DOES ATTITUDE AFFECT RISK?

An Investigation into the Potential for User Acceptance of Computer-based Interactive Monitoring Systems (CIMS) in the Management of Musculoskeletal Disorders in the Workplace

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Abstract

Despite high numbers of UK workers experiencing work-related musculoskeletal and stress-related disorders, current legislation and intervention practices do little to stem the tide of these conditions. Studies have shown that work-based computer users need regular support in order to comply with MSD prevention programs, such as those that promote work rest and stretch breaks. Successful implementation of health and safety programs requires collaboration. Traditionally, that has meant employers, employees and professionals (e.g. ergonomists, occupational health officers, health and safety representatives) working together towards a common goal, such as the reduction and prevention of computer-related ill health. With the user-centred approach taken by Human Computer Interaction, persuasive technologies may now play a part in the collaborative venture.

The study investigates work-based computer users' attitudes towards prospective persuasive technology, namely multi-factorial computer-based interactive monitoring systems (CIMS). Working with the user, multi-factorial CIMS should identify the physical, psychological and psychosocial factors that contribute to work-related musculoskeletal disorders. User attitude influences potential user acceptance (welcome, tolerate or rejection) of CIMS. A CIMS User Acceptance Model is presented by which potential barriers to acceptance may be considered, and where necessary addressed, in order for the individual to make an informed decision whether or not to become a CIMS user.

By understanding what acceptance means to potential users, employers and technology developers may gain greater insight into the needs and wishes of users and so inform management strategies and/or future design.

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1. Introduction

It is estimated that 2.1 million people in the United Kingdom (UK) are suffering from "*an illness they believed was caused or made worse by their current or past work*" (Health and Safety Executive, 2009). Just over two thirds of that figure may be accounted for by musculoskeletal disorders (539,000) and stress, depression or anxiety (442,000). Work-related ill health is not a new phenomenon. In the 18th century Bernardino Ramazzini, credited as being the founder of occupational medicine, extensively documented work-related ill health. When observing scribes and considering their related disorders Ramazzini reported:

> *"…. certain morbid affections gradually arise….. from some particular posture of the limbs or unnatural movements of the body called for while they work"*
>
> (Cordiner et al. 1998, p.6-2).

Despite awareness of these issues for over three centuries, individuals continue to experience work-related musculoskeletal disorders and stress-related ill health. This study considers ways in which contributing factors, such as emotion state, work habits and ill-advised postures adopted by work-based computer users, today's scribes, may be detected. It also considers some of the barriers that exist to prevent individuals taking advantage of related interventions.

This chapter introduces the reader to musculoskeletal disorders, their causes and current workplace approaches to prevention. It explains how advances in technology may be used to detect and manage the risks, which may cause or aggravate such disorders, before presenting the study's focus: the potential use of Computer-based Interactive Monitoring Systems in the battle against work-related musculoskeletal disorders.

1.1 The Nature of Work Related Musculoskeletal Disorders

As Ramazzini (1713a) observed, work-related ill health may be multidimensional in nature:

> *"The maladies that affect the clerks aforesaid arise from three causes. First, constant sitting, secondly, the incessant movement of the hand and always in the same direction, thirdly, the strain on the mind from the effort ....."*.

1.1.1 Defining MSDs

Repetitive Strain Injury (RSI) is a recognisable term to most office workers. RSI has two classifications: Type 1 and Type 2. Type 1 RSI refers to well defined, diagnosable conditions such as carpal tunnel syndrome (pain and compression in the wrist) and tendonitis (inflammation of a tendon). Repetitive tasks can cause these conditions, but they are not the exclusive cause. Type 2 RSI refers

to symptoms that do not have measurable signs of inflammation, muscle and/or tendon damage or nerve function limitation, and so do not fit within known conditions. As Type 1 RSI diagnoses are referred to by the name of the specific syndrome, the term RSI has generally been adopted to describe Type 2 conditions, which may also be referred to as "non-specific pain syndrome" or "diffuse RSI". (NHS, 2007).

The lack of a clear diagnosis/definition for diffuse RSI means that the term is interchangeable with others: Occupational Overuse Syndrome (OOS), Cumulative Trauma Disorder (CTD), Upper Limb Disorder (ULD), which relates specifically to the upper body, and Musculoskeletal Disorders (MSD) that may affect the muscles, tendons, ligaments, nerves or other soft tissues and joints in any part of the body. The HSE differentiates MSDs from other terms as the symptoms may occur outside of the work environment and then be made worse by work (Health and Safety Executive, 2007a). Where symptoms are attributable to the workplace, the term "work-related" may be added, e.g. WRMSD.

1.1.2 Risk Factors

The high level of MSDS reported by the HSE (2009) may be partly explained by their being influenced by biomechanical, psychological and/or psychosocial factors (Armstrong et al, 1993; Turk, 1993) and as such have a greater number of potential causes. Armstrong et al proposed a conceptual model for work-related neck and upper-limb MSDs that is based on sets of cascading exposure, dose, capacity and response variables, such that "*response at one level can act as dose at the next*" (Armstrong et al, 1993).

Conceptual frameworks developed by the National Research Council illustrate factors and physiological pathways that potentially contribute to MSDs. Figure_1 shows the Council's adapted version of its original framework. The arrows between "*The Workplace*" and the "*The Person*" boxes indicate research disciplines that have attempted to explain load-tolerance relationships, such as physiology, biomechanics, and epidemiology (National Research Council, 2001, p3). Psychosocial risk factors are also associated with or can predict change in musculoskeletal health (Parkes et al, 2005). Devereux et al (2002) found that workers highly exposed to both physical and psychosocial workplace risk factors were more likely to report MSD symptoms than those highly exposed to one or the other.

1.1.3 Physical Factors

Since Ramazzini, researchers have considered the correlation of posture to health. Contributing factors to MSDs may include: posture; force, strength, reach; anthropometric mismatches; prior injury; repetition, motion, duration of exposure, dynamic and static load (National Research Council, 2001; Pheasant and Haslegrave, 2006; Bridger, 2009).

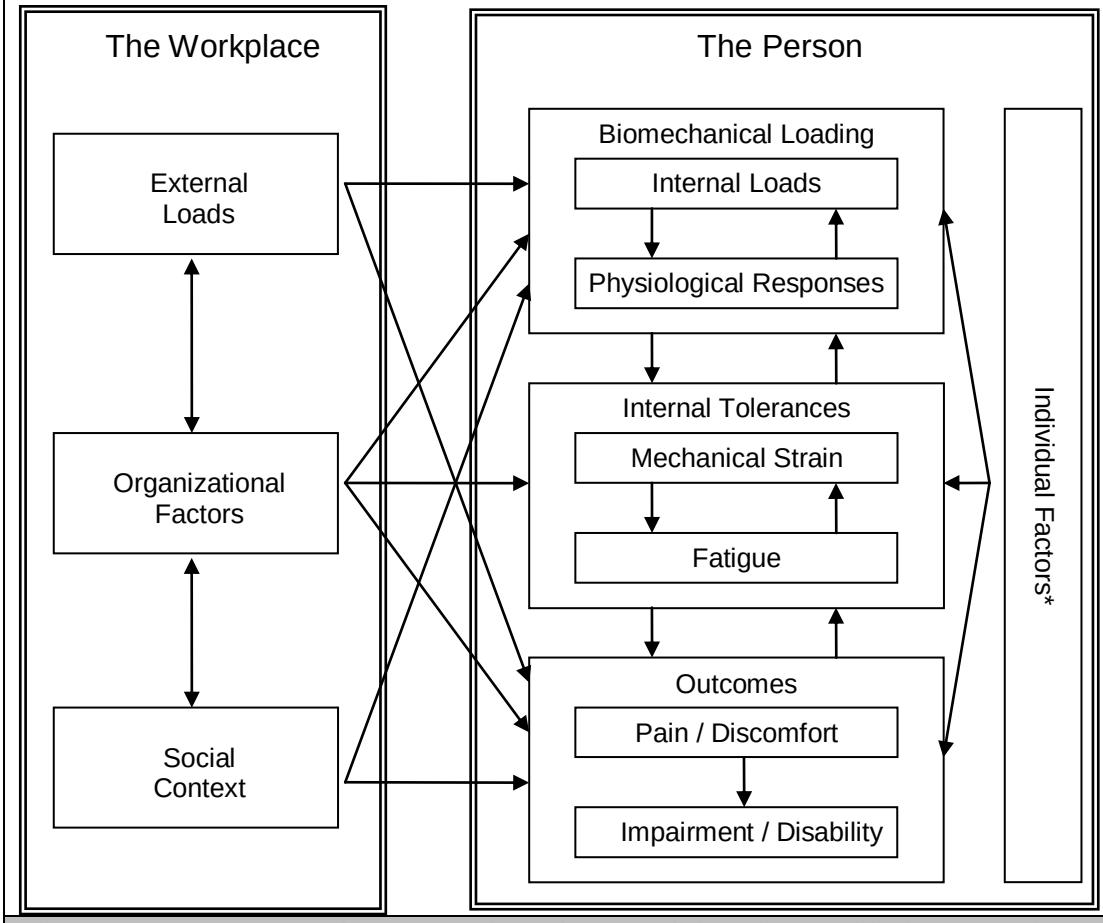


Figure_1: A conceptual framework of the possible roles and influences that various factors may play in the development of musculoskeletal disorders Based on Figure ES1 from National Research Council, 2001 (p.3)
**Where "Individual Factors" refers to Individual Physical and Psychophysical Factors and Non-Work-Related Activities (National Research Council, 2001).*

Discomfort and pain may be precursors of injury, but studies have shown that whilst MSDs may be incident dependent, e.g. excessive force caused by an accident, they are more often cumulative in nature. Resulting from repeated or prolonged low level physical stress on the body, incidents may go unnoticed if they are insufficient to trigger the body's warning system, i.e. pain. If the task/posture held is repeated with insufficient rest/recovery time, then the cumulative effect is what is more likely to trigger pain. Consequently, diagnosis attempts may wrongly focus on the onset of pain; considering recent events, rather than long term practices, work habits and/or postures adopted by the individual. To illustrate, computer work involves dynamic and static muscle loading. Both may result in injury if not well managed, but the contribution of the static loading element is often overlooked as its impact is less obvious to the individual. Rapid movement of the fingers during typing places a dynamic load on the muscles in the hands and fingers that can result in aches and pains attributable to repetitive actions and/or over-use. Insufficient rest breaks away from the activity may result in strain and the possibility of cumulative-based injury. Whilst the fingers are directly deployed in the activity, the muscles of the

arms, shoulders and neck are static, often tense, and may result in discomfort and/or pain from increased pressure inside the muscle and impediment of blood (Kroemer and Grandjean, 2003; Louhevaara and Kilbom, 2005).

Symptoms vary with time and between individuals. Turk (1993) reported how individuals discussing what appears to be the same phenomenon may describe significant differences in terms of "*severity, quality and impact of their pain*". Consequently, it is important that not only the somatic (sensory) component of pain is considered, but other factors such as the individual's attitudes, coping efforts, resources, moods/emotion-states, and stress levels. Observation provides additional data on an individual's symptoms or their attitude to pain, with behaviours such as facial expression (e.g. grimacing) when considering activities that trigger pain or (un)conscious rubbing, supporting or gesturing to affected areas (Turk, 1993; Marcus et al, 2007).

1.1.4 Psychosocial and Psychological Factors

Studies have considered the role of psychosocial factors and stress in the occurrence of MSDs (Westman et al, 2008). Factors influencing performance and work demands include: personality; self-efficacy; job satisfaction; autonomy; monotony; boredom; with work stress, fatigue and attention being of particular interest to the ergonomist (Halsegrave and Corlett, 2005, p816).

The 2007 Psychosocial Working Conditions (Health and Safety Executive, 2007b) survey indicated that around 13.6% of all working individuals thought their jobs were very or extremely stressful. Stress is a combination of physical and psychological reactions to events that challenge or threaten the individual. Under normal circumstances, stress response is a mechanism which allows the individual to deal with sudden changes, dangers or immediate demands in order to protect her/his self. Under abnormal circumstances stress can overwhelm and lead/contribute to ill health (Tennant, 2001; Michie and Williams, 2009). A study by von Knorring et al (1982) found that individuals with depressive orders who also reported pain were found to have a significantly higher muscular tension level than those without pain.

In the workplace, the impact of stress on the individual may include tension, headaches and MSDs, leading to errors, drops in productivity and possible need for sick leave. In a systematic review of literature, Michie and Williams (2009) identified the key work factors associated with work-related psychological ill heath and sickness absence, which included: long hours worked, work overload and pressure, lack of control over work and lack of participation in decision making. In addition, factors external to the workplace such as home and social life may be common sources of stress; compounding those experienced during the working day (Tennant, 2001) and contributing to MSDs (Cole and Rivilis, 2004).

Stress may also be task dependant, e.g. computer-related stress. This occurs when something unforeseen happens, such as a technical fault or software which blocks a user's desired action whilst failing to offer explanation or guidance as to how to proceed. Depending on the individual's technical abilities,

or external factors such as impending deadlines, s/he may become tense/anxious. If the problem is not dealt with, or if it re-occurs, then frustration builds. A laboratory study by Dennerlain et al (2003) showed how deliberately frustrating computer users increases their exposure to physical risk factors, e.g. frustration may result in increased muscle tension as the user grips the mouse tighter.

1.2 Management of MSDs

1.2.1 Workplace Legislation

The levels of work-related illness reported by the HSE might suggest a lack of legislation to protect workers, but this is not the case. Employees within the UK are protected by a raft of health and safety legislation which covers both the workplace and work practices. The "Health and Safety (Display Screen Equipment) Regulations 1992 as amended by the Health and Safety (Miscellaneous Amendments) Regulations 2002" exists specifically to protect work-based computer users.

The Display Screen Equipment (DSE) Regulations came into force in January 1993 to implement European directive 90/270/EEC; the aim of which was to address the minimum health and safety requirements for work with DSE. Table_1 shows the seven primary DSE Regulations.

1	Citation, commencement, interpretation and application
2	Analysis of workstations
3	Requirements for workstations
4	Daily work routine of users
5	Eyes and eyesight
6	Provision of training
7	Provision of information

Table_1: Primary DSE Regulations (Statutory Instrument 2792, 1992)

The Regulations require the employer to analyse workstations, environment and work tasks in order to "*reduce the risks identified in consequence of an assessment to the lowest extent reasonably practicable*". The term "workstation" means an assembly comprising of the elements shown in Table_2:

i. display screen equipment (whether provided with software determining the interface between the equipment and its operator or user, a keyboard or any other input device), ii. any optional accessories to the display screen equipment, iii. any disk drive, telephone, modem, printer, document holder, work chair, work desk, work surface or other item peripheral to the display screen equipment, and iv. the immediate work environment around the display screen equipment.

Table_2: Definition of a DSE Workstation
(Health and Safety Executive, 2002)

Coleman and Pearce (1994) point out that *"Failure to assess equates to negligence for all practical purposes"*. As the DSE Regulations aim to meet the needs of all employers with DSE regardless of industry type or size of workforce, the Regulations act to guide rather than prescribe how specific requirements should be met. One of the main requirements of the regulations is for employers to perform a *"suitable and sufficient analysis"* of users' workstations (Health and Safety Executive, 2002). In itself, that phrase goes a long way to explain why, despite the existence of Regulations, users continue to experience computer-related ill health. Words such as "*suitable*" and "*sufficient*" are interchangeable, with meanings changing based on the situation. As a result, the Regulations are open to interpretation. Misinterpretation, either wilfully or unintentionally, may be one explanation as to why work-based illnesses such as MSDs are still prevalent in such numbers. In addition, employers are often unaware of:

- The potential impact symptoms may have on an individual and the company/organization (e.g. loss of productivity, sick leave, insurance claims)
- The relatively low cost of some preventative measures and adjustments compared with the potential long term cost to both the individual and employer if no action is taken. In the UK, sick leave alone cost an estimated £17.3bn in 2008 (Guardian, 2009)
- Specific legislation or parts thereof. Although, ignorance of the law is no defence.

The HSE figures (2009) relate to all forms of work, not just computer use. Despite anecdotal evidence that over 60% of work-based computer users have experienced symptoms that may be caused/aggravated by computer work (AbilityNet, 2008), extensive review of literature failed to reveal any current computer-related statistics. One explanation for this may be that health and safety surveys gather data on symptoms and accidents/injuries rather than ongoing conditions. Related data came from research studies on specific user groups, e.g. Suparna et al (2005) considered the occupational health problems and role of ergonomics in information technology professionals, or from industry/media estimates. Bannerjee and Sharan (2003) estimated that 25% of computer users world-wide had computer-related injuries. The Trade Union Congress (TUC) (2004) estimated that 1 in 50 of UK workers was experiencing some degree of RSI. More recently, The Chartered Society of Physiotherapy, citing HSE figures from 2007/08, called on the UK Government to encourage employers to do more to prevent and reduce related conditions amongst workers (The Chartered Society of Physiotherapy, 2009).

1.2.2 The Individual's Responsibility

Whilst the main responsibility under the DSE Regulations lies with employers and their nominated representatives, individual computer users have a legal responsibility to enforce the regulations in order to protect themselves, their colleagues and visitors and to ensure that risks are reduced by following safe working practices. Studies have shown that employees are often unaware of their employer's health and safety and DSE procedures (Mulligan, 2006) and that, even when they are, users need help in order to maintain long-term compliance with injury prevention programs (Monsey et al, 2003). Potential barriers to compliance and adoption of good practice may include:

- Physical factors: an individual's lack of ability to detect their own comfort and symptom levels; loss of proprioception (the ability to perceive the location, movement and posture of one's body in physical space) and how that may impact/cause symptoms; lack of awareness/perception of potential triggers and their severity in terms of risk (Mulligan, 2006)
- Psychosocial and psychological factors: self-efficacy; job content/satisfaction; workload/pace (overload or under-load); role and control (low participation in decision-making; autonomy); fatigue; work stress; personality; home-work conflict (Briner and Rick, 2003; Bridger, 2009).

With finance being of ever greater concern to businesses, it is often unrealistic to provide the traditional in-person assessment method: one assessor working with one employee in one place at one time (Glasgow, 2004) to observe and review the individual, workstation and work practices, and provide related training and information that enables the individual to follow good practices. Self-assessment is often seen as a cheaper alternative. Placing the onus on the individual, the employer is able to save costs involved in training internal staff to assess or employing external contractors.

Self-assessment relies on the individual being aware and involved in the process, i.e. appreciating why the assessment is important. In a previous study by this author, lack of self-awareness was found to be a contributing factor in the failure of self-assessment methods used to identify the presence of risk (Mulligan, 2006). If the trend towards self-assessment continues, then additional monitoring methods will be needed to limit the inevitable risks.

1.2.3 Intervention

DSE Regulations 6 and 7 stipulate that users must be provided with training and information in health and safety aspects of computer work. Studies have shown that education programs can reduce the severity or occurrence of MSDs (Olafsdottir, 2004; Greene et al, 2005). If user education were sufficient in the battle against MSDs then other interventions would not be required; this is not the case as demonstrated by Montreuil et al (2006).

Intervention by way of workplace ergonomic modification is often vital in the management of WRMSDs. Example modifications include reducing highly repetitive and/or forceful movements, correct placement and use of equipment and lighting, adaptation of furniture and/or equipment to meet individual need, reducing awkward postures and prolonged periods spent in one position by ensuring that sufficient breaks are taken, consideration of task and job design (Bridger, 2009). Modifications cannot be applied in isolation and they may not be successfully considered or implemented if the need is not identified and acknowledged (Mulligan, 2006).

1.3 The Study

1.3.1 Background

As a Disability IT Consultant, one aspect of my work involves assessment of needs and provision of advice, information and support to individuals, organisations and professionals regarding the prevention of computer-related ill-health. Often problems exist because risks go unnoticed; individuals, colleagues, or employers are not aware of the potential outcome of ignoring risk; or belief that the risk "*won't happen to me*". Ignored risks can easily have a negative life-changing impact for the individual. Whilst it is possible to identify preventative adjustments or adaptations, or to assist where symptoms or disability exists, in themselves such measures will not result in recovery or cessation of symptoms/condition. It is necessary to take an holistic approach, involving ergonomic adjustments, adaptive technology, low-tech solutions, changes to work flow and/or practices and medical advice and/or therapeutic treatment.

Morse et al (2001) found that in the American State of Connecticut there was substantial under-reporting of MSD, with estimates of unreported cases exceeding those officially reported by a factor of 11:1. With individuals unable to recognise risk, the challenge in the prevention of MSDs is how to achieve early detection of risk factors before symptoms occur. Haque (2000) proposed the use of a health surveillance system in order to monitor health and safety in the workplace, data collection through self-administered questionnaires completed by employees, managers or supervisors, with feedback resulting from data analysed by trained staff. With advances in technology, and from a Human Computer Interaction (HCI) viewpoint, the development of a system which could monitor the user, detect where and when potential risk exists and then provide advice as to remedial action to be taken, might now appear to be a more obvious way of plugging the human awareness gap. This study considers the potential use of prospective Computer-based Interactive Monitoring Systems (henceforth referred to as "CIMS"). By developing CIMS around persuasive technology (captology) and user interaction, the computer and user may work together to address physical, psychological and psychosocial factors of MSDs with the ultimate aim of improving user well-being.

1.3.2 Review of Persuasive Technology

Fogg (1998) introduced the term "captology", which derives from the study of "*Computers As Persuasive Technologies*", to explain where technology and persuasion overlap. He stressed the need to understand both the effects and potential of interactive technologies that have the ability to "*change beliefs and behaviours*". Understanding informs design, especially when trying to persuade users to "*change attitudes and behaviours in beneficial ways*". Fogg illustrated the two domains (computers and behaviour) and their interaction/overlap (captology) through a Venn diagram. The current version is shown in Figure_2.

As computers become ubiquitous, the scope for persuasive technology increases. Whilst many studies have considered persuasive technology as a route to improving health/well-being (Dijkstra, 2006 (comparison of tailored

persuasive messages); de Rosis et al, 2006 (healthy eating); Grollemann et al, 2006 (support for smokers trying to quit)), studies into the use of such technology within the workplace, and specifically for work-based computer users, are limited (Morris et al, 2008 (activity based computer breaks)).

