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BRAIN COMPUTER INTERFACE (BCI) DEVICE AND ITS ROLE IN STRESS MANAGEMENT OF LOCO PILOTS, INDIAN RAILWAYS.

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ABSTRACT

Employee wellness and safety is an important part of a successful workplace. An Employer has a key role to play in preventing work-related injuries and diseases. An organization must recognize the importance of healthy, happier and safe workplaces for their employees. The objective of this paper is to prove Brain Computer Interface devices (BCI) would be of a great service to Indian Railways in handling Stress Management of Loco Pilots.

BCI is an external device and has a direct communication between the brain, bypassing the traditional pathway of peripheral nerves and muscles.

A mobile BCI has the advantage of ultimate portability as well as a low system cost derived from using customized Electroencephalogram (EEG) recording and signal processing modules. To implement a mobile BCI with online processing, a mobile terminal such as a mobile phone or a PDA might be an ideal platform for data transmission, signal processing, and feedback presentation.

This research aims to study the feasibility of BCI as a Tool for Stress Management of Loco Pilots.

Keywords: Brain Computer Interface (BCI) Loco Pilots, Health & Safety, Stress Management, Electroencephalogram.

INTRODUCTION

Indian Railways had seen a lot of highs and lows and Loco Pilots have made a huge contribution in it. The Loco Pilots duty requires it to be executed with perfection without a slight margin of error. Any negligence or even a small mistake can lead to fatal accident putting in risk not only the Loco Pilots but also thousands of passengers travelling in the train. Even though Railway has largest workforce of our country, Loco Pilots problems are still unattended and neglected.

BCI is a relatively new field of science with a seemingly limitless range of applications. It is a communication system that translates the activity of brain into commands to an external device such as mobile or computer. In other words, the user can react to the situation only by brain activity and without nerves and muscles. This device is very helpful for the disabled people to interact with others.

The BCI device can monitor workers' vital signs like heart rate, skin temperature, stress level, attention and fatigue, and provide real time analysis if the worker is in danger. The BCI can lead to more efficient and accurate work, as well as safer and healthier workforces. The gadget integrates a wearable and wireless EEG system with a mobile

phone to implement a visual-evoked potential (VEP) based BCI, which can be used to directly make phone calls based on users' EEG or raise an alarm under high pulse rate, high stress level, which can lead to strokes or accidents at workplace. Therefore, this can be effectively used to improve the safety measures of Loco Pilots in Trains.

REVIEW OF LITERATURE

T.V.Saranya and M.Shalini (2017) BCI for security application based on inter subject information for locker safety by implementing a protective opening of locker with the help of brain signal. This paper claimed that the brain waves are unique for each individual and does not match in any case. The locker can be opened only when the programmed person think about it. Therefore it is highly secured.

B. Rebsamen, E. Burdet, C. Guan, H. Zhang, C. L. Teo, Q. Zeng, C. Laugier, and M. H. Ang Jr. (2016), discussed in their article about a wheel chair system which activate with the help of BCI. This could be useful in various hospitals with comparatively low cost. They proved the brain programmed Wheel chair is very effective to navigate inside a typical office or hospital environment.

Huli, P. R. (2014) He had studied on Stress Management in Adolescents. The objective of his study was stress can be caused due to many factors and can alter the relationships dynamics in the family. He had observed that stress during adolescence were because of bothered family dynamics, inability to cope with studies, peer anxiety, drug abuse, lack of skill. One of the important trends which were being observed was getting minute satisfaction from the electronic media. He was concluded that Proper care should to be taken in helping to take the right decisions which may affect their future.

Devi, U. T. (2011), researched on "A Study on Stress Management and Coping Strategies with Reference to IT Companies". This research aims at identifying the level of stress among the IT employees to suggest the strategies for coping with the stress. It was identified that employees experienced pressure from heavy work load followed by competition, fear of job loss and others. The study identified various strategies like Stress management programs, Physical activities, Stress-audit, Life style modification programs etc. to cope with the stress.

RESEARCH GAP

From the above review of literature, the identified gap is that stress management can be effectively done with the help of modern technologies. With the advancement in technologies, many gadgets and devices have been developed and studied by innovators and researchers and are being used in western countries for workers, disabled, locked-in patients etc. This paper is giving an innovative idea to Railway Management to control the stress of Loco Pilots by using BCI.

OBJECTIVES OF THE STUDY

1. To understand the level of stress among the Loco Pilots.
2. To understand the technology underlying BCI.
3. To study how the BCI can help in stress management of Loco Pilots, Indian Railways.

HYPOTHESIS OF THE STUDY

H0: There is no significant relation between quality and problems of work life with the stress level of Loco Pilots.

