ORGANIZATIONAL SAFETY CLIMATE, PRECONDITION FOR UNSAFE ACTS AND UNSAFE ACTS OF TURKISH COMMERCIAL AIRLINE PILOTS

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ABSTRACT

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The aim of the current study is to investigate the relationship between organizational safety climate, preconditions for unsafe acts, particularly perceived stress, locus of control, risk perception and behavioral markers of Crew Resource Management (CRM) training, and unsafe acts of airline pilots among Turkish sample. Although unsafe acts got attention through years to analyze accident causation, there has been no study to investigate the relationship between unsafe acts, their antecedents and contributors. 155 airline pilots participated in the present study. The age range of the pilots was between 21 and 62. To measure unsafe acts of the pilots, Airline Pilot Behavior Inventory was developed. Pilots perceived stress was measured by asking them to rate their stress level in normal flight conditions. To measure preconditions for unsafe acts Aviation Safety Locus of Control scale, Risk Perception-Self and -Other scales and Safety Operation Behavior scales were adapted into Turkish. To measure safety climate, Aviation Safety Climate Scale was adapted into Turkish. The relationships between study variables were examined based on the Human Factor Analysis and Classification System framework. The present study is the first study to examine the relationship between unsafe acts of commercial aviation pilots and their antecedents and contributors. Evaluations of the findings, possible contributions of the study and limitations and possible suggestions for future research were discussed in the light of the literature.

Keywords: airline pilots, unsafe acts, preconditions for unsafe acts, stress, locus of control, risk perception, CRM training, safety climate, HFACS.

ÖZ

KURUM GÜVENLİK İKLİMİ, EMNİYETSİZ DAVRANIŞLARIN ÖNKOŞULLARI VE TÜRK TİCARİ HAVA YOLU PİLOTLARININ EMNİYETSİZ DAVRANIŞLARI

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Bu çalışmanın amacı kurum güvenlik iklimi, emniyetsiz davranışların önkoşulları, özellikle algılanan stres, kontrol odağı, risk algı ve ekip kaynak yönetimi eğitiminin davranışsal belirteçleri ve pilotların emniyetsiz davranışları arasındaki ilişkiyi incelemektir. Her ne kadar emniyetsiz davranışların kazalara etkisi yıllardır araştırılsa da bu davranışlar, öncülleri ve bunlara katkı yapan etmenler arasındaki ilişkiyi inceleyen bir araştırma yapılmamıştır. Bu çalışmaya, 155 hava yolu pilotu katılım sağlamıştır. Katılımcıların yaş aralığı 21 ve 62 arasında değişmektedir. Pilotların emniyetsiz davranışlarını ölçmek amacıyla, Hava Yolu Pilotları Davranış Envanteri geliştirilmiştir. Algılanan stres, pilotlara normal uçuş durumlarındaki stres seviyelerini derecelendirmeleri istenerek ölçülmüştür. Kontrol odağı, risk algısı ve ekip kaynak yönetiminin davranışsal belirteçlerini ölçmek amacıyla, Uçuş Emniyeti Kontrol Odağı ölçeği (Hunter, 2002), Risk Algısı-Kendi ve -Diğerleri ölçekleri (Hunter, 2006) ve Emniyetli Operasyon Davranışları ölçeği (You, Li ve Han, 2013) Türkçeye adapte edilmiştir. Kurum güvenlik iklimini ölçek amacıyla ise Uçuş Güvenlik İklimi ölçeği (Evans, Glendon ve Creed, 2007) Türkçeye adapte edilmiş ve kullanılmıştır. Çalışma değişkenleri arasındaki ilişkiler, İnsan Faktörü Analizi ve Sınıflama Sistemi modeli çerçevesinde incelenmiştir. Bu çalışma, bilindiği kadarıyla hem Türk hava yolu pilotları ile yapılan hem de ticari hava yolu pilotlarının davranışları ve bu davranışların öncülleri arasındaki ilişkiyi İnsan Faktörü Analizi ve Sınıflandırma Sistemi modeli çerçevesinde inceleyen ilk çalışmadır. Bulguların değerlendirilmesi, çalışmanın olası katkıları, limitasyonları ve gelecek araştırmalar için öneriler literatür ışığında tartışılmıştır.

Anahtar Kelimeler: hava yolu pilotları, emniyetsiz davranışlar, emniyetsiz davranışların önkoşulları, stres, kontrol odağı, rik algısı, CRM eğitimi, güvenlik iklimi, HFACS.

To my lovely family and especially my grandmother & grandfather…

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CHAPTER I

INTRODUCTION

A thousand eight hundred and ninety aircraft accidents occurred between 1959 and 2014 in total. Six hundred and sixteen of them were fatal accidents which was 33 % of total accidents. A thousand two hundred and seventy-four of them were non-fatal accidents which was 67 % of total accidents. Moreover, 404 aircraft accidents occurred between 2005 and 2014 in total in which 72 of them (18% of total) were fatal accidents while 332 of them (82% of total) were non-fatal accidents (Boeing, 2016).

When looking at fatal accidents by phase of flight in accidents occurred between 2005 and 2014, 10 % of fatal accidents occurred during taxi, load/unload, parked or tow; 13% of them occurred during takeoff and initial climb; 7% of them occurred during climb (flaps up); 13% of them occurred during cruise; 3% of them occurred during decent, 8% of them occurred during initial approach; 48% of them occurred during final approach and landing. When looking at onboard fatalities by phase of flight in accidents occurred between 2005 and 2014, 10% of them occurred during takeoff and initial climb; 8% of them occurred during climb (flaps up); 27% of them occurred during cruise; 3 % of them occurred during decent, 14% of them occurred during initial approach, 38% of them occurred during final approach and landing (Boeing, 2016).

In Turkey, 104 aircraft accidents occurred between 2001 and 2014. In these accidents, 255 people were killed, 81 people were injured and 96 aircrafts were damaged (TUİK, 2014).

1.1 Human Factors in Aviation

Humans are prone to make mistakes by their nature. Therefore, it cannot be surprising that aviation safety is affected by human errors. At the beginning of aviation history, approximately 80% of all factors that caused accidents could have attributed to mechanical failures. Therefore, research and developments were mainly focused on reducing these mechanical failures. While reducing mechanical issues, capabilities of aircrafts were increased, and aircrafts started to get faster and to reach higher altitudes. In the late 30s, problems regarding human capacities emerged with the rapid development of the technologies because aircrafts became four times faster than those at the beginnings and their altitude capacities exceeded 30.000 feet (ft.). Therefore, the first research on human factors were focused on human skills, capabilities and limitations (Wise, Hopkin, Garland, 2010).

After the introduction of jet aircrafts and the advancements in automation systems, the new era started for aviation industry. The jet era reduced the number of flight crew needed during operations. While flight crew was consisted of a pilot, a co-pilot, a flight engineer, a radio operator, and a navigator until the jet era, a pilot and a co-pilot were enough for an operation. However, the introduction of jet aircrafts and developments of advanced technological automation systems brought new problems with them. Although the physical workload of the crew was decreased significantly, the cognitive workload increased rapidly. The manner of interaction between flight crew was also changed with the introduction of flight management systems (FMS). Therefore, crew coordination became another problem (Wise, Hopkin, Garland, 2010).

Research showed that the percentage of human factors caused accidents increased up to 80 percent after these advancements (Boeing Aero Magazine, 2015; Wiegmann & Shappel, 1997). Consequently, researches on understanding human factors to increase aviation safety became more important. Accident investigations were also focused on human errors that caused accidents as well as mechanical failures (Wiegmann &

Shappell, 2003). Growing number of research has been dedicated to understand human factors both by aviation organizations and aviation researchers. Different perspectives and framework have emerged from these research in order to understand human factors contributing to aviation accidents. In aviation context, five major human factors perspectives have been developed in the human factors literature. These are cognitive, ergonomic and system design, aeromedical, psychosocial and organizational perspectives (Wiegmann et al., 2000; Wiegmann & Shappell, 2001; Wiegmann & Shappell, 2003). These perspectives will be briefly discussed in the following section.

1.2. Human Factors Perspectives

1.2.1. Cognitive Perspective

The principal assumption of this perspective is that mind of the pilots can be conceptualized as an information processing system. Information processing system was modeled by Wickens and Flach (1988). In this model, it is proposed that information coming from senses progressed through series of mental stages (e.g. attention allocation, pattern recognition, decision making and response execution). Errors occur when one or more of these mental stages do not process sensory information appropriately.

Cognitive models help to understand underlying causes of errors. However, they also have some limitations. Firstly, the application of these models into analysis and investigation is not defined fully. Moreover, these models focus on only pilot, and ignore task-related and contextual factors (Wiegmann & Shappell, 2001; Wiegmann & Shappell, 2003).

1.2.2 Ergonomics and System Design Perspective

The basic assumption of ergonomics and system design perspective is that the cause of an accident or error is the interaction of several different factors. The act of the operator is rarely the only cause of an accident or error. System design models propose that the connection between human, machine and environment is inseparable (Wiegmann & Shappell, 2001).

Application of system models helps to identify task-related and contextual factors. Yet, it places exclusive emphasis on interactions of components which give the impression that components of the system are unimportant (Wiegmann & Shappell, 2001; Wiegmann & Shappell, 2003).

1.2.3. Aeromedical Perspective

The assumption of aeromedical perspective is that errors are caused by some physiological conditions called pathogens such as dehydration, fatigue and spatial disorientation. These pathogens manifest themselves as errors when stimulated by environmental conditions (Wiegmann & Shappell, 2001).

Aeromedical perspective is highly criticized regarding that it does not define how these pathogens cause accidents. In the literature, it is suggested that these pathogens can be contributors of error but the cause-effect relationship between errors and pathogens is not clear (Wiegmann & Shappell, 2001; Wiegmann & Shappell, 2003).

1.2.4. Psychosocial Perspective

Psychosocial perspective assumes that flight operations require the interaction among pilots, air traffic controllers, dispatchers, ground personnel, maintenance personnel and flight attendants (Wiegmann & Shappell, 2001). Pilot’s performance is directly influenced by the interactions between group members. Therefore, errors occur when there is an impairment in these group dynamics and interactions (Wiegmann & Shappell, 2001; Helmreich & Foushee, 1993).

1.2.5. Organizational Perspective

Organizational perspective emphasizes the complex nature of accident and incidents causation. This perspective proposes that the erring decisions of managers, supervisors and others in the organizations play a role in the management of errors. One of the influential model developed upon organizational perspective is “Swiss Cheese” model of human error developed by James Reason (1990).

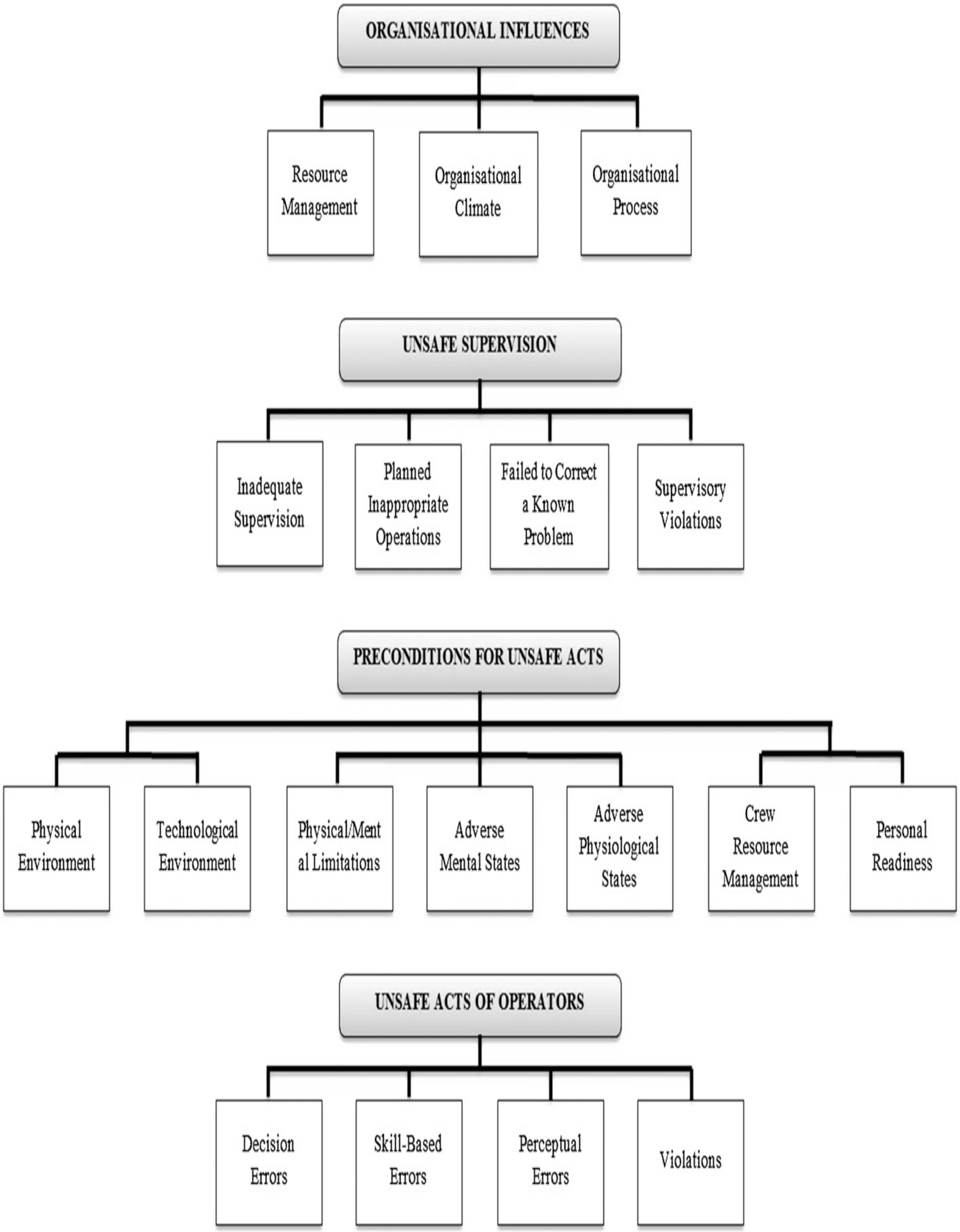
Swiss Cheese model of human error assumes that there are fundamental elements of all organizations that harmoniously work together in order for safe operations to occur. In the model, Reason described four levels of human error each of which influences the next. These levels are named as organizational influences, unsafe supervision, preconditions for unsafe acts, and unsafe acts of the operators.

According to Reason, accidents occur when there are breakdowns in the interaction among components of the operation process. These failures harm the integrity of the system and make it vulnerable to operational dangers. The failures in the system are named as “holes” within different layers. Reason suggests that these holes transform productive processes into failed ones. Unsafe acts of the operator are defined as active failures that are the immediate cause of accidents. Holes in other layers defined as latent failures which are the contributors of active failures. Reason suggests that focusing solely on active failures give ultimate cause of the accident but most of the causal factors that contribute accidents remain uncovered. Therefore, accidents should be investigated by analyzing all facets and levels of the system in order to understand all causes of the accidents (Wiegmann & Shappell, 2001).

Swiss Cheese model of accident causation helps to integrate major perspectives of human factors into a unified framework. However, it is criticized that it failed to define the “holes” of the cheese. Because there is a need to define the holes proposed by Swiss Cheese model, Shappell and Wiegmann developed a framework named “Human Factors Analysis and Classification System (HFCAS) as an accident investigation and analysis tool in aviation (Wiegmann & Shappell, 2003; Wiegmann & Shappell, 2001; Shappell et. al., 2007).

Human Factor Analysis and Classification System (HFACS) is specifically developed to define active and latent failures depicted in Reason's Swiss Cheese model. The framework was developed and revised by analyzing hundreds of accidents reports that contain thousands of human factors so it could be helpful in accident investigation and analysis tool (Shappell & Wiegmann, 1997; 1999; 2001; Wiegmann & Shappell, 2003). The same as Swiss Cheese model, HFACS defines four levels of failures; Unsafe Acts, Preconditions for Unsafe Acts, Unsafe Supervision and Organizational Influences (see Figure 1.1). Each level is also divided into categories based on the results of accident reports.

Figure 1.1. Overview of Human Factor Analysis and Classification System (HFACS, Adapted from Shappell & Wiegmann, 2001).



Unsafe Acts of the Operator

The unsafe acts of the operator are classified into two categories; errors and violations (Reason, 1990). Errors are defined as the mental or physical activities that fail to achieve intended outcome. Not surprisingly, these unsafe acts dominate most of the accident databases due to the fact that humans make mistakes by their nature (Wiegmann & Shappell, 2003). On the other hand, violations refer to the willful disregards of the rules and regulations that govern the safety operations **(**Reason, 1990). Although classifying unsafe acts into two categories may give some explanation about causes of accident, there is still a need to define types of errors and violations representing the granularity nature of causes of accidents. Therefore, sub-categories for each unsafe act type are formed; three sub-categories for errors and two sub-categories for violations.

