

WORK/REST SCHEDULES: ECONOMIC, HEALTH, AND SOCIAL IMPLICATIONS

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The organizers of this meeting cleverly invited me to give this opening address many months ago when the honor of the invitation readily overrode the precautions which should accompany the acceptance of such an honor. The impressive roster of participants, the complexities of their topics and their outstanding contributions of the past made apparent the problems of an adequate introduction as the time for the address approached.

Fortunately, I had some guidance in my dilemma. The organizing Chairman gave me a topic: "Work/Rest Schedules: Economic, Health and Social Implications." Further, he designated the talk as a keynote address. Since, in my times of speaking I had never had the task of delivering a keynote address, I turned to my dictionary. I found "keynote address" handily defined: "an address designed to present the issues of primary interests to an assembly and often to arouse unity and enthusiasm." While I suspect that the trailing additions of "unity" and "enthusiasm" are primarily referent to political conventions rather than scientific assemblies, they are reasonable virtues and I shall certainly not try to avoid them. At the least I shall try to follow the advice of the English novelist, Thackeray: "to make new things familiar - and familiar things new."

First, I shall try to extend an apparent and obvious underlying "unity" in our mutual commitment to research as the sine qua non in our approach to the understanding of work/rest schedules and their consequences. I shall point up the remarkable, symbiotic convergence of three disciplinary areas: sleep research, chronobiology and performance research in this research arena of work/rest schedules. I shall urge and applaud onward their unity and call for an enhanced collaboration in mutually beneficial efforts.

Secondly, I shall project from these foundations and their ever increasing findings, some of their "economic, health and social implications" relative to work/rest schedules.

Biological Rhythms, Sleep and Performance Research

We are gathered together around a common topic of concern--work/rest schedules. However, like all good causes or complex tasks we are drawn from different interests and areas of competence. In this instance, three core areas are clearly identifiable; chronobiology, sleep, and performance research. It is my contention that, while these disciplines have emerged essentially independently in their origins and are marked by differences in emphases, conceptual schema and procedures, they are necessarily interdependent in a comprehensive approach to work/rest schedules.

Let us look more specifically at these research areas. The biological rhythm and sleep areas share two common characteristics, their recency of development and their interdisciplinary character.

Human history, folklore, and curiosity have long been responsive to sleep and to the rhythmic aspects of nature. The seasons, the tides, the successive presence of sleep form the very warp of mankind's existence. A striking quotation recognizing both the place and the presence of sleep and its circadian character can be found as early as 300 B.C. in the Hippocratic writings collected in the Book of Prognostics (Adams, 1939):

The patient should wake during the day and sleep during the night. If this rule be altered it is so far worse: but there is little harm provided he sleep in the morning for the third part of the day; such sleep as takes place after this time is more unfavorable... (p. 47).

However, the essentials of the current developments of both chronobiology and sleep research and their momentum began in the 1950's. A few significant items should suffice to remind us of that recency. For sleep research the presence of the "activated" sleep or the rapid eye movement period was explicated in the 1950's, the first symposium on sleep, the CIBA symposium, was published in 1961, Kleitman's revision of Sleep and Wakefulness appeared in 1963. For biological rhythm research Harker's Diurnal Rhythms was published in 1959, the crucial Cold Spring Harbor symposium occurred in 1960, the term "circadian rhythms" was introduced by Halberg in 1959 and Cloudsley-Thompson's book Rhythmic Activity in Animal Physiology and Behavior appeared in 1961. Both areas have experienced an exponential expansion of research activities into the present.

Both, as emergent fields, drew their active participants from already established disciplines and their research was dispersed across an enormous range of journals. Though the biological rhythm researchers were more heavily drawn from the biological scientists and the sleep researchers from medicine, both groups involved biologists, pediatricians, physiologists, psychiatrists, endocrinologists, neurologists, biochemists and the ubiquitous psychologists. Indeed both involved the entire broad range of the life sciences.

The performance researchers do not share this history. This research area has a longer continuous history which extends from the psychophysical research in the early 1800's and mental abilities testing of the later 1800's into human factors research of today. It has been primarily a development within psychology.

