Psychological Effects of Classroom Noise on Early Childhood Teachers

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Abstract

The aim of this research was to examine the relationship between exposure to classroom noise and the psychological well-being of full-time teaching staff in 14 preschool settings located across Western Sydney. The participants comprised 25 teachers, each of whom was administered a range of instruments. The results indicated that 40% of teachers were subjected to daily or peak noise exposures beyond the maximum permissible levels according to the Australian Occupational Health and Safety (OH&S) standard. Further, the unique contribution of daily noise dose received by the staff to the prediction of their vocational strain, interpersonal strain, and defensive functioning was evident through multiple regression analyses. It was concluded that vocational strain amongst preschool teachers may be related, in part, to a combination of elevated daily doses of noise, and years of teaching experience.

Introduction

A number of contemporary studies concerning noise in early childhood educational settings have established its detrimental effects on both students and teaching staff (e.g., Baxter 2000, Maxwell & Evans 1999, Nelson & Soli 2000, Sorkin 2000). Understandably most of these projects have focused on children, as they are more vulnerable to long-term health, psychological, and educational impairments created by classroom noise than are adults (Evans & Lepore 1993, Evans & Maxwell 1997, Nelson & Soli 2000). However, McLaren and Dickinson (2002) have found that exposure to noise is also a problem amongst early childhood teachers with 30% being exposed to noise in excess of the maximum permissible level under New Zealand standards.

The Australian standard for exposure to noise in the occupational environment is consistent with that enacted in New Zealand: An average of 85 decibels (dB) for an eight-hour day, and 140 dB for peak noise level. Comparable common noise sources falling within the range of 85-140 decibels are: A handsaw – 85; A subway – 90-110; A rock concert – 110-120; Noisy squeeze toys – 135; An ambulance siren – 140. It is important to note that these levels specify maximum permissible exposure within the workplace. Repeated exposure to lower levels of noise may also cause hearing damage over the longer term (American Speech-Language-Hearing Association 2004, National Code of Practice for Noise Management and Protection of Hearing at Work 2000).

In addition to the physical damage caused by exposure to excessive noise, continued exposure has been associated with elevated levels of stress, high anxiety, increased annoyance, depression, and fatigue (Doherty 1999, Evans & Johnson 2000, Glass & Singer 1972, Kalveram 2000, Kryter 1994). Stress, in turn, has been observed as contributing to a number of psychosomatic conditions, including asthma, digestive tract disorders, heart diseases, migraines, chest and back pain (Bacon et al. 1994, Barsky 1988, Doherty 1999, Donoghue & Siegel 1994, Galloway, Panckurst, Boswell, Boswell & Green 1984b, Maddi & Kobasa 1984, Romanova & Grebennikov 1996, Wilder & Plutchik 1984). Hans Selye, whose research first demonstrated that the continuing presence of stressors modified the immune system, labelled these conditions "diseases of adaptation" (Selye 1956). Unsurprisingly, stress has been shown to disrupt both workers' performance (Evans & Johnson 2000) and their job satisfaction (Galloway, Panckurst, Boswell, Boswell & Green 1984a).

While teaching, in general, is currently considered a very stressful occupation (Finlay-Jones 1986, Hodge, Jupp & Taylor 1994, Jarvis 2002, Pithers & Fogarty 1995, Smith, Brice, Collins, Matthews & McNamara 2000, Wilhelm, Dewhurst-Savellis & Parker 2000), an analysis of the literature reveals that little or no attention has been specifically directed towards early childhood teachers' stress and its sources. Anecdotal evidence appears to suggest that much of employee "burnout" and turnover in the Australian early childhood workforce can be attributed, at least in part, to job strains and the nature of the working environment. For example, working conditions and the intensity of the workplace were cited by the respondents to a New South Wales (NSW) Childcare Workers' survey as their second most significant concern following wages (Warrilow, Fisher, Cummings, Sumsion & Beckett 2002). Many teachers appear worried about the impact of noise on their hearing, as they often report going home with "ringing ears". Indeed, school boards are becoming increasingly concerned about the relationship between noise and the performance of both teachers and their students.

It is reasonable to assume that the relationship between classroom noise and teachers' stress is a complex interaction of factors (including, for example, teaching experience or age), rather than a single causal link. If this is the case, then it is important to investigate whether and, to what extent, these factors contribute to employees' perception of stress in the targeted industry sector.

