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# 3

## Work Schedules

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The mental and physical health of workers depends not only on what they do at work but also on when they work and for how long they work. This chapter will therefore describe some of the temporal characteristics of work and examine their impact on workers. Understanding the psychological effects of work schedules is important because an increasing number of people work on schedules that do not conform to the standard “9-to-5,” Monday to Friday workweek.

Although this chapter will consider various forms of work schedule, it will focus on two main topics: shift work and long work hours. These topics have been chosen because they appear to pose the greatest problems for organizations and workers, they have attracted the most research attention, and they illustrate the dual importance of the arrangement and length of work time. The chapter will cover issues such as international changes in use of shift work and weekly work hours, the application of chronobiological and stress models, the reasons for alternative work schedules, comparisons between different forms of work schedule, differences in how individuals respond to work schedules, effects on physical and mental health, and possible societal, organizational, and individual interventions for minimizing schedule-related problems.

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### Definition of Stressor

Organizations make use of a wide range of work schedules by varying the times of day at which employees start work, the number of hours they work each day, and the days of the week and the weeks of the year they work. Examples of commonly used types of work schedule include shift work, compressed work (fitting the workweek into fewer days by extending daily hours), overtime, part-time, flexible hours (allowing workers to fix their own

daily start and end times outside core hours), annual hours/hours averaging (cumulative work hours calculated over an extended period), staggered hours (starting work at slightly different fixed times), time-autonomous (work time is shaped by tasks), special leave (e.g., parental, educational), and on-call (see International Labour Organization [ILO], 1995, for further details). Any schedule, including a standard workweek, can act as a stressor if it does not conform to the needs of the individual worker. However, the nature of some work schedules means that they have an increased likelihood of causing problems. Working at night or for extended hours, for example, can incur fatigue-related problems that are not associated with some of the other schedules.

Like most of the other types of work schedule, shift work encompasses a variety of different work patterns. Shift work refers to a system of working in which one group of workers replaces another during the workday so that the number of operating hours exceeds the work hours of any particular individual. A shift worker, however, is normally defined as someone who regularly starts or ends work outside of daytime hours (e.g., 7 A.M. to 7 P.M.). Shift systems that operate 24 hours a day, 7 days a week are known as continuous; those that stop at the weekend are semicontinuous; and those that stop for a period during weekdays as well as at the weekend are discontinuous. A distinction is also made between rotating systems in which workers periodically change from one shift (e.g., morning shift) to another (e.g., night shift) and permanent systems in which workers only work one type of shift (e.g., a morning shift or a night shift). The other main characteristics that distinguish between shift systems are the start times of shifts, length of shifts, speed of rotation (i.e., how many consecutive shifts of one type are worked before rotation), direction of rotation (in forward/delaying rotating systems, workers switch to a shift that begins later; and in backward/advancing rotating systems, they switch to an earlier shift), rest periods between shifts, and regularity or flexibility of shifts (which refers to the extent to which the pattern of shifts is fixed or the amount of choice workers have over which shifts they work).

In relation to the topic of length of work hours, there is no agreed definition of what constitutes long work hours. In looking at the effects of work hours, many researchers have treated weekly work hours as a continuum whereas others have set a threshold such as 48 hours and have examined the effects of working longer. Other research has instead concentrated on the effects of the number of consecutive hours worked (e.g., extended shifts).

## **Prevalence of Exposure to Different Work Schedules in the Workforce**

Data from a 1991 population survey in America revealed that only 31.5% of employed workers over 18 regularly worked a standard daytime weekday

schedule of 35 to 40 hours a week, and only 55% worked a fixed daytime weekday schedule of any number of hours (Presser, 1995). The figures also showed that 20.1% of people worked nonstandard hours and 40.1% worked nonstandard days. These proportions were similar for men and women. A similar survey conducted in 2001 found that 14.5% of full-time workers worked a shift other than a daytime one, which was 3.5% less than 10 years earlier (Bureau of Labor Statistics [BLS], 2002). This figure included 4.8% working evening shifts, 3.3% working night shifts, 2.8% on irregular shifts, and 2.3% on rotating shifts. Among part-time workers (< 35 hrs.), who constitute about one fifth of the American workforce, about 36% work a shift other than a regular daytime shift (Beers, 2000).

By way of comparison, the Third European Survey of Working Conditions conducted in 2000 found that 22% of the workforce was involved in shift work across 15 European Union member countries (Boisard, Cartron, Gollac, & Valeyre, 2003). The number of workers on rotating shifts had increased by 1.7% since 1995 to 16.8%, and the numbers working at least one night shift per month had increased by 1% to 18.4%. Although the proportion of shift workers was similar for men and women, 24% of men worked at least one night per month compared with 12% of women.

The number of hours that people work, both weekly and lifetime, has decreased around the world since the start of the twentieth century, but the decrease began to slow in the 1990s (ILO, 1995). By the end of the century, working weeks had become shorter (especially in countries that have high average weekly hours such as Japan), amount of allowable leave had increased, and workers entered the workforce later and left earlier. However, the global trend disguised some underlying changes and large variations between countries, occupations, and individuals. For example, the increase in the number of women in the workforce caused an increase in both the number of dual earners and the number of hours worked in dual-earner households (Clarkberg & Moen, 2001). The distribution of work hours also changed so that greater proportions worked short hours or long hours. For instance, between 1973 and 1994 part-time work increased in all industrialized countries except Italy (ILO, 1995).

In 2000, average weekly work hours in the European Union were 36.7 hours (40 hrs. for men, 32.5 hrs. for women, and 39.9 hrs. for full-time workers) (Boisard et al., 2003). Among different professional categories, managers had the highest average weekly hours at 44 hours per week. Comparable U.S. figures for 1999 (BLS, 2001) showed an average workweek of 38.4 hours (42 hrs. for men, 36 hrs. for women, and 42.7 hrs. for full-time workers), and 43.9 hours for managers. U.S. managers' average work hours and the proportion of them working more than 48 hours per week did not change much during the last decade, but nearly 30% worked more than 48 hours per week in 1999 (BLS, 2000). Indeed, Jacobs and Gerson (1998) reported that more than 25% of men and 10% of women in the United States currently worked in excess of 50 hours compared with 20% and 5% respectively in 1970. The

proportion of full-time Australian workers working more than 48 hours per week similarly increased from 19% in the late 1970s to 32% in the late 1990s (Pocock, 2001). Boisard et al. (2003) reported that 20.7% of full-time workers in the European Union worked more than 45 hours per week, but this proportion varied greatly from 10.6% in Belgium to 31.8% in the United Kingdom.

