

QAS 515.41
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RELATIONSHIPS BETWEEN STRESS AND HUMAN FACTORS ENGINEERING
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INTRODUCTION

Stress affects individual workers. Working time is lost, less work is done, therefore costs increase and overall performance suffers. In turn, workload on colleagues increases and may cause stress for them too. Stress at work is probably an “iceberg” where sickness absence only reflects the tip of the iceberg. There is a fair amount of under-performance at work because of people suffering from stress -sickness presenteeism- (Managing Stress at Work Guide; & Psychosocial Risk Factors in Work Related Stress).

The laboratory to which these concepts are applied is an Argentinean in-patient and outpatient laboratory for a non-profit organization. It employs around 30 people, and was originally designed to hold no more than 20 people, and a certain amount of equipment and samples. With time, more equipment was squeezed into the laboratory and the amount of samples more than doubled. The analysis that follows is intended to understand how the given conditions influence the laboratory employees’ performance.

WORK-RELATED STRESS

1. Types of stress

The hazard-stress-health relationship is created by *psychosocial hazards* and *physical work hazards*. The psychological effects of physical hazards reflect not only their direct action on the brain and their unpleasantness but also the workers’ awareness, suspicion or fear of the exposure to harm, which can give rise to the experience of stress (Research on Work-related Stress).

2. Signs and Symptoms

Some people show an acute reaction to stress. In others, the symptoms may appear over time, and may be mistaken for other health problems. An immediate acute reaction can include panicking, with anxiety, racing pulse, flushing, sweating, and dry mouth or trembling. Severe sustained stress can cause headaches, dizziness, blurred vision, aching neck and shoulders, or skin rashes (Managing Stress at Work Guide). See Table 1. Poor control of the risks causing work-related stress could lead to ill health and reduced performance and productivity (Understanding Ergonomics at Work). Increasing evidence links coronary heart disease with work-related stress. Shift work, which tends to involve heavier work, more stress, less control, and less educated workers than regular day work, also increases risk (Selected Occupational Risks).

3. Pressure vs. Stress

Pressure is not necessarily the same as stress. The right amount of pressure stimulates people to succeed, and success gives satisfaction. Personal performance

may improve with pressure, up to a certain point. Pressure that is too great, goes on for long, or comes from too many directions at once, leads to a fall in performance, as the person is no longer able to cope (Managing Stress at Work Guide).

4. Stress Factors

➤ *Psychological*

Work-related stress arises when work demands are too high or too low; the employee has little say in how they organize their work; poor support from management and/or colleagues; and there are conflicting demands, e.g. high productivity and quality (Understanding Ergonomics at Work). Stress factors at work make people feel unhappy about the type of work they, the people they work with, pay and conditions, lack of support or communication within the organization, an ill-defined role or conflicting priorities, the system of control rules and rewards, failing to do something well enough, and career prospects, like frustration, insecurity, limited promotion, over-promotion, lack of recognition, or insufficient training (Managing Stress at Work Guide).

➤ *Physical*

A wide variety of physical hazards have been extensively studied for their effects on the psychological experience of stress and on health. Most can be measured objectively, and with some degree of reliability and validity, and are therefore relatively easily monitored in the workplace. In some cases, standards exist which can be used in the regulation of exposure to these potential sources of harm: noise, vibration, heat, dim lighting, high acceleration, etc. The psychological effects of organic solvents or similar agents, carcinogens and toxic materials, appear dependent on the information available to and the awareness of workers. Poor physical working conditions can affect both workers' experience of stress and their psychological and physical health (Research on Work-related Stress; & Wickens, 2000).

HFE APPLICATION

Knowing how human performance degrades can help to support the design of more stress-tolerant interfaces, or to develop stress-reducing training techniques. Where possible, hazards should be removed from the environment (Wickens, 2000). Incorporating good management practices are essential to increase managers and supervisors' awareness and understanding, to avoid and minimize stress, and to help people cope (Managing Stress at Work Guide).

