

The Mystery of RSI

Sara Kiesler and Tom Finholt
Carnegie Mellon University

ABSTRACT: *A computer-related health epidemic known as repetitive strain injury (RSI) is rampant in Australia and threatens to overwhelm the workers' compensation system. RSI is a label given to a variety of painful, debilitating conditions believed to be caused by repetitive movements of the hands or arms. In Australia, the latest wave of RSI complaints is centered among female office workers who develop symptoms as a result of extensive typing at computer keyboards. In an analysis of this epidemic, we examine the nature of RSI and its known correlates with individual health and personality, ergonomics of computing, and work context. Based on available evidence, we speculate as to the reasons for the emergence of RSI in Australia. We argue that RSI is an extreme illustration of how the social context of work and technological change defines and influences the nature of health problems.*

A Day in My Life

Here I am—lost at 33.
Wondering where to go, wondering what to do
Totally ostracised by my peers—feeling hopeless,
As I tread the windmill of my life.
So many thoughts to express—where to start
Start with the pain—all encompassing so that I don't
know how to alleviate it—
To sit, to stand, to do something to make it go away.
Sometimes I feel like cutting. Yes cutting it off—
Being limbless, being nothing.
Take a pill—kill the pain
My independence, so valued, so wanted, has slipped away.
Nothing for me but carefulness.
Days stretching forever, unending.
Careful stretching my arms,
Careful putting on my clothes.
Careful turning a tap.
Careful drones on and on—infinite in my thoughts.
Wearing splints, spoiling my appearance
'What's wrong, broken your wrist?'
Given up explaining—no one wants to know.
How I envy, jealous am I of people being able to eat without
pain.
To drive, to comb my daughter's hair—
To make love without pain.
—(An RSI sufferer; Mersina, 1985)

A computer-related health epidemic known as repetitive strain injury (RSI) is rampant in Australia and threatens to overwhelm the workers' compensation system. RSI is

a label given to a variety of painful, debilitating conditions believed to be caused by rapid, repetitive movements of the hands or arms.¹ Traditionally, RSI affects manual laborers such as carpenters and meatcutters who make repeated movements with their arms and wrists in awkward positions. In Australia, the latest wave of RSI complaints is centered among female office workers who develop symptoms as a result of extensive typing at computer keyboards. Government, business, and labor have reacted vigorously to counter the spread of RSI. Every state in Australia has appointed blue-ribbon commissions to investigate the causes and possible solutions to the "RSI epidemic." In some places special work rules restrict the number of hours people may work at computer terminals to 3 to 5 hours a day. Firms are employing professionals to design equipment and run medical programs to counter the threat. Strangely, Australia is virtually alone in experiencing these RSI problems. In our analysis of this mysterious epidemic, we examine the nature of RSI and its known correlates in the human-computer design interface and context. Based on available evidence, we speculate as to the reasons for the emergence of RSI in Australia. We will argue that RSI is an extreme illustration of how the social context of work and technological change

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Correspondence concerning this article should be addressed to Sara Kiesler, Department of Social and Decision Sciences, Carnegie Mellon University, Pittsburgh, PA 15213.

¹ More exactly, RSI appears most often in work involving (a) rapid, repetitive movements, as those of people operating keyboards, (b) less frequent but more forceful movements, as in electronics assembly work, and (c) static load, as in welding but also in keyboard operators who hold wrists and shoulders in the same position for long periods (Stone, 1983).

defines and determines the nature of occupational health problems.

The Nature of RSI

At the outset, RSI is a real injury involving moderate to severe pain from working at a job. Some workers are awakened at night by the pain. Some lose their ability to grip objects normally and cannot perform even ordinary household chores. People with RSI are rarely malingering; frequently they are conscientious workers who resent losing time from their jobs (e.g., Ryan, 1986). If these workers try ignoring the pain and continue to work, they experience further deterioration (e.g., Brown & Dwyer, 1983). Despite the intensity of pain it causes, RSI involves soft tissue and cannot be measured directly (Littlejohn, 1986). In a minority of cases, as in some outbreaks of carpal tunnel syndrome, RSI can be measured using indirect but objective physical indicators such as electromyography. But even in instances of clinically defined disease, the nature, causes, and appropriate treatments or preventions of RSI are controversial. For example, repetitive movements with the wrist in a flexed position are thought to cause or to exacerbate carpal tunnel syndrome (Armstrong, 1983). Yet in some organizations where considerable investments have been made in ergonomic equipment and task design to ensure that peoples' wrists are held properly, the incidence of carpal tunnel and other RSI syndromes has continued unabated or has even increased (e.g., National Occupational Health and Safety Commission [NOHSC], 1986, p. 44; see also Westgaard & Aaras, 1980). In discussing light assembly work in Australia, Welch (1972) stated that "the peak of tenosynovitis was reached in 1963-64; since then remedial steps have been taken in most factories and the incidence has decreased" (cited in NOHSC, 1986, p. 22). He was proven wrong, as the incidence greatly increased after his article was published. We shall return to the relationship between ergonomics and injury. Suffice it to reiterate at this point that even in the United States, where carpal tunnel, tenosynovitis, and related clinical diseases are considered rare but clinically well-defined, the mechanisms of injury are actually unclear. Causes of carpal tunnel in the medical literature range from fracture to arthritis to obesity to congenital defects to vitamin deficiency, as well as to repetitive movements (e.g., Armstrong & Chaffin, 1979a, 1979b; Armstrong, Foulke, Joseph, & Goldstein, 1982; Cseuz, Thomas, Lambert, Love, & Lipscomb, 1966; Folkers, 1986; Frymoyer & Bland, 1973; Kendall, 1960). A common medical therapy for carpal tunnel in the United States is surgical "release." The surgery relieves pain but inexplicably fails to improve grip in many cases (e.g., Masear, Hayes, & Hyde, 1986). Many medical doctors in Australia believe that surgery may make the problem worse (e.g., Browne, Nolan, & Faithfull, 1984).