Since noise in early childhood settings is a potentially continuous stressor, and there is little opportunity to mitigate either the sources of noise or its impact, teachers have to reconcile themselves to it if they wish to remain within the industry. We supposed that a so-called "buffer" or "ostrich" psychological adaptation strategy would be mainly in use. This strategy implies the creation of a mental "barrier" between the individual and the stressful environment to prevent the full effects of the stressor being experienced. The perceptual defence mechanism of denial is one possible psychological technique to implement this strategy (e.g., Conte & Apter 1995, Plutchik 1995, Plutchik, Kellerman & Conte 1979). Denial is presumed to assist an individual avoid awareness of unwelcome reality and, in this sense, it is likely to be used to "block out" both recognition of being under stress and the awareness of its source. Plutchik, Kellerman, & Conte (1979) found an interesting difference between denial and other defence mechanisms. The use of denial correlated negatively with perceived stress and anxiety, while all other defence mechanisms showed positive correlations with stress. Therefore, on the one hand, the stressful environment can enhance the use of denial alongside other defence mechanisms. On the other hand, denial is the only defence with a "back action", such that it can considerably dampen one's conscious perception of the stressor (Evans & Johnson 2000, Plutchik, Kellerman & Conte 1979). On the basis of this perspective, two models were proposed for evaluation. First, we sought to test whether the set of the objective variables: Noise exposure, age, and length of service plus denial contributed to a prediction of perceived stress. It was expected that denial would be negatively related to self-reported measures of stress, while the objective variables would be positively related to the stress parameters. Second, we tested the combination of the objective variables and stress measures as the basis of a prediction of the overall use of defence mechanisms.

In summary, the present research was designed to examine: (1) The level of occupational noise, to which early childhood teachers are exposed, and (2) employees' perceived stress and the defence strategies they implement, if any, to manage the situation. Our principal concern was to examine an under-studied group of professionals at potential risk, with a focus on their exposure to noise, psychological well-being, and possible exposure-outcome relationship. It was hypothesized that a statistically significant, positive linear relationship would be evident between the level of noise to which early childhood teachers were exposed

and their scores on various psychological measures, including personal strain, chronic and recent distress, and the use of defence mechanisms.

Method

Participants

Data were collected from 25 full-time teaching staff located at 14 preschools across Western Sydney and operated under the auspices of the New South Wales Department of Education and Training. Full-time employees were selected for testing, since it was assumed that this group would experience noise over relatively longer periods than other staff (McLaren & Dickinson 2002). All the participants were female. Their mean age was 42.7 years (*SD* = 9.7), and they had accumulated an average of 13.9 years (*SD* = 8.5) of teaching experience. The student to teacher ratios were 10:1 for 16 participants (64%), 11:1 for two participants (8%), and 12:1 for seven participants (28%).

Noise Assessment

The initial stage of the study involved an assessment of the daily noise exposure for full-time teaching staff members, taken as an average eight-hour equivalent sound pressure level, and peak sound pressure level. The ambient noise level was monitored using a high-quality personal sound exposure meter "Casella", model CEL-310/K1, which is designed to meet the standards of the National Code of Practice (2000). The data collected included:

- The average sound pressure level throughout a trial period;
- An eight-hour equivalent sound level (i.e. average level throughout a trial period projected over eight hours);
- The dose% (the amount of actual exposure relative to the amount of allowable exposure for which 100% and above are hazardous);
- The peak sound pressure exceedence; and
- Event and time history.

The estimation of noise level, projected over eight hours, was used as it standardized the exposure received by participants during the approximately six hours of actual working time, assuming that the remainder of the eight-hour reference period was quiet. This enabled comparisons between individual exposure rates and with the OH&S eight-hour standard (see Figure1).