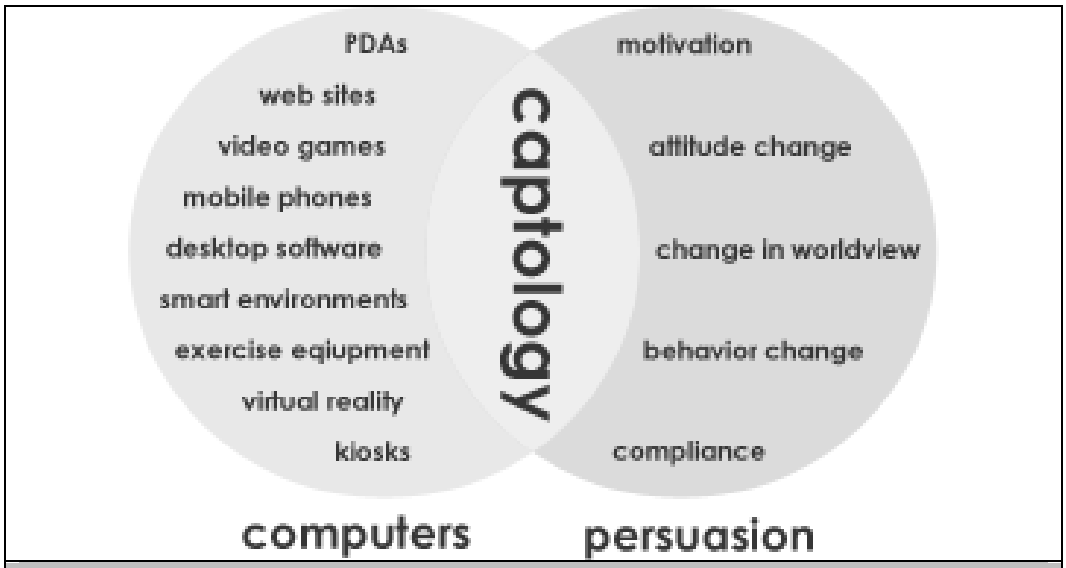


Figure_2: Overview of Captology
(Stanford University Persuasive Technology Lab, 2009)

When considering current persuasive technology approaches, a divide appears to exist between the fields of academic research, where affective computing considers the individual's emotion-state and psychological needs, and commerce, where ergonomic monitoring systems provide advice based on the user's posture and physical activity. It has not been possible to find any studies or products which aim to address both sets of needs; the focus of this study.

1.3.2.1 Technology and Emotion Recognition

Affect is the conscious subjective aspect of feeling or emotion. An individual's emotions can influence the emotions, thoughts and behaviours of others and vice versa (Hareli and Rafaelil, 2008). Affect, emotion, and feeling are all displayed through facial expressions, hand gestures, posture, voice characteristics, and other physical manifestation. The ability to detect these cues through technology could help to prevent/negate negative affect in computer workers; relieving frustration and anxiety before they have a chance to build, thus reducing the risk of stress-related health issues occurring.

In order to detect emotional information one must first capture data about the individual's physical state and/or behaviour. This may be achieved via one or more of the following methods: body posture, gestures, facial expressions, speech patterns and physiological sensing. In order to recognize emotional information, meaningful patterns must be identified from the data. At MIT's Affective Computing Lab research into physiological sensing is currently focusing on: Galvanic Skin Response (GSR), Electrocardiogram (EKG), Electromyogram

(EMG), Blood Volume Pressure (BVP), Respiration, and Temperature (Affective Computing Group, MIT, 2009). Other studies include:

- Motion Mouse (IBM's Blue Eyes Project): evaluates users' emotions when operating a computer. Gathering physical and physiological output, sensors measure data based on behaviour (mouse movements, button click frequency, finger pressure) and physiological functions (heart rate, skin temperature, skin electricity and GSR) (Ark et al, 1999)
- Touchpad pressure to indicate affective state (Mentis and Gay, 2002)
- Chair with pressure sensors used to recognise naturally occurring postures and associated affective states related to a child's interest level while performing a learning task on a computer (Mota and Picard, 2003)
- RoCo, a robotic computer, designed to move its monitor in subtly expressive ways that respond to and promote its users' own postural movement. Results showed that users tended to be more persistent in their task when RoCo's posture was congruous to their affective state than when it is incongruous (Ahn et al, 2007; Breazeal et al, 2007)

Current commercial monitoring systems, such as the Tension Taker by Ultrasis (Figure_3), blood pressure and heart rate monitors (Vrijkotte et al, 2000), are intrusive and are generally targeted at the home user, users with medical problems that need to be constantly monitored or used in laboratory settings. Commercial products that do not involve monitoring (e.g. relaxation / meditation CDs, relaxation techniques) also target the home-based user.

Figure_3: Tension Taker

1.3.2.2 Ergonomics and Posture Monitoring

> *"...those who sit at their work and are therefore called 'chair workers ... [T]hese workers ... suffer from general ill-health and an excessive accumulation of unwholesome humors caused by their sedentary life ...."* (sic) (Ramazzini, 1713b)

Ergonomics and posture-based research studies that have made use of monitoring systems include:

- A computer-aided system to evaluate postural stress in the workplace: human analysis of a video-based system produces detailed description of work tasks and a continuous record of trunk and shoulder activity on the same timescale (Keyserling, 1986)
- A posture monitor designed to support individuals with limited physical control; by promoting attention to maintaining proper trunk alignment when

seated. Whilst aimed at the disability market, this technology has the scope to be extended into wider fields (George, 1992)

- A sensing chair that uses pressure distributed sensors to gather information needed by a "virtual posture coach" to help the computer user maintain proper sitting postures (Tan et al, 2001)
- Share Aware: an interactive persuasive system to promote awareness of workstation ergonomics. Customisable system compromising a sensor seat cover and screen based application, providing information to the user about posture and duration (Sehgal and Lui, 2004)
- perFrames: Persuasive Picture Frames for Proper Posture: the picture frame contains a moving portrait of a person known to the user; someone s/he likes or loves. By providing affective feedback the user is persuaded into adopting better sitting habits while working at a computer (Obermair et al, 2008)
- SuperBreak: Using interactivity to enhance ergonomic typing break. A customisable system that provides activities for the user to conduct during rest breaks from computer use, e.g. activity and vision-based game and vision-based document reading (which allows the user to defer document reading until break session and requires hand gestures to turn pages, change document) (Morris et al, 2008).

From the studies listed above it can be seen that research is beginning to change from posture detection to include interactive, persuasive systems that focus on the user's posture, comfort and well-being.

Commercial technology aimed at work-based computer users focuses on encouraging the user to take breaks from her/his computer; some software utilities include suggestions for stretching exercises. Support for these utilities comes from studies that have considered a range of factors including: the influence of breaks on fatigue (Laporte, 1966), muscle endurance/strain (Hagberg, 1981) and static load (Jonsson, 1988); effect of different work-rest schedules (Koparadekar and Mital, 1994; Balci and Aghazadeh, 2003), performance, e.g. productivity and/or error rates (Henning et al, 1989); influence of exercise/stretching (Laporte, 1966; Hagberg, 1981; Galinsky et al, 2007); and the individual's ability to self-manage breaks (Henning et al, 1996).

Monitoring methods utilised by break reminder utilities currently include:

- Activity: keyboard and pointing device use is monitored, e.g. the system counts keystrokes, button clicks, movement of the mouse, and advises the user to take a break once thresholds have been reached
- Time: the system advises the user to take breaks based on the passing of time, e.g. a prompt may be issued every 30 minutes
- Time and activity: the system's advice is based on time passing, taking into account activity. It will not prompt the user to take a break if a natural break in activity has occurred
- Posture: by utilising a webcam the system monitors the user's posture and then provides prompts as to remedial action

Table_3 shows a selection of break reminder utilities and the monitoring method(s) utilised:

Product Name	Monitoring Method			Product Status
	Activity	Time	Posture	
KAZGuard	Yes	No	No	Bundled
Mousetron	Yes	No	No	Free
PostureMinder	No	Yes	Yes	Commercial
RSIGuard	Yes	Yes	No	Commercial
SoundBreak	No	Yes	No	Free
StretchBreak	No	Yes	No	Commercial
WorkPace	Yes	Yes	No	Commercial
WorkRave	Yes	Yes	No	Free
Table_3: Example Break Reminder Software Utilities				

1.3.3 Computer-based Interactive Monitoring Systems (CIMS)

As MSDs are multi-factorial in nature an holistic approach is called for. This study considers the potential use of prospective Computer-based Interactive Monitoring Systems (CIMS). Based on persuasive technology, multi-factorial CIMS (which focus on both the user's emotional and physical states) work with the user to address physical, psychological and psychosocial factors of MSDs.

The ultimate aim of CIMS is to improve user well-being. This would be achieved through the proposed CIMS:

- monitoring the work-based computer user across the working day
- detecting the individual's ergonomic state (e.g. posture, use and position of equipment and furniture, work tasks, work habits, local environment) as well as her/his psychological state (e.g. attention, fatigue, frustration and stress levels, emotions)

and

- providing advice on what remedial action may be taken.

Through a qualitative approach this study will consider work-based computer users' attitudes towards the proposed multi-factorial CIMS approach. The aim of the study is to explore potential for, and limitations of CIMS through the eyes of the end user; employers' views are not considered here:

- Why might users welcome, tolerate or reject CIMS?
- Do symptoms influence attitude?
- What perceived barriers (personally, professionally and/or technically) might prevent users from taking advantage of such systems?
- What risks would users want CIMS to detect?
- What monitoring and detection methods would end users accept / prefer?

These and other questions will be considered by way of two data collection stages:

- Stage 1: a survey that considers the factors that might influence an individual's potential acceptance (welcome, tolerate or rejection) of CIMS

- Stage 2: one-to-one, semi-structured interviews that consider the issues identified within the survey feedback and explore points of interest raised by the participants.

Thematic analysis of the data will establish potential users' concerns of and requirements from CIMS (Chapter 3) and this will be followed by discussion of the results and major findings (Chapter 4).

2. Methodology

A qualitative study was conducted to consider factors that might influence a work-based computer user's attitude towards computer-based interactive monitoring systems (CIMS). Qualitative research is a naturalistic interpretative approach, concerned with understanding the meanings people attach to actions, beliefs, decisions, and values. This may be achieved through learning about the participants "*social and material circumstances, their experiences, perspectives and histories*" (Ritchie and Lewis, 2003).

The study comprised two primary data collection stages: Stage 1 (survey) and Stage 2 (interview). The survey's purpose was to identify factors influencing an individual's potential acceptance (welcome, tolerate or rejection) of CIMS. One-to-one, semi-structured interviews at Stage 2 considered the issues identified by survey feedback and explored points of interest raised by the participants. At the analysis stage feedback was sought from the interview participants in order to confirm that their views had been accurately reflected and to request any post-interview thoughts. The three collection methods enabled data triangulation.

2.1 Stage 1 (Survey)

A combination of purposive and convenience sampling was conducted. Purposive sampling occurs when respondents are chosen because they have particular features or characteristics which will enable detailed exploration of the research objectives (Office for National Statistics, 2009a). By contrast, convenience sampling occurs where little or no attempt is made to ensure that the sample is an accurate reflection of the population, i.e. the researcher uses whoever is available (Office for National Statistics, 2009b).

For the purposive sampling method personalized invitations were sent out to 95 individuals, all of whom were known to the researcher in some capacity, e.g. client, colleague, acquaintance, friend, family member. The invitations explained the purpose of the study and contained a copy of the survey, which in turn contained a copy of the study Information Sheet (see Appendix_1, 2 and 3). 93 invitations were emailed and 2 were posted.

Personalized requests were also made of employer representatives and group leaders for onward distribution of the survey invitation to their colleagues/group members. Although the final number is unknown, it is estimated that these requests had the potential to extend the survey's scope by a further 100+. Whilst the researcher had no control over who did/did not receive the survey (convenience sampling), the representatives were selected based on their ability to reach populations who were underrepresented in the purposive sample, i.e. males and those individuals without reported symptoms.

An Informed Consent Form was not used for the survey stage of the study, as return of the completed questionnaire was taken as consent to participate.

The 40-question survey was designed to elicit feedback from the participants on experience of work-related MSDs, DSE procedures, and attitudes towards potential CIMS. The survey was piloted with two volunteers: a female office manager with symptoms (thumb and shoulder) and a male IT Support Technician with no experience of symptoms. Feedback received informed modifications.

The questionnaire contained three sections:

Section 1: General, e.g. job title, industry type, length of time spent at the computer, style of computer, keyboard, DSE experience

Section 2: Symptoms, e.g. existing or historic symptoms, location, severity, changes made to address symptoms. Participants with no symptom history were asked to skip this section

Section 3: Design for User Need, i.e. consideration of example interactive affect and ergonomic monitoring methods. Participants were asked whether they would welcome, tolerate or reject various methods and provide supporting comments for their responses

Table_4 lists the CIMS categories which formed the basis of the investigation; selected in order to cover both physical and emotion-state detection methods. The categories were presented as examples, which might be used on their own or combined to form multi-factorial CIMS. Participant suggestions for other detection methods (Survey Question 39 (Appendix_6c)) informed Stage 2.

CIMS Category		Example detection methods
A	Keyboard use	• key action (force/pressure used) • position of keyboard on work surface
B	Pointing device use	• hand/finger pressure on device • grip position • button action (force/pressure used) • speed and range of movement • position of device on work surface
C	Head position in relation to the screen	• distance from screen
D	Seated position	• fully in chair with back supported • perched • fidgeting
E	Upper body posture	• leaning towards the screen • leaning to one side
F	Facial expression	• frowning • eyebrow positions
G	Eye size	• changes can indicate mood
H	Eye gaze	• rapid movement • lack of movement • tracking eye gaze across screen
I	Voice monitoring	• volume of speech • tone • words used

Table_4: Example Computer-based Interactive Monitoring Systems (CIMS)

Participants were permitted to skip questions they did not wish to answer or withdraw from the survey at any time. An explanation of the interview stage of the study was provided and participants were asked to declare whether they would be willing to take part by selecting “yes”, “no” or “undecided”.

Of the 95 individuals polled 34 intentions to participate were received, resulting in 28 completed surveys. An additional 10 surveys were received as a result of the employer/group requests, resulting in a total of 38.

2.2 Stage 2 (Interviews)

26 out of the 38 survey participants volunteered to be interviewed. An additional five (5) stated that they were “undecided”, providing a potential interview pool of 31. Within the available timeframe, 13 interviews were conducted: 11 in person, one (1) by telephone and one (1) by email. Interviewees were selected based on convenience sampling (availability and location). Copies of the study Information Sheet, Informed Consent Form and example interview questions were sent to the interviewees (Appendix_2, 3 and 4); this allowed queries to be addressed ahead of the session.

Interviews were held at the interviewee’s preferred location; nine (9) choose their employer’s premises, two (2) their own home (also serving as a working location), one (1) by telephone and one (1) by email. Before each interview, the purpose of the study was re-explained and outstanding questions addressed. Interviewees were asked to read and sign the Informed Consent Form. An option to amend the form was provided, e.g. crossing through or re-wording any part. Informed consent was acquired via email correspondence for the remote interviews.

In-person interviews were recorded by audio digital recorder; key points and observation notes recorded in writing. Technical issues with sound quality rendered audio recording unworkable for the telephone interview; the interview was recorded in writing.

The interviews were conducted on a semi-structured basis. Example questions acted as a guide. Additional topics and interviewee thoughts were explored as they occurred. The example questions developed from professional knowledge of existing intervention practices and solutions, and from literature and commercial product reviews (Section 1.3.2). In addition, recurring themes/patterns identified from survey feedback, together with participant suggestions, comments and unexpected responses, informed the interview and its structure. Questions were designed so that participants with and without experience of MSD symptoms could constructively contribute to the study. They were developed and sequenced with the view to taking the participant on a journey from any existing/historic symptoms and coping strategies, through to issues which might surround their acceptance of CIMS.

The questions and interview process were piloted with the two study volunteers. This proved invaluable as it highlighted where questions provided insufficient

explanation of the topic being considered. An example of this was with Interview Question J1, “Trust (in the system)”, where the addition of a definition of trust and an example of where trust might be an issue aided interviewee comprehension. Piloting also identified where participants might struggle to articulate their thoughts, e.g. when requesting pilot volunteers to describe how certain events made them feel. This resulted in the development of a word grid for Interview Questions A1, C and G (Figure_4). The grid contents were based on basic emotions identified by emotion theorists such as Arnold, Izard and Plutchik (referenced in Ortony and Turner, 1990), with additional words being identified through discussion with the volunteers.

Annoyed	Comforted	Horrified	Impatient	Thoughtful
Uneasy	Guilty	Sceptical	Worried	Ineffectual
Relaxed	Proud	Indifferent	Apologetic	Depressed
Bored	Amused	Decisive	Sympathetic	Grateful
Upset	Irritated	Dispirited	Sad	Despondent
Regretful	Preoccupied	Alarmed	Relieved	Playful
Encouraged	Disappointed	Justified	Doubtful	Impatient
Pensive	Reassured	Happy	Anxious	Angry
Confused	Fear	Rage	Flustered	Excited
Despair	Satisfaction	Disgust	Defiant	Shame
Surprised	Joyful	Curious	Weak	Frustrated
Inefficient	Supported	Compromised	Rested	Contempt
Other, please explain…..				

FIG_4: Word Grid used for Interview Questions A1, C and G

A1 =	“*If you experience symptoms whilst working (or as a result of working), e.g. stress, headaches, eyestrain, physical discomfort, how/what does that make you feel?*”
C =	“*If you decide to take a work or rest break away from your computer, how/what does that make you feel?*”
G =	“*If the system advised you to take a work or rest break away from your computer, how/what would that make you feel?*”

As CIMS is prospective user testing was not possible. To aid participants’ understanding of CIMS, explanation of existing persuasive technology products, academic studies and experimental solutions was provided where appropriate.

At the end of the interview session, thirteen images of work and computer-based situations were shown to the interviewee singularly (Appendix_5). The purpose of this was to elicit instinctive reactions to each image/situation depicted and to establish whether or not the interviewee perceived there to be any risk, in terms of physical and/or emotion-state.

2.2.1 Thematic Analysis

Qualitative analysis identifies emerging categories, themes and theories from the data, rather than trying to establish whether data meet with prior knowledge or ideas (Greenhalgh and Taylor, 1997). Guidelines are applied flexibly to meet the

needs of the study, research question(s) and/or data. Adjusting methods as the study develops in light of information collected allows the researcher to be "*sensitive to the richness and variability of the subject matter*" (Greenhalgh and Taylor, 1997). For this study, Thematic Analysis was selected based on its ability to develop a story of the research study from the themes identified in the interview transcripts. Table_5 shows the phases of this approach as described by Braun and Clarke (2006).

Level 1:	Familiarizing yourself with your data: transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
Level 2:	Generating initial codes: coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
Level 3:	Searching for themes: collating codes into potential themes, gathering all data relevant to each potential theme.
Level 4:	Reviewing themes: checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis
Level 5:	Defining and naming: themes: ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
Level 6:	Producing the report: The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Table_5: Phases of Thematic Analysis (Braun and Clarke, 2006)

2.3 Conventions

Table_6 lists the abbreviation conventions used throughout the rest of this paper:

Abbreviation	Description
Pn(g)	Participant number (followed by gender) e.g. P21(F) relates to Participant Number 21 (who is female)
SQn	Survey Question number e.g. SQ12 relates to the survey question which asks "*Where is your primary workstation/desk location*?
IQ-an	Interview Question number e.g. IQ-B3 relates to the interview question which asks "*How do you measure the success of a strategy?*"

Table_6: Abbreviation Conventions Used in Paper

3. Analysis and Results

Whilst a qualitative approach has been taken in this study, it was necessary and beneficial to conduct qualitative and quantitative analysis on the data. In Stage 1 (Survey) participants were encouraged to provide comments to qualify responses and provide additional feedback. Few took advantage. As a result, the scope for qualitative analysis was limited and a predominantly quantitative approach was taken, with totals and/or percentages illustrating how participants responded (Section 3.1). By comparison, Stage 2 (Interview), where transcripts of the interviews provided the bulk of the data, a predominantly qualitative approach was possible (Section 3.2).

3.1 Stage 1 (Survey)

38 surveys received.

3.1.1 Section 1: General

Demographic characteristics relating to gender, age, and industry sector are presented in Table_7. Females and participants working for charity/not-for-profit organisations dominate the survey population. 76% of participants work full-time and 60% have been in their current job over two years (34% “two years or more”, 26% “more than 5 years”).

Demographic Characteristic	Description	n	%
Gender	Female	28	74
	Male	10	26
Age	21-30	11	29
	21-40	11	29
	41-50	4	11
	51-60	12	32
Industry Sector	Public	7	18
	Private	7	18
	Charity / Not-For-Profit	23	61
	No reply given	1	3
		38	100

Table_7: Demographic Characteristics: gender, age, industry

Every participant spent at least 3 hours at their work computer each day (55% “between three and six hours” and 45% “between six and eight hours”). When asked whether or not their employer provided DSE assessments:

- 82% replied “yes”
- 3% “no”
- 8% “don’t know”
- 8% did not answer.

Some participants qualified their responses and five (5) reported never receiving an assessment, despite being with their current employer for at least one year (Appendix_6a).

34 participants (89%) reported historic or current symptoms which they attributed to, or believed were worsened by, work. Of those, 27 (79%) work for employers who purport to comply with DSE Regulations. As can be seen from Table_9, the provision of DSE assessments does not ensure good practice. When considering the longest time they might spend at their computer before taking a work or rest break, 82% of the survey participants (69% of DSE compliance participants) reported spending over the recommended one hour (DSE Regulations, 2002).

Time spent	No DSE Compliance		DSE Compliance		Total	
	n	%	n	%	Total	%
Less than 1 hour	2	29	5	13	7	18
Between 1 and 2 hours	1	14	16	42	17	45
Between 2 and 3 hours	3	43	9	24	12	32
3 hours or more	1	14	1	3	2	5
	7	100	31	100	38	100

Table_8: Analysis of feedback from Survey Question 14:
"What might be the longest length of time you spend working at your computer before taking a break, i.e. short break away from the computer for telephone calls, paperwork, filing, photocopying, comfort break?"

3.1.2 Section 2: Symptoms

Chart Notes:
- The Y-axis labels for the charts shown here have been truncated to save space and allow the data to dominate.
- Full data labels may be found in the survey (Appendix_2).

