

A compressed shift schedule: Dealing with some of the problems of shift-work

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Summary

This study examines some of the psychological and behavioral effects of a 12-hour compressed shift schedule on coal miners in two organizations in Western Canada. It suggests that young, married compressed shift workers are more satisfied with their family relationship. They spend less of their leisure time with spouses when working shifts, and do not spend any more time with them on their days off. They have less time available for many leisure activities on their workdays. The extra time on days off is not reallocated to the leisure activities they were unable to do on their workdays. Some extra leisure time on days off may be spent on personal hobbies. There is no suggestion that the compressed shift schedule has any negative effect on the individual's health.

Introduction

Compressed work weeks are one set of reforms currently receiving a large share of public interest and enthusiasm. In practice, a compressed work week extends the length of the workday beyond the standard eight hours, so that the full week's worth of working time can be finished within three or four and one half days, allowing more than the usual two days off (Cohen and Gadon 1978, p. 49). By allowing for more intense periods of work and leisure, compressed shift schedules might better harmonize the productive needs of the organization with a more leisure-intense lifestyle for the employees. They may offer the potential for improving job satisfaction, morale, and the individual's satisfaction with his marriage and use of leisure time (Calvasina and Boxx, 1975; Dickinson and Wyting, 1965; Goodale and Aagaard, 1975; Hodge and Tellier, 1985).

Compressed shift schedules are a variation of a rotating or fixed shift schedule which extends the length of the workday and reduces the number of days in the work week, allowing more days off between shifts and fewer shifts variations. There are some suggestions that compressed shift schedules may ameliorate many of the social problems generated by shift work. These problems have been recognized in terms of disruption of the basic bodily rhythms of eating, sleeping, and elimination, and interruptions in the roles that the individual has to serve—as a father, mother or relative (Dunham and Hawk, 1977). Under a traditional shift schedule, the individual may not be able to participate in many non-work activities scheduled during the more highly valued weekends

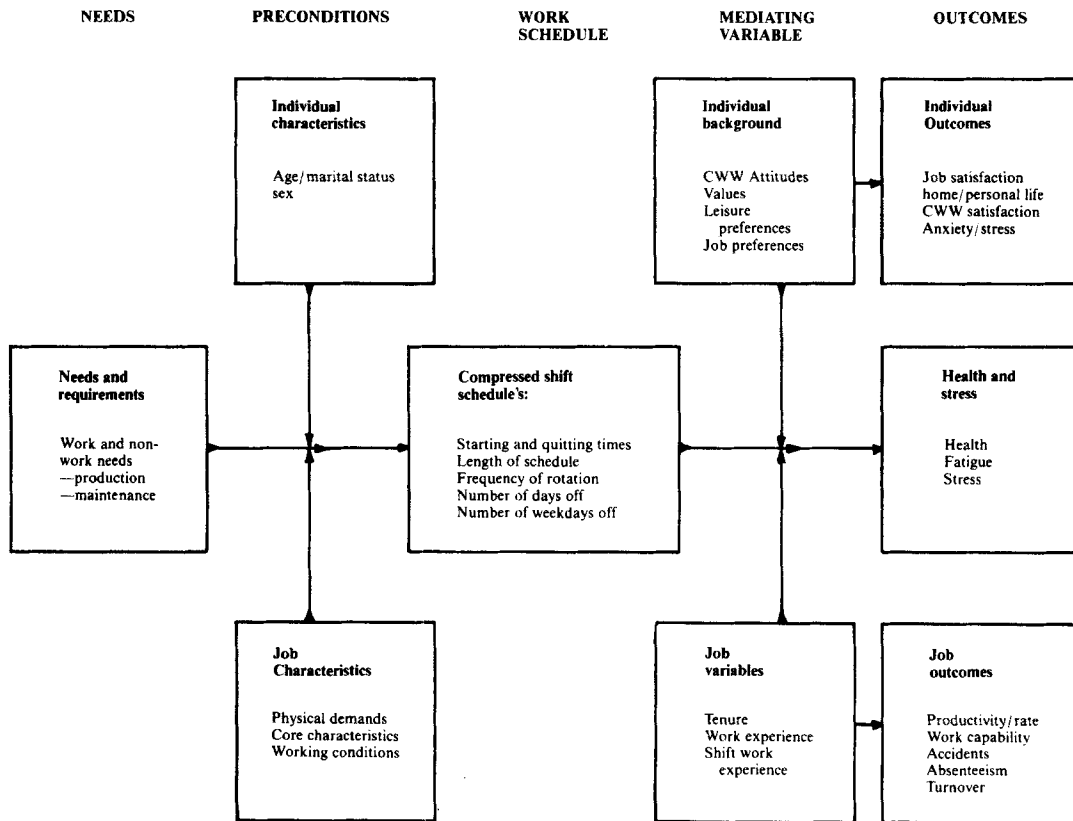
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and evening hours (Mott, Mann, McLoughlin and Warwick, 1965; Colquhoun, Blake and Edwards, 1986a,b; Colquhoun, 1969; Brown, 1975; Walker, 1978).