Errors are divided into three sub-categories which are skill-based errors, decision errors and perceptual errors. *Skill-based errors* occur with little or no conscious thought. Just like steering wheel or shifting gear automatically in an automobile, basic flight behaviors like screening monitors or stick and rudder movements are shown automatically. As a result, these automatic actions are usually vulnerable to attentional and/or memory failures. Some the examples of skill based errors are breakdown in visual scan, failed to prioritize attention, distraction, omitting checklist items, omitting step in procedure, inadvertent use of flight controls, over-reliance on automation and so on. *Decision errors*, however, represent intentional actions that proceeded as planed yet the plan itself is inadequate or inappropriate for the situation. They also referred as “honest mistakes”. Decision errors are the most heavily investigated forms of error in accident investigation and generally classified into three groups. One of them is procedural errors which mostly occur in highly structured tasks. Although, flight operations are highly structured, errors can still occur when the pilot do not recognize or misdiagnose the situation and the wrong procedure is applied. Even in aviation that is highly structured, many situations require to choose the best response from multiple options. However, sometimes, pilots can make poor decisions because of insufficient experience, time or other outside pressures. These poor decisions are called knowledge base errors. Decision errors can also occur when the problems are not well-understood and formal response procedures are not available. As a result, pilot may react these novel situations inaccurately and commit problem-solving errors. Improper procedure, misdiagnosed emergency, wrong response to emergency, exceeded ability, inappropriate maneuver, poor decisions are the examples of decision errors (Wiegmann & Shappell, 2003; Shappell et. al., 2007; Shappell & Wiegmann, 2000). The last sub-category of errors is perceptual errors which occur when the sensory inputs are degraded or unusual. *Perceptual Errors* are likely to occur when flying with incomplete information such as operating at night or in poor weather, thus, aircrew misjudge airspeed, altitude or decent rates as well as responding visual illusions incorrectly.

Violations are also divided into sub-categories; routine violations and exceptional violation. *Routine violations* are often referred as “bending the rules” (Shappell et. al., 2007). This of violations is habitual by nature and is often tolerated by management and supervisors (Reason, 1990; Shappell & Wiegmann, 2000). Omitted call-outs, self-performed checklists, checklists completed from memory, omitted briefings or performing briefings at wrong time are some examples of routine violations (LOSA, 2002). *Exceptional violations*, however, are defined as isolated departures from the authority (Wiegmann & Shappell, 2003; Shappell et. al., 2007; Shappell & Wiegmann, 2000). This type of violation is not necessarily indicative of typical behavior pattern of operator (Reason, 1990). Flew an unauthorized approach, flew an overaggressive maneuver or continued low-altitude flight in Visual Meteorological Conditions (VMC) are some examples of exceptional violations.

Preconditions for Unsafe Acts

Although the unsafe acts of the operator are directly linked to approximately 80% of all aviation accidents, Shappell and Wiegmann proposed that focusing only on unsafe acts is like focusing only on fever without understanding the underlying illness causing it (Wiegmann & Shappell, 2003; Shappell & Wiegmann, 2000). Therefore, understanding what leads to unsafe acts to occur is important for increasing aviation safety. Shappell and Wiegmann proposed three major preconditions of unsafe acts which are conditions of operator, environmental factors and personnel factors (Wiegmann & Shappell, 2003; Shappell et. al., 2007; Shappell & Wiegmann, 2000).

The conditions of operator are divided into three categories; adverse mental states, adverse physiological states and physical/mental limitations. Being mentally prepared is especially critical in aviation industry. Therefore, *Adverse mental states* were created to comprise these mental conditions. These mental conditions contain situational awareness, task fixation, distraction, mental fatigue due to sleep deprivation or other stressors. Personality traits, pernicious attitudes such as overconfidence or complacency, misplaced motivation, risk perception and other mental factor that can affect performance of operators can also be included in this category (Wiegmann & Shappell, 2003). *Adverse physiological states* are also important for flight safety. It refers to medical or physiological conditions that affect safe flight operations (Wiegmann & Shappell, 2003; Shappell et. al., 2007). Visual illusions, spatial disorientation, physical fatigue and pharmacological and medical abnormalities are included into adverse physiological states that affect performance of operators (Wiegmann & Shappell, 2003; Shappell et. al., 2007; Shappell & Wiegmann, 2000). The third and the last category of operator’s condition is physical/Mental limitations. This category refers to the instances when the operational requirements exceed the capabilities of the operators. Insufficient reaction time, visual limitations and incompatible physical capacities can be included in this category (Shappell & Wiegmann, 2000).

Environmental factors are another precondition for unsafe acts and, broadly, are divided into two; physical and technological environment. *Physical environment* refers to both operating environment such as weather, altitude, terrain and the ambient environment such as heat, vibration and lighting of the cockpit. On the other hand, *technological environment* includes the design of the equipment and controls, display characteristics, checklist layouts and automation (Wiegmann & Shappell, 2003).

Personnel factors are the last precondition for unsafe acts in HFACS, and divided into two general categories; Crew Resource Management (CRM) and personal readiness. *Crew Resource Management* includes communication and coordination within and between aircrafts, as well as air traffic controllers, maintenance personnel, ground personnel and other support personnel which improves operational safety. *Personal Readiness* is also important for flight safety. It includes instances such as disregarding crew rest requirements, violating alcohol restrictions, self-mediating and inadequate physical training (Wiegmann & Shappell, 2003; Shappell & Wiegmann, 2000).

Unsafe Supervision

Supervision plays important role for flight safety because supervisors can influence the condition of operators and the type of environment they operate in (Wiegmann & Shappell, 2003; Shappell & Wiegmann, 2000). Consequently, unsafe supervision is divided into four categories; inadequate supervision, planned inappropriate operations, failure to correct known problems and supervisory violations.

Inadequate supervision is the first category of unsafe supervision level. Supervisors are expected to guide, train and lead their personnel to ensure effective and safe operations. As a result, lack of guidance, training, oversight or leadership can result in errors or violations in the cockpit. Equally important, operational planning affects crew’s performance adversely. High operational tempo and crew flight schedules directly linked to poor performances as well as flight safety. Therefore, *planned inappropriate operations* are important for safe operations. They include insistence such as excessive workload, failures to provide adequate opportunity to crew for rest, poor crew pairing and so on. Supervisors are also expected to correct deficiencies among individuals, equipment, training and other safety related issues. Therefore, the third category, *failures to correct known problems*, is another safety issue in flight operations. Failures in correcting inappropriate behaviors or identifying risky behaviors, failures in correcting safety hazards and failures in reporting unsafe tendencies are some examples of this category. *Supervisory violations*, however, are defined as willful disregard of rules and regulations by supervisors. Failures in enforcing rules and regulations, authorized unnecessary hazards and violating procedures can be given as examples of supervisory violations (Wiegmann & Shappell, 2003; Shappell & Wiegmann, 2000).

Organizational Influences

Generally speaking, inappropriate decisions of upper-level management can directly affect supervisory level as well as the conditions and acts of the operators (Wiegmann & Shappell, 2003; Shappell & Wiegmann, 2000). Therefore, these organizational influences should be considered to improve safety performance of the operators (Wiegmann & Shappell, 2003). Shappell and Wiegmann proposed three major categories of organizational influences; resource management, organizational climate and organizational process (Wiegmann & Shappell, 2003; Shappell & Wiegmann, 2000; Shappell et. al., 2007).

Resource management refers to the allocation and maintenance of organizational assets. Aviation industry relies heavily on two objectives; the goal of safety and the goal of cos-effective and on-time operations. Corporate decisions should be made to achieve balance between these objectives. If the balance between these is not achieved, safety is the first thing that is affected. Like resource management, consistent organizational climate is another factor that affects operational safety. *Organizational climat*e is defined as a board class of organizational variables that affect performance of workers. It can be seen as a working atmosphere that requires communication and cooperation between workers and managers. Policies, open communication and organizational culture are important variables in organizational climate. Speaking for aviation safety, developing a consistent organizational climate and positive attitudes of manager for safety operations may help to increase safety performance of operators (Wiegmann & Shappell, 2003; Shappell & Wiegmann, 2000; Shappell et. al., 2007). Performance of the operators is also affected by organizational processes. *Organizational process* refers to corporate decisions and regulations that governs everyday activities of worker. Establishment and use of standard operating procedures and formal methods for maintaining checks and oversight between workers and management level are included in this category (Wiegmann & Shappell, 2003; Shappell & Wiegmann, 2000; Shappell et. al., 2007).

In the Scope of this thesis, factors that related to aviation safety will be discussed in the framework of Human Factors Analysis and Classification System (HFACS) because HFACS deals with the antecedents and contributors of unsafe acts in a unified manner.

1.3. Human Factors Related to Aviation Safety

Undoubt that aviation industry is one of the safest transportation system, yet it is not without hazards. Especially, increase in the percentage of human factors that causes accidents have led aviation organizations and aviation researchers to investigate direct and indirect causes of accidents deeply. As stated earlier, literature shows that unsafe acts of the pilots are seen as direct causes of the accidents. However, it is suggested that unsafe acts of the pilots are like the tip of the iceberg. Therefore, investigating what causes unsafe acts is important to prevent these acts and, consequently, increase aviation safety.

1.3.1. Unsafe Acts of Pilots

Unsafe acts of pilots are mainly investigated by analyzing accident databases. After Reason's classification of unsafe acts as errors and violations, Shappell and Wiegmann divided errors into three (skill-based errors, decision errors and perceptual errors) and violations into two (routine and exceptional violation) sub-categories based on their analysis of accident data bases.

Investigation of databases showed that skill based errors are the most common causes of accidents (Wiegmann & Shappell, 2001; Shappell et. al., 2007). In their study, Shappell and Wiegmann (2001) analyzed 119 aircrew-related accidents occurred between 1990 and 1996. They found that 60.5 % of accidents are caused by at least one skill based errors. In these accidents, decision errors were found to be associated with 28.6 % of the accidents. Violations were found to constitute 26.4 % of the accidents, and finally perceptual errors constituted 14.3 % of the accidents. In their other study (Shappell et. al., 2007), 1.020 aircrew related accidents that occurred between 1990 and 2002 were investigated and nearly similar results were found. Skill based errors were again associated with 56.5% of the accidents, the most frequent error type that cause accidents. Decision errors were found to be the second frequent error type that causes accidents with a percentage of 36.7. It is also found that 23.1 % percent of the accidents are caused by violations, and 6.5 % of accidents are caused by perceptual errors.

As stated earlier, research suggests that focusing only on unsafe acts to prevent accidents is just focusing only on symptoms without understanding underlying illness (Wiegmann & Shappell, 2003; Reason, 1990). As a result, understanding what causes unsafe acts can be much helpful to promote flight safety than just focusing on the direct causes of accidents. In their study, Wiegmann and Shappell (2001) found that 13.4% of accidents includes at least one factor related to adverse mental states. In addition to adverse mental states, 29.4% of the accidents were associated to at least one factor regarding CRM. As well as adverse mental states, organizational climate was found to be associated with 0.4% of accidents (Shappell et. al., 2007). Although these results come from accident investigations, it clearly shows that latent causes of the accidents are equally important for operational safety, consequently, aviation safety. Some studies suggested that stress (Orasanu, 1997), locus of control (Wickman & Ball, 1983), risk perception (Hunter, 2006,), CRM (Helmreich & Davies, 1996) and safety climate (Zohar, 1980, Griffin & Neal, 2000) are some of the antecedents of unsafe behaviors.

1.3.2. Preconditions for Unsafe Acts

As stated previously, adverse mental states and CRM are two of the leading contributors of accidents.

Metal states are one of the preconditions of unsafe acts that found to be associated with individual’s performance. When these states are not appropriate for the nature of job or the situations in which the job is operated, they can lead to unsafe acts. Literature suggests that mental states such as stress, locus of control and risk perception have an effect on operator's performance.

CRM is also found to be one of the leading contributors of accidents. It can be because communication and coordination within cockpit as well as between pilots and ATC, maintenance personnel and other support personnel. Therefore, any failure in these relations can contribute to occurrence of hazardous events.

1.3.2.1. Stress

Stress is regarded as the interaction between demand and the availability of resources to the individuals. When the demand requested from individuals exceeds individual resources, stress is developed (Martinussen & Hunter, 2010). In a review provided by Orasanu (1997)**,** it was suggested that stressful individuals make more errors, and the capacity of short-term memory is reduced. Moreover, visual scanning became chaotic when individuals were stressful, as well as reduced attention which causing selective hearing. Common stressors in occupational settings are anxiety, time pressure, mental and physical work load, fatigue, frustration and anger.

The link between stress and behavioral performances came from behavior literature. Evans, Palsane and Carrere (1987) found that stress was associated with self-reported accident involvement among drivers. It was also suggested that stress was related to higher violations and errors (Dorn & Matthews, 1995). Similar results were found among professional drivers. Job stress was found to be associated with high accident involvements and violations (i.e. speeding) among professional drivers (Öz, Özkan & Lajunen, 2010). Kontogiannis (2006) also showed that stress was associated with unsafe acts among drivers from different cultures. In line with these results, Maritime Coastguard Agency (2007) stated that people under stress are more vulnerable to cognitive failures, and these failures, in turn, were the causes of accidents. Day, Brasher and Bridger (2012) supported this view and found that the relationship between stress and accident involvement was positively mediated by self-reported cognitive failures.

Hoggan and Dollard (2007) also suggested that job stress can increase the accident risk and associated with decreased safety behavior. For example, Motowidlo, Packard, and Manning (1986) investigated job stress, its causes and consequences among nurses. They found that job stress was negatively associated with overall job performance which contains quality of patient care, tolerance with patients and communication and cooperation with other nurses and doctors. Similar results were also found among construction workers. Leung, Chan, and Yu (2012) suggested that incidents experienced by construction workers in Hong Kong were associated with emotional and physical job stress.

In aviation context, stress is one of the important factors that causes errors and violations. Several aviation accidents have occurred because of stress related causes (Wickens, Gordon & Liu, 2004)**.** Fornette et al. (2012) have revealed that high stress level was one of the leading causes of pilot errors. For example, in an aircraft accident occurred in 1999, the pilots did not perform some of the items of "Before Landing" checklist during bad weather landing which created stress for pilots (Martins, 2016). Moreover, it was found that stress affected maintaining the long, target-focused fixation that was important for the control of movements (Wilson, 2012). Visual scanning (Allsop & Gray, 2014) and attentional control (Moore et al., 2012) were other behaviors that were affected by high level of stress. Martinussen and Hunter (2010) investigated common behavioral effects of stress. They found that stress resulted in attentional narrowing that was converted into perceptual and cognitive tunneling, poor visual scanning, reductive thinking and filtering, decision making without exploring all relevant information, decisions made in hurry, applying old procedure, using non-standard terminology in communication, decrements in working memory and retrievals, and decrease in the ability to detect automation failures. Consequently, these lead to an increase in the number of pilots' unsafe behaviors and experiencing accidents and incidents.

1.3.2.2.Locus of Control

Locus of Control (LOC) refers to the degree to which people perceive that the consequences of the situation that they experience are under their control (Rotter, 1954). This control can be either internal which defined as a set of expectancies influenced by one's own effort or external which defined as a set of expectancies influenced by environmental factor that are beyond the control of individual.

Research proposed that LOC was also found to be related to safety behaviors in hospitals. Jones and Wuebker (1993) found that hospital works who had more internal safety attitudes were significantly less likely to experience severe occupational accidents that those who had more external safety attitudes. Salminen and Klen (1994) also found that external LOC was associated with taking more risks among construction workers. Moreover, LOC predicted risk taking behavior among drivers which is highly related to aviation safety (Özkan & Lajunen, 2005). Internal LOC is found to be related to speeding behavior (Warner, Özkan & Lajunen, 2010). When drivers thought that they were in control, they preferred to speed in highways. In addition to these, studies found that driving internality was positively associated to accident involvement in total and also to involvement in active accidents in which drivers hit another car or an obstacle (Özkan & Lajunen, 2005) while driving externality was positively associated to involving fatal accidents (Montag & Comrey, 1987). Özkan and Lajunen (2005) also found that internality was positively associated with errors and violations among drivers. That is, drivers who had internal traffic locus of control reported higher numbers of errors and violations than drivers with external traffic locus of control.

In aviation, LOC has been used to predict aviation safety. It is found that pilots show more internality than externality. It was also found significant negative relationship between hazardous situations experienced and pilots' internality scores (Hunter, 2002). Unlike traffic context, in aviation context, pilots who had higher internality scores experienced less non-fatal accidents yet no significant correlation was found between externality and hazardous events. Similarly, pilots showed higher internality than externality in Indian pilot sample (Joseph & Ganesh, 2006). In the same study, surprisingly, it was found that Indian civil aviation pilots showed more internality than Indian military pilots. This might indicate that there can be differences between civil aviation pilots from civil aviation training background and those from military aviation training background in terms of internality. It was also found that flight experience has an effect on pilots' internality. That is, with age and experience, pilots tend to perceive the outcome of the hazardous situations is under their control (Hunter, 2002). You, Ji and Han (2013) also found that LOC was significantly associated with pilot behaviors. Pilots who had internal locus of control reported higher safety behaviors than pilots with external LOC.

LOC was also associated with individual's risk perceptions. Individuals with high internality were found to detect errors with regard to perceiving subtle and incidental cues (Wolk & DuCette, 1974). This ability is highly related in aviation context in which breakdowns can occur under high workloads. Therefore, it can be concluded that internal pilots are able to detect risks and respond quicker than external pilots, especially when experiencing breakdowns. In similar fashion, You, Ji and Han (2013) stated that pilots who had high internal LOC scores were more likely to detect flight risks inherent in the operational situations. Vallee (2006) also demonstrated that internal pilots considered themselves less at risk than other pilots.

