PHYSIOLOGICAL, PSYCHOLOGICAL AND ATTENTION RELATED PERFORMANCE PROBLEMS OF SHIFT WORK SYSTEM IN ASELSAN

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ABSTRACT

PHYSIOLOGICAL, PSYCHOLOGICAL AND ATTENTION RELATED PERFORMANCE PROBLEMS OF SHIFT WORK SYSTEM IN ASELSAN

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Shift work is inevitable and increasing demand of working society of modern society. In this study, one aim was to observe physiological and psychological consequences of shift work on workers of Aselsan. Survey of Shift workers is used for this purpose, and as a result, some consequences of shift work is observed on cardiovascular and digestive symptoms, but in general trend, participants does not complain about physiological and psychological concerns. This can be explained by the young age group. Some complaints are seen on sleep disturbance levels due to disrupted circadian mechanisms of workers. Another aim was to measure attention related performance problems of workers. Attention levels of three-shift workers is examined throughout three different shifts. Hemoglobin and oxy-hemoglobin levels measured by fNIR device which gives information about attention levels of participants. Also reaction time tests are applied while fNIR devices are attached. As a result, decreased attention levels are observed in morning shifts where both fNIR and RTT results overlaps. Increased attention levels are observed by fNIR device in evening and night shifts which was oppose to RTT results. fNIR is a new technology,

and did not used in shift work area before, so different participant numbers and experiment protocols can be tried in future works.

Key words: Shift work, Reaction Time Test, fNIR, Survey of Shiftworkers

ÖZ

ASELSAN'IN VARDİYALI ÇALIŞMA SİSTEMİNİN FİZİKSEL, PSİKOLOJİK VE DİKKATE DAYALI PERFORMANS KRİTERLERİ ÜZERİNDEKİ ETKİLERİ

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Vardiyalı çalışma günümüzde artan bir taleple kaçınılmaz bir çalışma sistemi haline gelmiştir. Bu çalışmadaki hedeflerden biri, Aselsan'daki vardiyalı çalışanların vardiyalı çalışma sisteminden fizyolojik ve psikolojik olarak nasıl etkilendiklerini gözlemlemektir. Bu amaçla Vardiyalı Çalışanları Araştırma Anketi kullanılmış ve sonuç olarak bir takım kardiyovasküler ve sindirim sistemi semptomları gözlemlenmiştir. Ancak anket sorularının geneline bakıldığında, çalışanların fizyolojik ve psikolojik olarak çok fazla sorun iletmediği görülmüştür, bu sonucun katılımcıların yaş ortalamasının oldukça genç olmasından kaynaklandığı düşünülmektedir. Uyku ile ilgili problemlerde ise günlük vücut döngüsünün vardiya saatleri tarafından bozulmasına bağlı olarak birtakım olumsuz sonuçlar izlenmiştir. Çalışmanın bir başka amacı ise çalışanların dikkate dayalı performans problemlerini gözlemlemektir. Üç-vardiyalı sistemde çalışanların dikkat seviyeleri 3 farklı vardiya boyunca izlenmiştir. Beyindeki hemoglobin ve oksihemoglobin seviyeleri fNIR cihazı ile ölçülerek, kişilerin dikkat seviyeleri hakkında çıkarımlar yapılmıştır. Buna ek olarak, kişilere fNIR cihazı takılıyken, 2 farklı tepki süresi testi uygulanmıştır. Sonuç olarak, fNIR ve tepki süresi testi sonuçları doğrultusunda, gündüz vardiyasında dikkat seviyelerinde azalma görülmüştür. Akşam ve gece

vardiyalarında ise fNIR verileri doğrultusunda dikkat seviyelerinde artış gözlemlenmiştir, ancak bu sonuç dikkat seviyesinde azalma gösteren tepki süresi testi sonuçlarıyla çelişmektedir. fNIR yeni bir teknoloji olup daha önce vardiya sistemi ile ilgili çalışmalarda kullanılmamıştır. Vardiya sistemi için, farklı katılımcı sayıları ve profilleri ya da farklı deney protokolleri izlenerek gelişmeye açık bir alandır.

Anahtar Kelimeler: Vardiyalı çalışma sistemi, Dikkat testi, fNIR, Vardiyalı çalışanları araştırma anketi

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CHAPTER 1

INTRODUCTION

Shift work is a necessary component of modern society. Shift work becomes a very common subject worldwide at last decades, nearly 20% of the labor force worldwide works in shift schedules in last decade. Description of shift work is working hours outside 07.00h to 18.00. In other words, shift work is organizing the usual working hours in such a way that different employees or teams can work successively, and as a result this succession cover the 24 hour of the day. In many occupations, shift work becomes a common practice even in job groups that directly affect health and safety of others like transportation and healthcare services. Therefore, health or safety of people who gets the service may be at risk, if shift workers' alertness and performance are impaired. Evening, night, morning, rotating and irregular shifts are the common shift schedules. (Folkard and Tucker, 2003) The working hours for evening shift is generally between 14.00h and 00.00h, whereas night work is between 21.00h and 08.00h. Rotating shifts means that, workers periodically change their schedules from morning shift to evening shift to night shift and so on. Irregular work hours can be explained as the changing working hours that varies due to employer needs. (Boivin, 2007).

By the increasing popularity of shift work, the life quality of the people who gets service from shift workers increases as they can reach services whenever they want. But, on the other hand, quality of life, health, safety and social relationship of shift workers are affected by the odd working hours negatively. In lots of studies, the common ground is worker psychology and physiology influenced negatively by shift work schedules. Circadian rhythm of workers disrupted by the shift schedules where circadian rhythm is a daily cycle of activity observed in many living organisms, by the disruption of circadian rhythm, sleep and alerting cycles of an individual has

been overwhelmed. So, generally, shift workers complain about disturbed daytime sleep and excessive sleepiness during work shift. To come up with, basic sleep needs and circadian principles of human body conceal that shift work and human circadian sleep-wakefulness physiology are often incompatible. (Koller et al, 1994; Pilcher et al, 2000)

Shift work tolerance changes individual to individual. Shift workers, who do not like working in shifts, usually suffer from circadian disruption and sleep problems which lead to serious troubles in their social and family life as well as their working life. Whereas, shift workers, who do not complain about working in shifts, can adapt to unusual working conditions easily because of their personal attitudes against the work.

For workers with low shift work tolerance, impaired sleep observed usually which causes increased sleepiness/fatigue and results in increased accident risk. The main problem of the working schedule for this workers is the night shift but for some individuals early morning shifts may also create similar problems. Some characteristics of the working schedules may also increase the shift work disorders. For instance, short rest times between shifts and long shifts may exaggerate the problems coming with shift schedules. On the other hand, these problems may be prevented to some extent by napping, light treatment, extended rest breaks. (Åkerstedt, 2003)

One of the main problems about shift work is sleep disorders. In shift workers generally excessive sleepiness is observed at work which gives its place to insomnia during scheduled times for sleep. Lots of well-documented negative effects of shift work about sleep problems appear in literature such as decreased sleep, poor sleep, increased sleepiness, decreased alertness and as a result decreased performance efficiency and increased accident rates. Also there are some evidences about shift work and health conditions, shift workers, who especially works in night work, are generally more familiar to gastro-intestinal problems, obesity, cardiovascular problems than day workers. Main reason of these health problems can be described

by the disruption of circadian rhythms during shift work. (Atkinson and Morris, 2013)

Most negative effects of shift work on the worker is observed during night shift work, followed by day shift work, especially when the day shift work starts in the early morning. Afternoon shift work is the shift which has relatively few negative effects on sleep and health. But the main concern about evening shifts is that it can create social concerns as the timing of the shift interrupts with the majority of the social activities which are arranged due to day workers, who constitutes the majority. Even there are lots of different ways developed by both shift workers themselves and companies in order to adapt shift work schedules, more or less, every shift worker affected by the odd working hours and performance decrease is shown in different shift schedules. Therefore, for the companies, it is very important to integrate better countermeasures in the work place and educate their workers better about potential coping strategies. (Pilcher, 2013)

The aim of this study is to examine main factors that affect and affected by the shift tolerance of shift workers working in Aselsan Inc. Hence, health problems, sleep problems, and psychological problems of the workers caused by the shift work are examined by using a questionnaire. In addition, alertness and related performances of the workers, measured by objective methods are compared with the subjective evaluations of workers in order to understand if shift tolerance and objective meaures give consistent results.

After this brief introduction, the rest of the thesis is presented in four chapters, In Chapter 2, an overview of shift work literature is reported. Description of shift work, the main problems caused by shift work, shift work tolerance which changes among workers and the factors that affect and affected by the shift work tolerance will be discussed. In Chapter 3, methodology of the thesis is explained. The literature review and the theory related with the research methodology are also given in Chapter 3. Subjective and objective methods are used to measure the tolerance of workers against shift work. A questionnaire carried out among shift workers and standard day workers in order to find the problems caused by shift work, where day workers were

the control group. In addition, fNIR(functional near-infrared spectroscopy) observations applied to shift workers who work in three shifts. Observations hold out through the shifts. During fNIR experiments reaction time test is held by the participants. Chapter4 and Chapter 5 are devoted to interpret and discuss the results of methodologies stated in Chapter 3.

CHAPTER 2

OVERVIEW OF THE LITERATURE

2.1 Shift Work History

Competition among the companies increases faster more than ever in last decades. Main reason of this competition can be matched with the fact that society and its needs changing faster than ever. So the firms have to create new strategies in order to cover these needs and grow economically. Firms need to adopt new technologies and create new information processes in order to meet the needs of changing society. (Costa, 2003)

In addition, competition across the companies creates a 24-hour society. Most of the companies choose to work continuously. One reason is to reduce fix costs, but the main reason is to come up with the rising competition. This supports working in shifts in order to be the leader in sector. In today's modern world, in order to achieve some economic and social goals, firm's use shift work commonly. (Esquirol et al, 2011) So the working hours arranged according to these needs of companies Therefore, the borders between working and leisure times are not fixed anymore. Workers need to work in evening and night hours, even in weekends. (Costa, 2003)

The term shift work arises at this point. Generally, the shift work can be explained as the organization of working hours that differs from traditional diurnal work period. Irregular and odd working hours sometimes mentioned as synonymous of shift work. (Costa, 2010)

Most of the employers encourage working in shift system, working for long hours and working at night without thinking about the needs of the employees. This creates

a need to arrange the working hours of employees. But working in companies is not the only life of the workers. They need to organize their social lives according to this changing working conditions. So 24 hour society should also be created in leisure activities, transportation, communication, shopping parts of life in addition to industrial sector. That is the workers who work in shift systems need to find the things they need in any hour of the day. Time constraints should not limit the social lives of the shift workers, in order the shift system not affect their lives badly. (Moore, 1993; Costa, 2003)

What's more there are some necessities for shift work with increasing technology. For instance some machines have to be worked for 24 hours because of their setup times and setup costs. This thesis work is studied in Aselsan, and reason of Aselsan for working with shifts is to complete the tests of products in time as the tests take long times. Whatever the reason is, even a necessity or desire of boss, shift work becomes one of the more common working styles at last years. Last decades, the number of shift workers increase rapidly. Today, nearly one-fifth of the work force working in shifts. (Tierney and Anderson, 2013)

From the employee's point of view, shift work effects health, social life and family life negatively. And majority of the workers would prefer working in regular working hours. Also from the employer's point of view, shift work is not an optimal strategy. Negative side of the shift work for employers is the decreasing performance at afternoon and night shifts as the adaptation to circadian rhythm is very difficult, this rhythm can be described as, daily cycle of activity observed in many living organisms. In earlier findings, it is stated that major body rhythm makes the people more alert in earlier hours of a day. However, this rhythm becomes lower in later hours. With lower body rhythm at afternoon and night shifts, performance of workers declines. This study aims to find the factors which affect the performance of workers at different shifts.

Whatever the reason is in last decades shift work used widely for organizing the working time all around the world. The reason for increasing trend for shift work is

that it enables round-the clock activities both in technological conditioning, social services and productive and economic activities. Chemical industry, steel industry, textile, paper, food, mechanical industry hospitals, telecommunication industry are the main examples for the industries that use shift work widely. (Costa,2003)

2.2 Shift work description

"Shift work is an increasingly widespread practice in industry and services." (Kogi, 1996) There is no exact definition of a shift work but it is usually described as a working system that expands the period of production from standard daytime to 24 hours by enforcing workers to relay at the non standard working hours. (Akerstedt, 2003)

When a person works outside the regular working hours- 7.00 A.M to 6.00 P.M. – this working style is called shift work. (Monk and Folkard, 1992). In other words, shift work is organizing the usual working hours in such a way that different employees or teams can work successively, and as a result this succession cover the 24 hour of the day. (Costa, 2003) Generally companies use two or more teams during a day in order to arrange the working hours. (Härmä, 1993), Shift workers might work in the evening, in the middle of night, overtime, or extra long workdays. By shift work, the work can be organized such that the workers do the same work at the same work station at a certain pattern. Shift work may be organized in rotating pattern, continuously or discontinuously. (Esquirol et al, 2011; Natvik et al, 2011; Tierney and Anderson, 2013)

Saksvik describes shift work in his article as "any work organization of working hour that differs from the traditional diurnal working period which is between 7 PM to 6 AM". What's more, Driscoll states that shift work is a common experience among workers. By the changing world and changing economic and industrial needs of companies, most of the companies requires to work both in regular working hours and in non-standard working hours. As the developed countries create systems that functions at same level during 24 hours of day, shift work becomes more familiar

between many industries. As a result of this change in industries, most of the workers perform shift work. (Driscoll et al., 2007)

According to the survey carried in 15 European Union countries which was about the working conditions, in 2000, 24% of the workers work in regular working hours that is between 7.00 AM to 6.00 PM and in weekdays, rest of the workers work in shift systems. (Costa, 2003; Bara and Arber, 2009) So it can be concluded that most of the working power is used in shift work, night work or weekend work, that is most of the workers work in non standard working hours.

It is a common thought that shift work increases the risk factors for health and safety of workers at work, it also deteriorates the social well-being of employees. However in modern society, shift work cannot be avoided.

Development of the modern society causes new economic and productive strategies for firms and the social organization changes according to these new strategies, which resulted with the changing individual behaviors of employees. Another result of the newly developed strategies of the firms, employers need to adapt their production systems to demands of the market. They need to do some technological innovations in order to stay in competition. All these changes in structures of firms leads firms to 24 hour working conditions. But there is also another side of view, the employees try to balance their working and social lives, so they ask for their companies for more balanced working hours. (Costa, 2003)

On the other hand, from the employee's point of view, shift work disrupts biological rhythms, physical and mental health, safety, sleep, social life of workers, and work performance/effectiveness which is an obvious truth. Most studies consistently demonstrate the same result; shift work causes several problems for the workers. (Saksvik et al., 2010) Disruption of biological rhythms of workers is the main reason in increase of clinical and nonclinical problems in a shift worker's life. Shift work reduces the quality of performance, and may cause industrial accidents as a result. Chance of occurrence of industrial accidents is higher in night work than standard morning work. (Pati et al., 2001) However, negative effects of the shift work may

arise differently in every individual. Some of the workers can tolerate the work well but some workers may not tolerate and shift work causes serious problems in their lives. This is why identifying determinants of the shift work tolerance is important. By identifying the determinants of the shift work tolerance, appropriate personnel selection can be done easily and also different shift work systems and work conditions can be explored. Mismatches between individuals and their working schedules can be minimized. The causes of this mismatches are altered sleep-wake schedules, internal timing mechanisms and community rhythms of business, social, recreational and domestic activities which may vary person to person. (Costa, 2003; Loudoun, 2008)

As a result, as shift work challenges the human adaptability to temporal changes, it has adverse affects both from biological and social perspectives. Shift work interferes with the "physical, mental and social" well-being of workers. (Costa, 2010) Shift work conflicts with the circadian rhythms, sleeping and eating hours of workers, it increases the chance for errors and accidents in working environment, disrupts family and social relations. What's more, shift work is a risk factor for gastrointestinal and cardiovascular disorders (Moore, 1993; Costa 1996)

2.3 Characteristics of Shift Work

Shift work does not have strict rules. It may vary from company to company. Tasks and workloads may vary between night work and regular work hours in some companies, whereas workers may do exactly the same tasks in day and night works in some companies. Obviously, different rules of shift work between different companies/sectors causes different stress and related effects. Therefore, it is difficult to compare the effects of shift work on workers by only taking type of shift schedule and years spent in shift work into account if they work in different conditions. (Costa, 2010) Shift work can be described by 8 main characteristics;

- number of teams who rotate during the day, there may be 2, 3 or 4 different teams that swap in a working day.

- duration of the shift, working hours in different companies vary from 6 hours to 12 hours.
- scope of night work, in different companies number of consecutive night work may change, or in some companies there is a limit on number of nights per year.
- work on week-end, this may vary between continuous and semi- continuous shift systems. In semi-continuous shift systems, usually there is no week-end work. However, in continuous shift systems, the machines never turned off, so workers must work also on weekends. Also for continuous shift systems, the number of free-weekends per cycle may also vary between different companies.
- speed of rotation(fast, low, intermediate, absent) Speed of rotation is explained by the number of shifts that are worked consecutively. (Akerstedt, 2003) It is claimed that total sleep length and the amount of sleep cannot be changed across four consecutive night shifts. So if the rotation is faster that 4 days it may cause problems on sleep of shift workers. (Foret and Benoit, 1974)
- direction of rotation (clockwise or counter-clockwise) Usually it is claimed that the direction of rotation of the shift should be clockwise. The reason for this claim is that by this schedule workers can use the first one or two days-off for recovery from the night shift. Whereas, from the employee's point of view, they prefer counter-clockwise rotation(night work first) in order to recover from night work while working on company time. (Akerstedt, 2003)
- length of the shift cycle (days, weeks, months)
- time of start and end of shifts.

2.4 Shift Work Tolerance

Shift workers can be divided into two groups. Some of the shift workers do not like working in shifts and they suffer from circadian disruption and sleep problems which lead to serious troubles in their social and family life as well as their working life. The level of troubles that caused by the shift work differs from person to person. Whereas, some of the shift workers do not complain about working in shifts, as they

can adapt to unusual working conditions easily because of their personal attitudes against the work. (Costa, 2010) Intolerance against shift work mainly causes three types of medical complaints; digestive troubles, chronic fatigue/unusual nervousness, and sleep adaptations. 10 years or more experienced shift workers are the subjects who mark the highest low tolerance levels. (Natvik, 2011)

The main intolerance reason to shift work is that the working schedules force workers to adapt temporal patterns. And the workers usually have problems to adapt both in biological and social ways. (Akerstedt, 2003) And generally night work causes the main problem, it has the greatest negative impact on mental health. (Bara and Arber, 2009)

In literature, some variables that affect shift work tolerance have been studied more frequently than others. These variables can be listed as age, gender, personality traits such as neuroticism, chronic fatigue etc. , circadian preference, morningness and eveningness dimensions. Usually the subjective evaluations of the workers on their own shift work tolerance are used. While measuring sleep duration, sleep quality, sleep problems, chronic fatigue and alertness or sleepiness during shifts also the self-evaluations of the workers are used as these are the notions that cannot be measured from outside easily. In addition also health and stress problems of the shift workers generally measured by the self evaluated questionnaires. (Saksvik et al, 2011)

The variables measured above are personal characteristics that affect the tolerance of shift-workers. But generally they cannot explain the whole picture. Also family and other social issues affect the worker's life. Therefore, in some of the researches, the questions about work-family conflict, social disturbances, work satisfaction are also included in questionnaires.

What's more in some researches, objective measures are used in order to explain the shift work tolerance of individuals. For instance, Reid and Dawson and Bonnefond et al used neurobehavioral and cognitive performance tasks which are carried on at different times of shift. (Reid and Dawson, 2001; Bonnefond et al, 2003) Henning et al collected saliva and urine samples which are used to explain the indicator of

circadian rhythms. (Hennig et al., 1998) Korompeli et al and Sookian et al collects blood samples in order to measure neurotransmitters and hormones. (Sookoian et al., 2007; Korompeli et al., 2009)

Against all these intolerances, there are stages to cope with the shift work in literature. First one is adaptation. In first five years, the workers get used to the conditions, familiarity to unusual working hours, social life and family changes increases. Second stage is sensitization, which takes the next ten years. In this stage, job satisfaction and career development are on the forefront in worker's life. After twenty years accumulation stage takes place. Poor coping strategies accumulate. And the last stage is manifestation. In this stage, shift work disorders and diseases occur. (Tierney and Anderson; 2013)

2.5 Variables that affect shift work tolerance

2.5.1 Individual characteristics

Shift work tolerance is at different levels among workers. Individual characteristics are one of the main reasons of this. It has been widely examined in order to find the psychological and physiological factors which affect shift work tolerance. Individual characteristics may increase the adverse health effects of shift work or may cause better tolerance (Costa, 2010).

Morningness, languidness, flexibility and hardiness are the individual characteristics and show variety among workers. Being relatively alert in early morning and relatively sleepy in evening is described as morningness. Languidness shows the tendency of being sleepy and tired when cutting down on sleep. Ability to work and sleep at odd times of the day can be named as flexibility and elasticity to stressful life events is described as hardiness. In order to understand these characteristics of workers, Natvik uses insomnia, sleepiness, depression and anxiety as dependent variables in his study. (Natvik et al., 2011) Therefore, morningness, languidness, flexibility and hardiness are the characteristics of a person which directly points sleep and psychological problems of an individual.

Chandrawanshi and Reinberg argue that people divided into two types; morning type person(Homo larkensis) and evening type person(Homo owlensis). (Pati et al., 2001) Morning type people are more active earlier in the day and usually sleep relatively early at night (Jovanovski and Bassili, 2007). While, evening type people contrastly tend to wake up later in the morning and then are more active and tend to go to bed later in the day. (Tierney and Anderson, 2013) In literature, it is shown that morning type workers who are more alert in early morning hours and evening type workers who are more alert in night hours differ in their modification of circadian clock for night work. Obviously, morning type workers are less tolerant to night work while evening type workers are better in night work compared to day work as they have a natural circadian clock more delayed towards evening hours (Hildebrandt and Stratmann 1979; Folkard and Monk 1981; Moog 1987). Kaliterna et al. proposes young shift workers shows very low correlation between morningness and tolerance, this correlation inclines with the age (Kaliterna et al., 1995). While Harma cannot find any consistent relation between morningness and long-term tolerance to shift work. (Harma, 1993) On the other hand, Folkard and Hunt founded even opposite interactions. In their study, it is claimed that evening type person may be more advantageous in night shifts, but as they are less advantageous in day work, in long term tolerance levels they are worse than morning type workers (Folkard and Hunt, 2000). What's more, flexibilty of a worker increases the tolerance to shift work. (Iskra-Golec and Pokorski, 1990)

Another study of Knutsson(2004) shows that shift workers are generally healthier than the general population both in means of physiology and psychology. Therefore, depression, insomnia and related problems do not arise often. This is because of the selection process of shift work. In the literature, this is described as healthy worker effect. Healthier workers assigned to shift work, while the individuals who have problems directed to standard work. (Bara and Arber, 2009)

On the other hand, Costa(2010) claims that; realizing individual characteristics should not be discriminating in job assignment. But, if the workers know their individual characteristics, they could find their best way to cope with irregular working hours.

2.5.2 Biological structure

Circadian rhythm which is described as daily cycle of activity observed in many living organisms earlier, and the adjustment of circadian rhythm to odd working hours, in one of the main problems of a shift worker. When the synchronization of circadian rhythm is disturbed, this is explained as the major cause of perturbation of human homeostasis. This perturbation does not only discomfort workers in short term modification for sleep-wake cycle, but also in long term tolerance to odd working hours.(Costa, 2010)

Main problem of the night work and the main cause of the desynchronization of circadian rhythm is the mismatch between internal clock of human body and the environmental synchronizers which can also named as light/dark cycle. So, as a result, physiological and psychological disturbances caused by desynchronization of circadian rhythm starts with the sleep/wake rhythm. Body clock of a normal person adjusted to standard working hours. When a shift worker works in evening or night shifts, normal activity-rest cycle had to be modified. Body functions must be adjusted to new duty periods. Circadian rhythm of a worker need to be shifted progressively across successive night shifts, however a complete inversion cannot be reached in most cases. In literature, only permanent night workers shows a complete inversion. (Costa, 2003)

Normal shift workers consistently disturbed by the continuous shift rotation even though they attempt to adjust as quickly as possible to varying working hours. In addition, circadian system cannot completely rearrange itself to inverted sleep-wake schedule which is the case in night shifts. In literature, it has been concluded that internal circadian body clock of most workers cannot adjust to night work within one week. (Knauth, 1993) As a result, workers usually have to work at their lowest point of alertness and they are also forced to sleep at the circadian incline of awakeness which causes insomnia during night shift periods. (Tierney and Anderson, 2013) Circadian adjustment can only be seen in workers who have a total commitment to work they have done or who are an evening type people or who has bright light in their working environment. (Czeisler et al, 1990; Knauth, 1996)

Last but not least, circadian rhythm of a person is also known to demonstrate the amplitude and stability of an individual. Circadian rhythms are also been discussed to what degree individual characteristics are related to this individual differences. (Milia et al., 2005) Overlapping circadian rhythm and amplitude & stability of an individual proposes a new conclusion that circadian factors are related to flexibility and languidness of human-being. Flexibility directly related to stability and languidness to amplitude. Low scores on languidness means high alertness degrees across the day, this suggests these individuals are less influenced by sleep inertia. Individuals with high scores on languidness needs more sleep. What's more, high scores on flexibility, individuals show high alertness degrees between 16:00 and 22:00. (Natvik, 2011)

2.5.3 Sleep Strategies

Main complaint of shift workers is the sleep which is the only reason for circadian desynchronizations. Sleep length and quality changes significantly according to the variable retiring and rising times. Odd working hours push workers for adopting to temporal patterns of biological and social functioning, which causes serious sleep problems. (Costa, 2003) If there are several night shifts in a row which is the case for most shift systems (i.e. shift workers work in night shift for one week or more in a row), possibility for a bigger cumulative sleep deficit towards end of a span of night shifts increases. Similarly, after a week of consecutive morning shifts, possibility of cumulative sleep deficit is also valid. (Knauth, 1996) When shift workers sleep cycle disrupted because of odd working hours, the causes serious consequences in terms of safety in working place and health of the shift worker. Social behaviors and personality factors can also influence the poor sleep cycle. As a result, psychological and physiological well-being of workers may be interrupted. (Tierney and Anderson, 2013)

In order to improve tolerance and counteract stress in working environment, a good sleep hygiene is an important factor. The ability and possibility to adopt optimal sleep is not only about organization of shift schedules but also personal behavior and strategies of shift workers, they need to be able to combine positive effects of main

sleep and naps. If a worker can adopt proper sleeping routines and avoid eternal sleep disturbances like day light while night shifts, than he will be compensate the sleep disruption due to odd working hours better. (Costa, 2010)

It has been found that day sleep during night shift is usually 1-3 hours shorter than night sleep during morning shifts, evening shifts and days off. Therefore, it is hard to get enough sleep over consecutive night shifts for workers which may result in an accumulation of sleep debt. Normally human body desires to recover this debt, and it is difficult for workers to resist the body's internal body clock as the clock influences a state of sleep. As a result, mismatch between circadian clock which shows the lowest alertness during night hours and need to work at night hours is the fundamental problem of the shift work. (Akerstedt, 2003; Tierney and Anderson, 2013)

In a study by Akerstedt, high sleepiness levels in night shift and no sleepiness at all during the morning shifts has been recorded. It has been stated that evening type shift workers who liked night work reported that they sleep less during night shifts than the workers who preferred morning shifts. In addition, the workers who are less satisfied with their work or had more problems in their domestic lives, complained of permanent sleep disturbances. And these workers showed increased anxiety and morbidity and they are tend to use medications due to these psychological problems. (Akerstedt, 2003)

Flexibility of a person determines the sleep disturbance level. If sleep habits of an individual is not flexible, than chance of experiencing fatigue and sleep problems increases. What's more sleep need also determines sleep problems of an individual by linking it with job dissatisfaction also. Longer a worker preferred to sleep, the higher was the job dissatisfaction on night shift. In addition, Eveningness and sleep flexibility are also positively related to social disruption. In night shifts, higher tolerance to factors somatic health and sleep, the trait anxiety of the worker will also be higher, in addition high tolerance to somatic health and sleep causes low emotional control. On the other hand, no correlation has been found between sleep need and personality. (Tamagawa et al., 2007)

2.5.4 Ageing

Rhythm disturbances, sleep troubles and psychic depression are not caused by shift work only but they are also associated with ageing. Ageing is also related to general reduction of physical fitness and increased probability of health disorders which are consequences of shift work at the same time. There are evidences for health disorders pointed out with increased age are more common in shift workers than standard workers. Circadian adaptation to night work decreases by ageing, which causes more serious problems in sleep disturbances for older workers. Decreasing circadian adaptation also means increasing health complaints of older shift workers.

On the other hand, ageing usually means longer experiences of shift work, and this means progressive learning take place, which provides workers to develop better coping strategies. From this point of view, older shift workers are more able to we have to consider that ageing, which is generally connected with length of shift work experience, can also mean a progressive learning and development of better coping strategies which make the older shift workers more able to adopt conservative countermeasures towards problems caused by shift work. (Costa 2010) So, as the ageing is also associated with mental growth, professional expertise and improved strategic abilities, it may also be a positive effect in shift work.

However, some studies argues that there are no significant relationships between ageing and psychological and physiological health. (Tierney and Anderson, 2013)

2.5.5 Health Conditions

In addition to disruption of body clock, shift work system also directs workers to poor diet as it is difficult to eat at night like day-time. What's more, workers usually use stimulants such as coffee and cigarettes in order to be awake at night. These factors cause digestive problems. Like the health complaints associated to somatic anxiety, digestive problems also produces headaches, dizziness, lightheadedness, nausea, vomiting, diarrhea and pale complexion. (Tierney and Anderson, 2013) In

the long run, gastrointestinal (colitis, gastroduodenitis and peptic ulcers) may appear in shift workers.

Shift work may also causes severe disorders which affect neuro-psychic (chronic fatigue, anxiety, depression) and most likely cardiovascular (hypertension, ischemic heart diseases) functions as well (Costa, 1996; Natvik, 2011)

2.5.6 Family and living conditions

Acceptance and tolerance to shift work are also affected by the family conditions like marital status, number and age of children, living with old and/or ill people, and also by living conditions like housing location and comfort (e.g. rooms, protection from disturbing noises). Shift workers who lived in good housing conditions did not have significant health problems caused by shift work such as digestive problems, while the workers living in poor housing conditions have more complaints than standard workers. Happiness in marriage affects the shift work tolerance, as it reflects the partner's support for coping strategies and countermeasures. Family support is very important as it may act as a process of slight self-adjustment to worker's working schedules. But there is also a chance for family support to act negatively, it may cause worker to isolate periodically from the family context. (Costa, 2010)

Risk of divorce, in families where one of the partners works in shift schedule increases. Anxiety and behavioral problems have also be seen in children of these families. The main problem that is exaggerated by shift work is; work and family duties usually cannot be performed simultaneously. This is because the most valued times for family activities are spent at work or at sleep for shift workers, as they work at evenings, nights or weekends. Looking at first sight, it can be thought that shift workers physically have more time to spend with their families ,like when they work at night shift the whole day and evening they are at home, but the quality of interactions is lessened as the shift workers tries to recover from time spent at work mentally or sleeps. (Loudoun, 2008)

2.6 Variables that affected by shift work

2.6.1 Work ability and errors

Human error in working environment and resulting work accidents and injuries mainly caused by the sleepiness, sleep disturbances, chronic fatigue and oscillatory fluctuations of alertness and vigilance which are the factors that are deteriorated by shift systems. (Costa, 2003) After a night shift, usually workers feels a chronic state of tiredness lasts for several days, and a result of this feeling is lack of concentration and motivation. Motivation decreases especially for activities that require effort of skill. (Tierney and Anderson, 2013)

Like the relation between accidents and fatigue/sleepiness of shift workers, performance error is also affected by the same symptoms. In a study that takes place in gas works, errors in meter readings measured over a period of 20 years, and a peak in errors observed in night work. (Bjorvatn et al, 2006) There was also a secondary peak in errors during the afternoon. There also other studies in literature which measures error rates of workers but most of them uses laboratory type tests such as reaction time tests, mental arithmetic tests etc. and results usually show reduced reaction times and poorer mental arithmetic on the night shift.

2.6.2 Social Life

Shift workers usually have difficulties to join in society, and face with problems in their social lives when compared to standard workers. The main reason of these difficulties is the odd working hours and arrangement of most family and social activities according to day oriented rhythms of standard workers who forms the general population. Therefore, shift work can leads workers to social marginalization because of the mismatch between the time budgets such as working hours, commuting, leisure times of shift workers, and the complex organization of social activities.

Generally, shift work schedules interfere with the organization of family timetables. The level of this interference depends on the family composition (i.e. number and age of children, cohabiting persons), personal duties (i.e. school, housework) and the availability of community services (i.e. shop hours and transportation). When the workers have large families or lots of complementary duties, their constant problem is the time pressure. Usually shift workers cannot have enough time to do all their family responsibilities. This time budgeting problem may have negative effects on their marital relationships and parental roles. Social stress and work-family conflict associated with shift work arises due to disruption of family life and leisure activities. In addition to the disrupted family and social life, daytime sleep of shift workers also disturbed due to environmental conditions, such as domestic and traffic noise, presence of children and normal social activities. (Tierney and Anderson, 2013)

In addition to the family life problems, shift work also usually restricts social and leisure activities. Shift workers regularly have to sacrifice their leisure time to hold domestic tasks that are inflexible with respect to timing, such as banking or shopping. (Loudoun, 2008) Most shift workers try to value their leisure time during evening hours higher than at all other times of the day, as the evening is best for social contacts when the general population who works in standard day time concerned. But, a week of evening shifts and a week of night shifts delays social contacts. (Knauth, 1996)

Such social life problems are more common among shift workers than the biological problems. And this problems also cause main problem for adapting to work and may have a clear influence on the development of psychosomatic disorders. (Costa, 2003) Social life problems contribute to psychological distress, particularly anxiety and depression (Tierney and Anderson, 2013)

CHAPTER 3

METHODOLOGY

In this chapter, procedures used in the experiment, subjects, data collection procedures and statistical analysis methods are discussed separately.

3.1 Shift System of Aselsan

Aselsan uses 3 different work schedules for the technicians who work in Production Directorate;

- Standard day workers, who work only in morning shifts from 07.30h to 16.30h
- Two-shift workers, who work both in morning shifts from 07.30h to 16.30h and evening shifts from 16.00h to 00.00h.
- Three shift workers, who work in morning shifts from 07.30h to 16.30h, evening shifts from 16.00h to 00.00h and night shifts from 00.00h to 08.00h.

Two shift work schedules are used as temporary schedules in some departments. During peak periods, department managers decides to work both in morning and evening shifts, and work schedules of the employees are prepared according to this plan. After the peak season ends, employees turn back to the standard day working schedules. Therefore, from time to time, some standard day workers become two shift workers.

Three shift working schedules are administered by only Production Test Departments. Tests of end-products last for long hours and sometimes for several days. Therefore, test equipments are not stopped, so the technicians working in this

department covers the 24h of the day by their schedules. They also work in weekends and in official holidays. Their work load is not as heavy as the technicians working in Electronic Card and Device Production Departments. They are assigned to end-products test equipments and observe if anything goes wrong. If something wrong happens in test, they stopped the test and wait for the engineer to decide if test equipment induces the mistake, in this condition, test restarted by calibrating the equipment again. If engineer decides the problem is about the end-product, then the product is sent to Device Production Department to be fixed.

As a result, in Aselsan, employees work in three different shift schedules. Only, the work schedules of three-shift workers include night work. Working times for three different shifts are not same, employees duty period for morning shift is 8,5h whereas in evening and night shifts duty period is 8h. There are three different crews who cover the whole working time. And there is no interruption of weekend, the shift system is continuous. Slow rotating shift system is applied in Aselsan, three shift workers work for one week in each shift.

In this study, shift workers of Aselsan are examined by subjective and objective methods. A questionnaire is used in order to understand the psychological and physiological problems of the workers. Reaction time test applied throughout the shifts in order to find the changes in attention levels of participants. In addition, sheep reaction time test also applied to participants, by this test the concentration levels of participants are investigated. The concentration level is used as an indicator of performance, as it is not possible to measure the performance level of participants on work because no performance measure is identified for their tasks. While the participants doing the reaction time test and sheep reaction time test, measurements by fNIR(functional near-infrared spectroscopy) device are recorded.

3.2 Subjective Method

3.2.1 The instrument used

Standard Shiftwork Index, which was released by Barton et al in 1995, is a survey that is widely used in literature in order to understand the main complaints of shift workers. The problem about the survey is its length, it has lots of questions and it takes nearly one to two hours to answer whole questions. It was very difficult to get worker's attention to Standard Shiftwork Index, therefore, a short version of it "Survey of Shiftworkers"(SOS) is used in this study, which can be seen in Appendix A. SOS is also a questionnaire that is used in different works at past. For instance, Kaliterna and Prizmic used SOS in their study, in 1998. SOS is a relatively short and easy to administer. Employees can complete the survey without spending too much time on it. Survey of Shiftworkers is 8 pages in length and takes between 10-20 minutes to complete.

In SOS, some of the scales were reduced in size such as morningness, flexibility, chronic fatigue, while some of the scales were omitted such as job satisfaction, coping with shift work. In addition, two-hourly demonstration alertness ratings for different shifts were included. In the first part of the survey, questions about demographic information of workers take place. Then, questions about the working conditions, sleeping habits and problems of workers, alertness degrees in different parts of day are asked. And lastly, questions about leisure activities and questions about psychological and physiological problems take place.

3.2.2 Subjects Selection

For the subjective evaluation part of the study, questionnaire distributed to all male technicians who worked under Production Directorate. All three groups of workers; standard day workers, two shift workers and three shift workers answered the survey. The reason to distribute the questionnaire to standard day workers was to create a control group. While evaluating the results, the difference between day workers and shift workers observed in order to find out the complaints about shift schedules.

Questionnaire distributed to only male employees because the workers who work in three-shift schedules were the only male technicians. Therefore, in order to eliminate the gender differences, questionnaires are not distributed to female day workers.

There were 267 male technicians working in Production Directorate and 71 of them were available and willing to participate in this study. 21 of the participants were standard day workers, 19 of them were two shift workers and 31 of them were three shift workers. Standard day workers and two shift workers who participate in the questionnaire are the workers who actively take part in production. Their job is to produce electronic cards or end-product devices. Whereas, three shift workers are not doing same job with them, their work load is lighter than others. Their work description is to handle device tests. They assign end-products to test equipments and observe if anything goes wrong in tests. In table 1, the distribution of technicians according to years of service in present shift system is shown with the average age of workers.