A compressed shift schedule will only marginally increase the number of available leisure hours, but it offers extended periods of leisure time which may be more satisfying and productive. This paper seeks to understand the implications of a particular form of compressed work day—a 12-hour compressed shift schedule. How does this shift schedule affect an individual's sleep and tiredness, satisfaction at work and home, use of leisure time, and general health and capability to work? This paper first outlines some of the conditions affecting the implementation of such a shift schedule and then summarizes the effects.

A Shift Schedule and its Potential Effects

The impact of any shift schedule is based on many interacting conditions and variables. Organizations have unique work requirements making it necessary to work a 24-hour cycle to maximize the use of equipment and facilities. Individuals have their own critical necessities of



A more elaborate framework by Rosen and Primps (1981) recognizes the many individual and job characteristics that are important in understanding the implications of a compressed work week. Mediating variables might be labelled independent variables in some studies

Figure 1. The possible effects of a compressed shift schedule

'producing' income, assisting their families, and keeping up with social obligations, as well as basic 'maintenance' requirements such as sleeping, washing, and purchasing food or other necessities.

Understandably, some of an individual's reactions to a compressed schedule may be nourished by expectations and styles of life, as well as the physical working conditions under which the work is carried out. Working compressed shifts may be easy to 'take' for workers who are generally frustrated with night shifts, or for those whose work is varied and not too strenuous, and who are generally convinced of the need for the change.

The features of a shift schedule—the schedule's starting and quitting times, the number of hours worked, the frequency and number of rotations, the number of days worked, and the number of weekends off—all offer potentially different implications. For example, a night-shift which begins at midnight (24:00) may be less attractive than a night shift that begins at 20:00; a shift schedule with weekends off may be more attractive than one with days off during the week. A compressed work week will potentially have many different effects, depending on its design (Cunningham, 1982).

Reactions to a compressed shift schedule will undoubtedly depend on a person's age, marital status, education, training, and shift work experience. Work schedule satisfaction, subjective health estimates, personnel turnover and worker productivity may improve when schedules are introduced that are designed to incorporate non-work circadian principles (Czeisler, Moore-Ede and Coleman, 1982). A schedule might have disruptive effects on the individual's marriage, friends, and family, by restricting the time for companionship and emotional support (Hawkins, 1968; Tallman, 1970). A more traditional schedule may prohibit married workers from being available on evenings or weekends when the children are not at school, or from enjoying an evening because their shift begins at midnight.

By restructuring the number of hours per work, a compressed shift schedule allows workers to reorganize their time. The work itself may not change but their satisfaction with it may change. Monotonous work may become more fatiguing during a longer working day. It is conceivable that employees may find their job more satisfying because of the opportunity they have to more fully enjoy their leisure time. The extended period of time away from the workplace could provide individuals with a chance to 'get away' from the job and its tensions.

Method

Participants and setting

The study grew out of the interests of the employees, union, and management in an Alberta coal mine to experiment with an alternative shift schedule to the one they had been working. Twelve-hour compressed shift schedules were common in many organizations, but labor codes prohibited their adoption in mining industries. Thus, this experiment with a 12-hour shift schedule was an attempt to provide data for the government to make decisions on whether to implement similar schedules.

The people participating in this study were miners in two open pit coal mines owned and operated by a larger umbrella corporate organization. Each coal mine was located in Western Canada; one coal mine experimented with working the 12-hour compressed shift schedule while the other served as a comparison organization. At the time of the study, the experimental organization was much larger ($N=220$) than the comparison organization ($N=70$). The comparison organization was chosen because: (1) it carried out many of the same functions as the experimental organization, (2) it was located in the same province, although geographically

separated from the experimental organization so the effects in the experimental organization would not bias the feelings of those in the comparison organization, and (3) it operated under the same union with a similar labor contract.

The work of each organization fell under the general functions of mine operations, plant operations, maintenance, and technical and support staff. Mine operators operated the heavy equipment (truck, bulldozers, drag-lines, etc.) used for obtaining and transporting the coal from the coalfields (open pits). Plant operators were responsible for processing (cleaning and eliminating non-coal materials), and loading the coal onto railroad cars. Maintenance tradesmen (welders, mechanics, etc.) performed general repairs on the mine and plant equipment; technical staff were responsible for quality control and general engineering surveys and support staff performed general administrative assignments. Each coal mine (experimental/comparison) had roughly the same composition of mine operators (40/53 per cent), plant operators (17.5/12 per cent), maintenance workers (35/26 per cent), and technical and support staff (7.5/10 per cent).

