

THE EFFECTS OF HUMAN FACTORS ON UNMANNED AERIAL VEHICLE (UAV) OPERATOR PERFORMANCE

Hüseyin Erbil ÖZYÖRÜK¹

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ABSTRACT: The use of unmanned aerial vehicles (UAV) is increasing day by day and their usage areas are expanding. Also, UAV operations are getting more complex. In this regard, it is vital to monitor the performance of UAV operators in their duties and to understand the factors that affect performance. Human factors are among the most important factors affecting the performance of UAV operators. Therefore, important human factors will be briefly discussed in this study.

Keywords: Human factors, Unmanned Aerial Vehicle (UAV), Operator Performance

1. INTRODUCTION

When it comes to health; it should not be understood that only body parts are used completely and smoothly. Besides physical health, mental health is also very important. The deterioration of the physical health or mental health of the person creates significant problems in the functions of the individual and results in serious performance decrease.

The characteristics of a person with good mental and physical health are as follows (World Health Organization, 2018):

- He is in full relation with reality.
- He has the power to solve its problems.
- He can adjust the direction and intensity of his activities.
- His attention can be focused on a particular subject.
- He can think about a topic in detail and impartially.
- He can criticize himself.
- He can use his knowledge well.
- He can enjoy life by gathering its activities around a goal approved by the society.

There are many factors that affect the performance of unmanned aerial vehicle (UAV) operators. Some of them also arise due to the limitations of human physiology. In this study, some of these factors and their effects are discussed briefly.

¹ Phd., University of Turkish Aeronautical Association, Faculty of Air Transportation, Flight Training Department

2. SUBSTANCE USE BY UAV OPERATORS

2.1. Alcohol

Physiologically; effects of alcohol on the liver are quite common. Alcohol disrupts the functions of the liver by altering the physiological functioning. Under the influence of alcohol, the most important metabolic activities of the liver, especially carbohydrate, lipid and protein metabolisms, are disrupted, and the toxic substances formed increase the severity of the present toxicity (Bruha et al., 2012).

One of the organs that is severely damaged by alcohol is the heart. Alcohol causes the heart's ability to contract. There is important evidence that continuous alcohol drinking has a toxic effect on the heart muscle and leads to congestive heart failure (Wood et al., 2018).

Along with all these disorders that occur in physiological and metabolic reactions, psychological abnormalities occur due to the effect of alcohol on the nervous system. Impaired functions such as emotion, thought and perception in alcoholic person causes traffic accidents, suicide, murder, aggressive attitudes and behaviors. It disrupts decision making and thinking systems. It weakens the reflexes and impairs movement coordination. Worse; it differentiates the person's perception of himself / herself and emphasizes feelings of overconfidence or excessive insecurity (Cook, 1997).

Alcohol is excreted from the body at a rate of approximately 15 mg per 100 ml of blood per hour. For this reason, pilots should not fly for at least 8 hours after consuming a small amount of alcohol. If more is consumed, they should not fly for a proportionately longer period of time (Moriarty, 2014).

These restrictions on alcohol consumption imposed on pilots of manned aircraft should also be applied to UAV operators. Because, if UAV operators consume alcohol, similar negative effects will be seen physiologically and mentally. Unfortunately, the legal framework and monitoring mechanisms in this regard have not yet reached a sufficient level in Turkey and in the World.

2.1. Medication

Using sedatives in some periods is also a method that people use frequently. Although these temporarily give comfort, if the main reason that decreases performance is not eliminated, it will not have an effect and can create habit. If habits such as medicine, alcohol, tea, coffee or smoking are replaced by physical fitness activities, the positive effect on health will be observed more easily.

In principle, the pilot is not allowed to take medication before the flight. Many drugs, including aspirin, have side effects. Especially medicines with psychiatric and sedative side effects are unfavorable as they may impair flight performance in an extreme degree. Due to either lack of awareness or ignoring of these drawbacks, the pilots who take medication without the knowledge of the flight doctor are at risk before the flight. Pilots should refrain from self-medication, as the type of side effects medications have and how they will affect flight performance is a specialty (Wise et al., 2016).