Participants reporting pain were asked to complete Section_2 of the survey. As can be seen from Figure_5, (SQ27: "*Which of the following statements describe(s) your symptoms….*"), participants regard their symptoms as being predominantly transitory in nature, with 54% of responses accounted for by:
- "occasional" (14)
- "episodic" (12)
- "generally wearing off overnight or across the weekend" (10).

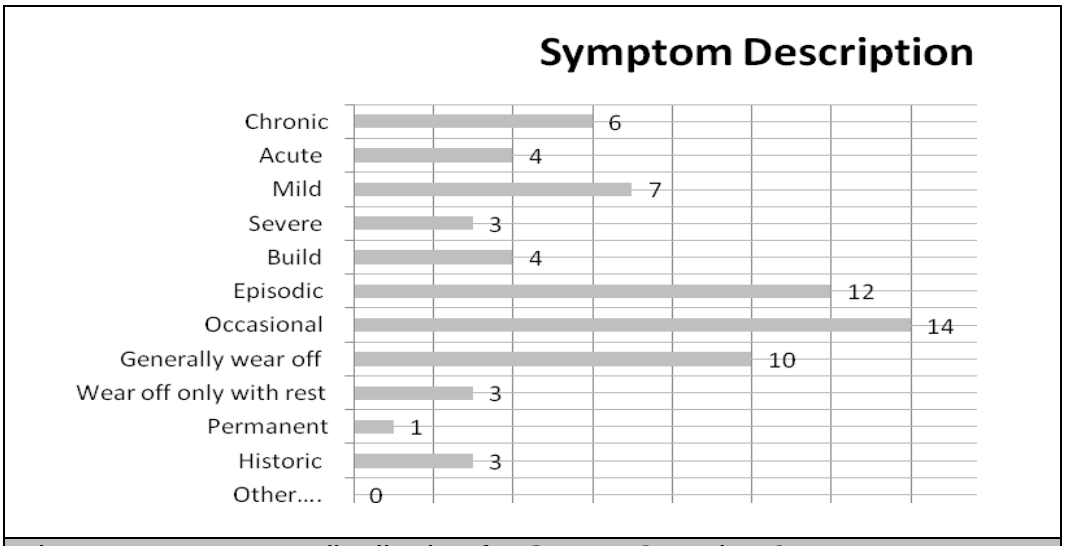


Figure_5: Response distribution for Survey Question 27:
"Which of the following statements describe(s) your symptoms"

When asked to map their symptoms to body areas, (SQ28: "*Please indicate which area(s) bother you*"), as anticipated from literature reviews and professional knowledge of computer-related MSDs, participants identified symptoms within the upper body and lower arm as being of most concern (88%) (Figure_6). Despite anecdotal evidence that most of the participants experience degrees of stress, tension or fatigue, only 5% declared these as health concerns.

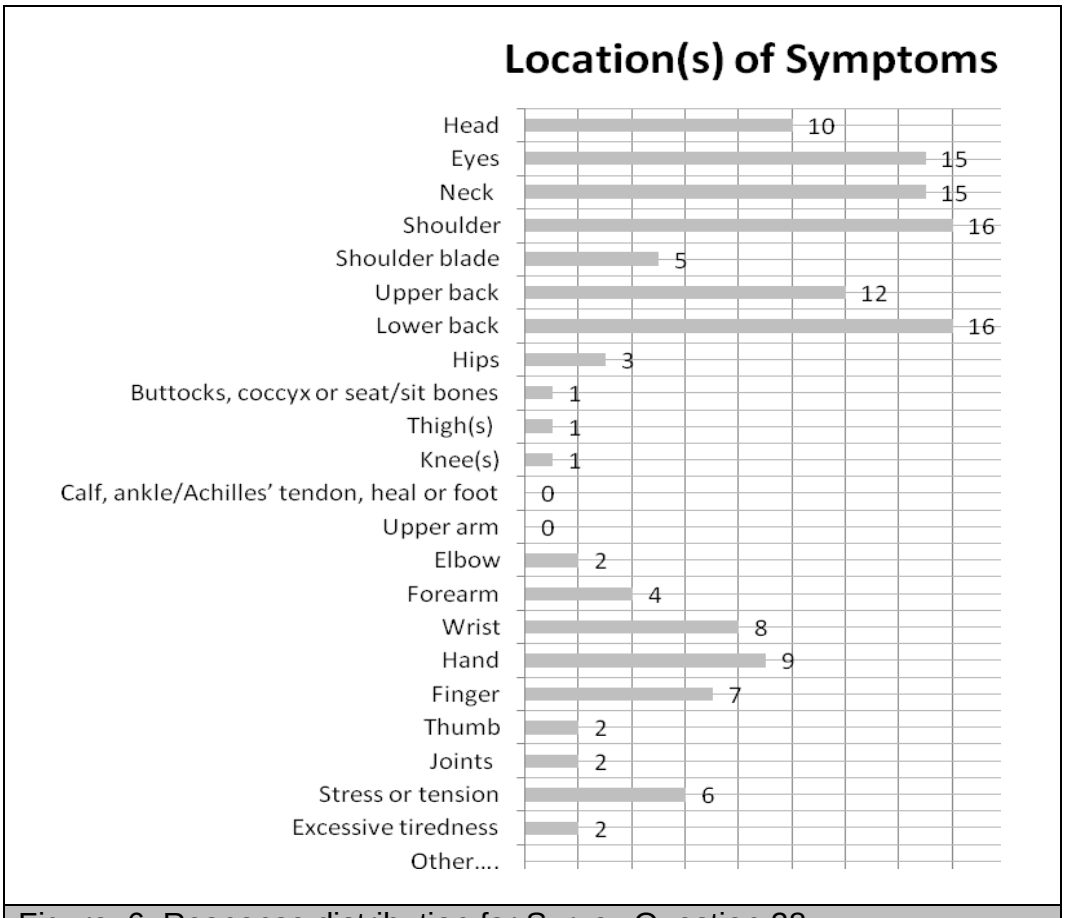


Figure_6: Response distribution for Survey Question 28:
"Which area(s) bother you"

In SQ29 participants were asked to declare the single body/symptom area concerning her/him most. As some participants felt unable to select just one area, the total number of responses (40) is higher than the anticipated 34. All responses bar one (hips) were contained within the upper body, with "Lower back" (25%) and "Shoulder" (20%) identified as the top two areas. Table_9 shows the ranked positions for reported symptom locations.

Rank	Location	n	%
1	Lower back	10	25
2	Shoulder	8	20
3	Neck	5	12.5
4	Head	4	10
4	Eyes	4	10
6	Hand	3	7.5
7	Upper back	2	5
7	Hips	2	5
9	Shoulder blade	1	2.5
9	Wrist	1	2.5
11	Other locations were not selected	0	0
		40	100

Table_9: Ranked positions for Survey Question 29:
"Please indicate which area(s) bothers you MOST"

In terms of discussing their symptoms with others, the top three selections were:

- DSE assessor: 16 (24%)
- Family: 14 (21%)
- GP/doctor: 9 (13%).

Four (4) participants admitted not discussing symptoms with anyone. Reasons are shown in Appendix_6b.

3.1.3 Section 3: Designing For User Need

All participants were asked to complete Section_3 of the survey.

Figure_7 shows how the participants responded to SQ35, SQ36, and SQ37 which asked if they would "welcome", "tolerate" or "reject" example CIMS; participants were asked to "select all that apply" for each category of acceptance. As the chart shows, CIMS relating to equipment use, position and posture achieved higher levels of acceptance than those focusing on emotion recognition; this finding was supported by Stage 2 (Interview).

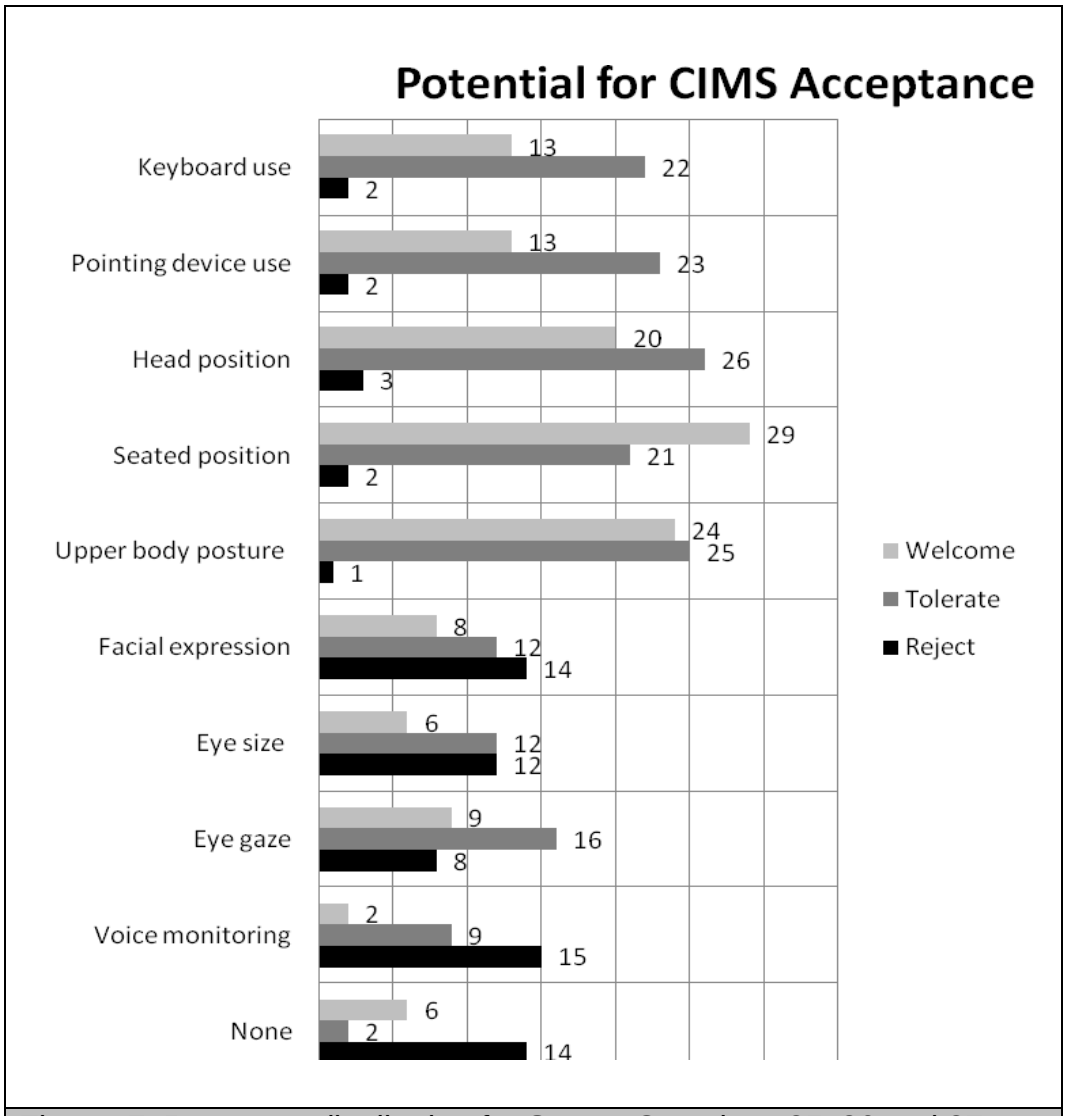


Figure_7: Response distribution for Survey Questions 35, 36 and 37: "Would you welcome (35), tolerate (36) or reject (37) any of the following detection methods"

Table_10 shows the CIMS ranking provided from SQ38, where participants were asked: "*From those methods which you would either WELCOME or TOLERATE, which detection method would you find MOST acceptable?*". These results confirm the participants' higher acceptance of physical over emotion recognition systems.

One explanation for the weighting towards physical methods might be perceived familiarity. 79% of survey participants reported never using an ergonomic, work or symptom-based break utility (commercially available persuasive technology). As the physical CIMS methods use familiar entities, e.g. the keyboard, pointing device, and user's posture, it may have been easier for participant's to imagine how they might be used to monitor and detect risk(s). Participants had no frame of reference for the facial expression, eye and voice-related methods.

Rank	Location	Responses
1	Seated position	15
2	Upper body posture	12
3	Pointing device use	6
4	Keyboard use	3
5	Head position	2
6	Facial expression	1
6	Eye gaze	1
8	Eye size	0
9	Voice monitoring	0

TABLE_10: Ranked positions for the survey Question 38: "From those methods which you would either WELCOME or TOLERATE, which detection method would you find MOST acceptable?"
NOTE: P24(M), P25(F) and P37(F) each selected two CIMS instead of the request one, and P26(F) declined to answer

3.1.4 Final Comments

At the end of the survey participants were invited to make final comments / study observations (Appendix_6d). The majority supported the survey data trends, i.e. employers are not as proactive as they should/could be and individuals feel that they should be able to manage their own well-being. The level of symptoms reported support the first trend, but indicate that despite their beliefs individuals are unable to self-manage.

3.2 Stage 2 (Interview)

3.2.1 Word Lists

For IQ-A1, C and G participants were presented with the word grid shown in Figure_4 and asked to select all of the words applying to the question presented.

For IQ-A1, "*If you experience symptoms whilst working (or as a result of working), e.g. stress, headaches, eyestrain, physical discomfort, how/what does that make you feel?*", negativity was the dominant feeling (70% of responses). The word cloud shown in Figure_8 depicts the dominance of each word; where word size is based on the number of times that word was selected from the grid (the colour/shade of the words in the cloud has no relevance). The words "impatient" and "irritated" dominate (11 and 9 responses respectively).

Figure_8: Word cloud depicting dominance of responses to IQ-A1: "*If you experience symptoms whilst working (or as a result of working), e.g. stress, headaches, eyestrain, physical discomfort, how/what does that make you feel?*"

Word	Occurrence
Impatient	11
Irritated	9
Inefficient and Frustrated	5
Annoyed, Compromised, Anxious, Ineffectual, Preoccupied, Depressed	4
Uneasy, Pensive, Disappointed, Fear, Satisfaction, Dispirited, Worried, Defiant, Weak, Bored, Indifferent, Thoughtful	3
Remaining words	2

For IQ-C, "*If you decide to take a work or rest break away from your computer, how/what does that make you feel?*", the overall feeling was one of positivity (57%). The top two responses were positive in nature, being "relieved" and "relaxed" (5 responses each), with "uneasy", "irritated" and "comforted" sharing third place (3 responses each).

For IQ-G, "*If the system advised you to take a work or rest break away from your computer, how/what would that make you feel?*", despite the top two responses being negative, "annoyed" and "irritated" (5 responses each), positive words occupied 10 out of the next 11 positions, resulting on an overall positive response (60%).

Whilst participants viewed break from the computer as positive in nature, as Table_9 shows, individuals appear unable to self-manage these breaks.

3.2.2 Themes

Following each interview recordings and notes were transcribed and initial analysis conducted. Reading of transcripts informed subsequent interviews and provided direction for literature reviews (Table_5: Level 1). The transcripts were analyzed on a line-by-line, sentence or paragraph basis according to relevance of content, i.e. at what level meaning could be attributed. Codes were assigned to data segments (Level 2). Whilst themes began to emerge (Level 3), it was not until all transcripts had been coded that meaningful review could take place in order to confirm over-arching themes, sub-themes and which were not supported by other transcripts (Level 4).

Coding allowed for themes and sub-themes to be analysed for frequency and relevance (Table_11). Refinement of the themes identified where overlapping occurred and allowed for clearer definitions and naming (Table_5: Level 5), e.g. it was possible to blend "Change" in to "Coping Strategies" to form a single theme which reflected "*actions which the individual instigates for her/himself in order to prevent or mitigate symptoms*". Further analysis identified that the theme could be dropped from the study as most were likely to continue whether or not the user had access to CIMS.

Trust was identified as an over-arching theme, with themes of "Purpose" (of CIMS), "Choice and Control", and "Privacy" being linked to the individual's ability to trust CIMS and her/his employer's deployment of CIMS. Self-awareness (or lack thereof) and self-confidence were also linked to trust, but in a less obvious way. Analysis of the interviewees' comments identified the fact that the majority did not trust their ability to contribute to their well being, with behaviour swayed by work demands, peer pressure and lack of self-awareness, e.g. loss of proprioception or track of time.

CHANGE	PRIVACY
= factors individuals change to relieve symptoms / how they view approach: • Location • Posture = move, stretch, walk • Reactive (rather than proactive / pre-emptive) • Task	= concerns and issues raised • Identification (e.g. too personal if can be identified through system) • Misuse • Not bothered (by issues of privacy) • Others made aware of problems • Posture versus affect • Security (trust, data protection)
CHOICE / CONTROL	PURPOSE
= users want choice and control • Control over who has access, when and why • Override, i.e. ability to override system if they disagree with advice or timing of advice, i.e. ignore prompt to take a break • System settings, e.g. ability to turn system ON/OFF, adjust feedback timing/format, log format, save frequency and so on • What the system monitors, i.e. affect, posture, DSE, or combination	= the how, what, when and why • Ability to review / track trends • Justification for change, expenditure etc. • Posture vs. affect vs. general DSE (e.g. environmental elements) • Propose remedial action / solutions • Provide context • Relevance • Reminder of good practice • Support individual • Warning (identification of bad habits, undesirable postures)
COPING STRATEGIES	SELF
= existing strategies used • DSE-related, e.g. changes to furniture, equipment, posture/position, settings, work habits and so on • Exercise, e.g. from gentle stretching to sporting activities • Letting off steam • Medication, i.e. prescriptions and/or over-the-counter • Movement • Reactive (rather than proactive / pre-emptive) • Relaxation techniques, e.g. massage, meditation, sauna • Therapeutic treatment, e.g. physiotherapy, sports therapy	= caused by / resulting in • Time, e.g. locked-in, too involved • Proprioception (lack of) • Behaviour, e.g. static for too long • Attitude, e.g. pull of work • Beliefs, e.g. peer pressure • Self-confidence
	TRUST
	= concerns and issues raised • Accuracy (ability of system to correctly detect and advise on situation) • Agreement (contract with computer) • Consultation (establishes trust) • Relevance (reason for each element of system) • Reliable (posture versus affect) • Sceptical (how can system know me better than I do) • Security / Employer misuse (could be used against individual if privacy and data protection not adhered to)

TABLE_11: Themes and Sub-themes Identified From Interview Transcripts

3.2.3 Trust

Taking “trust” as a theme in its own right, the main issues raised by participants were: trust in technology; trust in CIMS (emotion recognition versus posture recognition); and trust in their employers.

3.2.3.1 Trust in Technology

Before considering their potential for trust in CIMS per se, several clarified their view of technology in general:

P1(F): “*Well, like all computer systems, I am very sceptical of their working 100 per cent of the time*”

P10(F): “*... you know, every computer system that kind of thing crashes or has little gremlins that might make the data that is related to me slightly flawed and then might make me adjust in a way which not necessarily relevant*” (sic)

P14(F): “*... I think I would only want to use something that was automated or computer driven, if before that I had had a person actually go through with me the kind of messages it should be telling me and then if I did have a problem, like the video was telling me to lean to the left, then it would have been explained to me that occasionally it would tell me to lean to the right, but to ignore it and all of that kind of thing. So, yeah, I wouldn't want to just solely trust the system*”

P18(F): “*... I see it as a supportive system. I would definitely not rely on it. I wouldn't sit and wait for it that it hasn't reminded me to whatever ... it is to help me do a better job. I can't base my performance on it. I wouldn't be too fussed if it forgot to ping when it wasn't working today. That would be fine. I wouldn't put that much reliance on it*”.

3.2.3.2 Trust in the System (emotion recognition versus posture recognition)

When asked to rank the example CIMS in terms of trust, where “1” represents the system they would trust most and “9” represents the system they would trust least, there was a clear divide between those systems participants perceived as being able to measure something in time and space, e.g. mechanical use of equipment (e.g. force, frequency, time), location/position of equipment and/or user, compared with systems participants felt were more open to interpretation, e.g. facial expression, voice monitoring (Table_12).

Example Monitoring Method		Ranked Position in terms of Trust
A	Keyboard use (e.g. key action (force/pressure used), position of keyboard on work surface, number of presses)	1
C	Head position in relation to monitor (e.g. distance from screen)	2
E	Upper body posture (e.g. leaning towards the screen, leaning to one side)	3
B	Pointing device use (e.g. hand/finger pressure on device, grip position, button action (force/pressure used, number of presses), speed and range of movement, position of device on work surface)	4
D	Seated position (e.g. fully in chair with back supported, perched, fidgeting)	5
F	Facial expression (e.g. frowning, eyebrow positions)	6
H	Eye gaze (e.g. rapid movement, lack of movement, tracking eye gaze across screen)	6
G	Eye size (e.g. changes can indicate mood)	8
I	Voice monitoring (e.g. detecting the volume of your speech, tone, words used etc)	8

Table_12: Trust Ranking Positions for Example Monitoring Systems from questions IQ-J2
= Please rank the identified monitoring methods in terms of trust, where "1" is the method you would trust most and "9" is the method you would trust least.

Explanations for this clear separation of trust in physical versus emotion recognition included:

P15(F): "*I was thinking more that I would have more trust in it about posture ... because it is actually measuring something, so its ... presumably with posture it would know where I am in position within an area, so it is actually what springs to mind is a measurable thing. ... I suppose things like facial expression are measurable things, but not in my mind not in the same way as posture. Because obviously it is seeing that you are frowning for example but it's not an actual measurement like it can't .... whereas with body posture it can say "you are this many centimetres off centre", which is very factual, but with the frown you could be frowning just a little bit and it could be not in response to your actual work - could be a loud noise outside or something. Also, if I get some good news then I might stay happy for the rest of the day even though the work that I am doing is frustrating or potentially making me tired*".

P18(F): "*Keyboard use would definitely be number one and pointing device number 2. Much more likely to trust something that I can see ... understand how it measures, so posture ones I would trust more*"

P31(F): "*I think to use the words in the survey, I would "tolerate" the computer commenting on a few things like your body posture or your distance from the screen, ... even when I think of it watching my eye movement..... ok... but, when it comes to the system analysing other things through facial expression then I don't think ... those things just feel, personally I don't think the technology could accurately tell me more than I would know myself. ..... I think my earlier comments were based around the belief that the technology is not sophisticated enough to make those judgements about your moods, so therefore it's invalidated in my head*"

3.2.3.3 Trust In the Employer

Trust in employers elicited very mixed responses from participants, ranging from complete faith to complete mistrust.