Another trend in working hours that has occurred in recent years is the increase in the use of flexible work schedules in which workers can vary the times at which they start and end work. The proportion of U.S. workers on flexible schedules increased from 15% in 1991 to 28.8% in 2001 (BLS, 2002). This trend has occurred across all occupations (Beers, 2000). However, flexible schedules are more common for workers in service-producing (35.3%) than goods-producing industries (23.1%), more common for managers and professionals (45.5%) than other occupations, and more common for men than women (30% vs. 27.4%) (BLS, 2002).

## Major Theoretical Models

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The study of work schedules has associated both shift work and long hours of work with a range of deleterious effects on mental and physical health. This section examines some of the theoretical models that have been proposed to account for the relationships between work schedules and health outcomes. The range and nature of those outcomes are described in a later section of the chapter.

*Shift work.* A unique feature of shift work models is that they usually incorporate the notion of disturbed biological rhythms caused by working at night or in the early morning. Humans have evolved as a diurnal species that is normally awake during the day and asleep at night. Internal anticipation of the Earth's 24-hour cycle of light and dark is reflected in 24-hour rhythmic fluctuations in many physical and mental functions known as circadian rhythms. These rhythms—such as those involving body temperature, melatonin synthesis, urinary electrolyte production, blood pressure, short-term memory performance, and alertness—peak at different times of day but are normally higher during the day and lower during the night. The circadian system appears to be made up of at least two processes: a strong endogenous body clock and a weaker exogenous process that is more susceptible to external influence (see Folkard & Hill, 2002). Some rhythms, such as the sleep-wake cycle, are less strongly coupled to the body clock and in certain circumstances can “break out” from the body clock to run with their own natural periodicities. Studies in which people have been isolated from time cues have shown that the natural period of the body clock is closer to 25 hours than 24 hours (e.g., Wever, 1979), but it is normally entrained to run at 24 hours by zeitgebers such as the light-dark cycle and social cues (e.g., mealtimes).

The circadian system is therefore not adapted for night work because the rhythms prepare workers for rest when they have to work and for activity when they have to sleep. There is therefore a mismatch between the circadian system and the work schedule. Over a number of consecutive nights of work, the circadian system begins to adjust to the altered activity pattern, but the individual rhythms adjust at different rates depending on the extent to which they are controlled by the body clock. This produces internal dissociation between the rhythms and may account for some of the problems caused by shift work. It is also possible that the rhythms may never fully adjust to a nocturnal routine (Knauth & Ilmarinen, 1975) because (unlike jet lag) the external cues encourage the circadian system to remain on a diurnal pattern. For this reason, the rhythms also adjust more quickly back to a diurnal routine when a worker has days off (Knauth, Emde, & Rutenfranz, 1981).

As well as circadian rhythm disturbance, models of shift work also regularly feature sleep disturbance and social disturbance as likely causes of problems for workers. Curtailed and poor quality sleep are common experiences for shift workers (e.g., Akerstedt, 1985). Although environmental factors such as light and noise probably play a part in making daytime sleep difficult for night shift workers, the body clock is also responsible. Experiments have shown that ease of falling asleep and duration of sleep depend on the time of day at which sleep is initiated (Lavie, 1986; Zully, Wever, & Aschoff, 1981). Social disturbance also features in models of shift work because the work schedule often means that workers can only partake in domestic and leisure activities at times that are mismatched with those of the people around them such as family and friends (Colligan & Rosa, 1990).

To give a flavor of models of shift work and health, some example models will be described briefly in chronological order of publication. For more detailed overviews of these models see Taylor, Briner, and Folkard (1997) and Smith et al. (1999). The stress-strain model proposed by Rutenfranz, Knauth, and Angersbach (1981) was one of the first shift work models. In this model, the stress of altering work and sleep hours produces strain in the form of complaints and diseases. This pathway is influenced by intervening variables such as physiological adaptability, personality, family situation, and housing conditions. The destabilization model of shift work (Haider, Kundi, & Koller, 1981; Kundi, 1989) proposes that shift work causes health problems by interfering with the dynamic equilibrium that holds between work, sleep, and family. For example, shift workers may sacrifice sleep in order to spend more time with their family, and this may reduce their capacity to function effectively at work. Personality, social environment, and work situation moderate the destabilization process. The model also proposes that the shift worker's destabilization moves through stages of adaptation (first 5 yrs. of shift work), sensitization, and accumulation (after 15–20 yrs.), so that major health changes are only manifest during the last stage.

Models by Monk (1988) and Olsson, Kandolin, and Kaupinnen-Toropainen (1990) view the shift worker's ability to cope with shift work as

critical in determining whether the schedule will lead to health problems. Monk proposes that the ability to cope with shift work depends on interference from three interrelated domains: the biological clock, sleep, and social/domestic factors. Olsson and colleagues, in contrast, see shift work as just one of several occupational stressors whose effects depend on the appraisal and coping strategies of the worker.

In reviewing these and similar models of shift work, Taylor et al. (1997) observe a move from simple models that portray linear relationships to more complex models characterized by dynamic relationships based on multiple pathways and interrelationships between problems. These more complex models rely more heavily on concepts from stress theory. Nomothetic models (such as the stress-strain model) characterize stress in terms of features of the shift worker's environment, and idiographic models (such as coping models) characterize stress in terms of the transaction between the shift worker and his or her environment. According to Taylor et al. (1997), the trend toward using general stress concepts has increased diversity in shift work research but at the cost of a lack of clarity and falsifiability. Most of the models serve as heuristic frameworks rather than descriptions of data. Most shift work research has not been concerned with theory testing.