RSI as it is known in Australia arises in two forms. The minority of cases—in some accounts only 5%—consist of that cluster of medical injuries or diseases whose presence can be determined physiologically, such as carpal tunnel disease, epicondylitis, and tenosynovitis. Each of

these is a clinical entity defined in the international medical literature. The name of the condition varies with the location of the tissues involved. For example, epicondylitis occurs at the elbow; in sports it is called "tennis elbow." Tenosynovitis occurs at the forearm or wrist, and it has been called "golfer's wrist." Carpal tunnel is thought to be a nerve block that occurs at the base of the palm of the hand between the thumb and little finger where the carpal ligament stretches between the two muscle groups. With excessive use, it is thought, the ligament tightens and depresses the median nerve into the carpal bones just underneath.

In the United States, these clinical problems occur in less than 1% of the population, but in certain jobs or activities, in some places, they have occurred in as much as 20% of people. Novice tennis players get tennis elbow from using their racquets incorrectly; violinists and windsurfers get carpal tunnel from overpracticing (e.g., Owen, 1985; Sword, 1986). Recently, some food processing plants have experienced what is for the United States very high rates of carpal tunnel; for example, in one meatpacking plant, 14.8% of the employees have carpal tunnel syndrome (Masear et al., 1986).

It is instructive to read a description of conditions at such plants.

Meatpackers work in extreme heat or refrigerated cold, often standing shoulder to shoulder, wielding honed knives and power saws. Grease and blood make the floors and the tools slippery. The roar of the machines is constant. Occasionally, an overpowering stench from open bladders and stomachs fills the air. The workers cut themselves. They cut each other. They wear out their insides doing repetitive-motion jobs. They are sliced and crushed by machines.

Tim Denherder and a partner share a wobbly hydraulic bench that travels up and down with them as they split 175 beef carcasses every hour. The beef chain moves 84% faster than it did in 1979. There are no breaks except when the chain stops. And it only stops for a 30-minute dinner break at noon, a 10-minute break in the morning, and a 10-minute break in the afternoon.

At 28, [Tim] already has the hands of a packing house worker. They call what he has carpal tunnel syndrome, and he has had two operations for it. Long before the doctors were calling it a syndrome, the packing house workers knew about the hands. On the chain, workers say it is not unusual to see people forcing their fingers open in the morning and then forcing them back to grip the handle of a knife or saw for the day.

Even after an operation, the weakness and pain often return. Already, Tim Denherder's grip is so weak he cannot pick up his children and carry them up to bed. At night, he feels as if something sharp is digging into his wrist. He cannot open his hands all the way, and though he is a strong man who has worked all his life, his handshake has the grip of a boy.

"I think, what's going to happen to me 20 years from now when I can't do anything with my hands?" he said. "I'll be a cripple." He has looked for other work but no one will hire him, he said, because his hands are weak (Glaberson, 1987, Section 3, pp. 1, 8).

The large majority of RSI cases involve much the same pain, tenderness, and weakness as described above

but have no objective indications from radiological, vascular, electrodiagnostic, pathological, or other physiological tests. This form of RSI resembles hysterical or "conversion" illnesses such as hysterical blindness or shell-shock (Lucire, 1981). Conversion illnesses have been documented in workplaces, but unlike RSI, they were observed to sweep through a single workplace and then quickly disappear. For example, in a dormitory of our own university a large number of students suddenly developed skin rashes and stomach cramps from what they believed to be a brown spider. The spider was never found, and the problem came and left within a few days. By contrast, RSI has emerged throughout Australia, in both factory and office environments. Most workers acquire RSI gradually, and many are afflicted for years. The breadth, incidence, and severity of RSI has surprised and perplexed managers and workers (NOHSC, 1986, p. 1). RSI has entered the workers' compensation arena to such an extent that in the March and June quarters of 1985 no federal public servant who applied for RSI compensation was refused (Spillane, 1986). In the hardest-hit Australian state, New South Wales, the number of RSI compensation cases increased 100% from 1979 to 1980 to 1,344 cases. By 1984 there were 2,865 cases (NOHSC, 1986). Suits have been entered, and settlements as high as \$350,000 have been reached. Australian employers who are part of private insurance programs have encountered huge increases in compensation premiums—more than 2 billion Australian dollars in 1984 alone (Williams, 1985).

Although Australia's incidence of RSI in both factories and offices is extremely high by international standards, many experts claim the data reflect considerable *underreporting* of both frequency and severity of the problem (e.g., Ferguson, 1984; Walker, 1979). For instance, a study of women who assemble electronics equipment showed that

when symptoms first appear most workers continue working because of financial reasons or because they fear getting sacked if they go off work sick. Eventually the swelling and pain becomes so extreme that they are simply incapable of working any more. (We have been told of instances where women were in such pain every day that they spent their break periods in tears.) The usual pattern is that they go off work on compensation and a large proportion are never able to work again . . . a large majority of people said they felt permanently crippled by their condition and have not been able to write a letter for 12 or 18 months, twisting a door knob causes pain, also peeling potatoes, etc. . . . In many cases the husband and children take over a large share of the wife's housework but when this goes on for months or years, strains in the family relationships appear. Particularly with the migrant women, they feel they are not fulfilling their role as a wife and mother (Walker, 1979, pp. 20–21).

The biggest recent increases in RSI, and also the most public and professional controversy, center on office work by female keyboard operators and government clerks. In studies of various Australian industries, organizations, and states, the percentage of women doing keyboard work (data entry, typing, secretarial work) with

diagnosed RSI ranges from about 10%, which is considered abnormally high in the United States, to more than 50% (e.g., Ryan, 1986; Ryan, Mullerworth, & Bampton, 1985; Spillane, 1986; Western Australia Public Service Board, 1985). In New South Wales, nearly half of all the new claims for workers' compensation by women in the first half of the 1980s were for RSI, and the incidence was increasing yearly. In Victoria, RSI accounted for 62.5% of all claims by women in 1985. Table 1 shows the results of a study of government workers in Western Australia, which indicates how RSI has entered the office in that state.