Table 1:The distribution of workers according to the years of service

Years of Service	Number of workers engaged in the study	Average age of workers
0-2 years	35	24,7
2-4 years	18	26,5
4-6 years	9	28,3
6-8 years	4	30,25
10-12 years	1	30
12-14 years	4	33,75

33 of the participants were married and 38 were single. 44 of them live with dependants in their house.

Majority of the participants were under age of 30 and more than half of the participants are in adaptation stage of shift work, since they work for less than 5 years. The rest of the workers are in sensitization stage. Job satisfaction and career development are on the forefront in worker's life as stated in Tierney and Anderson's work. Workers, who were in accumulation or manifestation level of shift work

stages(i.e. work experience higher than 15 years) did not participate in this questionnaire. (Tierney and Anderson; 2013)

3.2.3 Data Collection Procedure

The scope of the study is explained to chief engineers and chief technicians of Production Directorate. In order to provide workers to fill the questionnaires with their real feeling towards their job and their complaints, it has been told them that no name and department information will be asked, and their answers to questionnaires will not be used against themselves by their managers.

The questionnaires distributed to workers by their chief technicians by mail. One week duration is provided for employees to fill out the questionnaires. Some of them send the questionnaires by mail. And some of them get print outs and returned them by hand.

3.2.4 Statistical Analysis

In the statistical interpretation of the questionnaire, answers given to each question set are compared between three groups of workers. Standard day workers were the control group. Positive/negative differences between answers of shift workers and standard workers show the effects of shift work.

3.2.4.1 Statistical Analysis of The Psychological and Physiological Disturbance Questions

3.2.4.1.1 Kruskal Wallis Test

For the statistical analysis of questions related with chronic fatigue, nervousness, disruption of leisure activities, biological health conditions and psychological problems, Kruskal-Wallis test is applied. By Kruskal-Wallis test, the difference between answers of day workers, two shift workers and three shift workers is examined. Kruskal Wallis test is a non parametric test. The reason for using a non

parametric test was that the number of n is small. So, normality assumption cannot be made. In the test, whether two or more samples are from the same distribution is evaluated. If there is no tie in all the values, the test statistic is:

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1) \quad (1)$$

In this formula, N is the total number of values in all sample, in this study N is 71 if there is no empty answers exist in each question; n_i is the number of values contained in the i^{th} sample; R_i is the sum of ranks in i^{th} sample; and k is the number of samples where k is 3 in this study, stands for day workers, two shift workers and three shift workers. (Field, 2009) After the H value is calculated, it is compared with the value . $\chi^2_{\alpha:k-1}$This value is found from the chi-squared probability distribution tables. While finding the value from the table, k-1 degrees of freedom, which is 2, and α as the desired significance is used. After estimating the parameters of the model, a check was performed to test the hypothesis:

H_0: there is no difference between means/medians of the samples

Against the alternative hypothesis

H_1: H_0 is not true i.e. there are differences between means/medians of the samples

If $H \geq \chi^2_{\alpha:k-1}$, then hypothesis is rejected, which means the results of questionnaires differs between the groups workers who work in three different work schedules.

As mentioned before, the Kruskal-Wallis test is applied for the questions about the work-load, chronic fatigue, nervousness, disruption of leisure and domestic activities, and physiological and psychological health problems. Totally 55 questions analyzed with this test. For each question hypothesis; 'there is no difference between medians of answers given by three groups' is tested. If the significance level given by the test is greater than the accepted significance level (α), H_0 is accepted which means no significant difference. If the probability obtained is less than the required significance level, then H_0 is rejected. In this study, significance level, α, which is the accepted probability of rejecting the null hypothesis, is taken as 0.05, and in some cases 0.1.

3.2.4.1.2 Factor Analysis

For the same question where the Kruskal Wallis test applied in the previous part, also the factor analysis is done in order to find the relation between questions. Factor analysis shows the variability between correlated variables. Hence, the variability between questions about work-load, chronic fatigue, nervousness, disruption of leisure and domestic activities, and physiological and psychological health problems is seen by the factor analysis. For describing the factors, equations like linear models can be used;

$$Factor_i = Y_i = b_1X_{1i} + b_2X_{2i} + ... + b_nX_{ni} + \varepsilon_i \quad (2)$$

In this equation, b values represents the factor loadings, it depends on the relative importance of each variable to the particular factor, X values represents the factors, i.e. the questions and ε is the random error. (Field, 2009) The number of n is the number of questions in questionnaire which are used in factor analysis, for this study, the number n is 55. Number i stands for the number of factors.

High b values shows that the related question is very important for that factor and similarly low b values shows that the related question is very unimportant for that factor. By the help of these results, questions are clustered. Simply, the clustering method is; question with high b value for factor i is in the i^{th} cluster and this applied for each question. In this study the minimum b value which provides the question for to be put into definite factor's cluster is taken as 0.5. So, If a question, Xi has a coefficient higher than 0.5 in i^{th} equation, than it is directly put into the cluster of i^{th} factor.

3.2.4.2 Statistical Analysis of Sleep Disturbance Questions

3.2.4.2.1 Testing Difference Between Shifts for Specific Work Schedules

Format of sleep disturbance questions are a bit different from other question, so a different technique is used in analysis of these questions. In sleep disturbance

questions there were 4 different sub questions for each question. For each 5 question about sleep disturbances, there were;

- Between successive morning shifts
- Between successive afternoon shifts
- Between successive night shifts
- Between successive days off

Therefore, for these questions not only the difference between groups of workers but also the difference between sub questions are analyzed. For the group of three shift workers it was important to find out if there is difference between sleep disturbances between two successive morning shifts and two successive night shift. So, for all three groups of workers, difference of sleep disturbances between the shifts they work is analyzed.

For three shift workers, first of all, Kruskal-Wallis test is applied in order to find if there is a significant difference between the successive morning shifts, successive afternoon shifts, successive night shifts and successive days off for the particular question. Kruskal Wallis Test used for comparing more than two samples that are independent as mentioned in previous section. For every particular question of sleep disturbances, between successive morning shifts, between afternoon shifts, between night shifts and between days off sub questions are independent samples. Therefore test statistic;

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1) \qquad (3)$$

is used in order to test whether there is dependency between the sub questions. (Field, 2009) After the H value is calculated, it is compared with the value $\chi^2_{\alpha:k-1}$. Degrees of freedom, k-1 is 3 in this condition, as the difference between 4 groups is analyzed. After estimating the parameters of the model, hypothesis of the test is checked:

H_0: there is no difference between means/medians of the samples

Against the alternative hypothesis

H_1: H_0 is not true i.e. there are differences between means/medians of the samples

If $H \geq \chi^2_{\alpha:k-1}$, then hypothesis is rejected, which means the results of at least two of the sub questions differ. Which means the sleep disturbance levels changes between different shifts.

After finding if there is a difference between the means of at least two of the sub questions by examining the hypothesis of Kruskal-Wallis test, in order to find to which sub questions answers correlate or differ, Kendall's Tau test is applied. (Field, 2009) Kendall's Tau is a statistic used to measure the association between two measured quantities. The test statistic is;

$$t_b = \frac{P-Q}{\sqrt{(P+Q+X_0)(P+Q+Y_0)}} \quad (4)$$

where, P is the number of concordant pairs, Q is the number of discordant pairs, X_0 is the number of pairs tied only on the X variable, Y_0 is the number of pairs tied only on the Y variable.

As a result, the Kendall's Tau-b test is applied to find correlations between answers given to sub questions for particular sleep disturbance question. After estimating the parameters of the model, a check was performed to test the hypothesis:

H_0: there is no correlation between two samples

Against the alternative hypothesis

H_1: H_0 is not true i.e. there is a correlation between two samples

For each question hypothesis of there is no difference between medians of answers given by three groups analyzed. If the significance level given by the test is greater than the accepted significance level (α), H_0 is accepted which means no significant correlation. If the probability obtained is less than the required significance level, then H_0 is rejected. In this study, significance level, α, which is the accepted probability of rejecting the null hypothesis is true, is taken as 0.1.

This procedure of first applying Kruskal-Wallis test and then Kendall's Tau-b Test, is applied for standard day workers group, 2-shift workers group and 3 shift workers group separately. For standard day workers group, difference and correlations of sub questions, "between successive morning shifts" and "between successive days off" for every particular sleep disturbance question are examined by two tests. For 2-shift

workers group difference and correlations of sub questions, "between successive morning shifts", " between successive afternoon shifts" and "between successive days off" every particular sleep disturbance question are examined by two tests. For 3-shift workers group difference and correlations of sub questions, "between successive morning shifts", " between successive afternoon shifts", "between successive night shifts" and "between successive days off" every particular sleep disturbance question is examined by two tests.

3.2.4.2.2 Testing Difference Between The Specific Work Schedules for Different Shifts

In addition, like the psychological and physiological disturbance questions, in sleep disturbance questions, also the difference between 3 groups mentioned. All three groups of workers answered the questions, "between two successive morning shifts" and "between two successive days-off". Therefore, for all the sleep disturbance questions and these particular sub questions, the hypothesis of " there is no difference between means/medians of the samples" is tested by Kruskal-Wallis test mentioned above. For the sub question, "between two successive afternoon shifts", 2-shift workers and 3-shift workers give answers. Therefore, for all the sleep disturbance questions and this particular sub question, the hypothesis of " there is no difference between means/medians of the samples" is tested by Kruskal-Wallis test mentioned above.

3.3 Objective Methods

In the second part of the study, only the 3-shift workers are covered. Alertness, attention level and depending performance levels of 3-shift workers are measured throughout the shifts. In this analysis, three different tests are used, first one was done by the fNIR(functional near-infrared spectroscopy) device. fNIR device is attached to foreheads of workers, while fNIR is attached, workers performed reaction time test which measures attention level of workers and sheep reaction time test which shows the attention dependent performance levels. The aim of the reaction time tests was to measure if workers get tired throughout the shifts, and fNIR device

is used to measure the hemoglobin and oxy-hemoglobin levels during performing the tasks. As a result, fNIR data and reaction time data are compared in order to reach a conclusion about attention levels and mental fatigue of workers throughout a workday. What's more, reaction time data and fNIR data are also compared in order to reach a conclusion if they can be used alternatively in similar studies.

3.3.1 fNIR(functional near-infrared spectroscopy) Tests

3.3.1.1 The instrument used

In order to measure effects of shift work on the concentration of employees fNIR(functional near-infrared spectroscopy) test is used. fNIR is a brain imaging system and it gives some results about working memory, attention, problem solving, decision making etc. fNIR system is shown in figure 1. It is composed of four parts, sensor part is the first part which is attached forehead of the worker as shown in the figure, second and third part of fNIR is used for reading data coming from sensor, and sending it to the computer, these are also power supply of the system. Last part is a computer, to read, save and analyze the data. Reason for fNIR to be preferred in this study is its portability, safety and being affordable and negligibly intrusive monitoring system. (Izzetoğlu et al, 2003)

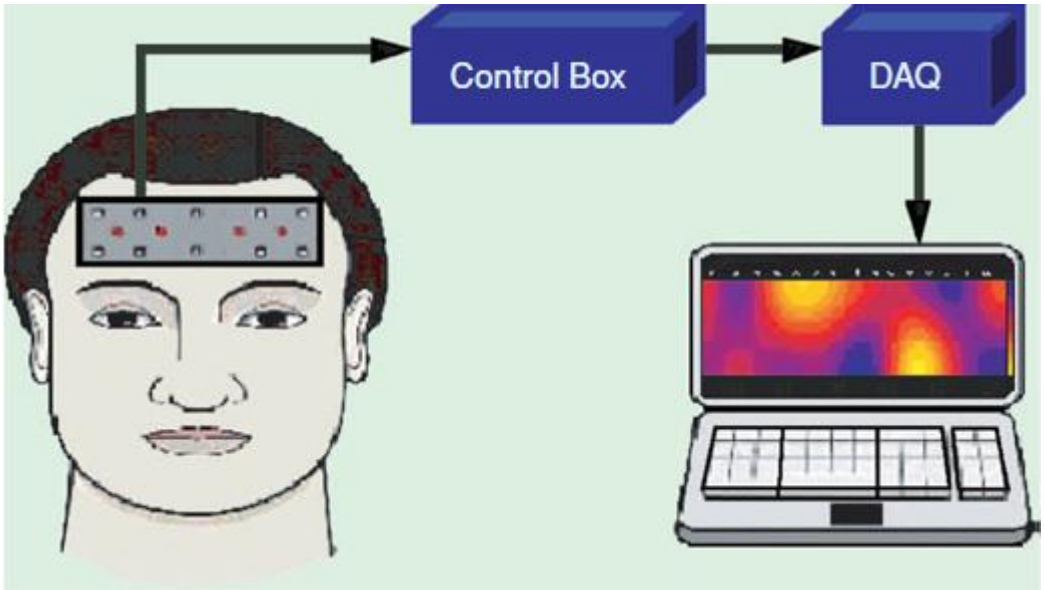

Figure 1: Portable fNIR system design (Bunce et al, 2007)

3.3.1.1.1 Literature Review on fNIR device

There were lots of neurophysiological and neuroimaging technologies exists and used in literature such as electroencephalography (EEG), event related brain potentials (ERPs), magnetoencephalography (MEG), positron emission tomography (PET), singlepositron emission computed tomography (SPECT), and functional magnetic resonance imaging (fMRI). These technologies have significantly increased our understanding of majority of the brain disorders. By this technologies, normative brain functions and neural underpinnings of various neurological and psychiatric disorders can be explained. fNIR is a relatively new technology, by fNIR, in clinical studies, neuroimaging of cortex can be done under more ecologically valid and realistic conditions which is not possible under constraints of other neuroimaging technologies. (Bunce et al., 2007)

While responding to several environmental stimuli, human brain experiences a number of physiological changes. These physiological changes include changes in blood levels, changes in electrochemical activity, and also changes in optical properties. These optical properties are capitalized by the functional optical imaging and light in the near-infrared range which changes between 700–900 nm is used in order to measure the changes in physiological properties. In visible and near-infrared light range, oxygenated hemoglobin(Oxy-HB) and de-oxygenated hemoglobin(deoxy-Hb) have some optical properties, so the changes in concentration of oxy-hemoglobin and deoxy-hemoglobin can be used for near-infrared spectroscopy measures. (Villringer and Chance, 1997) Absorption characteristics of oxy-hemoglobin and deoxy-hemoglobin according to light wavelength are given in Figure 2, so it can be understood why these molecules are the most common method used in near-infrared spectroscopy. After measuring relative changes in oxy-hemoglobin and deoxy-hemoglobin by fNIR, total blood flow can also be calculated from differential equation.

Usually, fNIR device includes a light source which is attached to participant's head via light-emitting diodes (LEDs) or fiber optical bundles (the optodes) which are the

red points shown in figure 3. It receives the light after interacting the tissue with a light detector which are the blue points shown in figure 3. fNIR used widely because it does not limit the movements of participant, it can be used while using a computer, watching television and even walking on a treadmill. And also another reason is that, it is safe, noninvasive and it can be used on same individual for several times.

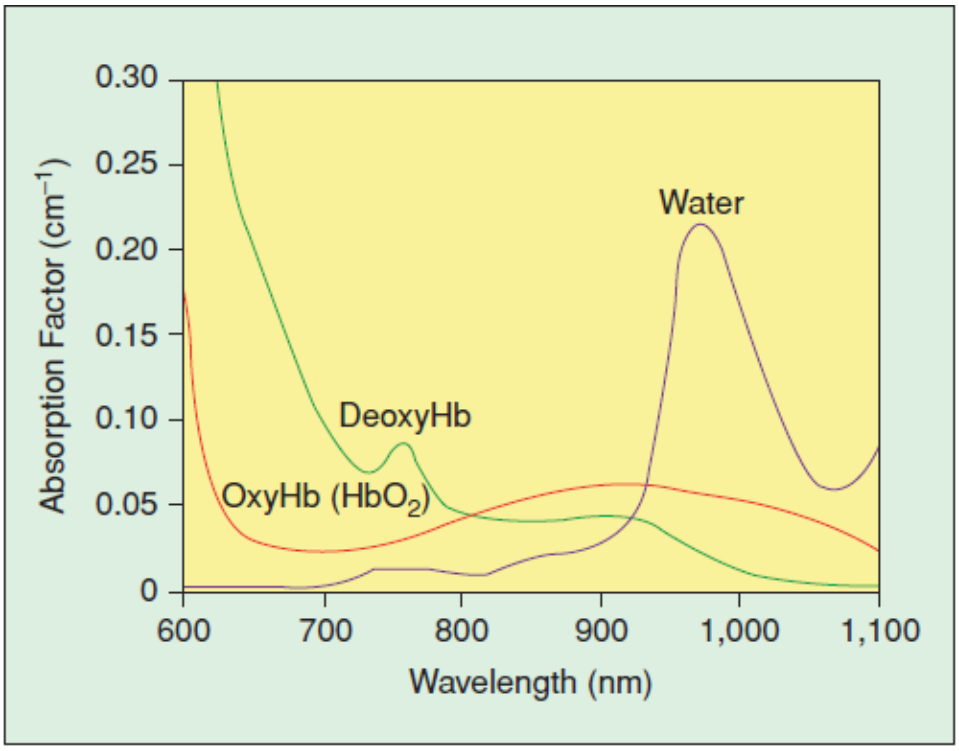

Figure 2: Absorption characteristics of oxy-Hb, deoxy-Hb, and water according to the light wavelength. (Bunce et al,2007)

In previous studies, fNIR system is used while the subjects perform cognitive tasks and motor tasks in order to find physiologically relevant information. (Strangman et al, 2002; İzzetoğlu et al.; 2003) Because of the functional challenges, these studies reported local increases in oxy-hemoglobin levels.

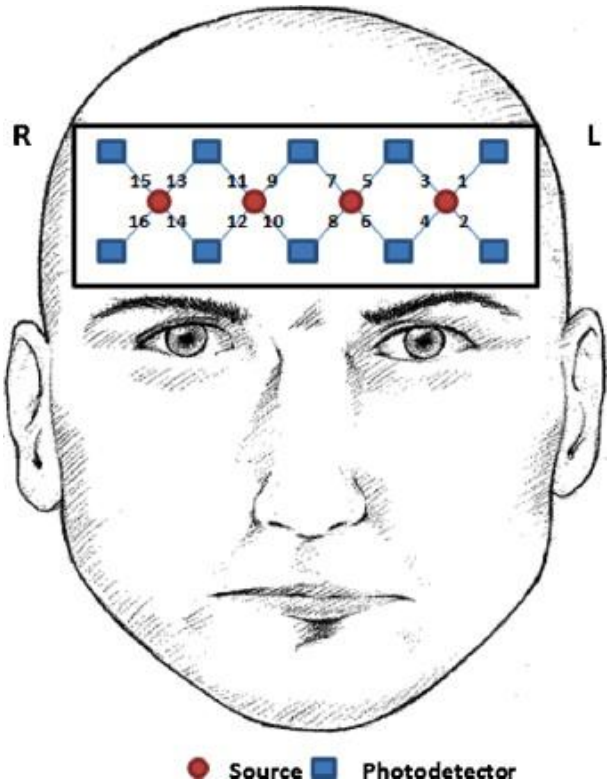

Figure 3: Light sources and detectors of fNIR device. (Meiri et al, 2012)

In a study, by Meiri et al.(2012), participants complete tasks which measures their arithmetic skill. The tasks accuracy and reaction times of participants are measured on arithmetic operations. As a result of t-tests, detectors 3,6,7 and 10 shows significance. 3,6 and 7 are the detectors found on left hemisphere which may mean that detailed processing occurs on the left, while 10 is on the right hemisphere and can be concluded as holistic process occurs on the right. As generally, the right hemisphere of the brain is believed to be responsible for holistic and symbolic processing (Dehaene et al., 2003) Also in a study by Izzetoğlu et al.(2007), participants complete a attention measurement study and significant blood oxygenation is observed in detector 11. In another study by Butti et al.(2006), participants complete a continuous performance test, and as a result, significant differences in oxygenation is observed in right hemisphere of the brain.

In a study by Ayaz et al., participants complete working memory and attention tasks. As a result in this experiment, only on detector 2, a significant change in blood oxygenation is seen. Detector 2 is on left hemisphere, so it can be said that cognitive work load increases the blood oxygenation in left hemisphere. It can be concluded

that fNIR device is sensitive to mental task load and practice level. (Ayaz et al., 2012)

3.3.1.2 Subjects Selection

fNIR tests applied to 3-shift workers working under Production Directorate. In production, only technicians working in Environmental Conditions Test Section and Electronic Device Test Section has three shift work schedules. So the fNIR experiments performed in these sections. There were 33 technicians who work in these 2 sections and 15 of them were available and willing to participate in this study. In morning shift, with 11 different employees, experiment is held, in afternoon shift with 8 different employees, experiment is held and in night shift with 4 different employees, experiment is held.

3.3.1.3 Data Collection Procedure

Scope of the study and the main properties of fNIR are explained to both chief technicians and the participants. Participants are convinced that the device is completely safe. And also participants are told that their names will be kept confidential and, information of test results will not be shared with their managers.

Experiments are held for three weeks. In morning shifts, 14 total experiments are done with 11 different employees. As there are not enough participants who were willing to participate in measurements, and working in morning shifts in this three weeks duration, the experiments repeated with 3 of the employees. So totally 14 different data from 11 employees reached in 1st shift. In afternoon shifts, there were only 3 workers for a week who works in 2nd shift. So, in afternoon shifts also repeated measurements are made. In three weeks, 17 experiments are held with 9 different participants. So, 17 different data reached in 2nd shift. Lastly, in night shifts there were only 2 workers for a week who works in the 3rd shift, which leads to repeated experiments. 2 of the workers working in night shift in this three weeks were not willing to participate in experiments, as a result, 11 experiments are held with 4 different participants.

Purpose of experiments was to measure the differences of attention/performance and hemoglobin/oxy-hemoglobin levels throughout the shifts. Therefore, three experiments were held in a shift for the same person. Experiments were done at the beginning of the shifts, before the lunch/dinner/breakfast break at the mid of the shift and at the end of the shift. For the first shift; experiments were held at 07.30h, 12.00h and 16.00h. For the second shift; experiments were held at 16.00h, 19.30h and 00.00h. And for the third shift; experiments were held at 00.00h, 04.00 h and 07.30h.

fNIR device is attached to foreheads of the subjects, three times a day, and in for 5 to 6 minutes the measurements are held. During device is attached, participants first close their eyes for 30 seconds and relax, this gives a base for the blood levels in their foreheads. Then they perform the Reaction Time Test and Sheep Reaction Time Test in a row. So two blocks of data is gained from each experiment, first block shows the hemoglobin/oxy-hemoglobin levels while Reaction Time Test is performed. And second block shows the hemoglobin/oxy-hemoglobin levels while Sheep Reaction Time Test is performed.

3.3.1.4 Statistical Analysis

On the fNIR device, there were 16 detectors. Each detector gives data of hemoglobin level and oxy-hemoglobin level. Because of the structure of the experiment, there were 2 different blocks for each experiment, one for Reaction Time Test and one for Sheep Reaction Time Test. For each block, 16 different data of hemoglobin levels and 16 different data point of oxy-hemoglobin levels exists. As a result, for every single experiment, 64 different data is collected. For the statistical analysis of these data independent samples t-test is applied as the data was continuous. By t-test, the difference between the beginning of the shift, middle of the shift and end of the shift data is examined for every single data point. In the test, whether two samples are from the same distribution is evaluated. The test statistic is:

$$t = \frac{\overline{X_i} - \overline{X_j}}{\sqrt{\frac{var_i^2}{n_i} + \frac{var_j^2}{n_j}}} \quad (5)$$

In this formula, i and j are the data groups that are compared with each other. X_i is the sample mean of data set i and X_j is the sample mean of the data set j. Similarly, var_i and n_i are the variance of data set i and number of data points exist in data set i, respectively. var_j and n_j are the variance of data set j and number of data points exist in data set j, respectively. (Scheaffer and McClave, 1995) In order to made a check for hypothesis, degrees of freedom should also be found by the formula;

$$d.o.f. = \frac{(var_i^2/n_i + var_j^2/n_j)^2}{(var_i^2/n_i)^2/(n_i-1) + (var_j^2/n_j)^2/(n_j-1)} \quad (6)$$

After the t value is calculated, it is compared with the value t_α with the particular d.o.f. value. This value is found from the t-test statistic distribution tables. While finding the value from the table, calculated degrees of freedom value and the desired significance level (α) is used. After estimating the parameters of the model, a check was performed to test the hypothesis:

H_0: there is no difference between means of the samples: $\mu_i - \mu_j = 0$

Against the alternative hypothesis

H_1: H_0 is not true i.e. there are differences between means of the samples

If $t_{calc} > t_\alpha$, then hypothesis is rejected, which means the hemoglobin or oxy-hemoglobin between two experiments in a day for the particular shift differs.

As mentioned before, the independent samples t-test is applied for all three shifts, the experiments done at the beginning of the shift and end of the shift are compared. And t- tests are done for all 64 data points for each shift. For each t-test hypothesis of there is no difference between means of data points at the beginning of the shifts and at the end of the shifts at three different shifts are analyzed. If the significance level given by the test is greater than the accepted significance level (α), H_0 is accepted which means no significant difference. If the probability obtained is less than the required significance level, then H_0 is rejected. In this study, significance level, α, which is the accepted probability of rejecting the null hypothesis is true, is taken as 0.1.

3.3.2 Reaction Time Tests

3.3.2.1 Standard Reaction Time Test

After the fNIR device is attached to participants, the first task was to complete a standard reaction time test. In the test, there is a basic traffic light and a button at the right of the traffic light. Participants press the pink button when they are ready and wait for traffic light to turn from red to green. The task is to press the button as soon as possible when green light is seen. The same task repeated for 5 times. In literature, there are also examples of standard reaction time tests used for shift work studies.

3.3.2.1.1 The instrument used

Online version of standard reaction time test is used from the website "http://getyourwebsitehere.com/jswb/rttest01.html", screenshot of test can be seen in Figure 4. The online test is applied on the computer where the fNIR data is also stored.

3.3.2.1.2 Subjects Selection

The participants who were available and willing to participate in fNIR experiments also complete the task of standard reaction time test. Therefore, a new subject selection process is not applied

3.3.2.1.3 Data Collection Procedure

In the first part of the fNIR measurements, after the device is started and a baseline is measured for 30 seconds. The participants asked for complete the test. Test duration was 1 to 2 minutes. As it is an online test when the test is started over for a new participant, the old data was erased. So after the completion of experiment by each participant, reaction time data is noted and transferred to excel files. Every participant completed reaction time test three times a day, at the beginning of the shift, at the mid of the shift and at the end of the shift.

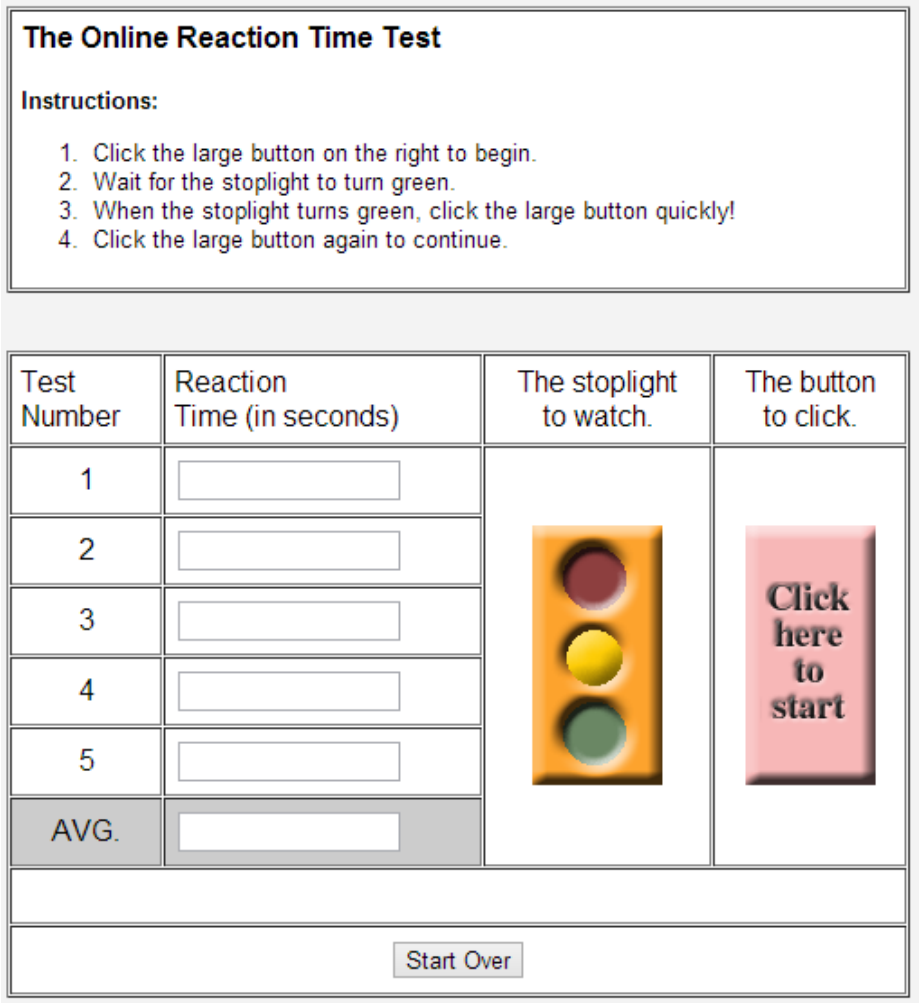

Figure 4- Reaction Time Test

3.3.2.1.4 Statistical Analysis

For each participant, three test results exist on reaction time test. In each test, 5 reaction times are observed. But in the statistical analysis, all 15 data points for a participant in a particular day is not used. For the beginning of the shifts, mean of 5 reaction times is used for a participant. This process is applied when the reaction time in the mid of the shift and reaction time at the end of the shift data were calculated. For the statistical analysis of these data independent samples t-test is applied as the data was also continuous like the fNIR data. By t-test, the difference between the beginning of the shift, middle of the shift and end of the shift data is examined for every single data point. In the test, t-test statistics were used as mentioned before and whether two samples are from the same distribution is

evaluated. After estimating the parameters of the model, a check was performed to test the hypothesis:

H_0: there is no difference between means of the samples: $\mu_i-\mu_j=0$

Against the alternative hypothesis

H_1: H_0 is not true i.e. there are differences between means of the samples

If $t_{calc}>t_{\alpha}$, then hypothesis is rejected, which means the reaction time of the participants differ between two experiments, at the beginning of the shift and at the end of the shift.

As a result, the independent samples t-test is applied for all three shifts, the experiments done at the beginning of the shift and end of the shift are compared. And t- tests are done for means of the 5 different reaction times of participants collected in each experiment. For each t-test hypothesis of there is no difference between means of data points at the beginning of the shifts and at the end of the shifts at three different shifts are analyzed. If the significance level given by the test is greater than the accepted significance level (α), H_0 is accepted which means no significant difference. If the probability obtained is less than the required significance level, then H_0 is rejected. In this study, significance level, α, which is the accepted probability of rejecting the null hypothesis is true, is taken as 0.1.

3.3.2.2 Sheep Reaction Time Test

After the fNIR device is attached to participants, the second task was to complete a sheep reaction time test. This test was like a short game, therefore was more attractive for the participants. At the beginning of the experiment, an instructions screen has come, and the participants press the "GO" button when they feel ready to start. In the task, five sheep come to the screen one by one. And participants press the button as soon as possible when they see the sheep. Sheep go across the screen very fast so in order to catch the sheep, they have to be fast. At the end of the experiment, results of reaction times for the 5 sheep has come to the screen. From the results also how many sheep that the participant was able to catch information can be seen.

3.3.2.1.1 The instrument used

Online version of sheep reaction time test is used from the website "http://www.bbc.co.uk/science/humanbody/sleep/sheep/reaction_version5.swf", screenshot of the test can be seen in Figure 5. The online test is applied on the computer where the fNIR data is also stored.

3.3.2.1.2 Subjects Selection

The participants who were available and willing to participate in fNIR experiments also complete the task of sheep reaction time test. Therefore, a new subject selection process is not applied.

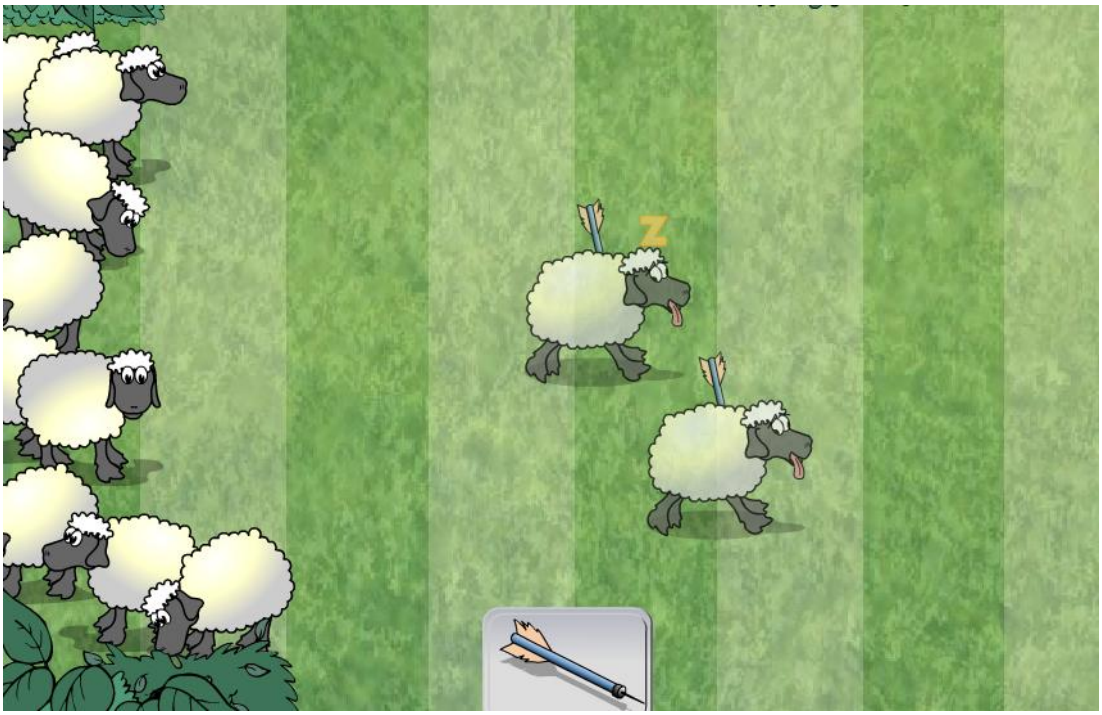

Figure 5- Sheep Reaction Time Test

3.3.2.1.3 Data Collection Procedure

In the second part of the fNIR measurements, after the device is started, a baseline is measured for 30 seconds and the standard reaction time test completed, the participants asked for complete the second test. Test duration was 1 to 2 minutes. As

it is an online test when the test is started over for a new participant, the old data was erased. So after each participant complete the test, reaction time data is noted and transferred to excel files. Every participant completed sheep reaction time test three times a day, at the beginning of the shift, at the mid of the shift and at the end of the shift.

3.3.2.1.4 Statistical Analysis

For each participant, three test results exists on sheep reaction time test. In each test, 5 reaction times and 5 data point of if the sheep is caught or not information are observed. This test used for measuring the performance related to alertness levels of participants. So the information of sheep is caught or not is used in analysis. Therefore for three experiments done in a shift for the particular worker, 3 scores found, for instance, the score at the beginning of the shift may be 4 if the worker caught 4 sheep at that experiment and so on. So, there were three scores out of 5 for each experiment. As the data is not continuous, and the data size is small, Mann-Whitney U Test is applied for the results. Test is applied in order to find if there is a significant difference between the performances of workers between the beginning of the shift and end of the shift. Mann-Whitney U Test used for comparing two samples that are independent. (Field, 2009) Test statistics are;

$$U_i = n_i n_j + \frac{n_i(n_i+1)}{2} - R_i \quad (7)$$

$$U_j = n_i n_j + \frac{n_j(n_j+1)}{2} - R_j \quad (8)$$

U_i and U_j values are used in order to test if there is dependency between the experiments. where n_i and n_j are the number of observations in data set i and j respectively. R_i and R_j are the rank of data set i and j respectively. After the U_i and U_j values are calculated, smallest among U_i and U_j is compared with the value U_{crit} value for particular ni and α values. After estimating the parameters of the model, hypothesis of the test is checked:

H_0: there is no difference between results of experiments

Against the alternative hypothesis

H_1: H_0 is not true i.e. there are differences between results of experiments

If smallest of U_i or U_j is smaller than U_{crit} value, then hypothesis is rejected, which means the results of experiments differ. Which means the performance levels related to sheep reaction time tests are differ between beginning of the shift experiments and en of the shift experiments.

3.4 Computer Package Used for Statistical Analysis

For all the statistical tests, Kruskal Wallis, Kendall's Tau, Independent samples t-test and Mann-Whitney U test, "IBM SPSS Statistics Version 21" package is used. It includes all the utilities to enter data to perform the analysis and give the results.

CHAPTER 4

RESULTS AND DISCUSSIONS

In this chapter, data gathered by, subjective and objective measurements are analyzed.

4.1 Results of Questionnaires

The questionnaire results are divided into two parts. First part of questions, are about psychological and physiological disturbance, while second part of questions are related with sleep disturbance. Questionnaire results can be seen in Appendix B.

4.1.1 Results of Psychological and Physiological Disturbance Questions

In order to evaluate psychological and physiological disturbance levels of participants, 50 questions in first part are analyzed. First Kruskal Wallis test is applied, and then a factor analysis is done.

4.1.1.1 Results of Kruskal Wallis Tests

In the first part of analysis, the questions about workload; personal characteristics like morningness and flexibility; effects of shift work on mood like chronic fatigue and neuroticism; effects of shift work on domestic life; physiological health problems and psychological health problems are examined by the Kruskal-Wallis Test. Grouping variable was the work schedules, 3 different work schedules compared; the differences between standard day workers, 2-shift workers and 3-shift workers are analyzed by the Kruskal Wallis Test. Test results are interpreted according to their significance levels, α level of 0.1 is used as mentioned before.

In workload questions, differences of workload perception of workers in morning shift between standard day workers, 2-shift workers and 3-shift workers are analyzed. Whereas in afternoon shift, only difference of workload perception between 2-shift workers and 3-shift workers are analyzed. No comparison is done for night shift, as there is only one group of workers working in this shift. No significant difference between workloads of workers is seen from the questionnaire results which can be seen in Table 2. Standard day workers and 2-shift workers are doing the same tasks; they participate in production of electronic cards and devices. However, 3-shift workers do not participate in production activities. A workload difference was expected due to this reason, but questionnaire results contradict with this expectations. Circadian adaptation after night work or psychological problems caused by shift work may cause the contradiction between low workload expectations and high workload perception of workers in 3-shift workers. They may feel that their workload is heavier than real workload because of external factors such as circadian factors, sleepiness levels caused by shift work.