More critically, the primary foci of these areas have been clearly different. Simply, biological rhythm research has been concerned with time as an independent variable in relation to a broad range of biological events, sleep research has primarily focussed on the phenomenon of sleep as both a dependent and independent variable and performance research has taken behavior as its dependent variable relative to a wide range of independent variables.

These different concentrations have developed independently valuable findings, concepts and procedures that are usefully transferable beyond their own specific domains. Let me cite some obvious ones.

Biological rhythms research as a result of its focus on time as a variable, has stimulated measurement of variations across time series. In the

process, it has identified a wide and important range of behavioral and physiological events which show systematic variations across time. Most importantly it has emphasized an alternative model for the determination of biological variations. It has proposed and demonstrated that significant variations may be a function of timing systems in contrast to homeostatic or feedback systems such as those operative in "drive/motivation" or restorative models, the organism's historical determinants of the "learning" models or environmentally evoked models of "reflex" action.

Sleep research has focussed on the measurement of sleep phenomena and their mechanisms. As a consequence it has developed sensitive measures of sleep and described its normative characteristics and variations thereof. There have been increasing capabilities in the prediction of the influence of precursor and concomitant environmental and behavioral variations as they modify sleep, including the effects of variations in sleep patterns and structure as these influence other dependent variables including performance.

In its long history of behavior measurement, performance research had developed a vast range of sophisticated "tests" including measures of sensory sensitivities, motor skills, mental abilities and psychological traits, attitudes and moods. Beyond these "tool" or technique contributions there have been significant advances in measurement procedures in such areas as psychophysics, scaling and research designs as well as in the methodological considerations of reliability, validity and the organization of behavior through factor analysis and classification procedures.

These research areas and their developed procedures and concepts find focus in the area of work/rest schedules. The human system has many of its properties, including sleep and performances, organized in a circadian system. A change in work/rest schedules is an exogenous imposition on this endogenous organization. There are consequent variations in the rhythmic systems, including sleep, and a vast set of performances as they occur in modified time periods.

Individual research efforts must, of course, emphasize particular aspects --certain elements of sleep, certain varied time schedules and biosystems, certain performance dimensions. However, this is a complex and interdependent process and a comprehensive understanding of work/rest schedules will be ultimately dependent upon all three areas.

I suspect, indeed I fervently hope, that to this point my comments have been a reminder--a review--a reaffirmation of what we all can agree upon. At best they simply make more explicit what implicitly your own efforts and time will achieve in the cross-fertilization of our various perspectives.

But let me turn to broader considerations. My assigned title included the topics, "Economic, Health and Social Issues." Certainly, our findings and our research must be ultimately embedded in the broad matrix of reality to be of use. No matter how accurate and scientifically impeccable our findings may be, if they remain entombed in speciality journals, they will constitute mere "adult show and tell games" among ourselves or will be still-born from an immaculate conception between our computers and our typewriters.

However, even with a commitment beyond "knowledge for knowledge" sake-- even with a strong desire and active effort to translate and to transfer our findings into active utilization--it behooves us to recognize the complexities surrounding the context where utility meets the reality of alternative and opposing demands. In the "real" world, significant "ifs" are seldom followed by simple "then that's". Rather "if" is more often "if it were possible" and "that" is more often a set of interactive and often conflicting consequences.

Economics and Shift Work

My comments on "Economics and Shift Work" will be brief and limited. Primarily, I offer them only as an object lesson in humility rather than an analysis of economic factors. That is a task which I found certainly exceeded my competence.

I began my foray into this domain in my usual simplistic way. I began with obtaining a piece of data. I found that data in an article in the AFL-CIO American Federationist (Zalusky, 1978):

A 1975 survey of 1,514 major private sector labor agreements showed 80% (a total of 1,214) had shift premiums of some type. A money differential was paid in 78% of these, 12% use the shorter hours for the same money as a premium, 6% combined shorter hours with a premium rate and 4% were in a miscellaneous category...the second shift average was 16 cents per hour and 21 cents per hour for the third shift. When a percentage form of shift premium was used...the average second shift premiums was 8% while the third shift premium was 10% (p. 4).