When asked how she would feel if the system saved the data so that her employer could review it, participant 5 responded:

P5(F): "*Yeah, that's an interesting one. (pause). Uh, yes, if they were using it to improve your working situation. I don't, know, uhm, that's tricky. I say, yes. You have to trust your employers*"

Participant 14 acknowledged her employer's right to access the data, providing she was consulted first:

P14(F): " *... and I suppose because they* (employer) *would be paying for it, the software, so then it seems reasonable that they would want to monitor how it was affecting you, and whether you are improving ... but, I would want to be consulted if it was going to be accessed*"

Participant 15 voiced concerns about the "remote" aspect of employers monitoring staff:

P15(F): "*My initial reaction is that I would like the control. ... I don't like the thought of being monitored I suppose. Also, it's monitoring where you can't necessarily see that you are being monitored. I don't know, if you are sat next to your boss that's fine, but if I'm being monitored by a camera ... I don't know, there is something about that which is disconcerting. So, I guess I am slightly cautious rather then strongly "no"*"

Several participants wanted assurances as to how the data would be used. Participants 18 and 23 sum up the feeling:

P18(F): "*I would want assurance that it was not going to be used against me, not personally, but as an employee. I think it should come with an assurance that those who agree to it ... that it isn't used against them*".

P23(M): "*I'd want to know exactly the fact that they are doing it or wanting to get access to it. I'd want to be in a position to give permission or not. We all know how well people can present reasons for doing something, but it comes back to trust*"

Whereas, others refuted the employers' right to access:

P21(F): "*... so if they are doing it remotely and monitoring use of their equipment that's one thing, but then monitoring me as a piece of equipment that's quite different*"

P31(F): "*I wouldn't like it at all. Not at all, no* (employer having access to data)*. In the worst case, it could be used as evidence against you*"

3.2.4 Purpose

The perceived purpose of CIMS is to support the individual in achieving well-being, managing symptoms. Participants were adamant that the data gathered should not be used against individuals in any employment disputes.

P15(F): "*....I mean obviously it would have benefits because if there were any changes that need to be made, you could sort of say this and this has been logged please could I have a different keyboard to help me that kind of thing .... so, supportive rather than ammunition against me*"

In terms of how CIMS would meet its goal supporting the individual, the following suggestions were made:

P5(F): "*I think that I would want them* (CIMS) *to monitor anything that could be damaging long term, so that if I continue doing it, like, a couple of months or whatever, ... yeah, I wouldn't want it to pick up on little things that didn't really matter because that would be annoying*"

P14(F): " *... if I felt that I was anxious and couldn't really understand why then maybe something that would monitor your stress or emotions would be*

quite useful but, if I wasn't having any problem then I would maybe feel that it was a bit too much to have that"

P16(M): "*I'd expect it to check on my position at the workstation, monitoring the way I am sitting. Also the way I am holding the mouse, if I am placing pressure on my wrists, and sort of pressure I put on the keyboard. Whether I am over exerting my fingers. I'd expect it to measure heat, temperature in the workplace, cos this office can get quite warm and I know that temperature can affect work performance"*

3.2.5 Choice and Control (Autonomy)

From iterative analysis of the transcripts it was possible to rename "Choice and Control" to "Autonomy", i.e. personal independence, an individual's right to choice and control.

Participants wanted the choice as to whether to use CIMS, or elements of CIMS, rather than being forced to. At best lack of autonomy would frustrate them:

P1(F): "*I would not want to be prevented from getting on with the task in hand. Cos that affects my autonomy and anything that affects my autonomy goes against the grain with me in any context (laughs) I know myself well enough these days (laughs). So, to be told that I can't use my computer because the computer says so would have me throwing it through the window*"

At worst, enforced usage might lead to individuals seeking alternative employment:

P21(F): "*I suppose the question is ... at what point would I decide it is too much and leave*"

Combining purpose and autonomy together, Participant 23 had strong opinions:

P23(M): "*What I want it to do is to warn of impending danger of injury and not just that, but to provide information about best practice and any corrective action or strategies to follow in order to minimise the risk of injury occurring. Where symptoms exist, it should try to either relieve the symptoms by offering suggestions about taking a break or carrying out some stretches/exercises (to be used advisedly). What I wouldn't want it to do is to take control away from me*".

When considering the practicalities of using CIMS, participants had a wide range of preferences and suggestions. Each voiced her/his preferences and dislikes, but there were few commonalities. By providing the user with control over CIMS settings and incorporating multiple modalities, such as text, graphics, animations, video and audio, CIMS may be customised to meet individual changing needs, e.g. several interviewees raised the issue of not wishing to have audio as that would not only alert her/him to the system's prompt, but also

their colleagues would be aware that a problem may have been detected (loss of privacy). In contrast, other interviewees felt that audio would be particularly beneficial to clarify matters, allow one to listen to the prompt rather than necessarily looking up at the screen to read it, and to provide companionship for solo or home-based workers (CIMS as social actor).

3.2.6 Privacy

In answer to the specific privacy questions (IQ-I1, and I2), most participants could not readily recognise an issue. Once the conversation delved deeper into the issues surrounding methods of data capture, data storage/format, and so on, the comments made by participants indicated where trust issues might come into play:

P15(F): "*... I don't know that I would just want it to be free information because, again, people would interpret it in a different way, mmm ... yeah..... I suppose I would have a reservation, because once it's logged, IT IS logged, if that makes sense*".

P17(F): "*I'd want it on my hard drive, others would be wary, sensitive, all sorts of issues … want it to be secure. I'd want to be the only person who could get at it, so yes, passworded, encrypted etc.*"

P31(F): "*I like the idea of it only being accessible by me and not by system operators.... The control for that data that is saved needs to be in my hands completely*"

Another privacy factor was with those detection and reporting methods which had the potential to identify individuals, and so encroach on their privacy. For some it was a matter of voicing concern which might need further consideration:

P10(F): "*Not major issues, but I am not overly keen on the last three, eyesight, eyegaze and voice monitoring. The others I have no issue with at all, but they (last three) just seem a bit more personal and, you know, I am very identifiable by my eyes and my voice whereas my posture if, you know, you can't see my face too much, then ..... (shrugs)*"

P16(M): "*I think I don't like sounds like beeps and that, cos I think that would be invasive for colleagues so, sort of a system of messages popping up on the screen. I'd know it was happening, but other colleagues wouldn't*".

P23(M): "*I think possibly the monitoring using cameras, it's more intrusive of privacy, but there again I think if the user is in control of implementing such a thing then you are doing it for your own benefit ... but I think, again, it depends how it is implemented and about the understanding that people are given*"

Whilst for others, they would reject such encroachment:

P21(F): "*I have concern for .... voice monitoring, eye gaze eyesight, facial expression, even ... because you really do need a lot of detail to identify those. Upper body, seated position, head position ... you still need to see me, but they could have less detail, I suppose, so it could be more anonimised. So, less concern, but still ....no. So, mouse and keyboard use or position ... but it's just annoying, I don't want it telling me that. I don't want it telling me that I am hitting something to hard ... maybe I am, but not being a typist either, so maybe if I was typing loads of stuff, but its just .... no*".

P30(F): "*I would have privacy issues with both the above (emotion and posture monitoring) because the data could be used by insurance companies, potential employers, existing employers, hospitals, and if it was shown that I had ignored advice this would be detrimental to me because they might refuse to pay out on a claim or employ me, oh all sorts of things*"

3.2.7 Self

Despite survey participants reporting that they felt able to self-manage, a common theme for interviewees was lack of self-awareness and/or self-confidence. They felt unable to trust their own judgment in terms of managing well-being:

P1(F): "*I resent the fact that my own shortcomings in managing my working environment over the years and lack of attention to symptoms or even lack of realising there were any, have put me in a position now where some of the things I do at work have a direct negative impact on what I do away from work*"

P2(F): "(a) *coping strategy would just be I suppose, changing posture, but then that's already when you have noticed that you have the strain somewhere so as much as it is beneficial it is not really because you have already incurred the strain so it's only beneficial for a time afterwards*"

P14(F): " *... even though I am aware that I need to sit differently it is not always easy to remember to notice that you are not*"

P31(F): "*You know, you asked me if I'm comfortable and I am never aware if I am comfortable or not. It's almost like I don't know what comfortable is. As soon as I consider the question I almost become uncomfortable just from that thinking process, so I am never sure what is really what*"

3.2.8 Perception of Risk

With the photographic images used at the end of the interview, it had been anticipated that participants with physical symptoms would rate risk from

posture-related images more highly than those participants without related symptoms; and visa verse for images selected to engender feelings of stress. Analysis of the comments and risk ratings revealed no correlation between the nature of image and reaction to risk in terms of reported symptom experience. Consequently, no further consideration was given to this element of the study.

3.3 Validation

3.3.1 Stage 1 (Survey)

As the participants had completed the surveys themselves it was not necessary to seek validation on their responses.

3.3.2 Stage 2 (Interview)

All interview participants received copies of their transcripts in order to verify validity. This also provided participants with the opportunity to provide post-interview comments. Comments received were factored into the coding process before final themes were identified.

Participants quoted in the paper received copies of Section 3.2 and were asked to verify that their views had been accurately represented. One modification was requested.

4. Discussion

Analysis revealed that experience of symptoms does not necessarily mean that individuals readily welcome intervention (Nieuwenhuijsen, 2004). Potential barriers exist that may prevent users from accepting CIMS as a part of their MSD intervention program. Trust was identified as a gateway to acceptance (trust of technology; CIMS method(s); and the employer); with "Purpose" (of CIMS), "Autonomy", and "Privacy" closely linked to the individual's ability to trust CIMS and employers' deployment of it. In addition, the individual must be able to trust her/his self. These five potential barriers need to be considered, and where necessary addressed, in order for the individual to be in a position to make an informed decision whether or not to become a CIMS user.

This chapter will consider each barrier, relating these barriers and the ethical factors that surround persuasive technologies to current literature, before introducing a CIMS User Acceptance Model.

4.1 Ethics in Persuasive Technology

Some of the themes and concerns raised by the study participants surround ethical use of CIMS. When captology and persuasive technology were in their infancy, Berdichevsky and Neuenschwander (1999) considered the placement of "ethics" and "technology" by imposing them on to Fogg's diagram of captology (Figure_9).

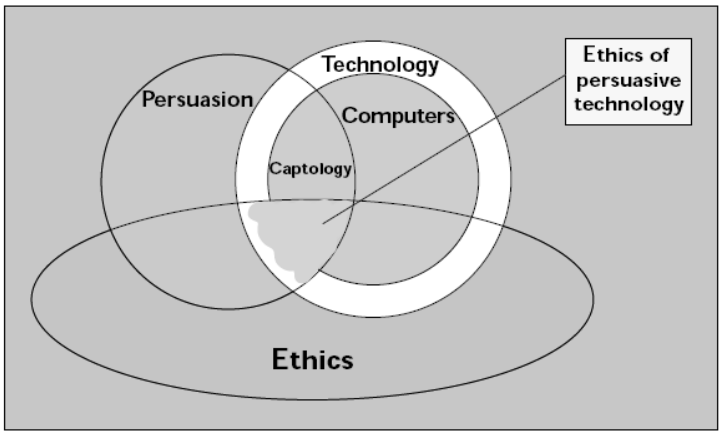


Figure_9: Convergence of ethics, persuasion and technology (Berdichevsky and Neuenschwander, 1999)

More recently researchers have sought to define what ethics means to the user. Kelly (2006) declared that he would accept technology if three out of the following four conditions were met:

- *"I know what information is being collected, where, why and by whom*
- *I assent to it either implicitly or explicitly and I am aware of it*
- *I have access to correct it, and can use the data myself*

- *I get some benefit for doing so (recommendations, collaborative filtering, or economic payment)"*

On first inspection, these conditions appear to relate closely to the potential barriers identified by the interviewees, but individuals are often inconsistent. Whilst some participants stated that privacy and trust did not factor highly in their view of CIMS per se, they, along with the other participants, emphasised their wish to be in control of the data. This may be interpreted as a wish for privacy and possible lack of trust in colleagues and employer. As a result, it is necessary to delve deeper into the specific ethical issues raised by the study.

4.2 Trust

Whilst some persuasive technologies may have a positive purpose, they can negatively intrude into the lives of the users. Technological trust may be influenced by a range of beliefs, attitudes, intentions, culture, knowledge of world states, as well as the technology user's behaviour. Worldviews differ amongst individuals colouring attitudes towards risks and benefits. By understanding what trust means to potential users technology developers may gain greater insight into the users' needs and wishes.

4.2.1 Trust in Technology

The Chambers Twentieth Century Dictionary's definition of trust is: "*worthiness of being relied on; confidence in the truth of anything*" (Chambers, 1975). In technical terms it was these two aspects which were identified as being of concern to the study participants:

- Worthiness of being relied on:
  - Will the technology be fit for purpose?
  - How likely is it to break down?
  - Are some monitoring and detection methods more error prone than others?
- Confidence in the truth of anything:
  - Are some monitoring and detection methods more capable of being accurate (truthful) than others, and if so, how/why?

Trust is temporal in nature. It takes time to build and it must exist before technology may be fully adopted and utilised. Whilst users may develop a degree of trust in the infrastructure of technology over time, e.g. hardware and mainstream software applications, potential CIMS users need to be assured that the new system is trustworthy; that there is no difference between capability and reliability. Trust is, however, not synonymous with user acceptance. Miller (2005) purports that trust should be tuned to result in accurate usage decisions.

When considering trust and automation, where automation is "*information technology that actively transforms data, makes decisions, or controls processes*" (Lee and See, 2002), Lee and See (2004) describe a conceptual model of the dynamic process that governs trust and its effect on reliance. The

model identifies three levels of information which the operator (in the CIMS case this would be the user) needs in order to develop trust:

- *Purpose: why the system exists*
- *Process: how the system works*
- *Performance: what the system has done*

These levels are the "how", "why" and "what" knowledge requested by interview participants 16 and 17 before they felt able to comment on the trustworthiness of any given CIMS.

4.2.2 Trust in CIMS Methods

The quality and relevance of the technology's ability to gather data and draw correct inferences will influence trust (Ijsselsteijn et al, 2006). Fairclough (2009) emphasises how the sensitivity of a monitoring method is "*a vital attribute*" in enabling the system to respond appropriately, e.g. being able to distinguish low levels of frustration from high levels of frustration.

As was shown by the trust ranking of example CIMS (Table_12 and Appendix_7), the participants ranked physical CIMS (equipment use and posture) more highly than affective measures. The low trust ranking of affective CIMS may be explained by the participants' lack of experience of such technology. If one does not understand the purpose of the technology (the what, why and how of it); if one feels that technology may reduce one's autonomy, or that it may encroach on one's privacy, then the perceived risks involved may result in a lack of trust in that technology. With no background knowledge of emotion recognition techniques, participants could only rely on affective information, i.e. does the system please or displease? If I do not like something then I may find it harder to believe that it has my best interests at heart. Trust will be lacking.

Participant 31 questioned how CIMS would be able to accurately detect her emotion-state better than she knows herself. Mismatches between user and system perceptions of a physical or emotion-state may result when the system fails to detect a state/change which has been perceived by the user or when the system detects a state/change which is imperceptible to the user (Fairclough, 2009). In both circumstances trust is tested.

Whilst participants with experience of symptoms wished to become comfortable in the physical sense, they did not want CIMS to make them uncomfortable in the psychological sense.

> "*the critical challenge is to calibrate trust*
> *to encourage appropriate reliance*".
> Lee and See (2002)

4.2.3 Trust in the Employer

A Harris Poll (Taylor, 2003) found that the largest decline in privacy concern was found among those who felt that "*not being monitored at work is extremely*

important" with the figure falling from 65% in 1994 to only 42% in 2003. Ubiquitous employee monitoring is now possible, and this may explain the drop. Measures include: computer use (keystroke tracking, email and Internet site usage); telephone monitoring; video surveillance, employee ID card location tracking. Employee monitoring may be transparent or covert. Workplace monitoring and surveillance may be disliked by employees, but generally tolerated as a part of the terms of employment (Charlesworth, 2003).

As reported by Participant 21, existing employer mistrust may, however, undermine potential acceptance of CIMS, e.g. declared social values, mission statement must match employer actions in order to engender trust from employees (Strebel, 1996).

4.3 Purpose

Study participants had a pragmatic awareness that employers may not have the resources to provide one-to-one DSE assessment of need and so interventions such as CIMS may be considered as part of the overall approach to meeting DSE Regulations and achieving employee well-being.

4.3.1 Consultation

> "*There would be no need to trust ..... any system whose workings were wholly known and understood*" (Raab, 2007).

Users need to understand how CIMS works in order to appreciate the range of manipulations they may be subjected to (Fairclough, 2009). In order to understand CIMS and be able to make an informed decision as to whether to accept or reject its use, participants wanted to know more about the system(s); what it was, how it worked and why it might be introduced.

By law employers must consult their employees on health and safety matters (Health and Safety Executive, 2008), but not on all monitoring measures; unless their use falls under specific legislation such as the Data Protection Act 1998 or Human Rights Act 1998. The definition and purpose of CIMS is therefore vital to the consultation process. The study has shown the participants' overwhelming view that CIMS should support well-being and so CIMS must be placed in the health and safety bracket.

Consultation should foster understanding and trust through system transparency and employer accountability. Lack of consultation may result in individuals being at a disadvantage if they do not fully understand the data acquisition system (Shapiro and Baker, 2001). As a result of lack of consultation on prior occasions, Participant 21 reported that she and her colleagues would try and find ways around CIMS and posed the question: at what point would she decide that it is too much and leave (her job). These views are supported by studies that have identified loss of trust and deterioration of working relationships as an outcome of workplace surveillance. Disaffected employees may undermine employers' plans (Strebal, 1996; Morrison, 2006). As Participant 21 points out, if CIMS is

viewed as a management tool for checking up on staff, rather than a user support tool to foster well-being, then resentment/cynicism may ensue, if not a complete rejection of CIMS (Morrison, 2006). Morrison's study indicated that individuals involved in technology change decision-making reacted more positively to change than did individuals with low levels of involvement.

4.3.2 CIMS as a Emotion-state Changer

79% of survey participants reported never using an ergonomic, work or symptoms-based break utility (limited version of CIMS). This high proportion may go some way to explain why CIMS that incorporated known aspects, e.g. posture/equipment use, were perceived as being more acceptable than those that involved emotion recognition, for which participants had no frame of reference. Several questioned whether a system should be allowed to try to change the user's emotion-state (Zimmermann et al, 2003).

4.3.3 CIMS as a Social Actor

Participant 1 reported that working alone, without social contact and feedback provided from colleagues on how long she had been working, was a factor in her own inability to manage her work/break habits. Ergonomics programs often advocate Buddy Systems which enable colleagues to share information about health and safety and so help foster a supportive environment (Ostrom et al, 2000). Use of CIMS as a social actor could provide lone workers with the benefit of social support that a colleague might ordinarily supply (Olsen and Kraft, 2009).

CIMS ability to provide feedback will help the user know what to do in order to make change. An archive facility enables her/him to review whether the change(s) make any difference (Gravina et al, 2007). These facilities may help to improve self-efficacy (perceived capabilities to attain specific goals or task outcome).

4.4 Autonomy

Persuasive technology is a category of technology which is intentionally designed to change an individual's attitude or behaviour. Ijsselsteijn et al (2006) emphasised that persuasion implies a "voluntary" change of behaviour, attitude, or both. The voluntary aspect came through strongly in this study, where participants repeatedly spoke of their wish for autonomy.

4.4.1 Choice

The individual's ability to choose whether or not to use CIMS closely relates to knowledge of its purpose and so will, in part, result from the consultation process; which engenders empowerment and ownership. Without the consultation process/knowledge of purpose, the ability to make a rational choice

diminishes. Choice also relates to control, with perceived control directly associated with higher satisfaction (O'Driscoll and Beehr, 2000).

4.4.2 Control

Most participants stated their requirement to configure CIMS to meet their personal and work needs; adjusting them on a task-by-task, or day-by-day basis as necessary. Being in control was imperative for most participants. This need is supported by several studies and papers on the subject of persuasive technology (Picard and Klein, 2002; Fairclough, 2009).

Another justification for user control was put forward by Participant 17, who described stress as a motivator, "*feel of adrenaline*". She questioned whether CIMS should report stress in all circumstances. Rickenberg and Reeves (2000) support this view stating that some arousal may be useful to determine what we do, how we channel focus/attention. Participant 17 would be more concern if stress levels did not reduce once a deadline/task had passed.

Identification of stress/frustration was a factor raised by several participants, who felt that they were better placed to identify how they felt than "a computer" could be. They would prefer to have that aspect of their emotions within their own control; a view supported by Reynolds and Picard's study (2001). Computers can very easily induce negative affective states in human users, such as frustration, anxiety and anger. Mainstream technology's inability to rectify these negative states may impede productivity, creativity and cognitive capacity (Mentis and Gay, 2002). Apart from Participant 23, who would want the system to provide solutions to problems he encountered, the participants could not see past the fact that they did not want their computers informing them of their emotion-state. Consequently, they could not effectively consider how the system might provide advice/guidance on overcoming technical issues.

Tailoring CIMS approaches to the attitudes, beliefs and knowledge of the user may enhance likelihood of increased well-being through the system-recommended change being implemented (Whysall et al, 2007). One example of this can be seen in terms of system feedback format, where participant preference was quite varied. Studies have shown that where feedback is tailored to reflect individual requirements/preferences relevance is increased, making it easier for the user to comprehend and remember (Fogg, 1999; Dijkstra, 2006). Providing the user with the ability to customise CIMS may result in increased positive behaviour change.

4.5 Privacy

Westin (1970, p7) asserts that privacy is:

> "*the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others*".

Privacy is a personal concept, with worldviews differing between individuals or even for the same individual under different circumstances. Influencing factors may include experience and context. Privacy decisions are often based on judgement rather than fact, as individuals rely on weak mental models and heuristics. In group situations such as the workplace, an individual users' privacy preferences may be influenced by social norms/group behaviour.