LOC is demonstrated to be related to safety operation behaviors (SOB) which referred as behavioral reflections of CRM training. Ji et al. (2011) stated that pilots who perceived higher risk inherent in the flight situations exhibited higher SOBs. Similarly, You, Ji and Han (2013) found that pilots with high internality scores reported higher SOBs than pilots with low internality scores. They also stated that the relationship between internality and SOB was mediated by risk perception of pilots. That is, internal pilots tended to perceive risk as high and show higher SOBs.

1.3.2.3. Risk Perception

Risk perception defined by Hunter (2002) as important cognitive skill to analyze the risk inherent in situations. This skill consists of both the accurate appraisal of external situation and the personal capacity to handle this situation.

Research has suggested that risk perception was related to risky behaviors in different contexts. Kern et al. (2014) reported that risk perception was positively associated to risk-taking behaviors among skateboarders. In terms of healthy behaviors, Rundmo (1999) proposed that individuals tended to engage in healthier behaviors when they perceived the risk as large. Contrary to these results, Rby, Dischinger, Kufera and Read (2006) found that low risk perception was associated with higher risky behaviors such as speeding for thrill, not wearing seat belts, drunk driving and binge drinking. Similar trend was observed among adolescents. Zhang, Zhang and Shang (2016) reported that risk perception was negatively correlated with risky behaviors among adolescents. That is, adolescents who perceived less at risk reported higher risky behaviors. DeJoy (1992) reported that low levels of perceived risk might associated with risky behaviors among drivers. Similarly, Rundmo and Iversen (2004) reported that risk perception was negatively associated with risky behaviors which were unsafe driving, speeding and rule violations among adolescents.

In aviation context, O’Hare (1990) proposed that pilots might fail to perceive the risk in flight accurately and might underestimate their likelihood of experiencing an accident. It was also stated that pilots who perceived that the flight situations contained less risk for themselves reported more hazardous events experienced than those who rated the flight situations as high in risk (Hunter, 2002). Moreover, Hunter (2006) found that pilots who had been in hazardous situations more while flying tend to rate the scenarios about risky flight situations as lower in risk and tend to inaccurately predict the general safety in aviation. In addition to these, research proposed that risk perception is affected by the experience. In the study conducted with helicopter pilots, Thompson, Önkal, Avcıoğlu and Goodwin (2004) found that the ratings of 13 risky incidents were higher among novice helicopter pilots than experienced pilots. It is suggested that with experience, pilots risk perception have reduced. Therefore, this reduction and differences in risk perception might also lead to differences between expert aircraft pilots and novice pilots, and directly influence the aviation safety. Hunter (2002) also suggested that pilots were tended to evaluate risks for themselves inherent in the situations less than risks for other pilots.

Research suggested that risk perception was directly associated with safety operation behaviors which are the behavioral reflections of CRM training (You, Ji & Han, 2013). It was proposed that pilots reported higher SOBs when they perceived higher risks for themselves inherent in the scenarios about risky flight situations.

Although risk perception is an important factor for aviation safety as well as accident or incident involvement (Orasanu, Fischer & Davison, 2002), there is little research on the relationship between risk perception and unsafe behaviors of pilots. Therefore, the association between risk perception and unsafe acts of the pilots still remains unclear.

1.3.2.4. Crew Resource Management

Until last decades, it was thought that motor skills and knowledge were enough to fly safely. For many years, pilot trainings were focused on technical skills to train “the perfect pilot”. However, accident investigations revealed that only technical skills and knowledge were not enough to prevent accidents or incidents (Ion, 2011).

The beginnings of crew resource management (CRM) had its roots on a workshop, Resource Management on the Flight Deck sponsored by the National Aeronautics and Space Administration (NASA) in 1979 (Helmreich, Merritt & Wilhelm, 1999). The research presented in this meeting proposed that the majority of aviation accidents were because of failures in interpersonal communication, decision making and leadership (Cooper, White, & Lauber, 1980). The term, “cockpit resource management”, was first applied to the process of crew training in order to reduce pilot error by making them better to use resources on the flight deck. Since then, CRM programs have spread all around the world. With the evolution in CRM trainings, CRM trainings were turned into joint trainings and were applied to other airline personnel such as flight attendants, dispatcher and maintenance personnel yet it turned into “crew” resource management rather than “cockpit” resource management (Helmreich, Merritt & Wilhelm, 1999).

CRM and non-technical skills (NTS) are used interchangeably to define the same concept. Both can be defined as “the cognitive, social and personal skills that complement technical skills and contribute to perform the task safely and efficiently” (Flin, O’Connor, & Cricton, 2008). It aims to increase the skills such as situation awareness, decision making, communication and cooperation among crew, and leadership and managerial skills (Flin et. al., 2003). Because CRM trainings became influential, the effectiveness of these trainings became a questions. Different researchers developed measurement tools addressing behavioral markers of CRM to investigate the effectiveness of CRM trainings. The Cockpit Management Attitudes Questionnaire (Helmreich et al., 1989), Line Operations Safety Audit (Helmreich, Klinect, &Wilhelm, 1999), Line/Line oriented Simulation Checklist (LLC, Helmreich et al., 1995) and NONTECHS (O’Connor et. al., 2002) were some of these measurement tools. These studies showed that crew showed positive attitudes towards CRM following CRM training. It was also shown that CRM trainings increased safety behaviors and decreased human error (Kanki, Helmreich & Anca, 2010). Salas et al (2001) conducted a comprehensive review on effectiveness of CRM trainings based on studies published between 1983 and 1999. They reported that CRM trainings generally produced positive reactions, enhanced learning and desired change in behavior. In 2006, Salas et. al. extended their review and found similar results. In their meta-analysis, O’Connor et al (2008) investigated the effectiveness of team training interventions in 93 different studies and concluded that team training was an effective tool to improve safety among different organizations including aviation.

Since CRM got attention based on accident investigation reports, numerous studies were conducted to measure its validity and effectiveness. Effectiveness studies basically focused on reactions to CRM trainings, and whether these trainings result in attitude change and behavioral change. However, the best of the knowledge, the role of CRM trainings on unsafe acts of pilots remains uninvestigated.

1.3.3. Organizational Influences

In past decades, numerous accidents occurred leading to questions regarding occupational safety. Chernobyl Disaster in 1986, the North Sea Piper Alpha oil rig explosion in 1988 and Columbia Disaster in 2003 are some examples of the contributing role of organizations on accident causation (Martinussen & Hunter, 2010). Since operators were started to be seen as workers in a team within organization with the development of CRM, organizational climate regarding safety became an issue for organizations in which safety is an important factor including aviation.

The Federal Aviation Administration (FAA) puts primary responsibility for safety on top management within aviation industry. According to FAA, managers are expected to take responsibility for operations and ensure that worker are involved in safety operation processes. The FAA also indicates that the success of aviation safety initiatives is related to top management's ability to develop and sustain a strong safety climate/culture (Federal Aviation Administration, 2006).

1.3.3.1. Organizational Safety Climate

Zohar (1980) defined safety climate as "a summary of molar perceptions that employees share about their work environment". In the literature, the term climate and culture are mostly used interchangeably by most researchers. However, in recent years, it was proposed that culture and climate are somewhat different constructs (Mearns & Flin, 1999). Schein (1996) defined culture as "the set of shared, taken for granted implicit assumptions that groups hold, and that determines the way how group perceive, think about and reacts to various environments". According to Schein (1990) climate, however, is a manifestation and measurable aspect of the culture. Safety climate describes workers' attitudes, perceptions and beliefs about safety and risks (Zohar, 1980). Because attitudes, perceptions and beliefs are important predictors of behaviors (Glendon, Clarke, & McKenna, 2006), safety climate can be used to predict unsafe behaviors of pilots and to prevent their occurrence.

The safety climate research has investigated the relationship between safety climate and safety outcomes such as safety behaviors, compliance with safety practices, and accident occurrence. Numerous studies showed that perceptions regarding safety climate were positively linked to self-reported safety behaviors and negatively correlated with accidents in different industries. For instance, Pousette, Larsson and Törner (2008) also showed that safety climate predicted safety behaviors among construction workers. Clarke (2006) found that organizational safety climate positively related to worker's safety compliance and participation on a meta-analysis. It was also found that positive safety climate was related to less accident involvements (Clarke, 2006). Lu and Tsai (2010) showed a positive relationship between organizational safety climate and safety behaviors of seafarers in container shipping. In Chinese manufacturing industry, Liu et. al. (2015) found results consistent with the safety climate literature. They showed that organizational safety climate predicted safety behaviors among Chinese manufacturing workers. Morrow, Koves and Barnes (2014) also found that organizational safety climate was correlated with safety performance in nuclear power plants. Moreover, Reason (1998) suggested that positive safety climate within organization can discourage an atmosphere of noncompliance to safety practices. Driver behavior literature is also in the same line with industrial behavior literature. For example, Amponsah-Tawiah and Mensah (2016) found that positive organizational safety climate negatively predicted speeding, rule violation, inattention and tired-driving behaviors of drivers working in haulage companies in Accra, Ghana. Öz, Özkan and Lajunen (2010, 2013, 2014) was also found that positive organizational safety climate was associated with less errors and violations among Turkish professional drivers.

Although literature suggests that safety climate is highly associated with safety behavior, safety climate research in aviation context mainly focused on examining factors of safety climate rather than safety outcomes of safety climate (O'Connor et. al., 2011). For example, Evans, Glendon and Creed (2007) developed a safety climate questionnaire in order to measure pilot's perceptions about workplace safety. They found three factor structure; management commitment and communication, safety training, and equipment and maintenance. The Federal Aviation Administration (FAA) stated that top management was primarily responsible for aviation safety in commercial aviation. It was also stated that the success of safety programs in aviation was mainly related to ability of managers to develop and sustain a strong safety climate in the organization (Fedaral Aviation Administration, 2006). One study showed that organizational safety climate was associated with safety behavior in aviation industry. That is, Lin (2012) found that positive safety climate was related to more safety behaviors among pilots in Taiwan.

Since safety climate literature strongly suggested that safety climate is highly related to safety related outcomes among operators, it can be critical to examine the relationship between safety climate and unsafe acts of the pilots. However, the best of the knowledge, safety climate research remains insufficient to show the relationship between these variables in the aviation context.

1.4.The Aims of the Present Study

In the light of the literature, the present study mainly aims to investigate the relationship between organizational safety climate, preconditions for unsafe acts (i.e. stress, locus of control, risk perception and crew resource management) and unsafe acts of pilots within commercial aviation in Turkey. The other purpose of the current study is to investigate differences between pilots from civil aviation school background and military aviation school background in terms of study variables. The relationship between study variables are investigated at the scope of HFACS framework in the present thesis study.

CHAPTER II

METHOD

2.1. Participants

A total of 165 commercial airline pilot participated in the present study. Three of them were excluded from the data set due to flying military aircraft. In addition to these 3 participant, 7 of the participant were excluded because they were the outliers in the data based on age, flight hours in a month, flight legs in a month, number of past 3-year incidents and flight stress level in normal conditions. A hundred and fifty-five actively flying commercial airline pilots were remained in the data set for further analysis.

There were 147 males (94.8 %) and 8 females (5.2 %) commercial airline pilots in the present study. The age range was between 21 and 62. The mean age of 155 commercial airline pilots were 39.01 (SD= 9.805). Two of the participants were graduated from high school (1.3 %), 100 of them were graduated from university (64.5 %), 52 of them have master degree (33.5 %) and one of them have doctorate degree (0.6 %). Fifty-nine of the participants had their vocational training in military aviation school (38.1 %) and 96 of them in civil aviation school (61.9 %).

The years of experience in commercial aviation were range between 1 to 25 years. The mean of 155 participants' years of experience in commercial aviation were 7.216 (*SD*= 6.513). The total flight hours in commercial aviation were range between 200 and 24,000 hours. The mean of the participants' total flight hours was 5,185.35 (*SD*= 5,228.568).

The range of flight hours in a month were 30 to 150. The mean of 155 participants' flight hours in a month were 75.10 (*SD*=14.291). In addition, the range of flight legs in a month were between 3 and 100. The mean of flight legs in a month were 30.75 (*SD*=14.531). Ninety-three of the participants indicated that they did not have any incidents in the past 3 years (60.0 %). Thirty of all participants mentioned that they had one incident (19.4 %), 18 of them had 2 (11.6 %), eight of them had 3 (5.2 %), two of them had 4 (1.3 %), three of them had 5 (1.9 %) and one of them had 6 incidents (0.6 %) in the past three years. The mean of past 3-year incidents was 0.77 (*SD*= 1.210). The mean of participants' flight stress in normal conditions were 3.54 (*SD*=1.785) out of ten.

Table 1.1 provides information about frequencies and percentages of demographic variables. Table 1.2 provides information about means and standard deviations of demographic information.

Table 1.1 Frequencies and Percentages of Gender, Education, Vocational Training, Current Position and Past 3-year Incidents

Demographic Variables	Frequencies/Percentages	
	N	%
Gender		
Male	147	94.8
Female	8	5.2
Total	155	100
Education		
High School	2	1.3
University	100	64.5
Master Degree	52	33.5
Doctorate Degree	1	0.6
Total	155	100
Vocational Training		
Military Aviation	59	38.1
Civil Aviation	96	61.9
Total	155	100
Past 3-Year Incidents		
0	93	60.0
1	30	19.4
2	18	11.6
3	8	5.2
4	2	1.3
5	3	1.9
6	1	0.6
Total	155	100

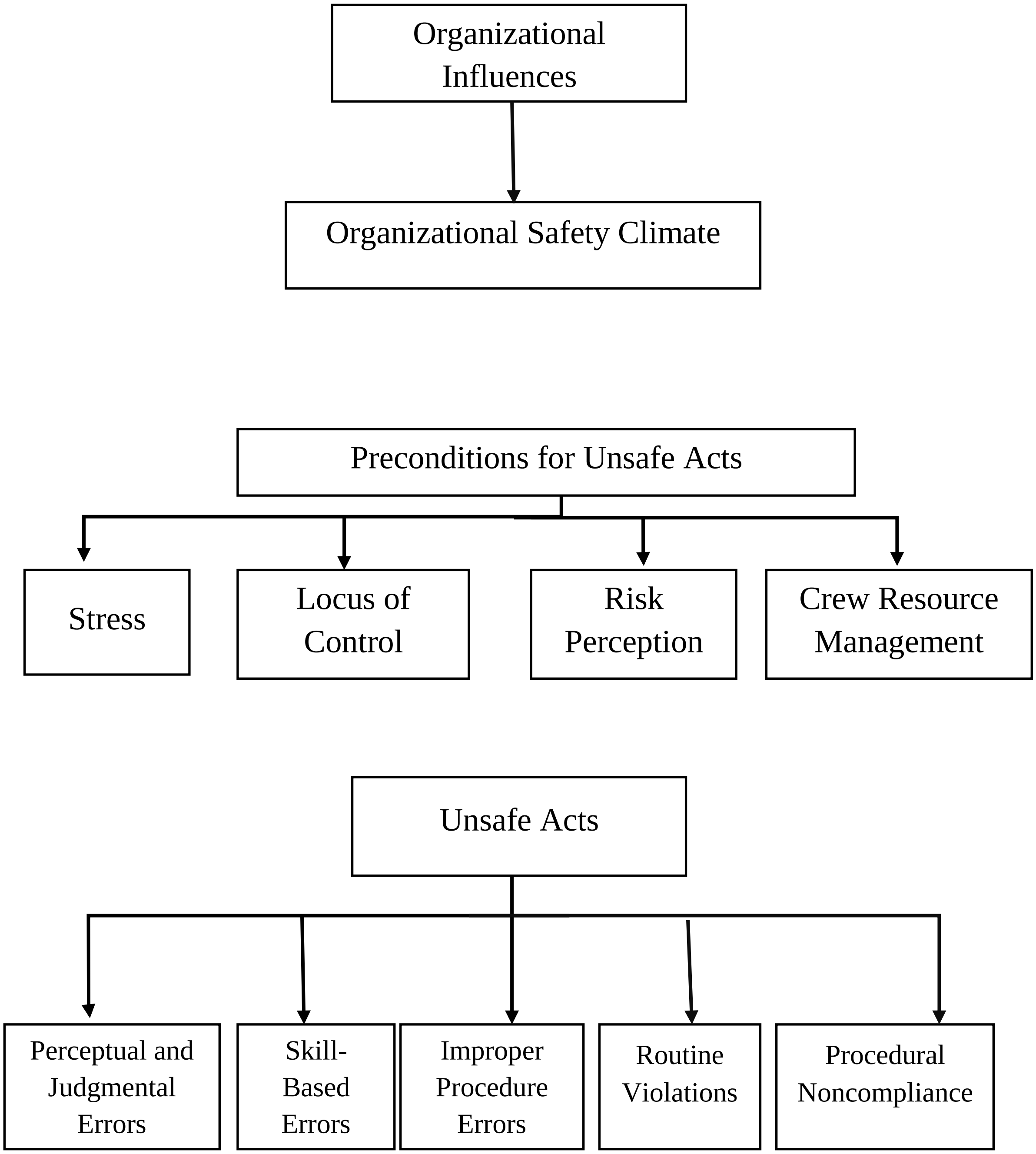
Table 1.2. *Means and Standard Deviations (SD) of Age, Years of Experience in Commercial Aviation, Total Flight Hours of Experience in Commercial Aviation, Flight Hours in a Month, Flight Legs in a Month, Past 3-Year Incidents and Flight Stress Level in Normal Conditions*

Demographic Variables	**Means/SD**	
	Mean	*SD*
Age	39.01	9.805
Years of Commercial Aviation Experience	7.216	6.513
Total Hours of Commercial Aviation Experience	5,185.35	5,228.568
Flight Hours in a Month	75.10	14.291
Flight Legs in a Month	30.75	14.531
Past 3-Year Incidents	0.77	1.210
Flight Stress in Normal Conditions	3.54	1.785

2.2. Procedure

Prior to ethical permission and data collection, Aviation Safety Climate Scale, Risk Perception-Self and –Other Scale, Aviation Safety Locus of Control Scale and Safety Operation Behavior Scale were translated into Turkish by the author and a translator. These two translations were compared by researcher and thesis supervisor to form most suitable translations of the items. The last version of the translated items was examined by former chairman of Turkish Airline Pilot Associaiton (TALPA), CP Gürcan Mantı, in order to increase appropriateness of the professional jargon. The corrections were made based on recommendations given by CP Gürcan Mantı, and the last version of the scale items were formed. Figure 2.1 shows the study variables based on HFACS framework.

