

ASIA-PACIFIC INSTITUTE OF INFORMATION TECHNOLOGY

Human Computer Interaction
(Research Paper)

HCI design and RSI

By:

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1. Introduction

Nowadays, computer has become a common tool that is being used by almost every individual. This is due to the fact that computer offer a lot of different services and facilities to help the users to perform and complete the tasks more efficient and effective. Therefore more and more people are working with computer for long hours. There is no doubt that computer has help users a lot but it also brings problems to the users. One of the problems is the Repetitive Strain Injury (RSI as short).

The term "repetitive strain injury (RSI)" is a general, umbrella term covering a host of injuries that all have a similar cause: excessive wear and tear on the soft tissues of the body (tendons, nerves, circulatory system, etc.)(John S. Rhodes & Scott Wright, 1999).The general cause of RSI can be categorized as the repetition of a single movement where the soft tissues are being injured. And now the RSI is attacking the largest work group, they are the computer users. Computer users are prone to RSI because they are performing the same operation from day to day for long hours that are operating with computer with mouse and keyboard. The excessive and improper use of keyboard and mouse for long hours can cause the soft tissue to be injured. Thus cause the users to be attacked and suffered by RSI.

But risk of attacking by RSI can be reducing dramatically by implementing the good HCI concept to the system or application that the users are working with. That is the purpose of this research paper to investigate, discuss and explain the HCI design that can be implementing to reduce the risk of attacking by RSI.

During the development of this research paper, I have faced some difficulties and problems. There are getting the resources and facts for this paper, summarize and analyze finding, getting a main point out of a long story and etc. But I also would like to thank to my lecturer Miss Palvin as she have given me some of the ideas and guide me to complete this research paper.

And now let me introduce to you the structure of this research paper. This research paper is built up by 7 sections there are introduction, overview, input design, output design, ergonomic, critical appraisal, conclusion and reference. Section 1 Introduction briefly introduces RSI and the structure of this research paper to all the audience. In Section 2 Overview explain about the overview of RSI include cause and symptom of RSI. Section 3 Input Design discuss on the input design issue with relation to RSI. While Section 4 Output Design discuss and explain the output design with relation to RSI. Then Section 5 Ergonomic talks about the study of ergonomic to prevent and reduce the risk of RSI. Section 6 Critical Appraisal describes the critical thinking I have learned from this research paper. And Section 7 Conclusion concludes and summarizes all the topics discussed in the previous sections. Finally Section 8 Reference list all the reference used in this paper.

2. Overview

2.1 Cause of RSI

Before continue with my research paper, I would like to briefly introduce and explain to the audience the cause of RSI. As mentioned above, the cause of RSI can be simplify as the repetition of the same motion for a long times. But there are also others cause, there are postures that place joints towards their extreme end of movement, applying excessive muscular exertion/force, pressing the body against hard objects, Vibration from vehicles or tools, Cold working temperatures and etc (John S. Rhodes & Scott Wright, 1999).

As to let the audience understand better the impact of HCI design to the risk of RSI, the audience must have some basic understanding on the factors that contribute to the risk of attacking by RSI. The factors that will cause RSI are excessive use of keyboard and mouse for long hours (2-4 hours), lack of rest, awkward postures, static posture for long hours, typing in a high speed, lack of exercise and etc (Emil Pascarelli & Deborah Quilter, 1994).

2.2 RSI symptom

The symptom of RSI is important to be introduce and explain to the audience because this help the audience to identify are them attacking by RSI. The symptom of RSI can be categorized to prior to RSI, initial stage, acute stage and chronic stage.

The symptoms prior to RSI are arm and hand has the strange feeling. And during the initial stage, the symptoms are feeling painful when typing. While at the acute stage, symptoms would be strength less, slow in respond, painful, daily activity is affected and etc. At the chronic stage, the victim will feel strength less, painful in sequence, any activity also causes pain, unable to work and etc (Emil Pascarelli & Deborah Quilter, 1994).

3. Input Design

3.1 Input Device

3.1.1 Keyboard

Keyboard is the primary input device that is attached to almost every single computer. And majority of the users are using keyboard as a primary input device to work with the computer. But unfortunately, the inappropriate use of keyboard is the main cause of RSI.

The QWERTY keyboard is the most common keyboard that is used by majority of the users. This keyboard does not implement a good design that let the users to type comfortable and easily. One of the examples of bad design would be the inappropriate placement of frequently use key shift like “a”, shift key and etc where the users need to hit the key using the weakest finger, small finger which subsequently damage the soft tissue of the finger (Emil Pascarelli & Deborah Quilter, 1994).