Computing in clerical jobs is highly correlated with RSI in Australia (see Table 1, for example). One explanation of the correlation is that computer workstations are not designed for human comfort and especially not for women's comfort. For example, the left pinky may be extended thousands of times a day for hitting control and shift keys (Baidya & Stevenson, 1982). People often ask why typewriters do not cause RSI. One answer is that typewriters were designed to be used by women; the inventor tested models on his own daughter. Typewriters elicit more wrist movement than do computer keyboards. As a result, less pressure is placed on the ulnar and median nerves. Typewriters require breaks to insert paper, change margins, adjust platens, and so on. Breaks reduce mus-

Table 1
Cases of RSI Reported in Western Australian Government Employment as of January 1985

Category	No. of operators	Reported cases	%
Secretary stenographers	397	70	17.6
Typists	1,163	137	11.7
Clerk typists	838	60	7.1
Word processing operators	340	99	19.1
Data processing operators	379	84	22.1
Telephonists	172	6	3.4
Accounting machinists	72	7	9.7
Computer programmers	749	9	1.2
Clerks	1,190	40	3.3
Clerical assistants	193	9	4.6
Telex operators	49	—	—
Journalists	12	—	—
Hansard/court reporters	32	7	21.8
Other keyboard operators	938	32	3.4
Other affected personnel		29	
Total	6,524	560*	8.58

Note. From *Report of the Repetitive Strain Injuries in the Western Australian Public Service Task Force* by Western Australia Public Service Board, October 1985. Perth: Author. Other affected personnel include draftspeople, Public Works, Main Roads Department; forestry officers, Forests; library assistants, Health Department; dental therapists, Health Department; assayers, Perth Mint; technical assistants, State Energy Commission; technical officers, Agriculture Protection Board; engineers, Main Roads Department; tradespeople, State Energy Commission; stamp duty assessors, State Taxation Department; and research officers, Metropolitan Transport Trust.

* Excludes "other affected personnel."

cular fatigue, which has been implicated in repetitive strain injury (e.g., Hagberg, Michaelson, & Ortelius, 1982).²

The secondary effects on work practices caused by computing might be another reason for computing to cause RSI. Computer power allows management and workers to increase productivity using means that also increase monotony, muscle strain, and fatigue. For example, with the introduction of computer data entry and word processing, files are accessed through the computer rather than kept in filing cabinets. This makes it possible to cut the number of work breaks and increase the pace of work, and managers can monitor these activities automatically using the computer. When the Australian Taxation Office introduced computers in the 1970s, the organization progressively increased productivity by increasing the rate of data entry; by 1981, data processing clerks were required to make 14,000 keystrokes per hour. Compensation claims by these clerks also increased each year. A health study in 1981 showed that 37% of the clerks had muscular strain injuries in neck, shoulder, elbow, wrist, or hand, and 25% were off work on compensation (e.g., Australian Council of Trade Unions-Victorian Trades Hall Council [ACTU-VTHC], 1982). Unions asked for a 10,000 keystroke/hour rate. Government officials not only refused, but proposed an individual log-in procedure that would allow for exact individual monitoring of productivity. This response prompted employee work rate refusals, employer stand-downs, and finally strikes. An arbitrator entered an 11,000 keystroke/hour limit. Some unions accepted this; some refused. As the dispute continued, the Queensland Taxation Branch was offering operators bonuses to key at a higher rate of 12,000, while the unions were educating their members about the hazards of working at computer terminals (Quinlan, 1984b, pp. 162-163).

The emergence of RSI in women office workers in Australia represents a unique experience. For the first time, a prolonged occupational health epidemic has struck women in offices. For the first time, serious labor-management disputes have involved women's office work; such disputes have heretofore been associated mainly with factory and outdoor work. For the first time, occupational safety and health officials face a national health problem whose true nature, cause, prevention, and cure are murky. After more than 100 reports and studies, even the rate and incidence of RSI in Australia is unknown (see NOHSC, 1986). In one comparison in the 1970s, the data given by the government from insurance statistics and the data from the state department of industrial relations from employer reports matched exactly in only 6% of cases (Morrissey, 1985, p. 139)! Although it seems clear that the average rate in Australia is exceedingly high compared with that in other countries, within Australia the variability is enormous. Despite this ambiguity and this variation, several variables consistently show a correlation with RSI. Let us summarize the research on these variables, and then look at whether they can explain the overall phenomenon.

Correlates of RSI

The first study of Australian workers with muscular problems was published by Ferguson (1971a).³ Ferguson examined the medical records of 77 women whose job was to assemble electronics equipment and who had lost time from work from upper body and limb injuries over the previous 12 months. He found that the majority suffered poorly defined but real physical symptoms involving the upper arm. He proposed a number of possible causes, since identified by other researchers as variables correlated with RSI. These variables fall into three categories: (a) worker characteristics, (b) equipment design and training (ergonomics), and (c) work practices.

The individual characteristic that best predicts RSI is the sex of the worker. In the 1980s, women have accounted for two thirds of the RSI compensation cases in Australia, and the proportion has increased each year. In research on workers and health records, the reported female:male ratio for RSI rose from 2:1 to more than 10:1. Unfortunately, nearly all the research consists of retrospective case studies, usually in one organization or industry. These studies look backward from health or compensation records or use questionnaires or interviews of workers who indicate they suffer from RSI. This research, at most, can suggest correlations and is not capable of identifying causes. Moreover, without proper comparison groups, even the correlations may be illusory. Take, for example, the following worker characteristics: small wrist size, pregnancy, oral contraceptives, menopause, and gynecological surgery, each of which has been found to be correlated with RSI. It has even been suggested these are causes of RSI and the reasons why women get RSI far more than do men (e.g., Sabour & Fadel, 1970). An equally plausible and more conservative hypothesis is that these individual factors have nothing to do with RSI. Pregnancy, menopause, oral contraceptives, and so on might be statistically correlated with RSI incidence only because these attributes are more characteristic of women than men. Women may acquire RSI more than men do for entirely different reasons.

In the main, the search for individual predictors of RSI independent of sex has been fruitless. Diseases such

² Another answer is that typewriters do cause RSI, as do pencils, ballpoints, and the traditional ink-dipped pen. In the first book on occupational diseases, published in 1713 in Latin, the physician, Ramazzini, (1713/1940), described how scribes' "incessant driving the pen over paper" caused intense fatigue and eventually, failure of grip. However, neither typing nor writing has been implicated in a national epidemic as computing has been in Australia.