Table 2: Kruskal Wallis Test Among 3 Different Work Schedules

No	Question	Chi-Square	df	Asymp. Sig.
1	workload, morning shift	0,892	2	0,64
2	workload, afternoon shift	0,379	1	0,538
3	The pacing of the job	15,678	2	0
4	Are you the sort of person who feels at their best early in the morning, and who tends to feel tired earlier than most people in the evening?	0,03	2	0,985
5	Are you the sort of person who finds it very easy to sleep at unusual times or in unusual places?	1,782	2	0,41
6	Do you feel that overall the advantages of your shift system outweigh the disadvantages?	0,014	2	0,993

On the other hand, results of the question 3 in Table 2 which measures the pacing of the job shows significant difference between three groups. Box plot in Figure 6 shows that the workers thought in afternoon and in night shifts they have less control on the work they have done. This result is compatible with the expected result

because 3-shift workers working in Test Departments do not have much control on their jobs. They just assign the end products to test devices.

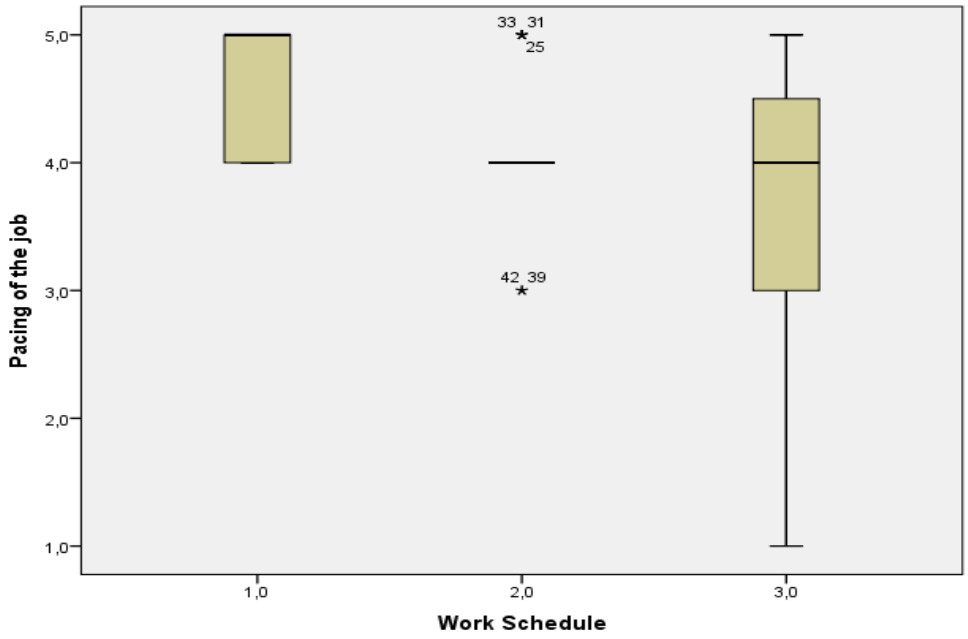

Figure 6: Box Plot of Pacing of the Job Variable

The question 4 in Table 2 which measures the morningness degree was; "Are you the sort of person who feels at their best early in the morning, and who tends to feel tired earlier than most people in the evening?". In Kruskal-Wallis test, no significant difference is seen in this data. Significance level is 0,985 which shows that the results of three groups nearly the same. Mean of this data was 5,014 out of 9 which indicates an average level of morningness. As a result, no matter in which schedule the participants work, they feel same about he morningness, they are a bit closer to the eveningness. This can be explained by the age of participants, the mean of the age data was 26.5 and there was nobody older than 36. Young people are more usually biased to eveningness than older people. Therefore, young age group of participants of questionnaire may cause the low morningness-high eveningness results of the questionnaire.

The question 5 in Table 2 which measures the flexibility degree was; "Are you the sort of person who finds it very easy to sleep at unusual times or in unusual places?" In this data also no significance difference is seen in Kruskal Wallis test. The

flexibilities of the workers do not differ between different work schedules. 3 shift workers found to sleep at unusual times or in unusual places as difficult as the morning workers which is not expected. Shift workers need to be flexible in order to be relatively more alert in afternoon and night shifts. (Natvik et al., 2011) Flexibility degree of workers may not be a criterion for shift worker selection in Aselsan, and this policy may be the cause of such a result.

There were three questions related to chronic fatigue in the questionnaire. The participants rated the sentences; I generally feel I have plenty of energy, I feel tired most of the time, I usually feel lively. In all three questions no significant difference between three groups of workers have been observed which can be seen in Table 3. Level of experiencing the chronic fatigue is nearly same for all working schedules. In order to find the mean of the chronic fatigue level, first and third questions are inverted into their negative meanings, and scores calculated by subtracting the original scores from 5. Then mean of sum of all three questions for all three groups found as 6.056 out of 15. So the result of for all three working schedules, the workers did not suffer from chronic fatigue is reached. In literature, studies of Natvik and Costa, shows a relation between chronic fatigue and shift work, but the results of this study shows that the shift work system of Aselsan did not affect the chronic fatigue levels of workers. (Costa, 1996; Natvik et al., 2011) What's more in study of Tamagawa, a relation between flexibility and chronic fatigue was found, less flexible worker's suffers chronic fatigue more. Even the flexibility of workers in Aselsan is low according to questionnaire results, they do not suffer from chronic fatigue. (Tamagawa et al., 2007) This result can also be explained by the age group of workers. Majority of the 3-shift workers are not married, and do not live with dependants. Even they are not flexible, they may found enough time to rest, as they do not have too much family responsibilities.

Table 3- Kruskal Wallis Test for Chronic Fatigue Questions Among 3 Different Work Schedules

No	Question	Chi-Square	df	Asymp. Sig.
1	I generally feel I have plenty of energy	0,906	2	0,636
2	I feel tired most of the time	0,895	2	0,639
3	I usually feel lively	0,421	2	0,81

There were six questions related to neuroticism in the questionnaire; Does your mood go up and down?, Do you feel 'just miserable' for no good reason?, When you get annoyed do you need some-one friendly to talk to?, Are you troubled about feelings of guilt?, Would you call yourself tense or 'highly strung'?, Do you suffer from sleeplessness?. The results of analysis of these questions can be seen in Table 4. In only question of feeling tense or highly strung, a significant difference between the answers of workers are observed. In Figure 7, box plot of this question can be seen. Even the means of three different groups are nearly the same, because of the outlier points of 3-shift workers group, mean rank of this group is calculated as the highest among others in Kruskal-Wallis Test. It can be concluded that the workers who describe themselves as tense or highly strung were the 3-shift workers. Shift work and being a small group in manufacturing area who do night work may increase the nervousness levels of these workers. Other questions about neuroticism do not show any significant difference among three groups.

There were 3 questions about the out-of- work activities, i.e. leisure, domestic and non-domestic activities, the results of Kruskal Wallis test can be seen in Table 5. In domestic and non domestic activities, significant difference among three groups is not observed. Although, there were many evidences in literature that shift work affects family life, for the workers in Aselsan, the results are different. (Natvik et al., 2007; Loudoun, 2008; Costa, 2010) The family life of employees, are not disrupted by the shift work schedules. There may be 2 reasons for this; first one is the age group of the workers, as the age average is low, domestic responsibilities of workers may be also low, majority of them are not married or at least they didn't have children. Second reason may be, sacrificing their leisure times to hold domestic tasks, which is found in study of Loudon. (2008) Second reason also clarifies the

significant difference in question about leisure activities. As seen in Figure 8, even the means of three groups are nearly same, majority of the 3-shift workers complain about the interference of their work schedules in their leisure times. That may be the reason why mean rank of three shift workers is higher than the others in Kruskal Wallis test. As a result, 3-shift work schedule interferes with the leisure activities of workers.

Table 4- Kruskal Wallis Test for Neuroticism Questions Among 3 Different Work Schedules

No	Question	Chi-Square	df	Asymp. Sig.
1	Does your mood go up and down?	1,152	2	0,562
2	Do you feel 'just miserable' for no good reason?	1,971	2	0,373
3	When you get annoyed do you need some-one friendly to talk to	4,091	2	0,129
4	Are you troubled about feelings of guilt?	1,867	2	0,393
5	Would you call yourself tense or 'highly strung'?	5,057	2	0,08
6	Do you suffer from sleeplessness?	2,26	2	0,323

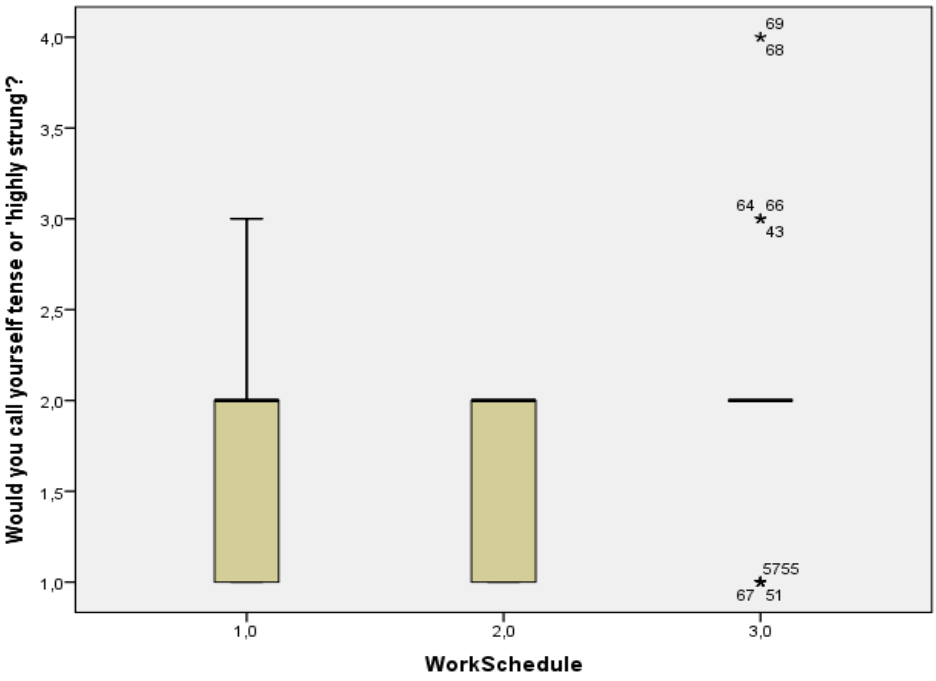

Figure 7: Box Plot of Feeling Tense or Highly Strung Variable

Table 5 - Kruskal Wallis Test for Out-of-Work Activities Questions Among 3 Different Work Schedules

No	Question	Chi-Square	df	Asymp. Sig.
1	How much does your shift system interfere with your leisure time?	5,184	2	0,075
2	How much does your shift system interfere with your domestic life?	3,359	2	0,186
3	How much does your shift system interfere with your non-domestic life(e.g. going to doctor, library, bank, hairdresser, etc.)?	0,295	2	0,863

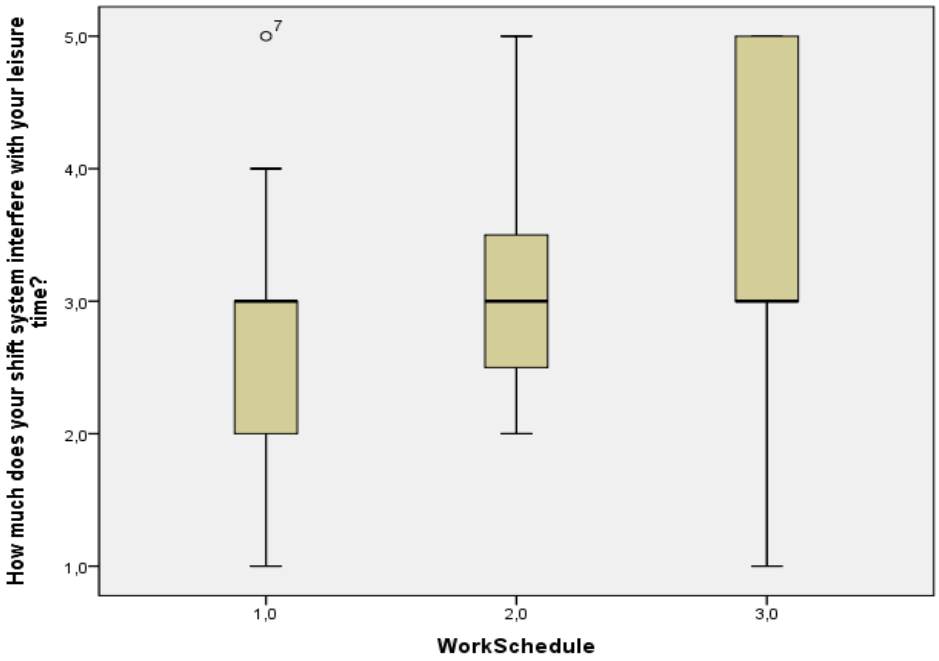

Figure 8: Box Plot of Feeling Leisure Time Variable

Physiological health problems are examined in three main subgroups, digestive problems, cardiovascular problems and body aches. There are lots of evidences in literature that the shift work affects digestive and cardiovascular systems. (Moore, 1993; Costa, 1996; Natvik et al., 2007; Costa, 2010; Tierney and Anderson, 2013).

There were 8 questions about digestive problems of workers, the results of Kruskal Wallis test can be seen in Table 6. In only one of them a significant difference among three groups is observed. In figure 9, it can be seen that the appetite problem of 2 and 3-shift workers is more than standard day workers. It can also be said that appetite

problems seen more in 3-shift workers than in 2-shift workers, this result can be explained by the weekly changing eating patterns. In other questions, no significant differences are observed among three groups. This result is different from the literature, where shift work causes digestive problems, reason of this result can also be explained by the age group of workers. As the majority of the workers are young, they are more though against biological consequences. In addition, food service in Aselsan may also be a reason of low digestive problem levels of workers. In evening shift, the meal break is closer to the beginning of the shift. Evening shift begins at 16.30h and the meals are served at 19.15h, so the workers eat their dinners in a reasonable time and they do not suffer from indigestion because of late dinner hours. In night shift, a breakfast is served in meal break, workers eat a light breakfast with milk. Therefore, they do not enforce their stomachs with heavy meals in 03.00h at night. As a result, both age group of workers and right approach of Aselsan in food service may prevent workers from suffering from digestive problems.

Table 6- Kruskal Wallis Test for Digestive Problems Questions Among 3 Different Work Schedules

No	Question	Chi-Square	df	Asymp. Sig.
1	How often is your appetite disturbed?	5,16	2	0,076
2	How often do you have to watch what you eat to avoid stomach upsets?	0,703	2	0,703
3	How often do you feel nauseous?	2,613	2	0,271
4	How often do you suffer from heartburn or stomach-ache?	0,081	2	0,96
5	How often do you complain of digestion difficulties?	1,34	2	0,512
6	How often do you suffer from bloated stomach or flatulence?	4,563	2	0,102
7	How often do you suffer from pain in your abdomen?	3,985	2	0,136
8	How often do you suffer from constipation or diarrhea?	1,456	2	0,483

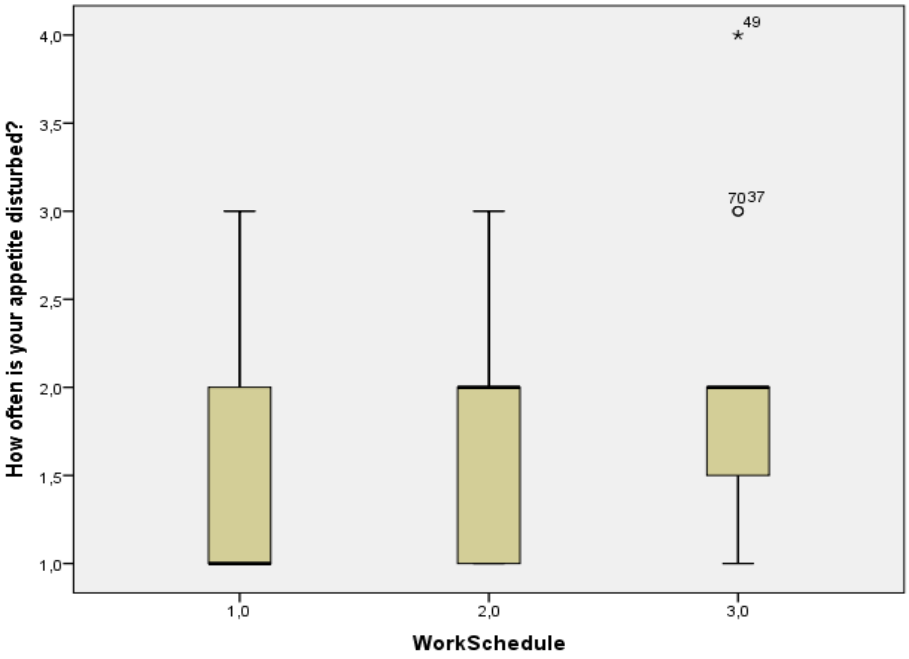

Figure 9:Box Plot of Appetite Variable

There are 7 questions about cardiovascular problems, the results of Kruskal Wallis test can be seen in Table 7. Also in this group of questions, only in one question, significant difference among three groups has been found. In figure 10, chest pains of three groups can be seen. Although the means of the groups are same, it is obvious that there are more people in 3-shift workers group who suffers from chest pains. In other questions, there were no significant differences seen among three groups. Lack of cardiovscular symptoms may be explained by the age group of workers. Young workers are less likely to suffer from cardiovascular diseases but existance of chest pains may be a symptom for cardiovascular diseases in future, this may be followed by the medical center in Aselsan in order to prevent possible future cardiovascular problems.

Table 7- Kruskal Wallis Test for Cardiovascular Problems Questions Among 3 Different Work Schedules

No	Question	Chi-Square	df	Asymp. Sig.
1	How often do you suffer from heart palpitations?	0,786	2	0,675
2	How often do you suffer from aches and pains in your chest?	4,737	2	0,094
3	How often do you suffer from dizziness?	0,76	2	0,684
4	Do you suffer from shortness of breath when climbing the stairs normally?	0,325	2	0,85
5	How often have you been told that you have high blood pressure?	0,793	2	0,673
6	Have you ever been aware of your heart beating irregularly?	1,867	2	0,393
7	How often do you feel "tight" in your chest?	0,03	2	0,985

There were 4 questions about body aches, the results of Kruskal Wallis test can be seen in Table 8. Arm/wrist, and knee/leg aches shows a significant difference among the groups. From the Figure 11 and 13 it can be seen that standard day workers suffer from arm/wrist, and knee/leg aches more than the 2-shift and 3.shift workers. The reason of this difference can be explained by the difference among work contents of three groups. Standard day workers are involved in production, they set out electronic cards and integrate devices by hand, while 3-shift workers are involved only in test activities. As the physical activity of standard day workers is more than shift workers through the work day, the arm/wrist, knee/leg aches can be explained by this difference. In shoulder/neck and back/lower back aches of participants, no significant difference is observed among the groups.

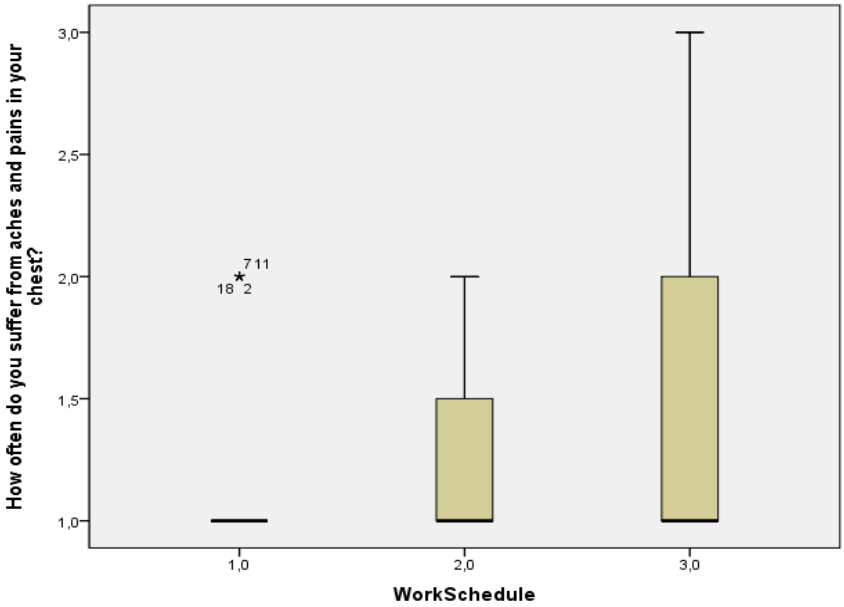

Figure 10: Box Plot of Chest Pains Variable

Table 8 - Kruskal Wallis Test for Body Aches Questions Among 3 Different Work Schedules

No	Question	Chi-Square	df	Asymp. Sig.
1	shoulder and/or neck ache	0,648	2	0,723
2	back and/or lower back ache	0,355	2	0,837
3	arm and/or wrist ache	19,936	2	0
4	leg and/or knee ache	9,983	2	0,007

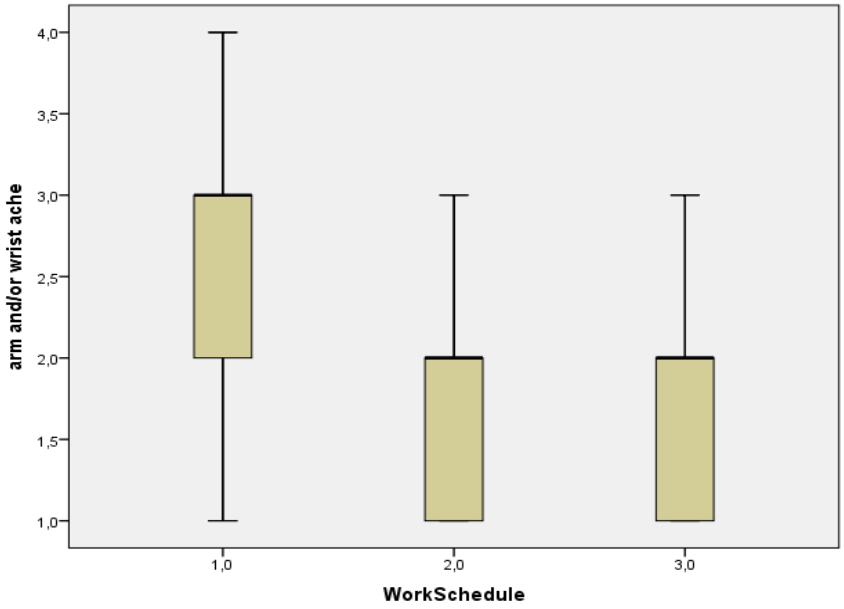

Figure 11: Box Plot of Arm or Wrist Aches Variable

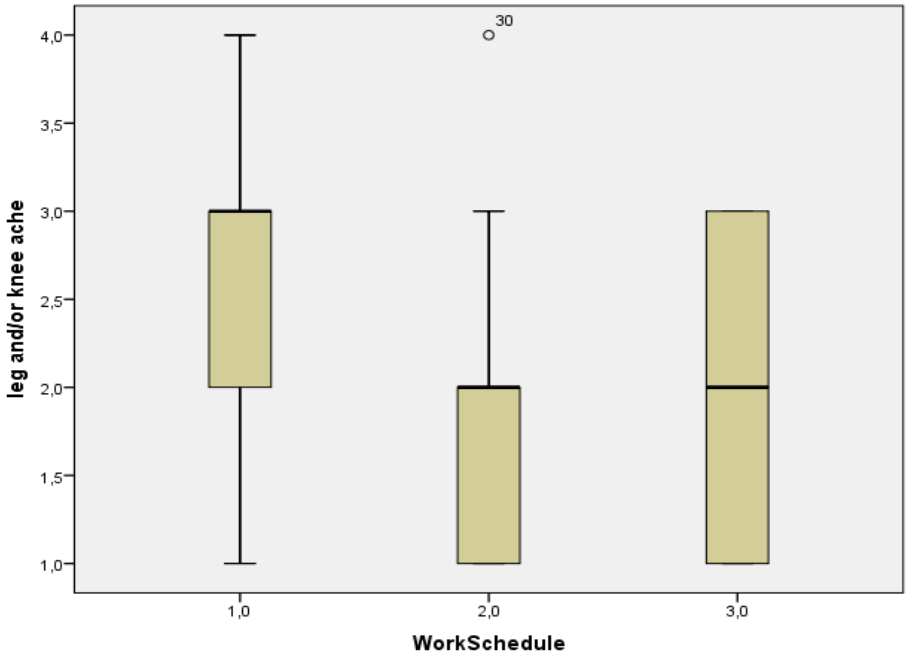

Figure 12: Box Plot of Leg or Knee Aches Variable

In addition to physiological health problems, psychological health problems also examined by the questionnaire, the results of Kruskal Wallis test can be seen in Table 9. There were 12 different questions measuring the psychologies of participants but no significant difference has been observed among groups, on contrary to the examples seen in literature. (Tierney and Anderson, 2013) As the majority of the shift workers are not married or at least they do not have children, they do not face with problems out-of-work usually, this may be the reason for 3-shift workers not facing with psychological problems. In addition, working in Aselsan, a leading firm in the sector, may also increase the job satisfaction of workers, and this also may be the reason of healthy psychologies of the workers. However, there is no study in Aselsan which meaures job satisfaction of workers, so this assumption can only be justified if such a study is done. As a result, few domestic responsibilities and high job satisfaction may minimize the psychological effects of shift work in Aselsan.

Table 9 - Kruskal Wallis Test for Psychological Health Questions Among 3 Different Work Schedules

No	Question	Chi-Square	df	Asymp. Sig.
1	been able to concentrate on what you are doing?	0,238	2	0,888
2	lost much sleep over worry?	0,034	2	0,983
3	felt that you are playing a useful part in things?	2,525	2	0,283
4	felt capable of making decisions about things?	1,876	2	0,391
5	felt constantly under strain?	0,863	2	0,65
6	felt you could not overcome your difficulties?	1,364	2	0,506
7	been able to enjoy your normal day to day activities?	3,762	2	0,152
8	been able to face up to your problems?	2,149	2	0,341
9	been feeling unhappy and depressed?	0,258	2	0,879
10	been losing confidence in yourself?	1,253	2	0,534
11	been thinking of yourself as a worthless person?	1,11	2	0,574
12	been feeling reasonably happy all things considered?	0,177	2	0,916

4.1.1.1 Results of Factor Analysis

Factor analysis is applied for all three groups of worker in order to understand the results of questionnaires better. For standard shift workers, 2-shift workers and 3-shift workers factor analysis is applied separately.

First factor analysis is applied for standard day workers. From the scree plot in Figure 13, it can be seen that the point of inflexion is on fourth factor. The questions are grouped under 4 factors, which can be seen in Table 10. Questions under the first factor are about psychological problems, workload and digestive problems mainly. The standard day workers' workload is reasonably good, the mean value of the workload for these workers is 3,7. Mean values of the questions about psychological problems are under 3 for all of the seven questions under Factor 1. In addition, mean values of the questions about digestive problems are under 2 for all of the three questions under Factor 1. By the information coming from workload question, it can be concluded that workers are satisfied with their jobs. So this makes them feel that they are playing in part of useful things. That is the reason why the standard day

workers did not face psychological problems. What's more, by the results of factor analysis and the mean values of questions, it can be seen that they also did not face digestive problems. This result can also be explained by the satisfaction of their working lives and absence of shift schedules. Questions under second factor are about cardiovascular problems and neuroticism. There is one question about neuroticism under second factor, which is "do you suffer from sleeplessness", mean value of this question is 2 for day-workers, and it shows a low level of neuroticism. For the four questions which are about cardiovascular diseases, mean values are also under 2 for all of them. This shows that the workers did not feel nervous, and comfort in their working lives keep them away from cardiovascular diseases. (Costa, 1996, Natvik et al., 2007) Questions that are grouped under third and fourth factors did not show any important relation among working lives and physiological-psychological diseases.

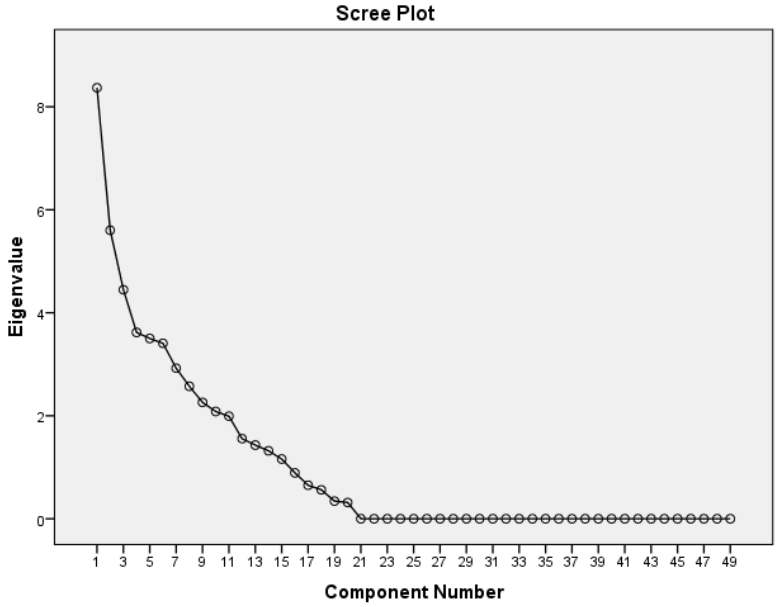

Figure 13: Scree Plot for Factor Analysis of Day Workers' Questionnaires

Table 10: Factor Analysis Table of Standard Day Workers' Questionnaires

Questions	Factor			
	1	2	3	4
been thinking of yourself as a worthless person?	,767			
been losing confidence in yourself?	,708			
been able to face up to your problems?	,644			
been feeling unhappy and depressed?	,643			
felt constantly under strain?	,629			
been able to enjoy your normal day to day activities?	,628			
felt that you are playing a useful part in things?	,614			
workload, morning shift	,566			
How often is your appetite disturbed?	,559			
How often do you feel nauseous?	,540			
How often do you suffer from minor infectious diseases,e.g. colds, flu, etc.?	,538			
How often do you complain of digestion difficulties?	,534			
back and/or lower back ache	,530			
Have you ever been aware of your heart beating irregularly?		,727		
How often do you feel "tight" in your chest?		,694		
Do you suffer from sleeplessness?		,692		
How often have you been told that you have high blood pressure?		,526		
How often do you suffer from heart palpitations?		,489		
Are you the sort of person who feels at their best early in the morning, and who tends to feel tired earlier than most people in the evening?			,578	
How often do you have to watch what you eat to avoid stomach upsets?			,575	
Do you feel that overall the advantages of your shift system outweigh the disadvantages?			,572	
Do you suffer from shortness of breath when climbing the stairs normally?			,532	
When you get annoyed do you need some-one friendly to talk to				,653
Does your mood go up and down?				,565
I feel tired most of the time				,526

Second factor analysis is applied for 2-shift workers. From the scree plot in Figure 14, it can be seen that the point of inflexion is on fifth factor. The questions grouped under 5 main factors. From the factor analysis of 2-shift workers which can be seen in Table 11, questions cannot be grouped reasonably, analysis didn't give any meaningful results. The reason for this result may be the number of two-shift workers participating in questionnaire. There were only 12 two-shift workers.

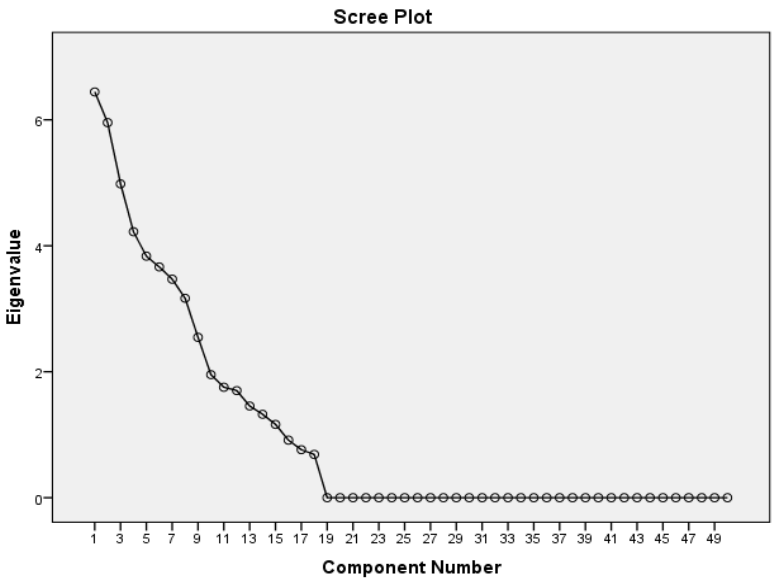

Figure 14:Scree Plot for Factor Analysis of 2-Shift Workers' Questionnaires

Table 11: Factor Analysis Table of 2-Shift Workers' Questionnaires

Questions	Factor				
	1	2	3	4	5
been losing confidence in yourself?	,784				
How often do you suffer from aches and pains in your chest?	,622				
I feel tired most of the time	,573				
felt constantly under strain?	,556				
Do you suffer from sleeplessness?	,535				
How often do you suffer from heart palpitations?		,621			
been able to enjoy your normal day to day activities?		,620			
Are you troubled about feelings of guilt?		,566			
How much does your shift system interfere with your leisure time?		,558			
How often do you suffer from heartburn or stomach-ache?			,667		
Do you suffer from shortness of breath when climbing the stairs normally?			,615		
leg and/or knee ache			,603		
How often do you have to watch what you eat to avoid stomach upsets?			,562		
How often do you complain of digestion difficulties?			,500		
Do you feel 'just miserable' for no good reason?				,635	
How often do you suffer from bloated stomach or flatulence?				,568	
Do you feel that overall the advantages of your shift system outweigh the disadvantages?					,697
arm and/or wrist ache					,501

Lastly, third factor analysis is applied for 3-shift workers. From the scree plot in figure 15, it can be concluded that, point of inflexion is on second or fourth factor. In component matrix taken from SPSS, shown in table 12, there were questions under factor 3 and 4 whose factor loadings are greater than 0.5, therefore, point of inflexion is taken as 4. In factor 1, there were questions about, psychological problems, neuroticism and cardiovascular problems mainly. As it is mentioned in previous part, chest pains variable in 3-shift workers was highest among other workers, which may be about cardiovascular problems and takes part in Factor 1 questions. What's more, feeling tense and highly strung was also available where the 3-shift workers gives highest ranks among others, this variable was about neuroticism and also takes part in Factor 1. As a result it can be concluded that neuroticism and cardiovascular diseases are related to each other by the help of factor analysis, there also exists examples of this relationship in literature. (Costa, 1996; Natvik et al., 2007) Questions that are grouped under second, third and fourth factors did not show any important relation among working lives and physiological-psychological diseases of participants.

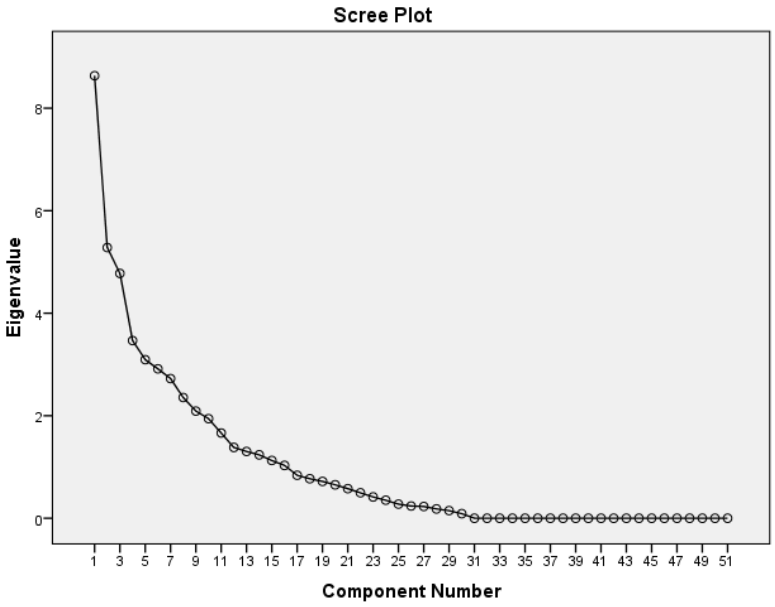

Figure 15: Scree Plot for Factor Analysis of 3-Shift Workers' Questionnaires

Table 12: Factor Analysis Table of 3-Shift Workers' Questionnaires

Questions	Factor			
	1	2	3	4
How often do you suffer from dizziness?	,718			
How often do you suffer from bloated stomach or flatulence?	,669			
been feeling reasonably happy all things considered?	,645			
Do you suffer from sleeplessness?	,619			
How much does your shift system interfere with your leisure time?	,611			
workload, afternoon shift	,609			
workload, night shift	,600			
been feeling unhappy and depressed?	,586			
Does your mood go up and down?	,562			
Would you call yourself tense or 'highly strung'?	,539			
How often do you suffer from aches and pains in your chest?	,509			
How often do you suffer from heart palpitations?	,508			
Do you feel that overall the advantages of your shift system outweigh the disadvantages?		,691		
The pacing of the job		,661		
How often do you suffer from pain in your abdomen?		,560		
felt you could not overcome your difficulties?			,600	
felt constantly under strain?			,565	
lost much sleep over worry?			,510	
been thinking of yourself as a worthless person?			,504	
I generally feel I have plenty of energy				,681
I usually feel lively				,563
arm and/or wrist ache				,545

4.1.2 Results of Sleep Disturbance Questions

In the second part of analysis, the questions about sleep disturbances are examined by the Kruskal-Wallis Test. In questionnaire, there were 5 sleep disturbance questions and each consists of 4 different sub questions; between successive day shifts, between successive afternoon shifts, between successive night shifts, between successive days off. 3-shift workers answered all 4 sub questions for each question. So firstly, Kruskal-Wallis Test is applied to 5 questions, in order to see that if 3-shift

workers experience different levels of sleep disturbances among 4 sub questions. The results of the Kruskal Wallis Tests are given in Table 13. It can be seen from the table that amount of sleep, sleep quality, rest level after sleep and difficulty in falling asleep parameters differs between different shifts.

Table 13:Kruskal Wallis Test for Sleep Disturbances of 3-Shift Workers

Question	Chi-Square	df	Asymp. Sig.
How do you feel about the amount of sleep you normally get?	37,093	3	,000
How well do you normally sleep?	34,684	3	,000
How rested do you normally feel after sleep?	28,664	3	,000
Do you ever wake up earlier than you intended?	1,960	3	,581
Do you have difficulty in falling asleep?	7,004	3	,072

In order to understand the differences between sub questions for these 4 questions, Kendall's Tau Correlation Test is applied after Kruskal Wallis Test. So Kendall's Tau Test is used in order to understand between which shifts- i.e. between morning shifts, between afternoon shifts or between night shifts, the participants have disturbances about sleep. First question was about amount of sleep the workers, normally get. Test results of Kendall' Tau can be seen in Table 14. Answers of "between two morning shifts" and "between two evening shifts" correlate. So there is no big difference between amount of sleep between morning and evening shifts. This means usually a worker can sleep while working in evening shift as much as he sleeps while working in evening shifts. This correlation can also be seen between "two evening shifts" and "two days off". From this results, it can be concluded that, night shift significantly differs from other shifts, and workers experience worst feelings about the sleep they get while working in night shifts.