Figure 2.1. Study Variables based on HFACS Framework.



Ethical permission (see Appendix A) was taken from METU Human Subjects Ethical Committee (HSEC) before the data collection. The participation was on a voluntary basis. Participants were informed about the aim and the content of the study by informed consent.

The data were collected via online survey package due to increasing accessibility to airline pilots. The survey package consists of demographic information form, Aviation Safety Climate Scale, Airline Pilot Behavior Inventory, Aviation Risk Perception-Self and –Other Scale, Aviation Safety Locus of Control Scale and Safety Operation Behavior Scale in this order. Convenience sampling method with snowball technique was used to reach commercial airline pilots. The announcement of the study and the survey link were posted on social media groups of pilots, Turkish Airline Pilots' Association (TALPA) official website and some of the news portals related to aviation. In addition to social media groups and TALPA website, some of the pilots were reached through direct messages explaining the aim of the study on social media and asked whether they wanted to participate in the present study. Pilots who wanted to participate in the study were provided the survey link.

The data of the present study was collected during a 3-and-a-half-month time period, starting from 15 December 2015 to 31 March 2016. Throughout the data collection procedure, the ethical guidelines were followed. Participants were not asked to mention their names, personnel information and their airline company where they worked for to ensure anonymity.

2.3. Measurement Instruments

Participants were presented an informed consent on the first page of the survey package (see Appendix B). After the informed consent page, participants were asked to fill demographic information form. Demographic information form was composed of questions about age, gender, education level, vocational training, year of experience in commercial aviation, total hours of flight in commercial aviation, number of flight hours in a month, number of flight legs in a month, type of the aircraft flied, passenger capacity of the aircraft, number of incident in the past 3 years, and flight stress level in normal flight conditions (see Appendix C).

2.3.1. Airline Pilot Behavior Inventory (APilotBI)

Airline Pilot Behavior Inventory (APilotBI) was developed for the present thesis study (see Appendix D for the items). In order to develop an item pool, Line Operations Safety Audit (LOSA, 1st Ed., 2002) manual of International Civil Aviation Organization (ICAO) and instructions (SHT-KOKPİT YOL BOYU, 2014) of Directorate General of Civil Aviation (DGCA) about audit of pilots during flight was examined. Item wordings were constructed based on the human error algorithm of James Reason (1990, see Figure 2.2). Because literature suggests that most of the accidents occurred during takeoff and landing, sample of items was aimed to capture the behaviors shown before takeoff, during takeoff and climb, cruise, decent, approach and landing. Forty-six items were developed initially based on sample error codes written in LOSA manual and DGCA instructions for auditing pilots during flight. While sampling behaviors based on sample error codes of LOSA and DGCA instructions, sample of accident causes found by Shappell and Wiegmann (2000) was used as a base. Then, these initial 46 items were checked by former chairman of TALPA, CP Gürcan Mantı for appropriateness for flight behaviors.

During data collection, participants were asked to rate how often they perform each behavior on a 6-point Likert type scale from 1 “never” to 6 “nearly all the time”. The scale consisted of an additional 7 point labeled as “not applicable” in order to eliminate the behaviors that might change based on aircraft type, and it was labeled as user-defined missing values for the analysis. The newly developed APilotBI were composed of 5 factor structure. Factor labels were Perceptual and Judgmental Errors for the first factor, Skill-based Errors for the second factor, Routine Violations for the third factor, Procedural Noncompliance for the fourth factor and Improper Procedure for the fifth factor. Factor analysis results and internal reliability coefficients are presented in the Result section of the present thesis study.

2.3.2. Aviation Safety Locus of Control Scale (ASLOC)

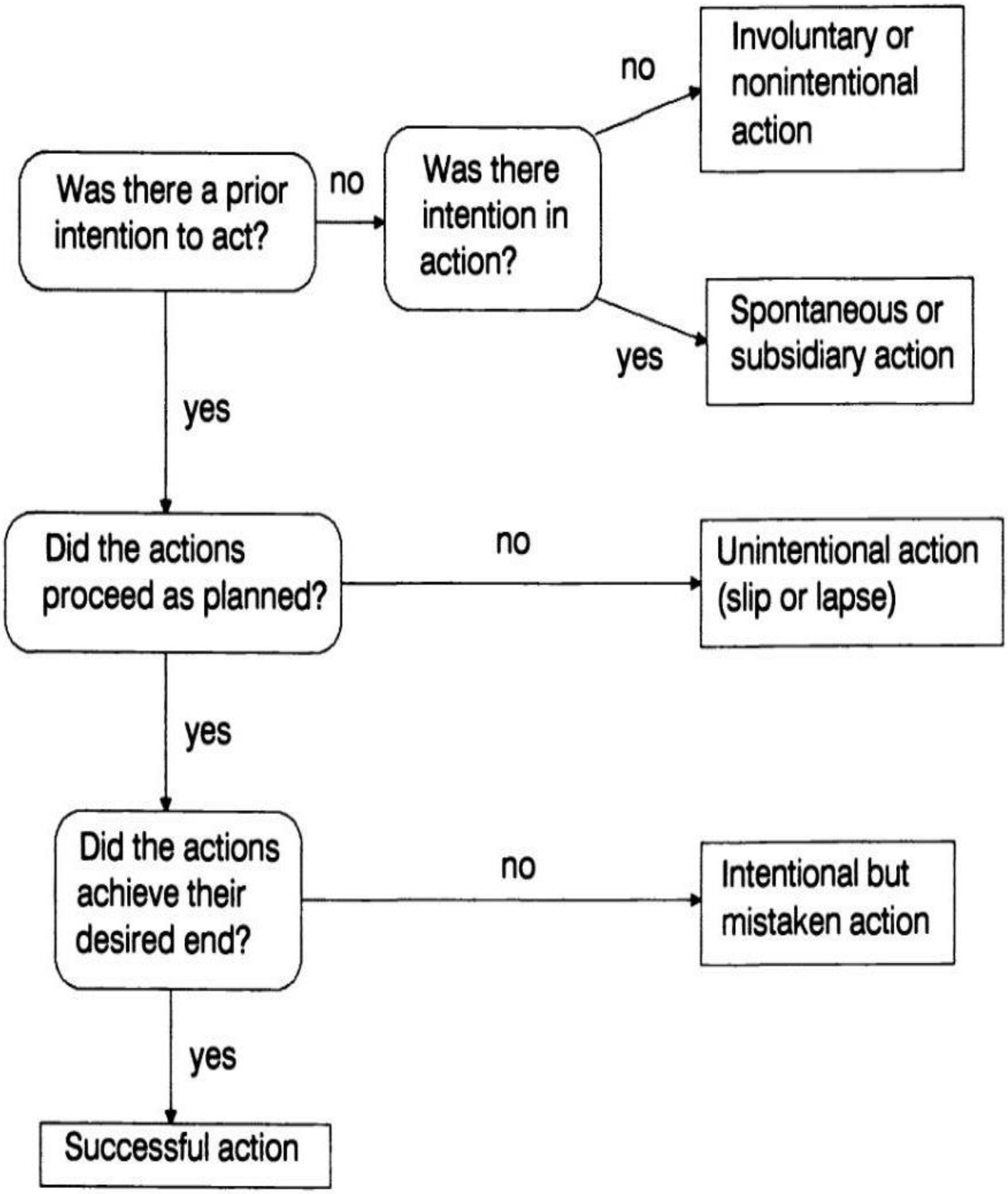
Aviation Safety Locus of Control Scale (ASLOC) was originally developed by David Hunter in 2002 in order to measure the construct of safety Locus of Control among pilot specifically (see Appendix E for items). The scale was composed of 20 items in total, 10 for internality subscale and 10 for externality subscale. The original internal reliability coefficients of the subscales were .69 for internality and .63 for externality. Participants were asked to rate each item on 5-point Likert type scale from 1 “strongly disagree” to 5 “strongly agree”. Factor analysis results and internal reliability coefficients of the adapted version of the scale are presented in the Result section of the present thesis study.

2.3.3. Risk Perception-Self and –Other Scales (RP-Self and RP-Other)

Risk Perception-Self (RP-Self) and Risk Perception-Other (RP-Other) scales originally developed by David Hunter in 2006 (see Appendix F for RP-Self and Appendix G for RP-Other). In each scale, participants were asked to rate the items from 1 “low risk” to 100 “high risk” on numeric scale.

RP-Self scale originally consisted of 26 sentences describing a situation. Seven of the sentences were related to non-aviation events (e.g. driving car and crossing the street), and the remaining 19 sentences were concerned with aviation situations. Participants were asked to rate risk in the situation for themselves if they were to perform the situation tomorrow. Participants were informed in the beginning of the scale about thinking themselves flying a light aircraft such as the one they flew in the aviation school for the aviation situations. The original RP-Self scale had 5 factors labeled as general low risk, high flight risk, altitude risk, driving risk and everyday risk with internal reliability coefficients of .93, .87, .87, .79 and .63, respectively. One of the sentences which is “Start a light aircraft with dead battery by hand-propping it” was dropped from the scale because it was recommended by TALPA that it was not appropriate. The remaining 25 sentences were used in the present thesis study.

Figure 2.2. The human error algorithm of James Reason (1990)



RP-Other scale originally consisted of 17 scenarios related to aviation. Each scenario was written in the third person perspective, and participants were asked to rate the risk present in the scenarios for the third person, not for themselves. Respondents were informed in the beginning of the scale about thinking the pilot performing the scenarios flew a light aircraft such as the one flown in the aviation school. The original RP-Other scale were composed of 3 factors labeled as delayed risk, nominal risk and high risk with Cronbach's alpha coefficients of .81, .75, and .32, respectively.

Factor analysis results and internal consistency coefficients of the adapted version of each scale are provided in the Result section of the present thesis study.

2.3.4. Safety Operation Behavior Scale (SOB)

Safety Operation Behavior Scale (SOB) was originally developed as a research project of China Civil Aviation Authority (CCAA) based on the Line/LOS Checklist Version 4.0 (LLCv4, Helmreich et al., 1997). Original SOB (see Appendix H for items) was composed of 27 sentences describing crew's operational behaviors and situations. It included 4 factors labeled as automation system understanding, leadership and management, situation awareness and decision making, and communication and cooperation. Internal reliability coefficients of the original subscales were .73, .69, .81, and .78 respectively. Because the original article about the development of SOB scale were written in Chinese, items and the normative information about the scale were obtained from the article written by You, Ji and Han in 2013. Participants were asked to rate each item on 4-point Likert type scale from 1 to 4 (1= poor, 2= Minimum Expectation, 3= Standard, 4= Outstanding). High scores in the scale indicated high levels of safety operations. Factor analysis results and Cronbach's alpha coefficients of the adapted version of the scale are provided in the Result section of the present thesis study.

2.3.5. Aviation Safety Climate Scale (ASCS)

Aviation Safety Climate Scale (ASCS) were developed by Evans, Glendon and Creed in 2007. The original ASCS consisted of 18 items measuring perceptions about safety climate in the company (see Appendix I for items). Three factor structure were proposed in the original study and named as Management Commitment and Safety Communication for the first factor, Safety Training for the second factor and Equipment and Maintenance for the third factor. Management Commitment and Safety Communication factor had 10 items with .93 Cronbach's alpha value. Safety Training and Equipment and Maintenance factors consisted of 4 items in each and had .86 and .89 Cronbach's alpha values respectively. Participants were asked to answer each item on 5 point-Likert scale from 1 "strongly disagree" to 5 "strongly agree". Factor analysis results and internal reliability coefficients of the subscales of Turkish adaptation of the scale are provided in the Result section of the present thesis.

CHAPTER III

RESULTS

3.1. Factor Analyses on Used Measurement Instruments

3.1.1. Factor Analysis on Airline Pilot Behavior Inventory

Initial Airline Pilot Behavior Inventory (APilotBI) had 46 items that contained pilot's errors and violations. Since the minimum requirement for factor analysis was decided to be 3 participants per item without missing values, participants who completed behavior inventory but did not complete the whole questionnaire package were included in the factor analysis for APilotBI. A total of 234 participants' responses was analized for factor analysis of APilotBI. The mean age for this sample was 37.64, the mean of total experience year in commercial aviation was 6.647, the mean of total flight hours in commercial aviation was 4,782.43, the mean of the flight hours in a month was 74.59, the mean of flight legs in a month 30.57, the mean of incident recording was 0.73 and the mean of perceived stress was 3.671.

Prior to factor extraction analysis, items which were rated as 7 "not applicable" were identified, and percentages of "not applicable" responses were analyzed for each item. Since the percentages of "not applicable" responses for each item did not constitute the majority of the responses, all of the 46 items were included in the factor extraction analysis.

Principal Component Analysis (PCA) was applied as a factor structure extraction method. Since the correlations among factors were exceed .50, Direct Oblimin rotation was conducted as a rotation method. The Kaiser-Meyer-Olkin Measures of Sampling Adequacy was .891, and Bartlett's Test of Sphericity was significant (*df*= 1035, *p*<

.001), it was indicated that APİLOTBI was factorable. Based on eigenvalues and the observation of scree plot, the number of extracted factors was decided as 5.

The first factor was composed of 11 items that were related to attentional and judgmental failures, and explained 31.823 % of the variance. Therefore, this factor was labeled as Perceptual and Judgmental Errors. The range of factor loadings of 11 items were between .860 and .306. The internal reliability coefficient for perceptual and judgmental errors factor was .85.

The second factor consisted of 12 items that were indication of skill based failures, and explained 7.540 % of the variance. Therefore, this factor was named as Skill-based Errors. The range of factor loadings were between -.827 and -.325. Cronbach's α coefficient for skill-based errors was .89.

The third factor included five items, and explained 4. 190 % of the variance. This factor indicated rule based violations that did not affect flight safety directly and extremely, therefore, it was labeled as Routine Violation. The range of factor loadings were between .738 and .371, and the internal reliability coefficient was .74.

The fourth factor was composed of 6 items, and explained 4.071 % of the variance. This factor was related to procedural violations such as omitting a part of the procedure. Therefore, it was named as Procedural Non-Compliance. The range of factor loadings was between .701 and .378, and the internal reliability coefficient for the items was .75.

The fifth and the last factor of APilotBI involved 5 items, and explained 3.410 % of the variance. This factor was related to decisional failures about procedural behaviors, therefore, it was labeled as Improper Procedure. The factor loadings were ranged between .670 and -.380. There were two reverse items in this factor. These are "Completing walk-around checks fully" and "Checking NOTAMs/ AIS/ MET briefing documents". The internal reliability coefficient of the factor was .71.

Seven of 46 items were excluded from the further analyses. One of the items which was item 13 was excluded since it had factor loading lower than .30. Remaining 6 items were excluded from further analyses because they were cross-loaded on two or more factors almost equally. Item 38 was loaded on two factors, with .450 on the first factor and .446 on the fourth factor. Item 28 was loaded on the first factor .392, on the fourth factor .371 and on the fifth factor -.337. Item 29 was loaded on the first factor with a loading of .362 and on the fifth factor with a loading of -.333. Item 5 was loaded on the fourth factor with a loading of .364 and also on the second factor with a loading of -.330. Item 7 was cross-loaded both on the fifth factor with -.391 and on the third factor with .355. Lastly, item 22 was loaded on both the fifth factor with a loading of -.389 and the second factor with a loading of -.347. Further analyses were conducted with remaining 39 items.

The item loadings of factors, communalities of items, eigenvalues of the factors, percentages of explained variance, and reliability coefficients are presented in Table 2.1.

