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The Impact of Different Rosters on Employee Work and Non-work Time Preferences

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ABSTRACT. Australian organizations are extending the 8-hour shift in response to market demands. The aim of this study was to quantify the impact of working time arrangements on employees who work shiftwork. A survey was developed to investigate preferred work and non-work time and to determine the potential impact of two rosters (mining and transport). A total of 256 shift-workers working either 8- or 12-hour shifts were matched on age, gender, marital and parenting status. Both groups placed higher value on work time during the day, Monday to Friday and preferred weekend work to night work. Furthermore, the two imposed rosters suggest that the benefits cited concerning 12-hour rosters and social time are more a reduction in the loss of preferred time than an absolute gain. KEY WORDS • preference • rosters • shiftwork • time

Introduction

The number of organizations introducing extended work hours continues to rise (Tepas, 1985; Rosa, 1991; Williamson, 1994; Duchon et al., 1994; Lowden et al., 1998; Axelsson et al., 1998). From an organizational perspective, the move away from the traditional working day occurs as a response to increased national and international market competition, economic pressures and globalization (Harma, 1998). One strategy that organizations utilize to compete in the market is extended shift schedules (shifts longer than 8 hours). For the
organization, the advantages of extended shifts include a reduction in worker numbers and shift teams, improved communication at shift changeover, reduced sickness absence, and improved morale and productivity (Lowden et al., 1998; Gillberg, 1998; Smith et al., 1998; Axelsson et al., 1998). However, factors such as increased sleepiness, impaired performance, high levels of fatigue and increased accident/injury rates have also been cited as potential areas of concern associated with extended hours of work (Rosa and Colligan, 1989; Budnick et al., 1994; Axelsson et al., 1998; Lowden et al., 1998).

From an employee perspective, the advantages of extended work shifts exist at both a personal and an occupational level. In addition to the aforementioned advantages of improved communication and lower sickness rates, benefits also include compression of the working week, reduced travelling time and longer blocks of non-work time (e.g. social, leisure and family time) (Colligan and Tepas, 1986; Lowden et al., 1998; Rosa and Colligan, 1989; Smith et al., 1998). Specifically, Smith et al. (1998) suggested that employees working 12-hour shift configurations had access to more free weekends than those working shorter 8-hour shifts. It has been widely reported that free time at weekends and in the evenings has greater value than free time during the week (Ernst et al., 1988; Hornberger and Knauth, 1993; Wedderburn, 1981). This is because the majority of people are involved in other activities such as work, study or school during the week. Other studies examining the social impact of extended workdays have reported that workers on 12-hour shifts were more satisfied with social aspects of their working time arrangements than those working 8-hour shifts (Jaffe et al., 1996; Lowden et al., 1998). The increased satisfaction was mainly attributed to the long periods of non-work time. Extended work shifts essentially compress the work week, providing longer blocks of time away from work. However, extended work shifts may also have adverse effects on the social and family lives of shiftworkers and their families. For example, Kundi and colleagues (Kundi et al., 1995) reported that nurses working 8-hour shifts were more satisfied than those working 12-hour shifts.

The value of time appears to be non-transferable across the days of the week, indicating acceptance of the societal norms of an evening and weekend society (Baker et al., 2003; Ernst et al., 1988; Hornberger and Knauth, 1993). This is reflected in the monetary compensation afforded shiftworkers for working at ‘socially valuable’ times (often termed penalty rates). While the payment of penalty rates is one way of compensating shiftworkers for the loss of socially valuable time, it may be more beneficial, both for employees and organizations, to reduce the impact of working time arrangements through novel and flexible rostering strategies. However, this would require some qualitative assessment of the social impact (or benefits/costs) of work schedules.

The benefits and costs associated with various working time arrangements will be dependent on a variety of factors. These include the employees’ marital
status (Mott et al., 1965), gender (Gadbois, 1981; Knauth and Costa, 1996), the number and age of dependants (De La Mare and Walker, 1968), the nature of the job (Iskra-Golec et al., 1996), and importantly the specific schedule that one works (De La Mare and Shimmin, 1964). Working time arrangements will have different ‘costs’ or ‘benefits’, which are likely to vary as employees move through the human life cycle (Hewitt, 1993). Tailoring working time arrangements to minimize the negative impact would have wide-ranging benefits for employees and employers alike. However, it is currently impractical to quantify the impact of a roster on individual employees. Thus, it is generally the employee who ‘flexes’ rather than the roster.

Therefore, the first aim was to measure the preferences for work, social, family and leisure time of employees working 8-hour shifts or 12-hour shifts. Secondly, the potential impact of two different roster schedules on employee time preferences was also quantified.

Do Employee Time Preferences Vary with Shift Length?