Table 14: Kendall's Tau b Test for "How do you feel about the amount of sleep you normally get?" question

Kendall's Tau b Test		Btw two successive morning shifts	Btw two successive afternoon shifts	Btw two successive night shifts	Btw two successive days off
Btw two successive morning shifts	Correlation Coefficient	1	,367*	0,171	0,155
	Significance level		0,027	0,344	0,371
	N	31	31	25	30
Btw two successive afternoon shifts	Correlation Coefficient	,367*	1	0,143	,406*
	Significance level	0,027		0,418	0,016
	N	31	31	25	30
Btw two successive night shifts	Correlation Coefficient	0,171	0,143	1	0,012
	Significance level	0,344	0,418		0,948
	N	25	25	25	24
Btw two successive days off	Correlation Coefficient	0,155	,406*	0,012	1
	Significance level	0,371	0,016	0,948	
	N	30	30	24	30

Second question was about sleep quality of the workers. Test results of Kendall's Tau can be seen in Table 15. Answers of "between two morning shifts" and "between two days off" correlate. So there is no big difference in the amount of sleep, between morning shifts and weekend days. This means usually a worker can sleep while working in morning shift as good as he sleeps in weekends. There is no other correlation between answers. As a result, during evening and night shifts, sleep quality of workers gets worse. Their sleep quality level is nearly same in morning shifts and weekends.

Table 15: Kendall's Tau b Test for " How well do you normally sleep?" question

Kendall's Tau b Test		Btw two successive morning shifts	Btw two successive afternoon shifts	Btw two successive night shifts	Btw two successive days off
Btw two successive morning shifts	Correlation Coefficient	1	0,226	0	,345*
	Significance level		0,165	1	0,037
	N	31	31	25	30
Btw two successive afternoon shifts	Correlation Coefficient	0,226	1	-0,085	0,212
	Significance level	0,165		0,633	0,209
	N	31	31	25	30
Btw two successive night shifts	Correlation Coefficient	0	-0,085	1	-0,039
	Significance level	1	0,633		0,826
	N	25	25	25	25
Btw two successive days off	Correlation Coefficient	,345*	0,212	-0,039	1
	Significance level	0,037	0,209	0,826	
	N	30	30	25	30

Third question was about rest level after sleep. Test results of Kendall's Tau can be seen in Table 16. Answers of "between two evening shifts" and "between two days off" correlate. So there is no big difference between rest amount of a worker between evening shifts and weekend days. This means while working in evening shift after sleep a worker feels as rested as he sleeps in weekends. This can be described by the low morningness levels of participants which was mentioned in the first part. Workers feel rested after sleep during evening shifts and days off well as because they can wake up late in this two conditions. Because of the eveningness characteristics, they feel better.

Table 16: Kendall's Tau b Test for " How rested do you normally feel after sleep?" question

Kendall's Tau b Test		Btw two successive morning shifts	Btw two successive afternoon shifts	Btw two successive night shifts	Btw two successive days off
Btw two successive morning shifts	Correlation Coefficient	1	0,215	0,03	0,203
	Significance level		0,193	0,868	0,227
	N	31	31	25	30
Btw two successive afternoon shifts	Correlation Coefficient	0,215	1	0,158	,426*
	Significance level	0,193		0,376	0,011
	N	31	31	25	30
Btw two successive night shifts	Correlation Coefficient	0,03	0,158	1	0,093
	Significance level	0,868	0,376		0,61
	N	25	25	25	25
Btw two successive days off	Correlation Coefficient	0,203	,426*	0,093	1
	Significance level	0,227	0,011	0,61	
	N	30	30	25	30

And the last question was about difficulty in falling asleep. Test results of Kendall's Tau can be seen in Table 17. Answers of "between two morning shifts" and "between two evening shifts" correlate. As a result the difficulty of a worker in falling asleep is nearly same in morning shifts and evening shifts. This correlation can also be seen between morning shifts and days-offs, as well as between evening shifts and days offs. It can be concluded that difficulty in falling asleep differs only in night shifts for 3-shift workers. Workers have difficulty in falling asleep in night shifts more than other conditions.

Table 17: Kendall's Tau b Test for " Do you have difficulty in falling asleep?" question

Kendall's Tau b Test		Btw two successive morning shifts	Btw two successive afternoon shifts	Btw two successive night shifts	Btw two successive days off
Btw two successive morning shifts	Correlation Coefficient	1	,489**	0,218	,623**
	Significance level		0,002	0,208	0
	N	31	31	25	30
Btw two successive afternoon shifts	Correlation Coefficient	,489**	1	0,172	,454**
	Significance level	0,002		0,331	0,005
	N	31	31	25	30
Btw two successive night shifts	Correlation Coefficient	0,218	0,172	1	0,074
	Significance level	0,208	0,331		0,662
	N	25	25	25	25
Btw two successive days off	Correlation Coefficient	,623**	,454**	0,074	1
	Significance level	0	0,005	0,662	
	N	30	30	25	30

2-Shift workers answered 3 sub questions for all 5 questions. They answered between successive day shifts, between successive afternoon shifts, between successive days off questions. Firstly, Kruskal-Wallis Test is applied to 5 questions, in order to see that if 2-shift workers experience different levels of sleep disturbances among 3 sub questions. The results of the Kruskal Wallis Test are given in Table 18. It can be seen from the table that amount of sleep, rest level after sleep, waking up earlier than the intended time and difficulty in falling asleep parameters differs between different shifts.

After applying Kruskal Wallis Test, Kendall's Tau Correlation Test is applied for the 4 questions, in order to understand between which shifts the participants have disturbances about sleep. First question was about amount of sleep the workers, normally get. Test results of Kendall's Tau can be seen in Table 19. Answers of "between two morning shifts" and "between two evening shifts" correlate. So there is no big difference between amount of sleep between morning and evening shifts. This

means usually a worker can sleep while working in evening shift as much as he sleeps while working in morning shifts which are both less than the days off sleep level.

Table 18: Kruskal Wallis Test for Sleep Disturbances of 2-Shift Workers

Question	Chi-Square	df	Asymp. Sig.
How do you feel about the amount of sleep you normally get?	10,621	2	,005
How well do you normally sleep?	1,554	2	,460
How rested do you normally feel after sleep?	6,438	2	,040
Do you ever wake up earlier than you intended?	7,329	2	,026
Do you have difficulty in falling asleep?	8,324	2	,016

Table 19: Kendall's Tau b Test for "How do you feel about the amount of sleep you normally get?" question

Kendall's Tau b Test		Btw two successive morning shifts	Btw two successive afternoon shifts	Btw two successive days off
Btw two successive morning shifts	Correlation Coefficient	1	,431*	-0,139
	Significance level		0,048	0,524
	N	19	19	19
Btw two successive afternoon shifts	Correlation Coefficient	,431*	1	-0,221
	Significance level	0,048		0,307
	N	19	19	19
Btw two successive days off	Correlation Coefficient	-0,139	-0,221	1
	Significance level	0,524	0,307	
	N	19	19	19

Second question was about sleep quality of the workers. Kendall's Tau Test did not applied for this question as no significance level is observed in Kruskal Wallis Test. Third question was about rest level after sleep. Test results of Kendall' Tau can be seen in Table 20. Answers of "between two evening shifts" and "between two days off" correlate. So there is no important difference between rest amount of a worker between evening shifts and weekend days. This means while working in evening shift after sleep a worker feels as rested as he sleeps in weekends. This means while

working in evening shift after sleep a worker feels as rested as he sleeps in weekends. This can also be described by the low morningness levels of participants just like the 3-shift workers' results which was mentioned in the first part. Workers feel rested after sleep during evening shifts and days off since they can wake up late in these two conditions. Because of the eveningness characteristics, they feel better in afternoon shifts.

Table 20:Kendall's Tau b Test for " How rested do you normally feel after sleep?" question

Kendall's Tau b Test		Btw two successive morning shifts	Btw two successive afternoon shifts	Btw two successive days off
Btw two successive morning shifts	Correlation Coefficient	1	0,391	0,122
	Significance level		0,079	0,592
	N	19	19	19
Btw two successive afternoon shifts	Correlation Coefficient	0,391	1	,481*
	Significance level	0,079		0,036
	N	19	19	19
Btw two successive days off	Correlation Coefficient	0,122	,481*	1
	Significance level	0,592	0,036	
	N	19	19	19

Last question was about waking up earlier than the intended time. Test results of Kendall's Tau can be seen in Table 21. Answers of "between two morning shifts" and "between two days off" correlate. As a result the probability that a worker wakes up earlier than the intended time, is nearly the same in morning shifts and weekends and are higher than the probability of 'waking up earlier than the intended time' in evening shifts. Although the rest amount of workers after waking up is as good as days off in evening shifts for this groups of workers, they do not wake up earlier than the intended time.

Table 21: Kendall's Tau b Test for "Do you ever wake up earlier than you intended?" question

Kendall's Tau b Test		Btw two successive morning shifts	Btw two successive afternoon shifts	Btw two successive days off
Btw two successive morning shifts	Correlation Coefficient	1	0,179	,646**
	Significance level		0,389	0,002
	N	19	19	19
Btw two successive afternoon shifts	Correlation Coefficient	0,179	1	0,194
	Significance level	0,389		0,368
	N	19	19	19
Btw two successive days off	Correlation Coefficient	,646**	0,194	1
	Significance level	0,002	0,368	
	N	19	19	19

Standard day workers answered only 2 sub questions for all 5 questions. They answered between successive day shifts and between successive days off parts. Therefore, as there are only two questions to compare, only Man-Whitney U Test is performed for all 5 questions. By this test, it has been seen that if day workers experience different levels of sleep disturbances among 2 sub questions. The results of the Man-Whitney U Test are given in Table 22. It can be seen from the table that amount of sleep, rest level after sleep and difficulty in falling asleep parameters differs between different shifts.

Table 22: Mann-Whitney U Test for Sleep Disturbances of Day Workers

Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
How do you feel about the amount of sleep you normally get?	59,500	290,500	-4,598	,000
How well do you normally sleep?	165,500	396,500	-1,658	,097
How rested do you normally feel after sleep?	68,000	299,000	-4,370	,000
Do you ever wake up earlier than you intended?	191,500	422,500	-,766	,443
Do you have difficulty in falling asleep?	121,000	352,000	-2,578	,010

The sleep disturbance questions compared among sub questions, in between the groups. But they are also compared among the groups. For the sub questions; "between successive morning shifts" and "between two days off", all three groups of workers give answers. Therefore these 2 sub questions of all 5 questions are compared by Kruskal-Wallis Test and if there is a significant difference between the sleep disturbance levels exists among groups of workers is found. The results of Kruskal-Wallis test is given in Table 23. Only in third question, " How rested do you normally feel after sleep?", between successive morning shifts sub question, a significant difference is observed. According to the literature, effects of shift work on sleep disturbances is very high, so a significant difference in all questions were expected, but the findings in literature are not reflected by these groups of workers. The reason of the contradiction in this results may be the eveningness levels of the workers. Workers feel better while working in afternoon shifts and this may even compensate the negative effects of night shifts on sleep disturbance.

Table 23: Kruskal Wallis Test Among 3 different Work Schedules

Question	Chi-Square	df	Asymp. Sig.
How do you feel about the amount of sleep you normally get? - Between consecutive morning shifts	0,031	2	0,985
How do you feel about the amount of sleep you normally get? - Between consecutive days off	0,494	2	0,781
How well do you normally sleep? - Between consecutive morning shifts	1,713	2	0,425
How well do you normally sleep? - Between consecutive days off	0,789	2	0,674
How rested do you normally feel after sleep? - Between consecutive morning shifts	9,402	2	0,009
How rested do you normally feel after sleep? - Between consecutive days off	3,192	2	0,203
Do you ever wake up earlier than you intended? - Between consecutive morning shifts	0,07	2	0,966
Do you ever wake up earlier than you intended? - Between consecutive days off	0,921	2	0,631
Do you have difficulty in falling asleep? - Between consecutive morning shifts	0,79	2	0,674
Do you have difficulty in falling asleep? - Between consecutive days off	3,319	2	0,19

4.2 Results of Objective Methods

fNIR experiments were performed with 3-shift workers and they also completed reaction time test and sheep reaction time test while the device was attached to their foreheads. In this study, all three tests are done together in order to compare the results of fNIR and reaction time tests. The results of three tests are analyzed and interpreted together. Test results of fNIR, reaction time and sheep reaction time tests can be seen in Appendix C.

Firstly, the tests performed in morning shift are analyzed. Difference of test results between beginning of the shift and the end of the shift is examined. In table 24, t-test results for reaction time test results and fNIR data is given, only the voxels which shows significant differences are given for fNIR data in Table 24. For the discrete data results of sheep reaction time test, Man-Whitney U Test is applied, and the result of this test is given in Table 25.

From the test results, it can be seen that reaction times shows a significant difference at α level 0,05 between at the beginning of the shift and at the end of the shift, when the means of two samples compared, it can be seen that the reaction time gets worse at the end of the shift. However, no significant difference is seen in sheep reaction time test. In some voxels, fNIR data show significant differences. Block 0 means the observations during reaction time test and Block 1 means the observations during sheep reaction time test. As it can be seen from the table 24, most of the differences in measurements of fNIR voxels are observed during reaction time test. Hemoglobin levels decreases during reaction time test at the end of the day compared to the beginning of the day. This shows the tiredness of the workers increase towards the end of the shift. Significant differences observed in middle voxels 5,6,7,8,9 is in accordance with the findings in the literature (Butti et al., 2006; Izzetoğlu et al., 2007; Meiri et al., 2012). fNIR data shows difference in only voxel 8 during sheep reaction time test. This result can be explained by the game structure of the test, most of the participants took the sheep reaction time test more seriously. So both in beginning and end of the shifts they complete it with high attention rates, whereas, they need to spend more attention on reaction time test at the end of the day as they get more tired. As a result, t-Tests of reaction time test and fNIR test shows that

workers get more tired at the end of the shifts in morning shifts. This data is also in confirmation with the questionnaire results. There were questions about two-hourly demonstration alertness ratings for different shifts. In figure 16, the questionnaire results of 3-shift workers in morning shift can be seen. According to questionnaire results, workers claim that they are more tired at the beginning of the shift then end of the shift. This result contradicts with reaction time test and fNIR results.

Table 24: t-Test results for RTT and fNIR data in morning shift

Tests		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Reaction Time Test	Equal variances assumed	-2,148	24	,042	-0,10863	0,05058	-0,21302	-0,00425
	Equal variances not assumed	-2,148	13,421	,051	-0,10863	0,05058	-0,21755	0,00029
HBT-Block 0-Voxel5	Equal variances assumed	2,077	18	,052	1,11696	0,53771	-0,01272	2,24664
	Equal variances not assumed	2,183	16,707	,044	1,11696	0,51176	0,03580	2,19812
HBT-Block 0-Voxel6	Equal variances assumed	1,710	19	,103	1,05893	0,61913	-0,23694	2,35479
	Equal variances not assumed	1,771	13,796	,099	1,05893	0,59806	-0,22558	2,34343
HBT-Block 0-Voxel7	Equal variances assumed	1,843	20	,080	0,80422	0,43636	-0,10601	1,71446
	Equal variances not assumed	1,843	19,446	,081	0,80422	0,43636	-0,10768	1,71612
HBT-Block 0-Voxel8	Equal variances assumed	2,220	22	,037	1,68935	0,76086	0,11143	3,26727
	Equal variances not assumed	2,220	15,325	,042	1,68935	0,76086	0,07062	3,30808
HBT-Block 0-Voxel9	Equal variances assumed	1,891	21	,073	1,52490	0,80656	-0,15243	3,20222
	Equal variances not assumed	1,829	12,825	,091	1,52490	0,83389	-0,27911	3,32890

Table 24 (cont'd) - t-Test results for RTT and fNIR data in morning shift

Tests		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
HBT-Block 0-Voxel16	Equal variances assumed	1,867	22	,075	0,70208	0,37608	-0,07786	1,48202
	Equal variances not assumed	1,867	19,848	,077	0,70208	0,37608	-0,08280	1,48695
HBT-Block 1-Voxel 8	Equal variances assumed	2,071	21	,051	2,36821	1,14377	-0,01039	4,74681
	Equal variances not assumed	2,065	20,544	,052	2,36821	1,14680	-0,01991	4,75633
HBT-Block 1-Voxel 12	Equal variances assumed	1,769	22	,091	1,09005	0,61623	-0,18793	2,36803
	Equal variances not assumed	1,769	21,807	,091	1,09005	0,61623	-0,18859	2,36868
OXY-Block 0-Voxel 8	Equal variances assumed	2,061	22	,051	0,83068	0,40305	-0,00520	1,66656
	Equal variances not assumed	2,061	14,521	,058	0,83068	0,40305	-0,03088	1,69224
OXY-Block 1-Voxel 8	Equal variances assumed	1,871	21	,075	1,39784	0,74698	-0,15560	2,95128
	Equal variances not assumed	1,822	14,595	,089	1,39784	0,76723	-0,24143	3,03711

Table 25: Test Result for Sheep RTT data in morning shift

Test	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Sheep Reaction Time Test	31,500	122,500	-1,589	,112

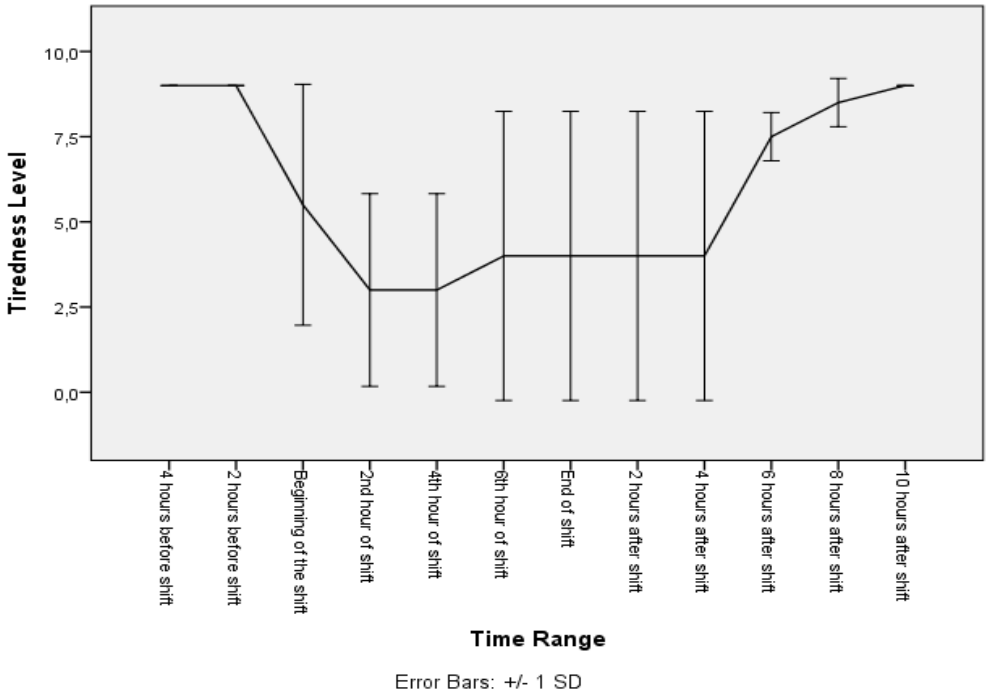

Figure 16: Tiredness level of 3 shift workers during a day when working in morning shifts

Secondly, the tests performed in afternoon shift is analyzed. 3 data points are eliminated while doing the analysis as they show conflicting distributions with the majority of the data. In table 26, t-test results for reaction time test and fNIR data is given, only the voxels which shows significant differences is given for fNIR data in Table 26. For the discrete data results of sheep reaction time test, Man-Whitney U Test is applied, result of this test is given in Table 27.

From the test results, it can be seen that reaction times shows a significant difference with α level of 0,1 between at the beginning of the shift and at the end of the shift, when the means of two samples compared, it can be seen that the reaction time gets worse at the end of the shift. However, no significant difference is seen in sheep reaction time test. In some voxels of fNIR data significant differences are observed. As it can be seen from the table 26, most of the differences in fNIR voxels are observed during reaction time test. Observing significant differences in middle voxels (6,8,10) is parallel with the results in literature (Butti et al., 2006; Izzetoğlu et al., 2007; Meiri et al., 2012). But it is interesting that hemoglobin level increases during reaction time test from beginning of the day to end of the day. This is in contradiction with the results of reaction time test that. In other words it implies that

workers feel more awake at the end of the shift, this can be explained by the eveningness results of the questionnaire. Workers feel better in late hours. What's more, this result can also be explained by lack of supervision and existence of lower workload in evening shifts. fNIR data shows difference in voxels 6, 8, 10, 11, 12, 13 during sheep reaction time test. Significant differences in right edge voxels (11, 12, 13) are observed in afternoon shift experiments, this result is similar with Ayaz et al.'s study. They also found significant difference in edge voxels whereas the difference in that study was at the left hemisphere. This result shows that participants from evening shift workers spend more attention to sheep reaction time tests than the morning shift participants. As a result, even though t-Tests of reaction time test shows that workers get more tired at the end of the shifts in afternoon shifts with significance level of 0.1, t-Tests of fNIR data shows that workers get more rested at the end of the shift. fNIR results are also contradicts with the alertness levels of the questionnaire results. Two-hourly demonstration alertness ratings for different shifts of 3-shift workers in afternoon shift can be seen in figure 17. According to questionnaire results, workers claim that they are more tired at the end of the shift then beginning of the shift, this result contradicts with fNIR results.

Table 26: t-Test results for RTT and fNIR data in afternoon shift

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Reaction Time Test	Equal variances assumed	-2,006	26	0,055	-0,05221	0,02603	-0,10572	0,00129
	Equal variances not assumed	-2,006	23,964	0,056	-0,05221	0,02603	-0,10594	0,00151
HBT-Block 0-Voxel6	Equal variances assumed	-2,045	23	0,052	-1,69418	0,82851	-3,40809	0,01973
	Equal variances not assumed	-2,086	19,733	0,05	-1,69418	0,81205	-3,38955	0,00119
HBT-Block 0-Voxel8	Equal variances assumed	-2,027	23	0,054	-1,44498	0,71275	-2,91942	0,02946
	Equal variances not assumed	-2,086	16,625	0,053	-1,44498	0,69271	-2,90898	0,01903

Table26 (cont'd) - t-Test results for RTT and fNIR data in afternoon shift

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
HBT-Block 0-Voxel10	Equal variances assumed	-2,863	22	0,009	-1,0374	0,36233	-1,78883	-0,28596
	Equal variances not assumed	-2,863	21,998	0,009	-1,0374	0,36233	-1,78884	-0,28596
HBT-Block 1-Voxel 6	Equal variances assumed	-1,771	23	0,09	-1,09391	0,61762	-2,37155	0,18373
	Equal variances not assumed	-1,726	15,6	0,104	-1,09391	0,63385	-2,44041	0,25259
HBT-Block 1-Voxel 8	Equal variances assumed	-1,908	23	0,069	-1,72514	0,90439	-3,596	0,14573
	Equal variances not assumed	-1,942	20,404	0,066	-1,72514	0,8882	-3,57554	0,12527
HBT-Block 1-Voxel 10	Equal variances assumed	-2,363	23	0,027	-2,00659	0,84925	-3,76339	-0,24979
	Equal variances not assumed	-2,302	15,532	0,036	-2,00659	0,87174	-3,85913	-0,15404
HBT-Block 1-Voxel 11	Equal variances assumed	-3,057	14	0,009	-1,54771	0,50622	-2,63345	-0,46198
	Equal variances not assumed	-3,002	12,038	0,011	-1,54771	0,51555	-2,6706	-0,42483
HBT-Block 1-Voxel 12	Equal variances assumed	-2,016	23	0,056	-1,42478	0,70682	-2,88695	0,03739
	Equal variances not assumed	-2,031	22,788	0,054	-1,42478	0,70157	-2,87683	0,02726
HBT-Block 1-Voxel 13	Equal variances assumed	-2,185	20	0,041	-0,92445	0,42304	-1,8069	-0,042
	Equal variances not assumed	-2,185	14,379	0,046	-0,92445	0,42304	-1,82955	-0,01935

Table 26 (Cont'd) - t-Test results for RTT and fNIR data in afternoon shift

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
OXY-Block 0-Voxel 6	Equal variances assumed	-1,757	23	0,092	-0,93658	0,53314	-2,03946	0,16629
	Equal variances not assumed	-1,762	22,996	0,091	-0,93658	0,53156	-2,03622	0,16305
OXY-Block 0-Voxel 8	Equal variances assumed	-1,805	23	0,084	-0,88679	0,49142	-1,90337	0,12979
	Equal variances not assumed	-1,833	21,108	0,081	-0,88679	0,48374	-1,89248	0,1189
OXY-Block 1-Voxel 8	Equal variances assumed	-2,059	23	0,051	-1,4011	0,6805	-2,80882	0,00661
	Equal variances not assumed	-2,064	22,982	0,051	-1,4011	0,67893	-2,80564	0,00343

Table 27: Test Result for Sheep RTT data in afternoon shift

Test	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Sheep Reaction Time Test	82,000	187,000	-,877	,380

Lastly, the tests performed during the night shift are analyzed. In table 28, t-test results for reaction time test and fNIR data is given, only the voxels which shows significant differences is given for fNIR data in Table 28. For the discrete data results of sheep reaction time test, Man-Whitney U Test is applied, result of this test is given in Table 29.

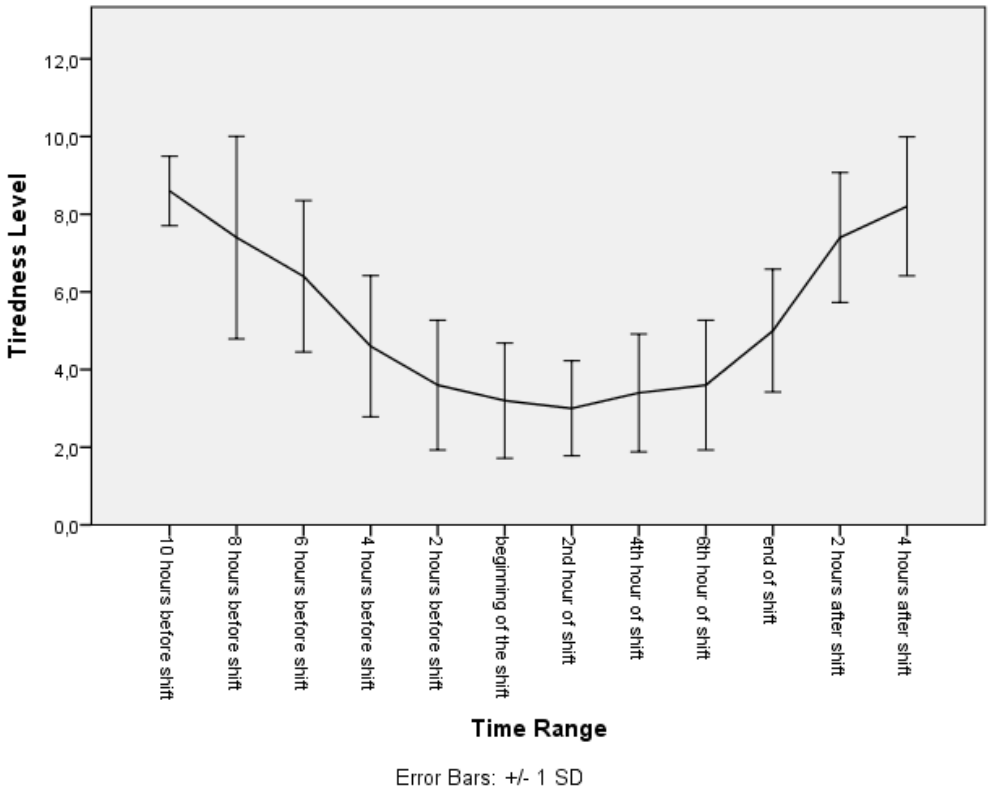

Figure 17: Tiredness level of 3 shift workers during a day when working in afternoon shifts

From the test results, it can be seen that reaction times shows a significant difference with α level 0,05 between at the beginning of the shift and at the end of the shift, when the means of two samples compared, it can be seen that the reaction time gets better at the end of the shift. However, no significant difference is seen in sheep reaction time test. Only one voxel of fNIR data shows significant differences. As it can be seen from the table 29, differences in fNIR voxel is observed during reaction time test, no difference is observed during sheep reaction time test. fNIR data shows difference in voxel 1 during reaction time test. Significant difference in left edge voxel 1 is similar with Ayaz et al.'s study. They also found significant difference in left hemisphere voxels. Hemoglobin level increases during reaction time test from beginning of the day to end of the day. So this result also overlaps with the result of reaction time test, workers get more awake at the end of the shift.

Table 28: t-Test results for RTT and fNIR data in afternoon shift

Tests		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Reaction Time Test	Equal variances assumed	2,303	20	,032	0,22309	0,09689	0,02099	0,42519
	Equal variances not assumed	2,303	19,949	,032	0,22309	0,09689	0,02095	0,42523
HBT- Block 0- Voxel1	Equal variances assumed	-2,132	13	,053	-0,73281	0,34372	-1,47537	0,00975
	Equal variances not assumed	-2,106	11,839	,057	-0,73281	0,34798	-1,49213	0,02651

Table 29: Test Result for Sheep RTT data in night shift

Test	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Sheep Reaction Time Test	55,500	121,500	-,376	,707

What's more, this result can be explained by lack of supervision and existence of lower workload in night shifts. As a result, by the results of t-Test of reaction time test and fNIR data, it can be concluded that workers get more rested at the end of the shift. However fNIR and reaction time test results contradicts with the alertness levels of the questionnaire results. Two-hourly demonstration alertness ratings for different shifts of 3-shift workers in night shift can be seen in figure 18. According to questionnaire results, workers claim that they are more tired at the end of the shift then beginning of the shift, this result contradicts with fNIR results.

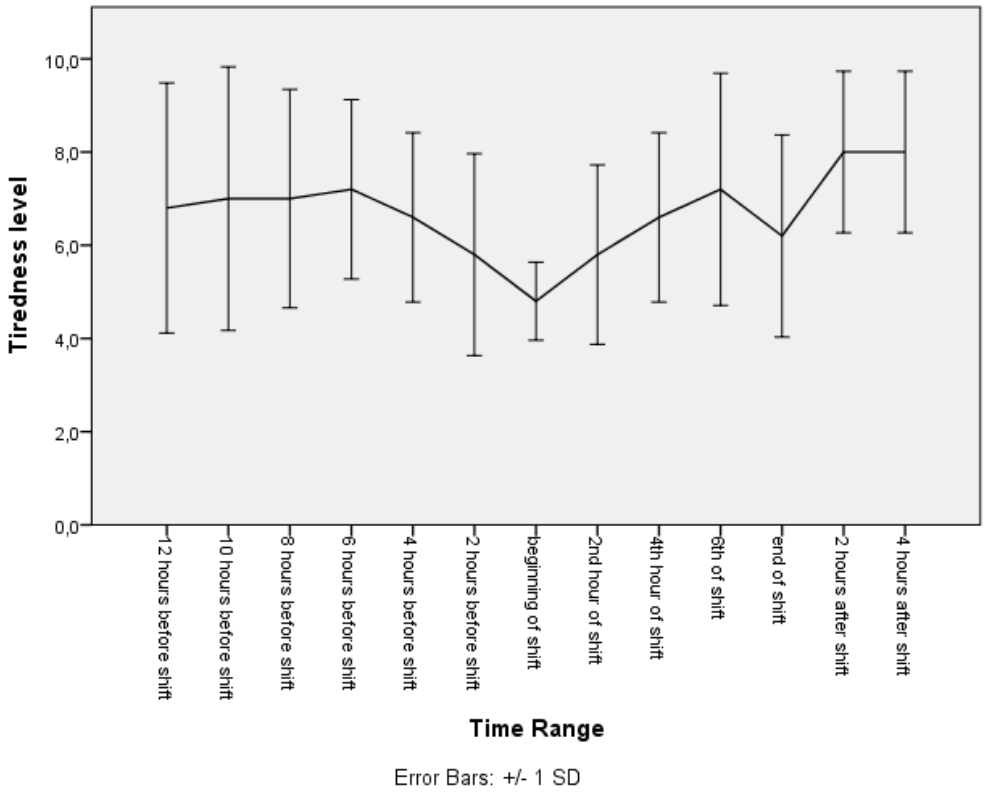

Figure 18: Tiredness level of 3 shift workers during a day when working in night shifts

As a result, fNIR tests show that attention level of participants decrease in morning shifts whereas their attention level increases in afternoon and night shifts throughout the shifts. In morning shifts, change in middle voxels is observed generally, and they show decrease in hemoglobin levels which leads to decrease in attention levels of participants, this result is also supported by the reaction time test. However objective test results contradicts with the questionnaire results of two hourly alertness demonstration ratings where the workers claim that they are more tired at the beginning of the shift. In afternoon shifts, also change in middle voxels is observed, but they showed increased levels of hemoglobin which leads to increase in attention levels of participants. This result is explained by the eveningness results of the questionnaire. But fNIR test results contradicts with the reaction time test results and also with subjective results of two hourly alertness demonstration of workers where they claim that they are more alert at the beginning of the shift. In night shifts, change in edge voxel is observed, and in this shift, also increase in levels of hemoglobin and hence, increase in attention levels of participants is observed, this result is also supported by the results of reaction time test. However, like the results

of morning shift, objective test results contradicts with the questionnaire results of two hourly alertness demonstration ratings where the workers claim that they are more tired at the beginning of the shift. This study demonstrates that using subjective techniques may not be sufficient in the evaluation of effects of shift work on the workers. Hence, results of subjective evaluations should be used together with objective measurements in order to hava a more clear understanding of the effects of shift work.

CHAPTER 5

CONCLUSION

5.1 Main Outcomes of the Study

In this study, shift system of ASELSAN and its consequences on workers are studied. The study is carried out among the shift workers working in Aselsan Inc, Therefore, results of the study reflects consequences of Aselsan's policies about shift schedules. There are two dimensions in study. Firstly, physiological and psychological problems caused by shift work are studied by a questionnaire, so subjective assessments of workers are obtained. Secondly, attention related performance problems caused by shift work are studied by fNIR device and reaction time tests. As there is no way to measure work performances because of the work contents of the participants, online version of standard reaction time test and sheep reaction time test are use for attention and performance measurements. So, objective assessments are collected by experiments.

First of all, physiological and psychological problems caused by shift work schedules are examined. In order to find problems of shift workers, a questionnaire is distributed among workers. 2-shift workers, 3-shift workers and standard day workers(as a control group) participate in questionnaire. In order to understand problems of shift workers, their answers compared to standard day workers' answers. Results of the study show that, shift workers suffers from some physiological problems such as cardiovascular diseases and digestive problems which are also problems recorded in different studies before. (Moore, 1993; Costa, 2003) In addition, while working in a rotating cycle, their sleep cycles disturbed as their circadian rhythms cannot adopt to new schedules as fast as the rotation speed of shift schedules which is one week. Beside the sleep disturbance problems, some other

problems are observed in psychological and physiological means but, in general, results of the questions did not show there are significant consequences of shift work on workers. This result can be explained by the age group of workers, the participants were under age of 40. As they are a young group, severe physiological and psychological problems are not observed.

Secondly, attention related performance problems caused by shift work schedules are examined. Only 3-shift workers participate in this study. Attention levels of the workers measured by objective methods throughout the shifts. Experiments held in morning shifts, afternoon shifts and night shifts. In every shift, 3 experiments are done; at the beginning of the shift, at the mid of the shift and at the end of the shift. Participants complete tasks of reaction time test and sheep reaction time test while fNIR device is attached on their foreheads. In order to get some indications about change in attention levels of participants during a shift, fNIR results, 2 reaction time test results and two-hourly demonstration alertness ratings are compared. It is also aimed to understand if objective test results and subjective test results(the answers of questionnaire) support each other.

Results of fNIR tests show that attention level of participants decrease in morning shifts whereas their attention level increases in afternoon shift. In morning shifts, change in middle voxels is observed generally, and they show decrease in hemoglobin levels which leads to decrease in attention levels of participants. The decrease of attention level in morning shift was an expected result, as the participants get tired during their work hours. In afternoon shifts, also change in middle voxels is observed, but they showed increased levels of hemoglobin which leads to increase in attention levels of participants. This result is explained by the eveningness results of the questionnaire. Workers feel better in late hours, so workers adapt to work in evening and night shifts easier. What's more, this result can also be explained by lack of supervision and existence of lower workload in evening shifts. In night shifts, change in edge voxel is observed, and in this shift, also increase in levels of hemoglobin and hence, increase in attention levels of participants is observed. This result is explained by the lack of supervision and existence of lower workload in evening shifts. This result also shows the right policy of Aselsan in shift work, lower

work load in afternoon and night shifts prevent workers from facing the undesirable effects of shift work.

Reaction time tests widely used in literature. Bjorvatn et al, in their study with shift workers, cannot find a significant difference on reaction times between day work and night work. However, they observe a significant reduction in reaction times across the successive night shifts. (Bjorvatn et al., 2006) Namita and Dhangauri, work with the nurses in another study, they also cannot find a statistically significant difference on reaction times between day work and night work, but when looked to the results table, it can be seen that reaction times at night work was higher than the day work. (Namita et al., 2010) In this study, reaction time test results are parallel with the fNIR data in morning shifts. Whereas reaction time test data contradicts with the fNIR results in both afternoon and night shifts. In addition, two-hourly demonstration alertness ratings reached by questionnaire are totally contradicts with the fNIR results in all work schedules. As a result, it can be concluded that, in shift work studies, it is important to implement objective experiments while interpreting performance related criteria. The self-assessment of participants may not show the reality as in this study.

5.2 Limitations and need for future research

In this study, performance related issues and attention levels of employees in shift work is measured by fNIR device. For only 5-minutes fNIR device is attached to employees, they complete reaction time tests. Reaction time tests are used for performance related criteria because it is not possible to measure work performances of employees because of their work contents. 3-shift workers in Aselsan only participate in test activities of end products. They assign end-products to test equipments and wait if the equipment gives an error. fNIR device can be used in shift workers, who works with computers, or works on desks constantly. As the workers are constant on their tables, while on work, fNIR measurements can be done and work performance levels can be compared with the fNIR data.

In addition, because of the time limitation of the study and availability of fNIR device, participant number was not very high. In Aselsan, there were only 3 workers working in afternoon shift per day and there were only 2 workers working in night shift per day. Increased number of participants in such a study may also give chance to reach different results.

