils, as well as information about work environment, conditions, and regulations.

The present study suggests one possible intervention to reduce noise levels in the classroom, through the application of a simple, short but regular relaxation program, although a more comprehensive investigation is a necessity. Although noise, stress, and concentration are important factors, lighting, temperature, and the condition of classrooms (Häggquist & Johansson, 1998), their functional attributes (Kadesjö, 1997), and opportunities for pupils to affect their own environment (Häggquist & Johansson, 1998) must also be examined in a comprehensive research programme.

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References