³ The first such study in England was published two decades earlier (Thompson, Plewes, & Shaw, 1951), yet most English people have never heard of RSI. Recently, an English journalist, Auberon Waugh, published a parody of the Australian epidemic in the prestigious *Spectator* entitled "Introducing Kangaroo's Paw, a Wonderful New Disease From Australia" (Waugh, 1986). In the article he said RSI is resistance to video display terminals that "has now spread to everything. Obviously, it is the disease England has been waiting for. I prophesy a tremendous future for this wankers' disease in Britain, as soon as a few more people learn about it. It will go through the country like a dose of salts" (p. 8).

as arthritis and diabetes are found in RSI victims (e.g., Barnes & Currey, 1967). These diseases, as well as some RSI problems such as carpal tunnel, may have a genetic basis. They run in some families and can appear quite independently of repetitive jobs and activities (e.g., Armstrong, 1983). But the incidence of known physical predispositions is so low as to be an unimportant predictor of the distribution of RSI. To our knowledge, no prospective study of families with and without the alleged predispositional attributes of RSI has been undertaken. Are there mental predispositions? Studies of "accident proneness," that is, a tendency of certain types of workers to experience injury, have identified such workers (e.g., Najman, 1978). These classifications are suspect because statistical artifacts explain the distribution of injuries rather well—multiple injuries are about as frequent in the population of workers as would be expected by chance (e.g., Lee & Wrench, 1982; Sampson, 1971). The probability of being injured once is nonzero, and for those injured once, the probability of being injured again is nonzero, and so on. Hence bad luck alone will result in the appearance of accident-proneness in some people.⁴

One cluster of worker characteristics we label "job dissatisfaction" is reliably correlated with job injuries and sicknesses in many countries but is rarely mentioned in the Australian literature. The phenomenon of interest is that workers who are absent from work for long periods due to sickness or injury tend to report more insecurity and to consider their jobs more monotonous, stressful, and detrimental to health than workers who are not absent (e.g., Kvarnstrom, 1983a, 1983b). Some studies show that absenteeism from work injuries is positively related to strikes and labor action (see Quinlan, 1984a). The RSI literature in Australia states or implies that negative attitudes are an outcome, not a cause of RSI, and that sick and injured workers resent the situation that has caused them pain, loss of income, and in some cases, loss of esteem in their families and communities. Although this argument is convincing, it might also be true that dissatisfactions predispose workers to report RSI. An uncorroborated report reached one of the authors describing a study sponsored by American air traffic controllers to assess how perceptual vigilance and tracking tasks in their work led to job pressures that might account for their exceedingly high rates of hypertension. The researchers found that these tasks had no relation to controllers' hypertension; rather, unpleasant work organization and poor relations with supervisors were reliably associated with the disease. Hypertension is a psychophysiological condition thus named because the problem varies with both psychological and physical states. RSI might show a similar pattern. Unfortunately, no prospective research has been done to examine the relative impact of attitudes of workers or managers on RSI. Studies of workers' *ongoing experience* in jobs, and not just of injured workers' perceptions and memories of job conditions, would help us to discriminate between predisposing and post hoc attitudinal factors in RSI. These studies should always involve comparisons across jobs and organizations to identify

factors in the social context of work that may produce negative attitudes.⁵

Poor ergonomic design of equipment and tools is, in some studies, associated with RSI. Ergonomic factors have long been associated with occupational injury in industry in the United States, Japan, and Europe (Ostberg & Nilsson, 1985). In Australia, ill-designed equipment and inadequate operator training are thought to produce bad posture, fatigue, and awkward arm or body movements, and hence RSI (Mills & Sallans, 1984; South Australian Health Commission, 1984; but cf. Oxenburgh, 1984). Taking a cue from the Swedes and a new California standard for government offices, Australian unions such as the Australian Public Service Association and a number of private firms are establishing detailed workstation design principles. They would probably come as a shock to most U.S. managers. The standards include footrests for short operators; identical viewing distance for screen, source document, and keyboard; a 38° angle of viewing; a 90° screen angle; a 33 mm keyboard; and fully adjustable height and knee clearance of computer tables. Ergonomic standards have been difficult and costly to implement for Australians because Australia imports most of its computers, and Australians have no part in most design decisions. Furthermore, and more disheartening, during the 1980s when many organizations invested heavily in better ergonomics design, the rate of RSI increased. This replicates the experience of some of the Swedish experiments in "biotechnology and sociotechnology" at the Volvo and Saab automobile plants, that is, deterioration of the experienced working environment despite extensive investment in worker comfort. Table 2 provides an example of data from the Kalmar Volvo plant, a plant that has been cited worldwide for its advanced ergonomics and job designs.

A highly cited factor associated with RSI in Australia today is work practices. Many work practices are changing with automation to increase productivity. These include fewer staff, heavier workloads, more task specialization, faster pacing of work, fewer rest breaks, more overtime, more shift work and nonstandard hours, and more piece work and bonus systems (e.g., Ryan, Mullerworth, & Pimble, 1984). These work practices can entail very prolonged rapid or forceful repetitive motions leading to fatigue and overuse of muscles. Normally, people self-cor-

⁴ This is a slight oversimplification. The distribution of injured workers is not identical with the distribution of reported injuries.

⁵ We recognize that researchers have much more difficulty finding sponsorship for research on social contexts than on physical and individual variables. Social context variables are very difficult to study, as they can produce illness through interactions of physical and mental states. Furthermore, social contexts are perceived as difficult or impossible to change. In one U.S. meatpacking plant, for instance, increasing overtime hours and work pace on the cutting lines is thought to be responsible for an increasing incidence of carpal tunnel syndrome. However, the medical experts have put their efforts into ergonomics and designing wrist supports, not to changing work requirements; they claim adjusting jobs is not feasible due to union seniority rules and the need to make a profit (see Masear et al., 1986, p. 226).