H1: There is a significant relation between quality and problems of work life with the stress level of Loco Pilots.

RESEARCH METHODOLOGY

The study used both primary and secondary sources. Primary data was collected using a questionnaire schedule among 42 Loco Pilots. The sample selection was on Stratified Convenience Sampling. The questionnaire and structured interview was developed to assess their stress level. Secondary sources included books, journals, articles and reports from newspapers, weekly's, magazines, etc. The data collected from both the primary and secondary sources were quantified and analysed in qualitative terms. For testing of hypothesis **Chi Square test is used.**

SAMPLING METHOD

Stratified convenience sampling method adopted for data collection from all the categories of Loco Pilot Mail, Loco Pilot Passenger, Loco Pilot Goods and Asst. Loco Pilots are as follows:

Sr. No	Category	Population	Sample
1	Mail LP	39	16
2	Passenger LP	8	3
3	Goods LP	36	6
4	Asst. LP	76	17
Total		159	42

The total size of the sample is drawn from the four categories i.e., 16+3+6+17 = 42. **Therefore 42 is the sample size for the study.**

RESULTS AND DISCUSSION

- Loco Pilot's ergonomic is the Loco Cabin in which they work. The control stand comes first and 79% of Loco Pilots claim that the design of control stand is not uniform. There are about 10 types of Diesel locomotives and almost 20 types of Electric Loco motives. The control stand differs from loco to loco and it leads confusion in day to day working.
- The Loco Pilots frequently use the operating handles to accelerate the speed and to apply the brake for controlling the speed. Almost 92% of Loco Pilots are stating that operating handles are not easily accessible to them.
- There are so many gauges and displays on locomotives such as speedometer, various air pressures gauges and oil pressure gauges. The Loco Pilots should continuously concentrate on the gauges on run. Almost 80% of Loco Pilots claims that it is difficult to read the gauges and displays during night on run since it were not illuminated properly.

- The Loco Pilots are working with both the electric and diesel locos. There is no problem for front visibility in electric locos since both side Loco Pilots cab is provided. In diesel locos only one cab is provided. If the cab is leading is known as short hood driving and if the cab is trailing it is known as long hood driving. In case of long hood driving front visibility is not clear especially on curves.
- The front visibility of locos plays a vital role in driving because Loco Pilots should constantly watch on track and signals. In case of signal passing at danger, severe punishments are imposed on Loco Pilots even though there is no lapses, accidents etc. It is stress to drive with improper visibility. Nearly 88.09% claim sometimes no proper front visibility.
- The lookout glasses should be clear for driving and for that proper maintenance should take place. During rain and fog, working of wipers should be important for driving. Nearly 93% of Loco Pilots claim that both the lookout glasses and wipers are not working properly.
- During night driving head light focus should be clear. As per railway rule, the focus should be minimum 250 Meters. Above 88% feels sometimes head light focus is not sufficient.
- The speedometer is having a vital role in driving. The speed of the different section, different locos, different coaches are varies. The Loco Pilots are supposed to run at maximum speed whatever the speed given in their manual to minimize the late running of trains. In any cases they are not supposed to cross the maximum speed. In case of over speeding, maximum penalty will be imposed to them. Almost 80% respondents are not happy on the existing system and they prefer Digital Speedometer.
- The Loco Pilot's seat quality is poor. It is enough to have Loco Pilots shuffling uncomfortably in their seats. All the basic necessary of the seat like height adjustment, side adjustment, forward and backward movement, back rest, hand rest, proper cushion and foot rest etc are not provided properly in all the times. In electric locomotive cabs, seat is very small and it is wall mounted without any adjustment. It is not comfortable for a Loco Pilot to drive while seated.
- The working space of loco motive is congested. 95.23 % of Loco Pilots claim that there is no enough space. There is no air conditioning and 95.32 % agree that there is no effective cooling and heating system. The Loco Pilots cab is not pollution free which can affect the health of lungs. Almost 96.45 % agree that cab is not pollution free. The temperature in Loco Pilots cab is more than atmospheric temperature during summer season.
- 100 % of Respondents claim that their cab is not sound proof. Everyone is finding difficulty with the position of the horns of the locos. According to them the horns are not located far from the Loco Pilots cab. The sound decibel of the horns normally exceeds the normal limits.
- A Loco Pilot in his each duty on an average crosses 100-200 level crossing gates. As per the railway rule he has to sound the horn from 600 meters before the level crossing gates continuously.