"Ah ha," I said, "Shift work, using the most manageable figure, adds nearly 10% to production costs. Certainly an economic factor".

Slight pause. "But three times as many units are being produced per 24 hours and/or start up times are eliminated and/or, if this were a construction project, completion time would be reduced, etc." It was clearly more complex than my simple labor cost figures displayed.

I retreated to my first line of defense against ignorance--the library. There I had the good fortune to find a ten year study by the Department of Applied Economics of Cambridge University entitled, "The Economics of Capital Utilization--A Report on Multiple Shift Work" (Morris, 1964). This is an empirical study of British manufacturing. It involved more than 54,000 establishments. There were more than two and a quarter million shift workers "discovered". The purpose of the study was to assess in detail the economics of shift work. Specifically, it was an effort to develop a theoretical model which would permit an economic decision, relative to the impact of shift work, on profits.

This is a tightly packed consideration. One cannot simply summarize this elaborate analysis. Most of the primary factors which determine the economic efficiency of shift work extend well beyond our purview which focusses on the worker. The listing of a few of these can reflect some of the extensity and complexity of these considerations:

- Demand for units of production. It is of little use to produce more units than the market can handle.
- Level of automation. In labor intensive systems, shift work may, in fact, increase costs per unit production.
- Capital costs per equipment unit. This involves a complex relation to initial costs, operative costs, wear and tear, depreciation, absentees, and capital depreciation "write offs". In general, the higher the unit operative costs the greater the effectiveness of shift work.

Even in the area of our primary domain--the worker--the critical economic factor is the wage differential paid. And while negative aspects, "health", "social disruptions", and "attitudes" will partially contribute to a wage differential, more salient factors, in economic terms, will be such variables as:

- the size of the labor pool.
- the strength of the union in negotiating wages.
- the base wage level of the day shift.
- the profit margin increase associated with a shift schedule.

I emerged then from my brief foray into the economics of shift work in due and unusual state of humility.

To recognize that a decision about a work/rest schedule will be significantly determined by economic consideration rather than a statistical level of significance findings is, I believe, properly deflating. It can minimally have the benefit of making one more courteous in demands for attention. It has sharply reduced my frustrations when I note that my precious findings are not immediately valued for themselves alone but relative to other grounds. And certainly courtesy and reduced frustrations are desirable ends.

Health and Shift Work

Let me turn to the second aspect of my specific concerns, "Health". It is my contention that, relative to work/rest schedules, we must be cautious in focussing on or confining our concerns to a narrow concept of "health", viz., demonstrable physical illness.

I hasten to add, I am not denying the importance of health factors. I am not so naive as to fail to recognize the specter of illness or the hope of health as powerful motivational forces. It is clear that if anyone can tie their independent variable to a threat of reduced mortality, be it cancer, heart damage or what have you, the doors to the treasury are open and the champions of protection are manifold.

However, I urge caution in our excessive dependence upon "health" as our primary justification. I do so for several reasons. First, as scientists we must respect data and these, relative to health, are discouraging. At the International Symposium on Night and Shift Work in 1969 (Swenssen, 1970), Thii-Evensen concluded from his extensive studies of more than 9,000 employees over a number of years that: "Thus, there are no probable grounds indicating that shift work in itself is harmful to health: (p. 81)." Two recent studies begin their search for shift work health effects by noting: "Research on the effects of shift work on health has been rather inconclusive (Åkerstedt & Torsvall,

1978)" and "There is no objective evidence, in the majority of studies, that shift work affects health to a significant degree (citations)". Neither is it evident that the form of work scheduling has a significantly higher health risk than permanent day work (8 citations): (Koller, Kundi, & Cervinka, 1978). Our own data then clearly dictate that we should not make a simple linkage between health and work/rest schedules as a raison d'etre of our concerns.

Secondly, the nature of our independent variable--schedules-- and the dependent variable of health suggests that where relations exist they will be tenuous, subtle and limited. The proximal causes are intrusive, direct and physically identifiable--carcinogens, bacteria, and system anomalies, etc. The distal causes lie in the complex domains of psychological and behavioral variables, and are comprised of interactive influences of bad habits and attitudes, psychological stress and social concomitants which ultimately increase susceptibilities to proximal causes or chronically result in wear and tear on systems.