Therefore if keyboard is the compulsory or must be used for the input data then the appropriate design guide should be followed. First of all, the system should enable the use of

hotkeys or shortcut keys because it helps to reduce the number of time to hit the keys (Emil Pascarelli & Deborah Quilter, 1994). Other than that, the system may be can have the feature that prompt the message to users to remind them for breaks, take a long breathe and etc after certain amount of time. This will subsequently help the users to avoid and reduce from static or awkward posture for a long time. Beside that, the system may be able to make use of the drop down list or other GUI components to reduce the keys that need to be typed by the users.

3.1.2 Mouse

Another common input device that is frequently use is mouse. Mouse has been used as a convenience pointing device to navigate through the various types of GUI components. The use of mouse actually would not cause the RSI but the inappropriate way of using mouse will cause RSI. One of the common examples is the users like to move the mouse using only palm and not the whole hand move together with the arm (Emil Pascarelli & Deborah Quilter, 1994). Using the palm to move the mouse for long hours will cause the finger tissue being injured or damaged. The design of mouse also encourages the repetitive movement of a single finger that is clicking the left button. This will further increase more damage to the finger.

Thus avoid the design that need to use the mouse excessively. The ideal way would be require the users to using keyboard and mouse interchange. With this solution, one of the hands can get a short rest when another hand is using mouse. Alternatively, there are also other pointing devices that are available to be used which will be discussed later. So consider other pointing devices to substitute the use of mouse if the device is suitable for the system.

3.1.3 Track Ball

One of the alternative pointing devices would be the track ball. Similar to a mouse, a track ball consists of a small box, sometimes an integral part of the keyboard, with a central rolling ball (David J. Bertuca, 2001). Track ball is typically a better pointing device as compared to mouse. This is due to the fact that less force is used to move the ball, and practically no effort is used to hold the device. Fine movements are easier with a track ball than with a mouse (David J. Bertuca, 2001). Due to the fact of the users no need to hold a device using finger. Thus it will not cause the users to injure their weak finger tissue.

One of the problems of implementing trackball in a system would be the user resistance to change because it requires very different finger movements compared to a mouse (David J. Bertuca, 2001). But track ball also cannot totally eliminate the risk of RSI because it also required the users to use the same finger to click.

3.1.4 Touch Pad

Touch pad is typically a flat pad that let the users to move their finger on the pad to move the cursor. The working of touch pad is similar to the track ball. Therefore a touch pad also can help to reduce the risk of RSI. But touch pad is better and more convenience because the users have the larger surface to move the finger where the track ball only limits the users to move around the ball.

3.1.5 Graphic Tablets

Graphics tablets are the most natural, but least used input devices. Most people perceive that such devices are useful only for drawing and graphics work. A graphics tablet consists of a flat surface that corresponds to the computer screen. Input to control cursor movements is made by using a stylus, which resembles a pen (David J. Bertuca, 2001). In short, the graphic tablet is just like a pen and a pad where the pen is the pointing device and the pad simulate the screen.

The graphic tablet can help to reduce the risk of RSI because it is just as using a pen which most of the people know how to operate. This is due to the fact that holding and using a pen required very little strength or pressure on the finger. But it also can cause RSI if the users are holding the pen too thigh which will cause the finger to be injured (Emil Pascarelli & Deborah Quilter, 1994).

3.1.6 Joystick

The use of joystick would be mainly on the game and not office. So any game application can consider the use of joystick. Joystick is use typically for fast cursor movements. Of course the exercise use of joystick can cause RSI because fast and repeated using the same finger cause injure. There is not much to be discussed on joystick, so it ends here.

3.2 Input and data entry method

3.2.1 Speech Recognition

Speech Recognition input technique is using voice to work with computer instead of hand. Speech recognition entry method basic requirement include microphone. But the core enabler speech recognition is the software. Microphone is only used to capture the voice and the analysis and processing will be done by the software. Therefore the performance of the software will determine the usability of the speech recognition entry method.

Certainly voice recognition technique can reduced the injured on hand but another part of the body is exposing to injury. That is the throat, the excessive use of throat also will cause injure to throat (Emil Pascarelli & Deborah Quilter, 1994). Therefore it is a good idea to combine the use of voice recognition technique and other input devices.