Table 2

Percentage of Blue Collar Workers Satisfied With the Working Environment in the Swedish Volvo Kalmar Plant in 1976 and 1983

Feature of the working environment	Percentage of satisfied workers	
	1976 ^a (N = 69)	1983 ^b (N = 70)
Physical workload	83	67
Work postures	55	57
Noise	80	64
Lighting	86	79
Windows, outlook	71	74
Climate, air pollution	49	39
Chemical labeling, etc.	58	58
Personnel areas	71	63
Safety hazards	81	77
Company health services	96	67
Safety and health precautions	86	84
Workplace and environment	83	—
Working place	—	54

Note. Reprinted from "Emerging Technology and Stress" by O. Ostberg and C. Nilsson. In *Job Stress and Blue Collar Work* (p. 163) by C. L. Cooper and M. J. Smith (Eds.), 1985, New York: Wiley. Copyright 1985 by J. Wiley & Sons. Used by permission.

^a Interview investigation reported by Gyllenhammar (1977).

^b Questionnaire investigation reported by Agurén, Bredbacka, Hansson, Ithregren, and Karlson (1984).

rect overuse problems by resting or changing position when they feel physical discomfort; this explains why computer programmers, computer scientists, and journalists have a low incidence of RSI even when they use a computer keyboard 8, 10 or more hours in a day. However, in nonprofessional factory and office jobs, work requirements and incentives act as barriers to prevent people from taking these self-corrective measures. Although no research has yet demonstrated a causal effect of work practices on RSI, a study in Europe showed that workers in jobs entailing higher daily keystroke rates have more injuries (e.g., Laubli, 1982). Also, injuries among people who do repetitive work tend to decline during vacation months (Kivi, 1984).

One difficulty of interpreting the overuse hypothesis is that repetitive, unrelieved work co-occurs with otherwise unchallenging, dead-end, monotonous, low status, low paid work. Are people getting sick from doing the job or from having the job? Are they getting RSI from physical overload or from psychological underload? It has been argued that RSI occurs even when employees work too hard of their own volition, which supports the overuse hypothesis. In a study of the free break system in Japan, researchers found that most Japanese operators continued to work even when they were tired and that they developed more complaints than those in a fixed break system (Pulket & Kogi, 1984). The study seems to show how injury may result in jobs where workers determine their own pace, but this conclusion is unwarranted. It is not

obvious that Japanese operators on the "free" break system are actually free; implicit social pressures to perform can produce more conformity than explicit pressures. In summary, the data indicate that work conditions are associated with RSI, but the mechanisms by which physical and social factors operate to produce injury are unknown.

The most effective method to illuminate the effects of worker characteristics, ergonomic factors, and work conditions on RSI would be to set up some experiments. For example, in places planning to introduce new computer systems, subunits could be randomly assigned to acquire these systems at different times. Equipment could be compared. Work rules and incentives could be systematically varied. Rehabilitative treatments could be assigned randomly to victims across jobs. To our knowledge, not a single true experiment in office working conditions has been conducted in Australia. In their absence, we can see how different rehabilitation strategies have taken effect. For example, if drugs alleviate pain, that suggests RSI is a true medical condition resulting from overuse. In Australia, the methods of reducing RSI include psychotropic, steroid, and other drugs; surgery, exercise; hypnosis; rest; immobilization by splints, gloves, casts, and bands; physiotherapy; and work modification. What is noticeable about this list is its length, which suggests either that RSI can be alleviated by anything or that nothing works. That the latter is more true is suggested by a questionnaire study of workers with RSI. When asked which of a list of treatments helped them most, the most frequent response was "none at all" followed by "rest" (Taylor, Gow, & Corbett, 1982). Hence the research on treatments tells us very little about the etiology of RSI.

The Australian Experience

The studies described above do not explain the following questions: (a) why RSI is epidemic in Australia and not in other countries; (b) why women are struck by RSI much more frequently than men, and why the ratios vary from 2:1 to more than 10:1 from study to study; (c) why women in offices are getting RSI, in some places more than women in assembly line jobs (e.g., Stone, 1983); (d) why office computers that are used worldwide are creating reports of RSI only in Australia; (e) why reported RSI has increased in this decade; (f) why the epidemic rages in some workplaces but not in other seemingly comparable workplaces; and (g) why rehabilitation has such poor prognosis.

The uniqueness of the Australian RSI phenomenon raises interesting questions. For example, why is Australia affected? Australian experts assume that RSI is a medical/biomechanical problem that exists everywhere, but is simply mislabeled in other countries (NOHSC, 1985, 1986). This does not seem to be the case. For example, although carpal tunnel syndrome is known in the United States, it is rare and is infrequently mentioned in conjunction with office work or computers. Australians have pointed to large numbers of "musculoskeletal" work injuries in the United States, but the large majority of these are back injuries from twisting, lifting, and using force

(U.S. Department of Health and Human Services, 1984). Curiously, back injuries are rarely if ever mentioned in connection with RSI in Australia.⁶ We believe RSI can be described as an international problem if all muscle, skeletal, overuse, and technology-related problems (e.g., vision impairments) are lumped together into one giant category. Even with that, the Australian statistics are exceedingly high in terms of number of jobs affected, incidence within jobs, and severity. For example, an Australian study recently identified 74 RSI sufferers in one Australian university in 1984, and followed up in 1985 on 101 sufferers. Many were secretaries; 91% used a computer terminal or word processor in their work. By contrast, a recent study of 109 clerical employees using workstations at the University of Michigan in the United States turned up no such health problem; indeed, the secretaries who had the highest work load complained the least, and the authors concluded that workstations were probably not an occupational stressor (Sutton & Rafaeli, 1987).