Taylor and colleagues have called for midrange theories that specify which shift features are related to which symptoms under which circumstances. The process model of shift work (Smith et al., 1999) is an example of this type of theory. The model is based on a framework originally proposed by Folkard and colleagues (Barton et al., 1995; Folkard, 1993) in which shift system features lead to disturbed biological rhythms, sleep, and family/social life. These disturbances result in acute effects on mood and performance and eventually chronic effects on mental and physical health. Individual and situational differences and coping strategies modify this process. Smith et al. (1999) tested a modified version of this model using survey data from three groups of shift workers. In support of the model, they found that individual (e.g., inflexible sleep habits) and situational (e.g., workload) factors resulted in sleep and social disturbances that triggered different types of coping behavior leading to acute (e.g., fatigue) and chronic outcomes (e.g., digestive and cardiovascular symptoms).

Finally, with respect to shift work, there are also a number of chronobiologic models that make specific predictions concerning levels of sleepiness, alertness, and performance on different shift schedules based on the sleep times of shift workers. The most developed of these models, the three process model, was first described by Folkard and Akerstedt in 1987 and has since been further refined and validated (e.g., Akerstedt & Folkard, 1997; Folkard, Akerstedt, Macdonald, Tucker, & Spencer, 1999). The model incorporates processes C, S, and W. C is a circadian sinusoidal component, S is a homeostatic component that falls during wakefulness and is reversed during sleep, and W is a short-lived wake-up process. Predicted alertness is the sum of these three components. Validation of the model using subjective alertness ratings

from shift workers has identified the need to additionally incorporate a first night shift compensation effect (shift workers are more alert on the first night shift and less alert on the second night shift than would be expected) and a time on shift effect (alertness decreases over the course of a shift).

*Long hours.* The time on shift effect also fits with the next topic, which is the theoretical basis of the relationship between long work hours and health. As with shift work research, the emphasis in this area has been on finding empirical evidence for the relationship rather than theory development. The main pathways that have been implicated in the relationship between work hours and health are increased fatigue, reduced motivation, prolonged exposure to work stressors, and the use of poor lifestyle habits such as smoking, lack of exercise, and inadequate diet (Sparks, Cooper, Fried, & Shirom, 1997; Spurgeon, Harrington, & Cooper, 1997). However, fatigue has proved difficult to define and can cover a range of physical and psychological functions, such as muscular, perceptual, and cognitive fatigue (White & Beswick, 2003). Fatigue has been viewed as one aspect of a general stress response (see Craig & Cooper, 1992). White and Beswick (2003) distinguish between acute fatigue, such as that incurred by a long workday, and cumulative fatigue, such as that incurred by a long workweek. Major factors that contribute to fatigue because of long work hours include high workload, insufficient sleep, and insufficient time for recovery.

One view is that the time required to recover from a stressor such as long work hours may be a better predictor of the severity of stress and the likelihood of chronic effects than the immediate response (e.g., Depue & Monroe, 1986). Recovery models that have been applied to work hours include the adaptive-cost hypothesis (e.g., Totterdell, Spelten, Smith, Barton, & Folkard, 1995), which proposes that the severity of aftereffects is a function of the effort required to adapt to aversive events, and the effort-recovery model, which proposes that sufficient recovery time is needed to offset the costs of work effort (e.g., Van der Hulst & Geurts, 2001). Increased fatigue and irritability in and outside work are seen as indicators of lack of adaptation or insufficient recovery from work.

Other researchers have used more general theories of work behavior to guide their studies of work schedules. Baltes, Briggs, Huff, Wright, and Neuman (1999), for example, used the work adjustment model and job characteristics theory to formulate their hypotheses on the effects of compressed workweeks and flextime. Nomothetic and idiographic models of job stress have also been applied to the issue of work hours. Bliese and Halverson (1996), for example, found that the relationship between work hours and well-being was best modeled from a nomothetic perspective. In other words, there was a stronger relationship between work hours and well-being at a group than at an individual level. This may suggest that long work hours act as a stressor when imposed on a group of workers but not when individuals choose to work long hours.

Related to the issue of individual preferences, Holton, Lee, and Tidd (2002) recently applied a discrepancy/congruency model to explain workers' response to work schedules. The model predicts that employees will be more satisfied and perform more effectively when they work the number of hours they prefer on schedules that fit their needs. In line with this model, Holton et al. (2002) found that work status congruence (the match between workers' preferences and organizational practices) was associated with job satisfaction, organizational commitment, retention, and performance.

## Causes and Predictors for the Stressor

There are a variety of reasons why nonstandard work schedules are used by organizations. In some cases, the requirement to use such a schedule is a necessity. For example, some form of shift work schedule is necessary to provide 24-hour capability in a range of essential services such as fire protection, police, health care, transport, telecommunications, power, and water utilities. Some production industries also require extended operating times to sustain continual production processes (e.g., chemical industry). In other cases, the reason for using nonstandard schedules is economic. Manufacturing organizations, for example, may choose to maximize their return on investment in expensive machinery by operating it continually (e.g., production lines). New technology has also made extended operations possible in some jobs. Data processing centers and call centers, for example, are commonly used around the clock seven days a week. The demand for nonessential services outside regular daytime hours and weekdays has also increased. Provision of extended hours of access to shops, restaurants, entertainment, fuel, broadcasting, and cleaning services is now more common. Changing patterns of work, such as greater participation of women in the workforce, has partly fueled the demand for extended services.

Beers (2000) reported that job gains in service occupations in the United States were largely responsible for keeping the proportion of shift workers relatively static between 1985 and 1997. In 2000, night work in Europe (Boisard et al., 2003) was most common for industrial workers (35.7%) and service/sales workers (23.4%) and least common for office staff (5.2%) and agriculture and fisheries workers (13.9%). In 2001, shift work in the United States (BLS, 2002) was most common in protective services such as police and firefighting (49.0%) and food services (40.4%) and least common among managers and professionals (6.7%) and farming, forestry, and fishing occupations (5.6%).