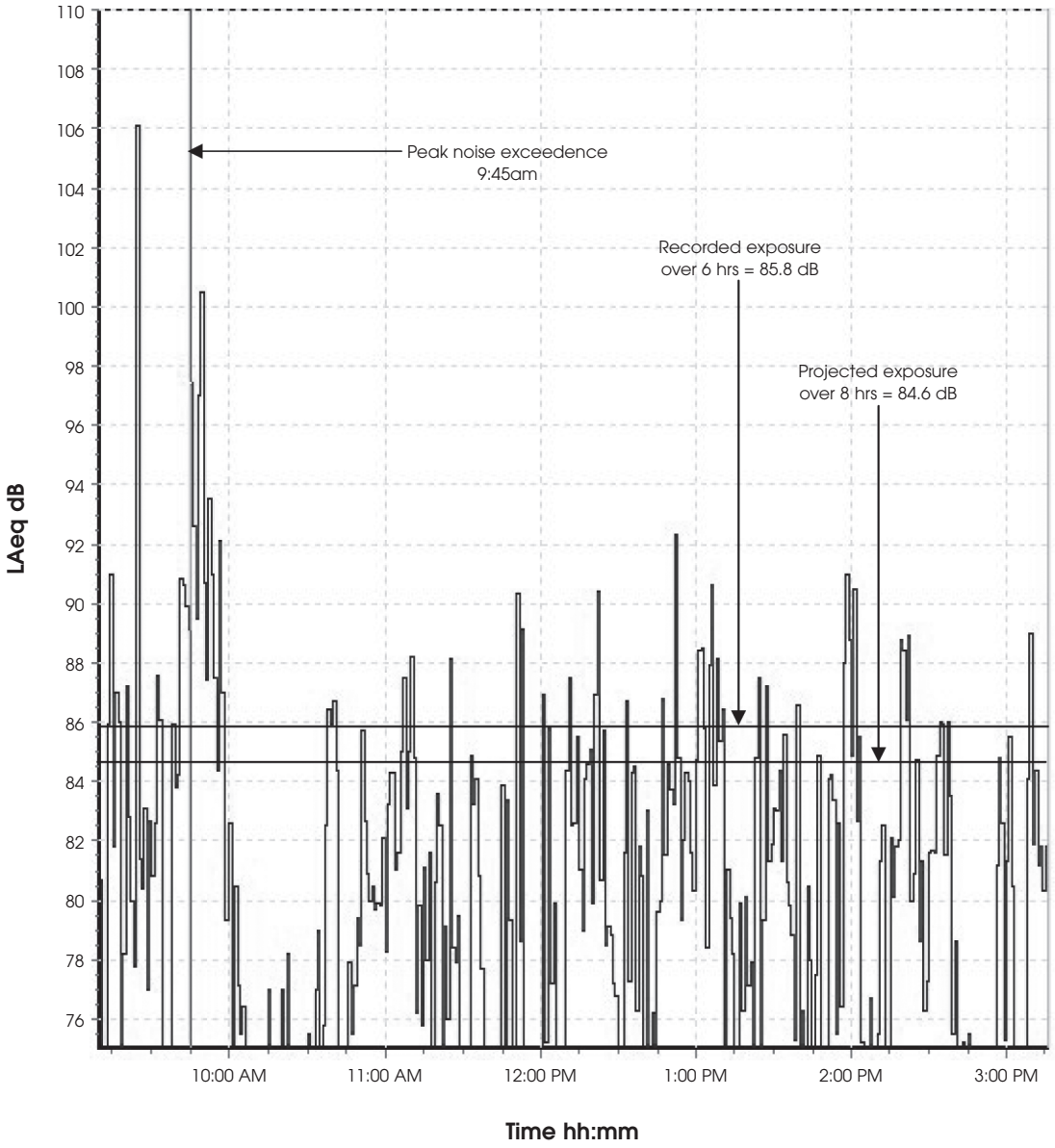

Figure 1: Individual recorded and projected noise exposure
Peak noise exceedence

Instruments

The second stage of the study involved the distribution of a series of psychological instruments, including the Personal Strain Questionnaire (PSQ), which was a part of the Occupational Stress Inventory revised edition (Osipow 1998); the General Health Questionnaire (GHQ-60) (Goldberg & Williams 1991); and the Life Style Index (LSI) defence mechanisms test (Plutchik, Kellerman & Conte 1979).

The PSQ consists of four subscales. According to Osipow (1998), the vocational strain scale assesses job attitudes and perceived performance; the psychological strain scale assesses the degree of one's psychological adjustment and mood problems; the interpersonal strain scale assesses the extent to which interpersonal relationships are disrupted; and the physical strain scale assesses worries about one's health and poor self-care habits. Each scale contains 10 items. A five-point (1-5) Likert-style scale is used by respondents to rate their level of agreement with a given statement (rarely/never, occasionally, often, usually, most of the time). Normative data obtained from samples of 364 female and 619 male adults is available as *T*-scores with a mean of 50 and a standard deviation of 10. A mean value for Cronbach's alpha of .94 is reported for this instrument.