One hundred and twenty-eight full-time (for 10.9 ± 8.4 years) shiftworkers working 8-hour shifts and 128 full-time (for 13.8 ± 9.5 years) shiftworkers working 12-hour shifts were selected from a larger subject population consisting of 763 shiftworkers from a variety of Australian organizations. Participants were matched on age (36 ± 9 years), gender, parenting and marital status. Four matrices were used to quantify the value of time assigned by the employees to paid work, social, leisure and family time (Baker et al., 2003).

Participants were required to value each hour of the day across the seven days of the week on a scale from 0 (least preference) to 10 (highest preference) for each activity. Data were averaged across subjects to produce mean and standard deviations for each hour of the week, thereby producing a mean matrix for each employee group for each of the four activities. The mean scores indicate the times in the week that are considered of greatest or least importance for particular activities. The mean scores are represented by contour maps, using shading to depict different preference levels.

Activity definitions

Preferred work time referred to ‘time you would prefer to work in your main area of paid employment across the week, irrespective of current work patterns’.

Preferred social time referred to ‘time you would prefer to spend with family and friends involved in fun and entertainment, eating, drinking and social life activities’ (Argyle, 1996).

Preferred leisure time referred to ‘time you would prefer to spend doing those...
activities that you do in your free time, because you want to, for their own sake, for fun, entertainment, self-improvement or for goals of your own choosing but not for material gain’ (Argyle, 1996).

Preferred family time referred to ‘time you spent with your partner, spouse, child(ren) and/or other family members involved in school or sporting activities, fun and entertainment, home duty situations, time at home etc.’ (Argyle, 1996).

Comparison of different shift schedules

The grid system represented a dimensionalization of a 168-hour time sequence into a $7 \times 24$-hour time sequence; thus the values for work, social, leisure and family are not independent observations. Therefore, it would be inappropriate to quote a multivariate statistic (for example, Hottelling’s T or Roy’s Greatest Root) due to matrix singularity. To address the large number of dependent variables and to control for the probability of a type-I error, an ad hoc technique was adopted. Significance was imposed at $p < .01$, with a further requirement of at least two contiguous cells, either vertical or horizontal, to be considered. Hence, multiple t-tests were employed to provide comparisons across the hours of the day, for each day of the week, for each key area, to determine significant differences between groups.

Work time

The 8-hour employee group preferred not to be engaged in paid work from approximately midnight to dawn any day. In contrast, the 12-hour group indicated preference scores above zero for all times across the week (Figure 1a and 1b). Figure 2 shows the differences in work time preferences between employees working 8-hour shifts and employees working 12-hour shifts. Employees working 12-hour shifts had significantly higher preferences for work in the early morning hours.

Social time

The highest preference for social time was at the weekends in the evenings for both groups (Figure 3a and 3b). However, the 12-hour group had significantly higher preferences for social time in the early morning and into the mid-afternoon on weekdays than the 8-hour group (Figure 4). Although the preferences of the 12-hour group were quite low (2–3) at these times, they were significantly higher than the 8-hour group.

Leisure time

Both groups had the greatest preference for leisure time in the afternoons/evenings of Friday, Saturday and Sunday (Figure 5a and 5b). Again,
FIGURE 1
Contour maps indicating the preferred working time for employees working 8-hour shifts (top panel) and 12-hour shifts (lower panel).

FIGURE 2
The difference in work time preferences for employees working 8-hour shifts and employees working 12-hour shifts. The dark grey area indicates the time of the week that 12-hour employees indicated higher preferences than 8-hour employees.
FIGURE 3
Contour maps indicating the preferred social time for employees working 8-hour shifts (top panel) and 12-hour shifts (lower panel).

FIGURE 4
The difference in social time preferences for employees working 8-hour shifts and employees working 12-hour shifts. The darker grey area indicates the time of the week that 12-hour employees indicated higher preferences than 8-hour employees.
the 12-hour group had significantly higher preferences for leisure in the early morning hours, in addition to the early afternoons of weekdays (Figure 6).

**Family time**

The 8-hour group had the highest preference for family time on Saturday evening, similar to the 12-hour group (Figure 7a and 7b). The 12-hour shift-workers valued family time significantly higher than the 8-hour shiftworkers throughout the early mornings Friday, Saturday and Sunday (Figure 8).

The 12-hour group generally indicated a wider range of times that they were prepared to use for non-work activities. They appear to rate all hours of the week as potentially valuable, while 8-hour employees do not rate the midnight to dawn hours at all.

**Does the Impact of Work Vary with Shift Length?**

The potential psychosocial impact of work schedules was quantified using two actual work rosters, one involving 8-hour shifts and one involving 12-hour shifts. The rosters were chosen as real-world examples of 8-hour and 12-hour roster systems, used commonly in Australian transport and mining industries respectively. The schedules of the transport and mining rosters were super-imposed over the mean time value matrices (work, social, family and leisure) of the 8-hour and 12-hour shiftworking groups. An example of the procedure is depicted in Figures 9–10. The scores in each block corresponding to the rostered work hours were summed to produce a score for work, social, leisure and family time for each shiftwork group for both rosters.