There is a higher proportion of shift workers among full-time workers under 24 years of age (22.5%) than after that age (13.5%) (BLS, 2002). The same data show that men are more likely to work a nondaytime shift than are women (16.4% vs. 12.1%), partly because they are more likely to choose occupations in which shift work is more common (Beers, 2000). Men are more likely to work both weekdays and weekends than are women (21.8%



vs. 14.7%) (Presser, 1995). Presser (1995) also demonstrated that marriage discourages shift work among women but not men and that having children affects women's but not men's likelihood of working shifts. Specifically, women with children ages 5 to 13 are less likely to work shifts than women with children under 5 or without children. This fits with women's reported reasons for working shifts. Women with preschool-age children are more likely to report child care as their main reason for working shifts. The most common reasons that shift workers in general give for why they work shifts are that it is the nature of the job (53.3%), personal preference (13.3%), better arrangements for family or child care (8.9%), and better pay (6.9%) (BLS, 2002). Night workers more commonly report personal preference as their reason for working shifts (21.5%).

Separate from shift work, there is a global trend toward using more flexible forms of work schedule in order to enhance economic efficiency by matching the demand for labor with supply (ILO, 1995). As well as responding to economic pressures, flexibility also enables organizations to take greater account of workers' preferences, needs, and capabilities (Martens, Nijhuis, Van Boxtel, & Knottnerus, 1999). However, according to the ILO (1995), organizations are also using longer time intervals for calculating average hours worked per week, and collectively agreed deviations from work time legislation are common. These trends makes long hours of work more likely for certain individuals at certain times. Schemes involving average hours enable employers to balance weeks of high and low volume by expanding and contracting work hours without incurring overtime costs. Use of overtime (or extended hours) usually increases during the initial stages of economic recovery when employers are unsure of the strength of recovery. Extending work hours can also be a more attractive option to employers than hiring and training new recruits who may prove surplus to requirements during recession. In the United Kingdom, workweeks exceeding 48 hours are more common for men (19%) than women (4%), for middle age (31% of 30–39-year-olds) than younger workers (5% of 20–24-year-olds), and in managerial positions (22%) (see White & Beswick, 2003).

At the same time as extending the work hours of some individuals, organizations are also reducing the work hours of others (see ILO, 1995). Sometimes work hours are reduced to obtain greater flexibility in order to extend operating time. Use of part-time work has also increased, partly because of the increase in the size of service industries and partly to accommodate the child care requirements of women. However, involuntary part-time work has also increased, and a study of European part-time workers found that 37% would prefer full-time work (ILO, 1995). Organizations also make greater use of contingent workers, and an increasing number of individuals have more than one job (Golden & Applebaum, 1992).

Allied to these trends is the increase in employees' desire for sovereignty over their time. A European survey found that, in return for more leisure time or money, 61% of people would work an early shift, 22% would work a

night shift, 44% would work on Saturday, and 21% would work on Sunday (ILO, 1995). However, these figures varied greatly between countries. Jacobs and Gerson (1998) reported that about half of employees would prefer to work fewer hours, rising to over 80% of those who work more than 50 hours per week. Twenty-five percent of workers said they would take a pay cut to reduce their hours of work, but 17% would increase their work hours for more money. Indeed, there is evidence of a time divide in which employees working long hours would prefer shorter hours and employees working short hours would prefer longer hours (Drago, 2000). In a study of over 4,000 couples, Clarkberg and Moen (2001) found that under half of wives and husbands were working a preferred schedule, and of these, two thirds felt they were working too much. Six years later, in the same study, 60% of individuals who wanted to reduce their work hours had done so, and those who wanted to reduce to zero work were most successful in doing so.

## Known Moderators

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Research has found that the relationship between work schedules and health depends on a wide range of factors, many of which are amenable to intervention. These factors include characteristics of the work schedule, characteristics of the work environment and job, individual differences and behaviors, and workers' control or influence over their schedule. This section will briefly describe current knowledge concerning some of these factors.

*Shift system.* One of the most important influences on the experience of shift work is the design of the shift system. For example, there is a long-standing debate about whether shift systems should be designed so that workers rotate between different shifts and, if so, how fast the rotation should be. Wilkinson (1992), for example, argued that permanent night shift systems are preferable because they allow the circadian system to adjust. In contrast, Folkard (1992) argued that, except for safety critical operations, it is better to use rapidly rotating systems to minimize circadian disturbance, reduce cumulative sleep deficit, and allow workers some normal social time. There seems to be some agreement that slowly rotating shift systems (e.g., weekly changes) are least desirable (Knauth, 1996), but a recent meta-analysis found that such systems have a less negative effect on sleep than rapid rotation (Pilcher, Lambert, & Huffcutt, 2000). The order of shifts in a rotating shift system is also important. Comparisons between systems have generally favored delaying systems (e.g., Barton & Folkard, 1993) because they encourage a sleep pattern more in line with the body clock and they avoid quick changeovers between shifts, but the evidence is not conclusive (Tucker, Smith, Macdonald, & Folkard, 2000). The start times of work shifts also have an impact, and research suggests that an early start to the morning shift should be avoided (e.g., Kecklund, Akerstedt, & Lowden, 1997).

Another shift system characteristic that has received considerable research attention and is relevant to the issue of length of work hours is the duration of work shifts and, relatedly, the compression of workweeks. Much of the research has focused on the use of 12-hour shifts compared with 8-hour shifts. Following a comprehensive review of research on the relative effects of 8-hour and 12-hour shifts, Smith, Folkard, Tucker, and Macdonald (1998) concluded that the evidence shows few differences between them. Schedules involving 12-hour shifts appear to have some advantages in terms of workers' satisfaction with their job, family, and social life but may cause fatigue-related problems particularly at the end of shifts (e.g., Mitchell & Williamson, 2000). More generally, a meta-analysis of compressed workweek schedules showed that they have positive effects on job and schedule satisfaction and performance ratings but no effects on absenteeism or productivity (Baltes et al., 1999).

*Job-related factors.* A number of other job-related factors such as work environment and job content can also modify the response to work schedules. For example, in relation to work environment, Parkes (2002) demonstrated that offshore workers reported better sleep quality and longer sleep durations than their onshore counterparts. Costa (1996) also points out that exposure and susceptibility to toxicological agents can vary over the course of 24 hours. Concerning job content, the impact of long hours may be greater for jobs requiring sustained attention and for sedentary jobs (Sparks et al., 1997). There is also limited evidence that social support in the workplace, especially from supervisors, can buffer the impact of shift work on job strain (Schmieder & Smith, 1996).