Some of the complexities inherent in such relationships are seen in the early classical study of Bjerner, et al. (1948). Table I displays some data from that study. Note that there is essentially no difference between day workers and current shift workers. However, current day workers who were former shift workers show higher health complaints. Bjerner notes further qualifications. Those shift workers who reported "sufficient sleep" has lower gastritis rates and, further, the higher levels of gastritis were primarily seen in workers over 40 years of age.

Table I
Relations Between
Shift Work and Stomach Disorders

Shift History	% Consulting Physicians	% Hospitalized
Day Work--never on Shifts	18.2	8.6
Day Work--formerly Shifts	29.1	13.7
Present Shiftwork	22.5	9.7

Adopted From: Bjerner, B., Holm, A. and Swenssen, A. (1948).

The recent study of Koller et al. (1978) of workers who had "dropped out" of shift work when compared with day worker and current shift workers showed similar complexities. While "attitude" questionnaire responses showed substantial differences, reported use of "doctors' consultations" or "hospitalization" showed no differences, although the "drop-out group" reported a higher use of drugs at the .05 level. Similarly, Akerstedt and Torsvall (1978) found substantial questionnaire differences relative to seven different schedules which included groups which continued on their shift periods, a non-change day group and the changes in shift schedules groups. Only one group showed a change at the .05 level of confidence in the number of "sickness" absences over a five month period. These paradoxically, were in workers going from a

night shift to a day shift.

Practically, then, to tie shift work to the tenuous variable of health courts the danger of limited findings from indirect influences, embedded in a tangle of alternative interactive variables.

This, of course, is not a plea to abandon health as a concern. Such studies must be done and may yield certain "risk" type individuals or groups for selection purposes. However, they are unlikely to show substantial effects on the total population. Rather, it is a plea that we do not make health our Holy Grail and within our concerns with health we focus our efforts appropriately. I agree with the statement by Mott, Mann, McLoughlin, and Warwick, (1965) in their review of shift work and physical health: "Much of the difficulty...arises from a lack of theory that could spell out the specific connection between job hours and ailments. Too often (there is) no effort to provide hypotheses about the direction of the differences expected and the reasons for the differences" (p. 72).

Nor is this a plea that we abandon efforts or hope for justifications of our efforts. We all readily recognize that research is expensive, that research support is limited and justifications are the prime determinants of priorities. More so than the neatness of the research design or the eminence of the researcher. Rather, my call is to seek more proximal effects as justifications and, in turn, to link these to valued justifications.

The most obvious of these is performance decrements. As I noted in my introduction, performance measurement is an old and honorable domain of research and advancing in precision in the measurement of mental and physical functioning. I, at least, perceive substantial empirical and theoretical linkages between this area and sleep and chronobiology, both of which are inherent aspects of work/rest schedules. I advise us to exploit these linkages.

And can there be justification from such findings? Of course, but it must not be simplistic. We are not automatically protected nor justified by the "magic multiplier" argument--a 1% laboratory decrement can be multiplied by 20 million workers. While an established short term memory effect of, say 2% during an "off schedule" period may be an irrelevancy for an assembly line worker, it can be claimed as a disaster for high level diplomacy or in the multithousands of landings involving millions of passengers in air transportation. Where a ten second "lapse" may be considered tolerable in unloading materials from vans they hold terrifying potentials for long distance truckers.

Social Issues

Let me turn to my last assignment, a consideration of "social issues". I suspect that the intent here was that I review the social consequence of shift work with the cataloguing of such factors as effects on family relations, social interactions, and worker's satisfaction. These inherent issues have been far better done than I could possibly manage. They are detailed, for example, in the work by Mott, et al., entitled Shift Work, (1965) which is specifically subtitled, "The social, psychological and physical consequences."

I shall not review these studies but stipulate the summary of their review of the literature: "In aggregate, these studies confirm the position that shift work can and does have effects upon the worker's family relations, his social participation, and his opportunities for leisure activities" (p. 92). And, "Most European and American studies that have probed into worker feelings about shift work agree on one point: few workers like shift work, many dislike it strongly, and many others have learned only to live with it" (p. 24). These general conclusions have been reaffirmed by the recent studies of Åkerstedt and Torsvall (1978) and Koller, et al. (1978).