All employees were given the opportunity to complete questionnaires before there was any indication that a 12-hour shift schedule would be implemented. The analysis was carried out for the mine operators and plant operators; the maintenance department was not used because of adjustments made in their schedule between measurements. Sample I consisted of married male workers under 39 years old ($N=68$ for the experimental and $N=17$ for the comparison organization). Significant changes were not evident for samples of unmarried workers or those over 40. The N s represent the number of individuals who were clearly identified as responding to both applications of the questionnaire. Employees were asked to use a personal identifier of their choice during both applications.

Sample II ($N=20$ and $N=19$ respectively) was chosen in each organization to represent a cross-section of workers in different departments and age groups. They filled out questionnaires in addition to undergoing several health-related tests. There was no significant differences between these workers and those in the larger general sample on questionnaire measures. Sample II questionnaire data are not reported here, as the N s were rather small for the comparison organization.

The 12-hour shift schedule

The 12-hour shift schedule introduces a number of changes in the scheduling of work and non-work. The key changes introduced by the schedule were: altered starting and quitting times, four extra work hours each shift, a shorter schedule of 4 instead of 5 days, and a greater number of days and weekends off. This is described in Table 1.

Under the 12-hour compressed shift schedule, each crew works four 12-hour days and then has four days off. Upon returning to work, the crew works four 12-hour night shifts. The regular shift schedule in operation before the experimental involved working five-day shifts, with one day off; then five afternoon shifts, with two days off; followed by five night shifts, before having another two days off. Members of the comparison organization worked a five-day shift schedule, with weekends off.

Measures

A number of indices of perceived work and non-work behavior were used as a basis for assessment. The questionnaire study measured: (1) sleep during day shift, (2) sleep during night shift, (3) tiredness, (4) the job's characteristics, (5) attitude toward the company, (6) satisfaction with the work, (7) tensions because of the job, (8) tensions because of the people around you, (9)

Table 1. The characteristics of each shift schedule

	Experimental organization		Comparison organization	
	Before experiment	Experimental schedule	Before experiment	During experiment
Starting and quitting times	8:00, 16:00, 24:00	8:00, 20:00	8:00, 16:00, 24:00	8:00, 16:00, 24:00
Length of schedule	8 hours	12 hours	8 hours	8 hours
Number of days of work before days off	5	4	5	5
Number of days on complete rotation	133	91	15	15
Number of weekend days off each year	20-30	55	104	104
Number of days off each year	93	203	104	104

Twelve-hour shift workers work more than 40 hours per week on average, a violation of labor codes and contract agreements. Some organizations pay for this extra time. Other offer extra time off, which is to be taken during a time which is convenient to the employee and employer. This is often called a 'floater day'.

tensions because of the job's danger, (10) family satisfaction, and related measures of non-work behavior. A major source for the measures of the job's characteristics were from the Job Diagnostic Survey (Hackman and Oldham, 1980), and measures of job tension were derived from Kahn, Wolfe, Quinn, Snoek and Rosenthal (1964). Measures of non-work behavior are related to: family satisfaction, solitary or near solitary activities, contacts with friends, relatives and family, and institutional maintenance activities (Gordell, 1976; Near, Rice and Hunt, 1978).

The specific items² for assessing work and non-work were derived from non-directive interviews with workers ($N=30$) in the experimental organization. The interviews helped to make the questionnaire items more specific to the organizations and communities (e.g. specific sports like hunting and fishing were identified as more important leisure outlets than biking or squash). Workers were asked open-ended questions such as: What are some of the problems/positive aspects you experience on shift work? What are some of the problems/positive aspects you experience at work? What are some of the problems/positive aspects you experience in the home/community? These questions were used to guide the interview and to assist the researcher in gaining a general understanding of the needs of this group of shift-workers.

The reliability of each item on the questionnaire was partially assessed by having a sample group ($N=21$) fill out the same questionnaire at two different times (separated by four days). There was not expected to be any reason for a variation in responses, and items were rejected if they were not significantly correlated ($p<0.01$).

Comparisons between samples indicated that there were no significant differences on any of the items used³. The most significant differences between groups at the time of the pretest were related to the use of leisure time after working day and night shifts. These differences may be attributed to

²Job satisfaction was arranged on a five-point interval scale from 'strong dissatisfied' to 'strongly satisfied'; the information on use of leisure time was arranged on scales from consuming: no time, less than 4 hours, 4 to 8 hours, 8 to 12 hours, and more than 12 hours per week.

³There were no significant differences between organizations on variables selected for analysis at the time of the pretest (Wilks' Lambda=0.68 and not significant).

the extra-organizational activities of comparison organization members, who were farmers; they were probably more inclined to work on their farms after work. Care was taken to exclude variables which were dissimilar at the time of the pretest. Members of the experimental organization are, on average, younger (32/39 years old), and the experimental organization was more recently constructed. There are many similarities in our samples of workers—years in labour force (10/11 years), marital status (66/80 per cent married), occupation of spouse (60/72 per cent were housewives), education (19 per cent of each organization had technical or university training), and experience working a 12-hour shift (50/45 per cent) in other organizations.