*Individual differences.* Individuals differ in their tolerance to shift work, and researchers have investigated a number of characteristics that might predict tolerance. Questionnaire measures based on circadian rhythm concepts have been somewhat more successful in predicting shift work tolerance than circadian rhythm characteristics themselves (e.g., Vidacek et al., 1995). For example, individuals who are categorized as evening rather than morning types, because they tend to wake up and go to sleep later and prefer activities later in the day, appear to adjust better to night work (see Harma, 1993). There is also evidence that shift work tolerance is greater for individuals who are more flexible in their sleeping habits or who can overcome drowsiness more easily (e.g., Costa, Lievore, Casaletti, Gaffuri, & Folkard, 1989). The predictive powers of these measures for shift work tolerance are small but greater than those of other individual difference measures (Kaliterna, Vidacek, Prizmic, & Radosevic-Vidacek, 1995). Neuroticism has also been linked to poor shift work tolerance (e.g., Parkes, 2002), but it may be a consequence rather than a predictor of poor tolerance (see Harma, 1993). In relation to age, older shift workers experience more problems than younger shift workers because circadian adjustment becomes more difficult with age (see Parkes, 2002).

Studies comparing male and female shift workers have generally found few differences in tolerance (Singer, 1989). Menstrual cycle phase can influence women's experience of different shifts such that problems caused by the night shift may be exacerbated during the premenstrual phase (Totterdell, Spelten, & Pokorski, 1995). However, outcomes are more likely to be influenced by differences in domestic workload than biological differences (Harma, 1993). For instance, some studies have found that women with children experience more fatigue-related problems than either women without children or men with or without children (Estryn-Behar, Gadbois, Peigne, Masson, & Le Gall, 1990). There is some evidence that women are more likely than men to show a positive relationship between long work hours and ill health, but this may also be due to differences in nonwork roles (Sparks et al., 1997). Men may also be more vulnerable to strain when their wives work long hours than vice versa (Galambos & Walters, 1992).

Mental and behavioral strategies adopted by shift workers also appear to influence their adjustment to the schedule. For example, use of effective coping strategies, commitment to shift work, and physical fitness have all been associated with less disturbance (Harma, 1993; Smith et al., 1999).

*Control over schedule.* One factor that appears to facilitate workers' reactions to schedules is the level of control or influence that they have over their schedule. Different forms of work schedule control have shown benefits. For example, shift work tolerance can be enhanced by participation in the design of the schedule (Kogi, 1996), choice of working on a particular schedule such as permanent night shifts (Barton, 1994), and ongoing influence over which shifts are worked (Barton, Smith, Totterdell, Spelten, & Folkard, 1993). Hours worked may be less influential on outcomes than schedule control and the extent to which schedules fit individuals' needs (Fenwick & Tausig, 2001; Gareis & Barnett, 2002). Similarly, for workers who reduce their work hours, the tradeoff of activities and job-role quality may be better predictors of distress than work hours (Barnett & Gareis, 2000a, 2000b). In relation to control over daytime work hours, a meta-analysis of flexible schedules found that the positive effects of flextime schemes diminish over time, are lower in jobs that are high in autonomy, and reduce with increasing flexibility (Baltes et al., 1999).

## Key Measurement Issues

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Many of the issues concerning measurement in the study of work schedules are shared by research on other sources of work stress and will therefore be described in the chapter on methodological issues. This section, however, will highlight some issues that are highly salient or unique to the study of work schedules. See Boggild and Knutsson (1999) for more detailed discussion of some of these issues.

The first issue concerns the problem of who to include in the target sample. Shift work, for example, encompasses a wide range of different schedules, and the amount of exposure to night work in particular varies greatly depending on the schedule and on the individual worker. Comparisons of working hours are also hampered by the fact that working hours can be calculated in many different ways. For example, working hours are measured through payroll records, self-reports of annual or weekly hours, retrospective self-reports of work during a target week, calculated workweeks, and time-use diaries. These different methods can produce different results (Herman, 1999; Jacobs, 1998). The problem of obtaining accurate figures is also likely to increase as people work more flexible schedules, take on additional jobs, travel more, and do more work at home.

Identification of appropriate comparison groups is also difficult. For example, shift work is more common for certain types of occupation, so discovered differences between shift workers and day workers may reflect occupational differences. Shift workers also tend to have lower socioeconomic status, but controlling for this factor is problematic because it is related to having an unhealthy lifestyle, which may be one of the mechanisms by which shift work causes problems. Comparing workers who do the same job may be one answer, but even then work conditions (e.g., smoke and noise) and job demands may be different at night than by day.

Primary selection into and secondary selection out of study groups may also bias results. People who apply to do shift work may have different personality characteristics and lifestyles, and they may be selected based on an assessment of particular capabilities such as an ability to cope with shift work. However, demonstration of a change in disturbance with increased exposure to shift work can counter a primary selection interpretation. A sizable proportion of shift workers (between 10 and 20% according to Kivimaki, Kuisma, Virtanen, & Elovainio, 2001) also switch back to day work, commonly due to health problems. This leads to a biasing effect known as healthy survivors. The bias is compounded by the fact that former shift workers, who typically have greater health problems than shift workers, make up part of the comparison group. A comparison group made up of individuals who have never done shift work may therefore be more appropriate. The healthy survivor effect also applies to long work hours because individuals who cannot cope with long hours sometimes switch to shorter hours. Individuals working long hours because of work demands (who may therefore be most likely to suffer problems) may also exclude themselves from studies due to lack of time.

Timing of measurement administration is another important consideration in work schedules research. Circadian rhythms can account for large amounts of variation in many physiological and mental processes. Hence, for example, taking measurements only during duty periods would mean that night workers were more likely to be sampled at the lowest point in their rhythms.

Finally, the assessment of work schedules is multidisciplinary, multimethod, and multifactorial. Shift work research, for example, includes studies involving laboratory, field, survey, intervention, archival, and epidemiological methods. Measures used include physiological parameters, polysomnographic indexes, cognitive performance, work performance, health and safety records, and self-reported attitudes, behaviors, and well-being. In relation to survey research, the Standard Shiftwork Index (and its shortened version) is probably the most widely used battery of self-report measures for assessing shift work schedules (Barton et al., 1995; Kaliterna & Prizmic, 1998).