Stress associated with exposure to the physical hazards of work

➤ **Climate**

Temperature and humidity at the extremes of physical work conditions are associated with the experience of stress and with effects on health; workers are often able to adapt to mid-range conditions without effort or attention (Research on Work-related Stress). The ideal laboratory temperature should be between 21-27°C in summer and 18-24°C in winter. There are no special requirements for equipments. Humidity is regularly the same as outside. It would be interesting to be able to maintain humidity around 70% where everybody feels comfortable. Humidity does affect certain equipment, so the upper limit should be no more than 80% relative humidity. Air movement should be avoided since it can affect some of the equipment. The windows

cannot be opened and each specific laboratory is like a little box where personnel and equipment work, so this is not an issue (Kroemer, 2001).

➤ **Fatigue**

It is the weariness resulting from bodily or mental exertion, reducing performance. Fatigue should be avoided by allowing short bursts of dynamic work, and avoiding long periods of static effort; keeping energetic work and muscle demand low; and encouraging many short rest pauses (Kroemer, 2001). It is important to provide “rest zones” for employees. There is a little room where personnel can relax for up to 30 minutes, it is possible to have breakfast or lunch in it. The work shifts in the laboratory during the day are six hours at a time, so those 30 minutes can really help unwind the employees. The problem is during the night shift, where they last up to 12 hours. It is necessary to provide resting zones with comfortable furniture to allow employees to nap during low work zones (this is usual in 24 hours laboratories in Argentina). Then the sleep loss and fatigue are diminished and the performance improves.

➤ **Lighting**

Dim lighting is a cause of stress because visual acuity is diminished and it can cause the task to take longer or it can even be harmful. At the same time, more lighting is needed with age to enhance the visual conditions. Proper vision requires sufficient quantity and quality of illumination (Kroemer, 2001). The laboratory should be redesigned to allow natural lighting. Only half of the laboratory receives natural lighting. There are some areas that need little light: the microscope zone, or some equipment and reactions that are sensible to light. The rearrangement of the laboratory could lead to improve lighting in those areas that need it the most. The range of Illuminance should be around 200-500 lx for those general areas, and specific areas where manual testing is needed should have around 5000-10000 lx directly pointed to the task.

➤ **Noise**

It can act as a physical and a psychological stimulus. High levels of noise directly damage the middle and inner ears with consequent impairment of hearing. Less severe noise may interfere with speech perception and communication and, particularly if it is prolonged, may give rise to the experience of stress, and to anxiety, irritability and tension, increase fatigue and impair performance efficiency (Research on Work-related Stress). There is some equipment that is really noisy (centrifuges). These equipments should be isolated in a special area prepared to absorb noise, avoiding the harm to employees that work in the same area. The room should contain sound-absorbing surfaces, and if possible be distant from the employees (Kroemer, 2001).

➤ **Vibration**

It reduces the quality of visual input for fine detail and the precision of motor control (Wickens, 2000). This is not a current issue at the laboratory, since most of the equipment emits little or no noticeable vibration. Further analysis could be made to test the amount of vibration in each laboratory area.

➤ **Workstation Design**

Good ergonomic design of workstations is essential to suit the task to the worker (Managing Stress at Work Guide). The redesign of the laboratory should include larger areas to accommodate more employees. There should be chairs in the all of the areas, but there is no space to hold them, forcing the employee to be standing most of the working time. The issue of space can be solved by rearranging the equipment,

disposing of those apparatus no longer in use, and by redesigning the distribution of the laboratory. Currently the hallways are wide, but the different “boxed” areas are small.

Stress associated with exposure to psychosocial hazards

➤ **Job rotation**

It will increase variety and interest, provide new challenges, and help to alleviate monotony (Managing Stress at Work Guide). Job rotation can increase job enrichment by allowing greater scope for personal achievement, recognition, and a more challenging or responsible work. In the laboratory this usually happens when there is a sick absentee. Also the night shift covers most of the areas in the lab, because personnel amount diminishes to three or four employees. This is fairly covered with the current schedule.