The GHQ-60 is an unscaled, single-score screening test that focuses on emotional distress and social dysfunction. Goldberg and Williams (1991) suggest that these dimensions should be examined through an emergence of various minor somatic symptoms and changes in social behaviour. The questionnaire contains 60 items, which respondents are asked to rate, using a four-point scale, as applying to their perception of their current condition (better than usual, same as usual, worse than usual, much worse than usual). Three types of scoring can be used to interpret the scale: Likert (0-1-2-3), GHQ (0-0-1-1), understood as a recent distress score, and CGHQ (0-1-1-1) for negative items and (0-0-1-1) for positive items, understood as a chronic distress score. The thresholds identifying respondents with severe psychological distress not only vary with the scoring method, but also across populations. The GHQ and CGHQ scoring methods were employed in the present research. The GHQ scoring method was selected because it had been used in various studies reporting a stable cut-score of 11/12 (Goldberg and Williams 1991). A score $\geq$ 12 identified individuals who were likely to have experienced distress of late. The CGHQ scoring method was used, as it tends to produce a less skewed distribution. This is useful for parametric analyses and, as some studies have shown, it also tends to increase sensitivity of the instrument (Goldberg & Williams 1991, Finlay-Jones 1986).

The LSI defence mechanisms measure was developed on the basis of psychoanalytic theory and empirical research (Conte & Apter 1995, Plutchik, Kellerman & Conte

1979). Its 97 items are grouped into eight scales: compensation (including identification and fantasy), denial, displacement, intellectualisation (including sublimation, undoing, and rationalization), projection, reaction formation, regression (including acting out), and repression (including isolation and introjection). Each scale contains from 10 to 14 items describing feelings, ideas, and behaviours that are presumed to represent the eight defence mechanisms. For each item, respondents are asked to indicate whether it is usually true for them by checking "Yes" (1) or "No" (0)". A total score on the use of defences can also be calculated. Normative data derived from a sample of 147 adults is available as both percentiles and *T*-scores with a mean of 50 and a standard deviation of 15. The variation in Cronbach's alphas for the scales (range = .30 to .86) the authors explain by the fact that some scales are, by design, multidimensional as are the defences they represent. In order to combine several concepts or clusters of items into a single scale a certain amount of internal consistency for that scale had to be sacrificed.

The three standardized self-report instruments represent methodologically different approaches to the assessment of perceived stress. While the PSQ items are mainly unambiguous statements relating to feelings and behaviour under stress ("I make errors or mistakes at my work"; "Lately I am easily irritated"; "I have troubles falling and staying asleep"), the GHQ and LSI items are less explicit. Respondents are not always consciously aware that they are under stress. For example, Evans & Johnson (2000) have found that individuals in noisy settings do not necessarily report greater levels of stress than those in relatively quiet settings, while physiological tests suggest that there is a stress-related response.

In comparison to the PSQ, the GHQ tends to focus, to a greater extent, on somatic symptoms associated with psychological disturbance ("Have you recently been getting a feeling of tightness or pressure in your head?"; "Have you recently been sweating a lot?"). Scores on a shortened version of GHQ have been predicted by teachers' distress and job dissatisfaction (Galloway et al. 1984a, Finlay-Jones 1986).

If stress is constant and it is not possible for a person to exercise control over it, there is evidence to suggest that they need excessive recourse to psychological mechanisms to ward off unacceptable feelings (Conte & Apter 1995, Doherty 1999, Evans & Johnson 2000, Plutchik 1995). Items of the LSI test are constructed allowing for the fact that "most individuals can report their own feelings and can describe behaviour that reflects their own ego defences, even though they cannot interpret the dynamic meanings of such behaviour" (Plutchik, Kellerman & Conte 1979, p.236). (For example, "I am free of prejudice", representing denial; "I believe people will take advantage of you if you are not careful", representing projection; "I get irritable when I don't get attention", representing regression.)

Participants also completed a background data sheet that, apart from the demographic details, contained a multiple-response, open-ended question concerning the main sources of noise in their classroom(s). The respondents were not asked to rate these sources.

Procedure

The preschools were visited to monitor participants' noise exposure, to keep a log to relate the data to actual sounds and activities, and to administer the questionnaires. Measurements of noise exposure were conducted by fitting a personal sound exposure meter (dose badge) to staff members for the duration of their working day. Staff noise exposures were automatically logged by these means starting from 8.45-9.00am when direct supervision began, throughout morning sessions (9.00am to 11.30am), lunch breaks, afternoon sessions (12.30pm to 3.00pm), and ending at approximately 3.15pm when all students were picked up. This totalled 5-5.5 contact hours and about 6 hours of monitoring time overall. The monitoring was conducted on regular, ordinary days in the absence of any special events or outings, and the questionnaires were administered out of hours. All responses were treated confidentially.