Surveys we have taken in our own university have failed to uncover RSI-like health problems from computing. In 1985, Hartman (1987) interviewed a random sample of 25 secretaries. They were asked, "Is there anything about computing that you don't like?" Twenty secretaries said "no." Of the 5 who answered affirmatively, 1 mentioned noise from the printers, 2 mentioned sitting for long periods, and 2 said eye strain. Nobody mentioned muscular strain or pains. Recently, we put a notice on one of the computer bulletin boards; the board reaches more than 2,000 faculty, staff, and graduate students. The notice asked anyone who had suffered any injury or problem as a result of using a computer keyboard to send us computer mail. We received 13 answers, less than 1% of the population. The problems were described as follows: one person reported a small skin cancer, maybe from sitting in front of a CRT; one reported carpal tunnel from playing the viola; one reported back injury; this person read a book on RSI by an Australian journalist and said the problem should be taken more seriously by the U.S. medical profession; one mentioned "hacker's neck," which lasted three days and was attributed to working with a keyboard on his lap for 10 hours a day; two mentioned that family members have carpal tunnel but do not use computers; one reported a pinched sciatic nerve from falling down the steps and said it was very painful to sit at work; one mentioned eyestrain; one cited a finger joint problem from hitting the keyboard in frustration; one reported carpal tunnel from typing a grant and being under tension, but problem has disappeared; and three mentioned pain in the left pinky from using a computer keyboard; one of these respondents explained that his machine has 11 keys operated with the left pinky. Together, the data on the university workplaces in the United States suggest, first, that acquiring a physical problem while computing has a nonzero probability, and second, that the incidence and severity is minimal compared to that in universities in Australia.

Hence RSI seems to be a health problem whose oc-

currence varies tremendously with location. What might be the reason? There is no evidence that Australian women and office workers have special bodily or genetic predispositions to RSI not true of women and office workers in other countries. At this time we cannot rule out a physical cause attributable to Australia such as meat in the diet, presence of snakes and crocodiles, or reverse torque of the Australian continent. A physical cause might be discovered in the future, just as occurred with a few other mysterious health problems. Gout is such a health problem. It is caused by genetically linked high uric acid level in the blood and was originally misattributed to ambitious and hyperactive personality types—behavior that turns out also to respond to uric acid. The bewitched girls whose bizarre behavior set off the Salem witch trials were probably victims of ergot poisoning, a convulsive disease caused by eating rye contaminated with the ergot fungus (Caporeal, 1976). These and other examples suggest that physical causes can arise from unexpected quarters. The epidemiological data, however, suggest that a simple physical cause of RSI in Australia is highly unlikely.

On the basis of all of the evidence, we speculate that the spread of RSI in Australia is indicative of a larger social problem. That is, RSI itself and the mounting claims payments associated with RSI are symptoms of a more fundamental difficulty that provokes complaints of RSI. We believe that this fundamental difficulty is rooted in dissatisfaction with the workplace that is revealed when new technology is introduced, and that this dissatisfaction is expressed in the form of "techno-illnesses," such as RSI.⁷

RSI cannot be studied in isolation. The context in which the complaints occur is as important as the complaints themselves. In Australia, that context is traditional offices converting to computer technologies. This conversion has occurred suddenly, with much greater rapidity and magnitude than in other countries. Several things happen during this speedy transition. The most significant, we feel, is that the installation of new technology focuses attention on the way work is done. This process begins with disruptions caused by the arrival of computer systems. Workers must adapt to new technology that is complex and requires special training. They must learn new concepts and jargon. And they must adjust to higher expectations for output. In the process of adapting to this new world, workers reexamine the nature of their jobs. For example, even the most trivial task, such as typing a memo, must be rethought when done on the computer. Files must be opened, editors and formatters must be invoked, the text of the memo must be input, files must be saved, and finally, the file must be sent to a printer to produce the document. We believe that the result of this

⁶ The location of muscular-skeletal problems seems to move with the countries in which their victims reside. In Finland, for instance, only 4.3% of total "rheumatic" disorders from repetitive work involve the neck and back; the percentage is much higher in Sweden.

⁷ Spillane (1986), Littlejohn (1986), Quinlan (1984b), and Willis (1986) arrived at similar conclusions but did not speculate, as we do, why RSI has emerged in Australian offices exclusively.

reexamination is that all aspects of the job are made more salient. In Australia, these jobs are not pleasant. Pool typists are given little autonomy, they are closely monitored, their earnings and status are low, and their physical work environment is uninteresting. Many secretaries spend 80% to 100% of their time on one task (Levick, 1986). They are not consulted about the nature of this specialization or about how their module might be coordinated with those of others (Magarey, 1985). Furthermore, many of these fragmented, unchallenging jobs are offered only as part-time work (see, e.g., Prerost, 1982; Red Ferns, 1982). When job characteristics increase in saliency, these negative features become more visible to workers.

Introducing new technology also elicits rethinking among managers, who sometimes use the inevitable chaos as a cover to implement nontechnological changes in staffing, organization, and work procedures. This would tend to increase the amount of change employees experience, as well as the attributions of blame that are made to new technology.

A theoretical underlying psychological process can account for negative somatic effects when technological change is juxtaposed on a work setting. First, technological change focuses attention on negative aspects of work such as repetitive typing on a keyboard. Communications from co-workers, supervisors, and the outside world legitimate particular interpretations of the problem (Salancik & Pfeffer, 1978; see also Fordyce, 1979). Then, attention focused on the stressor interferes with habituation to it (Matthews, Scheier, Brunson, & Carducci, 1980). It is the slowed habituation brought on by heightened attention that causes unpredictable stressors such as low-flying aircraft to have more severe consequences than predictable stressors, and ambiguous therapies to result in more chronicity than clear ones (e.g., Fordyce, Brockway, Bergman, & Spengler, 1986). Physical unpredictability and ambiguous treatments draw attention to suffering. Technological change can do so also.

An expected outcome of this process might be that workers grow dissatisfied, but gradually accommodate themselves to their changed jobs. This assumes, however, that the workers do not have an alternative. In Australia workers do have an alternative. They can make RSI claims. This is only possible, though, because in Australia RSI has been socially legitimated. We maintain that this social legitimization has occurred through four mechanisms. First, there is historical precedent for RSI-like conditions on the job in Australia. Second, RSI has become a cause célèbre of unions and feminist groups. Third, RSI has received official validation by the Australian medical establishment. Fourth, the Australian press has covered the RSI story in intense detail.