4. Output Design

There are not things much to be discuss in this section because the output design will not contribute much to cause of RSI. The only output device that will contribute to cause of RSI is the visual display terminal. Therefore, there is only one sub section under this topic. Poor VDT can cause your eye be injured.

4.1 Visual Display Terminal

The placement of the VDT should be the height of the VDT inline with your eye (Emil Pascarelli & Deborah Quilter, 1994). Beside that, the lighting of room when working with VDT is also important. This is because improper lighting can cause reflections of light on screen. This will subsequently causing user to work in an awkward posture to avoid from reflection. Hence, Operators must be able to regulate the amount and angle of the light and avoid reflections that contribute to awkward postures (Bland Bankart, 2001).

Factor concerning about VDT is contrast, resolution and refresh rate. The contrast of VDT should be adjusted until the text can be view easily and clearly. While the higher resolution of the VDT, the easier you can view the text on the screen. Refresh rate is the rate that screen on VDT is refresh. It is usually cannot be realized by human eye (Emil Pascarelli & Deborah Quilter, 1994).

5. Ergonomic

Ergonomic is traditionally the study of the physical characteristic of the interaction (Alan D., et al., 1998). In general, the aim in ergonomics is to fit the task to the individual, not the individual to the task (Jeffrey E. Fernandez, 1995). Therefore, ergonomic is a good prevention for RSI because the main cause of RSI is poor design of task, tool and environment. Other than that, ergonomic also have various benefits include increase productivity, improve heath and safety, increase job satisfaction, increase work quality, lower worker turnover, lower lost time at work, lower worker compensation claims and etc (The Typing Injury FAQ, 2002).

Since implementing ergonomic study in work place benefit both worker and management. Thus it is worth to take a look at the study of ergonomic with relation to RSI. To let the audience have a clearer and better understanding on ergonomic, I have categorized each factor to a subsection.

Someone may question that what is the relation between HCI and ergonomic. Ergonomic is a huge area which is distinct from HCI but sit alongside with it. Its contribution to HCI is in determining constraints on the way we design systems and suggesting detailed and specific guidelines and standards (Alan D., et al., 1998).

5.1 Workload factor

Certainly, the relation between workload and RSI is direct where the heavier workload the higher the probability to get injured by RSI. Of course, reduce the workload will be the solution to this factor. But when heavy workload cannot be avoid, then consider making the management of task more flexible or extensible where the worker can flexibility arrange which task to be done first. By doing so, the chance of repetition is reduced because worker can interleaved between different tasks. For example, the worker can do input task for 1 hour then switch to printing document and after that continue with input task. In such a way, when the worker is doing other none input task, their hand get rest and long hours

routine task can be avoid. In short, limit the duration of ‘continuous work’ or restructure work to include a greater number of tasks (Bland Bankart, 2001).

It not only reduces the chance of hurt by RSI but also bring benefit to management. It is due to the fact that, worker job satisfaction is increased because they are given more flexibility.

5.2 Working Culture factor

Working culture is the culture of the workplace includes worker perception on various workplace events. According to the book of Repetitive Strain Injury: A Computer User Guide, there is one RSI victim that complains that the main cause she gets hurt by RSI is the working culture of her workplace. According to her, if she rest or exercises in the office all of the staff will look at her even it only for a while. And every worker in her office is working in a high speed and under stress (Emil Pascarelli & Deborah Quilter, 1994).

From the above scenario, we have learned that working culture is crucial to the cause of RSI. A system that is best designed to reduce the workload and repetition also can cause RSI if the worker is under the working culture that required worker to work continuously and without rest.

Hence, the management should always encourage or develop a healthy working culture that allow for rest and exercise. Management may argue that doing so will reduce productivity. This is no really true, because when people do not get sufficient rest they tend to make mistake. Furthermore, worker turnover can be minimized if workers are satisfied with the work.

5.3 Workstation factor

The design of workstation has a great impact on prevention of RSI. A badly design workstation will cause the worker to work in awkward posture thus causing RSI. Beside that, a badly design workstation also reduce the efficiency and productivity.

A good design workstation principles are allow for changes in posture, support limbs, use gravity do not oppose it, reduce excessive forces, minimize fatigue, reduce excessive repetition, avoid muscle overloading, keep arm movements within normal work area, avoid contact stress/sharp edges on work surfaces, make the work surface adjustable, relocate work surface so able to work from both sides, allow enough desk space to comfortably accommodate the materials and equipment that are part of the job, furnish adjustable seating and etc (HAWORTH, *Ergonomics and Workstation Design Overview – HPS*).