To assess the impact of different shift schedules between organizations, the various measures were used as dependent variables in a multi-variate analysis of variance⁴. In order to explore the impact of the compressed schedule on each dependent variable, a group \times time ANOVA with repeated measures on time was conducted. In addition, independent-sample *t*-tests were used to determine if the changes produced by the compressed schedule were significantly different from the conditions in the comparison organizations during the first and second measurements. *t*-test comparisons were used to indicate if changes were the result of inherent differences between each organization. These *t*-tests assumed a design where the experimental change (X2) should be significantly different from each of the other measurements (X3, X4)⁵. There should not be any difference between X1/X3 or X1/X4.

Sample II workers also responded to the questionnaires. In addition, two nurses undertook to observe and measure certain aspects of each individual health and work capability: (1) respiratory functioning, (2) reaction time, (3) vigilance, (4) auditory functioning, and (5) blood pressure. These measures were carried out on sample II. These measures were undertaken in both the experimental and comparison groups, before and after the schedule was implemented. Tests were conducted at the beginning and end of the first and last day of each shift. Data is presented for only the end of the last day of the shift, before and after the shift schedule began. There was no significant differences between any measurements.

Respiratory functioning was measured with a vitalograph barometer. The measurements, FEV(1) and FVC(2) can be described as follows. FEV(1) is the 'forced expiratory volume', or the volume of air expelled after one second has elapsed. FVC(2) is the 'forced vital capacity', or the maximum volume of air which can be expelled after maximum inspiration, using maximum force.

Reaction time measures the individual's ability to respond (in milliseconds) to visual and auditory stimuli. The subjects were required to react 30 times—10 visual reactions to a red light, 10 auditory reactions to a tone indicator, and 10 visual and auditory reactions mixed together. Each stimulus was presented after an interval ranging from 1 to 30 seconds.

Visual vigilance was measured by displaying 36 slides each showing 17 lights. Each slide displayed a sequence of lights where one, two, or no lights were extinguished. The subjects were asked to identify the locations of extinguished lights as each slide was presented. A tachistoscopic lense controlled the exact time (100 milliseconds) the slide was exposed on the screen.

Auditory functioning is a measure of how the individual's hearing capacity might be affected by his/her work, over a longer period of time. An audiometer in a hearing test room is used for measuring low and high pitch noise (in decibels); in low pitched noise (SAL) is the average of three measurements at 500, 1000, and 2000 HZ, and high pitch noise (ELI) is an average of measurement at 3000, 4000, and 6000 at various decibels.

⁴Wilks' lambda=0.48, $p < 0.01$.

⁵Experimental group initial measurement=X1. Experimental group second measurement=X2. Comparison group initial measurement=X3. Comparison group second measurement=X4.

Blood pressure measurements (systolic and diastolic) were taken, although it was recognized that they are subject to extreme variations due to anticipation, lack of sleep, or alcohol consumptions the previous night.

The analysis of the questionnaires is based on data from sample I (see Tables 2 and 3). Health-related data in Table 4 is from the observations of sample II, the measures and absenteeism, turnover, and accident represents the total population of workers (Figure 2).

Results

To assess the overall impact of the 12-hour compressed work week on various attitudinal variables, a group × time multivariate analysis of variance (MANOVA), with questionnaire measures as dependent variables, was conducted. For the experimental organization, there was a significant change from time 1, which did not occur in the comparison organization. (Wilks' lambda=0.29 for the experimental group $p < 0.01$ and Wilks' lambda=0.68 for the comparison group ($p > 0.10$). This suggests that the 12-hour compressed work week has an overall impact on this set of attitudinal variables. Tables 2 and 3 illustrates the satisfaction, tiredness, and use of leisure time of young, married workers over the 6 months of the study. Table 2 suggests that

Table 2. Effect of 12-hour shift on young, married workers

Variables	Experimental organization N=68					Comparison organization N=17					t-test
	T1 M	(SD)	T2 M	(SD)	F(1,67)	T1 M	(SD)	T2 M	(SD)	F(1,16)	
Sleep and tiredness											
Sleep problems during day shift	2.9	(0.4)	2.9	(0.4)	ns	2.8	(0.4)	2.8	(0.3)	ns	
Sleep problems during nights	3.2	(0.5)	3.2	(0.4)	ns	3.4	(0.3)	3.2	(0.5)	ns	
Tiredness	1.8	(0.5)	2.1	(0.5)	8.7*	2.1	(0.5)	2.0	(0.4)	ns	US
Job's design and satisfaction											
Job's design	3.3	(0.7)	3.3	(0.7)	ns	3.5	(0.6)	3.3	(0.4)	ns	
Company satisfaction	3.4	(0.6)	3.5	(0.6)	ns	3.7	(0.3)	3.9	(0.3)	ns	
Job and work satisfaction	3.7	(0.6)	3.5	(0.6)	ns	3.6	(0.4)	3.7	(0.5)	ns	
Family satisfaction	3.8	(0.8)	4.1	(0.8)	4.2†	3.9	(0.9)	4.0	(0.4)	ns	
Job tensions from											
Job's design	2.2	(0.7)	2.2	(0.7)	ns	2.2	(0.6)	2.1	(0.5)	ns	
Interpersonal tensions	2.2	(0.6)	2.2	(0.7)	ns	2.0	(0.6)	2.2	(0.4)	ns	
Job's danger	2.1	(1.0)	2.2	(1.1)	ns	2.4	(0.3)	2.3	(1.3)	ns	