The impact of the transport (8H) and mining (12H) rosters was determined relative to the impact of a standard roster (0900h – 1700h, Monday–Friday week). As the ‘standard’ working week schedule is essentially the benchmark by which penalty rates are determined, the standard score was used as a reference point to compare the impact of the 8H and 12H rosters. A move away from the standard score was demonstrated by either a gain or loss of preference points, representing a ‘benefit’ or ‘cost’ to the employee.

**Preferred work time scores**

The scores allocated by participants for work time represented the hours of the day the participant preferred to work. Access to preferred work time was considered a ‘benefit’ to employees. Thus, the more hours in the roster that coincided with high preference points the more beneficial the roster, and the higher the score.
FIGURE 5
Contour maps indicating the preferred leisure time for employees working 8-hour shifts (top panel) and 12-hour shifts (lower panel).

FIGURE 6
The difference in leisure time preferences for employees working 8-hour shifts and employees working 12-hour shifts. The darker grey area indicates the time of the week that 12-hour employees indicated higher preferences than 8-hour employees.
FIGURE 7
Contour maps indicating the preferred family time for employees working 8-hour shifts (top panel) and 12-hour shifts (lower panel).

FIGURE 8
The difference in family time preferences for employees working 8-hour shifts and employees working 12-hour shifts. The dark grey area indicates the time of the week that 12-hour employees indicated higher preferences than 8-hour employees.
FIGURE 9

The transport roster imposed across the 24-hour day and a 7-week cycle using the mean preference scores for preferred work time (shaded areas represent hours worked).
The mining roster imposed across the 24-hour day and a 7-week cycle using the mean preference points for preferred work time (shaded areas represent hours worked)

**FIGURE 10**
Preferred non-work time scores

The non-work scores were determined by superimposing the roster schedules over the leisure, family and social matrices. The greater the scores obtained by summing the preference scores in the roster blocks, the greater the preference for non-work activities in those work periods. Thus, a requirement to work during a period highly valued for social, leisure or family time represented a cost.

Determining the impact of different shift schedules

The transport roster (8H) represented a cost for employees working 8-hour days in terms of work time. An average reduction (cost) in preferred paid work time of 40.7% was found for this group, as compared to the Standard roster (Figure 11). For preferred social time, a reduction of approximately 89.5% was found for the 8-hour employees and preferred leisure time was reduced by an average of approximately 35.3% (Figure 11). The score associated with preferred family time was 26.7% lower than the score associated with the standard roster (Figure 11).

The potential scores for work, social, leisure and family time of the 8-hour employees were also calculated for the mining roster (12H). If the 8-hour employee group worked the mining roster, preferred work time would be reduced by 47% compared to the standard roster. Similarly, both preferred social time (68.6%) and preferred leisure time (18.4%) were reduced compared to the standard roster. Overall, there would be only a 9.9% decrease in preferred family time for 8-hour employees if they were to work the mining roster (12H) (Figure 11).

Therefore, for employees regularly working an 8-hour shift system, both potential roster scenarios impacted most significantly on their preferred social time. Interestingly, the 8H roster schedule represented the highest cost in terms of preferred social time for employees currently working an 8-hour schedule.

If the 12-hour employee group were to work the transport (8H day) roster, they would incur an average reduction in preferred paid work time of approximately 35.2% compared with the standard score (Figure 11). For preferred social time, a reduction of 22.2% was found for the 12-hour employees and 14.9% reduction in preferred leisure time. Preferred family time was also reduced across the 12-hour employee population by 22.7%.

If the 12-hour employees were to work the mining roster, they would experience an average reduction in preferred work time of 40.2%. Further, preferred social time was reduced by 12.5%, and preferred leisure time by only 5.8%. For preferred family time the mining roster represented a cost of 11.4% for employees currently working 12-hour shifts compared with the standard score (Figure 11).
Therefore, for employees currently engaged in a 12-hour work shift system, the greatest cost of both an 8H and 12H system was evident in the preferred work time. Interestingly, the negative impact on preferred social and leisure time of the two roster scenarios (8H and 12H) for the 12-hour group was half that of the 8-hour group.

Conclusions

This article demonstrates that it is possible to objectively quantify the potential impact of a working time arrangement on the preferred work, social, leisure and family time of a group of employees. The way employees value time varies depending on their regular working time arrangements. The results provide an avenue through which the development of more sophisticated data analysis...
techniques may ultimately make it practical for organizations to tailor roster schedules to minimize the adverse impact on employees’ lives.