5.4 Worker factor

No two employees are alike and they may respond slightly differently to the same work environment (Bland Bankart, 2001). The variable factors are age, gender and experience.

Let us discuss the age factor first, people develop peak power in the early to mid-twenties and are susceptible to muscle strain in their teens. Teenagers should not initially be

exposed to the same work rates as established adults if the general system of work presents any risk (Bland Bankart, 2001).

Obviously, different gender can handle different amount of workload. Women develop only 50 – 60% of the muscle power of men and this occasionally means that a job safe for a man will not be for a woman (Bland Bankart, 2001).

Experience is the teacher of everything. An experience worker can work better and safer than inexperience worker. Regular undertaking of a task produces work hardening. This is lost after a period of rest and where feasible, employees who have been absent should be reintroduced gradually and allowed to work up to full speed (Bland Bankart, 2001).

5.5 Task factor

Task factor is the task that is being performed by worker with the workstation. Generally, task can be categorized to 2 types. There are the tasks that require standing and tasks that required seating. The following is some of the considerations to determine whether to stand or sit when performing the task.

Consider sit if the task required high visual attention, high degree of stability, precise foot control and not heavy material handling. And consider standing if the task required frequent handle heavy object, mobility is needed, doing variety of tasks and doing intermittent tasks (HAWORTH, *Ergonomics and Workstation Design Overview – HPS*).

5.6 Temperature

As mentioned in section 2.1 Cause of RSI, cold temperature can also cause RSI. This is because when temperature is cold, worker work in awkward posture by stiff their body as to keep themselves warm. So if you feel that your working temperature is cold, then do not hesitate to adjust the air conditioner.

If you are working in an opened office, you may be could talk to your colleague to adjust the air conditioner temperature.

6. Critical Appraisal

After brief research, I would say that a good HCI and ergonomic design cannot eliminate the problem of RSI. Instead, it can be used to reduce or prevent RSI. This is because a good HCI design can encourage users to work with a good working habit without expose to RSI. But if the users are still working with a risky working habit, then a best design system also cannot help.

Therefore, users themselves are the key to reduce and overcome the problem of RSI. A good design system only serves as a tool to guide and help users to work with a non risky working habit. The key here is that “Does the users want to make use of the tool to help them”. This would be a hard question to answer because the users certainly want to help themselves but the problem is the users found it hard to change their habit on how to operate the computer. Users are used to their bad habit and resistance to change. Some of the users even said that the bad habit have no problem at all.

But it is still worth to develop a design system because the new user can get themselves avoid from falling into the bad habit trap. While the existing user can gradually change their bad habit to avoid or reduce the risk of RSI.

Someone may question the efficiency and effectiveness of the HCI design to overcome the RSI problems. Yes, I admit that the efficiency and effectiveness of HCI design is still limited and not much for now. But for this moment, it is still during initial stage of the concept of design of HCI to overcome RSI. Every new concept that newly introduce also cannot show immediate effect include the concept of HCI design to overcome RSI. But this concept serves as a basic to let more researchers to research on it to achieve higher efficiency.

And I would like to conclude that the use of HCI design to reduce the problems of RSI is still during the infant stage which requires more development and research to carry out as to make the maximum use of the HCI design. And I would like to emphasize that implementing this concept will not decrease the productivity of workers. Instead it helps to bring a lot of benefits to both worker and employee as I mentioned in section 5 Ergonomic.

7. Conclusion

As a nutshell, RSI is repetitive strain injury that is caused by the improper habits on how to operate with computer. Most of the people perceive that RSI is not a serious problem but is only temporary pain. At the initial stage of RSI, it is only a temporary pain as a signal. But if the victim still work in a bad habit that lead to RSI, then it can be a serious problem which include unable to work.

Due to the fact, that most RSI cause is associated with the computer. Therefore, HCI can be a solution to RSI because every computer system also needs HCI to communicate. The solution of HCI are input, output design and ergonomic. Various solutions have been discussed on Section 3, 4 and 5.

The purpose of the research paper is to study the HCI design to overcome the problem of RSI. But beside that, the idea and critical thinking after the doing the research paper also is crucial. The main critical thinking that I have learned is HCI can help reduce the RSI risk but if the individual do not want to change their bad habit then the best HCI design also cannot help.

Finally, I would like to mention that I have learned a lot during the development of this research paper. And I would like to express my gratitude to Miss Palvin, my HCI lecturer because she has given me the chance to learn from this topic. And this is the end of my research paper.

8. Reference

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