Sleep and tiredness, design and satisfaction, and tension scores are combination of several items.

Analysis of variance with repeated measures * $p < 0.01$ † $p < 0.05$.

Not significant □ ns. Standard deviations are presented in parentheses.

Independent-samples t-test comparisons

SS = Significant support in additional comparisons between means for measurements X2/X3 and X2/X4.

PS = Partial support in additional comparisons between means for measurements X2/X3 or X2/X4.

NS = No support in either comparison.

US = Unsupported indicates that other differences in measurement may affect the results.

young, married workers were more tired when working a 12-hour day shift than they were under an 8-hour schedule. However, this may have been affected by differences between groups during the initial measurement (t -test for $X1/X3=2.10^\dagger$).

Table 2 indicates that compressed shift workers are more satisfied with their relationship to their families, although t -tests indicate no significant different from measurements in the comparison organization. Thus, the results are not conclusive. There did not appear to be any changes on other measures of satisfaction or tension. Workers were no more satisfied with shift work generally, were no more satisfied with their jobs, and they did not express any more job tensions. It seems as if the 12-hour shift affects the time that workers have available for performing family maintenance leisure activities. Table 3 suggests that the 12-hour shift reduces the amount of time that workers have available for carrying out leisure activities on working days.

There seems to be a significant reduction in the day shift time available for being with one's spouse (t -tests of $X2/X3=-2.9^*$; $X2/X4=2.0^\dagger$), for performing chores $X2/X3=-2.6^*$; $X2/X4=-$

Table 3. Effects of a 12-hour shift on young, married workers

Variables	Experimental organization <i>N</i> =68				<i>F</i> (1,67)	Comparison organization <i>N</i> =17				<i>F</i> (1,16)	<i>t</i> -test
	<i>T</i> 1 <i>M</i>	<i>T</i> 2 <i>M</i>	<i>T</i> 1 <i>M</i>	<i>T</i> 2 <i>M</i>		<i>T</i> 1 <i>M</i>	<i>T</i> 2 <i>M</i>				
Use of leisure time for family maintenance											
With spouse on day shift	4.4	(1.0)	3.4	(1.2)	21.7*	4.4	0.8	4.2	1.1	ns	SS
With children on day shift	4.3	(1.5)	3.3	(1.6)	10.8*	3.6	0.9	3.3	1.0	ns	NS
For chores on day shift	2.7	(1.0)	2.1	(0.9)	13.4*	2.8	(1.0)	2.8	(0.7)	ns	SS
For shopping on day shift	1.7	(0.5)	1.5	(0.6)	7.1*	1.9	(0.4)	1.8	(0.4)	ns	SS
With spouse on night shift	3.8	(1.2)	3.2	(1.3)	6.8*	4.0	(1.2)	4.0	(1.1)	ns	NS
With children on nights	4.0	(1.7)	3.1	(1.7)	8.2*	2.8	(1.6)	3.1	(1.0)	ns	US
For chores on night shift	2.3	(0.9)	1.9	(1.0)	4.7 [†]	2.8	(1.4)	3.0	(1.0)	ns	PS
For shopping on nights	1.6	(0.6)	1.5	(0.7)	ns	1.8	(0.6)	1.5	(0.5)	ns	
With spouse on days off	4.5	(1.1)	4.6	(1.0)	ns	4.8	(0.4)	4.5	(0.9)	ns	
With children on days off	4.9	(1.1)	4.8	(0.9)	ns	4.6	(0.8)	3.7	(1.2)	5.3 [†]	US
For chores on days off	3.3	(0.9)	3.6	(1.0)	ns	3.8	(1.1)	3.4	(1.1)	ns	US
For shopping on days off	2.3	(0.6)	2.3	(0.8)	ns	2.3	(0.6)	2.0	(0.5)	ns	
Use of leisure time for personal activities											
Watching T.V. on day shift	3.4	(1.0)	2.4	(1.0)	25.9*	3.5	(0.9)	3.0	(0.9)	ns	PS
With friends on day shift	2.4	(0.8)	2.1	(0.9)	3.7 [†]	2.5	(0.5)	2.3	(0.5)	ns	
On sports on day shift	2.1	(0.9)	1.9	(1.1)	ns	3.0	(0.6)	2.8	(1.0)	ns	
On hobbies on day shift	2.1	(0.9)	2.2	(1.0)	ns	2.3	(0.8)	2.3	(1.0)	ns	
Watching T.V. on nights	2.9	(1.0)	2.1	(0.9)	18.1*	3.1	(1.1)	2.8	(1.1)	ns	SS
With friends on nights	2.0	(0.8)	1.7	(0.9)	ns	2.1	(0.9)	1.7	(0.5)	ns	
On sports on nights	1.6	(0.8)	1.6	(1.0)	ns	1.9	(1.0)	2.3	(1.2)	ns	
On hobbies on nights	1.9	(0.9)	1.7	(0.8)	ns	1.9	(0.5)	1.8	(0.6)	ns	
Watching T.V. on days off	3.1	(1.0)	3.1	(1.1)	ns	3.2	(1.1)	2.8	(1.0)	ns	
With friends on days off	3.3	(0.8)	3.4	(0.9)	ns	3.4	(0.8)	3.1	(0.9)	ns	
On sports on days off	2.7	(1.0)	3.2	(1.3)	4.4 [†]	3.0	(0.7)	3.1	(1.1)	ns	
On hobbies on days off	3.0	(1.3)	3.5	(1.1)	4.8 [†]	3.2	(1.2)	3.1	(1.1)	ns	PS