The legal infrastructure and control mechanisms for medicine use by manned aircraft pilots are highly developed and have reached a certain level today. In this regard, inspections are also carried out strictly in practice. More importantly, as a result of the trainings given to

manned aircraft pilots on this subject, their awareness and level of knowledge about the possible negative consequences of medicine use are high. Similar trainings should be made legally compulsory for UAV operators and their awareness levels should be increased. In addition, control mechanisms regarding medicine use should be established.

3. FATIGUE

It is seen that disruption of family and social life, as well as extra-curricular tasks and exceeding limits, causes low motivation, psychological fatigue and a feeling of burnout. Fatigue is defined as a condition caused by the physical or mental work of the person that exceeds a certain limit and insufficient rest (Wise et al., 2016).

Fatigue, playing the role of a multiplier, can exponentially increase perceived stress, loss of situational awareness and crew resource management. Fatigue creates individuals who are dissatisfied and who complain about everything.

The most common causes of fatigue are as follows (Bendak & Rashid, 2020; Caldwell, 2005, 2012):

- Sleep deprivation (inadequate sleeping time and/or low quality of sleep)
- Circadian rhythm abnormalities (inappropriate work-rest scheduling and shifts)
- Task-induced influences (routine tasks, very complicated tasks, long duty periods etc.)
- Lack of training about consequences of fatigue

There are many symptoms of fatigue and they can be gathered in three major groups: physiological symptoms, behavioral symptoms and psycho-physical symptoms. Physiological symptoms emerge as a decrease in functions of whole body or some organs. Behavioral symptoms come out as a decrease in daily performances such as increasing errors or misunderstanding etc. Psycho-physical symptoms include increases in deterioration of sensation and exertion depending on duration and intensity of stress (Stellman, 1998).

It is obvious that pilots who participate in intense flight missions that last for days will not get enough rest. Short-term and excessive mental and physical activity can cause a feeling of fatigue, but this can be quickly corrected with rest. However, long-term and cumulative chronic fatigue causes psychomotor insufficiency, which impairs flight safety.

When signs of fatigue begin to appear, the UAV operators should take a rest as soon as possible and the task should be transferred to another pilot. After this measure is taken, factors such as excessive workload, intensity of the work schedule and insufficient rest periods, inappropriateness of working conditions, relations with the family and social environment etc., which are among the main causes of physical and mental fatigue, should be investigated and the real cause of fatigue should be determined. After determining the main reasons, measures should be taken to eliminate the relevant causes.

3. WORKLOAD

Workload is defined as the proportion of the amount of resources required for perception, decision-making, and action in a task to the amount of resources available. This definition covers both external and internal resources. Based on the definition, it is clear that workload level will be different for different operators and it may even be different for the same operator when he is in a different state of mind (Wise et al., 2016).

Actual and self-perceived workload are different concepts but both of them are directly related to the variables such as skill level, general fitness, degree of anxiety, presence of illnesses and consumption of chemicals by the crew members. Due to this reason, workload can be measured by using objective and subjective methods (Cullen et al., 2012).

Operators are dealing with a complex and dynamic environment in many flight operations. Workload determines the overall accuracy and quality of the cognitive process of the operators in such environments (Wiener & Nagel, 2014). Naturally, high workload will cause human errors by reducing the accuracy and quality of cognitive processes.

Because of these reasons, the workload of the operators should be monitored continuously in a systematic way. Measurement or assessment of the workload for a given task or operation may not be valid for a similar one or even for the repetition of the same one.

UAV operators are prone to making mistakes in perception or decision making, especially when participating in complex tasks such as multiple UAV operations. Therefore, companies conducting complex UAV flights should set up a system to monitor the workload of the operators.

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