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APPENDIX A

QUESTIONNAIRE

1. Age_____ Female / Male *(circle one)*

2. What kind of job do you do?_____

3. Are you: Married/Living with a partner _____

(tick one) Single _____

Separated/Divorced/Widowed _____

4. How many dependants live with you (e.g. children)? _____

5. How long have you worked altogether? _____

6. How long have you worked on your **present** shift system? _____ years
_____ months

7. How long **altogether** have you been working shifts? _____ years
_____ months

8. How many hours are you **contracted** to work for each week? _____ hours
_____ minutes

9. How many hours do you **actually** work each week? _____ hours
_____ minutes
(including overtime)

10. On average, how long does it take you to travel to and from work?

	TO WORK	**FROM WORK**
Morning Shift	10.1 _____ mins	10.2 _____ mins
Afternoon Shift	10.3 _____ mins	10.4 _____ mins
Night Shift	10.5_____ mins	10.6_____ mins

Please rate your workload on each shift that you work:

	Extremely Light	Quite Light	Average	Quite Heavy	Extremely Heavy
11. Morning or Day (12h) Shift	1	2	3	4	5
12. Afternoon Shift	1	2	3	4	5
13. Night Shift	1	2	3	4	5

	Entirely outside my control	Somewhat outside my control	In between	Somewhat under my control	Entirely under my control
14. The pacing of the job I do is:	1	2	3	4	5

	Definitely not		Probably not		In between		Probably yes		Definitely yes
15. Are you the sort of person who feels at their best early in the morning, and who tends to feel tired earlier than most people in the evening?	1	2	3	4	5	6	7	8	9
16. Are you the sort of person who finds it very easy to sleep at unusual times or in unusual places?	1	2	3	4	5	6	7	8	9

Your Shift System

Use the symbols to show a complete cycle of your shift system including rest days. Please do not use more weeks than necessary to show how your system "repeats itself".

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week 1							
Week 2							
Week 3							
Week 4							
Week 5							
Week 6							
Week 7							
Week 8							
Week 9							
Week 10							
Week 11							
Week 12							

	Definitely not	Probably not	In between	Probably yes	Definitely yes
17. Do you feel that overall the advantages of your shift system outweigh the disadvantages?	1	2	3	4	5

18. At what time do you normally fall asleep and wake up at the following points within your shift system? Please ignore options that do not occur on your shift system and use 24h time (e.g. 22:30) or clearly indicate "am" or "pm".

	FALL ASLEEP	**WAKE UP**
Between two successive **morning** or **day** (12h) shifts	18.1 _____	18.2_____
Between two successive **afternoon** shifts	18.3 _____	18.4_____
Before your first **night** shift	18.5 _____	18.6_____
Between two successive **night** shifts	18.7 _____	18.8_____
After your last **night** shift	18.9 _____	18.10_____
Between two successive **days off**	18.11_____	18.12_____
Between an **afternoon** and a **morning** shift (quick return)	_____	_____

19. How many hours sleep do you feel you usually need per day, irrespective of which shift you are on?

_____ hours _____ minutes

20. How do you feel about the amount of sleep you normally get? *(Circle one number for each)*

	Nowhere near enough	**Could do with a lot more**	**Could do with a bit more**	**Get the right amount**	**Get plenty**
20.1 Between successive morning shifts	1	2	3	4	5
20.2 Between successive afternoon shifts	1	2	3	4	5
20.3 Between successive night shifts	1	2	3	4	5
20.4 Between successive days off	1	2	3	4	5
Between an afternoon and a morning shift (quick return)	1	2	3	4	5

21. How well do you normally sleep? *(Circle one number for each)*

	Extremely badly	**Quite badly**	**Moderately well**	**Quite well**	**Extremely well**
21.1 Between successive morning shifts	1	2	3	4	5
21.2 Between successive afternoon shifts	1	2	3	4	5
21.3 Between successive night shifts	1	2	3	4	5
21.4 Between successive days off	1	2	3	4	5
Between an afternoon and a morning shift (quick return)	1	2	3	4	5

22. How rested do you normally feel after sleep? *(Circle one number for each)*

	Definitely not rested	**Not very rested**	**Moderately rested**	**Quite rested**	**Extremely rested**
22.1 Between successive morning shifts	1	2	3	4	5
22.2 Between successive afternoon shifts	1	2	3	4	5
22.3 Between successive night shifts	1	2	3	4	5
22.4 Between successive days off	1	2	3	4	5
Between an afternoon and a morning shift (quick return)	1	2	3	4	5

23. Do you ever wake up earlier than you intended? *(Circle one number for each)*

	Almost never	**Rarely**	**Sometimes**	**Frequently**	**Almost always**
23.1 Between successive morning shifts	1	2	3	4	5
23.2 Between successive afternoon shifts	1	2	3	4	5
23.2 Between successive night shifts	1	2	3	4	5
23.3 Between successive days off	1	2	3	4	5
Between an afternoon and a morning shift (quick return)	1	2	3	4	5

24. Do you have difficulty in falling asleep? *(Circle one number for each)*

	Almost never	**Rarely**	**Sometimes**	**Frequently**	**Almost always**
24.1 Between successive morning shifts	1	2	3	4	5
24.2 Between successive afternoon shifts	1	2	3	4	5
24.3 Between successive night shifts	1	2	3	4	5
24.5 Between successive days off	1	2	3	4	5
Between an afternoon and a morning shift (quick return)	1	2	3	4	5

The following items relate to how tired or energetic **you generally feel**, irrespective of whether you have had enough sleep or have been working very hard. Some people appear to "suffer" from permanent tiredness, even on rest days and holidays, while others seem to have limitless energy. Please indicate the degree to which the following statements apply to your own normal feelings. *(Circle one number for each).*

	Not at all		**Some-what**		**Very much so**
25. I generally feel I have plenty of energy	1	2	3	4	5
26. I feel tired most of the time	1	2	3	4	5
27. I usually feel lively	1	2	3	4	5

Please **rate how alert or sleepy you normally feel** at 2-hourly intervals before, during and after an average Morning (or Day), Afternoon or Night shift by circling the appropriate numbers. **Please only make ratings for those times when you are normally awake**

MORNING or DAY SHIFT

	Very alert		**Alert**		**Neither alert nor sleepy**		**Sleepy (but not fighting sleep)**		**Very sleepy (fighting sleep)**
28. 04:00	1	2	3	4	5	6	7	8	9
29. 06:00	1	2	3	4	5	6	7	8	9
30. 08:00	1	2	3	4	5	6	7	8	9
31. 10:00	1	2	3	4	5	6	7	8	9
32. 12:00	1	2	3	4	5	6	7	8	9
33. 14:00	1	2	3	4	5	6	7	8	9
34. 16:00	1	2	3	4	5	6	7	8	9
35. 18:00	1	2	3	4	5	6	7	8	9
36. 20:00	1	2	3	4	5	6	7	8	9
37. 22:00	1	2	3	4	5	6	7	8	9
38. 24:00	1	2	3	4	5	6	7	8	9
39. 02:00	1	2	3	4	5	6	7	8	9

AFTERNOON SHIFT

	Very alert		Alert		Neither alert nor sleepy		Sleepy (but not fighting sleep)		Very sleepy (fighting sleep)
40. 06:00	1	2	3	4	5	6	7	8	9
41. 08:00	1	2	3	4	5	6	7	8	9
42. 10:00	1	2	3	4	5	6	7	8	9
43. 12:00	1	2	3	4	5	6	7	8	9
44. 14:00	1	2	3	4	5	6	7	8	9
45. 16:00	1	2	3	4	5	6	7	8	9
46. 18:00	1	2	3	4	5	6	7	8	9
47. 20:00	1	2	3	4	5	6	7	8	9
48. 22:00	1	2	3	4	5	6	7	8	9
49. 24:00	1	2	3	4	5	6	7	8	9
50. 02:00	1	2	3	4	5	6	7	8	9
51. 04:00	1	2	3	4	5	6	7	8	9

NIGHT SHIFT

	Very alert		Alert		Neither alert nor sleepy		Sleepy (but not fighting sleep)		Very sleepy (fighting sleep)
52. 12:00	1	2	3	4	5	6	7	8	9
53 14:00	1	2	3	4	5	6	7	8	9
54. 16:00	1	2	3	4	5	6	7	8	9
55. 18:00	1	2	3	4	5	6	7	8	9
56. 20:00	1	2	3	4	5	6	7	8	9
57. 22:00	1	2	3	4	5	6	7	8	9
58. 24:00	1	2	3	4	5	6	7	8	9
59. 02:00	1	2	3	4	5	6	7	8	9
60. 04:00	1	2	3	4	5	6	7	8	9
61. 06:00	1	2	3	4	5	6	7	8	9
62. 08:00	1	2	3	4	5	6	7	8	9
63. 10:00	1	2	3	4	5	6	7	8	9
64. 12:00	1	2	3	4	5	6	7	8	9

Please try to decide which response option represents your usual way of acting or feeling.

	Almost never	**Quite seldom**	**Quite often**	**Almost always**
65. Does your mood go up and down?	1	2	3	4
66. Do you feel 'just miserable' for no good reason?	1	2	3	4
67. When you get annoyed do you need some-one friendly to talk to?	1	2	3	4
68. Are you troubled about feelings of guilt?	1	2	3	4
69. Would you call yourself tense or 'highly strung'?	1	2	3	4
70. Do you suffer from sleeplessness?	1	2	3	4

	Not at all		**Somewhat**		**Very Much**
71. How much does your shift system interfere with your leisure time?	1	2	3	4	5
72. How much does your shift system interfere with your domestic life?	1	2	3	4	5
73. How much does your shift system interfere with your non-domestic life(e.g. going to doctor, library, bank, hairdresser, etc.)?	1	2	3	4	5

Please indicate how frequently you experience the following, by circling the appropriate number:

	Almost never	**Quite seldom**	**Quite often**	**Almost always**
74. How often is your appetite disturbed?	1	2	3	4
75. How often do you have to watch what you eat to avoid stomach upsets?	1	2	3	4
76. How often do you feel nauseous?	1	2	3	4
77. How often do you suffer from heartburn or stomach-ache?	1	2	3	4
78. How often do you complain of digestion difficulties?	1	2	3	4
79. How often do you suffer from bloated stomach or flatulence?	1	2	3	4
80. How often do you suffer from pain in your abdomen?	1	2	3	4
81. How often do you suffer from constipation or diarrhoea?	1	2	3	4
82. How often do you suffer from heart palpitations?	1	2	3	4
83. How often do you suffer from aches and pains in your chest?	1	2	3	4
84. How often do you suffer from dizziness?	1	2	3	4
85. Do you suffer from shortness of breath when climbing the stairs normally?	1	2	3	4
86. How often have you been told that you have high blood pressure?	1	2	3	4
87. Have you ever been aware of your heart beating irregularly?	1	2	3	4
88. How often do you feel "tight" in your chest?	1	2	3	4
89. How often do you suffer from minor infectious diseases, e.g. colds, flu, etc.?	1	2	3	4
How often do you suffer from pain in your:				
90. shoulder and/or neck	1	2	3	4
91. back and/or lower back	1	2	3	4
92. arm and/or wrist	1	2	3	4
93. leg and/or knee	1	2	3	4

The following questions deal with **how you have felt in general over the past few weeks.** Please circle the most appropriate answer for each question. Remember to concentrate on present and recent complaints, not those that you have had in the distant past.

Have you recently:

94. been able to concentrate on what you are doing?	Better than usual	Same as usual	Less than usual	Much less than usual
95. lost much sleep over worry?	Not at all	No more than usual	Rather more than usual	Much more than usual
96. felt that you are playing a useful part in things?	More so than usual	Same as usual	Less than usual	Much less than usual
97. felt capable of making decisions about things?	More so than usual	Same as usual	Less than usual	Much less than usual
98. felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
99. felt you could not overcome your difficulties?	Not at all	No more than usual	Rather more than usual	Much more than usual
100. been able to enjoy your normal day to day activities?	More so than usual	Same as usual	Less than usual	Much less than usual
101. been able to face up to your problems?	More so than usual	Same as usual	Less than usual	Much less than usual
102. been feeling unhappy and depressed?	Not at all	No more than usual	Rather more than usual	Much more than usual
103. been losing confidence in yourself?	Not at all	No more than usual	Rather more than usual	Much more than usual
104. been thinking of yourself as a worthless person?	Not at all	No more than usual	Rather more than usual	Much more than usual
105. been feeling reasonably happy all things considered?	More so than usual	Same as usual	Less than usual	Much less than usual

APPENDIX B

QUESTIONNAIRE RESULTS

Table 30- Questionnaire Results for Morning Shift Workers(P: 1-7)

Participant	1	2	3	4	5	6	7
1	26	24	35	27	24	26	27
4	3		3		2		
5	60	33	156	84	39	48	108
6	49	33	96	84	5	4	6
7	49	33	96	84	5	9	6
8	42,5	59	59	45	42,5	42,5	45
10.1	50	25	30	40	30	50	45
10.2	75	25	30	40	45	50	60
11	3	5	5	4	3	3	3
14	5	5	5	5	7	5	5
15	9	9	9	1	4	1	8
16	5	5	3	1	5	7	3
17	4	4	3	2	2	2	3
18.1	00:30	00:00	00:00	23:30	23:00	00:45	23:30
18.2	06:00	06:40	06:30	06:30	06:15	06:10	05:30
18.11	01:30	01:00	00:00	01:30	01:00	02:30	01:30
18.12	10:30	09:00	08:30	10:30	10:00	09:30	10:30
19	6	7	8	6,5	7	5,5	7
20.1	3	3	3	4	4	4	3
20.4	4	4	5	4	4	4	4
21.1	2	4	3	4	4	4	4
21.4	4	3	4	5	4	4	4
22.1	2	3	3	3	4	4	3
22.4	4	4	4	5	4	4	4
23..1	1	5	5	3	2	3	2
23.4	1	5	5	1	3	2	2
24.1	1	2	4	3	5	3	2

Table 30 (cont'd) - Questionnaire Results for Morning Shift Workers(P: 1-7)

Participant	1	2	3	4	5	6	7
24.4	1	5	4	4	5	3	2
25	3	4	4	3	4	4	4
26	4	2	3	5	1	1	2
27	2	4	2	3	5	4	3
28					7		
29	9				7	5	6
30	8	2	2	5	5	3	6
31	6	3	2	4	3	3	4
32	4	3	5	3	1	3	3
33	5	4	5	3	3	3	3
34	3	4	5	3	5	7	4
35		4	7	3	5	3	5
36		7	7	3	6	3	5
37		7	7	3	7	5	6
38		7	7				
39			7				
65	3	1	2	2	2	3	2
66	3	2	3	2	3	2	2
67	2	3	3	2	1	3	3
68	1	1	2	1	2	1	2
69	2	2	2	2	2	1	2
70	3	2	2	2	2	2	2
71	1	3	2	2	2	3	5
72	4	3	3	1	4	3	5
73	1	3	2	1	1	3	3
74	1	2	3	1	1	1	2
75	1	1	4	1	1	1	2
76	2	2	3	2	1	1	2
77	2	3	3	2	2	1	2
78	1	2	3	2	1	1	2
79	1	2	3	2	1	1	2
80	1	2	2	2	2	2	2
81	1	2	2	2	1	2	2
82	2	2	1	1	1	2	2
83	1	2	1	1	1	1	2
84	3	2	2	2	1	2	2
85	2	2	2	1	2	1	2
86	3	1	1	1	1	1	1

Table 30 (cont'd) - Questionnaire Results for Morning Shift Workers(P: 1-7)

Participant	1	2	3	4	5	6	7
87	2	2	1	1	1	1	1
88	2	2	1	1	1	1	1
89	2	2	3	2	1	1	2
90	3	3	4	2	2	2	3
91	3	3	4	3	2	3	3
92	3	3	4	2	3	1	3
93	3	3	4	3	2	3	4
94	2	2	3	1	1	2	2
95	1	3	3	2	3	1	1
96	2	2	4	1	2	2	2
97	2	2	1	1	1	2	2
98	4	3	4	1	2	1	1
99	2	1	2	1	1	1	1
100	3	2	4	2	2	2	2
101	2	2	4	2	2	2	2
102	1	3	4	2	2	1	1
103	1	1	4	1	1	1	1
104	1	2	4	1	1	1	1
105	1	1	4	2	1	2	2

Table 30 (cont'd) - Questionnaire Results for Morning Shift Workers(P: 8-14)

Participant	8	9	10	11	12	13	14
1	23	25	25	23	27	25	24
4	2	1			2		
5	48	62	48	36	72	42	36
6	6	7	36	6	12	24	12
7	6	7	36	6	12	24	12
8	42,5	50	42,5	42,5	42,5	45	47,5
10.1	45	25	20	45	35	30	20
10.2	45	25	20	45	35	30	20
11	3	3	4	3	3	5	3
14	5	6	4	5	5	4	4
15	2	3	5	4	1	8	5
16	5	3	4	6	1	2	3
17	2	2	1	3	2	4	3
18.1	00:00	00:00	00:00	00:30	23:30	23:30	23:30
18.2	06:00	06:00	06:30	06:00	06:20	06:30	06:50
18.11	01:00	03:00	01:00	02:00	00:30	01:00	02:00
18.12	10:00	11:00	09:00	10:30	08:30	09:00	10:30

Table 30 (cont'd) - Questionnaire Results for Morning Shift Workers(P: 8-14)

Participant	8	9	10	11	12	13	14
19	6,5	6	6	6	6,5	7	6
20.1	4	3	3	4	3	3	4
20.4	4	4	4	5	4	4	4
21.1	4	4	4	5	4	4	4
21.4	4	5	4	4	5	5	4
22.1	4	3	4	3	3	4	3
22.4	4	5	4	4	5	4	4
23..1	2	3	2	1	2	3	5
23.4	2	2	3	2	3	3	4
24.1	1	1	2	4	3	2	3
24.4	1	4	3	4	4	4	3
25	4	4	2	3	3	4	3
26	1	1	4	4	4	1	5
27	3	5	3	2	3	4	3
28							
29	5	5		7		5	5
30	3	3	4	7	7	3	5
31	3	3	3	6	5	4	4
32	3	3	3	6	5	3	3
33	3	4	4	5	4	3	3
34	3	4	4	3	4	6	4
35	3	5	4		3	3	5
36	3	6	5		5	3	5
37	5	9	5		5	5	6
38			7		4		
39					4		
65	2	2	2	3	2	2	3
66	1	1	3	1	2	2	4
67	2	2	3	3	4	2	3
68	1	1	1	1	1	1	2
69	1	1	3	2	1	1	2
70	2	2	3	2	2	1	2
71	1	2	3	4	3	3	2
72	3	3	3	2	3	3	2
73	3	3	3	2	1	3	3
74	1	2	1	2	1	1	1
75	1	3	2	1	2	3	2
76	1	1	1	1	2	3	2

Table 30 (cont'd) - Questionnaire Results for Morning Shift Workers(P: 8-14)

Participant	8	9	10	11	12	13	14
77	1	3	1	1	2	2	1
78	1	2	2	1	1	2	3
79	1	3	2	3	2	1	1
80	2	2	2	1	2	2	3
81	2	1	3	2	2	2	2
82	1	1	2	1	1	2	1
83	1	1	1	2	1	1	1
84	1	1	1	2	1	1	2
85	1	1	2	1	2	2	2
86	1	1	1	1	1	1	1
87	1	1	1	1	1	1	1
88	1	1	1	1	1	1	1
89	1	2	2	1	1	1	1
90	1	3	2	3	4	2	2
91	2	2	2	3	2	2	3
92	3	2	2	3	4	3	3
93	2	2	2	4	3	2	3
94	2	1	2	2	2	1	1
95	1	2	3	2	1	2	2
96	2	1	2	1	1	2	2
97	2	2	2	1	2	2	1
98	1	1	2	3	2	2	3
99	1	1	1	2	1	2	2
100	2	2	2	3	2	3	4
101	2	1	2	2	1	2	2
102	1	1	2	3	2	2	2
103	1	1	3	2	1	1	1
104	1	1	2	3	1	1	2
105	2	1	2	1	4	2	1

Table 30 (cont'd) - Questionnaire Results for Morning Shift Workers(P: 15-21)

Participant	15	16	17	18	19	20	21
1	29	35	25	26	32	25	27
4	1	3		1	3	2	2
5	96	168	60	63	156	48	48
6	52	96	36	38	48	24	24
7	52	96	36	38	48	24	24
8	42,5	45	45	42,5	42,5	45	51,5
10.1	25	35	50	35	30	40	20
10.2	25	35	50	35	30	40	20
11	3	4	4	4	4	5	4
14	5	4	5	5	4	4	4
15	7	8	2	7	5	4	2
16	4	1	3	4	5	3	6
17	4	2	2	2	4	1	2
18.1	23:30	00:00	01:00	00:30	01:00	00:00	00:30
18.2	06:45	06:30	06:00	06:30	06:45	06:20	06:50
18.11	00:00	01:30	01:00	01:30	00:30	00:00	02:00
18.12	10:00	09:00	11:00	10:30	10:00	09:00	11:00
19	7	7	6	6,5	5	6	6
20.1	3	4	3	3	3	3	3
20.4	4	4	5	5	4	4	4
21.1	5	4	4	3	4	4	2
21.4	4	5	5	4	4	4	3
22.1	3	4	3	4	3	4	2
22.4	4	4	4	4	5	4	4
23..1	2	4	2	1	2	2	3
23.4	3	3	3	2	3	3	3
24.1	1	2	3	1	2	2	3
24.4	3	2	4	3	3	3	4
25	4	4	3	3	2	4	3
26	2	2	2	2	4	1	4
27	5	3	2	2	3	4	3
28							
29	6	5	5		5	6	
30	6	3	4	2	6	5	4
31	5	3	3	3	7	4	5
32	4	3	3	4	3	3	4
33	4	5	4	4	3	3	4
34	3	6	3	3	4	4	5

Table 30 (cont'd) - Questionnaire Results for Morning Shift Workers(P: 15-21)

Participant	15	16	17	18	19	20	21
35	6	5	5	3	5	3	3
36	6	3	6	4	5	3	5
37	7	5	7	5	6	6	4
38	8			7			4
39							4
65	4	3	3	2	3	2	2
66	3	4	3	2	3	4	3
67	4	3	2	3	3	2	2
68	2	2	1	2	2	1	1
69	3	2	2	1	2	2	1
70	1	2	3	1	2	2	2
71	3	4	3	3	4	3	3
72	2	4	4	2	3	3	3
73	3	2	2	3	3	2	2
74	2	2	1	2	2	1	1
75	2	1	2	1	2	1	2
76	2	3	1	2	2	2	1
77	2	2	2	1	2	2	1
78	2	2	1	2	2	3	2
79	2	3	1	2	1	2	1
80	2	1	1	1	2	1	2
81	1	2	2	2	1	1	2
82	1	1	2	1	2	2	3
83	1	1	1	2	1	1	1
84	2	1	2	2	1	1	2
85	2	2	2	1	2	1	1
86	1	1	1	2	1	1	1
87	1	1	2	1	1	1	1
88	1	1	2	1	1	2	1
89	2	1	3	2	2	1	2
90	3	2	3	1	2	3	4
91	2	1	4	2	2	3	2
92	3	2	4	3	3	3	2
93	3	4	2	2	1	2	2
94	1	1	2	1	2	1	3
95	2	1	3	4	2	2	1
96	1	2	1	2	3	2	2
97	2	2	2	1	2	1	1

Table 30 (cont'd) - Questionnaire Results for Morning Shift Workers(P: 15-21)

Participant	15	16	17	18	19	20	21
98	2	1	1	1	3	4	2
99	1	1	4	3	2	3	1
100	1	2	3	2	3	2	2
101	1	2	2	2	1	2	3
102	1	1	1	1	2	3	3
103	1	2	2	1	1	1	1
104	1	2	1	2	1	2	2
105	2	2	2	1	2	1	2

Table 31- Questionnaire Results for 2-Shift Workers (P: 22-31)

Participant	22	23	24	25	26	27	28	29	30	31
1	26	24	21	24	27	30	23	25	27	25
4		2		1	2	3			2	
5	48	48	12	60	73	96	37	48	84	36
6	36	42	12	24	48	36	19	24	68	24
7	36	42	12	24	48	36	19	24	68	24
8	51,5	51,5	45	42,5	42,5	42,5	42,5	45	45	47,5
10.1	20	25	25	30	25	40	20	50	30	50
10.2	20	25	35	30	25	40	20	50	30	50
10.3	30	40	30	35	25	50	20	40	30	55
10.4	30	40	30	35	25	50	20	40	30	55
11	3	3	4	5	4	3	4	4	3	4
12	3	3	4	3	4	3	4	3	3	3
14	4	4	4	5	4	4	4	4	4	5
15	7	8	4	3	7	4	3	8	6	4
16	5	7	4	5	3	4	7	5	5	2
17	1	4	4	2	2	3	2	2	2	2
18.1	00:00	23:00	00:30	00:00	01:00	23:30	23:00	23:30	00:30	01:00
18.2	06:30	06:50	06:30	06:20	06:30	06:10	06:40	05:30	06:20	05:50
18.3	02:30	01:30	02:30	02:00	03:30	03:00	02:30	02:00	02:00	03:30
18.4	10:30	09:30	11:00	09:30	10:00	09:00	09:30	10:30	08:30	10:00
18.11	00:30	01:00	01:30	00:30	02:30	01:30	00:00	02:00	01:30	00:30
18.12	09:30	11:00	10:30	09:00	10:00	10:30	09:30	09:30	10:30	10:00
19	6	7	5	6,5	5	6	6	6	5	6
20.1	3	3	4	4	3	2	2	3	3	4

Table 31 (Cont'd) - Questionnaire Results for 2-Shift Workers (P: 22-31)

Participant	22	23	24	25	26	27	28	29	30	31
20.2	4	4	4	3	4	3	4	4	3	5
20.4	4	3	4	4	4	5	4	4	4	3
21.1	3	3	4	5	2	3	5	5	4	3
21.2	4	2	4	5	3	4	5	4	5	3
21.4	4	3	4	5	3	4	5	4	4	4
22.1	4	4	4	3	4	4	4	5	4	3
22.2	4	4	4	3	5	4	4	4	4	4
22.4	5	4	4	4	5	4	4	4	4	4
23.1	2	4	3	2	3	2	4	2	1	2
23.2	2	3	2	2	2	2	2	2	2	2
23.4	3	4	3	3	3	2	4	3	2	2
24.1	4	2	3	2	1	2	3	2	2	2
24.2	3	2	2	2	1	2	2	2	2	2
24.4	4	4	4	4	3	2	4	3	2	3
25	3	4	3	4	4	2	2	4	2	3
26	2	3	5	2	2	4	3	2	4	4
27	3	3	3	5	3	3	2	3	3	3
28										
29					7		5	5	7	
30	4	4	2	2	5	5	3	3	6	7
31	4	5	3	3	4	5	4	5	4	7
32	3	6	3	3	4	4	4	5	3	6
33	3	7	2	4	4	4	4	4	3	6
34	5	6	3	5	6	5	6	5	4	5
35	5	5	4	4	4	5	3	3	4	5
36	6	4	5	6	5	6	3	3	5	5
37	4	4	5	5	5	6	5	5	4	5
38		4	5	5		7				4
39						7				
40								8		
41	3	5	4	4	6	6		7	5	2
42	3	4	1	4	5	5	4	6	2	3
43	1	5	1	3	5	5	3	5	2	3
44	1	1	1	3	6	4	2	5	3	4
45	2	2	2	5	4	4	2	4	3	5
46	3	3	3	5	4	8	4	4	6	6
47	3	7	3	7	3	8	4	4	6	5
48	4	7	5	7	3	7	5	3	5	5

Table 31 (Cont'd) - Questionnaire Results for 2-Shift Workers (P: 22-31)

Participant	22	23	24	25	26	27	28	29	30	31
49	4	7	5	5	7	7	5	3	5	5
50							6			
51							6			
65	1	3	2	3	3	3	3	3	2	2
66	2	3	4	3	3	4	2	1	2	4
67	1	2	1	2	3	2	1	2	2	2
68	2	1	1	1	2	2	1	2	2	1
69	1	2	2	1	1	2	2	1	2	1
70	2	1	3	2	2	2	2	2	2	2
71	2	3	2	3	4	4	3	2	5	3
72	2	2	5	4	4	4	3	2	4	3
73	2	3	2	3	1	2	3	3	2	3
74	2	3	2	2	2	1	2	2	2	2
75	1	2	2	4	3	2	2	3	2	1
76	1	1	2	1	2	1	1	2	3	2
77	2	2	1	2	3	2	1	2	2	1
78	1	2	1	2	3	2	1	2	2	1
79	1	2	2	1	2	3	1	1	2	1
80	2	2	2	1	2	1	2	2	2	2
81	1	3	1	2	2	2	2	3	1	1
82	2	1	1	1	1	2	2	1	2	1
83	1	1	2	1	1	1	2	2	1	2
84	3	1	2	2	2	1	1	1	2	1
85	2	1	2	3	2	1	1	2	3	2
86	1	3	1	1	1	1	1	1	1	1
87	2	2	1	1	1	1	2	1	1	1
88	1	1	2	1	2	1	1	1	2	1
89	2	2	3	2	2	1	1	2	2	2
90	2	3	3	2	2	3	3	3	2	3
91	2	3	3	3	2	2	3	1	2	3
92	1	2	2	1	2	2	1	1	3	2
93	1	1	1	2	3	1	2	2	4	2
94	3	3	1	2	2	2	1	1	2	1
95	2	1	3	2	2	3	2	3	2	3
96	3	2	2	3	2	1	2	3	1	4
97	3	2	2	2	2	1	2	2	2	2
98	1	1	3	2	1	1	2	4	3	2
99	1	2	2	1	1	1	1	2	1	2

Table 31 (Cont'd) - Questionnaire Results for 2-Shift Workers (P: 22-31)

Participant	22	23	24	25	26	27	28	29	30	31
100	2	2	1	2	4	3	1	1	2	2
101	2	1	1	2	1	2	2	2	2	1
102	3	4	2	3	2	1	2	1	2	2
103	1	1	4	2	1	1	1	2	1	3
104	1	2	1	1	4	2	1	1	1	1
105	1	1	2	1	1	1	1	2	2	4

Table 31 (Cont'd) - Questionnaire Results for 2-Shift Workers (P: 32-40)

Participant	32	33	34	35	36	37	38	39	40
1	21	30	28	22	29	27	24	23	25
4		3	2			2			4
5	24	84	60	36	120	36	24	27	60
6	7	36	24	12	72	24	6	4	6
7	7	36	24	12	72	24	6	4	12
8	47,5	45	42,5	49	42,5	45	47,5	42,5	42,5
10.1	30	40	20	25	35	15	20	45	30
10.2	45	40	20	25	35	15	30	45	30
10.3	30	45	35	25	30	20	30	60	30
10.4	30	45	35	25	30	20	30	45	30
11	5	4	4	4	5	4	4	4	3
12	3	3	4	4	5	3	4	4	2
14	4	5	4	4	4	3	4	5	3
15	7	1	4	3	7	2	8	4	5
16	5	4	3	2	8	6	4	1	9
17	2	3	4	2	3	2	4	2	3
18.1	23.30	22:30	00:00	23:00	23:00	22:45	00:00	00:00	00:00
18.2	06:00	06:00	06:40	06:30	06:10	06:40	06:10	06:00	06:10
18.3	04:00	02:00	01:30	02:00	01:30	02:30	03:00	02:00	01:30
18.4	11:00	09:30	09:00	09:30	10:00	10:30	10:00	08:00	11:00
18.11	02:30	03:00	01:00	01:30	02:00	00:30	02:00	01:00	00:00
18.12	10:30	11:30	10:00	10:00	10:30	10:30	10:00	09:00	10:00
19	5	7	6	6	6,5	7	6	6	8,5
20.1	4	3	3	4	4	3	3	4	4
20.2	5	4	3	5	4	4	3	4	4

Table 31 (Cont'd) - Questionnaire Results for 2-Shift Workers (P: 32-40)

Participant	32	33	34	35	36	37	38	39	40
20.4	5	5	4	3	5	4	4	4	4
21.1	3	3	4	3	5	4	4	4	3
21.2	2	3	5	4	4	4	5	4	4
21.4	3	3	4	4	5	5	4	4	4
22.1	3	4	4	4	5	4	4	4	3
22.2	4	3	4	4	5	4	4	4	4
22.4	5	4	5	4	5	5	4	4	4
23.1	3	1	5	2	2	3	4	2	3
23.2	2	3	4	3	2	2	3	2	1
23.4	3	2	4	3	4	3	3	2	3
24.1	1	1	4	3	3	2	2	1	1
24.2	3	1	4	5	4	3	2	1	1
24.4	3	2	4	4	4	3	4	1	1
25	4	3	4	3	3	3	4	4	3
26	2	5	2	2	2	4	1	1	3
27	4	3	5	3	5	3	4	4	2
28								9	
29	5				6	4	5	6	7
30	4	6	2	6	6	4	3	3	5
31	4	5	3	5	7	4	3	3	3
32	4	5	3	5	7	3	4	3	3
33	5	4	5	4	5	3	5	4	3
34	5	4	5	4	5	4	5	3	4
35	5	3	4	3	5	5	4	3	4
36	6	5	5	5	4	5	3	4	4
37	7	5	5	5	4	6	5	5	4
38	8	4	7	4	4			7	7
39		4		5	4			9	
40				6				9	
41	3	5	3	6		2	3	9	
42	3	3	3	5	6	1	4	5	8
43	4	3	4	4	7	1	3	3	6
44	4	3	4	3	6	1	4	3	4
45	5	4	5	6	6	4	5	3	4
46	6	4	5	6	5	5	6	3	4
47	6	4	6	7	4	6	6	3	4
48	5	8	6	7	4	6	6	4	4
49	5	8	5	7	4	6	5	5	6

Table 31 (Cont'd) - Questionnaire Results for 2-Shift Workers (P: 32-40)

Participant	32	33	34	35	36	37	38	39	40
50					4			7	
51					6			9	
65	3	2	1	2	2	3	3	2	3
66	3	2	2	3	2	3	2	1	3
67	2	2	3	2	3	3	4	2	2
68	1	2	2	2	1	2	2	1	2
69	2	1	1	2	1	2	2	1	2
70	2	1	2	1	2	2	1	2	2
71	3	3	4	5	3	3	2	2	3
72	2	2	3	3	2	5	1	1	1
73	3	2	4	4	3	2	3	2	1
74	1	2	3	2	2	1	1	1	1
75	2	2	2	2	2	1	1	1	1
76	2	2	1	1	1	1	2	1	1
77	2	2	1	2	2	1	2	2	1
78	2	1	1	1	3	2	1	2	1
79	2	1	2	1	1	1	1	1	1
80	1	2	1	2	2	1	2	2	1
81	2	1	2	1	3	2	2	1	1
82	1	2	2	1	1	2	1	1	1
83	1	1	2	1	1	1	1	1	1
84	1	1	2	2	1	2	1	1	1
85	1	1	1	1	2	1	1	2	1
86	1	1	2	1	1	1	2	1	1
87	2	1	1	1	2	2	1	1	1
88	1	2	1	1	1	1	1	1	1
89	1	1	1	2	1	2	1	2	1
90	2	3	2	2	3	1	2	2	2
91	4	3	2	2	2	3	2	2	2
92	2	2	3	1	2	1	1	1	2
93	1	2	3	2	1	1	2	2	2
94	2	1	2	1	1	1	3	1	2
95	1	1	2	1	2	2	3	1	1
96	2	1	2	3	2	3	1	2	2
97	1	2	1	1	2	2	2	1	2
98	1	2	1	1	2	2	2	1	2
99	2	1	1	2	1	1	2	2	2

Table 31 (Cont'd) - Questionnaire Results for 2-Shift Workers (P: 32-40)

Participant	32	33	34	35	36	37	38	39	40
100	1	2	3	2	1	2	1	2	3
101	2	3	2	1	1	1	2	2	2
102	2	1	2	2	1	1	2	1	2
103	1	1	2	2	1	1	1	1	1
104	2	1	1	1	1	1	1	1	2
105	2	2	1	2	2	1	2	2	2

Table 32- Questionnaire Results for 3-Shift Workers (P:41-48)

Participant	41	42	43	44	45	46	47	48
1	23	21	30	26	28	24	27	31
4			2	2	1	1	2	2
5	24	12	168	36	48	24	48	60
6	12	9	156	12	29	24	48	12
7	12	9	156	12	29	24	48	12
8	45	45	51,5	51,5	42,5	42,5	49	45
10.1	25	30	20	20	50	20	50	25
10.2	25	30	20	20	60	20	55	25
10.3	25	30	20	20	60	20	50	25
10.4	25	30	20	20	60	20	50	25
10.5	25	30	20	20	50		50	25
10.6	25	30	20	20	60		50	25
11	3	3	4	4	4	5	4	4
12	2	3	3	3	4	3	3	3
13	2	3	3	3	3	3	3	3
14	3	4	4	5	5	4	5	5
15	5	8	7	7	7	5	3	7
16	3	2	1	5	2	1	9	7
17	1	3	3	3	4	3	3	2
18.1	00:00	23:00	01:30	01:00	00:00	00:00	01:00	00:00
18.2	06:20	06:20	06:50	06:30	06:00	06:30	06:00	06:30
18.3	02:30	03:00	03:00	01:30	02:00	01:00	02:00	01:00
18.4	10:30	10:00	11:30	10:00	10:30	11:00	08:00	10:30
18.5	14:00	17:00	18:00	18:00				18:00
18.6	22:00	22:45	23:00	23:00				22:30
18.7	10:30	11:00	10:00	10:00				09:30
18.8	18:00	17:00	18:00	18:00				17:00

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:41-48)

Participant	41	42	43	44	45	46	47	48
18.9	10:30	09:30	12:00	12:00				09:30
18.10	18:00	17:00	06:50	06:50				18:00
18.11	00:00	00:30	02:00	02:00	01:30	01:30	01:00	01:30
18.12	09:00	09:30	11:30	11:30	11:00	10:30	07:00	10:30
19	6,5	5,5	5,5	5,5	6	8	5	8
20.1	3	4	3	3	3	4	3	3
20.2	3	4	4	4	4	5	4	4
20.3	4	4	3	3				2
20.4	4	4	5	5	5	5	4	4
21.1	4	3	3	3	4	4	3	3
21.2	4	2	4	4	3	5	4	3
21.3	3	3	3	3				2
21.4	5	3	3	3	5		4	4
22.1	4	3	2	4	4	3	3	3
22.2	3	4	3	3	4	4	4	2
22.3	3	3	2	3				2
22.4	4	4	3	3	5		4	4
23.1	2	3	2	2	2	3	4	1
23.2	1	3	3	3	4	4	4	2
23.3	2	3	4	3				2
23.4	2	4	2	3	4		5	1
24.1	2	3	4	4	2	3	2	2
24.2	3	3	3	3	2	3	2	3
24.3	3	3	4	4				2
24.4	4	5	4	4	3		3	3
25	3	4	2	2	3	3	4	3
26	4	2	4	4	4	4	3	3
27	2	3	3	3	3	3	4	3
28								
29					5	5	3	
30	6	5	8	8	6	3	5	1
31	6	5	5	5	3	3	5	2
32	5	4	5	5	3	3	4	4
33	5	4	4	4	3	3	4	4
34	4	3	5	5	5	3	4	6
35	5	3	3	3		3	4	7
36	6	5	5	5		4	5	6