## Outcomes of the Stressor

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Shift work and long work hours have been connected with a wide range of negative outcomes. This section of the chapter will describe some of these. It should be borne in mind, however, that although research may have shown that the risk of these outcomes is significantly higher than for standard work schedules, this does not mean that the risk is necessarily high in absolute terms. Some of the outcomes may also require many years of exposure to the schedule stressor before they materialize.

In broad terms, research supports a link between both shift work and long work hours and ill health. For example, a study of a patient population (Martens et al., 1999) found that patients working rotating shifts, compressed workweeks, and irregular hours had greater physical and psychological complaints than a control group. Concerning long hours, a meta-analysis of 21 study samples found a small, significant trend of increased health symptoms with increasing work hours (Sparks et al., 1997). Psychological effects of longer work hours were shown to be greater than physiological effects. Another recent review of the literature (Van der Hulst, 2003) also found that there was evidence of a relationship between long work hours and adverse health. Although there was evidence of both physiological changes and changes in health behavior resulting from long work hours, Van der Hulst concluded that there was greater support for a physiological recovery mechanism than a lifestyle mechanism.

*Sleep and fatigue.* Two studies involving very large sample sizes have linked work hours to sleep disturbance. Ribet and Derrienic (1999) found from interviews with 21,000 French workers that shift work and long work hours were two of the four main risk factors for sleep disturbance. Similarly, using interviews with a Swedish population sample of 58,000 individuals, Akerstedt, Fredlund, Gillberg, and Jansson (2002) found that shift work was a predictor for sleep disturbance and that overtime work was a predictor for fatigue. There is widespread agreement that shift work can disturb the duration and quality of sleep (e.g., Tepas & Carvalhais, 1990). In a review of long working hours, White and Beswick (2003) reached the conclusion that the evidence supports a link between long work hours and fatigue.

*Gastrointestinal disorders.* A number of studies have reported increased incidence of gastrointestinal disorders (including appetite disturbance, abdominal pains, and peptic ulcer) in shift workers (Costa, 1996). There are a number of possible explanations including changes to neuroendocrine functions due to altered sleep patterns, changes to meal times (which can act as circadian synchronizers), and changed content of meals (including increased carbohydrate intake).

*Cardiovascular diseases.* Shift work and long work hours have also been linked with increased risk of cardiovascular diseases (Costa, 1996; White & Beswick, 2003). Based on an assessment of 17 studies that have examined the risk for shift workers, Boggild and Knutsson (1999) estimated that male and female shift workers have a 40% increase in cardiovascular disease risk. However, not all of the large-scale studies in that review found an association, and the results concerning dose response were mixed. A number of possible mechanisms have been proposed to explain the heightened risk of cardiovascular disease for shift workers including circadian disruption, social disruption, health behaviors (e.g., diet, smoking, alcohol use, exercise), and biochemical changes (e.g., cholesterol). Research concerning these mechanisms is limited, but there is some support for explanations based on dietary differences and increased smoking in shift workers (Boggild & Knutsson, 1999; Kivimaki et al., 2001). Concerning long work hours, a number of studies have found an increased risk of coronary heart disease and acute myocardial infarction in workers who worked long days or long weeks (see Liu & Tanaka, 2002).

*Cancer.* A number of recent studies have also linked night work to increased risk of breast cancer (e.g., Davis, Mirick, & Stevens, 2001; Hansen, 2001; Schernhammer et al., 2001) and colorectal cancer (Schernhammer et al., 2003). In relation to breast cancer, the research has found that the increase in risk for night workers may be as high as 50 to 60% and that the risk depends on dosage of night work (in terms of both number of night shifts worked per week and years of employment on night work). The explanation for the link is thought to be that melatonin production is suppressed by exposure to light during night work, and the suppressed melatonin level enhances tumor development.

*Menstrual and pregnancy problems.* Further, in relation to women's health, shift work has been linked to higher rates of menstrual problems (e.g., Uehata & Sasakawa, 1982) and, in some but not all relevant studies, to higher risk of adverse pregnancy outcome such as preterm birth, low birth weight, and miscarriage (see Costa, 1996; Infante-Rivard, David, Gauthier, & Rivard, 1993). A meta-analysis of working conditions and pregnancy outcome (Mozurkewich, Luke, Avni, & Wolf, 2000) found that shift work was a risk factor for preterm birth. The researchers put this risk into perspective by stating that one preterm birth might be avoided for each 23 to 171 women who discontinue shift work. Long work hours were not associated with preterm birth.

*Other health problems.* Musculoskeletal disorders, such as back problems, have also been associated with shift work and working long hours, especially in occupations requiring strenuous physical work such as nursing (Guo, 2002; Lipscomb, Trinkoff, Geiger-Brown, & Brady, 2002). Shift work has been associated with a number of other minor and major health outcomes. For example, compared with day workers, shift workers are at higher risk for common infections such as colds and flu (Mohren et al., 2002). Mohren and colleagues found in their study that controlling for health behaviors, sleep, and job demands reduced the association. It is likely that increases in infection are due to depressed immune functioning caused by shift work.

*Mental health.* As well as being linked to problems of physical health, shift work has also been linked to mental health problems (see Cole, Loving, & Kripke, 1990; Costa, 1996; Koller, Haider, & Kundi, 1981). Studies have found increased acute psychological and somatic symptoms such as job strain and irritability among shift workers. Shift workers may also be at greater risk for a number of chronic psychological problems including chronic fatigue, persistent anxiety, neurotic disorders, and depression. Indeed, it has been observed that shift work maladaptation and depression share a number of core complaints, possibly because they have circadian disturbance in common (Healy, Minors, & Waterhouse, 1993). Long work hours have also been associated with poor psychological health and depression (White & Beswick, 2003), but there is a paucity of research on chronic effects.