Results

Noise Exposure

Of the 25 preschool teaching staff monitored, the highest individual noise exposure levels were 85.0, 85.1, 85.8, and 86.1 dB during the six-hour workday. These values were projected over eight hours, assuming that the remainder of the eight-hour reference period was quiet, and resulted in daily equivalent exposures of 84.1, 84.2, 84.6, and 85.3 dB respectively. Thus, one teacher exceeded the Australian OH&S limit of 85 dB and three staff approached this limit. These exposures corresponded to 70-103% of the noise dose that is considered harmful. Nine staff recorded peak noise rates that exceeded the maximum permissible level of 140 dB for peak noise. In total, 10 of the staff evaluated were subjected to noise beyond the maximum acceptable levels under Australian standards. Twenty-three teachers were subjected to daily noise exposure over 75 dB. In the process of data screening, it was found that the peak noise recorded by the badge was, in some cases, an artifact due to knocking the microphone. Consequently, we disregarded five of the fourteen peak noise cases where the data were inconsistent with the nature of the activities being observed or recorded at the time. The other nine cases were considered accurate reflections of the actual noise being experienced at the time, for example, while a staff member was comforting a distressed student screaming close to the ear of the teacher (see Figure 1).

The lowest levels of noise exposure recorded amongst all of the preschools were 73.9 and 74.3 dB over an eight-hour equivalent period, or 6% and 8% of the maximum noise dose respectively. In each case, the students were put to sleep for 1-1.5 hours after lunch, while the teachers moved to another room, completing paperwork and overseeing the students through a window. Table 1 summarises the descriptive statistics relating to the daily noise exposure for the overall sample, and for the sub-samples of teachers whose average daily noise exposures were under or above 80 dB. The distinction of 80 dB was made based on the principle that sounds louder that 80 dB are potentially hazardous (American Speech-Language-Hearing Association 2004).

Noise parameters	Overall group (*N* = 25)		High exposure subsample (*n* = 12)		Low exposure subsample (*n* = 13)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Recorded dB	80.48	3.24	83.65	3.46	77.75	4.31
Projected (standardized) dB	79.41	3.22	82.17	1.89	76.87	1.69
Dose %	33.28	25.72	53.25	23.79	14.85	6.12
Peak sound exceedence cases (%)	9 (36.00)		6 (50.00)		3 (23.07)	

Table 1
Descriptive Statistics on Staff Daily Noise Exposure: Overall Sample, Higher and Lower Exposure Rates Subsamples

The log of events and activities associated with the measurements indicated that the highest levels of noise were recorded when a large number of students were located in a confined space such as the free-play area, when they were fighting over playthings, or when the students were involved in rough play. High levels of noise were also evident when students were distressed, when they dropped heavy play equipment, and during music time, when the students were playing instruments. From the teachers' perspective, the main causes or sources of noise (most teachers noted more than one source) in their classrooms included:

- Poor weather, which kept students indoors (10, 20.8% of all responses);
- Insufficient space, such as a confined indoor area (8, 16.6%);
- A resonant floor, furniture, and/or play equipment (e.g., wooden blocks) (6, 12.5%);

- Distressed students (6, 12.5%);
- Outside noises from traffic or a nearby school (5, 10.4%);
- Over-exuberant students or those with behavioural problems (4, 8.3%);
- Noisy indoor activities (e.g., assemblies, music, bells) (4, 8.3%);
- Air conditioners (4, 8.3%); and
- Alarms sounding on exit doors (1, 2.1%).

The time histories also suggested that afternoon sessions were generally as noisy as morning sessions, and that noise levels did not always decrease during lunchtime. Anecdotal reports from two staff revealed that the staff rooms in which they had lunch were as noisy as the classrooms (e.g., see Figure 1).

Psychological Instruments

Table 2 lists the mean scores and standard deviations for the four scales, distributed across all participants, and across high and low exposure subsamples (defined as above or below 80 decibels). In the case of the Personal Strain Questionnaire (PSQ) and the eight scales of the Life Style Index (LSI), the data are expressed in terms of *T*-scores (female normative sample and generic norms respectively). In the case of the General Health Questionnaire (GHQ), two scoring methods were used (chronic distress and recent distress). The GHQ (recent distress) scoring method was used to determine the number of participants per group who exceeded the cut-score of 11/12. Data for the remaining instruments were distributed normally.