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:41-48)

Participant	41	42	43	44	45	46	47	48
37	6	5	5	5		5	5	6
38		4	4	4		7	7	
39		4	4	4		9	7	
40						9	9	9
41	5	5				9	3	9
42	4	5	7	7		9	4	5
43	3	3	4	4		5	4	3
44	3	3	4	4		3	4	3
45	4	5	3	3	1	3	4	3
46	6	6	3	3	3	3	4	3
47	6	6	2	2	3	3	4	4
48	7	6	4	4	3	3	4	2
49	7	5	5	5	5	3	4	2
50			5	5		9	7	
51						9	9	
52	5	4						3
53	5	4						3
54	3	5						4
55	3	5	7	7				4
56	4	5	5	5				4
57	4	5	4	4				3
58	3	6	4	4				4
59	3	6	5	5				5
60	5	6	6	6				5
61	8	7	6	6				5
62	8	5	7	7				5
63	8	5	7	7				5
64								5
65	2	2	3	1	2	2	1	2
66	3	2	3	1	2	4	1	2
67	3	4	3	2	3	2	1	1
68	1	1	1	1	1	2	1	2
69	2	1	3	1	2	2	2	2
70	3	2	4	1	2	2	2	1
71	1	4	3	1	4	3	1	3
72	3	4	2	1	4	3	1	2
73	3	3	1	1	2	3	1	2
74	3	2	2	1	2	2	1	2

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:41-48)

Participant	41	42	43	44	45	46	47	48
75	3	3	1	2	1	1	1	2
76	2	1	1	1	2	1	1	2
77	2	2	2	1	2	1	1	3
78	1	2	1	1	1	1	1	3
79	2	2	1	1	1	1	1	3
80	1	2	2	1	1	1	1	2
81	1	2	1	1	1	1	1	2
82	1	1	1	1	1	2	1	1
83	2	1	2	1	1	1	1	2
84	1	1	2	1	2	1	1	2
85	2	2	2	1	1	2	2	2
86	2	2	1	1	1	1	1	1
87	1	1	1	1	1	2	1	1
88	1	1	1	1	1	1	1	1
89	1	2	1	2	2	2	1	1
90	2	2	2	1	1	3	2	2
91	2	2	3	1	2	3	2	2
92	2	2	1	1	1	2	1	2
93	3	1	2	1	2	3	1	2
94	1	2	2	2	2	2	2	1
95	2	3	4	1	2	2	1	2
96	2	2	1	1	2	2	2	3
97	2	2	2	2	2	2	1	2
98	2	2	3	1	3	2	1	1
99	1	3	4	1	2	3	2	2
100	3	2	3	2	3	2	1	2
101	2	2	2	2	2	2	1	2
102	3	1	2	1	2	2	1	1
103	1	1	2	2	1	1	1	1
104	1	1	3	3	1	2	1	1
105	1	1	2	1	2	2	2	2

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:49-56)

Participant	49	50	51	52	53	54	55	56
1	29	24	27	26	23	23	28	25
4			3	1	1		2	
5	60	48	73	48	30	18	84	43
6	24	48	50	9	30	8	60	24
7	24	48	50	9	30	8	60	24
8	45	47,5	42,5	49	45	45	42,5	42,5
10.1	40	30	20	25	20	25	40	50
10.2	40	30	20	25	20	25	40	50
10.3	30	25		30	20	35	40	40
10.4	30	25		30	20	35	40	40
10.5	30	30		30	20	25	40	40
10.6	30	30		30	20	25	40	40
11	5	3	4	4	4	4	3	3
12	4	2	2	4	3	4	2	3
13	4	2	2	4	3	3	2	3
14	5	4	5	4	4	3	4	3
15	3	1	5	3	5	1	3	5
16	5	1	3	5	8	2	4	2
17	4	2	5	3	3	2	3	3
18.1	23:00	00:00	00:30	00:30	23:00	00:00	00:30	23:45
18.2	06:00	06:30	06:50	06:50	06:30	06:40	06:10	06:00
18.3	01:30	01:30		02:00	01:00	02:00	03:00	02:00
18.4	10:30	10:00		09:00	10:00	10:00	11:00	10:00
18.5				18:00	17:30	18:00	17:00	18:00
18.6				23:00	22:30	22:00	22:45	23:00
18.7		09:30		09:30	09:30	10:00	10:00	09:30
18.8		17:00		17:00	17:30	17:00	18:00	17:00
18.9				09:30	10:00	09:30	11:00	10:00
18.10				17:00	18:00	17:00	17:30	17:00
18.11	02:00	00:30	02:00	01:30	01:00	01:30	00:00	02:00
18.12	11:00	09:30	09:40	10:00	08:30	09:00	10:00	10:00
19	6	6,5	6,5	6	8	6	5,5	6
20.1	4	3	3	3	4	4	2	3
20.2	5	4	4	5	4	4	3	5
20.3		3		3	3	3	2	4
20.4	4	4	4	5	4	5	4	4

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:49-56)

Participant	49	50	51	52	53	54	55	56
21.1	5	2	4	3	3	5	4	3
21.2	3	4	4	4	3	4	4	3
21.3		2		3	3	2	3	4
21.4	5	4	5	5	4	4	4	5
22.1	4	3	4	2	3	3	3	3
22.2	3	4	4	4	3	4	3	4
22.3		3		4	2	3	4	3
22.4	5	4	5	4	3	4	4	5
23.1	3	3	1	4	3	2	3	1
23.2	2	3	2	3	3	1	2	1
23.3		3		3	3	2	2	2
23.4	4	3	3	4	3	2	3	2
24.1	1	2	1	2	4	3	2	3
24.2	1	3	2	2	2	3	2	3
24.3		3		3	2	3	3	2
24.4	2	2	1	3	3	3	5	3
25	4	4	5	3	4	5	4	3
26	2	2	1	1	1	3	3	4
27	5	3	4	4	3	3	4	4
28								
29	5	7		6		5	5	
30	3	6	3	5	3	5	3	3
31	3	3	1	4	3	4	3	3
32	3	3	1	3	4	4	4	3
33	2	3	2	3	5	6	5	4
34	2	3	1	2	5	6	5	5
35	5	5	4	2	4	8	3	4
36	5	5	5	3	5	8	3	3
37	5	5	5	5	7	7	5	4
38	5	7	6		7	8		5
39	5							
40	7					5	7	
41	7			3	5	5	4	6
42	7	5		2	1	5	4	2
43	5	4		3	1	3	3	2
44	5	3		4	3	3	3	1
45	3	3		4	3	3	4	2
46	3	4		4	3	4	4	2

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:49-56)

Participant	49	50	51	52	53	54	55	56
47	5	4		4	4	4	3	4
48	5	5		7	5	6	5	5
49	5	7		5	5	6	5	6
50	5	9						
51	5							
52		3		5	2	5	3	2
53		3		5	2	5	3	3
54		3		4	3	5	4	4
55		3		4	3	6	5	4
56		3		4	3	6	5	5
57		3		5	3	4	6	5
58		5		6	5	4	6	6
59		5		6	6	7	7	6
60		7		7	7	8	5	5
61		9		7	8	8	5	5
62		9		7	8	7	5	5
63				8	8	7	5	5
64								
65	2	2	2	2	3	2	2	4
66	1	1	1	4	4	3	3	3
67	4	1	3	2	2	2	1	3
68	2	1	1	2	2	2	2	2
69	1	2	1	2	2	2	1	2
70	2	2	2	2	2	2	1	2
71	5	2	3	3	5	2	2	4
72	3	2	4	3	3	2	3	3
73	3	3	3	3	1	3	1	2
74	4	2	1	1	2	2	1	2
75	4	2	1	2	1	2	1	1
76	3	1	1	2	1	2	1	1
77	3	2	1	2	1	1	1	1
78	3	1	1	1	2	1	2	2
79	3	2	1	2	2	2	2	1
80	3	2	1	2	1	2	1	1
81	3	1	2	1	2	2	1	2
82	1	1	1	2	1	2	2	2
83	1	1	1	1	1	2	2	1
84	2	1	1	1	2	1	2	1

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:49-56)

Participant	49	50	51	52	53	54	55	56
85	1	1	2	1	1	2	2	2
86	1	1	1	1	1	1	1	1
87	1	1	1	1	1	1	2	1
88	1	1	1	2	2	1	2	1
89	1	1	2	2	2	1	2	1
90	1	3	2	2	3	3	3	2
91	1	3	1	2	2	3	2	2
92	1	2	1	3	3	3	3	2
93	1	2	1	3	3	2	2	2
94	2	2	1	2	1	2	1	2
95	3	3	1	3	2	2	3	2
96	2	2	2	3	2	1	2	1
97	2	1	1	2	2	2	2	1
98	3	2	1	2	2	2	3	2
99	2	1	1	2	1	2	2	1
100	2	2	2	3	2	1	3	1
101	2	1	2	2	3	2	1	1
102	2	2	2	1	2	2	2	1
103	1	1	1	1	1	2	1	1
104	3	1	1	1	2	1	2	1
105	2	2	1	1	2	2	1	1

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:57-64)

Participant	57	58	59	60	61	62	63	64
1	28	26	26	36	34	31	25	33
4	3	1	2		1	2	1	2
5	84	48	53	187	192	120	60	192
6	42	36	25	187	174	60	24	180
7	42	36	25	187	174	60	24	180
8	42,5	42,5	53	50	50	50	48	50
10.1	30	20	60	30	30	15	30	30
10.2	30	20	60	30	30	15	30	30
10.3	35	30	60	60	30	15	30	45
10.4	35	30	60	40	30	15	30	45
10.5	35	20	60	50	30	15	30	45
10.6	35	20	60	75	30	15	30	90

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:57-64)

Participant	57	58	59	60	61	62	63	64
11	4	3	5	4	3	2	4	4
12	4	3	4	3	3	3	4	5
13	3	3	3	3	3	3	4	4
14	3	4	4	2	1	4	5	2
15	1	5	5	4	5	5	3	7
16	5	7	5	2	5	3	7	3
17	1	3	5	3	2	1	2	1
18.1	23:00	00:00	22:30	23:00	01:00	22:30	23:00	23:00
18.2	06:30	06:30	06:05	06:30	06:40	06:30	06:00	06:15
18.3	02:00	03:00	01:00	02:00	02:30	02:00	04:00	02:30
18.4	10:00	11:00	12:00	10:30	11:30	12:00	12:00	09:00
18.5	18:00	16:00	10:30	18:00		17:00	18:00	23:00
18.6	22:30	22:30	21:00	22:45		22:45	23:00	09:00
18.7	09:00	10:00	10:00	10:30		11:00	11:00	12:00
18.8	16:30	17:00	18:00	16:00		17:00	18:00	17:00
18.9	09:30	10:00	10:00	10:00		09:30	10:00	12:00
18.10	17:30	17:00	18:00	18:30		17:00	17:00	17:00
18.11	01:00	01:00	23:00	23:00	01:00	23:30	01:00	00:00
18.12	09:00	10:00	12:00	08:00	10:30	08:00	09:00	09:00
19	7	6,5	8,5	7	6	8	7,5	8
20.1	4	3	2	3	3	4	4	2
20.2	4	4	2	5	3	1	4	3
20.3	4	3	2	1		1	4	2
20.4	3	4	2	4	3	4	4	4
21.1	4	3	4	3	3	3	4	4
21.2	3	4	4	4	3	2	4	4
21.3	4	2	4	1		2	4	2
21.4	4	4	4	3	3	3	4	5
22.1	5	3	3	4	3	3	4	3
22.2	5	3	3	5	3	2	4	3
22.3	4	4	3	2		2	4	2
22.4	5	4	3	4	3	3	4	4
23.1	1	3	3	3	3	4	1	2
23.2	1	3	3	2	2	3	3	3
23.3	2	2	3	5		3	3	4
23.4	3	3	3	3	3	3	3	3
24.1	2	3	4	2	2	2	1	3
24.2	3	2	4	1	4	3	1	3

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:57-64)

Participant	57	58	59	60	61	62	63	64
24.3	2	2	4	5		3	1	3
24.4	3	3	4	2	3	2	1	3
25	3	3	2	4	4	3	4	3
26	4	3	4	3	3	3	1	3
27	2	3	2	4	4	3	4	1
28				4				9
29		6	9	5	7	6	3	9
30	8	5	9	3	6	4	3	8
31	6	3	8	3	4	3	3	5
32	6	3	8	3	4	3	3	5
33	5	3	7	3	4	3	4	7
34	5	4	6	4	3	4	3	7
35	4	3	5	4	3	4	3	7
36	5	3	5	6	7	5	5	7
37	5	4	5	6	7	6		7
38	4		5			7		8
39	4		5			8		9
40								9
41		3			7		9	9
42	5	3	5		5	7	5	7
43	4	2	5		5	6	3	7
44	4	2	5	3	5	5	3	5
45	6	2	5	3	4	5	4	5
46	6	3	5	3	3	5	4	4
47	7	4	5	3	3	5	4	4
48	5	4	5	3	3	6	4	5
49	4	8	5	3	5	7	5	6
50	4		5	4	5	8		7
51	4		5					9
52	4	3				8		9
53	5	3				4	6	9
54	5	2				5	3	9
55	4	2				5	3	7
56	4	2				3	3	7
57	6	4	7	6		3	3	6
58	3	5	7	5		6	6	5
59	3	5	7	4		6	6	6
60	3	6	7	7		6	6	8

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:57-64)

Participant	57	58	59	60	61	62	63	64
61	6	6	7	9		7	7	9
62	7	7	7	7		5	5	8
63	7	7	7	5		5		9
64								9
65	2	1	2	3	2	2	2	2
66	2	2	2	2	2	2	1	3
67	2	2	2	3	2	3	2	2
68	1	1	2	4	1	1	1	2
69	1	2	2	2	2	2	2	3
70	1	2	2	3	1	3	1	4
71	3	3	5	3	5	5	3	5
72	3	5	3	3	5	5	2	5
73	3	3	5	1	5	2	1	1
74	1	2	2	2	1	2	2	2
75	1	2	1	2	1	2	1	2
76	2	2	1	1	1	1	1	2
77	2	2	3	1	2	1	1	3
78	2	1	2	1	2	1	1	3
79	1	2	3	2	2	1	1	3
80	1	2	2	1	1	1	1	2
81	1	2	2	2	1	1	1	2
82	1	2	3	2	1	1	1	2
83	3	2	2	2	1	1	1	2
84	2	1	2	2	1	1	1	2
85	1	1	1	2	1	2	1	2
86	2	1	1	1	1	1	1	2
87	1	1	1	2	1	1	1	1
88	1	1	2	1	1	1	1	1
89	2	2	2	3	2	3	2	2
90	3	4	2	3	3	4	2	3
91	3	2	2	2	3	4	2	4
92	1	2	2	3	2	2	3	2
93	1	3	2	3	2	2	2	2
94	2	1	2	2	1	2	2	2
95	1	1	1	2	3	2	1	1
96	1	2	1	2	1	2	2	2
97	2	1	2	1	2	2	2	2

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:57-64)

Participant	57	58	59	60	61	62	63	64
98	1	2	1	2	2	2	1	1
99	2	2	2	2	2	2	1	1
100	2	2	2	1	2	1	2	2
101	3	1	2	2	2	2	2	2
102	1	1	2	3	2	2	1	2
103	1	1	2	2	1	1	1	1
104	1	1	2	2	1	1	1	1
105	2	1	2	2	2	2	1	2

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:65-71)

Participant	65	66	67	68	69	70	71
1	32	29	25	25	24	26	29
4	3	1		3	5	2	5
5	194	70	63	69	84	108	100
6	180	54	9	9	84	36	54
7	180	54	9	69	84	36	54
8	50	50	50	48	50	50	50
10.1	30	55	35	60	25	45	40
10.2	30	40	35	60	20	50	45
10.3	40	60	60	90	30	45	30
10.4	40	45	35	60	20	50	30
10.5	40	50	60	60	20	45	30
10.6	40	75	50	80	20	80	60
11	3	3	4	5	4	4	3
12	5	5	5	5	5	5	5
13	5	4	4	5	5	5	4
14	3	2	2	4	2	5	3
15	7	7	3	8	7	7	8
16	4	7	3	3	5	3	5
17	2	1	1	5	1	5	2
18.1	23:30	01:00	00:00	23:30	23:30	01:00	23:45
18.2	06:30	06:00	06:30	06:00	06:30	06:00	06:15
18.3	01:00	02:30	01:30	01:30	01:00	02:00	02:00
18.4	08:30	10:00	10:00	07:30	07:00	09:00	10:30
18.5		02:00	18:30	09:30	02:00	01:00	02:00
18.6		10:30	23:00	16:00	09:00	11:00	10:00
18.7		11:30	09:30		10:00	13:30	12:00

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:65-71)

Participant	65	66	67	68	69	70	71
18.8		18:00	13:00		17:00	18:00	17:00
18.9		11:30		10:00	10:00	22:00	11:30
18.10		14:00		11:00	15:00	09:00	17:00
18.11	01:00	23:30	01:00	00:00	00:00	03:00	00:00
18.12	09:00	09:45	09:00	07:30	07:30	10:00	10:30
19	7,5	6	6,5	6,5	8	7,5	8
20.1	4	3	4	4	4	3	3
20.2	4	4	5	5	4	4	4
20.3	3	4	3	2	2	1	4
20.4	4	4	5	4		4	4
21.1	4	3	2	5	4	5	4
21.2	4	4	2	3	3	5	4
21.3	2	1	2	1	2	1	3
21.4	4	5	4	4	4	5	4
22.1	4	3	4	5	4	3	3
22.2	4	4	2	4	4	4	4
22.3	2	1	2	2	3	1	3
22.4	4	5	4	3	4	5	4
23.1	3	1	4	3	4	2	3
23.2	3	2	3	4	4	3	4
23.3	4	4	1	5	3	1	3
23.4	3	2	3	5	3	1	2
24.1	3	2	3	2	2	1	2
24.2	3	2	3	3	3	1	2
24.3	4	5	3	5	2	1	4
24.4	3	2	3	2	3	1	2
25	3	3	4	5	4	5	3
26	3	4	3	4	5	1	2
27	3	5	3	5	3	5	3
28				9			
29	5	9		9	5	3	8
30	4	3	3	3	5	3	6
31	4	5	3	1	4	2	3
32	6	5	5	1	4	4	6
33	6	6	7	1	3	1	7
34	7	6	5	1	3	1	7
35	4	7	7	1	4	1	7
36	4	7	6	1	6	1	7

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:65-71)

Participant	65	66	67	68	69	70	71
37	8	7	5	8	7	2	8
38	9	8	7	9	8	3	9
39			9	9		4	
40				9			
41	5			9			
42	4	5		5		1	9
43	4	3	5	2	2	1	8
44	5	2	5	1	3	1	5
45	5	4	5	1	3	2	3
46	6	5	5	1	4	1	3
47	6	5	5	1	4	2	3
48	7	5	5	1	4	2	3
49	7	6	7	7	5	1	5
50	8	8	7	9	7	9	9
51			9	9	9		
52				9		5	8
53			7	9		9	5
54			5	8		9	5
55		7	6	8		9	8
56		6	9	7		9	6
57		6	9	6	4	9	5
58		7	7	6	4	5	4
59		7	7	9	5	5	4
60		9	7	9	5	6	5
61		9	7	9	6	4	9
62		7	9	7	7	3	8
63		9	9	9	9	9	8
64			9	9	9	9	8
65	3	3	3	4	2	4	2
66	2	3	2	3	2	2	2
67	3	1	3	3	1	2	2
68	2	3	2	2	1	1	3
69	2	3	1	4	4	2	2
70	3	4	2	4	3	2	2
71	4	5	5	5	5	5	3
72	3	5	5	5	5	5	4
73	4	1	5	5	3	3	2
74	2	2	2	2	1	3	2

Table 32 (Cont'd) - Questionnaire Results for 3-Shift Workers (P:65-71)

Participant	65	66	67	68	69	70	71
75	2	2	3	3	1	2	4
76	2	1	2	2	1	2	2
77	2	1	3	2	1	2	4
78	2	2	1	2	1	2	3
79	2	2	2	3	2	2	2
80	2	1	2	2	1	2	1
81	2	3	1	2	1	2	2
82	2	1	1	3	1	1	1
83	2	1	2	3	1	1	2
84	2	3	2	3	2	2	1
85	2	1	1	1	2	2	2
86	3	1	1	1	2	1	1
87	2	1	2	1	1	1	2
88	2	1	1	2	1	1	1
89	2	2	2	2	2	2	3
90	3	3	3	4	4	1	2
91	2	3	3	4	4	2	2
92	3	1	2	2	2	2	1
93	3	1	2	1	3	3	1
94	2	3	1	1	2	1	2
95	2	1	2	4	1	1	2
96	2	4	2	1	2	1	2
97	2	3	2	2	2	1	2
98	2	1	1	4	1	1	2
99	2	1	1	3	1	1	1
100	3	2	1	4	2	1	2
101	2	2	2	2	2	1	2
102	2	3	1	4	2	1	1
103	2	1	1	1	1	1	1
104	2	1	1	4	1	1	1
105	2	1	2	4	2	1	2

APPENDIX C

RESULTS OF fNIR AND REACTION TIME TESTS

Table 33 - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	RTT	Sheep RTT	HBT-Block 0-V1	HBT-Block 0-V2	HBT-Block 0-V3	HBT-Block 0-V4	HBT-Block 0-V5	HBT-Block 0-V6
1	0,253	0,6	-0,729647	0,795112	-0,828754	0,538314		0,795633
1	0,2718	1						
1	0,2628	0,8	0,226257	0,146632	-0,260695	0,267211	0,085814	0,112379
1	0,2408	0,6	0,521701	0,130894	0,27321	0,535194	0,164879	-0,632619
1	0,2564	1	0,344573	-0,376826	0,181531		-0,004981	0,014389
1	0,275	1	-0,12848	1,102248	0,083767			
1	0,2346	1		0,780989	0,509932		0,512693	0,100267
1	0,272	1		0,949295	0,258671		0,229853	
1	0,2906	1		-0,204149	-1,116952	-0,851901		0,321328
1	0,3466	1		0,175431	0,282892	-0,519109	0,134749	-1,218288
1	0,375	1	-1,195046	-0,438618	-0,287055	-0,534792	1,767484	1,204536
1	0,3346	0,8	-0,896086	-0,629146	-1,36525	-1,541422	-1,556702	-1,137429
1	0,3126	1	-0,022986	-0,052463	-0,485418	-0,989304	0,467458	-0,154927
2	0,2504	0,8	-0,877522	-1,021869	-0,766969		-2,494568	-9,441145
2	0,3	1						-0,415274
2	0,2594	1	0,424674	-0,452917	0,50351		-1,694043	3,148022
2	0,2622	1	0,106989	-0,94274	-0,613516		-0,071989	-3,069316
2	0,2528	1	-0,136189	-0,091806	-0,372801	-0,56746	0,068995	-0,539639
2	0,3208	1	-0,601502	0,183874	-0,689259			-0,924152
2	0,278	1		0,850576			0,499401	0,008537
2	0,3438	1		-0,381458	-0,4106	-0,524907	-0,113996	-0,649069
2	0,3032	1		-0,09593	-0,159537	0,314776	0,916325	0,246283
2	0,4404	0,6		0,655243	0,663453	0,03974	1,10106	0,210781
2	0,3216	1	0,161179	1,330096	0,54004	0,38489	0,880888	0,341617
2	0,2874	1	-0,300293	0,403354	-0,641216	-0,102815	-0,697295	-0,745772
2	0,269	0,8	0,62842	-0,136238	-0,706368	-1,128857	0,989647	-0,838624
3	0,4474	1	-1,996125	-3,140251	-2,441814		-4,746741	-4,859508
3	0,4718	1						
3	0,2888	1	-0,139696	0,545253	-0,629562	0,596738	-1,157263	-3,802005
3	0,2718	1	0,110878	-0,244651	0,199929	-0,15312	-0,770298	-1,466014
3	0,275	1	0,027032	-1,644404	-0,622838	-4,070328	-0,193174	-0,942272
3	0,3184	1	-0,947577	-0,131797	-1,081636	-0,074469		
3	0,2938	1					0,838365	0,565235
3	0,3718	0,8		0,536008	0,55768	0,404302	-0,170932	-0,14437
3	0,3566	0,8		1,279775	-0,502235	-0,08931	-0,751297	-1,170281
3	0,4094	0,8		-0,245235	-1,362332	0,028039	-1,352837	1,521521
3	0,4656	1	-1,558774	-0,698728	-1,680022	-2,146193	-1,182664	-0,845042
3	0,9248	1	0,768019	0,588297	0,792008	-0,390614	-0,180678	-0,662404
3	0,2428	0,8	-0,750223	-1,034266	-1,077273	-1,089497	-0,417525	-0,497251

Table 33 (Cont'd) - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	HBT-Block 0-V7	HBT-Block 0-V8	HBT-Block 0-V9	HBT-Block 0-V10	HBT-Block 0-V11	HBT-Block 0-V12	HBT-Block 0-V13	HBT-Block 0-V14
1	0,605401	-0,370497	-1,243575	-0,969386	-0,471729	-0,272719	0,263368	0,591103
1								
1	0,326562	0,000346	0,193752	-0,543991	0,460868	0,672929	-0,057926	0,097195
1	-0,115612	0,229787	-0,438211	0,127721	-0,335052	-0,678972	0,049256	-0,964287
1	0,107604	0,192423	0,398059	0,403538	0,216568	0,321169	-0,241548	0,196778
1		-0,0083	-0,439179	-0,542862	0,095977	-0,733299	-1,117309	
1	0,273354	0,903663	0,627221	0,936602		0,40951		
1	-0,122165	-0,060773	0,992433	0,137479	0,640778	0,090857		0,141123
1	0,70675	2,187966	1,78884	2,466561	2,275718	2,518932		0,690702
1	0,671966	1,37436	0,943332	0,631827	0,077665	-0,097902	-0,757189	-0,553364
1	1,733895	2,948123	1,444776			0,455538	-0,328079	-0,541661
1	-2,104815	-0,671028	-1,551363	-0,890235		-1,17756	-1,222729	-1,797508
1	0,631611	0,099917	-0,008858	0,595972		-0,217463	-0,291156	-1,794274
2	-5,969749	-8,779404	-1,92675	-4,582508	-0,614129	-1,996893	-1,014976	-0,535925
2	-0,408309	-0,157922	-0,077609	0,519195				
2	-2,929745	-0,44335	-3,193519	-0,579995	-0,980059	-1,18107	-1,072112	-0,005566
2	-0,296791	-1,255801	0,305448	-2,350482	-0,059006	-1,280667	0,059158	-1,771135
2	0,636563	-0,066801	0,668657	-0,7161	1,141202	-1,607826	-0,304477	-0,205687
2		-0,258577	-0,003512	-0,305273		-0,346243	-1,21408	
2	0,113732	1,553453	0,657138	1,655947	1,440196	1,126076		
2	-1,513002	-0,324364		0,18986	-0,2742	-0,272259	0,078428	0,172992
2	-0,84589	-1,44238	-0,802436	-1,413138		0,059087	-1,250617	-1,742771
2	1,851285	3,433043	2,15711	2,126124	1,010912	-0,047867	-0,156685	-0,54612
2	0,378363	0,389335	-0,007303	0,319181		0,276132	0,666193	0,468053
2	-0,32418	-0,881021	-0,452247	-0,822169		-0,34621	0,007118	-0,534339
2	1,694979	0,212102	-0,144708	0,601186		-0,333484	0,501677	-2,046409
3	-2,420006	-4,776805	-7,538682	-3,922813	-1,664724	-3,094272	-0,721382	-2,445983
3								
3	-0,377343	-4,333985	-0,739188	-3,881426	-0,298407	-1,14489	-0,156879	0,289308
3	-0,833428	-1,358118	-0,327099	-0,877944	2,159163	1,270022	-0,183428	-3,64338
3	-0,493027	0,194616	0,021263	-0,14594	-0,115079	-2,9302	-0,745406	-2,944846
3		-0,612698		-0,768065		-0,358165	-0,863977	-0,801334
3	0,68003	1,49515	0,357805	2,399412	0,444942	0,666954		
3	-0,075679	0,023905	-0,023593	0,695936	0,52702	0,688652	0,265238	0,494372
3	-2,228129	-4,928155	-2,670753	-3,860469	-1,061607	-0,632647	0,155256	-0,569236
3	0,741622	2,345108	1,351789	1,914014	0,707907	0,307405	0,060764	
3	-1,556862	-1,509831	-4,33454	-2,171177		-1,648841	-1,34244	-1,956187
3	0,549463	0,41248	-0,027659	-0,794891		-0,339427	0,286728	-0,711417
3	-0,118547	-0,3979	-0,361583	0,172654		-0,56329	0,020616	-0,204162

Table 33 (Cont'd) - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	HBT-Block 0-V15	HBT-Block 0-V16	HBT-Block 1-V1	HBT-Block 1-V2	HBT-Block 1-V3	HBT-Block 1-V4	HBT-Block 1-V5	HBT-Block 1-V6
1	-0,308023	0,943283	-0,859388	-0,474792	-3,001616	-1,454567		-1,448803
1								
1	0,424737	-0,391582	0,671081	1,586335	-0,008038	3,472379		2,97183
1	0,599373	0,124208	1,011979	0,289675	0,741659	1,42969	0,801984	-0,304388
1		0,074715	-0,009666	-0,642899	0,150286	0,100022	-0,117055	0,137352
1	-0,694362	-1,162042	-0,553577	0,33856	-0,481498			
1		0,461087			-0,320782		-0,717772	-1,460092
1	0,588631	0,955782	0,547109	0,873153	-0,552588			
1		-0,019321	-1,416452	-0,910032	-2,177674	-1,678374		0,119584
1	-0,217922	-0,550313	-1,406548	0,269968	0,058562	-0,746643	-0,711546	-1,986845
1	-1,409401	-1,106467	-2,367865	-1,397731	-1,138546	-0,735379	2,356131	2,584815
1	-1,842318	-0,720685	-1,395479	-0,909614	-2,252182	-2,003431	-1,849528	-1,507923
1	0,160665	-1,089063	0,148767	-0,083501	-0,789089	-1,258166	1,086506	0,451739
2	-0,513191	-1,452122	-0,711689	-1,545111	-0,751625		-3,224601	-5,127417
2								
2	-0,640668	-1,645098	-3,628528	-1,708226	-4,731135		-9,314366	-2,554367
2	0,35422	0,018636	0,209152	-1,182909	-0,91721		-0,587115	-5,004891
2	0,36556	0,145529	-0,159893	0,172686	-0,530452	-0,036921	0,184428	-0,677087
2		-0,303679	-2,118818	-1,106299	-2,66865			-1,680236
2		1,591391		0,358517	0,635826	0,309626	1,186717	0,666531
2	0,099678	-0,06536	-0,541075	-0,595612	-0,959141	-0,917602	-0,241935	-0,984856
2	-1,153263	-1,537073	-0,836469	0,317102	-0,397866	0,421099	0,617576	0,315126
2	0,239275	-0,059171	0,206063	0,822637	0,57821	0,207033	0,349183	-0,373244
2	-0,282019	-0,407685	-0,343403	0,91421	0,079947	0,158581	0,657528	0,137836
2	-0,540844	-0,142242	-1,049836	0,012183	-1,626105	-0,306506	-1,424191	-0,842639
2	0,522887	-1,524318	0,83849	0,054191	0,168054	-0,067741	0,948514	0,367483
3	-1,718072	-2,250475	-2,127592	-3,131666	-4,518395			
3								
3	0,103609	0,2653	-0,01618	2,19131	-0,841194	0,16184	-2,497115	-8,206337
3	0,694093	-2,321176	0,226615	-0,312867	0,137976	-0,372199	-0,730658	-3,363998
3	-0,349494	-2,292305	0,236798	-2,019318	-0,590782	-5,514941	0,213685	-0,486123
3	-0,70278	-0,961313	-1,69495	-0,609485	-2,047563			
3		0,288536	1,818576				0,632863	
3	-0,051226	0,555867	0,081597	0,468654	0,275654	0,181695	-0,654435	-0,364471
3	-1,221514	-0,294029	-1,080172	1,367066	-1,244202	-0,447061		-2,3836
3	0,027585	-0,206826	-0,559775	-0,445737	-2,270012	-0,214282	-2,461857	1,481301
3	-2,039218	-1,798984	-2,302854	-1,073839	-2,617302	-2,820646	-1,986365	-0,525896
3	-0,089242	-0,752813	-0,017591	0,453687	0,015797	0,138691	0,02835	0,162888
3	-0,496779	-1,137133	-1,666288	-1,175526	-1,641373	-0,96833	-0,499555	-0,500509

Table 33 (Cont'd) - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	HBT-Block 1-V7	HBT-Block 1-V8	HBT-Block 1-V9	HBT-Block 1-V10	HBT-Block 1-V11	HBT-Block 1-V12	HBT-Block 1-V13	HBT-Block 1-V14
1	-0,251291	-1,813704	-1,959699	-2,74496	-1,481011	-2,059599	-0,924813	
1								
1	0,615368	1,343722	0,574023	0,389179	0,936222	1,862229	0,927277	1,455758
1	0,320816	1,065539	-0,387981	1,201102	0,006476	0,469824	-0,023879	-1,172817
1	-0,137815	-0,010451	-0,207402	0,221684	0,013308	0,552429	-0,499861	0,857601
1		-0,018669	-1,067486	-0,779429	-0,337386	-0,783537	-1,357629	
1	-0,482772	-0,284903	-0,294455	-0,163474		-0,837486		
1	-0,822717	-0,800515	0,064249	-0,620806	-0,145892	-1,006624		-0,110983
1	0,329685	3,123991	1,804466	2,810826	2,64724	3,195147		0,30394
1	0,049034	1,209393	0,225387	0,061805	-0,436439	-0,180859	-1,384994	-1,023505
1	2,489709	8,502936	1,762128			0,861332	-0,907518	-0,523241
1	-3,112287	-0,489434	-2,534066	-0,698764		-0,899574	-2,614099	-2,786934
1	1,444658	0,944967	1,061225	1,79342		0,825173	-0,062415	-1,324408
2	-4,283928		-1,617056	-4,27751	-0,421158	-1,377054	-1,41403	0,425717
2			-0,123911	-0,9402				
2	-8,019369	-5,890868	-8,913033	-6,301529	-3,694682	-6,327897	-6,195231	-0,316141
2	-0,966648	-2,484049	0,275254	-3,636333	-0,220807	-1,447577	0,191155	-2,700319
2	0,869539	0,10032	0,944389	-0,221024	2,074068	-1,547092	-0,231836	0,03905
2		-0,982352		-1,041254		-1,069487	-2,211756	
2	-1,172062	0,947081	-1,013997	0,66019	0,757351	0,693513		
2	-0,185943	-0,567056		0,712886	0,334677	-0,069749	0,495961	0,583165
2	-1,581002	-2,589351	-1,664916	-2,509715		0,171883	-2,149096	-3,285472
2	1,691805	3,70102	2,213196	2,238766	0,416903	-0,694192	-1,082271	-1,159718
2	-0,23198	0,265523	-1,287181	0,138794		0,216855	1,409009	0,616027
2	-1,197049	-1,197679	-1,469822	-1,23757		-0,309623	-0,068432	-0,460586
2	1,567691	1,482951	0,717853	1,206632		0,927617	1,55623	-1,276847
3					-0,669835	-3,689145	-1,168971	-1,547333
3								
3	-0,705059	-1,778443	-2,096822	-2,038242	-0,479704	-3,400674	0,170003	1,318743
3	-0,862414	-2,075607	-0,39546	-1,516404	2,827418	1,394147	-0,451095	-3,795222
3	-0,125585	0,583822	-0,050314	0,274183	0,200458	-0,270276	-0,632002	-6,680799
3		-1,005496		-1,187362		-0,593494	-1,549424	-0,587025
3	-0,090132	0,809985	-0,839487	1,343333	-1,023595	-0,654099		
3	-0,421874	-0,12829	0,133633	1,021247	0,953528	0,761506	0,406406	0,459794
3	-4,609349	-8,480042	-5,582283	-8,933542		-1,991065	0,170593	-2,250746
3	0,502285	2,577347	1,080189	1,972746	0,458138	-0,347324	-0,308971	
3	-2,645044	-2,143497	-5,421228	-3,289109		-2,2251	-1,603734	-2,410882
3	-1,193369	-2,366058	-1,161935	-1,111002		0,14713	-0,307316	-0,662493
3	0,142925	-0,335593	0,16269	0,723818		-0,213729	0,712313	0,272987