Our previous report indicated that employees working a ‘normal’ day shift (Monday to Friday, 9am–5pm) had different time preferences for work and social time compared to employees working shiftwork (Baker et al., 2003). As an extension of these findings the current study examined the time valuation of shiftworkers working different types of shiftwork (8-hour shifts versus 12-hour shifts). Shiftworkers working 8- and 12-hour shifts both indicated a peak preference for work during the daylight hours from Monday to Friday. The peak preferred working times were consistent with the dominant societal norm of an evening and weekend society (Baker et al., 2003; Hornberger and Knauth, 1993). However, the peak preference times for shiftworkers working 12-hour shifts extended to an earlier start in the morning and a later finish in the afternoon, compared to 8-hour shiftworkers. In addition, while the preference scores for work across the night/early morning hours (midnight – 0600h) were low for both groups, the 12-hour shiftworkers had a significantly higher score over this period.

Employees currently working 12-hour shifts considered any time of the day or night acceptable for non-work activities. This finding supports previous research showing that shiftworkers selected activities outside of the workplace that were time flexible, and in many cases individual, rather than group-determined (Blakelock, 1960). The 12-hour shiftworker group viewed all hours across the week as potentially more valuable than did the 8-hour group. The question remains however: do employees who are accustomed to working extended shifts consequently have a wider preference for time, or do they work extended shifts because they have a broader range of time preferences?

Individuals who work at times of social high value are generally compensated financially (Allan et al., 1998). However, as more organizations now operate on a 24-hour basis, compensation may become increasingly redundant if the value of time is no longer differentiated across the hours of the day and/or the days of the week. The current findings do not support such a trend. Rather, in line with previous findings, the data suggest that the value of time remains disparate across the week, irrespective of the system of work. The standard working week continues to be perceived as a marker for working time, despite the fact that it may be increasingly out of step with the occupational and economic changes of society (Bittman and Pixley, 1997; Levine and Pittinsky, 1997).

The potential impact of different roster schedules on the work and non-work time of employees was assessed quantitatively. The change from one roster to another is known to take considerable time and can be a difficult organizational process (Baker et al., 1997). For employees working 8-hour shifts, the overall impact of the mining roster (12-hour shifts) was less than the overall impact of the transport roster (8-hour shifts). The majority of workers would have experi-
enced a reduction in each of the preferred activity times when compared to the Monday to Friday work schedule; however, the ‘costs’ were generally lower for the mining roster (12H) than the transport roster (8H). Thus, the benefits often cited in association with 12-hour shifts may not necessarily be an outright gain in preferred time, but rather a reduction in the ‘costs’. The mining roster reflected more of the preferred family time than the transport roster. The ‘benefits’ may be due to the longer breaks away from the workplace rather than the availability of ‘free’ time when working on a day-to-day basis.

Overall, employees working 12-hour shifts would have experienced a reduction in access to preferred activity times on both the mining (12H) and transport (8H) rosters. In both roster schedules, the greatest reduction in percentage points was found for preferred working time when compared to the standard working week. This is not surprising as shiftworkers indicate preferred working times that parallel the standard working week (Baker et al., 2003).

As a result of the matching of subjects on factors such as parenting and marital status, there were only 10 females in the shiftwork populations, compared with 118 males. The gender division of the current samples does not precisely reflect the general distribution across Australian organizations that employ full-time shiftworkers. Currently, 13.7% of the workforce are full-time shiftworkers and of those 71.6% are male and 28.4% are female (ABS, 1997). The consequences of a majority vote with relation to implementing a new roster may therefore be highly detrimental to such a group. It has been suggested that the optimal roster should be developed as a compromise between the organization and employees (Baker, 1980; Barton and Folkard, 1993; Folkard, 1992; Knauth, 1997); however, implementation of a new roster based on democratic principles may not be equitable for all workers. The current technique of quantitating the psychosocial impact of working time arrangements may allow organizations to cater better for specific employee subgroups and to minimize the adverse effects.

Shiftworkers working 8- or 12-hour shifts would have preferred to work the mining roster, compared to the transport roster across all four activities. However, a Monday to Friday schedule of 0900h to 1700h would obviously reflect more of the preferred times these shiftworkers identified as their peak preference for paid work, social, leisure and family activity times. The process of determining the potential impact of the roster indicated that shiftwork itself has an effect on employees’ life activities. That is, the difference in impact between rosters is relatively small compared to the overall shiftwork effect. Nevertheless, the process may enable organizations to anticipate the areas incurring most negative impact for employees and provide additional support and training to minimize the impact. Baker (1980) reported that the adverse consequences associated with shiftwork could be reduced by recognizing physiological and social needs and by providing shiftworkers with additional support services.
By combining information regarding the potential impact of a roster on an employee’s work and non-work life with support services, it may be possible for an employer to minimize adverse consequences associated with shiftwork. It may mean that within one organization there are variations of the roster, which accommodate a range of employee groups or subgroups.

References


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