When asked about their attitude towards privacy, most participants initially reported that it was of little concern to them; this despite previously voicing concerns over data access rights, which implies issues with privacy control. Participants' initial inability to perceive privacy issues with CIMS may be related to analogical trust of the researcher, i.e. prior knowledge of the researcher deemed her as trustworthy and that trust transfers to CIMS (Raab, 2007). As the interview developed deeper into what might constitute privacy, participants reported the following concerns/expectations with regards to CIMS:

i. That feedback from the system should not alert colleagues to potential problems, which might result in embarrassment for the user (privacy as personal dignity)
ii. That data may be taken out of context
iii. The potential to be identified through data held by the system, e.g. video images, voice recordings (privacy as anonymity)
iv. That data recorded should be securely stored (security) and used appropriately (support the employee); not mis-used

The first two points are perhaps more easily addressed. Point (i.) through CIMS compliance with autonomy, as the user would be able to adjust the settings to meet her/his privacy preferences, i.e. provide discreet text/symbolic messages (Fairclough, 2009). Picard and Klein (2002) argue that control of the monitoring function should always lie with the user. If data is taken out of context, point (ii.) then there is the potential for discrimination if the individual is included in a particular profile/classification. Providing context which the user may update should s/he wish (proposed by Participant 15), may help to address this concern (Bullington, 2005; Fairclough, 2009).

Points (iii.) and (iv.) fall under the category of data privacy; the expectation of privacy in the collection and sharing of data about oneself. Concerns exist where uniquely identifiable data relating to the individual are collected and stored. Fairclough (2009) reported that "*a technology designed to promote symmetrical communication between user and system creates significant potential for asymmetry with respect to data protection, i.e. the system may not tell the user where his or her data are stored and who has access..*".

Participants voiced concerns over who would be given access to the information and under what conditions. Ownership of data, i.e. does the individual own rights to data, have rights to view, verify, change or challenge the data. The European Union requires all member states to legislate to ensure that citizens have a right to privacy. In the UK this is regulated by the Data Protection Act 1998. The Data Protection Act gives individuals the right to know what information is held about them; providing a framework to ensure that personal information is handled properly (Information Commissioner, 2009). Such controls are designed to

ensure that consensually gathered information is not used in ways that do not relate to the original grounds for consent.

Privacy protection may be seen as a risk-management device; with the level of trust in technology reflecting the degree of trust in risk management (Raab, 2007). Existing mistrust of an employer led participants to lean towards mistrust of CIMS. Achieving transparency with CIMS is key. So that whilst employers may know more about the users through the user of CIMS, the users should be fully aware of what the employers know and how that information will be treated.

Palen and Dourish (2003) argue that what is important is not what the technology does, but rather how it fits into cultural practice. Privacy management is a dynamic entity with, as the study participants demonstrated, individuals responding to circumstances as they are presented rather than applying static rules. An individual's need for privacy, if considered in isolation, may threaten their chances of increasing their well-being, i.e. if the user's privacy needs are met then s/he is more likely to accept CIMS and so benefit from it, whereas if privacy needs are not met then the user is more likely to reject CIMS and so lose any benefit it may bring. As individuals often rescind their right to privacy where rewards may be gained (Acquisti and Grossklags, 2005), privacy concerns may be balanced with the other barriers identified by the study. Consequenly, CIMS should not be seen as an instrument through which privacy concerns are reflected, but part of the wider circumstance within which the concerns of the individual are formulated and interpreted.

4.6 Self (the "user")

As well as considering the potential barriers discussed above, perhaps more importantly, the user must consider her/his self; the degree to which one may understand and trust oneself. An individual's self-efficacy will feed their self-confidence; a critical factor in the decision-making process (Bandura, 1983). Several participants declared awareness of own limitations. For those participants who reported a lack of self-awareness, they might trust CIMS to report problems and prompt for action more than they would trust themselves. For those individuals who posses self-awareness, they felt able to interpret what CIMS was reporting and know whether or not to trust the advice given.

As with trust, decision making is based on an individual's attitudes, beliefs, culture. These aspects have the capability of changing over time based on knowledge acquired through new experiences. User acceptance of CIMS is not simply a matter of achieving trust. There must be a willingness to accept advice and change behaviours and resistance to change is common (Neumann et al, 1999). Participants had a pragmatic awareness that their employer was unlikely to have the resources to review all CIMS logs. Working in partnership with CIMS, the individual would need to take ownership for her/his own well being. Employee behaviour may be seen as one of the greatest determinants in workplace safety (Gordon, 2003). As one participant reported, future consequences of behaviour are easily ignored in the present, e.g. continuing to work on a piece of work, even though a break is due, only to "*hurt*" later on. The

ability to shift between different behavioural strategies is necessary for appropriate change behaviour decision-making.

When considering health-related behaviour change, Niewenhuijsen (2004) found that self-efficacy and "*intention to change*" demonstrated a positive relationship with health-related behaviour change. According to the Stage of Change model (Prochaksa and DiClemente, 1982) an individual's readiness for change will be different from her/his neighbours; with each person's ability to change taking place according to where s/he is within the various model stages: (pre(contemplation)), preparation, action, sustaining/maintaining health behaviours. This starts to explain the varied responses provided by participants.

Montgomery (2004) defines wellness as a combination of factors, which include:

- Physical wellness, which entails personal responsibility and care for minor illnesses and knowing when professional medical attention is needed
- Emotional wellness, where one recognizes awareness and acceptance of one's feelings and the degree to which one feels positive and enthusiastic about oneself and life
- Occupational wellness, which recognizes personal satisfaction and enrichments in one's life through work.

CIMS adoption is more likely to succeed if the individual is able to recognise strengths and weakness in her/his self and make sense of how CIMS may support these personal traits in the promotion of wellness. In order to take ownership, where individual attitude and behaviour play a vital role (Gravin et al, 2007) the individual needs to be self-aware and self-confident. Both are skills that most participants appear to be lacking.

4.7 The CIMS User Acceptance Model

The study found that a variety of physical, psychological and psychosocial aspects impact on an individual's potential for acceptance of new technology and the change it brings. Take up of an intervention such as CIMS requires the individual to be ready to accept a desirable lifestyle change (Nakajima et al, 2008). The Stage of Change model, which is cyclical in nature, identifies an individual's readiness for change. Each person's ability to change and stage position will be dependent on attitudes, beliefs and current knowledge. Table_13 shows each stage and definition identified by Whysall et al (2007).

In terms of readiness, the Stage of Change model is one way by which the individual's potential for CIMS acceptance may be considered (Whysall et al, 2007). It works for Participant 21 who is not prepared to follow ill-health preventative advice and may be firmly placed at pre-contemplation. According to the other participants in this study the model does not tell the whole story. Whysall et al (2007) found worker stage of change may be unrelated to their perceived cost-benefit of MSD intervention. It is this very individualism of the user which is at the centre of any health-related behaviour change.

Stage of Change	Definition
Pre-contemplation	Not intending to reduce the risk
Contemplation	Intending to take action in next six months
Preparation	Intending to take action in the next 30 days; and/or have developed specific plans for the steps that are to be taken
Action	Working to reduce risk
Maintenance	Having taken action more than six months ago; and are working to consolidate the gains made and prevent relapse
Relapse	*Definition not provided*

Table_13: Stage of Change Model Definitions (Whysall et al, 2007)

For persuasive technology an additional aspect of acceptance is involved. CIMS monitors the individual in order to encourage a voluntary change in behaviour. Being ready to accept change does not mean that the individual is prepared to accept any/all change. Study participants have indicated that they might be ready to accept CIMS based on posture detection, but not emotion-state; that posture measured by equipment position, body/head distance from the computer screen would be acceptable, but use of cameras would not (Table_14).

THEME	EXAMPLES of READINESS to ACCEPT CHANGE
Trust	• Ready to accept what I know and understand, e.g. physical aspects or position, posture, equipment use • Not ready to accept what I do not know or understand, e.g. emotion-state measurements
Purpose	• Ready to accept a system which will support me in my attempts to improve my well-being • Not ready to accept a system which might be used against me
Autonomy	• Ready to accept a system which I can adjust as my personal and work needs dictate • Not ready to accept a system which takes over or which is controlled remotely by others
Privacy	• Ready to accept a system which will maintain my privacy, e.g. silhouette of my upper body to show posture • Not ready to accept something which invades my privacy, e.g. video surveillance
Self	• Ready to accept a system as I am aware of my own shortcomings which prevent me form managing my own well-being • Not ready to accept a system as I do not want it; do not believe I need it

Table_14: Examples of readiness states for CIMS

Following the user-centred approach taken by HCI, a CIMS User Acceptance Model is proposed which places the "user" at its centre, so that each user may be treated as an individual.

Technology user acceptance models already exist, so why present a new one? Previous models, such as the Technology User Acceptance Model (TAM) (Davies, 1989), identified "perceived usefulness" (the degree to which a person believes that using a particular system would enhance his or her job performance) and "perceived ease of use" (the degree to which a person believes that using a particular system would be free from effort) as factors in user acceptance. A study by Venkatesh et al (2008) found negative association with behavioural intention of using technology, i.e. if the user perceives the technology as being difficult to use, then s/he is less likely to have a positive attitude towards the concept. With regards to CIMS, apart from Participant 21 who flatly refused to countenance use of CIMS, the participants could all see the potential for "usefulness" of CIMS, but "ease of use" was not raised by any of the study's participants; this finding is supported by other studies (Keil et al, 1995; Hu et al, 1999). Usefulness on its own does not explain the attitudes expressed by the participants as to whether or not they would accept CIMS.

More recent studies have found that the type of technology impacts user attitude and usage (Curran et al, 2005; Im et al, 2008). Due to the variety of influencing factors involved, e.g. perceived risk, a sub-construct or antecedent of trust (Im et al, 2008), attitudes towards different technologies used to deliver the same service are discrete from each other. Whilst the identification of risk starts to explain the findings of the present study, it does not go far enough. The present study confirmed that technology cannot be viewed as a single homogeneous group when considering user acceptance.

Whilst Nieuwenhuijsen (2004) found that process of health behaviour change is interactive, he found no significant relationship between knowledge of ergonomic risk factors, awareness of preventative activities and health behaviour change. Knowledge may influence choices in behaviours and actions, but it is not the most important variable influencing an individual's behaviour change (Haslam, 2002). As such, knowledge of CIMS, with regards to its purpose, scope of autonomy and approach to privacy is insufficient.

Taking the issues that surround persuasive technology into account, and by applying the participants' themes to CIMS, the CIMS User Acceptance Model is proposed. With trust as its bedrock, the model identifies purpose, autonomy, and privacy as potential barriers to acceptance. At the core of the model is the user (the individual, the self), who must not only establish her/his level of trust in CIMS through interpretation of the barriers, but also consider how far s/he can trust her/him "self" in coming to that decision (Figure_10 and Table_15).

Each potential user must be provided with sufficient information about CIMS and its intended implementation in order to understand and interpret each of the barriers as they may apply to her/him "self" (attitudes, beliefs, behaviours). This will establish to what degree s/he trusts before acceptance may even start to take place.

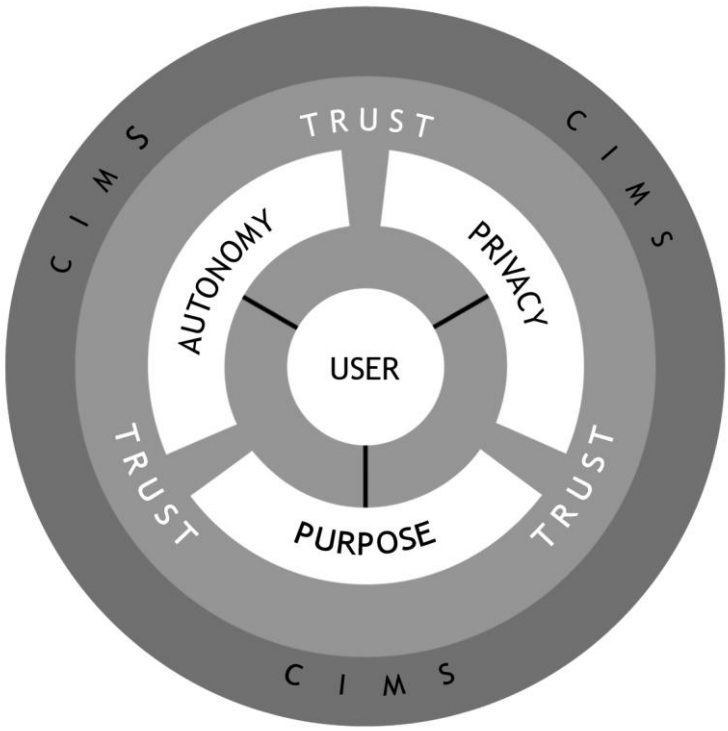


Figure_10: CIMS User Acceptance Model

Potential Barrier	Definition	Themes
User	Individual who is a work-based computer user	Individual Self
Purpose	A system designed to support the individual in the prevention/reduction of MSDs	What, why and how
Autonomy	Providing the user with the ability to: • choose when/if the system is used • control the system by configuring each element to meet her/his personal and work needs	Control Choice
Privacy	Ability of the system to protect the user's data/identity to the user's satisfaction	Security Who, how, when
Trust	The degree to which the user believes that the system, its purpose and configuration, and those who support her/his use of it may be relied upon	Accuracy, Agreement, Misuse, Relevance, Reliability

Table_15: Components of the CIMS User Acceptance Model

For the individual to achieve successful adoption of persuasive technologies such as CIMS s/he needs to appreciate the potential benefit, be willing to change and be supported through the change process (Haslam, 2002). Beyond initial

acceptance, study participants raised practical concerns, similar to the questions posed by Ijsselsteijn et al (2006):

- they would want the technology to be subtle, rather than irritating or controlling
- they do not want to be frequently interrupted or continually receive the same feedback
- incorrect inferences, improper feedback, or bad timing may be tolerated, but for how long?

Before Participant 31 is able to enter into a "*contract*" with CIMS, these and other practical concerns need to be addressed. True levels of acceptance may only be known if CIMS is developed and computer workers use it.

4.8 Study Limitations

4.8.1 Self-reports

The HSE (2009) notes that whilst its figures come from self-reports and so "*are not an exact measurement of the true extent of work-related illness*", such self-reports provide a reasonable indicator as they have previously confirmed through "*high levels of agreement between individuals and their general practitioners*" (GPs), with agreement being particularly high for cases of self-reported stress, depression or anxiety and MSDs. This observation is supported by studies such as that conducted by Deyo and Diehl (1983). As the majority of survey participants were known to the researcher, the self-reports provided by the survey could be verified through contact history, client case notes, and further interrogation at the interview stage.

4.8.2 Project Timing, Participation and the Potential for Bias

At the project planning stage it was envisaged that the survey would be conducted during May and June of 2009. Due to unforeseen circumstances, the survey was delayed until July, by which time many of those who had declared an interest were no longer available. This reduced the sample size, the industry sector spread and number of participants without symptom experience. Consequently, the participants of this study do not represent a randomly selected sample of work-based computer users.

4.8.3 Stage 1 (Survey)

The combination of purposive and convenience sampling methods used was designed to ensure an even distribution of males to females, industry types, known symptoms (known to the researcher through prior discussion or professional involvement) versus no known symptoms. The survey reach and feedback received was significantly skewed in some areas. For example, from the purposive sampling, 75 females and 20 males were canvassed. A potential population of 100+, predominantly males, should have been reached via the employer/group representative survey. Non-availability of primary contacts

meant that invitations were not passed on within a suitable timeframe. Only 10 participants were found using this method (8 females and 2 males). The small sample size may have resulted in bias as more females than males (28:10) took part in the survey. When considering participants experience of symptoms, 34 reported symptoms compared to 4 without.

4.8.4 Stage 2 (Interview)

Whilst there was a potential interview pool of 31, availability prevented participants from taking part who as a result of their survey feedback might have provided insightful comment.

4.8.5 The Hypothetical Nature if CIMS

As CIMS does not yet exist, participants may have swayed their responses in favour of known aspects, e.g. posture/equipment use were perceived as being more acceptable than those which involved emotion recognition, for which participants had no frame of reference.

4.9 Future Studies

Whilst the study has begun to answer the questions that surround user acceptance of CIMS, many remain unanswered. Some of these may offer opportunities for further research.

4.9.1 Potential Bias

4.9.1.1 Gender

Berkley (1997) found that sex differences in attitudes exist that affect not only reporting, coping and responses to treatment, but also measurement and treatment. At interview stage the female to male ratio was 11:2. Whilst the comments of the two male interviewees were in line with those of the females, repeating the study with a greater male population would confirm if gender bias had any part to play in the study outcome.

4.9.1.2 Industry Sector

When considering implementation of the Stage of Change Model, Whysall et al (2007) found private versus public-sector differences in their study. Participants in the study were predominantly from the charity / not for profit sector. Repeating the present study with a greater spread of industry sectors would confirm if sector bias had any part to play in the study outcome.

4.9.2 Adaptations of CIMS and the User Acceptance Model

The study asked participants to considered multi-factorial CIMS; systems that would monitor posture and emotion-state, utilising a variety of monitoring methods. Further investigation would be needed in order to establish whether the barriers within the CIMS User Acceptance Model remain relevant for each of the possible uni-factorial CIMS and monitoring methods, e.g. monitor posture, but not emotion-state; use of keyboard use, but not cameras and so on.

4.9.3 Applying the Model to Other Persuasive Technologies

By separating the user acceptance variables identified in this study from CIMS (Figure_11), they may be applied to other forms of persuasive technology. Further research would be needed in order to establish if all of the variables remain potential barriers for different types of persuasive technology.

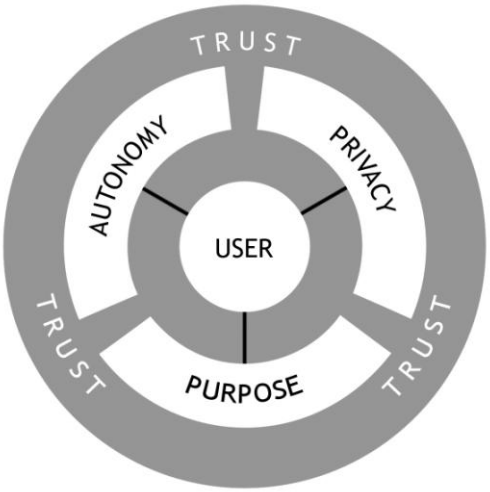


Figure_11: Persuasive Technology User Acceptance Variables

4.9.4 The Employer's Viewpoint

Im et al (2008) reported that managers should "*try to convince users that it* (technology) *is of value*", by emphasising the benefits involved. CIMS acceptance was considered only from the users' perspective. Employer attitude towards CIMS would need to be considered in order to identify correlation and/or differences that might inform management strategies and/or design (Ouadahi, 2008).

5. Conclusion

Despite high numbers of UK workers experiencing work-related musculoskeletal and stress-related disorders (HSE, 2009), current legislation and intervention practices do little to stem the tide of these conditions. Studies have shown that work-based computer users need regular support in order to comply with MSD prevention programs, such as those that promote work rest and stretch breaks (Monsey et al, 2003).

The purpose of this study was to investigate work-based computer users' attitudes towards the prospective persuasive technology of computer-based interactive monitoring systems (CIMS); where attitude may influence user acceptance of CIMS (welcome, tolerate or rejection). The perceived purpose of CIMS would be to promote work-based computer user health and well-being by monitoring and detecting risk(s) and providing advice on remedial actions in terms of the user's emotion-state, posture and work habits. It is not envisaged that CIMS would replace other forms of legislative compliance, but should be seen as a part of a larger toolkit of interventions, policies and personnel with which the user collaborates to achieve and maintain well-being.

Successful implementation of health and safety programs requires collaboration. Traditionally, that has meant employers, employees and professionals (e.g. ergonomists, occupational health officers, health and safety representatives) working together towards a common goal, such as the reduction and prevention of computer-related ill health. Developments in technology, the user-centred approach taken by HCI and the scope of persuasive technologies, means that today technology can play a part in the collaborative venture.

The potential for persuasive technologies to motivate, stimulate and even convince workers to avoid bad work habits/posture and adopt good ones means that they have the potential to play a key part in the prevention/reduction of MSDs and stress. By utilising persuasive technology, CIMS may be able to facilitate a positive change in its users (Nakajima, 2008). For health-related behaviour change interventions such as CIMS to be realised, it is vital that knowledge about user behaviour and what facilitates health-related behavioural change is used to feed the design and evaluation of such persuasive technologies (Michie, 2008). For users to benefit from persuasive technologies such as the proposed CIMS they must be willing to adopt and integrate the intervention into their work routines and behaviour (Whysall et al, 2007). Just as MSDs are multi-factorial in nature, emotion and stress can also be the result of a combination of factors. Herein lies the challenge for the ergonomist and for CIMS.

Analysis revealed that experience of symptoms does not mean that individuals readily welcome intervention. A combination of knowledge, understanding, and trust is required; in CIMS and all that it entails. From thematic analysis, five potential barriers to user acceptance were identified: self (the user), purpose (of CIMS), autonomy, privacy and trust. As represented by the CIMS User

Acceptance Model, through consideration of these barriers each potential user should be provided with sufficient information about CIMS and its intended implementation in order that s/he may interpret each of the barriers as they apply to her/him “self”. This process establishes the individual’s ability to welcome, tolerate or reject CIMS.

6. References

AbilityNet. (2008). “DSE Workstation Assessment”, “Disability Awareness” and “Effective Assessment” courses.

Acquisti, A. and Grosskags, J. (2005). Privacy and Rationality in Individual Decision Making. *IEEE Security and Privacy*, 3 (1), 26-33

Affective Computing Group. MIT. (2009). Retrieved 13th September 2009 from: http://affect.media.mit.edu/index.php

Ahn, H., Teeters, A., Wang, A., Breazeal, C., Picard, R.W. (2007). Stoop to conquer: Posture and affect interact to influence computer users’ persistence. Paper presented at the *Second International Conference on Affective Computing and Intelligent Interaction*, Lisbon, Portugal.

Ark, W.S., Dryer, D. C. and Lu, D. J. (1999). The Emotion Mouse. Proceedings of HCI International (the 8th International Conference on Human-Computer Interaction) on Human-Computer Interaction: Ergonomics and User Interfaces-Volume I, 818-823

Armstrong, T. J., Buckle, P., Fine, L. J., Hagberg, M., Jonsson, B., Kilborn, A., Kuorinka, I. A. A., Silverstein, B. A., Sjogaard, G., and Viikari-Juntura, E. R. A. (1993). A conceptual model for work-related neck and upper-limb musculoskeletal disorders. *Scandinavian Journal of Work, Environment and Health*. 19, 73-84.