To determine whether differences between participants' scores were evident on the basis of noise exposure, an independent *t* test was conducted with high and low levels of noise exposure as the independent variable. Although the sample sizes were limited, the *t* test was still considered more informative than a simple visual display of the mean scores. The results indicated that, in comparison with participants in the low noise exposure subgroup, participants in the high exposure subgroup obtained significantly higher scores on the interpersonal strain dimension of the PSQ ($t(23) = 2.12$, $p = .04$), and the regression and displacement dimensions of the LSI ($t(23) = 2.17$, $p = .04$; $t(23) = 2.56$, $p = .02$). No significant differences were evident for the remaining dimensions of the instruments. The participants in the high noise exposure subgroup recorded higher scores on the chronic distress dimension of the GHQ than those in the low exposure subgroup, although it should be noted that the difference was not statistically significant ($t(23) = 1.76$, $p = .09$).

Subscales	Overall group (*N* = 25)		High exposure subsample (*n* = 12)		Low exposure subsample (*n* = 13)		t
	M	*SD*	*M*	*SD*	*M*	*SD*	
PSQ							
Vocational strain	44.92	8.68	47.33	10.56	42.69	6.11	1.36
Psychological strain	46.00	7.31	47.92	7.42	42.69	6.11	1.28
Interpersonal strain	45.76	8.48	49.25	7.79	42.54	8.04	2.12*
Physical strain	46.04	8.61	48.58	9.69	43.69	7.05	1.45
LSI							
Denial	60.72	12.70	59.83	11.87	61.54	13.84	-.33
Repression	42.88	11.64	43.42	10.87	42.38	12.74	.22
Regression	36.88	14.14	42.83	16.99	31.38	8.19	2.17*
Compensation	39.88	14.87	41.42	17.62	38.46	12.38	.49
Projection	43.64	14.12	44.00	13.78	43.31	14.99	.12
Displacement	30.48	7.33	34.00	8.61	27.23	3.96	2.56*
Intellectualisation	48.88	15.68	49.67	16.08	48.15	15.91	.24
Reaction formation	53.96	15.91	53.08	17.41	54.77	15.06	-.26
Defence total	44.64	6.59	46.01	6.93	43.37	6.27	1.00
GHQ							
Chronic distress score	15.52	11.54	19.58	13.85	11.77	7.66	1.76
Recent distress: cut-score exceedence cases (%)	4 (16)		2 (16.6)		2 (15.4)		

*$p<.05$

Table 2
Descriptive Statistics: Overall Sample, Higher vs. Lower Exposure Rates Subsamples. Participants Exceeding the GHQ Threshold

On 11 of the 13 variables, the scores pertaining to the high exposure subsample were greater than those of the low exposure subsample. Effect sizes were from .46 to .67 for the strain indicators, and from -.11 to .76 for the defence mechanism indicators.

Table 3
Correlations of All Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Noise dose	—															
2. Age	-.22	—														
3. Teaching experience	-.13	.68**	—													
4. Vocational strain	.35	.09	.32	—												
5. Psychological strain	.31	.23	.25	51**	—											
6. Interpersonal strain	51**	-.16	-.10	.66**	.55**	—										
7. Physical strain	.13	-.05	-.01	.43*	.51**	.59**	—									
8. Chronic distress	.31	.17	.28	.66**	.67**	.65**	.82**	—								
9. Denial	-.13	-.11	-.27	-.24	-.04	.03	-.11	-.25	—							
10. Repression	.13	.06	.07	.26	.02	-.11	-.01	.13	.11	—						
11. Regression	.54**	-.25	-.23	.41*	.50*	.60**	.62**	.57**	-.07	-.18	—					
12. Compensation	.13	-.16	-.28	.16	.23	.24	.59**	.40*	-.01	-.08	.61**	—				
13. Projection	.07	-.00	.01	.20	.21	.04	.43*	.46*	-.25	.19	.36	.41*	—			
14. Displacement	.45*	-.15	.01	.27	.31	.45*	.61**	.66**	-.22	-.18	.71**	.60**	.56**	—		
15. Intellectualisation	.11	.04	-.35	-.24	-.13	-.16	.19	.03	-.06	-.03	.14	.43*	.16	.23	—	
16. Reaction formation	.00	.24	.30	.38	.13	.19	.17	.33	-.09	.31	.05	-.21	.31	.10	.01	—
17. Defence total	.30	-.08	-.19	.29	.29	.29	.61**	.56**	.10	.29	.63**	.68**	.69**	.65**	.51**	.41*

*p<.05. **p<.01.