Analysis of variance with repeated measures * $p<0.01$, $^\dagger p<0.05$. Not significant = ns. Standard deviations are presented in parentheses. Independent-samples t -test symbols are indicated in Table 2.

Table 4. Measures of health and functioning

Variables	Experimental organization (N=21)		Comparison organization (N=19)	
	T1	T2	T1	T2
Respiratory functioning				
FEV	100.5	102.5	97.4	96.2
FVC	96.7	99.7	95.4	96.1
Reaction time				
Visual	474	411	465	473
Auditory	392	363	416	395
Visual and auditory	453	413	459	433
Vigilance				
Task 1	5.6	5.5	5.2	5.1
Task 2	4.5	4.5	3.4	3.1
Task 3	2.8	2.8	2.7	2.4
Task 4	3.3	3.2	2.5	2.6
Auditory functioning				
SAL(R)	9.2	8.7	16.6	17.5
SAL(L)	9.9	9.9	15.5	15.9
ELI(R)	11.0	10.7	27.1	23.8
ELI(L)	12.9	13.0	28.4	24.1
Blood pressure				
Systolic	122.1	121.5	132.8	135.8
Diastolic	70.5	77.2	81	85.7

These measures were taken during the mornings and afternoons of the first and last days of shift. There were no significant differences in any of the measurement taken using analysis of variance with repeated measures.

2.5*), and for shopping ($X2/X3=-2.8^*$; $X2/X4=1.8$). Young married workers may have less time available for personal chores on night shift (t -tests for $X2/X3=-2.5^*$). They may be spending less time on day shift with their children and less time on night shifts with spouses, however, t -test comparisons with the comparison organization are not significant. Differences at the time of the initial measurement may account for changes in the amount of time with children on night shift (t -tests for $X1/X3=-2.1^\dagger$), and doing chores on days off ($X1/X3=2.1^\dagger$). The decreased time available for children in the comparison organization may be affected by other factors (t -tests for $X3/X4=2.4^\dagger$; $X2/X4=3.8^*$). Generally, the time lost for family maintenance during day and night shift has not correspondingly increased during days off.

The reduction in T.V. watching when on days (t -test for $X2/X3=-3.5^*$) and nights ($X2/X3=-3.2^*$; $X2/X4=1.9$) is the most significant effect on the compressed shift on the individual's personal leisure time. This result may relate to a corresponding reduction in the time with one's spouse, if we assume that much of the T.V. watching is done in their presence. There is only one area where individuals are using more of their leisure time—on personal hobbies (t -test for $X2/X4=-2.4^\dagger$). They are not using their additional leisure time on days off for spouses and family.

Table 4 illustrates that health-related measures did not seem to be affected by the compressed shift schedule for the sample observed. There was a fear that health-related changes might result from more concentrated exposure to coal dust and to plant noises. These tests provide no indication of changes in one's health, although it might be argued that a longer observation period (perhaps, 2 years) would be needed.