➤ **Mental Workload**

Job demands depend on the type, quantity, and schedule of tasks; the task environment; and conditions of the task. Any condition in which more is demanded from the operator than can be given, will cause that performance of the task to be less than optimal and the operator to suffer, physically or psychologically (Kroemer, 2001). Persons' capabilities and attitude must be matched with those demands. The laboratory technicians during the day shifts and the personnel working the night shifts are the most affected by overloading. Measuring their workload physiologically, through questionnaires, and through the understanding that people are different, can help management to understand the impact on employees' performance and then agree to hire more personnel to fairly distribute the tasks.

➤ **Sleep Loss**

It can have an external influence on sustained visual tasks, by increasing the frequency of eye closures. Sleep loss may simply curtail the amount of information that can be perceived in a way that will quite naturally degrade performance (Wickens, 2000). The schedule at the laboratory allows only three night shifts per week per employee, with one or two days in between. There are permanent day shifts and permanent night shifts. There should be a rearrangement of the time where the night shift starts and ends, but the shifts are up to 12 hours long by Argentinean law, so it is difficult to change the schedules. Night shifts pay more than one third more than regular shifts. It is a very difficult issue that goes a little beyond of ergonomics.

➤ **Training**

Highly skilled operators are generally more immune to the negative effects of stress than novices. Skill leads to automaticity of tasks and to replacement of knowledge-based behavior by rule and skill-based behavior (Wickens, 2000). Training is part of the hiring process, making it less an issue for the laboratory.

CONCLUSION

The laboratory needs a thorough redesign: the job redesign, which should incorporate clear objectives, flexibility and variety, well-managed schedules, and adequate control of hazards; plus the laboratory structure redesign to allow better climate, lighting, and to enhance the overall working experience.

Table 1. Source: Managing Stress at Work Guide.

Physical signs	Intellectual signs	Behavioral signs	Emotional signs
Headaches	Inability to concentrate, easily distracted	Unsociability	Irritability or anger
Tension	Worrying	Restlessness	Tension
Indigestion	Mistakes	Lying to cover up mistakes	Moodiness
Breathlessness	Muddled thinking	Reckless driving	Alienation
Rashes or skin irritation	Persistent negative thinking	Increased drinking or smoking	Job dissatisfaction
Frequent colds, flu, or other minor infections	Difficulty making decisions	Loss of appetite or overeating	Anxiety or insecurity, feeling nervous, apprehensive
Crying	Memory lapses or errors	Disturbed sleep or insomnia	Sensitivity to criticism
Tiredness, cannot relax	Tunnel vision	Taking more work home	More suspicious
Palpitations	Bad dreams or nightmares	Too busy to relax	More gloomy, depressed
Nausea (feeling sick)	Less intuitive	Not looking after oneself	More fussy
Susceptibility to allergies	Less sensitive	Antisocial behavior	Drained, no enthusiasm
Excessive sweating	Impaired judgment	Unable to unwind	Cynical, inappropriate humor
Clenched fists or jaw	Short-term rather than long-term thinking	Low productivity	Feeling of pointlessness
Fainting	Hasty decisions	Accident-prone	Loss of confidence
Constipation or diarrhea		Impaired speech (stammering)	Less satisfaction in life
Rapid weight gain or loss		Voice tremor	No motivation
Recurrence of previous illness		Withdrawing from supportive relationships	Reduced self-esteem
		Reduced sex drive	

Table 2. Source: Managing Stress at Work Guide.

Management and style of organization	<ul style="list-style-type: none"> ➤ ➤ ➤ ➤
Role in the organization	<ul style="list-style-type: none"> ➤ ➤ ➤ ➤
Career	<ul style="list-style-type: none"> ➤ ➤ ➤ ➤ ➤ ➤ ➤ ➤
Decision making or control	<ul style="list-style-type: none"> ➤ ➤
Relationships at work	<ul style="list-style-type: none"> ➤ ➤ ➤ ➤
Job and workplace design	<ul style="list-style-type: none"> ➤ ➤ ➤ ➤ ➤ ➤ <p style="margin-left: 40px;">rather than the root of problem</p>
Workload or pace of work	<ul style="list-style-type: none"> ➤ ➤ ➤
Work schedule	<ul style="list-style-type: none"> ➤ ➤ ➤ ➤ ➤ ➤

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