Table 33 (Cont'd) - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	HBT-Block 1-V15	HBT-Block 1-V16	OXY-Block 0-V1	OXY-Block 0-V2	OXY-Block 0-V3	OXY-Block 0-V4	OXY-Block 0-V5	OXY-Block 0-V6
1	-1,355206	0,591131	0,94211	1,20202	0,678023	0,939557		2,265278
1								
1	0,435776	0,137023	-0,087845	-0,100483	-0,169503	-0,156088	-0,461077	-0,025104
1	0,418934	0,344924	-0,150192	0,183705	0,040162	0,04139	-0,120117	-1,423878
1	-0,075105	0,354422	0,852964	0,163504	0,975753		0,665603	0,17761
1	-0,734053	-0,914282	-0,603128	-0,274201	-0,188159			
1		-0,184927		-0,646535	0,667499		0,621074	0,577897
1	0,624539	0,904232	0,592008	1,134642	0,443425		0,36316	
1		-0,705584	-0,240987	0,583133	-0,671731	-0,417502		-0,16809
1	-0,083257	-0,99657	0,906945	1,627896	0,805296	1,144402	0,573429	0,222501
1	-2,363786	-2,506369	-1,225198	-0,74932	-0,204903	-0,007509	0,981876	0,77814
1	-3,103964	-1,129027	-0,00933	-0,214942	0,113458	0,65119	0,471898	0,677398
1	1,302735	-0,179261	0,82044	1,034681	0,280121	0,515845	1,940994	1,654311
2	-0,233627	-0,185758	-0,167706	-0,574389	-0,285995		0,315421	-1,679221
2								-0,016968
2	-4,072381	-3,751875	-0,981321	-0,358892	-1,27959		-1,469488	0,957181
2	0,870569	-0,175395	0,04903	-0,442766	-0,183474		-0,396293	-1,728345
2	0,998527	0,437021	0,929748	0,404027	0,855833	0,250574	-0,041284	-0,421343
2		-0,793441	0,589936	0,435419	0,629799			-0,459496
2		0,561221		-2,226232			-0,540322	-0,441332
2	0,437649	0,286104	0,184203	0,094325	-0,302076	-0,505691	0,047816	0,202258
2	-2,637189	-2,970007	-0,393785	-0,35405	0,208063	0,74545	-1,954817	-1,271061
2	-0,386949	-0,683122	-0,011411	-0,567644	0,735759	-0,445489	0,711032	-0,267866
2	-0,122277	0,049231	0,338712	1,424068	0,837086	1,297914	0,797545	0,604297
2	-0,598964	0,04422	-0,079214	0,16241	0,174128	0,039166	0,290916	-0,006015
2	2,816051	0,444933	2,216723	2,771937	1,705512	2,444306	2,03423	2,544025
3	-1,756887	1,896809	-2,047476	-1,760279	-1,100527		-0,541958	-0,915926
3								
3	0,747938	1,528132	-0,645012	-0,132163	-0,607091	0,254425	-0,285708	-1,791078
3	0,909178	-2,554254	-0,167325	-0,332815	-0,247364	-0,52821	-0,841822	-0,903806
3	-0,304377	-2,517738	-1,124995	-2,253601	-1,154207	-2,690658	-0,948296	-2,276282
3	-1,301005	-1,168244	-0,857359	-1,031109	-1,867878	-0,625126		
3		-0,250315	1,708943				1,336331	0,463512
3	-0,42515	0,76112	-0,109804	0,925344	0,403283	0,487468	0,354229	-0,055549
3	-3,095914	-0,989648	0,271972	1,965309	-0,055415	0,59802	0,013811	-0,332215
3	-0,43452	-1,175433	0,956309	1,248299	1,051158	1,30572	0,376605	1,311771
3	-2,54495	-1,439567	-1,567578	-0,846303	-1,541254	-1,125487	-1,449583	-1,299892
3	-1,38378	-1,36712	1,044936	0,505434	1,13235	0,407722	0,963558	0,303181
3	0,341994	-0,774693	1,949043	2,577432	1,787645	2,09031	1,858756	1,897899

Table 33 (Cont'd) - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	OXY-Block 0-V7	OXY-Block 0-V8	OXY-Block 0-V9	OXY-Block 0-V10	OXY-Block 0-V11	OXY-Block 0-V12	OXY-Block 0-V13	OXY-Block 0-V14
1	0,942634	0,044468	0,131415	-0,338602	0,559134	0,743334	1,5483	0,614464
1								
1	0,417982	0,083091	0,321734	0,040861	0,525025	0,675759	0,691654	1,080202
1	-0,042813	0,774605	1,026262	0,644896	0,679409	-0,293261	0,085757	-2,098335
1	0,805164	0,827363	1,100894	1,129096	0,743866	0,954017	0,052934	0,464131
1		0,14134	-0,275053	-0,89295	0,275006	-0,934881	-0,483194	
1	0,129908	0,201212	0,564386	0,263117		0,552297		
1	0,361852	0,147497	0,165656	-0,293363	-0,407675	0,75985		0,944981
1	-0,465213	-0,790745	-0,430452	-0,7685	-0,82657	0,062765		0,597333
1	0,414321	0,214173	0,657469	0,12985	0,447328	0,597201	0,62682	0,849417
1	0,277686	0,496539	1,072596			0,488321	-0,614845	-0,580648
1	0,389499	0,483412	0,829973	0,374938		1,137862	0,66921	0,884049
1	1,705058	1,346606	1,704773	1,137686		1,560687	1,46001	1,042134
2	-0,967295	-1,823086	-0,557166	-0,886907	0,350582	0,362874	0,25862	0,594669
2	-0,056127	-1,273244	0,226469	-0,929309				
2	-1,144638	0,37564	-0,87202	0,055597	-0,763166	0,385441	-0,806203	0,156054
2	-0,829703	-1,810993	-0,719924	-1,393934	-0,37037	-4,616414	-0,832923	-1,105677
2	0,040838	-0,29553	1,668525	-0,110605	1,971993	0,133322	-0,26942	0,190595
2		-0,266405	0,4394	0,130577		0,698387	0,597877	
2	-0,4071	-0,918028	-0,565636	-0,736721	-0,62826	-0,414231		
2	0,424847	-0,240521		0,266763	0,58748	0,574759	0,766992	1,004684
2	-2,461383	-1,970768	-1,628405	-1,292032		-0,784667	0,323621	-0,168753
2	1,181524	0,923611	1,34315	0,105874	1,240179	-0,085673	0,2952	-0,114676
2	0,243162	0,622946	0,168439	0,624846		0,985356	1,531557	1,997556
2	0,478117	-0,174153	0,020356	0,068939		0,403785	0,907865	0,363517
2	2,139231	2,396582	1,204443	1,389272		18,20087	2,252348	2,730887
3	9,364494	-0,960277	0,927041	-1,193978	-0,928618	-0,991925	-0,405095	-0,493226
3								
3	-0,182241	-2,052413	-0,009007	-1,42888	-0,078889	-0,353967	-0,337506	0,314274
3	-0,531069	-0,641562	-0,533545	-0,307375	-0,829509	0,331182	-1,112602	-0,795964
3	-1,812995	-2,34323	-1,713791	-2,203228	-1,094061	-3,027593	-1,653782	-2,464025
3		-0,827732		-1,079828		-1,086802	-0,715606	-1,147228
3	1,087438	0,616452	1,100267	0,65105	1,09598	1,44504		
3	0,230181	-0,473642	0,136807	0,081608	0,705937	0,521981	0,516613	0,53861
3	-0,689557	-0,675616	-0,491236	-0,6	3,165192	-0,33501	0,553065	-0,344928
3	0,869132	1,652211	1,235748	1,409521	1,756856	1,30985	1,564518	
3	-1,834897	-2,023635	-1,092594	-1,617328		-1,448349	-1,520024	-1,912625
3	1,146191	0,472184	0,917908	0,294699		0,973655	1,271299	0,768646
3	1,329171	1,258685	1,00832	1,02358		1,308026	2,498239	2,120288

Table 33 (Cont'd) - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	OXY-Block 0-V15	OXY-Block 0-V16	OXY-Block 1-V1	OXY-Block 1-V2	OXY-Block 1-V3	OXY-Block 1-V4	OXY-Block 1-V5	OXY-Block 1-V6
1	0,715093	1,756873	1,466187	1,467762	0,489096	1,442935		1,118679
1								
1	1,545676	0,784465	1,617283	1,526659	1,098266	2,435013		2,133775
1	0,360131	-0,143885	-0,694273	0,053771	-0,231353	0,426635	-0,209482	-1,612624
1		0,20126	0,823581	0,373503	1,17213	0,809565	0,853968	0,491015
1	-0,291205	-0,271916	-0,327662	-0,299285	-0,205176			
1		0,693392			0,210013		0,049456	0,099079
1	-0,561754	-1,226721	0,886421	1,83354	0,374217			
1		0,311487	-0,175179	0,611161	-0,747289	-0,759532		-0,105256
1	0,867329	0,96741	0,928126	2,539084	1,068339	1,835426	0,212616	0,362288
1	-1,389887	-0,512727	-1,672473	-1,146251	-0,065954	0,400619	1,013465	1,330742
1	0,11809	0,412525	0,785241	0,297918	0,782163	1,522538	1,215932	0,99387
1	2,713493	1,863176	3,188386	3,198686	1,675521	2,227484	3,76586	3,61058
2	0,588753	0,062433	-0,377715	-0,44342	-0,513531		-0,3004	-1,151161
2								
2	-0,118022	-0,287369	0,100244	-0,550094	-1,714649		-1,943437	0,180636
2	-0,537575	-0,64709	0,12676	-0,063408	0,126013		-0,386989	-1,998903
2	0,63807	-0,602569	1,662282	1,170407	1,489731	1,332094	0,309645	0,372206
2		0,602124	1,130082	0,385371	0,183795			-0,819666
2		-0,516061		-2,306096	-3,813446	-2,243343	-1,224883	-0,988094
2	0,584197	0,986099	0,582714	0,598617	0,131943	-0,224922	1,049135	1,156731
2	0,279165	-0,458365	-0,328555	0,132041	0,292266	1,345208	-1,873139	-1,311014
2	0,210311	-0,037146	1,359555	0,486784	2,143472	0,685542	1,617188	0,320428
2	1,333897	1,398825	0,882363	2,515622	1,747207	2,453917	1,721783	1,676188
2	0,43953	-0,043497	-0,066625	0,65333	0,768968	0,565859	0,674353	0,238609
2	2,41082	2,11459	4,603864	4,579964	3,559464	4,643548	3,711532	4,455256
3	0,099893	-0,906203	-1,370095	-0,4573	-0,367748			
3								
3	0,066945	0,519343	-0,181318	1,955851	-0,334899	1,229641	0,735719	-2,245128
3	-0,283188	-0,373954	0,054109	0,513315	-0,081316	0,151725	-0,160261	-0,344502
3	-1,798256	-2,215683	-0,087247	-1,784598	-0,41325	-1,653013	-0,120705	-1,154223
3	-0,508091	-1,250933	-1,080872	-1,823604	-2,85269			
3		1,636978	3,200154				1,454294	
3	-0,042742	0,401671	0,229993	1,825999	0,916148	1,187837	1,527808	0,876176
3	0,214698	-0,342728	0,095826	2,57619	-0,02305	0,804274		-0,652771
3	0,948181	0,903529	0,917829	1,261571	0,940912	1,345136	-0,10836	1,281848
3	-1,999353	-1,804021	-1,377034	-0,751642	-1,283734	-0,610336	-1,482774	-0,59026
3	0,458267	0,10966	0,503579	0,412493	0,20275	0,276253	0,711726	0,886683
3	2,078396	2,014108	2,772477	3,577071	2,777204	2,886748	2,861202	2,888707

Table 33 (Cont'd) - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	OXY-Block 1-V7	OXY-Block 1-V8	OXY-Block 1-V9	OXY-Block 1-V10	OXY-Block 1-V11
1	0,27168	-0,812235	0,184259	-0,49356	0,168793
1					
1	1,93785	1,779688	2,151783	1,97643	2,367511
1	0,014312	1,144518	1,009898	2,05846	0,724842
1	0,805546	1,351904	1,267138	1,60952	0,831841
1		0,261861	-0,306375	-0,95051	0,462674
1	-0,634364	-0,727644	-0,046594	-0,52244	
1	0,10876	-0,021582	0,095159	-0,48187	-1,03412
1	-0,760928	-0,877318	-1,169084	-1,31136	-1,332664
1	0,24821	0,16618	0,751625	0,45284	0,564173
1	0,472262	0,773177	0,732821		
1	0,799753	0,999902	1,049309	0,60806	
1	3,469496	3,033636	3,659249	2,70143	
2	-0,994174		-0,129977	-0,79429	0,885995
2			0,410928	-0,5761	
2	-0,765187	-0,811753	-0,976177	-1,7424	-0,336402
2	-1,185011	-2,553258	-0,560724	-1,89139	-0,190491
2	0,40755	0,339454	2,67893	0,63156	3,403326
2		-0,683921		-0,2259	
2	-0,964747	-1,738231	-1,784069	-1,74921	-1,597615
2	0,277288	0,35595		1,34903	1,695267
2	-3,139125	-2,002382	-2,249661	-1,53029	
2	2,00101	1,474786	2,256666	0,55458	1,823094
2	0,310312	1,480977	0,696456	1,27773	
2	0,77207	-0,167899	0,462178	0,47869	
2	3,577453	4,212303	2,563631	2,69357	
3					-0,171432
3					
3	0,84005	-6,334045	0,012549	-1,60276	0,317691
3	0,066655	0,112301	0,119479	0,39704	-0,407336
3	-1,18864	-1,827637	-1,61043	-1,85032	-1,025496
3		-1,582244		-1,61119	
3	0,689276	0,160904	0,778537	0,27217	0,832994
3	1,169352	-0,142005	0,48148	0,55892	1,469948
3	-1,465345	-0,038251	-1,174176	-1,14528	
3	0,542406	1,679826	1,341484	1,51361	1,87477
3	-2,317781	-2,341388	-0,896609	-1,87169	
3	0,522111	-0,724341	0,113404	-0,74043	
3	2,639292	2,143373	1,922872	1,54062	

Table 33 (Cont'd) - fNIR and Reaction Time Tests Results of Morning Shift

Experiment	OXY-Block 1-V12	OXY-Block 1-V13	OXY-Block 1-V14	OXY-Block 1-V15	OXY-Block 1-V16
1	0,70603	0,582614		0,087644	1,798056
1					
1	3,576263	2,112081	3,270324	3,244519	2,057901
1	1,690228	-0,273968	-4,858779	-0,457792	-0,259165
1	1,777903	0,508079	1,65923	0,789017	1,065633
1	-1,180456	-0,447235		0,056289	0,37484
1	-0,07862				0,277305
1	-0,143443		0,556289	-0,860685	-0,970342
1	0,052502		0,526303		0,13209
1	0,950093	0,365585	1,05879	1,375802	1,199789
1	0,705497	-0,900385	-0,478454	-2,798975	-1,136356
1	1,426164	0,670463	0,920369	0,107285	0,288428
1	3,491448	2,699699	2,945525	5,238369	4,584415
2	1,415599	0,234983	1,534228	1,339	0,999233
2					
2	-0,888616	-1,025876	0,627718	1,710445	-0,529196
2	-4,978178	-0,854398	-0,661963	-0,429394	-0,478051
2	1,07397	0,195067	1,430071	2,173512	0,19387
2	0,478074	0,857344			1,061028
2	-0,789269				-1,436562
2	1,812363	2,177748	2,852945	1,716524	2,81471
2	0,039258	0,539291	-0,493134	0,043884	-0,959005
2	0,295222	0,683111	-0,218995	0,639671	0,150871
2	2,114734	3,528707	4,088603	3,142072	3,503829
2	0,941995	1,284016	0,45352	0,39757	-0,461972
2	4,087716	4,461698	3,968731	5,957161	5,498054
3	0,15685	-0,750916	0,19686	1,477172	1,627993
3					
3	-0,175646	0,058151	1,546606	0,821469	1,860114
3	1,691304	-0,709522	0,766595	0,088493	1,010193
3	-1,124672	-1,206222	-0,882523	-1,638463	-1,712737
3	-1,900816	-1,510976	-2,035679	-1,161087	-2,140443
3	1,237119				2,726761
3	1,087802	1,143535	1,118171	-0,101238	1,159662
3	-0,994793	1,786832	-1,368926	-0,505533	-1,163542
3	1,103067	1,427267		1,027035	1,256095
3	-1,449344	-1,738358	-1,830983	-2,453048	-1,917561
3	0,649121	0,49627	0,304698	-0,790996	-0,873384
3	1,934867	2,992192	2,562765	3,217288	2,626713

Table 34- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	RTT	Sheep RTT	HBT- Block 0- V1	HBT- Block 0- V2	HBT- Block 0- V3	HBT- Block 0- V4	HBT- Block 0- V5	HBT- Block 0- V6
1	0,2814	0,8	-2,4197181	-0,5234246	-3,9305829	0,28605214		-1,2405046
1	0,4	0,8	0,00158311	-0,0178149	-0,0544855	-0,0557651	0,06651647	-0,1197846
1	0,2342	1						
1	0,2314	1	0,12996747	0,01178618	-0,6030391	-0,0589923	-0,376213	-0,0969493
1	0,2532	1	0,65877707	-0,4118921	0,01790336	-1,6053324	-0,0762784	-0,1111397
1	0,2126	1	-0,2262029	-0,1406435	-0,0729594	-0,1391143	-0,9644211	-0,9835478
1	0,2718	1		0,28941184	0,07113414		1,71116486	0,19140102
1	0,2374	1		-0,4440927	0,52715922	-1,1296731	1,48474005	1,07999578
1	0,203	0,8		-0,251467	-0,2330718	0,43696943	-1,2985997	-1,7158899
1	0,378	0,8	-0,4409654	-0,6943375			-0,4920424	0,07699308
1	0,2344	0,8		-1,8335156	-1,4533577	-1,983396	-0,539895	-1,4492194
1	0,2684	1		-0,7724748	-0,6218148	-1,3039788	0,86583574	0,41266994
1	0,3064	0,6		0,05799129	0,23500292	0,48351124	1,33909097	0,70170359
1	0,247	1		-1,5886269	-1,5223405	-3,3281225	-1,1112565	-8,7272012
2	0,2468	1	0,82528791	-1,2743141	1,19663475			
2	0,4656	0,6	0,70318554	1,89994925	1,25553344			
2	0,3124	0,8	0,48381672	0,10401564	0,73929217	0,08352915		-0,9360895
2	0,3498	0,8	-0,0647771	0,88515936	-0,5385186	0,34505856		-0,32411
2	0,2752	1	1,51649608	0,31838064	0,719805		1,02289238	0,22194427
2	0,2376	0,6	0,46383174	-0,2705432	0,56641423	-0,7788137	0,7167337	-0,7267753
2	0,2626	1		-1,3523537	-0,89655		0,54445559	0,22375812
2	0,2642	1		-1,2153267	-0,9547528		-0,1258056	-0,2246064
2	0,231	1		-2,2648963	-2,6381942		0,01436474	
2	0,2594	0,8	0,73596771	1,34607774	0,18335701	0,6614475	-1,3274523	-0,0259204
2	0,275	1		-0,1502418	-1,4132732	-2,1012317	-1,9441057	-2,1670437
2	0,2438	0,8		-0,9289794	-0,6907595	0,16477364	0,02440548	-0,4251678
2	0,3222	1		-0,8279427	-1,2030023	-0,0895538		1,41599523
2	0,2972	1	0,50779283		1,13376124			0,43342541
3	0,3844	1						
3	0,456	0,8	0,00375155	0,09926751	0,04491647	-0,0389445	0,00078138	0,18202293
3	0,2686	0,8	0,22072608	0,35718764	0,32325141	0,39577525		-0,2089977
3	0,2656	1	0,22004536	0,19731179	0,57984307			1,39387675
3	0,2654	0,8	-1,092802	-1,7478337	-1,1880529	-0,738721	-0,6723303	-0,8294571
3	0,2064	0,8	0,06080214	0,6327728	-0,1722763	-1,0861872	4,05470052	1,48671878
3	0,2654	1						
3	0,3624	1		-0,3083152	-0,290816		1,41273436	0,82382434
3	0,347	1		-0,5553178	0,39892124	0,10414892	-0,5064263	-0,7680467
3	0,356	1	0,27095987	0,26727995	-0,297784	-0,2057088	0,02121111	-0,0964507
3	0,2342	1		-0,3197462	0,19460699	-0,5539659	-0,3248206	0,86652718
3	0,2594	1		-0,387802	-0,5533183	-0,4805806	0,55903488	1,53784171
3	0,3816	1		-0,6250624	-0,0106899	-0,4678797	4,16721155	4,66247433
3	0,4378	1	-0,4273554	-0,28547	-0,4785554	-0,2029517	-0,2066348	0,22002976

Table 34 (Cont'd)- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	HBT- Block 0- V7	HBT- Block 0- V8	HBT- Block 0- V9	HBT- Block 0- V10	HBT- Block 0- V11	HBT- Block 0- V12	HBT- Block 0- V13	HBT- Block 0- V14
1		-3,3272293		-1,2064716		-3,3458143	-1,7566113	
1	-0,43649288	0,14350893	-0,4283544	-0,2936259	0,01813443	-0,2598473	-0,3713735	-0,0853543
1								
1	-0,33997494	0,13787532		-0,0602185		0,28820572	0,00765246	
1	0,66145417	0,46103711	0,5908815	-1,1095831	0,60162662	-2,6934056	-1,1226554	-0,3167687
1	-0,00451861	-1,840589	-1,3708581	-1,6420571	-0,9809823	-0,6510185	0,04433069	-0,0060015
1	1,41867758	0,72881427	0,53532394	-0,5905943	-0,5546716	-5,2658075	-0,4817818	-1,9887029
1	1,59299433	1,49118331	1,10297483	0,55842914	0,8211713	-0,4436168	-0,2944642	0,06493108
1	-1,07060626	-1,4103385	-1,4519479	-1,3258433	-0,7156637	-0,0794488	-0,4552357	0,02967095
1	-0,72271786	-0,2404997	-0,1718137	-0,0964514	0,07586847	-0,0054143	0,26462369	0,22272632
1	-0,2064146	-1,0568396	-0,010579	0,70256693	-0,2853178	0,01887585	0,71260483	0,46687296
1	1,93740396	1,46961279	0,16647786		0,31702812	-0,0563493	-0,5225283	-1,8187843
1	1,37643648	0,39633131	2,24155027	-0,010545	0,78138701	-0,5405785	0,35935183	0,16771296
1	-3,25246055	-6,8399547	-1,5132947	-2,1222462		-0,8560395	-1,1484014	
2		-2,3542545		-4,0944644	0,72410287	-1,3537976	0,07866763	
2	-1,42302005	-0,2924724	-0,127198	-0,0196327	0,14281401	0,00395143	-0,4481594	-0,5581062
2		-0,2926055	0,06418398	-0,4198251	0,10204379	-0,3538999	-0,4935474	
2		0,42794814		0,5499113		0,19402697	-0,441812	
2	1,17570592	1,15898612	0,89948142	1,03920549	0,51041936	-0,4175429	0,38381983	0,33411426
2	0,61163977	-1,0730245		-1,3975872		-1,0997243	-0,7353121	
2	0,48509831	0,20195043	-0,2889594	-0,2313418	-0,7926902	-1,7621336	-1,0947589	
2	-0,28108749	0,01903221	-0,3017521	-0,5975848	-0,801949	-1,9845121	-1,0292673	-1,355329
2	-2,56324439	-0,7305728	-2,2244592	-0,3379275	-1,7472247	-4,1389986	-1,6154046	0,30175827
2	-3,79859257	0,46282744	-1,8992014	0,68104972	-1,2656629	0,65047972	-0,3905879	0,81101929
2	-1,58626393	-1,108459	0,16538415	-0,6766535	0,61782931	0,18459884	-0,7846871	-1,0104868
2	0,38791848	-0,1793531	0,2452591		0,51284634	0,98746041	0,2721114	-0,0371756
2	-1,91047119	1,10542489	-0,2944792	1,5919334		-0,1386609		
2	-0,1023694	-0,2995146	0,23549415	0,24719322		0,70187931	0,7733876	
3								
3	0,13454966	0,4952209	1,2332163	0,61930965	0,14251048	0,28742985	-0,0047877	-0,1088526
3		-0,0946144		-0,2513549		-0,4265509	-0,2054814	
3		1,92602332		1,94992404	1,04454186	1,14142775	0,29608535	-0,2173707
3	0,13687808	0,00378449	0,11182703	0,76074854	-0,6025266	-2,3169741	-0,4480943	-0,947698
3	2,68085581	0,53287062		1,94706751	1,04196274	-0,0690102		
3								
3	1,4074285	1,05760673	0,09209724	-0,2797546	0,01664652	-1,6760331	-0,3819748	-0,9489825
3	-3,45115165	1,62477752	-2,1725352	0,74648125		-0,3982061	-0,0139113	-0,4838652
3	-0,25551696	-0,1381377	-0,0815949	-0,1109836	-0,0167911	-0,2522972		
3	-0,12356025	0,26710389	1,32388266	0,89453861	2,42680537	0,69238057	-0,3297289	2,15770167
3	1,13881302	0,55540097	0,16450476	0,29304643	0,26390112	0,24366727	0,44932292	-0,5934234
3	2,86564271	2,71628641	0,31920584	-0,773391		-0,7435039	0,65150344	0,06620133
3	-1,32890686	-0,7331267	-1,2936546	-0,5434943		-0,9291024	-0,6808325	0,06997516

Table 34 (Cont'd)- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	HBT- Block 0- V15	HBT- Block 0- V16	HBT- Block 1-V1	HBT- Block 1-V2	HBT- Block 1-V3	HBT- Block 1-V4	HBT- Block 1-V5	HBT- Block 1-V6
1	-5,1141022		-1,440985	0,04007433	-3,5183943	1,6500327		-0,5138253
1	-0,1854579	-0,09104169						-1,0651507
1								
1	-0,1022357	0,01163353	0,03437301	-0,6703519	-1,5848159	-0,1294199		-0,8828157
1	-0,2863377	-0,05213494	0,69525907	-0,7082709	-0,6234445	-2,4676501	-0,6563426	-1,1589519
1	0,07365022	0,49130561	-0,7249153	-1,380011	-0,7487121		-0,8039886	-1,2970813
1	0,04429473	-0,34052504	2,09170109	0,42895843	0,19297637		1,83730587	-0,1258325
1	0,20852387	0,2276087	0,69390081	-0,7575224	0,63894519	-1,8123627	1,61495288	1,78452241
1	-0,2999997	-0,2570298	1,8012587	0,38528842	-0,5235222	1,89521526	-2,1333492	-1,4333288
1		0,05726336	-0,6318528	-1,2127602			-0,8593741	-0,0619861
1	0,12743001	0,54142183	-2,349762	-3,1584155	-2,1304923	-2,5289512	-1,7307264	-0,5153237
1	0,60469573	-0,12474059	-0,1612638	-0,805043	-0,8683104	-1,5176669	1,57093017	0,94140861
1	1,39576297	0,80715617	0,08095878	-0,4804397	-0,5096832	0,06805424	1,71663525	0,43787767
1	-0,0378922	-0,68062651		-2,5985402	-2,2090957	-5,1821129	-2,5011665	-1,1259527
2	0,71750704	-0,17914947	2,33705509	2,76996622	3,19979165	5,4231112		2,75245026
2	2,18067266	3,58179971	5,1583569	4,3718624	1,31312915			
2	-0,869833	-0,13745276	-0,8204218	-1,422396	-0,2834668	-0,583349		-0,5433125
2	-0,2792746	0,26521283	-0,4757149	1,00561457	-1,8669737			-1,2781062
2	-0,0889366	0,35193015	2,45098668	0,85995831	1,52401125		1,01602653	0,59311482
2		-2,92922808	0,48555707	-0,6508348	0,6881681	-1,4118627	-0,5665903	-0,8831644
2		-0,42269478	0,15567852	-1,8259168	-1,3204133		0,134994	0,55778205
2	-1,7453847	-1,8445577	0,45513597	-1,3907254	-1,0079823		-0,1556948	0,25364224
2	-0,8973103	-1,83691912	-1,2687495	-3,585251	-1,3251349		0,04037917	0,92729307
2	-0,2810128	0,56368059	1,34769182	2,28428638	0,42330636	1,46191667	-0,9877077	0,27374166
2	-1,201837	-0,69033693	-0,223019	0,15889779	-1,7315085	-2,6052968	-2,71206	-2,8837685
2	0,30247452	0,1385658	-0,4360312	-1,234399	-0,9353125	-0,5683771	-0,6078849	-0,6623497
2			-0,4364911	-1,1284875	-0,5408726	0,64650568		3,6681899
2			0,97549675		0,92120678			-0,7491331
3								
3	0,10244912	-0,33309635	1,23822011	2,03830294				0,91288173
3	-0,4708696	-1,05329211	-1,1686812	-0,8084209	-0,4213353	-0,6123764		-1,1974426
3	0,16627435	0,43490427	-0,6372325	-0,5918016	-0,3220984			0,47535001
3	-1,1770182	-1,88395811	0,63207272	0,42664916	1,73795501	0,49313193	1,31302568	2,83392141
3		-0,47002951	-1,3639233	-0,4054199	-1,147316	-2,0586829	-1,9545133	-1,1923609
3								
3	-0,4477959	-0,34104473	0,62564335	-0,6776527	-0,2973967		1,06602791	1,26455006
3	0,06012909	0,68881601	0,05247989	-0,5518923	0,22123697	0,95073915	-1,324857	-0,9367816
3	-0,020069		0,37426374	0,78223367	-0,5877369	-0,1932159		-0,3006254
3	-0,1111635	2,93315641	-0,9995205	-0,5638955	-1,4581823	-2,1991018	-1,314701	-0,3628598
3	0,08112521	-0,22238127	0,69452558	0,43908722	-0,2418214	0,98865804	1,05114464	3,19859906
3		0,35960737	-0,1118072	-1,7968448	-1,3354519	-1,2143907	4,72595464	4,86065379
3	0,04939591	-0,00837927	-0,9814789		-1,6154193		-1,79593	-1,0595119

Table 34 (Cont'd)- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	HBT- Block 1-V7	HBT- Block 1-V8	HBT- Block 1-V9	HBT- Block 1-V10	HBT- Block 1-V11	HBT- Block 1-V12	HBT- Block 1-V13	HBT- Block 1-V14
1		-2,5229568		-1,0905018		-3,4866422	-1,024554	
1	-1,595609	-0,1933939	-1,078428	-0,2751505		0,16366955	0,01418853	0,11617302
1								
1		-0,8270078		-1,0035268		-0,0592433	-0,5325926	
1	0,68779892	-0,2305728	0,26041841	-1,8546335	0,8094895	-4,3217379	-1,7724159	-0,3189827
1		-2,9462988	-2,28958499	-2,7648148	-1,152869	-1,2515292		
1	1,54745324	0,30602809	-0,0468357	-0,7247447	-1,5996177	-5,3791722	-1,408422	-2,4510981
1	1,70739299	1,71189314	1,11706006	0,64567412	0,75515558	-0,0247219	-0,5868945	
1	-1,2593211	-2,2934051	-1,96375358	-2,0830748	-0,7805641	0,06821812	-0,1140221	0,912893
1	-1,7668512	-0,6008875	-0,94140579	-0,6554156	-0,9760158	-0,3930244		
1	-1,7706958	-1,1638706	0,38408681	0,62822815	0,08832013	0,30672911	-0,70611	2,25207507
1	3,02684456	2,3340034	0,40685606	-0,5636336	0,81373013	0,26888091	0,22846592	-1,8451602
1	1,39671654	0,14379816	2,00475677	-1,7225701	-0,8245089	-1,6202904	-0,565756	-0,3108967
1	-3,3676247	-8,4596483	-1,76932152	-4,0769471		-1,5637092	-1,0980964	
2		2,32799997	1,95368715	2,02596971	0,78063927	0,52827479	1,48158484	4,11309873
2	-2,1934581	-1,4976765	1,85596187	2,85710338		0,73053559		
2		0,38526443	-0,95960296	-0,7343892	-1,1247376	-1,5501841	-0,6843134	
2		-0,0852378		0,1084933		-0,2405557	-1,0750726	
2	1,57364764	1,24366626	1,28054504	1,61440843	0,9766289	0,40407894	0,86282985	1,68893567
2	-0,078217	-1,3965308		-2,0107958			-1,1546974	
2	0,47446534	0,07497943	-1,10041411	-0,6585824	-1,5585233	-1,5701639	-1,6362284	
2	-0,4150775	-0,1922781	-0,7801664	-0,6021661	-1,1196875	-1,7608608	-1,2276909	-1,2323947
2	-2,0779171	0,59494083	-1,90476612	0,66203962	-0,9928797	-4,1559819	-0,9104541	1,564953
2	-4,059327	0,48155829	-2,75138586	0,50978396	-1,4258409	0,92289713	2,24342102	1,21914591
2	-1,9075938	-1,2397219	0,18376742	-0,906201	0,4573044		-1,6284476	-1,064385
2	-0,7084848	-0,940468	-0,35501134		0,10249356	0,34435221	-0,0131854	-0,4385599
2	-1,4148393	3,29950399	1,30875251	4,3036139		1,38626496		
2	-1,8446202	-1,6392663	-0,93557888	-0,6414823		0,10207766	0,16057456	
3								
3	1,09815857	-0,4440062	0,12117147	-1,337624		0,27818477	0,66425247	0,39101218
3		-0,7252246		-1,4922185		-1,4289803	-0,7745781	
3		1,57027528		1,94266634	1,22552412	1,43766002	-0,0627201	-0,2019858
3	1,4818441	2,60499399	2,55190259	3,98094019	2,43113273	1,89409578	2,4258568	3,09251003
3	0,37160622	1,43696966		7,41107827	1,76844102	2,16854458	2,10609835	
3								
3	0,85367273	0,47840098	-0,98161264	-0,5045115	-0,2995604	-1,1888646	-0,8084223	-1,0498326
3	-4,9730361	1,84891623	-3,02625794	0,73599667		-0,1538043	-0,0559856	0,11105925
3	-0,3414055	-0,1313551	-0,17284376	0,10319153	-0,2040707	0,04509009		
3	-0,3392871	-0,389803	1,29272657	1,65829823	2,1042206	1,30271412	-0,87358	1,56253337
3	1,74905156	1,51578775	0,84948511	1,06877005	1,57851252	1,36744693	1,21688247	0,67785851
3	3,13124324	2,58519116	0,71814852	-1,9787633		-2,141953	0,2726136	-1,1490803
3	-3,855329	-3,2568076	-2,97613596	-1,8544073		-2,4451214	-1,507657	

Table 34 (Cont'd)- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	HBT- Block 1-V15	HBT- Block 1-V16	OXY- Block 0-V1	OXY- Block 0-V2	OXY- Block 0-V3	OXY- Block 0-V4	OXY- Block 0-V5	OXY- Block 0-V6
1	-3,5572342		-0,1603769	1,90993647	-0,6277255	0,24231648		-2,1491807
1	0,97923508	1,87996881	-0,2160744	-0,13927014	0,07349287	0,06721489	0,21811857	0,35812117
1								
1	-0,4336873	-0,4559237	-0,0122587	0,34480427	-0,2795358	0,12141061	-0,055693	-0,1314679
1	-0,3152724	0,34345357	0,55008628	-0,5428136	0,64946509	-0,7538983	0,1305618	-0,3944037
1	0,11517026	0,16801156	1,33041855	1,5946095	1,03528635	0,85462719	0,60304537	1,12562583
1	-1,0000347	-1,089758	1,37462933	0,15647649	0,77215808		0,40132893	-0,3634754
1	1,06066177	1,09001797	0,5899277	-0,45216213	0,44231401	-0,6736595	0,25349353	-0,471484
1	0,56850327	0,41773639	-1,6860052	-2,3160124	-1,561937	-1,0670739	-1,375454	-1,838313
1		-0,3231735	-0,1540818	0,38195148			-0,4618391	-0,105491
1	0,00922261	0,43973266	0,16862976	-0,57190762	-0,0289364	0,43590743	0,39431608	0,90126048
1	1,61563001	0,49105042	1,68998444	2,03353205	1,65705561	1,82082979	1,90334854	1,76638289
1	1,18330325	0,75354238	1,58474568	0,77600687	0,93201297	1,05902594	-0,0346891	-0,051384
1	-0,1085895	-0,9798515		0,68886175	-0,9003978	-0,2843431	-0,6351502	-3,2361856
2	1,39769369	2,54352953	1,51865094	1,54159818	1,53579126			
2	1,16471751	3,49399508	1,31023477	-0,36512102	2,01079918			
2	-1,015622	-0,0640176	0,75220751	1,04300049	0,84651264	0,67022529		0,00484352
2	-0,9955882	0,09888664	-0,1619716	0,22930939	-0,2941366	-0,136679		-0,1983612
2	0,86668356	1,34574191	2,69742083	1,06763587	1,70491755		1,34937416	0,62465135
2		-3,7180636	-2,1090742	-2,22661027	-1,3982476	-2,4320696	-2,0320575	-2,1371056
2		-0,0285483	-0,9694039	-1,90476025	-1,3113765		-0,7999537	-1,4127301
2	-1,9309984	-2,0517349	-0,7582036	-1,0959916	-0,9976577		-1,6675643	-2,2211258
2	0,06941076	-0,8686156	-0,8814801	-3,6914112	-1,4230866		-0,6117516	
2		0,19691848	0,1847883	-0,47658258	0,59977641	-0,975604	0,33277786	-1,0082359
2	-1,6965161	-0,9944862	0,36619076	0,17032336	-0,1183767	0,47173239	-0,5395272	-0,2417917
2	0,40291462	-0,0889928	1,2642824	0,98650165	0,4267487	0,02511198	1,05080255	1,22325515
2	0,351911		0,83699024	1,01313501	0,06535368	1,03414969		0,71954199
2			0,34831495		1,87409319			1,52756787
3								
3	-0,6945794	-1,2769367	-0,427101	-0,16869191	-0,2878009	0,10815132	0,02211949	-0,2534813
3	-1,0344298	-1,4387626	0,51679485	0,35942946	0,29063648	0,24891737		0,2154288
3	0,15898061	-0,0088413	0,05987267	0,76819553	0,28601403			0,94707681
3	2,62561552	2,89919491	0,50954773	-1,55329176	-0,126301	-0,8642038	-0,3154739	-1,53189
3	1,85078687	1,03434015	-0,423504	0,58593478	0,20611437	0,15160972	1,09958356	0,87496403
3								
3	-0,416573	0,07824106	1,21959098	0,51400229	0,4901064		0,0319413	-0,4628537
3	0,44429909	1,3229766	0,6454461	0,79494652	0,49204551	0,43353528	0,59856838	0,59283371
3	-0,101866		0,6374871	-0,00452238	0,28961256	0,07365159	-1,4030809	0,20351822
3	-0,3575679	2,52817547	1,16215712	0,90916403	0,42260134	0,37363283	0,22190831	0,85115785
3	1,23858917	0,94675185	2,6146772	2,67308063	2,04033053	2,39495385	2,7886921	3,86527418
3	0,31457303	-0,0937512	0,73435989	0,10309735	1,01304942	0,02455455	-0,6079622	1,25182907
3			-0,2561214	-0,26026391	-0,0070211	-0,6770937	0,42224474	0,44822975