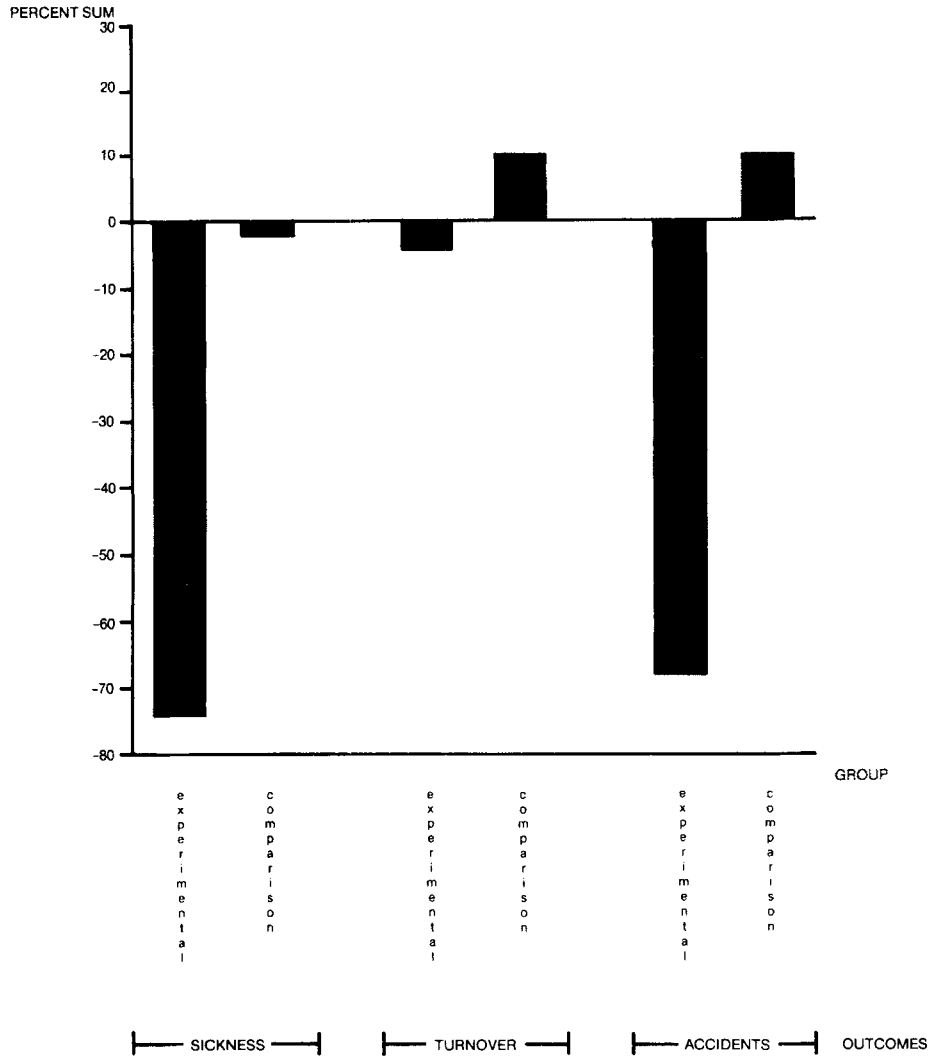


Figure 2. Job outcomes—percentage change

Figure 2 presents data on absentees, turnovers, and accidents for the 6-month period during the experiment and the same period one year before it began. These frequency distributions were calculated from raw data provided by the company; the calculations take into account the number of hours worked during each period. Specifically, the data was multiplied by the number of hours worked and multiplied by 1,000,000. The distributions are a percentage change over the two periods of the study—before experiment when working 8-hour schedule compared with during the experiment when working 12-hour schedule. As can be seen, absentees and the number of accidents in the experimental organization was considerably lower.

The differences in pretest conditions—the start-up conditions— must be recognized as interacting with these results⁶. Recognizing the limitations of the data, the number of hours of sick

time, as well as the number of hours of accidents have decreased noticeably. It is not realistic to expect that a 12-hour shift schedule will automatically produce such drastic changes, although it is conceivable that more modest changes might occur. In this particular setting, there was a rather high rate of absentees and accidents in the corresponding 6-month period one year before the new schedule began.

Employee turnover did not seem to improve measurably under the 12-hour shift schedule. However, much of the larger turnover in the initial period before the experiment began might be accounted for by one time period when there was a mass exodus from the organization. Turnover was still high during the period of the study due to an abundance of jobs and a larger number of employees. In this case, the 12-hour shift was not a factor to encourage people to stay with the organization.

Discussion

The analysis provides a better understanding of how a 12-hour compressed shift schedule affects an individual's sleep and tiredness, satisfaction at work and home, use of leisure time, and general health and capability to work.

Sleep and tiredness

The sleep problems often expressed by shift workers (Wyatt and Marriott 1953; Mann and Hoffman, 1960) were not ameliorated by the compressed shift schedule. Some workers expressed more tiredness at work, but this did not seem to be associated with any increase or decrease in sleep problems at home. Some employee statements might provide a perspective why they may have felt more tiredness at work.

'When you are at work under the 12-hour shift schedule, there is no time for anything else. I have a meal, a little television and then I'm off to bed'.

'After the shift, you better go home and prepare yourself for the next day. If you go out on the town after 12-hour day, look out for the next day at work. You are going to be tired⁷'.

Although there is some indication of increased tiredness at work, this is not conclusive.