Rather than adumbrate these social and attitudinal consequences of shift work I take this opportunity to comment upon the more fundamental implications of varied work/rest schedules relative to man's nature and his contemporary society. I do not do this merely as a jeremiad about our times--a crying aloud in the wilderness. Rather, it is a sharing of a perspective and concern with you who are the most knowledgeable and authoritative group in the best sense of those words. As such, this perspective, if valid, weighs most heavily in your hands.

The message that I want to convey can be bluntly and simply stated. The difficulties that may be associated with varied work/rest schedules can be interpreted as pathological symptoms of our society rather than signs of inadequacy in the individual worker.

This proposition emerges from the linkages of chronobiology, sleep and performance. I find it increasingly evident that the natural course of human behavior is systematically organized in the "time and tides" of a 24 hour or circadian framework. In short, the work/rest or, more explicitly, the performance/sleep tendencies reflect a fundamental biological rhythm. I do not feel the necessity to argue the proposition before this group.

Accepting this, however, carries with it other conceptual properties inherent in biological rhythms. At a metatheoretical level, at least, such rhythms are conceived of as innate, inherent adaptive systems that have been shaped in the evolution of the species. These are functional systems of natural wisdom which have been hammered out by survival on the particular anvil of the species' environmental niche.

This line of reasoning relative to the development of adaptive biological systems by evolution has been described by Campbell as "evolutionary epistemology" (1975), and has been elaborated and developed by the ethologists such as Frisch, Lorenz and Tinbergen and more recently by the social biologists such as Wilson.

For all these there is a common theme and concern that speaks directly to my concern about shift work and society. Tinbergen (1969) states the matter dramatically, "...the unprecedented degree of power over natural events which we have achieved carries in its wake a dangerous consequence...(we) have changed our environment (including our social environment) out of all recognition. As a result, our behavioral environment is no longer faced with the environment in which this organization was molded and, as a consequence, misfires...the very success of our behavior has led to a situation from which only a better understanding and controlled change of our behavior can extract us" (p. x).

Lorenz has specifically considered the problem of release from extra-specific environmental selection factors under the concept of "intraspecific" selection effects (1974). In this model, the nature of the organism is shaped into an appropriate system by negative feedback from extraspecific environmental factors leading to adaptive survival systems. However, when these extraspecific environmental factors are "brought under control" and/or are replaced by intraspecific factors, the species may become a victim of its own decisions. Specifically in regard to mankind, Lorenz states:

...No such salubrious regulating forces are at work in the cultural evolution of mankind. To his detriment, man has learned to govern all the forces of his extraspecific environment, but he knows so little about himself that he is helplessly at the mercy of the workings of intraspecific (factors)...As no biological factor has ever done before, the competition between man and man works in direct opposition to all the forces of nature..." (p. 18).

In our society, the amount of shift work being imposed upon us resembles the "good-news, bad-news" announcement of the airplane pilot when he said: "Ladies and gentlemen, I have two announcements. One is good news and one is not so good. The bad news is that we are lost--we have no idea where we are. The good news is, however, that we have a 200 mile an hour tailwind." Figure 1 shows you data from the US Department of Labor estimates of the number of shift workers in manufacturing in metropolitan centers since 1959. This is a growth rate of 6% per decade and an extrapolation into the beginning of the next century yields a figure in excess of 50%. Or consider these figures. In 1974, the Bureau of Labor statistics reported an estimate of 2.3 million workers whose schedules included the midnight shift; by 1977, three years, this had increased to 2.6 million--an increase of 300,000 persons. They estimate in 1977 over 13.5 million people--18% of the workforce worked on other than day time schedules. In short, there can be no doubt that this is an ever increasing part of our society.