Table 34 (Cont'd)- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	OXY-Block 0-V7	OXY-Block 0-V8	OXY-Block 0-V9	OXY-Block 0-V10	OXY- Block 0-V11	OXY-Block 0-V12	OXY-Block 0-V13	OXY-Block 0-V14
1		-2,5011784		-2,4843367		-0,5649911	1,42321279	
1	-0,3637914	0,20637694	-0,4640076	-0,0548401	-0,00499064	0,26155444	0,11686658	0,23968392
1								
1	-0,2442687	0,32311192		0,47073735		0,56765252	0,31766787	
1	0,51591028	-0,1871187	1,0774845	-0,599879	0,25460134	-1,4924758	-1,6279841	-1,1792729
1	-0,1157687	0,49373113	0,79740357	0,78966331	1,33848484	1,50947906	-0,2970746	-0,0609366
1	-0,177303	0,03361069	0,22031631	0,30630313	0,36656608	-1,7843983	-1,0937077	-1,5007393
1	0,40086559	-0,0700439	0,14989264	-0,4047896	0,62667807	-0,697732	0,23844035	0,15433579
1	-0,6546706	-1,5081511	-0,562866	-1,0936236	-1,04431036	-0,5495243	-0,7112463	-0,5257922
1	-0,2555861	-0,3977875	-0,1833295	-0,2980646	-0,36616757	-0,2235741	-1,0857956	-0,5057746
1	0,37390664	0,60380967	1,04518703	1,21963867	1,02952501	1,7565531	1,27582979	2,06027669
1	2,35211934	1,93866651	1,72488725		1,93705064	1,28187683	1,719047	1,028554
1	-0,0318442	-0,4250959	-0,3149949	-0,7507554	0,23712537	-0,9604739	0,91747513	0,08756045
1	-1,9352395	-3,6178901	-0,867628	-1,393763		0,63280225	-0,1910793	
2		0,25527088		0,25475629	1,42390545	2,53886181	1,27541645	
2	0,00498547	1,08644406	-0,5452727	1,17228825	-1,86965011	1,46660379	0,60842278	1,14616348
2		0,09147414	0,3322418	0,42684011	0,48725431	1,16795782	0,59864381	
2		0,13656256		0,13222387		0,6390255	0,16017417	
2	1,13657878	0,81210044	1,05990659	0,84145337	1,35121442	0,27898096	0,11317443	-0,3503339
2	-1,7203055	-2,0945153		-1,0912015		-0,8812378	-1,6967303	
2	-0,3560692	-1,2942134	-1,4533236	-0,7391142	-0,67268093	-1,3056063	-1,3401386	
2	-1,1309584	-1,8245808	-0,6943009	-1,5957035	-0,61395922	-2,0450749	-1,4796934	-2,1734263
2	-0,0411514	0,19485851	0,6405019	0,86843196	0,88821181	0,90797481	0,77828877	1,09511641
2	-0,4028493	0,09657719	0,33056253	0,40620947	0,20353429	-0,2175535	-0,3648417	0,00163128
2	0,02605273	0,12376124	0,16031529	0,3595594	-0,12580791	0,02882125	-0,867406	-0,407598
2	1,53327881	1,14744686	1,40063242		1,57657316	1,49594478	1,18132155	1,01079986
2	-1,1540878	-0,8242676	-0,9595973	-0,5836154		1,14952783		
2	1,53336243	0,86010408	1,00325733	0,6382971		1,03198747	1,92048309	
3								
3	-0,1397001	0,38221827	0,5198464	0,43680364	-0,63612523	-0,2373837	-0,0269252	0,47150522
3		0,13577783		-0,3513068		-0,1489869	0,58293759	
3		1,10245883		0,70518667	0,00526036	0,69454715	-0,1900232	-1,0575666
3	-0,0648154	-0,9438998	0,3462268	0,00854406	0,39097475	-1,2391689	-0,4648883	-1,5955344
3	0,37147138	0,23539099		-3,9983927	1,21270287	1,17325768		
3								
3	0,05473933	-0,1438307	0,73107726	0,22056316	0,6013783	-0,3027764	-0,4755424	-0,7788118
3	-0,6901191	1,5485476	-0,1456754	1,4343042		1,50455556	0,38559009	-0,0152078
3	-0,3504807	-0,029541	-0,1404305	0,13760511	0,06502657	-0,6041649		
3	0,2825906	-0,0428489	0,07403784	0,28704548	1,70163891	1,03212283	-0,3498528	1,02576853
3	2,36190999	2,82077313	1,45220085	1,76138909	1,66322892	2,11222862	2,00093777	2,18643229
3	0,83892251	0,47775538	1,20212754	-0,05958		0,27570588	2,68633181	0,37093668
3	-0,2000513	0,38366415	-0,9301852	-0,3766516		-0,3265069	-0,1304248	-0,0529075

Table 34 (Cont'd)- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	OXY-Block 0-V15	OXY-Block 0-V16	OXY-Block 1-V1	OXY-Block 1-V2	OXY-Block 1-V3	OXY- Block 1-V4	OXY-Block 1-V5	OXY-Block 1-V6
1	-0,618067		2,16093896	3,03119806	0,73689346	0,9704544		-1,5951645
1	0,18173674	0,22714147						0,36014115
1								
1	0,14926421	0,8335648	0,17394742	0,76376262	-0,8577196	0,21218909		-0,557919
1	-0,664321	-1,8437334	1,03088273	-0,0245937	0,9621865	-0,52253425	-0,7373023	-0,6154651
1	0,81642582	1,7225326	3,289207	2,95266133	2,32417592		1,66502636	2,31843932
1	-1,3219346	-1,2142744	1,85404593	-0,0110255	1,09911756		0,00767712	-0,4903862
1	-0,1249033	-0,3341445	1,0935996	0,02541407	0,79760098	-0,08196348	0,67826628	0,29081385
1	-0,9396852	-0,6572351	-0,8510121	-2,4298413	-1,3492066	-0,65065661	-1,2397104	-0,8597476
1		-0,5916558	-0,2191866	0,5327446			-0,9065904	-0,4069731
1	1,07532768	1,77048314	1,78605208	0,92939511	1,99108479	2,24406878	2,27524668	3,86400335
1	3,16510603	2,83992879	2,67989972	3,52503517	2,40785745	3,17889393	2,96847493	3,0076552
1	1,08405685	0,41734	4,43940393	4,71986027	2,92693583	4,6803781	1,01995589	1,29677066
1	0,03360379	-0,6261203		1,07922274	-0,7326072	-0,38467575	0,16310394	-3,5430789
2	1,53833516	1,94801524	4,60157448	5,81974364	4,37457723	3,711377		-3,4729235
2	1,95690931	2,38391575	6,08638557	2,29845578	2,47916198			
2	0,24585058	0,97888067	1,74490374	2,09606868	1,24210272	2,07482486		0,89149383
2	0,24228865	0,20600143	-0,4054556	-0,1512145	-1,4553402			-1,1810667
2	-0,1835289	-0,7863606	4,5436893	3,24203613	3,12161463		2,70298476	2,14122471
2		-1,675579	-0,8862784	-1,5183749	-0,1065317	-1,61376232	-1,2659363	-1,4844551
2		-2,1537402	-0,4224936	-1,6809598	-1,1772511		-0,4602918	-0,8814128
2	-2,455994	-2,3859194	0,19300855	-0,8794607	-0,8640229		-1,7949841	-2,1742719
2	0,89302933	0,16728761	-0,7727282	-3,5483405	-1,1675872		-0,1885085	-2,4034832
2	-0,8485669	-0,5371026	1,07962268	0,78463823	1,61557213	-0,97751054	1,34754635	-1,0958824
2	-0,6511967	-0,1635541	1,44079467	0,91568866	0,49497159	1,20154448	-0,0003117	0,52967248
2	1,4172536	1,30743489	1,88000272	1,80357928	0,82808345	2,25414486	1,35401952	1,57020016
2			3,94103652	4,33076375	2,64137603	4,12006774		3,50252641
2			0,1260144		1,62426488			1,11752533
3								
3	-0,5284986	-0,2346447	1,85345216	2,34979487				1,69256398
3	0,36155282	0,07062016	0,08983654	-0,0171291	0,06677914	-0,00324083		-0,1689456
3	-0,1845617	-0,3420947	0,0495517	0,73180116	0,01585585			0,53178366
3	-1,7400274	-3,0483145	3,01366399	1,68855512	2,08911111	0,76185706	1,46417829	1,39306463
3		1,31147485	-0,003362	2,03605225	0,06204385	0,75242817	1,26822021	1,56818169
3								
3	-0,8613927	-0,5032899	1,84756637	0,76551315	0,80282989		-0,1960066	-0,574773
3	0,40502291	0,8252958	1,87724291	2,53374921	1,15926255	1,95892931	1,0465605	1,71140957
3	0,31385559		1,09998931	0,15813055	0,7371864	0,44695024		0,58780649
3	0,21463282	1,22206944	1,33409115	0,68099563	0,01081955	0,22621136	-0,2336997	0,56378901
3	2,37864473	1,96970684	5,2334729	5,29265136	3,95947064	4,88857473	4,9532713	6,60458215
3		0,74612003	2,76354601	1,95719138	1,24266929	1,2843386	0,08739656	2,32902179
3	0,046584	0,18534031	-0,6485085		-0,7195581		-0,1434218	-0,1114887

Table 34 (Cont'd)- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	OXY-Block 1-V7	OXY-Block 1-V8	OXY-Block 1-V9	OXY-Block 1-V10	OXY-Block 1-V11
1		-2,1188974		-2,3803041	
1	-0,3881887	-0,437253	-1,4176197	-0,9502243	
1					
1		-0,3734039		-0,1529133	
1	0,11151882	-0,3915045	0,91033819	-0,7547021	0,23729366
1		0,83059074	1,23785193	1,28188667	2,44436098
1	-0,5140699	-0,4766453	-0,0459778	0,17489242	0,1631081
1	0,40617813	0,15241334	-0,0520645	-0,2861221	0,67701425
1	-0,2073308	-1,7744013	-0,2084637	-1,1897624	-1,1631147
1	-1,1061287	-0,8348386	-0,4624354	-0,4837047	-0,9990814
1	1,45315324	1,95151543	2,40723134	2,54635993	2,94004851
1	3,76942987	3,15487604	2,85634698	-0,7107222	2,963792
1	0,33949123	-0,2522805	2,28507861	0,87651924	2,66055042
1	-1,8552732	-3,7925384	-0,4956066	-1,6369495	
2		3,75840068	1,17734944	4,70572514	4,55907567
2	-0,7671538	1,863809	-4,1705512	4,23808483	
2		1,06499938	0,68353447	1,46345539	1,00909982
2		-0,703287		-0,4197805	
2	2,24148134	2,26362816	2,21672509	2,43346538	2,3521969
2	-1,4179179	-2,4065658		-1,7051927	
2	-0,2586461	-1,0933137	-1,2143469	-0,0940062	-0,4832731
2	-1,2944561	-2,0320801	-0,8437018	-1,3445866	-0,791584
2	0,41389692	1,27189481	1,4476034	1,83545503	1,53349404
2	0,12537371	1,04446637	1,16478517	1,45672789	1,14986763
2	1,49489332	1,24351627	1,05314914	1,20749462	0,94679243
2	1,6123521	1,56373652	1,8508901		1,73833157
2	-0,3726901	0,50319777	0,0922336	0,69780837	
2	0,63365677	0,4386132	0,56963339	0,44403829	
3					
3	0,81687058	0,645335	1,06030303	-0,2645093	
3		-0,0764265		-0,790961	
3		1,19150051		0,91036648	0,06313729
3	2,16024656	2,59266657	3,45979658	3,05938064	3,90471954
3	0,89247132	1,29272437		-4,5370453	0,18737376
3					
3	-0,407738	-0,6479681	0,42693725	0,2983518	0,42052273
3	-0,5762851	2,50456312	0,26485676	2,43783372	
3	-0,3472931	0,03794296	-0,0523614	0,3807454	0,49390066
3	0,21932836	-0,1696876	0,50381868	1,02080068	1,70520103
3	4,25754772	5,02980264	3,00693136	3,16858371	3,7209445
3	1,13047469	0,98340536	1,94092539	0,8030561	
3	-1,0110777	-0,5974035	-1,6803951	-0,9314317	

Table 34 (Cont'd)- fNIR and Reaction Time Tests Results of Afternoon Shift

Experiment	OXY-Block 1-V12	OXY- Block 1-V13	OXY-Block 1-V14	OXY-Block 1-V15	OXY-Block 1-V16
1	-0,5804429	2,68921449		0,88243586	
1	0,48492402	0,86451486	1,00945228	1,34468578	1,67257423
1					
1	0,22044692	0,21011952		0,49084541	1,25710812
1	-2,0079392	-2,86066823	-2,1680316	-1,824728	-2,8092658
1	2,34951401			1,86595024	3,03354226
1	-1,8208938	-1,49968759	-1,9546359	-2,0970799	-1,9098746
1	-0,733773	0,3710106		0,48697029	-0,0886058
1	0,35188772	-0,26219561	0,93613591	-0,141769	-0,0057345
1	-0,5223181				-1,8238699
1	3,56624388	2,76993328	4,47609489	3,46309356	4,01878565
1	2,45134037	3,01560726	1,96926387	4,94056527	4,775719
1	1,34317168	3,29185908	3,11998843	3,10022725	2,45433403
1	1,13859329	0,2041898		0,92762464	0,64683244
2	6,29904931	4,2275395	4,57862296	5,36488351	6,77141568
2	4,91561807			1,85948914	3,33830683
2	2,39617532	1,63545031		1,39865341	2,45484476
2	0,04167046	-0,30783159		-0,0568852	-0,050183
2	2,04748044	0,67810253	1,24414283	0,99620474	0,25771876
2		-1,4308647			-0,8800002
2	-0,5419772	-0,97031481			-2,0816301
2	-2,0854039	-1,60981365	-2,2966868	-3,0325541	-2,7533418
2	2,01936961	1,68072916	2,59399635	1,85327197	1,1736663
2	0,04683941	0,32874526	0,66176566		0,04277554
2		-0,1253093	0,37063642	-0,275784	0,94759317
2	1,93849532	1,37729307	1,10245851	2,0696139	1,88394877
2	3,30578019			0,28514158	
2	0,73778642	1,97112757			
3					
3	0,31614139	-5,06016294	-3,8115491	1,37959303	1,66079552
3	-0,8971445	0,47876395		0,26494825	-0,5205751
3	0,92182914	0,19818966	-1,1868226	0,57262943	0,20229841
3	2,34286789	3,22227096	2,00737224	1,54094842	0,61331215
3	0,19300817	-0,57137093		-6,3658148	2,14127125
3					
3	-0,1624647	-0,53707465	-0,672638	-1,1696098	0,04134892
3	3,02960888	0,66151276	1,32744959	1,20548925	1,9084316
3	-0,4542051			0,66157905	
3	1,72484667	-0,50728662	1,05369664	-0,0409916	1,39585153
3	3,8040958	3,56557461	4,34459926	5,8973905	4,31176755
3	1,43838858	3,81085429	1,31460666	-1,8480577	1,79596504
3	-1,075071	-0,95488113			

Table 35 - fNIR and Reaction Time Tests Results of Night Shift

Experiment	RTT	Sheep RTT	HBT-Block 0-V1	HBT-Block 0-V2	HBT-Block 0-V3	HBT-Block 0-V4	HBT-Block 0-V5	HBT-Block 0-V6
1	0,3782	1	-0,566757	-0,847321	-0,369996	-0,994142	-0,885811	-2
1	0,6622	1	-0,252244	-0,364328	-0,50417	-0,270462		
1	0,3312	1						
1	0,7092	0,8	0,246144	0,029353	-0,008643	-0,389119	-0,35889	-0,978749
1	1,0122	1	1	3	1	1	-0,306913	0,508123
1	0,8752	0,8	-0,359528	-0,164112	0,178722	-0,540387	0,527892	0,823379
1	0,8282	1		0,436128	-0,432456	-0,154496	2	1
1	0,3438	1		0,329386	0,46717	-0,220808	0,576775	0,018534
1	0,8062	0,6		-0,672835	-0,937006	0,699187	2	1
1	0,7464	1	-1	-0,232188	0,039925	0,386861	0,124301	1
1	0,8376	0,8	0,755642	1	0,9273	0,567153	1	0,519836
2	0,359	1	0,372692	-0,268962	0,154623	-0,037974	-0,224826	-0,297915
2	0,5408	1	-0,033524	0,008405	-0,0537	-0,068012	-0,460524	-0,650424
2	0,378	1	0,096502	0,119264	0,299182	0,461974	0,361146	-0,029783
2	0,403	1	-0,022873	0,096795	-0,213663		0,139224	-0,211555
2	1,422	1	0,747811	1	2	-1	3	0,121266
2	1,0002	1	-2	-4	-2	-4	0,156022	-0,116564
2	0,8686	1		-0,484855	0,343421	-0,689814	-0,738273	-2
2	0,3782	1		0,258899	-0,233392	-0,210576	2	0,519498
2	0,5436	1		-0,339544	-1	-0,00978	-0,276288	0,86528
2	0,3874	1	0,757324	-0,993314	0,524349	0,362508	2	0,975061
2	0,322	1	0,589934	0,895252	0,379252	-0,052094	-0,338287	-0,193461
3	0,3722	0,8	0,403684	-0,388456	-0,403098	-0,818569	-0,48252	
3	0,3312	1	0,710094	0,459702	0,520952	0,228213		0,405151
3	0,422	1	0,343122	-1	-0,834424	-1	-0,597773	-1
3	0,3406	1	0,833585	2	0,876183	2	0,684732	0,921171
3	1,0842	0,6	0,027639	1	0,282357	0,078946	0,557546	0,818272
3	0,4842	0,8	0,342379	0,839751	0,340132	1	0,328903	2
3	0,597	1		0,450274	-0,844209	-0,89221	-1	-0,880509
3	0,3972	1		-1	-1	-2	0,162513	0,448188
3	0,356	0,8		-0,133944	0,052732	-0,438205	0,954289	-0,596159
3	0,3296	0,8	1	-1	0,142878	-2	0,391083	0,514181
3	0,3622	1	2	1	1	0,635847	0,992171	0,853229

Table 35 (Cont'd) - fNIR and Reaction Time Tests Results of Night Shift

Experiment	HBT- Block 0- V7	HBT- Block 0- V8	HBT- Block 0- V9	HBT- Block 0- V10	HBT- Block 0- V11	HBT- Block 0- V12	HBT- Block 0- V13	HBT- Block 0- V14
1	-9	-1		-0,392964	-1	-0,183603	-0,647103	-0,713296
1		-0,708729	-2	-0,907008	-0,588996	-0,923166	0,82665	-0,081888
1								
1	-2	-0,472228	-3	-0,061521	-0,366615	-0,936646	0,15821	-0,297568
1	-2	-2	-0,658625	-7	0,498262	0,433179	0,297091	-0,591025
1	0,416851	1	-2	0,577734	-0,494553	-0,602917	-1	-2
1	0,833281	1	0,520305	0,241262	0,532746	-0,221913	-1	-1
1	-0,438898	-1	-0,311499	-0,206122	0,132719	0,055242	-0,08982	0,056432
1	0,217248	2	-0,437174	1		-0,147614	-1	-0,362437
1	0,394681	1	0,352928	0,599143	-0,073632	-0,393125	-0,820689	-0,232226
1	1	2	3	2	1	0,641865	-0,104268	-0,123316
2	-0,075735	-0,007457		-0,469736	0,337101	-0,050076	0,041684	0,605193
2	-0,575243	-0,572742	-0,405749	-0,174435	-0,122609	0,045446	-0,318393	0,213529
2	0,457016	-0,020669	0,051833	1	0,498738	0,248658	0,3545	-0,168479
2	-0,424273	-0,25075	-0,200704	-0,281629	0,09955	-0,638609	0,133794	-0,203732
2	-0,004543	-0,374995	1	0,315395	1	1	2	2
2	-0,752767	-0,402083	0,546061	0,752041	0,994395	-0,813818	0,703727	0,065991
2	-3		-0,044215	-4	0,52007	-0,354336	-0,187129	-0,427968
2	0,686554	0,564203	-0,276475		0,279563	-0,098982	-0,957072	-1
2	0,111527	1	-0,297013	2		2		1
2	2	0,485552	0,223351	0,308942	-0,602213	-0,509146	-0,115431	-0,225421
2	0,118218	0,56292	-0,231977	0,592276	-0,511321	-0,403913	-0,501504	-0,422059
3	1	2	4	2	2	1	1	2
3	-1	0,374225	-2	-0,05504	-0,577299	-0,375504	-0,287107	-0,022773
3	1	-0,881244		-0,430883	-0,406483	-0,818131	-0,195328	-0,502741
3		0,676486		0,801369	0,351238	0,658514	1	1
3	-2	0,424885	-1	-0,381203	-0,141786	0,113828	-2	-3
3	-0,436687	1	-1	0,248111	-1	0,74992	-2	
3	-2	-2	-2	-4	-0,761998	-1	-2	-2
3	0,316243	0,256754	-0,66686	-0,542215	0,106409	0,046544	-1	-2
3	1	-0,244856	0,511781	0,512369		0,505802	-0,828899	-1
3	0,201814	-0,1795	0,473604	-0,110395	1	0,587758	-1	-2
3	0,703692	2	0,566503	0,825085	0,236358	0,519904	0,85916	0,594926

Table 35 (Cont'd) - fNIR and Reaction Time Tests Results of Night Shift

Experiment	HBT-Block 0-V15	HBT- Block 0- V16	HBT-Block 1-V1	HBT- Block 1-V2	HBT-Block 1-V3	HBT-Block 1-V4	HBT-Block 1-V5	HBT-Block 1-V6
1	-0,443605	-0,329535	-1	-1	-0,820773	-2	-2	-2
1	0,299423	-0,148679	-0,862815	-0,859949	-1	-0,845176		
1								
1	-0,107079	0,067508	-0,362138	-0,293109	-0,481176	-0,703574	-0,792068	-1
1	0,198938	-1	1	4	1	2	-0,973417	0,371801
1	-2	-2	-1	-1	-0,490017	-1	0,253604	1
1	-0,595261	0,281567	-1	0,335152	-2	-0,793829	1	1
1	-0,15008	-0,020469	-0,394708	0,102703	0,095999	-0,616263	-0,796454	-1
1	2	0,437016	-2	-2	-2	0,832693	5	2
1	-0,683022	-0,089456	-1	-0,390774	-0,627004	0,220043	-0,283664	1
1	-0,441803	0,280943	0,337658	0,703695	0,251171	0,199866	-0,628438	-0,835455
2	0,103422	2	0,512252	-0,110788	-0,12883	0,093331		
2	0,064174	0,047384	-0,245484	0,186427	-0,016715	0,696168	-0,620778	-0,430609
2	0,200121	0,229228	0,268275	0,636596	0,60263	1	0,663588	0,411854
2	0,055467	-0,125977	0,029578	0,421713	-0,023092		0,865627	0,382368
2	0,274528	0,842332	0,079349	6	1	-2	1	-1
2	-0,274274	-1	-4	-6	-4	-6	-0,547722	-0,567144
2	-0,58751	1	-2	-1	-0,221378	-1	-4	-3
2	-1	-0,762608	-0,522097	-0,122654	-0,651873	-0,395354	1	0,216596
2	-0,928192		-2	-1	-3	-0,717182	-2	-0,687485
2	-0,212894	0,70914	0,798405	-1	0,596563	0,380154	2	0,479497
2	-0,383667	-0,19561	0,997359	2	1	0,334858	-0,410988	-0,230173
3	0,593497	2	-0,433858	-0,781449	-0,976542	-2	-1	
3	0,286678	0,514757	0,507995	0,558582	0,627948	0,367294		0,939015
3	-0,565588	-2	-0,325045	-3	-2	-2	-2	-3
3	2	1	0,682652	2	0,305561	2	0,330804	0,590254
3	-2	-0,82363	-0,657853	1	-0,06814	-0,63672	-0,714502	-0,012442
3	-2	-0,893322	-0,124279	0,769515	-0,040957	1	-0,529048	2
3	-2	-2	-3	0,361498	-2	-2	-3	-2
3	-1	-2	-2	-2	-2	-2	0,146753	0,754983
3	0,134226	-0,682407	-0,842438	-0,782794	-0,813947	-1	0,367412	-2
3	-2	-3	1	-2	0,189071	-2	-0,344316	0,052806
3	0,46729	0,306093	1	0,980344	0,991731	0,11821	0,519585	-0,014663

Table 35 (Cont'd) - fNIR and Reaction Time Tests Results of Night Shift

Experiment	HBT-Block 1-V7	HBT-Block 1-V8	HBT- Block 1-V9	HBT-Block 1-V10	HBT-Block 1-V11	HBT- Block 1-V12	HBT-Block 1-V13	HBT-Block 1-V14
1	-10	-0,827332		0,408925	-0,376642	0,431563	0,300761	0,068846
1		-2	-4	-2	-2	-2	0,800726	-0,163445
1								
1	-3	-0,835746		-0,064753	-0,500827	-1	0,320591	-0,243922
1	-4	-3	-2	-9	0,41524	-0,320266	-0,050957	-2
1	-0,104215	2	-3	0,771989	-1	-1	-2	-3
1	0,594232	1	-0,298663	-0,529371	-0,114201	-0,850739	-3	-2
1	-2	-3	-2	-1	-0,234615	-0,143169	-0,639779	0,002134
1	0,319014	3	-2	0,970662		-0,65275	-2	-0,945248
1	0,567531	1	0,49263	1	-0,497678	-0,125812	-2	0,309932
1	0,078713	1	3	2	1	0,393934	-0,855523	-0,148416
2	-0,026451	0,125075		-0,510876	0,500524	0,178822	0,049668	0,758802
2	-0,86332	-0,505706	-0,475275	0,240644	0,167369	0,565155	-0,348044	0,434874
2	0,474807	0,481462	-0,016293	0,659317	0,919409	0,694693	0,751341	0,02429
2	-0,594936	0,011748	-0,585796	-0,536507	-0,118755	-1	0,336862	-0,229601
2	-1		1	0,269696	0,708699	3	2	5
2	-2	-0,979655	1	0,565089	1	-2	0,503158	-0,250467
2	-4	-1	-0,543516	-5	0,106317	-0,312528	-0,080465	-0,644719
2	-0,023681	0,260243	-1		0,053639	-0,180115	-2	-1
2	-2	-0,307506		0,431882		0,736986		0,499408
2	2	1	0,206788	0,393155	-1	-0,476018	0,086304	-0,158677
2	0,129102	0,513181	-0,470398	0,713766	-0,779119	-0,303254	-0,527478	-0,219354
3	0,656981	2	4	2	3	1	0,499613	1
3	-2	0,458443	-3	-0,083188	-0,885861	-0,830041	-0,681155	-0,523181
3	0,140167	-2		-0,636605	-0,488698	-1	-0,087415	-0,888193
3		0,309498		0,582603	-0,384396	0,262189	0,413035	0,451658
3	-4	-0,306811	-2	-1	-0,396345	0,179825	-3	-4
3	-1	1	-2	0,192828	-2	1	-2	0,299857
3	-5	-3	-4		-2	-3	-3	-3
3	0,231227	0,589858	-0,97018	-0,752885	0,24281	0,095576		-2
3	0,734821	-0,770858	-0,066952	0,299736		-0,002473	-2	-3
3	-1	-0,910559	-0,778682	-0,847679	-0,187321	-1	-2	-2
3	0,298212	1	-0,29444	0,219141	-0,39336	-0,117949	0,938041	1

Table 35 (Cont'd) - fNIR and Reaction Time Tests Results of Night Shift

Experiment	HBT-Block 1-V15	HBT-Block 1-V16	OXY-Block 0-V1	OXY- Block 0-V2	OXY-Block 0-V3	OXY-Block 0-V4	OXY-Block 0-V5	OXY- Block 0-V6
1	0,582797	0,103253	-0,033833	0,395324	-0,280459	0,234026	-0,24908	-0,010586
1	0,389299	-0,033909	-0,028569	0,087271	-0,421802	-0,158136		
1								
1		0,510572	0,582374	0,432945	-0,099272	0,454535	0,022176	0,05482
1	-0,315681	-3	2	2	2	2	0,923784	1
1	-3	-4	-0,060781	0,260321	0,627281	0,88383	0,580737	0,687703
1	-1	0,467412	-0,438038	-0,483365	-0,758101	0,11896	0,700196	0,447162
1	-0,328868	-0,04667	0,331973	0,105667	0,264625	0,01445	0,24205	-0,067181
1	3	0,236653	0,00545	-0,099975	0,450813	0,638658	0,426186	1
1	-1	-0,267945	0,133737	1	0,537238	1	0,763642	0,954124
1	-1	-0,453649	1	2	1	1	0,768309	0,476224
2	-0,171981	2	0,775425	1	1	0,940937	-0,898351	-0,577115
2	0,422183	0,549619	0,007334	-0,129927	0,227023	0,023043	-0,624502	-0,790649
2	0,668953	0,545287	0,025566	-0,441332	0,076222	0,006154	-0,368785	-0,81116
2	0,361435		-1	-0,322269	-0,746994		-0,460163	-0,893205
2	1	3	0,808578	-0,7164	2	2	1	1
2	-0,981505	-3	-3	-3	-2	-3	-1	-1
2	-1	2	1	0,398984	1	1	0,23786	0,351585
2	-2	-0,70333	-0,158236	-0,157502	-0,174358	0,252579	0,923898	0,378892
2	-2		0,852413	0,935842	0,496703	3	-0,123494	2
2	0,001374	0,950526	-0,321764	-0,364582	-0,315238	-0,099262	0,233946	-0,416878
2	-0,361428	0,061133	2	2	2	1	0,947362	0,607835
3	0,308637	2	0,107752	0,568128	-0,257644	0,127759	0,11223	
3	0,473015	0,283482	0,571843	0,22172	0,682017	0,865653		0,755726
3	-0,445924	-2	-0,746801	-1	-2	-2	-3	-2
3	1	0,565685	0,379062	2	1	2	0,73199	0,20155
3	-2	-0,390224	0,718238	1	1	2	0,265795	0,524512
3	-3	-0,838242	0,499782	0,680607	-0,080565	1	-0,62374	0,147141
3	-3	-3	0,691916	2	0,808746	2	2	1
3	-2	-2	-1	-1	0,064025	-0,292513	0,10196	0,112021
3	-0,704585	-2	0,092138	0,430492	2	1	2	1
3	-1	-2	0,021875	-0,009572	0,080893	-0,194818	-1	-0,3304
3	0,530164	0,171265	2	2	2	2	1	1

Table 35 (Cont'd) - fNIR and Reaction Time Tests Results of Night Shift

Experiment	OXY-Block 0-V7	OXY-Block 0-V8	OXY-Block 0-V9	OXY-Block 0-V10	OXY- Block 0-V11	OXY-Block 0-V12	OXY-Block 0-V13	OXY-Block 0-V14
1	1	-0,946732		-0,442421	-0,272626	-0,25672	-0,785796	-0,124971
1		-0,41029	-1	-0,437433	-0,281415	-0,462045	1	0,245159
1								
1	-0,048299	0,174592	1	0,309385	0,25196	0,228189	0,284631	0,347865
1	-0,772713	-0,552585	0,27882	-0,494927	0,792641	0,874268	2	1
1	0,042849	0,360143	0,134053	0,01804	0,047261	-0,446584	-1	-2
1	0,541661	0,427391	0,522207	0,23258	0,288737	-0,476371	-1	-2
1	-0,436667	-0,832136	0,16182	-0,095698	0,475319	0,133643	0,458901	0,342651
1	-0,177704	1	-0,5622	1		0,396695	0,205045	0,652258
1	0,715766	0,804982	0,523053	0,643506	0,345656	0,580555	0,69929	0,376345
1	0,441911	0,62973	0,801748	0,28286	0,926555	0,484066	0,724818	0,810935
2	-0,019559	0,317441		0,003881	0,452675	0,678252	0,069049	0,981893
2	-0,477483	-0,558564	-0,167399	-0,309293	-0,193348	-0,443967	-0,558526	-0,619797
2	0,145455	-0,927569	0,168928	0,476055	-0,025489	-0,361593	-0,264018	-0,890171
2	-0,46167	-0,915172	-0,31977	-0,875051	-1	-1	-0,566509	-0,465294
2	1	-0,15142	1	1	0,97309	0,329163	0,508231	0,055535
2	-1	-0,978724	-0,822217	-0,630169	-0,841161	-2	-1	-2
2	0,022593		1	-0,56049	0,961756	-0,204281	0,487375	-0,255765
2	0,60453	0,296509	0,480412		1	0,499714	-0,253312	-0,069807
2	0,045903	1	0,204374	2		3		2
2	0,490678	-0,092384	-0,231454	-0,053917	-0,342312	-0,123023	-0,609315	-0,840917
2	0,447162	0,741548	0,321035	0,731841	0,524512	0,426755	0,523825	0,56343
3	0,318659	0,917573	0,617137	0,836994	0,827255	1	1	2
3	0,537552	0,322442	0,341701	-0,117946	-0,258836	0,129848	0,354819	1
3	-1	-3		-1	-0,946699	-1	-0,966494	-0,522763
3		-0,333985		0,358546	0,444319	0,660365	1	2
3	-0,558509	-0,163534	-0,014872	0,390571	1	0,02082	-1	-3
3	-0,571525	0,154219	0,016489	0,603217	-0,640342	0,611877	-1	
3	-0,690363	-0,162344	0,110029	0,12446	2	0,205377	0,200062	-0,164131
3	-0,199245	-0,073209	-0,053447	0,352197	0,403993	0,157488	-0,423695	-0,976722
3	1	1	1	2		2	2	2
3	-1	-1	-0,794503	-0,983524	-0,37186	-0,812528	-0,772915	-1
3	0,643296	1	0,946877	0,989405	0,952669	1	1	0,756839

Table 35 (Cont'd) - fNIR and Reaction Time Tests Results of Night Shift

Experiment	OXY-Block 0-V15	OXY- Block 0-V16	OXY-Block 1-V1	OXY-Block 1-V2	OXY-Block 1-V3	OXY- Block 1-V4	OXY-Block 1-V5	OXY-Block 1-V6
1	-0,896385	-0,540806	0,471214	1	0,540456	1	0,268912	0,073258
1	0,330524	0,503205	-0,858699	-0,237485	-1	-0,525296		
1								
1	-0,667816	0,555536	0,685015	0,939397	0,085475	1	0,308116	0,808737
1	1	0,995783	2	3	2	3	1	1
1	-2	-2	0,268845	0,887189	1	2	0,992961	2
1	-1	-0,771389	-0,966644	-1	-2	-0,080502	-0,223728	-0,159208
1	0,198536	0,371379	0,31572	-0,137871	0,146843	0,05192	-0,217213	-0,466457
1	0,078021	0,332852	0,77824	0,368289	0,905993	1	1	2
1	0,638417	0,466223	0,710817	2	0,9675	2	1	2
1	0,544808	0,820449	1	2	1	2	0,73152	0,794133
2	0,161513	2	2	2	2	2		
2	-0,374362	-0,684377	0,568094	0,618316	1	1	1	1
2	-0,409897	-0,505685	0,543619	-0,050176	1	0,952035	2	0,932729
2	-0,147806	-1	-2	-0,122277	-0,702035		-0,540053	-0,745189
2	-0,937887	-0,742276	-0,0075	-1	1	3	2	2
2	-2	-2	-4	-5	-3	-4	-0,93483	-1
2	-0,202864	-0,907053	1	0,320609	1	2	1	0,875571
2	-0,672954	-0,273074	-0,029758	-0,067987	-0,276739	0,872078	0,58312	0,578401
2	0,799838		0,801116	1	0,241377	3	-0,384546	2
2	-0,209145	-0,109283	0,194653	0,309248	0,163825	0,498551	0,618115	-0,238312
2	0,725193	0,902489	3	5	4	3	2	2
3	0,85902	2	-0,105161	0,30227	-0,186689	-0,169666	0,505179	
3	0,741644	1	1	0,448099	1	1		1
3	-1	-1	-1	-2	-3	-2	-4	-3
3	1	2	0,685422	3	1	3	1	0,110379
3	-1	-2	1	1	2	2	0,64291	1
3	-2	-2	1	1	0,786398	2	-0,510422	0,472663
3	-1	0,136942	1	3	1	3	2	2
3	-0,85017	-2	-1	-0,985553	0,680932	0,477827	0,608344	0,614703
3	3	2	0,645408	0,837651	2	2	2	2
3	-0,920304	-1	-0,185091	-0,161235	0,109415	-0,118754	-2	-0,379054
3	1	0,778431	3	3	3	2	2	2

Table 35 (Cont'd) - fNIR and Reaction Time Tests Results of Night Shift

Experiment	OXY-Block 1-V7	OXY-Block 1-V8	OXY-Block 1-V9	OXY- Block 1-V10	OXY-Block 1-V11
1	1	-0,844096		0,091896	0,416044
1		-1	-2	-1	-2
1					
1	-0,286816	0,388903		0,530735	0,325676
1	-1	-0,910703	-0,142532	-0,709033	0,961433
1	0,333201	1	0,610089	0,446144	0,769757
1	0,130621	-0,119507	-0,419552	-0,892481	-0,630545
1	-1	-2	-0,986567	-0,700168	-0,356564
1	0,255603	3	-0,569589	2	
1	1	2	0,887985	2	1
1	0,234923	0,701312	1	0,356854	1
2	0,204413	0,839239		0,195116	0,948166
2	0,449823	1	0,242691	0,662538	0,600903
2	1	0,675447	0,723977	0,860161	0,959045
2	-0,518944	-1	-1	-2	-3
2	0,635262		0,640164	0,42404	1
2	-2	-1	-1	-0,824539	-1
2	0,395066	-3	2	0,349847	2
2	0,404867	0,23439	0,282735		1
2	-0,708872	0,801319		2	
2	0,809415	0,181035	0,019748	0,247623	-0,102452
2	1	2	1	2	1
3	0,451954	2	0,876726	0,707505	1
3	0,753229	0,449062	0,657199	0,04816	0,336543
3	-1	-4		-2	-1
3		-0,520884		0,330614	0,234247
3	-0,308112	0,011243	-0,014293	0,575336	1
3	-0,582003	0,368655	0,39188	0,813499	-0,259567
3	-1	-0,418083	0,031086		2
3	-0,082321	0,125078	0,239583	0,519798	1
3	1	1	1	2	
3	-2	-1	-1	-0,943288	-0,84473
3	1	2	2	2	2

Table 35 (Cont'd) - fNIR and Reaction Time Tests Results of Night Shift

Experiment	OXY-Block 1-V12	OXY- Block 1-V13	OXY-Block 1-V14	OXY-Block 1-V15	OXY-Block 1-V16
1	0,213038	0,832234	0,86557	0,272443	0,504084
1	-0,919423	1	0,256794	0,318071	0,957887
1					
1	0,42841	0,666622	0,814061		1
1	0,798869	3	1	2	0,657469
1	0,09015	-1	-2	-3	-3
1	-1	-3	-3	-3	-1
1	-0,28145	0,305404	0,20377	0,197343	0,915997
1	0,792933	0,93528	1	0,472219	1
1	1	1	1	1	1
1	0,778664	0,60133	0,969406	0,484765	0,868491
2	1	0,237903	0,805948	0,791441	3
2	0,556828	0,871567	0,508376	0,783703	0,470562
2	0,422384	2	0,335063	1	0,838271
2	-3	-0,383104	-0,581158	0,220233	
2	0,706726	0,328543	0,768835	-2	0,084656
2	-2	-2	-2	-3	-3
2	0,438076	1	-0,034395	-0,73424	-1
2	1	0,017071	1	-0,916741	0,109898
2	3		2	0,598622	
2	0,142435	0,423873	-0,266391	0,262004	0,313155
2	1	1	1	2	2
3	2	1	2	0,787667	2
3	0,447092	0,743227	1	1	1
3	-2	-1	-1	-2	-2
3	0,686284	1	2	0,701424	2
3	0,090042	-1	-4	-1	-2
3	0,883676	-0,786685	0,042594	-3	-2
3	0,358585	0,563024	-0,05892	-2	0,63163
3	0,311939		-1	-1	-3
3	2	3	3	3	2
3	-0,966096	-0,584177	-1	-0,51032	-0,792543
3	2	2	1	2	2