References to RSI-like ailments in Australia can be found as far back as the 19th century. In her famous book, *My Brilliant Career*, the teenager Miles Franklin wrote,

Among the dairying fraternity little toddlers, ere they are big enough to hold a bucket, learn to milk. Thus their hands become

inured to the motion, and it does not affect them. With us it was different. Being almost full grown when we started to milk, and then plunging heavily into the exercise, it had a painful effect upon us. Our hands and arms, as far as the elbows, swelled, so that our sleep at night was often disturbed by pain (Franklin, 1901/1986, p. 14).

In more modern times, RSI has affected telegraph operators. The constant keying of the signaling apparatus produced a condition that the operators called "glass arm" (Dargan, 1985). In railway journals, telegraph publications, and medical journals from the 19th century through the early 20th century, descriptions of telegraphist's cramp were quite common (e.g., Ferguson, 1971b; Thompson & Sinclair, 1912). Its symptoms resemble those associated with carpal tunnel syndrome: tingling in the fingers accompanied by weakness in the hand. Apparently, telegraph workers suffering from "glass arm" were eligible for settlements to cover treatment. The early incidence of RSI in Australia means that the condition was documented in the medical literature and the diagnostic characteristics were considered well known. Thus, when similar symptoms emerged in another generation of workers, in a completely different line of work, an explanation was available—complete with prescribed treatments and estimates of recovery time.

The key question is, however, why, suddenly in the 1980s, did RSI develop as an epidemic? Willis (1986) suggested, and we agree, that an important mechanism was the adoption of RSI as a cause by unions and feminist groups in Australia. The unions' behavior arises as a natural result of a strong trade union tradition of resistance in Australia. Further, the workers' health movement has been an important aspect of this resistance. Occupational health and safety have become labor relations issues in part because unemployment (previously low) reduced the ability of workers to leave unpleasant jobs. Also, the massive entry of Anglo-Saxon women into white-collar clerical positions using keyboard technologies meant that injuries could not be dismissed with racist stereotypes as easily as they were when similar injuries were incurred by migrant workers in industrial jobs. Concurrently, feminist groups took up the cause of RSI as a symbol and natural consequence of the women's movement's outcry against deskilling and partial-work in the so-called secondary labor market (Bevege, James, & Shute, 1982). Hence, RSI can be understood as a labor relations and political issue, a form of economic and political resistance to conditions of work or society, whose legal and medical disposition could lead to the expenditure of millions or even billions of dollars by business and government.

Not surprisingly, Australian medical experts have been called to testify on RSI. On the whole, these experts have come to agree, and have been disposed to make definitive statements about RSI (e.g., Browne, Nolan, & Faithfull, 1984; Stone, 1983). These pronouncements come despite the fact that RSI covers a range of conditions from carpal tunnel syndrome to tenosynovitis to ill-defined pain, all of which have overlapping symptoms but dramatically different implications in terms of worker

impairment. Nonetheless, Australian doctors remain quite confident that they know RSI when they see it. This official medical position has led business and the government to take the RSI problem seriously. It is unlikely that the compensation system would include a category for RSI in the absence of some official recognition of the condition by physicians.

Historical precedent, political meaning, and official recognition would be irrelevant without some means for the public to find out about RSI. Thus, in Australia, the press has played a large role in popularizing RSI. Periodically, the media becomes absorbed with a particular story, and the story assumes a life of its own. Health problems are particularly likely candidates for this treatment. In the United States coverage of herpes, drug use, and AIDS can all be described by this pattern. In Australia, RSI has been a lead story off and on for the last five years. Sample headlines include, "The RSI Epidemic: Technology Spawns its Own Disease" (McIntosh, 1986); "Change of Diet Could Be Key to Relief of RSI Pain" (Smith, 1986); "Woman Claims Damage for RSI" (1986); "RSI—Control the Curse: Curb the Costs" (Galbraith, 1985); "RSI: Scientists Seek Solutions to Centuries-Old Health Problem" (1986); "Hi-tech Epidemic: Victims of a Bright New Technology That Maims" (O'Mara, 1984). This coverage, although sometimes at the level of grocery store tabloids, has served a very important function. It has taken the official pronouncements of the doctors and of the government on RSI and communicated it to a mass audience. In Australia RSI is a household concept. Everyone, particularly those in the vulnerable worker groups, is very aware of the alleged causes of RSI, its symptoms, and the fact that the government and businesses believe that RSI is a real disease.

Armed with this knowledge, Australian office workers have a legitimate ticket out of the pink ghetto. Workers in other countries, of course, have recourse to workers' compensation or litigation when they are injured on the job. As consciousness about health and well-being has increased worldwide, pressures to improve these systems, as well as to set work environment standards, have increased too (Ostberg & Nilsson, 1985). In 1972, New Zealand introduced a no-fault insurance system that covers work injuries (Palmer, 1979). The same year, Finland passed an accident insurance act making it possible to compensate for pain in muscles and tendons contracted at work (Kivi, 1984). In 1977, Sweden passed a law requiring employers to establish working conditions adapted to the physical and psychical makeup of the worker. Recently in the United States, states have increased compensation award levels and expanded the types of injuries covered (Tinsley, 1986). Increased levels of compensation have led to increased injury claims and to stronger expectations that injury on the job deserves economic remediation (e.g., Kivi, 1984; Klar, 1983). Despite these changes, workers still have difficulty making claims for many injuries, such as damage they acquire gradually; in many U.S. states the limit is 2 years. Usually they must prove damage through clinical tests. And, most impor-

tant, the medical doctors who certify work injuries must believe the work environment is dangerous. What marks Australia in this regard are three distinguishing factors: (a) RSI is considered an occupational injury even though the victim has worked on the job in a "normal" office environment months or years without developing it; (b) RSI is compensable with or without physical indications; and (c) certifying physicians believe office environments are dangerous.

We do not intend to suggest that RSI is a scam to promote the practice of medicine or that Australian workers use RSI claims to defraud their employers. We believe that they legitimately have symptoms of RSI. We speculate that if the work environment were better and if jobs were more satisfying, RSI complaints would not be as important. The epidemic in Australia ostensibly involves RSI, but we hypothesize that it is really related to bad work conditions and an unfulfilling work life. The ambiguous nature of RSI makes it the perfect candidate for many workers as they seek an approved exit from the computing pool while preserving benefits and some salary. In addition, the social status of women in Australia may be improving more slowly relative to technological change than in other technology-advanced countries. Managers who are technology optimists but hold traditional stereotypes of women may be contributing to a double bind of secretaries whereby the only way they can gain sympathy, if not respect, is to get injured.