Shift Work in Industrial Settings of the United States

I have previously admitted that I doubt that shift work effects can be defined in disaster terms and hence do not anticipate a growth of a Zero Shift Work movement similar to a Zero Population or an Anti Shift Work movement matching Anti Nuclear forces or even the sympathy of the Sierra Club. However, I do believe we must recognize shift work as yet another instance of the accretion of a system of behavior which is incompatible with the nature of the human organism. I have no doubts that man's biological rhythms, which include sleep and performance, were shaped by extraspecies factors that included time organized in a 24 hour period. Nor do I doubt that the presence and amount of varied schedules of work and rest are determined by intraspecies transient factors such as profit and production of material goods. While elephants may be taught to dance, dogs to sing and lions to leap through hoops of fire, these acts are, minimally, unseemly and are only useful in supporting their enslavement.

Let us try to remember, then, as we serve to make shift work more compatible, that we are homogenizing the twenty-four hours and, arbitrarily, turning persons off and on around tireless machines, continuous processes and insati-

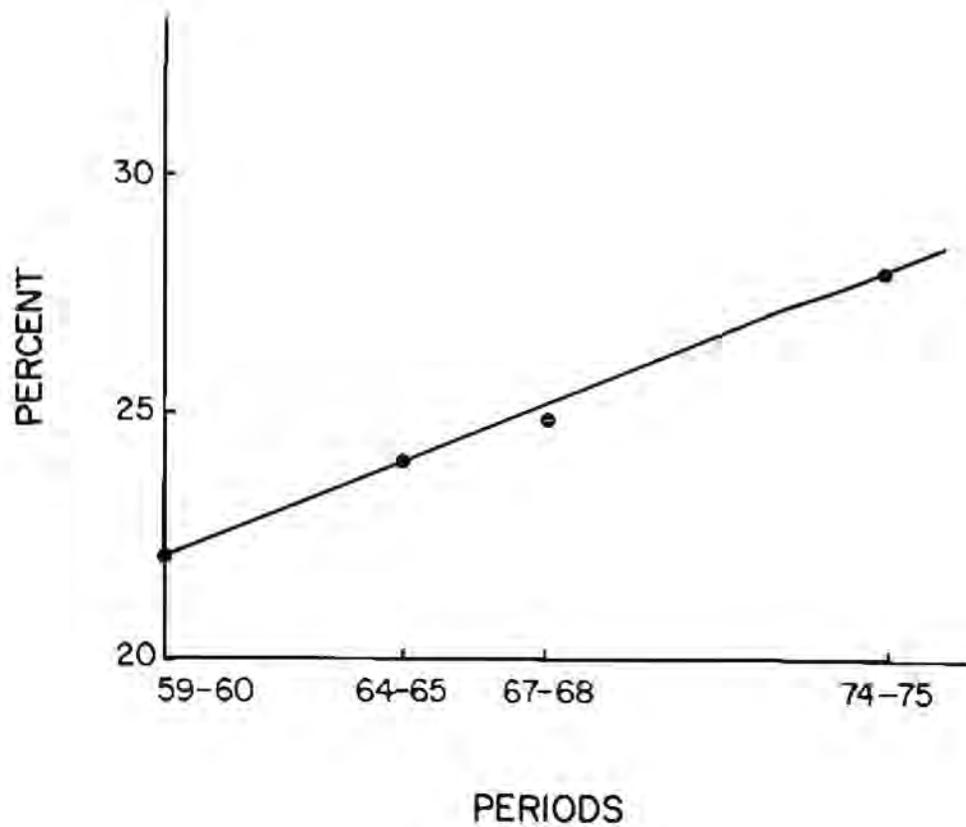


Figure 1. Number of shift workers in manufacturing in metropolitan centers since 1959. (Data from the U.S. Department of Labor estimates)

able output demands. As a consequence, the biological nature of man is being unnaturally bent and all of the accrued adaptive systems such as families and group membership are affected. Moreover, as this continues, the effect will continue into perpetuity since there is no likelihood that man's nature will change to accommodate man's failure to recognize himself as his own worst enemy. Let us at least express our reservations and question our complicity.

The nature of my talk has led me to speak in very general terms in an area of such complexities that highly specialized research is demanded. While I can protectively rationalize my position by recalling the definition of a specialist as one who says more and more about less and less, I can only hope that my comments do not fit the equally tart definition of the generalist who knows less and less about more and more until he knows absolutely nothing about absolutely everything.

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