- In addition to that a Loco Pilot should sound the horn on curves, cuttings, approaching tunnels, running through a station, where the visibility is restricted and for warning the trespassing public. This facts show they are very much exposed to sound pollution on entire duty hours.
- Most of the Loco Pilots attended the run over cases on their duty. In the run over case if the victim is survived they have to carry the victim to the nearby railway station towards their journey where the medical facility is available. For example the medical facility is available in rear station within few kilometers, but there is no provision to back the train for immediate medical attention. In case of, the victim is killed, the Loco Pilots have to collect the body parts and clear the track for free movement of other trains. They have to hand over the body to the available railway servant nearby. In case of cattle run over they have to stop the train and remove the carcass and clear the track for the free movement of other trains. They are mentally disturbed after attending such run over cases and cattle run over. But immediately they have to continue their journey without any time gap till their destination. Even after reaching destination there is no counseling given to cope up the mental disturbance.
- This clearly shows that Loco Pilots working environment is not conducive for proper working with good health. These analyses fulfil the objectives such as to study the various causes of stress and its level.

HYPOTHESIS TESTING

NO	PARAMETERS	ALWAYS	SOMETIMES	NEVER
1	Continuous concentration during the entire duty	39	03	0
2	Palpitation during untoward incidents like run over cases	34	06	02
3	Feeling irritation while long honking	30	10	02
4	Possibility of relaxing in duty hour	0	05	37
5	Feeling sleepy after a continuous Shift	32	08	02
6	Back Pain while working	20	15	07
7	Numbness and tingling after continuous working in one position for more than approximately six hours.	0	39	03
8	Headache during day time trains on summer season	0	38	04
9	Holding back the Natural Calls for long hours on entire duty	39	03	0

Based on this table the calculated value of Chi Square Test is 397.66 and the table value of chi square at 5% level of significance for 26 degree of freedom is 21.792. So the calculated value of chi square is much more than table value.

Therefore H0 is rejected and H1 is accepted. Thus it is proved that-

"There is a significant relation between quality and problems of work life with stress level of the Loco Pilots".

BRAIN COMPUTER INTERFACE (BCI)'s ROLE IN STRESS MANAGEMENT OF LOCO PILOTS

BCI can be used to analyse the stress level of Loco Pilots which in turn helps the Railways to understand and provide quality service for better involvement of Loco Pilots. These data and analysis can be used to personalize Stress relief programmes for Loco Pilots in the form of special Yoga or Meditation exercises, music which can give dedicated, motivated and passionate workforce for Railways. Stress Management maybe an insignificant activity but if it is implemented correctly, it is beneficial for both the Loco Pilots and the Railway by reducing manual error.

BCI with all its advancement carry the potential to provide a link between human brain and device systems. BCI can be used for providing a connection between Loco Pilot's brain and his cabin which can lead Loco Pilots using his Brain Signals to operate in his cabin. This can lead to reduction in reflection time a very important measure which really omits the accidents in time. Every seconds of the delayed action will cause a severe impact because the train will cover the distance of 1km within 33 seconds.

BCI can also reduce the confusion and the Stress which Loco Pilot goes through while operating different types of cabins. For instance If a Loco Pilot sees an obstacle on his path it may take him a few seconds to realise the danger and to take the necessary actions. These lapses of seconds can lead to a fatal accident. But suppose a Loco Pilot is operating with BCI, the moment the BCI realises the Stress Level of Loco Pilots and receives signal from brain it takes the control of train in which it applies brake and horn some seconds before Loco Pilot will actually responds to apply it. BCI is a part of machine learning it will understand the behaviour of Loco Pilots with time, which in turn may leads to even faster results leading to efficient services. By reducing the reflection time of Loco Pilots, we can avoid a major fatal accident or minimize the impact of accident by reducing the train speed.

If the BCI able to monitor the alertness of the Loco Pilot, it can give audio and visual warnings when the Loco Pilots loses his concentration/ alertness/falling asleep. This will help them to avoid Signal Passing at Danger (SPAD). Since the Loco Pilots are facing more than hundreds of signal on his duty shifts, if he passes any one of the signal at danger for one foot also, draws major punishment i.e., removed from service even though there is no loss of Railway property, causalities and no time loss. Avoiding major punishment for minor human lapses may definitely trigger the stress level on duty. BCI will be a major relief for Loco Pilots on this case.

CONCLUSION:

The problem of stress is unavoidable and inevitable in any occupation. The present study concludes various important acumens related to stress of Loco Pilots that is very essential for the Indian Railways to identify since driving job comes under a safety cadre. BCI is a futuristic technology that Railways is yet to explore in various areas. This pilot study proved that Stress of Loco Pilots is significant that they required a proper stress management strategy. The primary objective of this research is to highlight the advantages of BCI and also suggests ways to deploy such methods to analyse the stress of Loco Pilots in Indian Railways.

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