Table 2.1. *The Factor Loadings of Items, Communalities, Eigenvalues, Percent of Explained Variance, and Reliability Coefficients of Airline Plot Behavior Inventory*

	Components			**Communality**		
Items	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**	
APilotBI 45	**.860**					.638
APilotBI 15	**.684**					.624
APilotBI 41	**.643**					.571
APilotBI 21	**.615**					.502
APilotBI 18	**.604**					.482
APilotBI 34	**.550**					.518
APilotBI 38	.450			.446		.549
APilotBI 20	**.449**	-.314		-.308		.466
APilotBI 36	**.444**					.412
APilotBI 8	**.435**					.442
APilotBI 28	.392			.371	-.337	.649
APilotBI 29	.362				-.333	.550
APilotBI 9	**.345**					.519
APilotBI 46	**.306**					.423
APilotBI 13						.248
APilotBI 30		**-.827**				.760
APilotBI 35		**-.757**				.589
APilotBI 4		**-.738**				.513
APilotBI 37		**-.681**				.509
APilotBI 42		**-.653**				.694
APilotBI 26		**-.648**				.650
APilotBI 25		**-.642**			.304	.485
APilotBI 3		**-.639**				.544
APilotBI 27		**-.485**	.322			.489
APilotBI 44		**-.420**				.329
APilotBI 39		**-.375**				.239

Table 2.1. *Continued*

APilotBI 11		**-.325**				.434
APilotBI 14			**.738**			.588
APilotBI 24			**.662**			.595
APilotBI 12			**.609**			.629
APilotBI 16	.335		**.476**			.465
APilotBI 10			**.371**			.256
APilotBI 40				**.701**		.615
APilotBI 32				**.681**		.567
APilotBI 33				**.528**		.552
APilotBI 43				**.526**		.574
APilotBI 17				**.410**		.421
APilotBI 31				**.378**		.425
APilotBI 5		-.330		.364		.316
APilotBI 1					**.670**	.458
APilotBI 2					**.552**	.340
APilotBI 19					**-.492**	.555
APilotBI 6				.321	**-.444**	.560
APilotBI 7			.355		-.391	.585
APilotBI 22		-.347			-.389	.651
APilotBI 23					**-.380**	.486
Eigenvalues	14.638	3.469	1.928	1.873	1.568	
Percent of Explained Variance	31.823 %	7.540 %	4.190 %	4.071 %	3.410 %	
Reliability	.85	.89	.74	.75	.71	

Note. Factor loadings < .30 were suppressed. Factor Labels. Factor 1= Perceptual & Judgmental errors, Factor 2= Skill-based errors, Factor 3= Routine Violations, Factor 4= Procedural Noncompliance, Factor 5= Improper Procedure.

3.1.2. Factor Analysis on Aviation Safety Locus of Control

As a factor extraction method, PCA was conducted for adapted version of 20-item Aviation Safety Locus of Control scale (ASLOC). Direct Oblimin rotation was applied as a rotation technique since the correlations among factors exceeded .50. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .749 and Bartlett's Test of Sphericity was significant (*df*= 190, *p*< .001) which indicated the factorable nature of adapted version of ASLOC. Based on eigenvalues and the observation of scree plot, the number of extracted factors was decided as three for further analyses.

The first factor included 9 items, and explained 20.415 % of the variance. Since the items loaded on this factor were related to fate, chance and luck, this factor labeled as Fate. The range of factor loadings were between .748 and -.382. There was a reverse item in this factor which is "People can avoid getting injure if they are careful and aware of potential dangers". This item was loaded on the Internality factor in original factor structure of ASLOC. However, in the present thesis study, it was negatively loaded on Fate factor. The internal reliability coefficient of the items was .80.

The second factor was composed of 6 items, and explained 14.974 % of the variance. It was named as Internality because the items loaded on this factor were related to the construct of Internal Locus of Control (LOC). Although item 15 which was "Most accidents can be blamed on poor FAA/DGCA oversight." was loaded on Externality factor in the original factor structure of ASLOC, it was positively loaded on Internality factor. This could be indicated that pilots in this sample internalized the management of FAA/DGCA. Factor loadings were ranged between .787 and .302. The internal reliability coefficient of the items was .59.

The third and the last factor of adapted version of ASLOC consisted of 4 items, and explained 7.373 % of the variance. This factor was labeled as Regulation Internalization because items loaded in this factor were related to following proper procedures and using safe equipment. One item which was "Accidents are usually caused by unsafe equipment and poor safety regulations" was loaded on Externality factor in original factor structure of ASLOC. However, in the present thesis study, it was positively loaded on Regulation Internalization factor which could be an indication that pilots in this sample internalize the usage of unsafe equipment and the poor safety regulations. The range of factor loadings was between .753 and .400, and Cronbach's alpha coefficient was .61.

One item which was "Accidents and injuries occur because pilots do not take enough interest in safety." was loaded both on the second factor with a value of .447 and on the third factor with a value of .421. Since loadings of this item on two factor were approximately equal, it was excluded from analyses. The remaining 19 items were included in further analyses.

The factor loadings of items, communalities, eigenvalues, percentages of explained variances, and reliability coefficients of the factors are presented Table 2.2.

3.1.3. Factor Analysis on Risk Perception-Self Scale

PCA method was conducted to analyze factor structure of 25-item adapted version of Risk Perception-Self scale (RP-Self). As a rotation method, Direct Oblimin was applied since the correlations among factors were exceeded .50. Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .857 and Bartlett's Test of Sphericity was significant ($df = 300$, $p < .001$) which indicated the factorable nature of the scale. Based on eigenvalues and the observation of scree plot, the number of factors extracted was four in the final analysis.

The first factor consisted of 10 items, and explained 35.312 % of the variance. Factor label was decided as Altitude and Fuel Risk since the items were mainly related to the risk inherent in the situation about altitude and fuel remaining in the aircraft. The range of factor loadings was between .862 and .593. The internal reliability coefficient for Altitude and Fuel Risk factor was .92.

The second factor included 5 items, and explained 11.643 % of the variance. This factor was labeled as Everyday Risk since the items were mainly related to everyday risks that one could be exposed daily such as driving a car and crossing the street. The factor

Table 2.2. *The factor loadings of items, communalities, eigenvalues, percentages of explained variances, and reliability coefficients of ASLOC*

	Components			Communality
Items	Factor 1	Factor 2	Factor 3	
ASLOC 20	**.748**			.556
ASLOC 13	**.731**			.523
ASLOC 7	**.717**			.537
ASLOC 5	**.673**			.443
ASLOC 16	**.672**			.445
ASLOC 12	**.568**			.322
ASLOC 18	**.496**			.278
ASLOC 9	**.468**	.356	-.348	.477
ASLOC 17	**-.382**			.289
ASLOC 14		**.787**		.575
ASLOC 8		**.734**		.535
ASLOC 10		**.541**		.308
ASLOC 11	-.303	**.468**		.341
ASLOC 4		.447	.421	.477
ASLOC 19		**.395**		.263
ASLOC 15		**.302**		.144
ASLOC 1			**.753**	.628
ASLOC 2			**.746**	.521
ASLOC 6			**.737**	.677
ASLOC 3			**.400**	.212
Eigenvalues	4.083	2.995	1.475	
Percent of Explained Variance	20.415 %	14.974 %	7.373 %	
Reliability	.80	.59	.61	

Note. Factor Loadings < .30 were suppressed. Factor Labels. Factor 1= Fate, Factor 2= Internality, Factor 3= Regulation Internalization.

loadings were ranged between .902 and .638. Cronbach’s α coefficient for Everyday Risk factor was .83.

The third factor was composed of 6 items, and explained 7.743 % of the variance. It is named as General low risk since the items indicated general low risk both in daily context and in flight situations. The range of factor loadings was between .806 and .506, and the internal reliability coefficients of the items was .80.

The fourth and last factor included 2 items, and explained 5.499 % of the variance. This factor was labeled as VFR (Visual Flight Rules) Risk because the key concept in both items were related to VFR. The factor loadings of these 2 items were .772 and .738, respectively. The internal reliability coefficient of the VFR Risk factor was .80.

Two items in the RP-Self scale were excluded from the further analyses. One item which was “Fly in a clear air at 6,500 feet between two thunderstorms about 25 miles apart” had factor loading lower than .30, therefore, excluded from the analyses. The other item which was “Climb up a 10-foot ladder to replace an outside light bulb.” was cross-loaded on both the second factor and the first factor with loadings of .375 and .301, respectively. Further analyses were conducted with the remaining 23 items.

The factor loadings of items, communalities, eigenvalues, percentages of explained variances, and reliability coefficients of the factors are presented Table 2.3.

Table 2.3. *The Factor Loadings of Items, Communalities, Eigenvalues, Percent of Explained Variance, and Reliability Coefficients of RP-Self Scale*

	Components				**Communality**
Items	Factor 1	Factor 2	Factor 3	Factor 4	
RP-Self 21	**.862**				.693
RP-Self 15	**.838**				.713
RP-Self 9	**.780**				.631
RP-Self 23	**.746**				.722
RP-Self 20	**.719**				.630
RP-Self 8	**.677**				.555
RP-Self 13	**.651**				.566
RP-Self 22	**.642**				.659
RP-Self 4	**.640**				.505
RP-Self 5	**.593**				.577
RP-Self 7					.239
RP-Self 17		**.902**			.836
RP-Self 11		**.784**			.795
RP-Self 19		**.729**	.315		.771
RP-Self 18		**.687**			.598
RP-Self 2		**.638**			.433
RP-Self 6	.301	.375			.357
RP-Self 24			**.806**		.675
RP-Self 12			**.717**		.599
RP-Self 16	.301		**.657**		.680
RP-Self 1			**.612**		.454
RP-Self 3			**.527**		.427
RP-Self 10			**.506**		.484
RP-Self 14				**.772**	.742
RP-Self 25				**.738**	.710
Eigenvalues	8.828	2.911	1.936	1.375	
Percent of Explained Variance	35.312 %	11.643 %	7.743 %	5.499 %	
Reliability	.92	.83	.80	.80	

Note. Factor Loadings < .30 were suppressed. Factor Labels. Factor 1= Altitude & Fuel Risk, Factor 2= Everyday Risk, Factor 3= General low risk, Factor 4= VFR Risk.

3.1.4. Factor Analysis on Risk Perception- Other Scale

PCA was conducted on adapted version of 17- scenario Risk Perception-Other (RP-Other) scale as a factor extraction method. Since the correlations among factors exceeded .50, Direct Oblimin was applied as a rotation technique. Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .856, and Bartlett’s Test of Sphericity was significant (*df*= 136, *p*< .001) which indicates that scenarios of RP-Other scale were factorable. Based on eigenvalues and the observation of scree plot, the number of factors extracted was three for further analyses.

The first factor was composed of 7 scenarios, and explained 33.661 % of the variance. It was labeled as Delayed Risk since the scenarios were related to the situations that had risk but did not require immediate response. Factor loadings of 7 scenarios were ranged between .866 and .454. The internal reliability coefficient of the scenarios was .83.

The second factor included 3 scenarios, and explained 18. 227 % of the variance. This factor was named as Nominal Risk because scenarios indicated that there was no unusual risk in the situations. The range of factor loadings was between .916 and .825, and Cronbach’s α coefficient of the scenarios was .87.

The last factor consisted of 4 scenarios, and explained 6.865 % of the variance. This factor was named as High Risk which indicated high urgency and time pressure. The range of factor loadings was between .870 and .603. ınternal reliability coefficient of the scenarios was .85.

Three scenarios in the scale were excluded from the further analyses. One scenario which was “It is late afternoon and the VFR pilot is flying west into the setting sun. For the last hour, the visibility has been steadily decreasing, however his arrival airport remains VFR, with 4 miles’ visibility and haze. This is a busy uncontrolled airfield with a single East-West runway. He decides to do a straight-in approach” was loaded both on the second factor and the third factor (.496 and .398, respectively). The other scenario which was “Just after takeoff a pilot hears a banging noise on the passenger side of the aircraft. He looks over at the passenger seat and finds that he can't locate one end of the seatbelt. He trims the aircraft for level flight, releases the controls, and tries to open the door to retrieve the seatbelt." was also loaded on two factors, with a value of .446 on the third factor and of .426 on the first factor. The third scenario which was "During the planning for a 2-hour cross-country flight, a pilot makes a mistake in computing the fuel consumption. He believes that he will have over an hour of fuel remaining upon arrival, but he will really only have about 15 minutes of fuel left." Also excluded from further analyses since it did not reach criterion value of .30. Therefore, further analyses were conducted with 15 scenarios.

The factor loadings of items, communalities, eigenvalues, percentages of explained variances, and reliability coefficients of the factors are presented Table 2.4.

3.1.5. Factor Analysis on Safety Operation Behavior Scale

PCA was conducted as a factor extraction method for adapted version of Safety Operation Behavior scale (SOB). Direct Oblimin rotation was selected as a rotation technique since the correlations between factors exceeded .50. Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .917 and Bartlett's Test of Sphericity was significant (*df*= 351, *p*< .001) which indicated that adapted version of SOB was factorable. Based on eigenvalues and the observation of scree plot, the number of factors extracted was decided as three for final analyses. There were no items loaded lower than .30, and cross-loaded on two or more factors almost equally. Therefore, all of 27 items were retained in the analyses.

The first factor was composed of 14 items, and explained 43.402 % of the variance. Since items loaded in the factor were the indicators of crew and automation systems management, this factor was labeled as Crew and Automation System Management. The range of factor loadings was between .900 and .338, and the internal reliability coefficient of items was .93.

Table 2.4. *The factor loadings of items, communalities, eigenvalues, percentages of explained variances, and reliability coefficients of RP-Other Scale*

	Components			**Communality**
Items	Factor 1	Factor 2	Factor 3	
RP-Other 16	**.866**			.657
RP-Other 11	**.750**			.617
RP-Other 15	**.718**			.634
RP-Other 14	**.705**			.599
RP-Other 17	**.592**			.425
RP-Other 9	**.482**			.466
RP-Other 7	**.454**			.454
RP-Other 12		**.916**		.850
RP-Other 13		**.884**		.794
RP-Other 10		**.825**		.730
RP-Other 8		.496	.398	.540
RP-Other 2			**.870**	.723
RP-Other 4			**.703**	.703
RP-Other 3			**.695**	.767
RP-Other 1			**.603**	.317
RP-Other 5	.426		.446	.573
RP-Other 6				.138
Eigenvalues	5.722	3.099	1.167	
Percent of Explained Variance	33.661 %	18.227%	6.865 %	
Reliability	.83	.87	.85	

Note. Factor Loadings < .30 were suppressed. Factor Labels. Factor 1= Delayed Risk, Factor= Nominal Risk, Factor 3= High Risk.

The second factor included 5 of all items, and explained 9.588 % of the variance. This factor was labeled as Situation Awareness and Decision Making because items of the factor were related to awareness of crew’s workload and fatigue, and decision making process of the crew. Factor loadings of items were ranged between .849 and .515, and Cronbach's alpha coefficient of the items was .83.

The last factor was composed of 8 items, and explained 5.250 % of variance. Since the items of the factor were linked to crew communication and cooperation, it was labeled as Communication and Cooperation. The range of factor loadings was between -.781 and -.428. The internal reliability coefficient of 8 items was .88.

The factor loadings of items, communalities, eigenvalues, percentages of explained variances, and reliability coefficients of the factors are presented Table 2.5.

3.1.6. Factor Analysis on Aviation Safety Climate Scale (ASCS)

As a factor structure extraction method Principal Component Analysis (PCA) was conducted for adapted version of Aviation Safety Climate Scale (ASCS). Direct Oblimin rotation was used for rotation method because the correlations among components were exceeded .50. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .944 and Bartlett's Test of Sphericity was significant (df= 153, p< .001) which indicated that the items were factorable. Using the eigenvalues and the observation of the scree plot, only one factor was extracted for the final analysis. There were no items that had factor loadings lower than .30.

The only factor contained all of the 18 items, and was named as Organizational Safety Climate. It explained 62.294 % of the total variance. The item loadings were between .895 and .645. Cronbach's alpha coefficient of the items was .96. The item loadings of factors, communalities of items, eigenvalues of the factors, percentages of explained variance, and reliability coefficients are presented in Table 2.6.

Table 2.5. *The factor loadings of items, communalities, eigenvalues, percentages of explained variances, and reliability coefficients of SOB Scale*

	Components			**Communality**
Item	Factor 1	Factor 2	Factor 3	
SOB 20	**.900**			.800
SOB 16	**.855**			.699
SOB 22	**.840**			.631
SOB 19	**.820**			.660
SOB 17	**.798**			.660
SOB 15	**.790**			.643
SOB 18	**.789**			.647
SOB 21	**.656**			.575
SOB 23	**.537**			.570
SOB 12	**.527**			.324
SOB 26	**.517**	.413		.652
SOB 14	**.515**			.437
SOB 11	**.476**			.511
SOB 10	**.338**			.303
SOB 8		**.849**		.693
SOB 25		**.769**		.720
SOB 27	.310	**.705**		.632
SOB 24		**.690**		.613
SOB 9		**.515**		.360
SOB 1			**-.781**	.645
SOB 5			**-.776**	.685
SOB 2			**-.753**	.574

Table 2.5. *Continued*

SOB 7			-.699	**.503**
SOB 3			**-.638**	.568
SOB 4	.338		**-.557**	.542
SOB 6			**-.487**	.574
SOB 13			**-.428**	.504
Eigenvalues	11.719	2.589	1.418	
Percent of Explained Variance	43.402 %	9.588 %	5.250 %	
Reliability	.93	.83	.88	

Note. Factor loadings < .30 were suppressed. Factor Labels. Factor 1= Crew and Automation Management, Factor 2= Situation Awareness and Decision Making, Factor 3= Communication and Cooperation.