*Absence.* One indicator of health outcomes is absenteeism. Although there is some evidence that workers on rotating shifts have more sick leaves (e.g., Ohayon, Lemoine, Arnaud-Briant, & Dreyfus, 2002), it has also been reported that rotating shift workers are less inclined to stay absent from work (Costa, 1996). In fact, the picture is somewhat more complex in that absence rates vary across the shift cycle (Nicholson, Jackson, & Howes, 1978). For example, absences are likely to be higher on morning shifts because of difficulties in awakening and at weekends because of the social value of this time. One study found that the introduction of flextime reduced absenteeism (Dalton & Mesch, 1990). Absenteeism has not commonly been included in studies of long hours.

*Mortality.* Few studies have examined whether shift work or long hours are associated with mortality. A study by Nylén, Voss, and Floderus (2001), however, examined this issue using Swedish mortality data for more than 9,000 women and 11,000 men between 1973 and 1996. The results indicated that shift work was not associated with mortality. There was, however, an increased mortality risk for men and women who reported working more than 5 hours per week on an extra job. Overtime work in excess of 5 hours per week had a weak positive association with mortality, but less than 5 hours overtime was protective for men. Part-time work was also associated with increased mortality risk in men.



*Performance and safety.* Apart from health disorders, there is also the influence of work schedules on performance and safety to consider. Although different types of performance peak at different times of day, a composite view of 24-hour work performance based on data from a number of studies has shown that speed and accuracy decline reaching a trough during the night (Monk, Folkard, & Wedderburn, 1996). Comparing incident risk (which includes both accidents and injuries) on different shifts is difficult because work conditions usually differ, but a few studies have overcome the problem (e.g., Smith, Folkard, & Poole, 1994). Pooling the available data for incident risk on shifts, Folkard and Tucker (2003) have found that risk is higher on afternoon shifts and highest on night shifts compared with morning shifts; increases over the course of a shift, but falls after the second hour of a night shift; increases over consecutive shifts of any kind, but increases more on night shifts; and increases between rest breaks within a shift. Concerning long work hours, White and Beswick (2003) concluded that there is a link with the likelihood of accidents (especially in occupations involving driving), but the link with performance was considered less conclusive. Studies have, however, shown that overtime can lower productivity (Shepard & Clifton, 2000) and impair cognitive performance (Proctor, White, Robins, Echeverria, & Rocskay, 1996). One difficulty in this research area is that workers may exert compensatory effort to overcome fatigue-related deficits.

*Family outcomes.* Finally for this section on outcomes, work schedules can also have an impact on the families of workers. Although shift work has some advantages for scheduling nonwork activities, it has been related to a number of adverse effects including greater marital dissatisfaction, more family conflict, and greater emotional problems and lower school achievement in children (Barton, Aldridge, & Smith, 1998; Staines & Pleck, 1983; Wedderburn, 1993). Fenwick and Tausig (2001), however, found that only non-Monday to Friday schedules were associated with greater family conflict. Findings concerning the impact of long work hours on family-related outcomes are not clear-cut but suggest an association with increased family conflict. In a study of 190 dual-earner families, Crouter, Bumpus, Head, and McHale (2001) found that long work hours for men were not associated with marital quality; but when long hours were combined with work overload, they were associated with poor relationships with adolescent children.

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## Major Empirical Studies

Whereas the theoretical development of the understanding of work schedules has been limited to a relatively small number of models, there have been many hundreds of empirical studies conducted on the topic. These studies range from small-scale experimental studies conducted in sleep laboratories to large-scale population surveys. Although the research varies in quality, it is difficult to identify a small number of studies that stand as hallmarks

within the field. Many of the best studies have already been discussed (and some are still to be discussed) in relation to their individual contributions within the wide range of topics. Rather than present these studies again, this section will therefore be curtailed to leave space for other substantive issues.

## Future Research Needs

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Although international research on working time is flourishing, a number of research needs are apparent. First, there is an obvious need for more theoretical development and theory testing. In particular, more attention is required to elucidate the precise biological, psychological, and social pathways by which work schedules produce particular effects. It is by no means clear, for example, how acute effects become transformed into chronic effects. Another question concerns whether some individuals are at greater risk of health disorders than are others (Boggild & Knutsson, 1999).

As in many other areas of work stress, there is also a need for more longitudinal studies that can both tease out causal relations and investigate how individuals adapt to work schedules over weeks, months, and years. Empirical studies also need to take greater heed of potential nonlinear effects and the effects of combinations of work schedule (and individual) characteristics. For example, Lipscomb et al. (2002) found that musculoskeletal problems were predicted by the combination of nondaytime shifts and weekend work and by the combination of long workdays and long workweeks.

Controlled studies to evaluate the potential benefits of interventions such as diet modification, fitness training, and use of bright light treatment (see next section) for shift workers are also required. For example, most current studies of bright light involve simulated night work rather than actual night work. There are also unanswered questions about the health effects of continually phase shifting circadian rhythms using bright light (Eastman et al., 1995).

Researchers have begun to develop models that can simulate the likely impact on alertness and fatigue of shift workers' sleep patterns (e.g., Akerstedt, 1998; Folkard et al., 1999) and work schedules (e.g., Dawson & Fletcher, 2001; Kostreva, McNelis, & Clemens, 2002). Further development of these models is required including additional validation of results against actual work schedules. For example, current models are unable to account for some known trends in safety risk (Folkard & Tucker, 2003) and take no account of individual differences such as morningness and sleep flexibility. Future computer-aided design of shift schedules (e.g., Nachreiner, Qin, Grzech-Sukalo, & Hedden, 1993) will also need to take account of the personal preferences of workers because of the trend toward flexible schedules and the positive benefits of worker choice. On this issue, there will also need to be an assessment of the potential tradeoff between the positive influence of worker choice and the potential negative influence of workers who choose work hours that maximize short-term social benefits to the long-term detriment of health.

There is also a need for more evidence-based research that can be used to support the development and implementation of working time regulations. At present, many of the parameters used in such regulations are based on indirect or slim evidence. In relation to this issue, the recent increase in the application of meta-analysis to work schedule issues is a welcome development because it represents a move away from idiosyncratic use of evidence from single studies. However, in order for meta-analysis to be viable, researchers will have to be more stringent in reporting the exact characteristics of the work schedules that they have studied. One final point here is that further research is needed on cultural differences in reactions to work schedules. The majority of research on work schedules takes place in a few countries, yet working time practices from one culture may not travel well to another.