Balci, R. and Aghazadeh, F. (2003). The effect of work-rest schedules and type of task on the discomfort and performance of VDT users. *Ergonomics*, 46(5), 455-65

Bandura, A. (1983). Self-evaluative and Self-efficacy Mechanisms Governing the Motivational Effects of Gaol Systems. *Journal of Personality and Social Psychology*, 45(5), 1017-1028

Banerjee, P and Sharan, D. (2003) Computer Users Falling Into Mousetrap. *The Times of India* (31st March 2003). Retrieved 17th August 2009 from: http://timesofindia.indiatimes.com/cms.dll/html/uncomp/articleshow?msid=41906870

Berdichevsky, D., and Neuenschwander, E. (1999). Towards an ethics of persuasive technology. *Communications of the ACM 42(5),* 51-58

Berkley, K. J. (1997). Sex differences in pain. *Behavioural and Brain Sciences*, 20, 371-380

Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3:2, 77-101

Breazeal, C., Wang, A., and Picard, R. (2007). Experiments with a Robotic Computer: Body, Affect and Cognition Interactions. In *Proceedings of HRI, 2007. Washington DC*.

Bridger, R. S. (2009). "*Introduction to Ergonomics: Third Edition*". CRC press, Taylor & Francis Group, Boca Raton, Florida.

Briner, R. B. and Rick, J. (2003). Risk Assessment of Psychosocial Factors. *Occupational Health Review*, 102, 21-25

Bullington, J. (2005). 'Affective' computing and emotion recognition systems: The future of biometric surveillance? In proceedings: *Information Security Curriculum Development (InfoSecCD) Conference 2005*, Kennesaw, GA, USA

Chambers (1975). *Chambers Twentieth Century Dictionary*. Ed. MacDonald, A. M. , W & R Chambers Ltd, Edinburgh, Scotland

Charlesworth, A. J. (2003). Opinion. Privacy, Personal Information and Employment. *Surveillance & Society*, 1(2), 217-222

Chartered Society of Physiotherapy (The). *Repetitive strain injury (RSI) still blights British workers* Retrieved 17th August 2009 from: http://www.csp.org.uk/director/press/pressreleases.cfm?item_id=94919D04DEF6F9D2538544B581A5DF50

Cole, D. C. and Rivilis, I. (2004). Individual factors and musculoskeletal disorders: a framework for their consideration. *Journal of Electromyography and Kinesiology*, 14, 121-127

Coleman, James S. 1990. "*The Foundations of Social Theory"*. In: Marsh, S. P. (1994). "Formalising Trust as a Computational Concept". Doctor of Philosophy thesis, for Department of Computing Science and Mathematics, University of Stirling.

Cordiner, L., Davies, S., Haines, H., Haslegrave, C., Hide, S., and Wilson, J. (1998). *"Ergonomics Application in the Workplace: A distance learning course on the fundamentals and practice of ergonomics"*. Nottingham: Institute for Occupational Ergonomics, University of Nottingham.

Curran, J. and Meuter, M. (2005). Self-service technology adoption: comparing three technologies. *Journal of Services Marketing*. 19(2), 103-113.

Davies, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13 (3), 319-340

de Rosis, F., Mazzotta, I., Miceli, M., and Poggi, I. (2006). Persuasion Artifices to Promote Wellbeing. In IJsselsteijn, W. et al. (Eds.): *PERSUASIVE 2006*, LNCS 3962, pp. 84 – 95.

Dennerlein, J., Becker, T., Johnson, P., Reynolds, C., and Picard,. R. W. (2003). Frustrating Computer Users Increases Exposures to Physical Factors. *Proceedings of the International Ergonomics Association 2003* (24-29)

Devereux, J. J., Vlachonikolis, I. G. and Bucklen, P. W. (2002). Epidemiological study to investigate potential interaction between physical and psychosocial factors at work that may increase the risk of symptoms of musculoskeletal disorder of the neck and upper limb. *Occupational and Environmental Medicine*, 59, 269-277

Deyo, R. A. and Diehl, A. K. (1983). Measuring Physical and Psychosocial Function in Patients with Low-Back Pain. *Spine.* 8(6), 635-642.

Dijkstra, A. (2006). Technology Adds New Principles to Persuasive Psychology: Evidence from Health Education. In IJsselsteijn, W. et al. (Eds.): *PERSUASIVE 2006*, LNCS 3962, pp. 16 – 26.

Fairclough, S. H. (2009). Fundamentals of physiological computing. *Interacting with Computers*, 21, 133-145

Fogg, B. J. (1998). Captology: The Study of Computers as Persuasive Technologies. *CHI98*, April 1998. Special Interest Groups (SIGS).

Fogg, B. J. (1999). Persuasive Technologies. *Communication of the ACM*, 42 (5), 27-29

Galinsky, T., Swanson, N., Sauter, S., Dunkin, R., Hurrell, J., and Schleifer, L. (2007). Supplementary Breaks and Stretching Exercises for Data Entry Operators: A Follow-up Field Study. *American Journal of Medicine*, 50, 519-527.

George, C. L. (1992). The Posture Monitor: An Automated Prompting Device for Body Alignment. *IEEE Journal of Special Education*. 10 (2), 147-152.

Glasgow, R. E., Bull, S. S., Piette, D. and Steiner, J. F. (2004). Interactive Behavior Change Technology: A Partial Solution to the Competing Demands of Primary Care. *American Journal of Preventative Medicine*, 27(2S), 80-87

Gordon, S. (2003). Privacy: A Study of Attitudes and Behaviours in US, UK and EU Information Security Professionals. *Symantec Security Response White Paper*, Symantec, Cuertino, California, USA.

Gravina, N., Lindstrom-Hazel, D. and Austin. J. (2007). The effects of workstation changes and behavioural interventions on safe typing postures in an office. *Work*, 29, 245-253

Greene, B. L., DeJoy, D. M., and Olejnik, S. (2005). Effects of an active ergonomic training program on risk exposure, worker beliefs, and symptoms in computer users. *Work*, 24, 41-52.

Greenhalgh, T. and Taylor, R. (1997). How to read a paper: Papers that go beyond numbers (qualitative research). *BMJ*, 315, 740-743

Grolleman, J., van Dijk, B., Nijholt, A., and van Emst, A. (2006). Break the Habit! Designing an e-Therapy Intervention Using a Virtual Coach in Aid of Smoking Cessation. In IJsselsteijn, W. et al. (Eds.): *PERSUASIVE 2006*, LNCS 3962, pp. 133-141.

Guardian, The (2009). "*Sick leave is a problem for managers*". Retrieved 10th September 2009 from: http://www.guardian.co.uk/society/joepublic/2009/aug/21/sick-leave-managers-problem

Hagberg, M. (1981). Muscular endurance and surface electromyogram in isometric and dynamic exercise. *Journal of Applied Physiology*, 51, 1-7

Hareli, S., and Rafaeli, A. (2008). Emotion cycles: On the social influence of emotions in organizations. *Research in Organizational Behavior*, 28, 35-59

Haslam, R. A. (2002). Targeting ergonomics interventions – learning from health promotion. *Applied Ergonomics*, 33, 241-249

Haslegrave, C. and Corlett., N (2005). *Work conditions and the risk of injury*. In: Evaluation of Human Work. Ed. Wilson, J. R. and Corlett, N. Chapter 31, p809-823. CRC press, Taylor & Francis Group, Boca Raton, Florida, USA

Haque, M. N. (2000). Surveillance on self-report: a trial of health and safety monitoring on occupational settings. *Occupational Medicine*, 50 (2), 182-184.

Health and Safety Executive. (2002). *Health and Safety (Display Screen Equipment) Regulations 1992 as amended by the Health and Safety (Miscellaneous Amendments) Regulations 2002*. Norwich: HSE Books

Health and Safety Executive (2007a). "*Inspection Pack – Musculoskeletal Disorders*". Retrieved 7th September 2009 from: http://www.hse.gov.uk/foi/internalops/fod/inspect/msd.pdf

Health and Safety Executive (2007b). "*Psychosocial Working Conditions in Britain in 2007*". Retrieved 7th September 2009 from: http://www.hse.gov.uk/statistics/pdf/pwc2007.pdf

Health and Safety Executive. (2008). "*Consulting employees on health and safety"*. HSE, INDG232(rev1). Retrieved 24th September 2009 from: http://www.hse.gov.uk/pubns/indg232.pdf

Health and Safety Executive. (2009). "*Self-reported work-related illness and workplace injuries in 2007/08: Results from the Labour Force Survey".* Retrieved 16th August 2009 from: http://www.hse.gov.uk/statistics/lfs/lfs0708.pdf

Henning, R.A; Sauter, S.L; Salvendy, G and Krieg, E.F (1989) Microbreak length, performance, and stress in a data entry task. *Ergonomics,* 32 (7) ,855-864

Henning, R.A, Callaghan, E.R, Ortega, A.M, Kissel, G.V, Guttman, J.I and Braun, H.A. (1996). Continuous feedback to promote self-management of rest breaks during computer use. *International Journal of Industrial Ergonomics* 18, 71-82

Hu, P. J., Chau, P. Y. K., Liu Sheng, O. R. and Yam Tam, K. (1999). Examining the technology acceptance model using physician acceptance of telemedicine technology. *Journal of Management Information Systems*, 16(2), 91-112

Im, I., Kim, Y. And Han, H-J. (2008). The effects of perceived risk and technology type on users' acceptance of technologies. *Information and Management*. 45, 1-9.

IJsselsteijn, W., de Kort, Y., Midden, C., Eggen, B., and van den Hoven, E. (2006). Persuasive Technology for Human Well-Being: Setting the Scene. IJsselsteijn, W. et al. (Eds.): *PERSUASIVE 2006*, LNCS 3962, pp. 1–5

Information Commissioner (2009). "*Getting it right. A Brief guide to data protection for small businesses*". Retrieved 20th September 2009 form: http://www.ico.gov.uk/upload/documents/library/data_protection/practical_application/getting_it_right_-_data_protection_for_small_businesses.pdf

Jonsson, B. (1988). The static load component in muscle work. *European Journal of Applied Physiology*, 57, 305-310

Keil, M., Beranek, P. M. and Konsynski, B. R. (1995). Usefulness and ease of use: field study evidence regarding task considerations. *Decision Support Systems*, 13(1), 75-91

Kelly, K. (2006). "*Symmetrical and Asymmetrical Technologies*". Retrieved 25th September 2009 from: http://www.kk.org/thetechnium/archives/2006/02/symmetrical_and.php

Keyserling, W. (1986). A Computer-aided System To Evaluate Postural Stress in the Workplace. *American Industrial Hygiene Association Journal*. 47, 641-649.

Koparadekar, P. and Mital, A. (1994). The Effect of Different Work-rest Schedules on Fatigue and Performance of a Simulated Directory Assistance Operator's Task, *Ergonomics*, 37 (10), 1697-1707

Kroemer, K. H. E. and Grandjean, E. (2003). "*Fitting the Task to the Human. Fifth edition. A Textbook of Organisational Ergonomics*". Taylor & Francis Group, London, UK.

Laporte, W. (1966). The Influence of a Gymnastic Pause upon Recovery following Post Office Work. *Ergonomics*, 9(6), 501 – 506

Lee, J. D. and See, K. A. (2004). Trust in computer technology and te implications for design and evaluation. In: *AAAI Technical Report FS-02-02*

Lee, J. D. and See, K. A. (2004). Trust in automation: designing for appropriate reliance. *Human Factors, 46*(1), 50-80.

Louhevaara, V. and Kilbom, A. (2005). "*Dynamic work assessment*". In: Evaluation of Human Work. Ed. Wilson, J. R. And Corlett, N. Chapter 15, p341. CRC press, Taylor & Francis Group, Boca Raton, Florida, USA

Lu, X., Toivonen, R., and Takala, E-P. (2009). Exploring Time-Dependent Symptoms Outcomes in Office Staff. *Human Factors and Ergonomics Manufacturing*. 19(23), 241-252

Marcus, G. M., Cohen, J. C., Varosy, P. D., Vessey, J., Rose, E., Massie, B. M., Chatterjee, K., and Waters, D. (2007). The Utility of Gestures in Patients with Chest Discomfort. *The American Journal of Medicine*, 120, 83-89.

Mentis, H. M. and Gay, G. K. (2002). Using TouchPad Pressure to Detect Negative Affect. In: *Fourth IEEE International Conference on Multimodal Interfaces* (ICMI'02)

Michie, S. (2008). Designing and implementing behaviour change interventions to improve population health. *Journal of Health Services Research and Policy*, 13(3), 64-69

Michie, S. and Williams, S. (2009). Reducing work-related psychological ill health and sickness absence: a systematic literature review. *Occupational and Environmental Medicine*, 60, 3-9

Miller, C. A. (2005). Trust in adaptive automation: The role of etiquette in tuning trust via analogic and affective methods. Paper presented at the *First International Conference on Augmented Cognition*, Las Vegas, NV, USA.

Monsey, M., Ioffe, I., Beatini, A., Lukey, B., Santiago, A. and James, A. B. (2003). Increasing compliance with stretch breaks in computers users through reminder software. *Work*, 21, 107-111

Montgomery, K. F. (2004). "*Understanding the relationship between the design of workplace environment and wellness*". MSc Thesis in Environmental Design, Texas Tech University, Texas, USA.

Montreuil, S., LaFlamme, L., Brisson, C. and Teiger, C. (2006). Conditions that influence the elimination of postural constraints after office employees working with VDU have received ergonomics training. *Work*, 26, 157-166.

Morris, D., Bernheim Brush, A.J., and Meyers, B. R. (2008). SuperBreak: using interactivity to enhance ergonomic typing breaks. In *Proceeding of the twenty-sixth annual SIGCHI conference on Human factors in computing systems*, April 05-10, 2008, Florence, Italy

Morrison, R. (2006). Employee involvement, attitudes and reactions to technology changes. *Journal of Leadership & Organisational Studies,* March, 2006

Morse, T., Dillon, C., Warren, N., Hall, C. and Hovey, D. (2001). Capture-recapture Estimation of Unreported Work-Related Musculoskeletal Disorders in Connecticut. *American Journal of Industrial Medicine*, 39, 636-642.

Mota, S. and Picard, R (2003). Automated Posture Analysis for Detecting Learner's Interest Level. In *Proc. CVPR Workshop Computer Vision and Pattern Recognition for Human Computer Interaction*, June 2003.

Mulligan, J. E. (2006). "*Display Screen Equipment (DSE) Workstation Risk Assessment: Is Self-Assessment Valid as the Primary Method of Meeting the Legal Requirements?*" A report presented in part consideration for a Postgraduate Certificate in Applied Ergonomics, The University of Nottingham.

Nakajima, T., Lehdonvirta, V., Tokunaga, E. and Kimura, H. (2008). Reflecting Human Behaviour to Motivate Desirable Lifetstyle. In *DIS '08: Proceedings of the 7th ACM Conference on Designing Interactive Systems*, 405-414.

NHS (2007). "*Repetitive Strain Injury – Introduction"*. Retrieved 7th September 2009 from: http://www.nhs.uk/Conditions/Repetitive-strain-injury/Pages/Introduction.aspx

National Research Council (Institute of Medicine) (2001). "*Musculoskeletal Disorders and the Workplace: Low Back and Upper Extremities*". National Academy of Sciences, The National Academies Press, USA.

Neumann, W. P., Wells, R., Norman, R., Jeans, B., Dubblestyne, D., Harvey, H., and Peter, O. (1999). Roles and Relationships for Making Ergonomics Change: Results of a 2-day focus session with industry personnel. *Proceedings 31st Association of Canadian Ergonomists Conference*, Hull, Quebec, Canada

Nieuwenhuijsen, E. R. (2004). Heath behaviour change among office workers: An exploratory study to prevent repetitive strain injuries. *Work*, 23, 215-224

O'Driscoll, M. P. and Beehr, T. A. (2000). Moderating effects of perceived control and need for clarity on the relationship between role stressors and employee affective reactions. *Journal of Social Psychology*, 140(2), 151-159

Obermair, C., Reitberger, W., Meschtscherjakov, A., Lankes, M., and Tscheligi, M. (2008). perFrames: Persuasive Picture Frames for Proper Posture. Oinas-Kukkonen, H. Et al (Eds) In: *Persuasive 2008*, pp128-139

Office for National Statistics (2009a). "*Purposive Sampling*". Retrieved 19th August 2009 from: http://www.ons.gov.uk/about/who-we-are/our-services/data-collection-methodology/services-available-from-dcm/purposive-sampling

Office for National Statistics (2009b). Designing sampling strategies for qualitative social research: with particular reference to the Office for National Statistics' Qualitative Respondent Register" (page 1) Retrieved 19th August 2009 from: http://www.ons.gov.uk/about/who-we-are/our-services/data-collection-methodology/reports-and-publications/designing-sampling-strategies-.pdf

Olafsdottir, L. (2004). Prevention, health and safety program in companies provide a more successful and healthier workplace. *Work*, 22, 27-30

Olsen, e. and Kraft, P. (2009). ePsychology: A pilot study on how to enhance social support and adherence in digital interventions by characteristics from social networking sites. *Persausive'09*, Clarement, California, USA.

Ortony, A. and Turner, T. J. (1990). What's Basic About Basic Emotions? *Psychological Review*, 97 (3), 315-331

Ostrom, L. T., Stack, T. L. and Wilhelmsen, C. A. (2000). Building A Sustainable Ergonomics Program. *ERGON-AXIA Conference*, Warsaw, Poland.

Ouadahi, J. (2008). A Qualitative Analysis of Factors Associated with User Acceptance and Rejection of a New Workplace Information System in the Public Sector: A Conceptual Model. *Canadian Journal of Administrative Sciences*, 25, 201-213

Palen, L. And Dourish, P. (2003). Unpacking "Privacy" for a Networked World. *CHI 2003*, Ft. Lauderdale, Florida, USA.

Parkes, K.R., Carnell, S. and Farmer, E. (2005) "*Musculoskeletal Disorders, Mental Health and the Work Environment*". HSE Research Report 316. HSE Books, UK.

Patient UK: Repetitive Strain Injury – RSI Retrieved 19th August 2009 from: http://www.patient.co.uk/health/Repetitive-Strain-Injury-RSI.htm

Pheasant, S. and Haslegrave, C. M. (2006). "*Bodyspace: Anthropometry, Ergonomics and the Design of Work. Third Edition*". CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.

Picard, R. (2001). "*Building HAL: Computers that sense, recognize and respond to human emotion*". Retrieved 16th September 2009 from: http://vismod.media.mit.edu/tech-reports/TR-532.pdf

Picard, R. W. and Klein, J. (2002). Computers that recognise and respond to user emotion: theoretical and practical implications. *Interacting with Computers*, 14, 141-169

Prochaska, J. O. and DiClemente, C. C. (1982). Transtheoretical therapy: toward a more integrative model of change. *Psychotherapy: Theory, Research and Practice*, 19 (3), 276-288

Raab, C. D. (2007). Trust, Technology and Privacy. *End and Means, Journal of University of Aberdeen, Centre for Philosophy, Technology and Society*, 3(1).

Ramazzini, B. (1713a). Quotation from '*De Morbis Artificum Diatriba'*. Retrieved 17th August 2009 from: http://www.todayinsci.com/R/Ramazzini_Bernardino/RamazziniBernardino-Quotations.htm

Ramazzini, B. (1713b). Quotation from *'Sedentary Workers and Their Diseases: Diseases of Workers"*. Translated by WC Wright (1964),281-285). Quoted in *Physical Activity and Health: a Report of the Surgeon General* (1996). Retrieved 17th August 2009 from: http://www.todayinsci.com/R/Ramazzini_Bernardino/RamazziniBernardino-Quotations.htm

Reynolds, C. and Picard, R. W. (2001). Designing for Affective Interaction. *Proceedings from the 9th International Conference on HumanComputer Interaction*

Richie, J, and Lewis, J. (eds). (2003). "*Qualitative Research Practice: A Guide for Social Science Students and Researchers*". Sage Publications Ltd., London.

Rickenberg, R. And Reeves, B. (2000). The Effects of Animated Characters on Anxiety, Task Performance and Evaluations of User Interfaces. *CHI 2000*, The Hague, Amsterdam, Holland.

Sehgal, A. and Lui, W. L. P. (2004). Share Aware: An Interactive Persuasive System *CARPE* '04 New York, New York USA

Shapiro, B. and Baker, R. (2001). Information technology and the social construction of information privacy. *Journal of Accounting and Public Policy*, 20, 295-322

Stanford University Persuasive Technology Lab (2009). Catology: The study of Computers as Persuasive Technology Retrieved 4th September 2009 from: http://captology.stanford.edu/

Statutory Instrument (1992) No. 2792: *The Health and Safety (Display Screen Equipment) Regulations 1992*. Retrieved 26th August 2009 from: http://www.opsi.gov.uk/si/si1992/Uksi_19922792_en_1.htm

Strebal, P. (1996). Why Do Employees Resist Change? *Harvard Business Review*, 1996, May/Jun, 86-92

Suparna, K., Sharma, A.K., and Khandekar, J. (2005) Occupational health problems and role of ergonomics in information technology professionals in national capital region. *Official Publication of Indian Association of Occupational Health*. 9(3), 111-114.

Tan, H. Z., Slivovsky, L. A., and Pentland, A. (2001). A Sensing Chair Using Pressure Distribution Sensors. IEEE/ASME Transactions on Mechatronics, 6 (3), 261-269

Taylor, H. (2003). Most People Are "Privacy Pragmatists" Who, While Concerned about Privacy, Will Sometimes Trade It Off for Other Benefits. *Harris Poll #17* Retrieved 24th September 2009 from: http://www.harrisinteractive.com/harris_poll/index.asp?PID=365

Tennant, C. (2001) Work-related stress and depressive disorders. *Journal of Psychosomatic Research*, 51, 697-704.