Table 2.6. *Factor Loadings, Communalities, Eigenvalues, Percentages of Explained Variance and Reliability Coefficients of ASCS Items*

	Components	**Communality**
Items	Factor 1	
ASCS 2	.895	.801
ASCS 10	.869	.755
ASCS 6	.854	.730
ASCS 11	.853	.728
ASCS 7	.844	.712
ASCS 18	.841	.707
ASCS 1	.826	.682
ASCS 17	.803	.645
ASCS 13	.772	.595
ASCS 14	.770	.592
ASCS 16	.765	.585
ASCS 4	.763	.583
ASCS 5	.754	.568
ASCS 15	.749	.561
ASCS 12	.747	.558
ASCS 3	.730	.532
ASCS 8	.680	.463
ASCS 9	.645	.415
Eigenvalues	11.213	
Percent of Explained Variance	62.294 %	
Reliability	.96	

Note. Factor loadings < .30 were suppressed. Factor Labels. Factor 1= Organizational Safety Climate.

3.2. Descriptive Statistics and Correlations between Study Variables

3.2.1. Descriptive Statistics of Study Variables

Prior to bivariate correlation analysis, descriptive statistics were conducted in order to investigate means standard deviations (*SD*), and minimum and maximum values of study variables. The results of the descriptive statistics are presented in Table 3.1.

3.2.2. Bivariate Correlations between Study Variables

In order to investigate associations between study variables, bivariate correlation analyses were conducted. When demographic variables were examined, age was positively correlated with total flight hours in commercial aviation (*r*= .752, *p*< .001), with everyday risk (*r*= .247, *p*=.002), and general low risk for self (*r*=.212, *p*= .009). It was also positively correlated with situation awareness and decision making (*r*= .293, *p*< .001), communication and cooperation (*r*= .276, *p*= .001), and total score of SOB (*r*= .255, *p*= .001). In addition to these, age was negatively related to perceptual and judgmental errors (*r*= -.216, *p*=.007) and improper procedure errors (r= -.186, p= .020). Total flight hour in commercial aviation was also negatively correlated with perceptual and judgmental errors (*r*= -.172, *p*= .033), and with VFR risk for self (*r*=-.213, *p*= .008). Moreover, it was positively related to everyday risk for self (*r*= .199, *p*= .013), with internal aviation safety LOC (*r*= .222, *p*= .006), situation awareness and decision making (*r*= .222, *p*= .005), communication and cooperation (*r*= .21, *p*=.007), and total score of SOB (*r*= .162, *p*= .043). In addition, flight hours in a month was positively related to fate (*r*= .217, *p*= .007), and situation awareness and decision making (*r*= .215, *p*= .007). Number of legs flown in a month was positively correlated with routine violations (*r*= .168, *p*= .038). Flight stress in normal flight conditions was positively correlated with perceptual and judgmental errors (*r*= .222, *p*= .005), procedural

Table 3.1. *Sample Size (N), Minimum and Maximum Values, Means and Standard Deviations (SD) of Study Variables.*

VARIABLES	***N***	***Minimum***	***Maximum***	***Mean***	***SD***
1.Age	155	21	62	39.01	9.805
2.Total Hours	155	200	24,000	5,185.35	5,228.568
3.M-Hour	155	30	150	75.10	14.291
4.M-Leg	155	3	100	30.75	14.531
5.Incident	155	0	6	0.77	1.210
6.Stress	155	0	8	3.54	1.785
7.Perceptual	155	1.00	3.45	1.797	0.480
8.Skill-Based	155	1.00	4.25	1.245	0.375
9.Routine	154	1.00	4.00	1.764	0.620
10.Procedural	155	1.00	5.00	1.637	0.615
11.Improper	155	1.00	4.00	1.380	0.463
12 APilotBI	155	1.14	3.82	1.793	0.379
13.ASCS	155	1.17	5.00	4.152	0.860
14.Altitude	153	1.00	87.70	38.633	19.523
15.Everyday	153	10.20	100.00	61.028	20.523
16.General	153	1.00	56.67	23.571	15.076
17.VFR	153	1.00	100.00	43.255	25.151
18.RP-SELF	153	7.74	76.61	40.011	14.589
19.Fate	155	1.00	3.78	1.966	0.692
20.Internal	155	1.33	5.00	3.029	0.704
21.Regulation	155	1.00	5.00	3.939	0.765
22.ASLOC	155	2.37	4.84	3.697	0.464
23.Delayed	147	9.00	100.00	66.788	18.603

Table 3.1. *Continued*

24.Nominal	**144**	**1.00**	**100.00**	**22.044**	**19.369**
25.High	145	25.25	100.00	78.853	17.635
26.RP-OTHER	147	18.29	95.21	60.585	13.915
27.Crew-Man	155	1.93	4.00	3.308	0.429
28.SA-DM	155	1.40	4.00	3.072	0.573
29.Com-Coop	155	1.25	4.00	3.322	0.456
30.SOB	155	1.63	4.00	3.268	0.404

Note. Total Hours= Total Flight Hours in Commercial Aviation, M-Hour= Flight Hours in a Month, M-Leg, Number of Legs in a Month, Incident= Number of Past 3-year Incidents, Stress= Flight Stress in Normal Flight Conditions, Perceptual=Perceptual & Judgmental Errors, Skill-Based= Skill-Based Errors, Routine= Routine Violations, Procedural= Procedural Noncompliance, Improper= Improper Procedure, APilotBI=Total Score of APilotBI, ASCS=Organizational Safety Climate, Altitude=Altitude Risk, Everyday= Everyday Risk, General= General low risk, VFR= VFR Risk, Fate= Fate factor of ASLOC, Internal= Internality, Regulation= Regulation Internalization, ASLOC=Total Score of ASLOC, Delayed= Delayed Risk, Nominal=Nominal Risk, High= High Risk, RP-Other= Total Score of RP-Other, Crew-Man= Crew & Automation Management, SA-DM= Situation Awareness & Decision Making, Com-Coop= Communication & Cooperation, SOB=Total Score of SOB

noncompliance (*r*= .174, *p*= .030), improper procedure (*r*= .209, *p*= .009), total score of APilotBI (*r*= .159, *p*= .048). It was also positively related to altitude risk for self (*r*= .323, *p*< .001), total score of RP-Self (*r*= .249, *p*= .002), delayed risk for others (r= .203, p= .014), high risk for others (*r*= .171, *p*= .040=, total score of RP-Other (*r*=234, *p*= .007). However, it is negatively correlated with situation awareness and decision making (*r*= -.216, *p*= .007).

The relationship among subscales of APilotBI and other study variables were examined. It was found that perceptual errors were negatively correlated with general low risk for self (*r*= -.168, *p*= .038), internality (*r*= -.171, *p*= .034), regulation internalization (*r*= -.229, *p*= .004), situation awareness and decision making (*r*= -.188, *p*= .019), communication and cooperation (*r*= -.180, *p*= .025), and total score of SOB (*r*= -.174, *p*= .031). Skill-based errors were negatively correlated with organizational safety climate (*r*= -.241, *p*= .003), regulation internalization (*r*= -.158, *p*= .049), and communication and cooperation (*r*= -.190, *p*= .018). Routine violations were negatively related to organizational safety climate (*r*= -.208, *p*= .010), regulation internalization (*r*=

-.228, *p*= .004), total score of ASLOC (*r*= -.164, *p*= .042), crew and automation system management (*r*= -.193, *p*= .016), communication and cooperation (*r*= -.233, *p*= .004), and total score of SOB (*r*= -.221, *p*= .006). Procedural noncompliance was negatively associated with organizational safety climate (*r*= -.210, *p*= .009), regulation internalization (*r*= -.192, *p*= .017), crew and automation system management (*r*= -.218, *p*= .007), situation awareness and decision making (*r*= -.203, *p*= .011), and total score of SOB (*r*= -.218, *p*= .006). Improper procedure was negatively correlated with organizational safety climate (*r*= -.228, *p*= .004), crew and automation system management (*r*= -.171, *p*= .033), situation awareness and decision making (*r*= -.199, *p*= .013), communication and cooperation (*r*= -.164, *p*= .041), and total score of SOB (*r*= -.201, *p*= .012). Total score of APilotBI was negatively correlated with organizational safety climate (*r*= -.193, *p*= .016), regulation internalization (*r*= -.230, *p*= .004), crew and automation system management (*r*= -.210, *p*= .009), situation awareness and decision making (*r*= -.174, *p*= .030), communication and cooperation (*r*= -.223, *p*= .005), and total score of SOB (*r*= -.236, *p*= .003).

The associations between organizational safety climate and other study variables were analyzed. Organizational safety climate was found to be negatively related to altitude and fuel risk for self (*r*= -.181, *p*= .025), general low risk for self (*r*= -.227, *p*= .005), total score of RP-Self (*r*= -.210, *p*= .009). However, it was positively correlated with regulation internalization (*r*= .199, *p*= .013), crew and automation system management (*r*= .375, *p*< .001), situation awareness and decision making (*r*= .256, *p*= .001), communication and cooperation (*r*= .323, *p*< .001), and total score of SOB (*r*= .382, *p*< .001).

The correlations among subscale of RP-Self and other study variables were investigated. The results showed that altitude and fuel risk for self was positively correlated with fate factor of ASLOC (*r*= .216, *p*= .007), delayed risk for others (*r*= .260, *p*= .001), nominal risk (*r*= .387, *p*< .001), high risk for others (*r*= .208, *p*= .012), total score of RP-Other (*r*= .355, *p*< .001). However, it was found to be negatively correlated with regulation internalization (*r*= -.188, *p*= .020), total score of ASLOC (*r*= -.202, *p*= .012), crew and automation system management (*r*= -.230, *p*= .004), situation awareness and decision making (*r*= -. 181, *p*= .025), communication and cooperation (*r*= -.211, *p*= .009), and total score of SOB (*r*= -.245, *p*= .002). Everyday risk for self was positively associated with delayed risk for others (*r*= .499, *p*< .001), high risk for others (*r*= .501, *p*< .001), and total score of RP-Other (*r*= .515, *p*< .001). General low risk for self was found to be positively associated with fate (*r*= .223, *p*= .006), nominal risk for others (*r*= .496, *p*< .001), total score of RP-Other (*r*= .219, *p*= .008). It was also found to be negatively associated with total score of ASLOC (*r*= -.207, *p*= .010). VFR risk for self was positively correlated with, delayed risk (*r*= .271, *p*= .001), high risk for others (*r*= .257, *p*= .002), and total score of RP-Other (*r*= .323, *p*< .001). It was found to be negatively correlated with situation awareness and decision making (*r*= -.209, *p*= .009). Total score of RP-Self was positively correlated with fate (*r*= .208, *p*= .010), delayed risk (*r*= .372, *p*< .001), nominal risk (*r*= .389, *p*< .001), high risk for others (*r*= .313, *p*< .001), and total score of RP-Other (*r*= .471, *p*< .001). However, it was negatively associated with total score of ASLOC (*r*= -.167, *p*= .039), crew and automation system management (*r*= -.170, *p*= .036), and total score of SOB (*r*= -.172, *p*= .034).

The correlations between subscales of ASLOC and other study variables were investigated. Fate was found to be positively associated with nominal risk (*r*= .371, *p*<. 001). However, it was negatively delayed risk (*r*= -.247, *p*= .003), and high risk for others (*r*= -.168, *p*= .043). Regulation internalization was positively associated with crew and automation system management (*r*= .248, *p*= .002), situation awareness and decision making (*r*= .172, *p*= .032), communication and cooperation (*r*= .228, *p*= .004), and total score of SOB (*r*= .258, *p*= .001). Total score of ASLOC was positively correlated with delayed risk (*r*= .214, *p*= .009), high risk for others (*r*= .167, *p*= 045), crew and automation system management (*r*= .228, *p*= .004), and total score of SOB (*r*= .186, *p*= .020). However, it was negatively correlated with nominal risk (*r*= -.340, *p*< .001). Correlations among study variables are represented in Table 3.2.

Table 3.2. *Correlations among study variables*

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.Age	1														
2.Total Hours	.752**	1													
3.M-Hour	-.032	.103	1												
4.M-Leg	.097	.009	.125	1											
5.Incident	-.143	-.017	.064	.019	1										
6.Stress	-.084	-.082	.010	-.050	.151	1									
7.PERCEPTUAL	-.216**	-.172*	-.059	.030	.070	.222**	1								
8.SKILL-BASE	.037	.065	.043	.056	.076	.096	.484**	1							
9.ROUTINE	-.057	.012	-.110	.168*	.129	.007	.527**	.512**	1						
10.PROCEDURE	-.065	.017	-.056	.057	.142	.174*	.689**	.506**	.591**	1					
11.IMPROPER	-.186*	-.102	-.095	.079	.045	.209**	.592**	.551**	.544**	.601**	1				
12.APBI	-.122	-.047	-.040	.079	.115	.159*	.864**	.761**	.755**	.845**	.730**	1			
13.ASCS	.005	-.102	.051	.034	-.077	-.145	-.053	-.241**	-.208**	-.210**	-.228**	-.193*	1		
14.ALTITUDE	-.007	-.062	.024	.019	.032	.323**	.093	.154	.104	.144	.111	.142	-.181*	1	
15.EVERYDAY	.247**	.199*	.052	.060	-.031	.087	-.046	.033	.001	.004	-.078	-.031	-.092	.299**	1

Table 3.2. *(Continued)*

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16.LOW	.212**	.147	-.029	.090	-.108	.075	-.168*	.142	.049	-.034	-.037	-.024	-.227**	.629**	.275**
17.VFR	-.077	-.213**	-.116	.036	.001	.103	-.057	-.054	.090	-.019	.062	-.036	-.111	.467**	.217**
18.RP-SELF	.116	.031	.004	.059	-.020	.249**	-.014	.130	.088	.073	.039	.061	-.210**	.911**	.585**
19.FATE	.025	.065	.217**	.111	.080	-.106	-.035	.037	.111	.100	-.084	.054	-.009	.216**	.060
20.INTERNAL	.133	.222**	.112	.138	-.128	-.042	-.171*	.069	-.013	-.017	.123	-.052	.010	.040	.124
21.REGUL	.058	.077	.091	.033	-.091	-.083	-.229**	-.158*	-.228**	-.192*	-.151	-.230**	.199*	-.188*	.097
22.ASLOC	.066	.087	-.068	-.001	-.149	.026	-.137	-.048	-.164*	-.145	.066	-.143	.071	-.202*	.050
23.DELAYED	.137	-.022	-.105	-.123	.087	.203*	-.005	-.034	-.014	-.047	-.039	.053	-.068	.260**	.499**
24.NOMINAL	.050	.068	.128	.132	.073	.131	-.050	.082	.050	.003	-.056	.011	-.115	.387**	.027
25.HIGH	-.029	-.086	-.088	-.048	.006	.171*	.104	-.072	-.006	-.023	-.001	-.009	-.060	.208*	.501**
26.RP-OTHER	.104	-.037	-.069	-.034	-.040	.234**	-.010	-021	.002	-.038	-.045	-.039	-.110	.355**	.515**
27.CREW-MAN	.156	.059	-.005	-.028	-.040	.007	-.117	-.149	-.193*	-.218**	-.171*	-.210**	.375**	-.230**	.024
28.SA-DM	.293**	.222**	.215**	.067	-.080	-.216**	-.188*	-.032	-.136	-.203*	-.199*	-.174*	.256**	-.181*	.110
29.COM-COOP	.276**	.215**	.029	.042	-.133	-.098	-.180*	-.190*	-.233**	-.134	-.164*	-.223**	.323**	-.211**	.097
30.SOB	.255**	.162*	.064	.016	-.088	-.085	-.174*	-.154	-.221**	-.218**	-.201*	-.236**	.382**	-.245	.074

Table 3.2. *(Continued)*

VARIABLES	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
16.LOW	1														
17.VFR	.318**	1													
18.RP-SELF	.766**	.573**	1												
19.FATE	.223**	.036	.208**	1											
20.INTERNAL	.001	.010	.063	.056	1										
21.REGUL	-.135	-.128	-.136	-.178*	.304**	1									
22.ASLOC	-.207*	-.067	-.167*	-.742**	.545**	.618**	1								
23.DELAYED	.103	.271**	.372**	-.247**	.049	.042	.214**	1							
24.NOMINAL	.496**	.130	.389**	.371**	-.066	-.132	-.340**	.100	1						
25.HIGH	.011	.257**	.313**	-.168*	.038	.076	.167*	.572**	-.177	1					
26.RP-OTHER	.219**	.323**	.471**	-.126	.023	.011	.105	.924**	.310**	.711**	1				
27.CREW-MAN	-.151	-.006	-.170*	-.134	.099	.248**	.228**	.076	-.041	.076	.081	1			
28.SA-DM	-.019	-.209**	-.110	.076	.063	.172*	.036	-.002	.114	-.055	.009	.545**	1		
29.COM-COOP	-.117	-.137	-.146	-.029	.113	.228**	.154	.089	-.030	.060	.104	.670**	.641**	1	
30.SOB	-.128	-.104	-.172*	-.063	.109	.258**	.189*	.071	-.004	.048	.082	.917**	.777**	.871**	1

** Correlation significant at the .05 level (2-Tailed). **Correlation significant at the .01 level (2-Tailed).*

Note. Total Hours= Total Flight Hours in Commercial Aviation, M-Hour= Flight Hours in a Month, M-Leg, Number of Legs in a Month, Incident= Number of Past 3-year Incidents, Stress= Flight Stress in Normal Flight Conditions, Perceptual=Perceptual & Judgmental Errors, Skill-Based= Skill-Based Errors, Routine= Routine Violations, Procedural= Procedural Noncompliance, Improper= Improper Procedure, APilotBI=Total Score of APilotBI, ASCS=Organizational Safety Climate, Altitude=Altitude Risk, Everyday= Everyday Risk, General= General low risk, VFR= VFR Risk, RP-Self= Total Score of RP-SELF, Fate= Fate factor of ASLOC, Internal= Internality, Regulation= Regulation Internalization, ASLOC=Total Score of ASLOC, Delayed= Delayed Risk, Nominal=Nominal Risk, High= High Risk, RP-Other= Total Score of RP-Other, Crew-Man= Crew & Automation Management, SA-DM= Situation Awareness & Decision Making, Com-Coop= Communication & Cooperation, SOB=Total Score of SOB

3.3. Main Analyses

3.3.1. Group Comparisons on Study Variables

3.3.1.1. Comparisons Based on Incident Recording on Study Variables

An independent sample t-test was conducted in order to examine group differences based on incident recording on study variables.