If, as we suspect, it is really the quality of work life that underlies the RSI dilemma, this implies that the present emphasis in RSI research is misdirected. That is, the nearly exclusive focus on biomechanical factors and individual-level variables will not illuminate the real problem, which might instead be embedded in the social structure of the workplace and the organization of work life in Australia. Attention should turn toward understanding what it is about the work that these RSI victims perform that causes them to escape the workplace with RSI. Several possibilities seem relevant. First, the work is unrewarding. There are few opportunities for advancement. Personal initiative is not encouraged. One of us visited a university in which clerks doing word processing were not permitted to use a spelling checker program and were reprimanded for altering the text, even to correct a spelling error. This approach to the organization of office tasks needs to be reformed. When workers acquire computing skills, they can become much more than mere typists. This increased sophistication should be encouraged and recognized by expanding job definitions. Pool word processors should have more access to learning computing skills and to promotion opportunities as they learn more about computing, for example, advancement to accounting departments if they become familiar with spreadsheets. Second, the introduction of new technology needs to be managed better. Too often computers in offices are approached as replacements for typewriters when they are actually more complex. This complexity needs to be handled through appropriate training and orientation. Firms frequently adopt a "sink-or-swim" approach to

installing the technology. Instead, clerical workers should be teaching each other, and those who have special teaching abilities should be paid more. Finally, some aspects of office word processing cannot be improved. Typing other people's papers is not intrinsically interesting. Also, typing other people's papers is not as necessary in a computer environment. Therefore, businesses and other employers need to concentrate on improving those aspects of the work environment that can be easily manipulated, for example, providing a pleasant physical space to work in, including "social enclosures" that facilitate socializing, and enlarging jobs to encompass both administration and typing.

The obvious question is, Aren't these factors present in other places too? That is, certainly Australia does not have a monopoly on data entry clerks and pool word processing operators who are unhappy or bored with their work. The answer to this question is complex. Yes, life for low-level clerical and secretarial employees is hard everywhere. But this hardship, and particularly the reaction of secretarial employees outside Australia to new technology, is not expressed in the form of RSI complaints. However, there are analogous health issues. Each nation has its own set of new-technology health problems. In the United States, a major concern is with radiation from visual display terminals, or VDTs (e.g., Horton, 1984). This is a special preoccupation of the press and is also a concern of Congress, the Occupational Safety and Health Administration (OSHA), and other branches of the federal government. As with RSI, it is not hard to imagine that VDT ailments could reach epidemic proportions as computer technology proliferates. In Europe, the chief concern is with ergonomics, the physical arrangement of keyboards and screens to reduce eye and muscle strain. Entire institutes have been created by European governments to develop standards for construction of computer workstations (e.g., Ostberg, Moller, & Ahlstrom, 1986). In Japan, a curriculum in "robot medicine" has been established to counter stress and health problems caused by automation (Noro, 1984). Still another work-related problem is painter's syndrome, a form of brain damage diagnosed in the Scandinavian countries and acknowledged by the workers' compensation systems of these countries to occur in all painters exposed to paint solvents for seven years or more. In the United States, where this new syndrome is beginning to spread and to affect litigation, clinical neurologists do not agree on a physical basis. Some argue that variability across subtests of the Wechsler Adult Intelligence Scale-Revised (WAIS-R), across psychomotor and attention tests, or across emotional reactivity measures is evidence of neurotoxic damage. Some argue that the scores of appropriate control groups do not differ from the scores of painters and that psychologists have given a false syndrome legal respectability.⁸ (See Cherry, Hutchins, Pace, & Waldron, 1985;

Gregersen, Angelso, Nielsen, Norgaard, & Uldal, 1984; Gregersen, Klausen, & Elsnab, 1987; White & Feldman, 1987.)

These examples illustrate, we think, that it is not simply RSI that is significant, but the existence of socially legitimated work-related health problems. Once a socially valid health problem is created, it becomes an avenue and occasion for workers to express and reveal pain—and in some cases negative feelings about their jobs—without fear of reprisal. That is, an RSI problem in Australia or an eye strain problem in Sweden is likely to be taken seriously by superiors. To address these problems requires addressing both the underlying causes and the mechanisms through which injuries are expressed. We believe that this article describes some of the causes in a speculative fashion and suggests the direction research should take. We do not claim that RSI and other new-technology health issues are purely social in nature. Indeed, the evidence we have reviewed is not inconsistent with the view—strongly held by many laypeople and professionals—that socially conditioned illness always has a physiological basis and, ultimately, a physiological cure. But we feel that examining these problems from a social perspective provides valuable insight that is lost when these problems are regarded solely as individual medical/biomechanical problems.

Our analysis does not resolve the problem of how to categorize RSI as a health problem. RSI stands at the intersection of three traditional categories of illness: physical overuse injury, psychophysiological syndrome, and hysterical or conversion illness. Overuse injuries such as writer's cramp and tennis elbow can be measured physiologically, and they vary with physical changes such as rest and drug therapy. Psychophysiological syndromes such as asthma and hypertension can be measured physiologically, and they vary with physical changes and with social changes such as psychological treatment and leaving work. Conversion illnesses such as hysterical paralysis and shellshock cannot be measured physiologically, and they vary with social changes. RSI, falling somewhere in these categories, is a classic demonstration of some anomalies and inadequacies of the existing paradigm of clinical knowledge. It seems clear that the professional and public definition of an illness/injury such as RSI does not occur in a vacuum and that it is important to try to understand its social, organizational, economic, and political context. Research using a social perspective would improve our ability to discriminate among RSI problems and would lead to better understanding of schemes for classifying occupational illness.

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⁸ The authors wish to thank an anonymous reviewer for this information on painter's syndrome and for pointing us to the literature on this subject.

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