Effect size for the chronic distress indicator was substantial at .70. However, all scores of both groups were within normal limits. Overall group *T*-scores on the PSQ subscales did not reveal any differences between the teachers and the normative sample, all being between 44.9*T* and 46.0*T*. Four (16%) of all participants exceeded the GHQ threshold indicating serious psychological distress. The LSI results compared with the norm group whose means would be around 50*T*, showed that the participants in the present study scored higher on denial 60.7*T* (effect size of .71) and considerably lower than the norm on displacement 30.4 *T* (effect size of -1.30).

Pearson product-moment correlations between the scores on the 13 dependent variables, daily noise dose, age of participants, and years of work experience using alpha levels of .01 and .05 are shown in Table 3. Statistically significant positive correlations were evident between noise dose and interpersonal strain ($r(23) = .51$, $p < .01$), the defences of regression ($r(23) = .54$, $p < .01$) and displacement ($r(23) = .45$, $p < .05$). Age and teaching experience did not relate significantly to any variables except to each other, and all measures of perceived stress correlated significantly with each other. Physical strain and chronic distress also correlated positively and significantly with four out of eight defence mechanisms: Regression, compensation, projection and displacement, and with the use of defences overall. The defence mechanisms of denial, repression, intellectualisation and reaction formation failed to reach significance in relation to either of stress measures, with denial being the only defence relating negatively to all stress measures except interpersonal strain.

To test whether the stress parameters could be influenced by various possibly explanatory variables, we regressed each stress measure on noise exposure, age, length of service, and denial, using a stepwise procedure. This strategy was designed to remove "weak" candidate predictors from the models and identify "stronger" predictors, if any existed. Due to the limited sample size, two predictor variables at a time were tested for their effect on each response variable consecutively. Table 4 lists those stress measures which appeared to significantly relate to the predictors: Vocational strain and interpersonal strain. The best prediction of vocational strain was achieved by the combination of noise dose and teaching experience. Noise dose emerged as the only significant predictor of interpersonal strain. Neither denial nor age contributed to the prediction of the stress measures.

An analogical stepwise procedure was used to relate the overall use of defence mechanisms to the objective variables and the measures of perceived stress. The best sets of predictor variables were selected with the order of stepping specified by the procedure. The results indicated that the combination of physical strain and noise dose accounted for 42% of the variance in the total use of defence mechanisms (See Table 4). Age, vocational strain, interpersonal strain, psychological strain, and chronic

distress failed to contribute significantly to the prediction of the overall use of defence mechanisms.

Criteria/Predictor variables entered stepwise	R^2	R^2 change	F	p
Vocational strain				
1. Noise dose	.124	.124	3.252	.084
2. Teaching experience	.260	.136	3.875	.036
Interpersonal strain				
1. Noise dose	.266	.266	8.332	.008
Defence total				
1. Physical strain	.372	.372	13.618	.001
2. Noise dose	.420	.048	7.952	.003

Table 4
Stepwise Regressions of Outcomes on Noise Dose, Teaching Experience, and Stress Measures

Discussion

The initial aim of this study was to explore the extent of classroom noise in preschool facilities of Western Sydney in relation to the Australian OH&S standard. The results revealed that 10 of 25, or 40% of the monitored teaching staff were exposed to daily or peak noise rates in excess of the Australian standard for exposure to noise in the occupational environment. More particularly, one teacher exceeded the daily limit of 85 dB eight-hour equivalent, and nine staff exceeded the 140 dB limit for peak noise level. Three staff recorded values that approached the OH&S daily limit, and 23 or 92% of teachers were subjected to daily noise exposure of over 75 dB eight-hour equivalent. According to the National Code of Practice, if exposure to these noise levels occurs repeatedly, it may have adverse effects on the health and well-being of some workers.

Despite the evidence of excessive noise exposure, the outcomes of the present research should not be considered conclusive, since a convenience sample of a limited size was investigated. Nevertheless, two facts support extrapolation of the findings to a sizeable proportion of Western Sydney early educational facilities. First, the sample was derived from schools of diverse size and socio-economic

characteristics distributed across an area of approximately 160 square kilometres. Second, anecdotal reports from many teachers revealed that the monitoring days were quieter than usual and no-one suggested otherwise. Conducting more than one monitoring session per participant may be useful in future studies as a more reliable method of evaluation of typical noise exposure.

Importantly, the results pertaining to noise exposure that were obtained in the present study were consistent with the results of a similar study in New Zealand (McLaren & Dickinson 2002). Therefore, it might be argued that the results reflect a much broader issue across developed nations in which early childhood education is an established practice. Further research concerning noise in all types of early educational settings, and across different nations, may be valuable in understanding both the scope of the problem and possible remedies. For example, a larger per-person area in the classroom might assist to avoid crowding and conflicts and, thereby, may reduce noise. Sound-absorbing floor, acoustic ceilings and windows, sound dampers on furniture legs, and the careful selection of low-noise play equipment may also reduce exposure for both staff and students. Some of these measures would be less costly than others and could easily be put into effect at the school level, while others may require policy decisions.