The only significant result was found for routine violations. It was found that there was a significant differences between pilots who did not have any incident records and pilots who had experienced incidents once or more than once (*t*(152)= -2.571, *p*= .011, 95% *CI*[-.455, -.060]). Pilots who did not have any incident records (*M*= 1.660, *SD*= .524) reported lower routine violations than pilot who had experienced incident at least once (*M*= 1.918, *SD*= .718). In other words, pilots who did not experience any incidents committed routine violations less than pilots who had experienced at least one incident in their commercial aviation carriers.

It was found that there was no significant relationship between having no incident record and experiencing at least one incident throughout commercial aviation career on other study variables. Table 4.1 represents t-test comparisons results based on incident records on study variables.

3.3.1.2. Comparisons Based on Vocational Training on Study Variables

An independent sample t-test was conducted in order to examine group differences based on vocational training on study variables.

In the t-test analysis, it was found that there was a significant difference between pilots from military aviation school and civil aviation school on improper procedure (*t*(153) = -2.699, *p*= .008, 95% *CI* [-.351, -.054]). Pilots who were graduated from military aviation school (*M*= 1.254, SD= .369) reported lower improper procedure errors than pilots who were graduated from civil aviation school (*M*= 1.457, *SD*= .498). That is, pilots graduated from military aviation

Table 4.1. *Number of Participants, Means, Standard Deviations (SD), t Scores and p Values of Comparison based on Incident Record on Study Variables*

	N	***M***	***SD***	***t***	***p***
Organizational Safety Climate				1.172	.243
No Incident Record	93	4.218	.820		
Having Incident Record	62	4.052	.916		
Perceptual and Judgmental Errors				-.631	.529
No Incident Record	93	1.777	.419		
Having Incident Record	62	1.827	.562		
Skill-Based Errors				-.637	.525
No Incident Record	93	1.230	.301		
Having Incident Record	62	1.269	.467		
Routine Violations				-2.571	.011**
No Incident Record	93	1.660	.524		
Having Incident Record	62	1.918	.718		
Procedural Noncompliance				-1.658	.099
No Incident Record	93	1.571	.548		
Having Incident Record	62	1.737	.696		
Improper Procedure Errors				-1.067	.288
No Incident Record	93	1.347	.405		
Having Incident Record	62	1.428	.538		
Total Score of APilotBI				-1.523	.130
No Incident Record	93	1.755	.323		
Having Incident Record	62	1.849	.447		
Altitude and Fuel Risk				-.702	.483
No Incident Record	92	37.729	19.118		
Having Incident Record	61	39.997	20.201		

Table 4.1. *(Continued)*

Everyday Risk				**-.020**	**.984**
No Incident Record	92	61.001	20.123		
Having Incident Record	61	61.069	21.104		
General low risk for Self				.123	.902
No Incident Record	92	23.694	15.346		
Having Incident Record	61	23.386	14.785		
VFR Risk				.115	.909
No Incident Record	92	43.446	25.185		
Having Incident Record	61	42.967	25.304		
Total Score of RP-Self				-.369	.712
No Incident Record	92	39.655	14.416		
Having Incident Record	61	40.547	14.950		
Fate				-1.244	.215
No Incident Record	93	1.909	.696		
Having Incident Record	62	2.050	.684		
Internality				.885	.378
No Incident Record	93	3.070	.712		
Having Incident Record	62	2.968	.691		
Regulation Internalization				.524	.601
No Incident Record	93	3.965	.760		
Having Incident Record	62	3.899	.775		
Total Score of ASLOC				1.490	.138
No Incident Record	93	3.742	.434		
Having Incident Record	62	3.629	.501		
Delayed Risk				-.251	.802
No Incident Record	88	66.472	18.425		
Having Incident Record	59	67.261	19.015		

Table 4.1. *(Continued)*

Nominal Risk				-1.541	.126
No Incident Record	86	20.012	17.392		
Having Incident Record	58	25.058	21.787		
High Risk for Others				.126	.900
No Incident Record	89	79.000	17.642		
Having Incident Record	56	78.621	17.780		
Total Score of RP-Other				-.586	559
No Incident Record	88	60.033	14.320		
Having Incident Record	59	61.409	13.366		
Crew and Automation System Management				.878	.381
No Incident Record	93	3.333	.408		
Having Incident Record	62	3.271	.460		
Situation Awareness and Decision Making				1.226	.222
No Incident Record	93	3.118	.568		
Having Incident Record	62	3.003	.579		
Communication and Cooperation				.926	.356
No Incident Record	93	3.350	.444		
Having Incident Record	62	3.280	.472		
Total Score of SOB				1.115	.266
No Incident Record	93	3.298	.391		
Having Incident Record	62	3.224	.423		

school committed lower improper procedure errors than pilots graduated from civil aviation school.

When the t-test comparison was conducted for subscales and total score of RP-Self, it was found that pilots graduated from military aviation school were significantly different from pilots graduated from civil aviation school on VFR risk (*t*(151)= -2.265, *p*= .025, 95% *CI* [-17.536, -1.195]). Pilots from military aviation school (*M*= 37.439, *SD*= 25.298) reported lower VFR risk than pilots from civil aviation school (*M*= 46.571, *SD*= 24.518). In other words, pilots from military aviation school perceived lower VFR risk for themselves than pilots from civil aviation school.

In terms of subscales and total score of SOB, there was a significant difference between pilots graduated from military aviation school and pilots graduated from civil aviation school on situation awareness and decision making (*t*(153)= 2.689, *p*= .008, 95% *CI*[.066, .434]). Pilots graduated from military aviation (*M*= 3.227, *SD*= .532) reported higher safety operation behavior based on situation awareness and decision making than pilots graduated from civil aviation school (*M*= 2.977, *SD*= .579). In addition, it was found that pilots from military aviation (*M*= 3.419, *SD*= .433) were significantly differed from pilots from civil aviation (*M*= 3.262, *SD*= .461) on communication and cooperation (*t*(153)= 2.117, *p*= .036, 95% *CI*[.011, .305]). That is, pilots from military aviation reported higher safety operation behaviors on communication and cooperation among crew than pilots from civil aviation school.

There were no significant differences between pilots graduated from military school and from civil aviation school on other study variables. Table 4.2 represents t-test comparisons based on vocational training groups on study variables.

Table 4.2. *Number of Participants, Means, Standard Deviations (SD), t Scores and p Values of Comparison based on Vocational Training on Study Variables*

	N	***M***	***SD***	***t***	***p***
Organizational Safety Climate				1.161	.247
Military Aviation	59	4.254	.892		
Civil Aviation	96	4.089	.839		
Perceptual and Judgmental Errors				-1.761	.08
Military Aviation	59	1.711	.406		
Civil Aviation	96	1.850	.515		
Skill-Based Errors				.668	.51
Military Aviation	59	1.271	.356		
Civil Aviation	96	1.229	.388		
Routine Violations				-.687	.493
Military Aviation	59	1.720	.634		
Civil Aviation	95	1.791	.614		
Procedural Noncompliance				-1.070	.286
Military Aviation	59	1.570	.540		
Civil Aviation	96	1.679	.655		
Improper Procedure Errors				-2.699	.008**
Military Aviation	59	1.254	.369		
Civil Aviation	96	1.457	.498		
Total Score of APilotBI				-1.148	.253
Military Aviation	59	1.748	.336		
Civil Aviation	96	1.820	.402		
Altitude and Fuel Risk				-1.230	.221
Military Aviation	58	36.153	20.057		
Civil Aviation	95	40.147	19.138		
Everyday Risk				.950	.344
Military Aviation	58	63.037	20.751		
Civil Aviation	95	59.800	20.277		

Table 4.2. *(Continued)*

General low risk for Self				.547	.585
Military Aviation	58	24.426	15.646		
Civil Aviation	95	23.049	14.778		
VFR Risk				-2.265	.025*
Military Aviation	58	37.440	25.298		
Civil Aviation	95	46.805	24.518		
Total Score of RP-Self				-.607	.545
Military Aviation	58	39.093	14.699		
Civil Aviation	95	40.571	14.571		
Fate				.457	.648
Military Aviation	59	1.998	.707		
Civil Aviation	96	1.946	.686		
Internality				.615	.540
Military Aviation	59	3.073	.720		
Civil Aviation	96	3.002	.696		
Regulation Internalization				-.623	.534
Military Aviation	59	3.890	.815		
Civil Aviation	96	3.969	.735		
Total Score of ASLOC				-.245	.807
Military Aviation	59	3.685	.475		
Civil Aviation	96	3.704	.459		
Delayed Risk				1.221	.224
Military Aviation	57	69.140	17.983		
Civil Aviation	90	65.300	18.933		
Nominal Risk				.132	.895
Military Aviation	54	22.321	17.228		
Civil Aviation	90	21.878	20.639		

Table 4.2. *(Continued)*

High Risk for Others				-.449	.654
Military Aviation	55	78.011	18.172		
Civil Aviation	90	79.369	17.381		
Total Score of RP-Other				.863	.389
Military Aviation	57	61.831	13.116		
Civil Aviation	90	59.796	14.414		
Crew and Automation System Management				.597	.552
Military Aviation	59	3.334	.418		
Civil Aviation	96	3.292	.437		
Situation Awareness and Decision Making				2.689	.008**
Military Aviation	59	3.227	.532		
Civil Aviation	96	2.977	.580		
Communication and Cooperation				2.117	.036*
Military Aviation	59	3.419	.433		
Civil Aviation	96	3.262	.461		
Total Score of SOB				1.732	.085
Military Aviation	59	3.340	.405		
Civil Aviation	96	3.335	.399		

3.3.1.4. Comparison of Risk Perception for Self and Other

A paired sample t-test was conducted in order to investigate the differences between risk perception for self and other of participants.

It was found that there was a significant difference between pilots' perception of risk for themselves and perception of risk for others (*t*(146)= -16.935, *p*< .001, 95% *CI*[-22.990, -18.185])). Pilots reported that risk perception for self (*M*= 39.998, *SD*= 14.718) was lower than risk perception for others (*M*= 60.585, *SD*= 13.915). That is, pilots perceived the risks inherent in the situations less for themselves than perceived for other pilots. Since the factor structures of RP-Self and RP-Other scales were not comparable, the paired sample t-test analysis was conducted with total scores of the scales. Table 4.3 represents results of t-test analysis between RP-Self and RP-Other.

Table 4.3. *Number of Participants, Means, Standard Deviations (SD), t Scores and p Values of Comparison between RP-Self and RP-Other*

	N	***M***	***SD***	***t***	***p***
Risk Perception				-16.935	.000**
Risk Perception-Self	147	39.998	14.718		
Risk Perception-Other	147	60.585	13.915		

3.3.2. Exploratory Analysis about the Pathways between Study Variables

A total of twenty-five hierarchical regression analyses was conducted in order to analyze pathways between study variables based on proposed model of Human Factors Analysis and Classification System (HFACS). Hierarchical Regression analyses were conducted separately variables for substandard conditions of operator, i.e. flight stress, risk perception for self, aviation safety locus of control, and risk perception for others, and substandard practices of operators, i.e. safety operation behaviors.

In the first block of analysis, pilot behavior, flight stress and safety climate path was examined. Age and flight hours in a month were added in the first step of hierarchical regression analysis as control variables. In the second step, flight stress in normal flight conditions was added in to the model. In the third step, organizational safety climate was included. Perceptual and judgmental errors were included in to the model as an outcome variable (see Table 5.1). Results showed that age was significantly predicted perceptual and judgmental errors (R^2= .051, F(2, 152)= 4.074, p= .019). Older pilots were reported less perceptual and judgmental errors (β= -.218, t= -2.754, p= .007). After controlling demographic variables, flight stress was significantly predicted perceptual and judgmental errors (R^2= .093, F(3, 151)= 5.169, p= .002). That is, pilots who perceived higher stress in normal flight conditions reported more perceptual and judgmental errors (β= .206, t= 2.653, p= .009). However, organizational climate did not significantly predict perceptual and judgmental errors after controlling the effects of demographic variables and stress level (R^2= .093, F(4, 150)= 3.867, $Sig.\ F_{change}$= .811 p= .002). Then, skill based errors were included as outcome variable and the other three steps were kept the same. The results showed that neither demographic variables (R^2= .003, F(2, 152)= .255, p= .775) nor perceived stress in normal flight conditions (R^2= .013, F(3, 151)= .672, p= .570) predicted skill-based errors significantly. When organizational safety climate was added in the model after controlling the effects of demographic variables and stress, it was found that organizational safety climate significantly predicted skill based errors (R^2= .067, F(4, 150)= 2.693, p= .033). Pilots who scored high on organizational safety climate reported less skill-based errors (β= -.235, t= -2.942, p= .004). Third analysis of the first hierarchical regression block was conducted with routine violations as an outcome variable, and the three steps were kept the same. The results showed that none of the variables included in the model were significantly predicted routine violations. In the fourth analysis, procedural noncompliance was the outcome variable. The results showed that both demographic information (R^2= .008, F(2, 152)= .586, p= .558) and perceived stress (R^2= .036, F(3, 151)= 1.902, p= .132) did not significantly predicted procedural noncompliance. After controlling the effects of demographic information and perceived stress, organizational safety climate significantly predicted procedural noncompliance (R^2= .070, F(4, 150)= 2.841, p= .026), and pilots who scored higher on organizational safety climate reported less procedural noncompliance (β= -.187, t= -2.343, p= .020). In the last analysis of the first block hierarchical regression, improper procedure errors were added into the model as an outcome variable. The results showed that age was significantly predicted improper procedure errors (R^2=.045, F(2, 152)= 3.575, p= .030). That is, older pilots reported significantly less improper procedure errors than younger pilots (β= –.189, t= -2.388, p= .018). After controlling the effects of demographic information, perceived stress in normal flight operation also predicted improper procedure errors significantly (R^2=.083, F(3, 151)= 4.560, p= .004). Pilots who feel more stressed reported significantly higher improper procedure errors (β= .196, t= -2.506, p= .013). In the third step of the analysis, organizational safety climate was entered into the model, and it was significantly predicted improper procedure errors (R^2=.121, F(4, 150)= 5.181, p= .001). In other words, pilots who perceived more positive organizational climate reported that they committed improper procedure errors less frequently (β= –.198, t= -2.558, p= .012).

In the second block of the hierarchical regression analysis, age and flight hours in a month were added in the first step as control variables. In the second step, subscales of RP-Self were added into the model. In the last step, organizational safety climate was included in the analysis. Subscales of APilotBI were entered as outcome variables separately into the model (see Table 5.2). Results showed that age significantly predicted perceptual and judgmental errors (R^2= .052, F(2, 150)= 4.153, p= .018) and older pilots reported significantly lower perceptual and judgmental errors (β= −.222, t= -2.787, p=.006). After controlling the effects of demographic variables, RP-Self significantly predicted perceptual and judgmental errors (R^2=.138, F(6,146)= 3.894, p= .001). That is, pilots who perceived higher risk in altitude and fuel risk dimension of RP-Self reported that they experienced perceptual and judgmental errors more frequently (β= .362, t= 3.319, p=.001). General low risk dimension of RP-Self was also predicted perceptual and judgmental errors significantly (β= −.318, t= -3.079, p=.002). However, everyday risk and VFR risk dimensions did not significantly predict perceptual and judgmental errors. In the third step, organizational safety climate was added into the model. It was found that organizational safety climate did not significantly predicted perceptual and judgmental errors after controlling the effects of demographics and RP-Self (R^2= .142, F(7, 145)= 3.343, Sig. F_{change}= .397, p= .002). In the second analysis, skill-based errors were added into the model as an outcome variable, and organizational safety climate significantly predicted skill based errors after controlling the effects of demographics and risk perception for self (R^2= .096, F(7, 145)= 2.207, p= .037). That is, pilots who reported more positive organizational safety climate scored low on skill based errors dimension (β= −.226, t= -2.765, p=.006). Routine violations were included into the model as an outcome variable and the other three steps were kept the same in the third analysis of the second block. Results showed that none of the variables in these three steps was significantly predicted routine violations. In the fourth analysis, procedural noncompliance was the outcome variable. Results showed that after controlling the effects of demographic information and dimensions of risk perception for self, organizational safety climate significantly predicted procedural noncompliance (R^2= .103, F(7, 145)= 2.379, p= .025).