Trade Union Congress (TUC) (2004). *RSI Day – workforce warned on dangers of RSI*. TUC. Risks 145. Retrieved 17th August 2009 from: http://www.tuc.org.uk/h_and_s/tuc-7706-f0.cfm#f2

Turk, D. C. (1993). Assess the Person, Not Just the Pain. *Pain: Clinical Updates, International Association for the Study of Pain*. 1(3)

Ultrasis (2009). Tension Taker. Retrieved 5th August 2009 from: http://www.ultrasis.com/products/product.jsp?product_id=6

Venkatash, V, Morris, M. G., Davis, G. B. and Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, 27 (3), 425-478

Von Knorring, L., Perris, C. Eisemann, M, Eriksson, U. and Perris, H. (1982) Pain as a Symptom in Depressive Disorders. I. Relationship to Diagnostic Subgroup and Depressive Symptomatology. *Pain*, 15, 19-26

Vrijkotte, T. G. M., van Doornen, L. J. P., and de Geus, E. C. J. (2000). Effects of work stress on ambulatory blood pressure, heart rate and heart rate variability. *Hypertension: Journal of the American Heart Association*. 35 (4), 880-886 Retrieved 16th September 2009 from: http://hyper.ahajournals.org/cgi/content/full/35/4/880

Westin, A. (1970). *Privacy and Freedom*. The Bodley Head Ltd, London, UK

Westman, A.S.J., Linton, A.S.J., Öhrvik, J., Wahlén, P., and Leppert, J., (2008). Do psychosocial factors predict disability and health at a 3-year follow-up for patients with non-acute musculoskeletal pain? A validation of the Örebro Musculoskeletal Pain Screening Questionnaire. *European Journal of Pain,* 12 (5), 641–649.

Whysall, Z. J., Haslam, C. and Haslam, R. (2007). Developing the Stage of Change Approach for the Reduction of Work-related Musculoskeletal Disorders. *Journal of Health Psychology*, 12, 184-197.

Zimmermann, P., Guttormsen, S., Danuser, B. and Gomez, P. (2003). Affective computing - a rationale for measuring mood with mouse and keyboard. *International Journal of Occupational Safety and Ergonomics*, 9(4), 539 -51

Appendix_1

Invitation to Participate in Research Project Survey

Dear

I hope this finds you well?

As you [know / may know], I am currently studying for an MSc in Human Computer Interaction with Ergonomics at University College London (UCL) and have reached the research project stage. I am looking for study participants and wondered whether you would be willing to take part? Please be assured that you are under no obligation to take part in the study; participation is entirely voluntary and you are free to withdraw from the study at any time. Confidentiality and anonymity will be maintained and it will not be possible to identify you from any publication.

The project poses the following question: “If your work-based computer could warn you that you might be putting yourself at risk (through posture, work habits and/or changes to your emotional-state) would you want it to?” The first stage of the study is a survey; a copy of which is attached (MS Word format).

Please do not hesitate to contact me should you have any questions regarding the study or survey.

I look forward to hearing from you.
With thanks,
Jan

Appendix_2

MSc Human Computer Interaction Research Project - Survey

Contains copy of the project “Information Sheet”

MSc Human Computer Interaction Research Project - Survey

My name is Jan Mulligan. I am studying at University College London (UCL) for an MSc in Human-Computer Interaction with Ergonomics and am currently conducting research into the attitude of work-based computer users to risk. The study considers whether:

"If the computer could warn you that your working habits,
posture, and/or emotional state might be putting you at risk of developing or aggravating symptoms,
e.g. stress, headaches, eyestrain, physical discomfort,
would you want it to and, if so,
what monitoring methods would you find acceptable?"

I am looking for study participants and would be grateful if you would take part by completing the attached questionnaire; it should take about 20 minutes. You are free to skip questions which you do not wish to answer or to stop at any time; there is no need to give a reason. You will see that the survey asks you to provide your contact details (name and email address and/or telephone number); this is so that I may invite some participants to take part in a more in-depth interview process. Completing the survey does not, however, oblige you to take part in the interview stage. Again, you are completely free to decline to take part or to stop at any time.

Please be assured that outside of the correspondence between us your confidentiality and anonymity will be maintained; it will not be possible to identify you from any publications.

The next page provides you with more information on the study, my contact details and those of my project supervisors. Please do not hesitate to contact us should you have any questions.

Thank you for your time.
Jan Mulligan
Email: j.mulligan@ucl.ac.uk

Information Sheet for Participants in Research Studies

You will be given a copy of this information sheet.

Title of Project:	**Does attitude affect risk? Potential for user acceptance of interactive affect and ergonomic monitoring systems**
This study has been approved by the UCL Research Ethics Committee [Project ID Number]:	MSc/0809/018
Name, Address and Contact Details of Investigators:	**Jan Mulligan** XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX, XXXXXXX Email: j.mulligan@ucl.ac.uk Tel: XXXX XXXXXXX **Rachel Benedyk** UCL Interaction Centre, MPEB 8th Floor, University College London, Gower Street, London WC1E 6BT **Nadia Berthouze** UCL Interaction Centre, MPEB 8th Floor, University College London, Gower Street, London WC1E 6BT

We would like to invite you to participate in this research project. Before you decide whether you would like to take part, please read the following information carefully and, should you wish, discuss it with others. Please feel free to ask us if there is anything that is not clear or if you would like more information.

Details of Study

This is an exploratory study to consider work/office-based computer users' attitudes to risk in the context of work-related computer use and their acceptance levels of technology-based interactive affect and ergonomic monitoring systems to support the prevention, reduction and possible recovery from symptoms which may be exacerbated by computer use. The study aims to consider:

- If the computer could warn the user that s/he might be putting her/himself at risk, would the user want it to?
- What risks would users want the computer to detect?
- What monitoring and/or detection methods would users welcome/tolerate/reject?
- What advice provision methods would users welcome/tolerate/reject?
- Are users influenced by previous or existing symptoms?
- Does work location have an impact on views?

The first stage of the study is the completion of a questionnaire. Based on your feedback you may then be invited to take part in an interview. The venue for the interview will be of your choosing. Ideally the interview will include a visit to your workstation(s) so that your computer set-up and working posture may be observed and, with permission, digitally recorded (photographed).

Participation

If you decide to take part in the survey you may skip any questions which you would prefer not to answer. You are free to withdraw at any time; without giving a reason. All data will be collected and stored in accordance with the Data Protection Act 1998 and it will not be possible to identify you from any publication.

SECTION 1: General

This section asks about you, your job and your computer use.

- If you are completing the questionnaire on a computer, please make your response(s) stand out by using the highlight or colour change features
- If you are completing the questionnaire by hand, please circle your response(s)
- Please use the COMMENT space provided at the bottom of most questions to provide any additional information which you feel may be relevant or which allows you to explain your response more fully

1. **Name:**

   _____

2. **Email address:**

   _____

3. **Telephone Number:**

   _____

4. **Gender**
   a) Female
   b) Male

5. **Age**
   a) 18-20
   b) 21-30
   c) 31-40
   d) 41-50
   e) 51-60
   f) 61-65
   g) Over 65

6. **Job title:**

   _____

7. **Industry Sector:**
   a) Public
   b) Private
   c) Not-For-Profit / Charity
   d) Other…. Please explain:

   _____

8. **Employment category** (Please select all that apply)**:**
   a) Full-time
   b) Part-time
   c) Employed
   d) Self-employed
   e) Contractor
   f) Temporary worker, e.g. Agency staff
   g) Other…. Please explain:

   _____

9. **Contracted hours worked each week**
   a) 0-8
   b) 9-16
   c) 17-24
   d) 25-35
   e) 36+
   COMMENT:

10. **Overtime hours worked each week (whether paid or not)**
    a) 0-8
    b) 9-16
    c) 17-24
    d) 25-35
    e) 36+
    COMMENT:

11. **Length of time in current job:**
    a) Less than one month
    b) Between one and six months
    c) Between six months and one year
    d) More than one year
    e) More than two years
    f) Five years or more
    COMMENT:

12. **Where is your primary workstation/desk location?**
    a) Single occupancy office
    b) Shared occupancy office
    c) Open plan office
    d) Home-based office (room dedicated for work purposes)
    e) Home-based workstation/desk (dedicated area of shared purpose room)
    f) Home-based ad hoc set-up (set-up computer on work surface as needed and pack away afterwards, e.g. kitchen table)
    g) Other…. Please explain:

    _____

13. How long do your spend at your work computer across a typical day?

a) Less than one hour
b) Between one and three hours
c) Between three and six hours
d) Between six and eight hours
e) More than eight hours

COMMENT:

14. What might be the longest length of time you spend working at your computer before taking a break, i.e. short break away from the computer for telephone calls, paperwork, filing, photocopying, comfort break?

a) Less than one hour
b) Between one and two hours
c) Between two and three hours
d) Three hours or more

COMMENT:

15. What style of computer do you have?

a) Desktop computer (base unit generally located at desk level or in cage under desk)
b) Tower computer (base unit generally located under desk at floor level)
c) Portable computer (screen size of 14" or more)
d) Notebook computer (screen size of less than 14")
e) Other…. Please explain:

---

16. What style of keyboard do you use?

a) Standard
b) Compact (e.g. does not have built-in number pad)
c) Ergonomic (e.g. adjustable, split style, vertical)
d) Specialist (e.g. industry specific, one handed, chorded)
e) Built-in (part of portable computer / notebook)
f) Other…. Please explain:

If you do <u>not</u> have a standard keyboard, please explain why, e.g. did you inherit it, chose it, or was it provided for a specific reason?

---

17. What style of pointing device do you use?

a) Standard mouse
b) Ergonomic mouse (shaped to fit hand)
c) Ergonomic mouse (vertical)
d) Rollerball / Trackball (static device)
e) Graphics Tablet / Pen style
f) Handheld device
g) Built-in touchpad (part of portable computer / notebook; generally located in front of the keyboard area)
h) Built-in Trackpoint (part of portable computer / notebook; generally located between the G+H keys)
i) Other…. Please explain:

_____

If you do <u>not</u> have a standard mouse, please explain why, e.g. did you inherit it, chose it, or was it provided for a specific reason?

_____

18. What style of monitor do you use?

a) CRT (chunky / TV-style / glass fronted)
b) TFT (flat screen / external)
c) TFT (flat screen / built-in to portable computer / notebook)

If you answered (a) or (b), how is the monitor mounted?

d) On its own fixed height stand
e) On its own height adjustable stand
f) On a modular-based stand (e.g. formed of one of more 1” or 2” blocks)
g) On a fixed height monitor stand
h) On a height adjustable monitor stand
i) On a monitor arm
j) Other…. Please explain:

_____

If you answered (c), how is the computer mounted?

k) On the work surface (at desk level)
l) On book, telephone directory, box files or something similar
m) On a modular-based stand (e.g. formed of one of more 1” or 2” blocks)
n) On a fixed height monitor stand
o) On a height adjustable monitor stand
p) On a monitor arm
q) In a portable computer stand
r) Other…. Please explain:

_____

19. How would you describe your typing style?

(Please select all that apply)

a) Touch typist trained (look at the monitor when typing)
b) Touch typist self-taught (look at the monitor when typing)
c) Semi-touch typist (regularly look between monitor and keyboard)
d) Non-touch typist (look down at keyboard most of the time and use most fingers)
e) Non-touch typist (look down at keyboard most of the time and use two or more fingers)
f) Non-touch typist (look down at keyboard most of the time and use one finger)
g) One handed
h) Voice recognition, e.g. Dragon Naturally Speaking (DNS) (keyboard rarely used, if ever)
i) Other…. Please explain:

_____

20. Does your company provide you with Display Screen Equipment (DSE) Workstation Assessments?

This the process by which the health, safety and comfort of each employee who uses a computer may be considered; with appropriate action being taken to rectify any problems identified

a) Yes
b) No
c) Don't know

COMMENT:

If you answered "No" or "Don't know" to Question 20, please go to Question 25

21. When was your last DSE assessment?

a) Within the past six months
b) Between six months and one year
c) Between one and two years
d) More than two years ago
e) Can't remember

COMMENT:

22. Who conducted the assessment?

a) I completed a printed form
b) I completed an on-line survey
c) Internal contact (e.g. colleague, line manager, DSE assessor, IT Department, Occupational Health, Human Resources / Personnel etc.,)
d) External assessor / consultant
e) Can't remember
f) Other…. Please explain:

_____

23. Did the assessment result in any changes to your furniture or computer equipment?

a) Yes
b) No
c) Can't remember

If you answered (a) "Yes", were the changes aimed at:

a) Helping with an existing symptom / injury
b) Preventing symptoms occurring
c) Don't know

COMMENT:

24. Did the assessment result in any recommendations for you to change your working habits, e.g. vary your work tasks more frequently, take more regular breaks from the computer, conduct stretching exercises, etc.

a) Yes
b) No
c) Can't remember

If you answered (a) "Yes", were the changes aimed at:

d) Helping with an existing symptom / injury
e) Preventing symptoms occurring
f) Don't know

COMMENT:

25. Have you ever used a work, ergonomic or symptom break reminder utility such as: Break Reminder, MacBreakZ, RSIGuard, WorkPace, WorkRave? These software utilities prompt the user to take a break and/or conduct gentle stretching exercises

a) Yes
b) No
g) Don't know

COMMENT:

26. Do you have (or have you ever had) any symptoms which you attribute to or which you believe may be aggravated by computer use?

Example symptoms include: headaches, eyestrain, aches, pains, numbness, pins and needles, stress, tension, excessive tiredness

a) Yes
b) No
c) Prefer not to answer

If you answered (b) "No" or (c) "Prefer not to answer" to Question 26, please go to:
Section 3 (Designing For User Need) – found on Page 13

SECTION 2: Symptoms

This section asks about any symptoms that you have (or have had in the past) which you attribute to or which you believe may be aggravated by computer use.

27. Which of the following statements describe(s) your symptoms….
(Please select all that apply)

a) Chronic (long-lasting, recurrent in nature)
b) Acute (recent, rapid onset, short-lasting)
c) Mild (not severe, but persistent)
d) Severe (intense, debilitating)
e) Build across the working day / week
f) Episodic (triggered by certain activities, postures, types of work, levels of workload)
g) Occasional (no real pattern to when they occur or wear off)
h) Generally wear off overnight or across a weekend
i) Wear off only with rest, e.g. when take a holiday
j) Permanent: may change in intensity, but do not wear off
k) Historic (have had symptoms in the past, but have been symptom-free for six months or more)
l) Other…. Please explain:

_____

28. Please indicate which area(s) bother you (Please select all that apply)

a) Head (e.g. headache, migraine)
b) Eyes (e.g. hot, sore, tired, stinging, dry, weeping eyes; eyestrain)
c) Neck
d) Shoulder
e) Shoulder blade
f) Upper back
g) Lower back
h) Hips
i) Buttocks, coccyx or seat/sit bones
j) Thigh(s)
k) Knee(s)
l) Calf, ankle/Achilles' tendon, heal or foot
m) Upper arm
n) Elbow
o) Forearm
p) Wrist
q) Hand
r) Finger
s) Thumb
t) Joints
u) Stress or tension
v) Excessive tiredness
w) Other…. Please explain:

_____

29. Please indicate which area(s) bothers you <u>MOST</u> (<u>Please select just ONE</u>)

a) Head (e.g. headache, migraine)
b) Eyes (e.g. hot, sore, tired, stinging, dry, weeping eyes; eyestrain)
c) Neck
d) Shoulder
e) Shoulder blade
f) Upper back
g) Lower back
h) Hips
i) Buttocks, coccyx or seat/sit bones
j) Thigh(s)
k) Knee(s)
l) Calf, ankle/Achilles' tendon, heal or foot
m) Upper arm
n) Elbow
o) Forearm
p) Wrist
q) Hand
r) Finger
s) Thumb
t) Joints
u) Stress or tension
v) Excessive tiredness
w) Other…. Please explain:

_____

30. For the area which bothers you <u>MOST</u>, which of the following describe(s) your symptoms (<u>Please select all that apply</u>)**:**

a) Aching
b) Burning
c) Cramping
d) Discomfort
e) Dull
f) Nagging
g) Numbness
h) Pain
i) Sharp
j) Stiffness
k) Swelling
l) Tense
m) Tingling / pins and needles
n) Weakness
o) Other…. Please explain:

_____

31. Have you discussed your symptoms with.... (Please select all that apply)

a) GP (general practitioner / your doctor)
b) Medical Consultant
c) Therapist (e.g. physiotherapist, osteopath)
d) DSE workstation assessor (or similar workplace consultant)
e) Counsellor
f) Line manager
g) Colleague(s)
h) Family
i) No one
j) Other…. Please explain:

_____

If you answered (i) "No one", please explain your reasons for this:

_____

32. Have you received/used any of the following? (Please select all that apply)

a) Medical diagnosis
b) Prescription Medication
c) Over-the-counter medication
d) Aids / supports: tubi-grip/strapping, hand/wrist splint; back belt; walking stick etc.
e) Therapeutic treatment, e.g. physiotherapy, osteopathy, chiropractic treatment, acupuncture, Alexander Technique
f) Relaxation methods and related exercises, e.g. Yoga. Pilates, Tai Chi
g) Relaxation techniques, e.g. meditation, aromatherapy
h) Sports and related exercise, e.g. swimming, gym, step class
i) Other…. Please explain:

_____

33. Has your workstation furniture (e.g. chair, desk) been adapted in any way to help with your symptoms?

a) Yes
b) No

If you answered (a) "Yes", please explain what changes have been made, how they came about and if they have been of any help

_____

34. Has your computer equipment (e.g. monitor, keyboard, pointing device, software) been changed in any way to help with your symptoms?

a) Yes
b) No

If you answered (a) "Yes", please explain what changes have been made, how they came about and if they have been of any help

---

Please go to Section 3 (Designing For User Need) – found on page 13

SECTION 3: Designing For User Need

With recent advances in technology it is now possible for computers to monitor the user's work habits, activities, posture and/or changes to the user's emotional state and react accordingly, e.g. if the user appears to be tired or experiencing stress then the computer might suggest that a break is taken or if the user has adopted a poor posture for longer than a few minutes then the computer might suggest alternative postures which are less likely to result in discomfort or that the user conducts gentle stretching exercises.

This section of the survey considers such technology.

NOTE: Questions 35, 36, and 37 appear to be the same, but they are not. In turn, they ask you to consider whether you would "welcome", "tolerate" or "reject" the monitoring methods described

35. Would you WELCOME any of the following detection methods?
(Please select all that apply)

a) Keyboard use (e.g. key action (force/pressure used), position of keyboard on work surface)
b) Pointing device use (e.g. hand/finger pressure on device, grip position, button action (force/pressure used) speed and range of movement, position of device on work surface)
c) Head position in relation to monitor (e.g. distance from screen)
d) Seated position (e.g. fully in chair with back supported, perched, fidgeting)
e) Upper body posture (e.g. leaning towards the screen, leaning to one side)
f) Facial expression (e.g. frowning, eyebrow positions)
g) Eye size (e.g. changes can indicate mood)
h) Eye gaze (e.g. rapid movement, lack of movement, tracking eye gaze across screen)
i) Voice monitoring, e.g. detecting the volume of your speech, tone, words used etc.
j) None

COMMENT:

---

36. Would you TOLERATE any of the following detection methods?
(Please select all that apply)

a) Keyboard use (e.g. key action (force/pressure used), position of keyboard on work surface)
b) Pointing device use (e.g. hand/finger pressure on device, grip position, button action (force/pressure used) speed and range of movement, position of device on work surface)
c) Head position in relation to monitor (e.g. distance from screen)
d) Seated position (e.g. fully in chair with back supported, perched, fidgeting)
e) Upper body posture (e.g. leaning towards the screen, leaning to one side)
f) Facial expression (e.g. frowning, eyebrow positions)
g) Eye size (e.g. changes can indicate mood)

h) Eye gaze (e.g. rapid movement, lack of movement, tracking eye gaze across screen)
i) Voice monitoring, e.g. detecting the volume of your speech, tone, words used etc.
j) None

COMMENT:

---

37. Would you REJECT (refuse to use) any of the following detection methods (Please select all that apply)

a) Keyboard use (e.g. key action (force/pressure used), position of keyboard on work surface)
b) Pointing device use (e.g. hand/finger pressure on device, grip position, button action (force/pressure used) speed and range of movement, position of device on work surface)
c) Head position in relation to monitor (e.g. distance from screen)
d) Seated position (e.g. fully in chair with back supported, perched, fidgeting)
e) Upper body posture (e.g. leaning towards the screen, leaning to one side)
f) Facial expression (e.g. frowning, eyebrow positions)
g) Eye size (e.g. changes can indicate mood)
h) Eye gaze (e.g. rapid movement, lack of movement, tracking eye gaze across screen)
i) Voice monitoring, e.g. detecting the volume of your speech, tone, words used etc.
j) None

Please explain your reasons for rejecting this method (s) and then go to Question 39:

---

38. From those methods which you would either WELCOME or TOLERATE, which detection method would you find MOST acceptable?
(Please select just ONE)

a) Keyboard use (e.g. key action (force/pressure used), position of keyboard on work surface)
b) Pointing device use (e.g. hand/finger pressure on device, grip position, button action (force/pressure used) speed and range of movement, position of device on work surface)
c) Head position in relation to monitor (e.g. distance from screen)
d) Seated position (e.g. fully in chair with back supported, perched, fidgeting)
e) Upper body posture (e.g. leaning towards the screen, leaning to one side)
f) Facial expression (e.g. frowning, eyebrow positions)
g) Eye size (e.g. changes can indicate mood)
h) Eye gaze (e.g. rapid movement, lack of movement, tracking eye gaze across screen)
i) Voice monitoring, e.g. detecting the volume of your speech, tone, words used etc.

Please explain your reasons for selecting this method (s):

39. Can you think of any other detection methods which you would welcome or tolerate which have not been listed above?

a) Yes
b) No

If you answered (a) "Yes", please describe the method here:

---

40. If you have rejected all of the monitoring methods listed in Question 37, please explain your reasons for this:

YOU HAVE REACHED THE END OF THE SURVEY.
THANK YOU FOR YOUR TIME

The next stage of this research project involves interviews with selected survey participants

- Ideally, to facilitate observation of the participant at her/his workstation, interviews will take place at the participant's place of work. If a workplace interview is not possible, then the location will be of the participant's choosing
- The interviews will take place during July and the early part of August (no later than the Bank Holiday weekend) and will be arranged to suit each participant's availability

Would you be willing to take part in the interview stage of this project?

a) Yes
b) No
c) Undecided

COMMENTS:

If you wish to, please use the space below to provide any additional thoughts / comments you may have on the topics raised by this survey, or on the survey itself…….