Satisfaction at work and home

The shift schedule did not seem to have any affect on job satisfaction and tensions. These results are difficult to collaborate with other studies on the effects of 12-hour compressed shift schedules, although improved satisfaction is often a noticeable result of working a 4-day week (Calvasina and Boxx, 1975).

Family satisfaction seems to have improved for compressed shift workers, although this finding is not conclusive. Workers may be more satisfied with their ability to be a companion to their spouse, and their ability to be a father, and with their marriage in general. Thus, compressed shift

⁶This interaction should not have had the same effect on the data in Tables 2 and 3; the start-up condition had been over for 8 months before the experiment began.

⁷Some workers, ($N=14$) wanted to talk to me after filling out their questionnaires. These interviews (chats) were unsolicited and open-ended, focusing on positive and negative aspects of the schedule.

schedules may reduce many of the unfavorable reactions which have often been reported by married shift workers (Wyatt and Marriott, 1953). It is important, in future research, to determine the extent to which a 12-hour shift schedule affects satisfaction at home, as the larger blocks of free and discretionary time may improve the worker's chances for effectively fulfilling family roles and for enhancing the quality of family relationships. On the other hand, inappropriate or non-productive use of the extra discretionary time could result in decreases in marital and family satisfaction.

Use of leisure time

Compressed shift schedules are likely to have the greatest impact on the individual's non-work life, because of the opportunity it provides for workers to be available during a greater number of daytime and early evening hours. This makes it possible to perform a greater variety of activities, and to benefit from the support and encouragement of friends and family. It seems that compressed shift work, or shift work generally, does not affect the frequency of contact with friends, at least for this sample of younger workers. This seems to confirm other suggestions that shift workers under the age of 40 had the same number of friends as day shift workers (Mott *et al.*, 1965).

Individuals seem to have less time for leisure activities which they once performed on the 8-hour schedules. While workers are allocating much more time for the spouse, household chores, television, and shopping on their working days, they are not spending correspondingly more time on these activities on days off. There seems to be a decrease in time for many more 'maintenance-type' activities than personal leisure activities.

Considering that much of a married person's discretionary time is spent in the presence of other members of his family, better family relationships could result. In this study, married individuals are spending less time with their family, spouse, and children on workdays; they also appear not to be using their extra time on days off with their families. There is some non-conclusive evidence of greater family satisfaction, perhaps because the new schedule reduces the amount of night and weekend work, a major dislike of shift workers (Wedderburn 1967, pp. 85-107). The following statements might explain why family satisfaction might be higher, even though they are not spending as much time with their families.

'I may not be spending any more time with my family, but what time I have with them is more enjoyable. I'm not having to worry about going to work as often, so I can relax more with them . . . I don't have to worry about going to work at midnight'.

'When I had to go to work at midnight, I was always on edge. All I could do was sit around and watch T.V. and wait to go to work'.

General health and productivity

There does not seem to be any negative affects of the compressed shift schedule on the individual's health, as measured by respiratory functioning, reaction time, vigilance, auditory functioning, and blood pressure. Other studies have indicated that general health problems are not universally related to shift work but occur only for a minority of individuals who cannot adapt their rhythmic functioning to new schedule demands (Mott *et al.*, 1965).

The effect of shift work on productivity is not clear in this study or in others (Mann and Hoffman, 1960). Studies on the effects of the 10-hour compressed day schedules have mixed results, using measures of absenteeism and performance. The short-term impact seems to be more

positive (Ivancevich, 1974) than what may be experienced in the long term (Ivancevich and Lyon, 1977). Other studies have indicated that productivity efficiency followed the circadian body temperature rhythm of both day workers and night workers (see studies by Colquhoun *et al.*)

In this study, the effects of a compressed shift schedule on sickness, turnover, and accidents could also be affected by changes in one's circadian rhythms. Fewer absentees and accidents may not be associated with day or night shift work but may evolve because fewer adjustments are required under a 12-hour compressed shift. These results might be different for an older workforce or for those who had experienced this change over a longer period of time.

In a pure research sense, the findings reported and the conclusions drawn have implications only for the viability of the 12-hour compressed shift schedule with the present sample. We are reminded of Table 1 which illustrates that the characteristics of a 12-hour compressed shift schedule are more complex than a 4-day work week.

A further reservation derives from the fact that most of the individuals were very interested in working the 12-hour shift schedule, possibly because of the dread of other shift schedules. One of the principal motivating forces behind many work innovations—such as a compressed shift schedule—is its acceptance by interested parties. Every effort was made to control for the psychological investment or expectations of the workers before proceeding onto the shift schedule. However, the workers themselves wanted to work the 12-hour shift schedule, and thus the implications of the study must revolve around this fact. It should be noted, however, that the major implications of the 12-hour schedule were on the individual's use of leisure time, and not on the attitudinal measures which are more prone to exaggeration.

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