## Implications for Practice, Policy, and Intervention

There are a variety of ways in which the problems induced by work schedules can be reduced. Interventions are possible at three levels: societal, organizational, and individual. Examples of interventions at each level will be described. However, Kogi (1996) describes the importance of using multifaceted interventions based on consensus building at all levels.

*Societal interventions.* Most countries have national or local regulations concerning hours of work for night and shift workers. Agreements on hours of work also exist between countries. For example, the International Labor Organization has adopted many conventions and recommendations on hours of work and shift work (see Kogi & Thurman, 1993). The European Community Directive on Working Time also contains legislation pertaining to shift work. The directive includes a limit of an average of 48 hours work a week (but workers can choose to work more), a limit of an average of 8 hours work in 24 hours for night workers, a right to a minimum daily rest period of 11 hours, a right to a day off each week, a right to 4 weeks paid leave each year, a right to a rest break if the workday is longer than 6 hours, and a right for night workers to receive free health assessments.

*Organizational interventions.* The most obvious intervention for an organization to take is to change the work schedule. In relation to shift work, this can involve changing the way the night shift is covered, changing the speed and direction of rotation between shifts, changing the timing of shifts, and changing the duration of shifts. Research evidence concerning such changes has been collated into principles for designing and evaluating shift schedules (e.g., Knauth, 1996; Kundi, 2003). Computer models incorporating principles of shift schedule design (see section on future research) offer organizations the possibility of examining the likely consequences of different schedules.

Researchers (e.g., Kogi, 1996; Jeppesen, 2003) have advocated the importance of adopting a participatory approach that involves all stakeholders during the planning and implementation of new shift systems.

A more radical solution to the design of shift schedules, which may be appropriate for some types of work, is to adopt a “follow the sun” approach in which work is moved between groups of workers located in different time zones around the world so that each group of workers remains on a daytime schedule. This kind of global shift work scheme has been used for customer service operations and software development (e.g., Carmel, 1999), but it may cause its own kind of problems such as task coordination and intercultural difficulties.

Other potential organizational interventions include selection of workers who can tolerate nonstandard schedules and provision of appropriate occupational health services. There is currently insufficient basis for selecting shift workers because the predictive validity of most individual difference measures for shift work tolerance is low and desirable scores are easily faked (Monk et al., 1996). However, preventive medical consultations are warranted, in which workers are advised against shift work if they have specified medical conditions and informed if they meet criteria that are predictive of shift work intolerance (Koller, 1996). Occupational health services should also offer shift workers regular health assessments, counseling, maternity protection, and the option to transfer to day work (Koller, 1996). Improvements in health care and treatment of disease can enable workers to participate in work schedules from which they would otherwise have been excluded. For example, insulin-dependent diabetes is now easier to control during night work (Costa, 2003).

*Individual interventions.* A wide range of interventions for helping individual employees adjust to shift work have been investigated, including naps, fitness, drugs, phototherapy, and behavior modification. Taking a nap before (e.g., Harma, Knauth, & Ilmarinen, 1989) or during a night shift (e.g., Smith & Wilson, 1990) may have beneficial effects for alertness and performance although negative effects have also been found (e.g., Rosa, 1993). Naps may compensate for sleep loss, but they may also increase drowsiness immediately following the nap and may slow circadian adaptation. There is some evidence that improving fitness can improve adaptation to night work. For example, Harma, Ilmarinen, Knauth, Rutenfranz, & Hanninen (1986) found that a group of nurses who undertook a fitness-training program for 4 months were more alert and performed better on memory tests than a control group, especially on the night shift.

A number of “alertness-enhancing” drugs have been considered as possible countermeasures to fatigue induced by work schedules, including amphetamine, caffeine, modafinil, and pemoline. In a review of use of these drugs, Akerstedt and Ficca (1997) ruled out amphetamine because of its side effects, deemed caffeine appropriate for ad hoc use, and judged that modafinil and pemoline were promising but required more testing in applied settings. Another drug under consideration is orexin, a hypothalamic peptide whose production is impaired in narcolepsy (Siegel, Moore, Thannickal, & Nienhuis, 2001).

There is also promise of interventions that can adjust shift workers' circadian systems to suit their work schedule. For example, oral ingestion of melatonin has been found to induce phase shifts of endogenous melatonin (which is normally secreted at night by the pineal gland). Taking melatonin at the desired bedtime has been found to improve the sleep and alertness but not the performance of shift workers (Folkard, Arendt, & Clark, 1993).

Lewy, Wehr, Goodwin, Newsome, and Markey (1980) discovered that very bright light (about 2,500 lux) could suppress the secretion of melatonin at night. Subsequent research has shown that appropriate timing and magnitude of bright light can advance, delay, and even suppress circadian rhythmicity (e.g., Jewett, Kronauer, & Czeisler, 1991). Studies of bright light treatment during simulated night shifts have demonstrated large circadian phase shifts and enhanced alertness and performance (e.g., Campbell & Dawson, 1990; Czeisler et al., 1990; Eastman, 1992; Martin & Eastman, 1998). However, more research on the health effects and practical feasibility of these interventions is required (Eastman et al., 1995).

Shift workers may also benefit from behavioral and cognitive techniques such as sleep hygiene programs (that encourage shift workers to adopt particular sleep habits) and counseling programs (see Penn & Bootzin, 1990; Rosa et al., 1990). There have also been various initiatives to produce and evaluate educational programs and guidelines for shift workers (e.g., Tepas, 1993; Wedderburn & Scholarios, 1993).

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## Conclusion

The variety of work schedules used by organizations is probably greater now than it has ever been. This variety provides employers and employees with the necessary flexibility to meet diverse requirements. Unfortunately, some work schedules can seriously compromise the health and productivity of employees. Problems are most likely to arise when work schedules are unsympathetic to the body clock, do not allow sufficient time for physiological and psychological recovery, and do not take account of employees' preferences. Current trends toward a 24-hour society and toward a time divide between households that work long hours and households that work short hours threaten to increase the prevalence of schedule-related problems. Wider recognition and understanding of the links between the temporal nature of work and well-being will be essential in preventing or minimizing these problems.

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