Appendix_3

Interview Participant Informed Consent Form

NOTE:
For the purposes of the study this form was printed with smaller margins. As a result, the text and line spacing were not as cramped as they appear here.

Informed Consent Form for Participants in Research Studies

(This form is to be completed independently by the participant after reading the Information Sheet and/or having listened to an explanation about the research.)

Title of Project:	**Does attitude affect risk? Potential for user acceptance of interactive affect and ergonomic monitoring systems** 
This study has been approved by the UCL Research Ethics Committee [Project ID Number]:	MSc/0809/018

Participant's Statement:

I ……(please print your name here)

agree that **(please cross through those points which you do not agree with / consent to)**

- I have read the information sheet and/or the project has been explained to me orally;
- I have had the opportunity to ask questions and discuss the study/project;
- I have received satisfactory answers to all my questions or have been advised of an individual to contact for answers to pertinent questions about the research and my rights as a participant and whom to contact in the event of a research-related problem;

- I understand that the information I submit during the survey and/or interview process may be published in the study report and that, on request, I will be sent a copy. Confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications;
- I consent to the information I provide being digitally recorded (audio) and used for the purposes of the study, i.e. transcription, analysis and use within the report;
- Where they exist, I consent to existing digital photographs of me at my workstation being used for the purposes of this study, i.e. for analysis and comparison purposes. Photographs which include facial images will be edited so that it will not be possible to identify me;
- Where they exist, I consent to existing digital photographs of me at my workstation being published in the study report. Photographs which include facial images will be edited so that it will not be possible to identify me;
- Where they exist, I consent to existing digital photographs of me at my workstation being used for post-study purposes, e.g. publication in journals, reports, conferences. Photographs which include facial images will be edited so that it will not be possible to identify me;
- I consent to the information I submit being used for post-study purposes, e.g. publication in journals, reports, conferences;
- I understand that I am free to withdraw from the study at any time;
- I consent to the processing of my personal information for the purposes of this study only and that it will not be used for any other purpose. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.

Signed:	Date:

Investigator's Statement:

I, Jan Mulligan, confirm that I have carefully explained the purpose of the study to the participant and outlined any reasonably foreseeable risks or benefits (where applicable).

Signed:	Date:

Appendix_4

Example Questions for Semi-structured Interviews

MSc Human Computer Interaction Research Project
Interview: Example Questions

"If the computer could warn you that your working habits, posture, and/or emotional state might be putting you at risk of developing or aggravating symptoms, e.g. stress, headaches, eyestrain, physical discomfort, would you want it to and, if so, what monitoring methods would you find acceptable?"

Taking into account the statement shown above, please consider the example questions based on your experience of using computers in a workplace setting and your attitude to related risk. The questions are designed to act as a guide for the interview, not to restrict it. Some of the questions appear to ask for yes/no responses or that you make a selection from a list of choices. I do, however, hope to elicit more information from you based on your thoughts on the topics and reasons for your responses. I also hope that we may explore other areas of interest as they emerge from our discussion.

Participation:

- Before the interview starts you will be given the opportunity to ask any questions that you may have and you will be asked to sign a consent form which I will bring with me (a copy of the form will be sent to you, for references purposes, ahead of the session).
- Please be assured that outside of the correspondence between us your confidentiality and anonymity will be maintained; it will not be possible to identify you from any publications.
- You are free to skip any question(s) which you do not wish to answer or to stop the interview at any time; there is no need to give a reason.
- Should we not have time to complete the interview within the allocated time then, with your agreement, we may complete the interview through subsequent email or telephone contact.

Thank you for your time.
Jan Mulligan

Tel: XXXX XXXXXXX
Email: j.mulligan@ucl.ac.uk

EXAMPLE QUESTIONS

A) Symptoms:

1. If you experience symptoms whilst working (or as a result of working), e.g. stress, headaches, eyestrain, physical discomfort, how/what does that make you feel? Please select all that apply:

Annoyed	Comforted	Horrified	Impatient	Thoughtful
Uneasy	Guilty	Sceptical	Worried	Ineffectual
Relaxed	Proud	Indifferent	Apologetic	Depressed
Bored	Amused	Decisive	Sympathetic	Grateful
Upset	Irritated	Dispirited	Sad	Despondent
Regretful	Preoccupied	Alarmed	Relieved	Playful
Encouraged	Disappointed	Justified	Doubtful	Impatient
Pensive	Reassured	Happy	Anxious	Angry
Confused	Fear	Rage	Flustered	Excited
Despair	Satisfaction	Disgust	Defiant	Shame
Surprised	Joyful	Curious	Weak	Frustrated
Inefficient	Supported	Compromised	Rested	Contempt

Other, please explain…..

2. Do your symptoms impact on your life outside of work? If “yes”, how does that make you feel?

B) Strategies:

1. What coping strategies, other than technical adaptations, have you tried / do you currently use?
2. Have they been / are they: more, less or equally beneficial than the technical adaptations?
3. How do you measure the success of a strategy?

C) If you decide to take a work or rest break away from your computer, how/what does that make you feel? Please select all that apply:

Annoyed	Comforted	Horrified	Impatient	Thoughtful
Uneasy	Guilty	Sceptical	Worried	Ineffectual
Relaxed	Proud	Indifferent	Apologetic	Depressed
Bored	Amused	Decisive	Sympathetic	Grateful
Upset	Irritated	Dispirited	Sad	Despondent
Regretful	Preoccupied	Alarmed	Relieved	Playful
Encouraged	Disappointed	Justified	Doubtful	Impatient
Pensive	Reassured	Happy	Anxious	Angry
Confused	Fear	Rage	Flustered	Excited
Despair	Satisfaction	Disgust	Defiant	Shame
Surprised	Joyful	Curious	Weak	Frustrated
Inefficient	Supported	Compromised	Rested	Contempt

Other, please explain…..

D) Interactive Affect and Ergonomic Monitoring System:

1. What would you expect/want the system to do?
2. What would you not expect/want the system to do?
3. What benefit(s), if any, would you expect/want such a system to provide above and beyond those provided by your existing strategies?

E) System feedback timing / frequency:

1. When would you want the system to notify you that there might be a problem? e.g.
   - every time it notices something
   - periodically (e.g. once an hour)
   - at predetermined times of day (e.g. you chose set times throughout the day)
   - when you log off
   - on demand (only when you ask it to)
   - variable (you adjust the settings to suit your work pattern, symptom levels etc.)
   - other…..

F) System feedback methods: *Please see IMAGE sheet for examples of the options……*

1. Which of the following would you accept (welcome, tolerate, prefer) or reject and why:
   a) On-screen text messages
   b) Option a, with animated cartoon-style character
   c) Option a, with drawing/sketch support
   d) Option a, with animated drawing/sketch support
   e) Option a, with virtual assistant support
   f) Option a, with animated/video-based virtual assistant support
   g) Your choice from options a-f, plus natural voice audio
   h) Your choice from options a-f, plus computer-generated audio
   i) Natural voice audio only (no on-screen text)
   j) Computer-generated audio message only (no on-screen text)
   k) Other, please explain……

G) If the system advised you to take a work or rest break away from your computer, how/what would that make you feel? Please select all that apply:

Annoyed	Comforted	Horrified	Impatient	Thoughtful
Uneasy	Guilty	Sceptical	Worried	Ineffectual
Relaxed	Proud	Indifferent	Apologetic	Depressed
Bored	Amused	Decisive	Sympathetic	Grateful
Upset	Irritated	Dispirited	Sad	Despondent
Regretful	Preoccupied	Alarmed	Relieved	Playful
Encouraged	Disappointed	Justified	Doubtful	Impatient
Pensive	Reassured	Happy	Anxious	Angry
Confused	Fear	Rage	Flustered	Excited
Despair	Satisfaction	Disgust	Defiant	Shame
Surprised	Joyful	Curious	Weak	Frustrated
Inefficient	Supported	Compromised	Rested	Contempt

Other, please explain…..

H) System data storage:

1. Would you want the system to save a recording of:
   - what it monitors
   - what it detects
   - what it recommends

2. If you answered "yes" to any of the previous options:
   a) how often would you expect/want the system to save a recording, e.g. every few minutes, on an hourly basis / daily basis, per event etc.
   b) how long would you expect/want the system to save the recording(s) for, e.g. permanently (stored until it is manually deleted), stored for a set period of time and then automatically deleted etc.
   c) in what format would you expect/want the information to be saved/stored, e.g. open access plain text, MS Word or Excel file / password protection plain text, MS Word or Excel file / open access encrypted file (only readable through the system's software) / password protected encrypted file (only readable through the system's software) / other…..

I) Privacy:

1. In principle, would use of an interactive affect and ergonomic monitoring system give you cause for concern about your privacy? Please explain…

2. With the choice of monitoring methods discussed in the survey (shown below), which, if any, give(s) you cause for concern with regards to your privacy and why?
   a) Keyboard use (e.g. key action (force/pressure used), position of keyboard on work surface, number of presses)
   b) Pointing device use (e.g. hand/finger pressure on device, grip position, button action (force/pressure used, number of presses), speed and range of movement, position of device on work surface)
   c) Head position in relation to monitor (e.g. distance from screen)
   d) Seated position (e.g. fully in chair with back supported, perched, fidgeting)
   e) Upper body posture (e.g. leaning towards the screen, leaning to one side)
   f) Facial expression (e.g. frowning, eyebrow positions)
   g) Eye size (e.g. changes can indicate mood)
   h) Eye gaze (e.g. rapid movement, lack of movement, tracking eye gaze across screen)
   i) Voice monitoring, e.g. detecting the volume of your speech, tone, words used etc.
   j) None

J) Trust (in the system):

Example definition of trust:

"reliance on the integrity, strength, ability, surety, etc., of a person or thing; confidence"

1. What, if any, trust issues do you perceive there to be with regards to Interactive Affect and Ergonomic Monitoring Systems. An example might be the system's ability to accurately detect that you do have a problem, rather than reporting false negatives, e.g. a frown might be as a result of non-work thought (e.g. trying to remember something that you need to buy on the way home etc.) rather than frustration with the computer or your work.

2. Please rank the identified monitoring methods in terms of trust, where “1” is the method you would trust most and “9” is the method you would trust least:
   NOTE: please consider that the method you would trust most may not be the same as the method which you would prefer to use

Keyboard use (e.g. key action (force/pressure used), position of keyboard on work surface, number of presses)	
Pointing device use (e.g. hand/finger pressure on device, grip position, button action (force/pressure used, number of presses), speed and range of movement, position of device on work surface)	
Head position in relation to monitor (e.g. distance from screen)	
Seated position (e.g. fully in chair with back supported, perched, fidgeting)	
Upper body posture (e.g. leaning towards the screen, leaning to one side)	
Facial expression (e.g. frowning, eyebrow positions)	
Eye size (e.g. changes can indicate mood)	
Eye gaze (e.g. rapid movement, lack of movement, tracking eye gaze across screen)	
Voice monitoring (e.g. detecting the volume of your speech, tone, words used etc)	

COMMENTS on your ranking choices…….

K) Trust (in your employer):

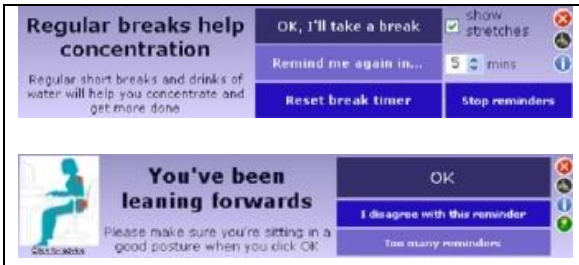
1. Would you be happy to know that your employer (or your employer's representatives) could have access to the system's monitoring, detection and/or recommendation records?
2. If your answer is "no", please explain why not / what concerns do you have?
3. If your answer is "yes", how would you expect/want your employer to use that information? Do you believe that the information would be used in that way? If not, why not? Please explain:

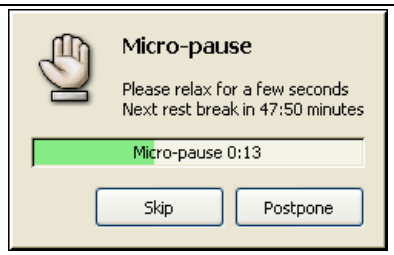
L) Do you think that your responses to the survey or the questions posed today:

1. Have been influenced by anything? Example reasons might include:
   - existing or historic symptoms
   - previous experience of monitoring systems (e.g. direct exposure, witnessing someone else using one, anecdotal)
   - your work location
   - the industry you work in
   - your employer
   - other....

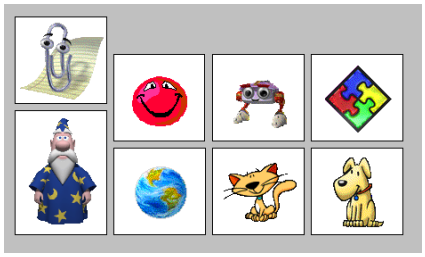
2. Would change if you were considering your personal computer use, i.e. home-based / non-work computer use? If "yes", why, how?

Image Sheet



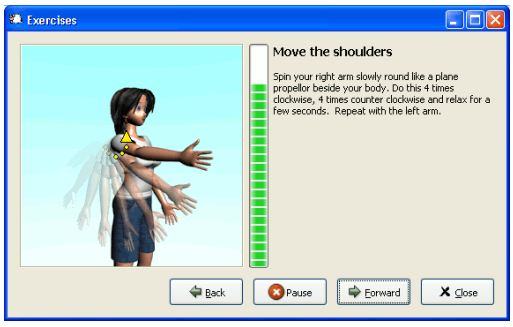


Examples of text-based messages

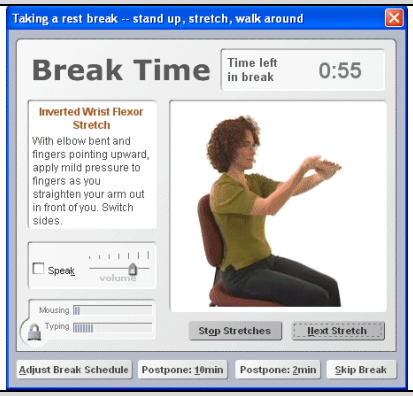


Examples of animated cartoon-style characters

Text-based message with example of drawing/sketch



Text-based message with examples of animated characters



Text-based message with example of virtual assistant support
NOTE: image may be static, animated or video-based

Appendix_5

Contact Sheet of Photographs Used During Interviews

NOTE:
During the interviews larger versions of the images were shown to the participant (one image at a time).

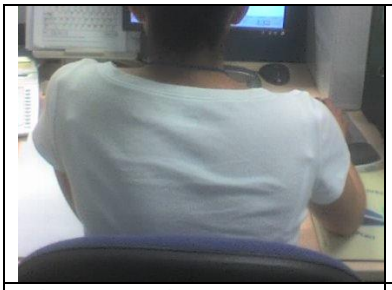
MSc Human Computer Interaction Research Project
Interview: Photograph Sheets

"If the computer could warn you that your working habits, posture, and/or emotional state might be putting you at risk of developing or aggravating symptoms, e.g. stress, headaches, eyestrain, physical discomfort, would you want it to and, if so, what monitoring methods would you find acceptable?"

Please consider the following photographs and explain your instant reaction to each photograph, i.e. how the picture makes you feel emotionally and/or physically.

Thank you for your time.
Jan Mulligan

Tel: XXXX XXXXXXX
Email: j.mulligan@ucl.ac.uk



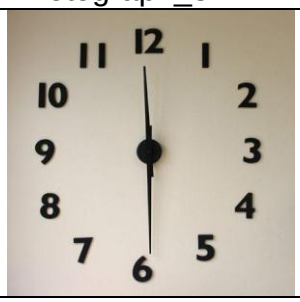
Photograph_1

Photograph_2

Photograph_3

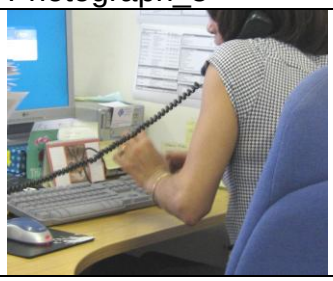
Photograph_4

Photograph_5

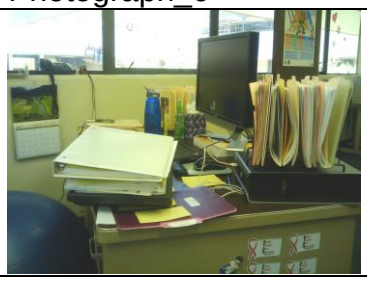


Photograph_6

Photograph_7



Photograph_8



Photograph_9

Photograph_10

Photograph_11

Photograph_12

Photograph_13

Appendix_6

Survey Comments

Appendix_6a:
Survey Question 20, "Does your company provide you with Display Screen Equipment (DSE) Workstation Assessments?"

Despite responding "yes" to, some participants qualified their responses:

P17(F) "*We put some health and safety policies in place and I go through basic workstation assessments with every new employee – but don't think it is a formal DSE as such*"

P18(F) "*Only people who have/develop problems might get offered one*"

P25(F) "*But it is only paper based unless requested*"

Whilst others, reported never having an assessment:

P7(F) "*Have not had one*"
(time in current job is reported as being "more than two years")

P26(F) "*I don't know that I have ever had a DSE – I had never heard of it till this moment.*"
(time in current job is reported as being "*between 6 and 12 months in role, but with the employer for over 12 years*")

P29(M) "*Never*"
(time in current job is reported as being "more than one year")

P36(F) "*Never had one*"
(time in current job is reported as being "more than one year")

Appendix_6b:
Survey Question 31, "Have you discussed your symptoms with...."

P2(F): "*Comes sporadically so haven't thought to mention it*"

P26(F): "*I see it a symptom of physical inactivity and I just need to do some serious moving around, go for a walk or something*"

P30(F): "*Not entirely sure of the cause, but think it's the way I sit and use my right arm*"

P34(M): "*It wears off overnight so assume as not too serious I think*"

Appendix_6c:

Survey Question 39: "Can you think of any other detection methods which you would welcome or tolerate which have not been listed above?"

P1(F): "*Quantity of a particular computer-based action. E.g. "you've clicked the mouse 350 times in the last hour, it's time you did something else before your hand seizes up" – or similar!"*

P9(F): "*Something on the monitor that reminds me to move/switch position*"

P12(F): "*To monitor the effect on eyes tension*"

P18(F): "*I would like to be reminded to take a break from using the mouse when a particular job requires a lot of mousing*"

P25(F): "*Some way of looking at the type of work being done, e.g. intense focus of a spreadsheet is a bit different from reading your emails*"

P29(M): "*Monitor position in relation to head*"

P32(M): "*Simply telling you how long you have been at the keyboard / computer*"

Appendix_6d:

Final Comments:

P7(F): "*In many cases, I feel the computer user is probably aware of what causes pain, etc. and could probably help themselves! However, some employers are not always in a rush to provide an audit, or other equip to alleviate symptoms*"

P13(F): "I suppose my main issue with such computer use is the amount of strain on the eyes but I was not sure if this could be monitored through the 'Eye size' or 'eye gaze' part of monitoring..... ".

P17(F): "*I think this could be really useful, but I have a sort of horror vision of my computer turning into my Mum and nagging me to sit up straight, smile, be polite, etc. which I found deeply irritating and rather patronising even when I was a child! It could be quite fun if it was a bit ironic with warnings and danger levels – "risk of pain level 5 occurring in 10 minutes" – like something off ER or in a submarine*"

P18(F): "*A lot of people where I work are only using computers to put in info, or collate data and most of them have had no training whatsoever, and no idea that the way they are sitting, keyboarding or mousing cause aches they might be experiencing....*".

P20(F): "*I think employers would be unlikely to welcome/tolerate many of these suggestions*"

P23(M): "*Depending on the proposed detection methods used (e.g. photographic evidence of poor posture, or lack of pressure in a chair backrest indicating that the user is not sitting back into chair) may be construed by some users as "Big Brother". However, those with symptoms may welcome the intervention. Prevention versus Cure*"

P26(F): "*My husband works writing software which enables, for example, teachers to see what their students have got going on their screens etc, and also enables employers to see what employees are doing on their desktops or networked laptops. Its nickname is 'master-and-slave' and there's something not quite all right about computers keeping such a close eye on us. I think I would rather learn to spot my own physical stillness and get moving*"

Appendix_7

Interview Participants' Trust Ranking of Example CIMS Systems

IQ-J2 Please rank the identified monitoring methods in terms of trust, where "1" is the method you would trust most and "9" is the method you would trust least:

NOTE: please consider that the method you would trust most may not be the same as the method which you would prefer to use

		1	2	5	10	14	15	16	17	18	21	23	30	31	TOTAL	RANK
a	Keyboard use	x	3	3	3	1	3	x	x	1	x	1	1	1	17	1
b	Pointing device use	x	3	3	3	2	4	x	x	2	x	1	3	3	24	4
c	Head position in relation to monitor	x	2	2	1	3	2	x	x	3	x	1	4	2	20	2
d	Seated position	x	1	2	2	4	7	x	x	3	x	1	4	4	28	5
e	Upper body posture	x	1	1	2	5	1	x	x	3	x	1	2	5	21	3
f	Facial expression	x	4	5	x	7	8	x	x	9	x	3	9	8	53	6
g	Eye size	x	4	6	4	6	6	x	x	9	x	6	9	7	57	8
h	Eye gaze	x	4	4	4	9	5	x	x	9	x	3	9	6	53	6
i	Voice monitoring	x	4	6	x	8	9	x	x	9	x	4	9	8	57	8
		Note1						Note2	Note3		Note4					Note5

Notes

1 Participant 1 had limited time availability and so this question was dropped

2 Participant 16 would want to see the systems working first before making a judgement on trust

3 Participant 17 would not immediately "trust" any of the monitoring systems. She would want to know how each system worked, could be adapted to meet individual. Quote from interview ttrasncript: "*need to establish what is normal for you*"

4 Participant 21 does not want to use any type of monitoring system, so has no immediate trust. Experience of the WII-fit weighing in system, where the system states that the user is a different weight every time one weighs in, even if last weigh was only a few seconds ago.

5 Final ranking positions are reached by ordering the Total entries based on lowest total taking first place, second lowest total taking second place and