The second aim of the present research was to investigate preschool teachers' perceived stress and its relationship to classroom noise. No significant differences in levels of personal strain were evident between the teachers and the PSQ normative sample. The teachers' mean scores (converted to *T*-scores) were similar to the norms for all four subscales. Further, the PSQ mean scores obtained in the present research showed no prevalence over the corresponding means of 37 Australian non-teaching female professionals (Pithers & Fogarty 1995). This implies that, on the average, the preschool teachers feel personal strain similarly or less than the community generally. At the same time, 16% of respondents scored above the GHQ threshold, indicating severe psychological distress. This compares with 9% for the general Australian population cited by Finlay-Jones (1986). Finlay-Jones (1986) also reported that 17% of Australian teachers, mainly from primary and secondary sectors, exceeded the GHQ threshold, which is consistent with the outcome of the present research.

The apparent conflict between the PSQ and GHQ scores may have resulted from the GHQ questions being less explicitly focused on supraliminal stress in comparison to the questions in the PSQ. Participants may have felt less able to recognise and/or admit that they were under stress when asked in a straightforward way, but may have responded more sincerely to less direct questions concerning the subject. The higher teachers' *T*-scores on denial in comparison to the LSI normative sample supports, at least in part, the assumption that some teachers may be unwilling to recognise that

they are under stress. In other words, they may use denial to a greater extent to control their perception of stress. Contrary to expectations, denial did not show a significant moderating effect on any of the stress measures. Nevertheless, it was the only variable of all of the defence mechanisms in which a negative correlation was evident with the majority of stress parameters.

On 11 of the 13 dependent variables, the scores of the high exposure subsample were greater than those of the low exposure subsample. Effect sizes indicated that the strain measures showed larger deviations between groups than most of the defence measures. Effect sizes may also suggest that the use of particular defence mechanisms under elevated exposure to noise vary considerably across people, while their perception of strain reliably increases with the higher exposure rate. Even though all scores of both subgroups were within normal limits, the results of multiple regression analyses indicated that the level of daily noise dose predicted subjective perceptions of vocational strain, interpersonal strain, and overall defensive functioning.

These findings partially confirm the hypothesized relationship between the level of preschool teachers' exposure to classroom noise and their perceived stress. Specifically, statistically significant positive relationship was evident between the doses of noise to which staff were subjected and the level of interpersonal strain, understood as a disruption in interpersonal relationships and a tendency to withdraw from the social environment. Poor job satisfaction, attitudes, and performance, as attributes of vocational strain, are significantly associated with higher levels of classroom noise, in combination with longer periods of professional teaching. The increase in noise dose also appears to be associated with regression and displacement. These defence mechanisms imply tendencies to retreat under stress to earlier or more immature patterns of behaviour, such as crying, displaying temper, or blaming; and/or to discharge pent-up anger on irrelevant objects or people, including oneself. The last interpretation, however, may not be a valid representation considering the fact that both the high exposure and the low exposure subsamples scored well below the norm on displacement. In general terms, the differences between the high and low exposure subsamples on all defence mechanisms but one and on their total score suggest that teachers, who are exposed to relatively higher noise doses, may be more likely to be required to develop stress coping strategies.

It is important to note that noise dose emerged as the second most significant predictor of total defensive functioning following physical strain. Therefore, it would appear that the combination of the tiring job and classroom noise may aggravate teachers' worries about their physical well-being. This may explain, to some extent, the relatively greater recourse to psychological defence mechanisms.

The results of this study should be interpreted with caution due to a number of limitations, not least of which is the small sample size. The small size and convenience character of the sample limited the research power and may have impacted the reliability of the outcomes. Further, the data on noise were obtained by means of a single monitoring session per participant during one school term, and thus may not reflect typical exposure. Finally, only one type of early educational facilities, allegedly the "quietest" one, was investigated. Nevertheless, the research has generated important pilot data suggesting a possible association between noise in preschool settings and stress perceived by the teachers. The outcomes provide the basis for a broader study to understand and manage classroom noise as an integral issue in early childhood education. This may include regular monitoring of teaching staff in all types of early educational settings, and further investigation of all aspects of noise in these facilities including per-person space in the classroom, the design of premises, furniture, ventilation, heating, and some educational trends.

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