Table 5.1. *Hierarchical Multiple Regression Analysis for Demographics, Perceived Stress in Normal Flight Conditions and Organizational Safety Climate Path*

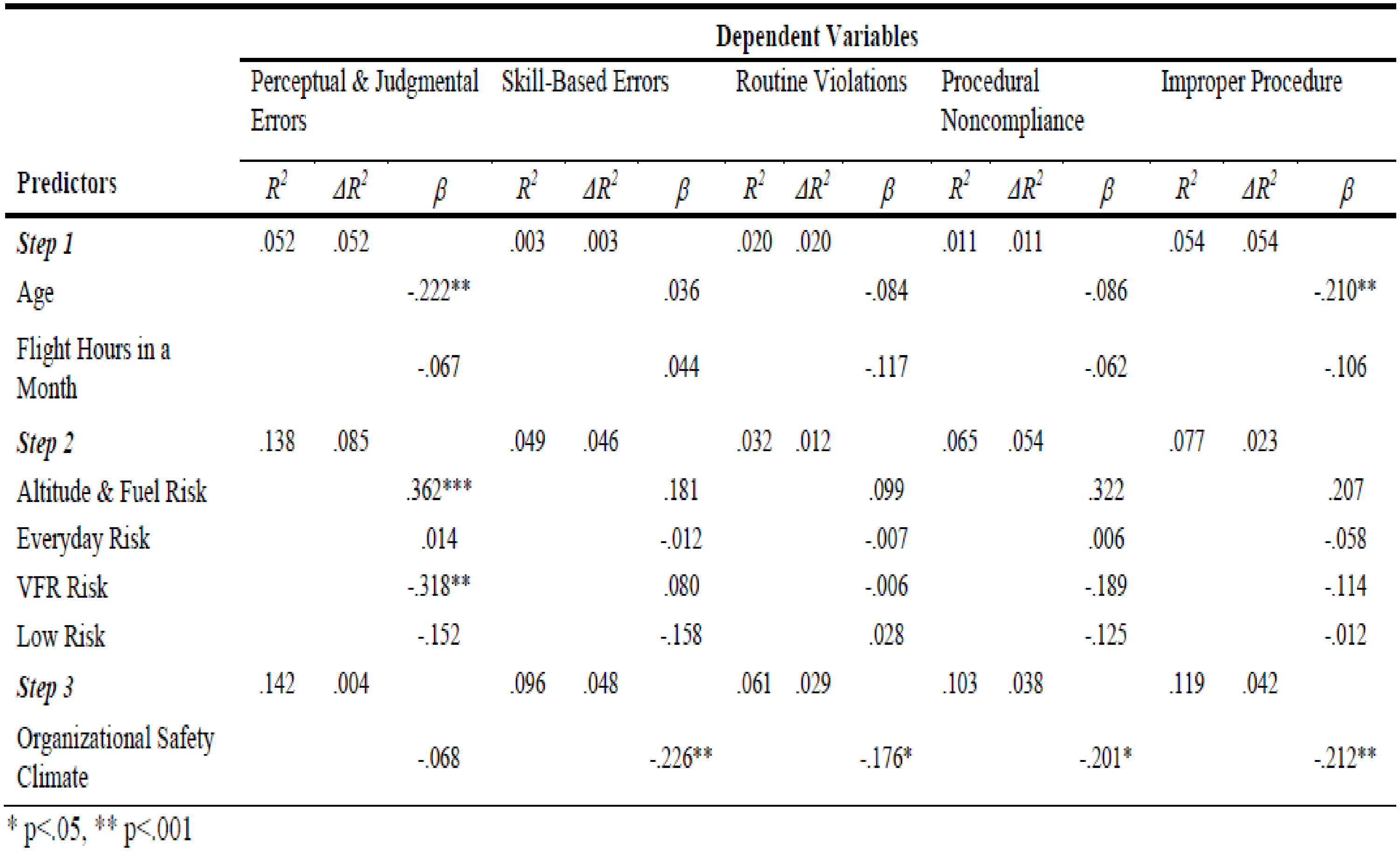
	Dependent Variables														
	Perceptual & Judgmental Errors			Skill-Based Errors			Routine Violations			Procedural Noncompliance			Improper Procedure		
Predictors	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Step 1	.051	.051		.003	.003		.016	.016		.008	.008		.045	.045	
Age			-.218**			.039			-.060			-.067			-.189*
Flight Hours in a Month			-.066			.044			-.112			-.058			-.101
Step 2	.093	.042		.013	.010		.016	.000		.036	.029		.083	.038	
Stress Level in normal flight conditions			.206**			.100			.003			.170			.196*
Step 3	.093	.000		.067	.054		.057	.042		.070	.034		.121	.038	
Organizational Safety Climate			-.019			-.235**			-.206			-.187*			-.198*

* p< .05, ** p< .001

In other words, pilots who perceived organizational climate more positive reported that they engaged procedural noncompliance less frequently ($\beta = -.201$, $t = -2.474$, $p = .015$). In the last analysis of the block, improper procedure errors were included into the model. Results showed that age was significantly predicted improper procedure errors ($R^2 = .054$, $F(2, 150) = 4.252$, $p = .016$). Older pilots reported less improper procedure errors than younger pilots ($\beta = -.210$, $t = -2.643$, $p = .009$). Although dimensions of risk perception for self did not significantly predicted improper procedure errors after controlling the effect of demographics ($R^2 = .077$, $F(6, 146) = 2.031$, $p = .065$), improper procedure errors were significantly predicted by organizational safety climate in the third step of the model ($R^2 = .119$, $F(7, 145) = 2.793$, $p = .009$). Pilots who had more positive perceptions about organizational safety climate reported that they engaged in improper procedure errors less frequently ($\beta = -.212$, $t = -2.622$, $p = .010$).

In the third block of the hierarchical regression analyses, sub-dimensions of ASLOC were added in the second step of the model, and the first (age and flight hours in a month and the third step (organizational safety climate) were kept the same as previous analyses. In the first analysis of the third block, perceptual and judgmental errors were added as an outcome variable (see Table 5.3). Results showed that age was significantly predicted perceptual and judgmental errors ($R^2 = .051$, $F(2, 152) = 4.074$, $p = .019$). Older pilots reported that they engaged in perceptual and judgmental errors less frequently ($\beta = -.218$, $t = -2.754$, $p = .007$). After controlling the effects of control variables, subscales of ASLOC were also significantly predicted perceptual and judgmental errors ($R^2 = .105$, $F(5, 149) = 3.471$, $p = .005$). That is, pilots who scored higher on regulation internalization reported less perceptual and judgmental errors ($\beta = -.201$, $t = -2.405$, $p = .017$).

Table 5.2. *Hierarchical Multiple Regression Analysis for Demographics, Risk Perception for Self and Organizational Safety Climate Path*



	Dependent Variables														
	Perceptual & Judgmental Errors			Skill-Based Errors			Routine Violations			Procedural Noncompliance			Improper Procedure		
Predictors	*R^2*	*ΔR^2*	*β*	*R^2*	*ΔR^2*	*β*	*R^2*	*ΔR^2*	*β*	*R^2*	*ΔR^2*	*β*	*R^2*	*ΔR^2*	*β*
Step 1	.052	.052		.003	.003		.020	.020		.011	.011		.054	.054	
Age			-.222**			.036			-.084			-.086			-.210**
Flight Hours in a Month			-.067			.044			-.117			-.062			-.106
Step 2	.138	.085		.049	.046		.032	.012		.065	.054		.077	.023	
Altitude & Fuel Risk			.362***			.181			.099			.322			.207
Everyday Risk			.014			-.012			-.007			.006			-.058
VFR Risk			-.318**			.080			-.006			-.189			-.114
Low Risk			-.152			-.158			.028			-.125			-.012
Step 3	.142	.004		.096	.048		.061	.029		.103	.038		.119	.042	
Organizational Safety Climate			-.068			-.226**			-.176*			-.201*			-.212**

* p<.05, ** p<.001

However, after controlling the effects of demographics and dimensions of ASLOC, organizational safety climate did not predicted perceptual and judgmental errors significantly (R^2= .104, F(6, 148)= 2.878, Sig. F_{change}= .877, p= .011). In the second analyses of the block, skill-based errors were added into the model. After controlling the effects of demographics and subscales of ASLOC, organizational safety climate significantly predicted skill based errors (R^2= .087, F(6, 148)= 2.340, p= .035). Pilot who had more positive perception about organizational climate reported less skill based errors ($\beta = -.212$, t= -2.637, p=.009). After skill-based errors, routine violations were added into the model as an outcome variable. Results showed that, after eliminating the effect of the control variables, the dimensions of ASLOC significantly predicted routine violations (R^2= .076, F(5, 148)= 2.443, p= .037). Specifically, pilots who internalize flight regulations more reported less routine violations ($\beta = -.218$, t= -2.558, p=.012). Organizational safety climate also significantly predicted routine violations after controlling the effects of ASLOC (R^2= .102, F(6, 147)= 2.782, p= .014). That is, pilots who had more positive perceptions of organizational safety climate reported that they engaged in routine violations less frequently during flight operations ($\beta = -.164$, t= -2.053, p=.042). When the outcome variable was procedural noncompliance, none of the predictor variables had associations with procedural noncompliance. In the last analysis of the block, improper procedure errors were included in the model as an outcome variable. It was found that age vas significantly predicted improper procedure (R^2= .045, F(2, 152)= 3.575, p= .030). Older pilots reported less improper procedure errors than younger pilots ($\beta = -.189$, t= -2.38, p=.018). In the second step of the analysis, it was found that internality and regulation internalization predicted improper procedure errors (R^2= .118, F(5, 149)= 3.982, p= .002).

Table 5.3. *Hierarchical Multiple Regression Analysis for Demographics, Locus of Control and Organizational Safety Climate Path*

	Dependent Variables														
	Perceptual & Judgmental Errors			Skill-Based Errors			Routine Violations			Procedural Noncompliance			Improper Procedure		
Predictors	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Step 1	.051	.051		.003	.003		.016	.016		.008	.008		.045	.045	
Age			-.218**			.039			-.060			-.067			-.189*
Flight Hours in a Month			-.066			.044			-.112			-.058			-.101
Step 2	.104	.053		.044	.040		.076	.061		.050	.043		.118	.073	
Fate			-.055			-.019			.098			.080			-.113
Internality			-.078			.121			.071			.050			.234**
Regulation Internalization			-.201*			-.205			-.218**			-.183*			-.222**
Step 3	.104	.000		.087	.043		.102	.026		.080	.030		.151	.033	
Organizational Safety Climate			-.012			-.212**			-.164*			-.177*			-.186*

* p< .05, ** p< .001

In other words, pilots scored high on internality reported more improper procedure errors ($\beta = .234$, $t = 2.850$, $p = .005$), while pilots who internalized regulations more reported less improper procedure errors ($\beta = -.222$, $t = -2.678$, $p = .008$). After controlling the effects of demographics and dimensions of ASLOC, organizational safety climate significantly predicted improper procedure ($R^2 = .151$, $F(6, 148) = 4.380$, $p < .001$), i.e. pilots who had more positive perceptions about their organization's safety climate reported less improper procedure errors ($\beta = -.186$, $t = -2.396$, $p = .018$).

In the fourth block of hierarchical regression analyses, dimensions of the risk perception for others were entered into the model. The first and the third steps were again kept the same (see Table 5.4). When the outcome variable was perceptual and judgmental errors, age was the only variable that reached significance level ($R^2 = .044$, $F(2, 137) = 3.128$, $p = .047$), and older pilots reported less perceptual and judgmental errors than younger pilots ($\beta = -.205$, $t = -2.448$, $p = .016$). In addition, age in the first step ($R^2 = .066$, $F(2, 137) = 4.843$, $p = .009$) and organizational safety climate in the third step ($R^2 = .107$, $F(6, 133) = 2.655$, $p = .018$) reached significance when the outcome variable was improper procedure errors. Both older pilots ($\beta = -.240$, $t = -2.904$, $p = .004$) and pilots who perceived their organization's safety climate more positive reported less improper procedure errors. However, none of the variables reached significance when the outcome variables were skill-based errors, routine violations, and procedural noncompliance, respectively.

In the last block of the hierarchical regression analyses, dimensions of SOB were included in the second step of the model, and the first and the third steps were kept the same as in the previous blocks of analyses (see Table 5.5). Perceptual errors were predicted only by age ($R^2 = .051$, $F(2, 152) = 4.074$, $p = .019$). Older pilots reported that

Table 5.4. *Hierarchical Multiple Regression Analysis for Demographics, Risk Perception for Others and Organizational Safety Climate Path*

	Dependent Variables														
	Perceptual & Judgmental Errors			Skill-Based Errors			Routine Violations			Procedural Noncompliance			Improper Procedure		
Predictors	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Step 1	.044	.044		.003	.003		.021	.021		.011	.011		.066	.066	
Age			-.205*			.039			-.069			-.088			-.240**
Flight Hours in a Month			-.045			.043			-.128			-.061			-.095
Step 2	.052	.008		.013	.010		.028	.007		.017	.005		.068	.002	
Delayed Risk			-.043			-.027			-.050			-.066			-.005
Nominal Risk			-.014			.070			.081			.024			-.033
High Risk			.105			-.048			.009			-.009			-.038
Step 3	.053	.011		.069	.056		.060	.031		.052	.035		.107	.039	
Organizational Safety Climate			-.037			-.239			-.180			-.190			-.199*

* $p < .05$, ** $p < .001$

they experienced perceptual and judgmental errors less frequently ($\beta = -.218$, t= -2.754, p=.007). However, other variables in the model did not predicted perceptual and judgmental errors significantly. Skill based errors were only predicted significantly by organizational safety climate (R^2= .093, F(6, 148)= 2.523, p= .024). That is, pilots who scored high on organizational safety climate reported less skill-based errors ($\beta = -.203$, t= -2.380, p=.019). Improper procedure errors were predicted by age (R^2= .045, F(2, 152)= 3.575, p= .030) and organizational safety climate (R^2= .101, F(6, 148)= 2.780, p= .014). Older pilots reported less improper procedure errors ($\beta = -.189$, t= -2.388, p=.018). Moreover, pilots who had more positive view of their organization's safety climate reported less improper procedure errors ($\beta = -.194$, t= -2.286, p=.024). However, none of the variable reached the significance level when the outcome variables were routine violations and procedural noncompliance.

Table 5.5. *Hierarchical Multiple Regression Analysis for Demographics, Safety Operation Behaviors and Organizational Safety Climate Path*

	Dependent Variables														
	Perceptual & Judgmental Errors			Skill-Based Errors			Routine Violations			Procedural Noncompliance			Improper Procedure		
Predictors	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Step 1	.051	.051		.003	.003		.003	.003		.008	.008		.045	.045	
Age			-.218**			.039			-.060			-.067			-.189*
Flight Hours in a Month			-.066			.044			-.112			-.058			-.101
Step 2	.069	.018		.058	.055		.071	.055		.063	.056		.070	.025	
Crew & Automation Management			.012			-.064			-.091			-.204			-.106
Situation Awareness & Decision Making			-.078			.141			.080			-.145			-.080
Communication & Cooperation			-.089			-.259			-.217			.102			.002
Step 3	.069	.000		.093	.035		.088	.017		.083	.020		.101	.032	
Organizational Safety Climate			-.007			-.203**			-.140			-.152			-.194*

* p< .05, ** p< .001

3.3.3. Exploratory Analysis for Mediation Effects between Study Variables

Mediation analysis was performed in order to explore the mediation effects between current study variables. For the mediation analysis, indirect macro of Andrew Hayes was used. Age and flight hours in a month were added into the analyses as control variables.

3.3.3.1. Organizational Safety Climate – Precondition for Behaviors – Pilot Behaviors

In the first block mediation analyses, the relationship between organizational safety climate, perceived stress in normal flight conditions and sub-dimensions of APilotBI was examined but none of the analyses did reached the significance. In the second block of mediation analysis, the relationship between organizational safety climate, risk perception for self and for others, and sub-dimensions of APilotBI was investigated. However, none of the analyses in second block did reach the significance level.

In the third block of the mediation analyses, the relationship between organizational safety climate, locus of control and sub-dimensions of APilotBI was explored. Results showed that the proposed model was significant when the outcome variable was routine violations (R^2= .089, *F*(4, 149)= 3.624, *p*= .008.). It was found that organizational safety climate significantly predicted regulation internalization (*B*= .172, *SE*= .071, *p*= .016). and routine violations (*B*= -.146, *SE*= .057, *p*= .012). Routine violations were also predicted by regulation internalization (*B*= -.149, *SE*= .065, *p*= .023). The predictive power of organizational safety climate on routine violations decreased after mediating effect of regulation internalization was added into the model (*B*= -.120, *SE*= .065, *p*= .023). Indirect effect of regulation internalization was tested on indirect macro of Andrew Hayes (2008) with 5000 bootstrap. Indirect effect was also significant (*B*= -.026, *SE*= .019, 95% *CI*[-.077, -.002]). Therefore, regulation internalization partially mediated the relationship between organizational safety climate and routine violations (see Table 6.1 and Figure 3.1).

Figure 3.1. The mediation effect between organizational safety climate, regulation internalization and routine violations.

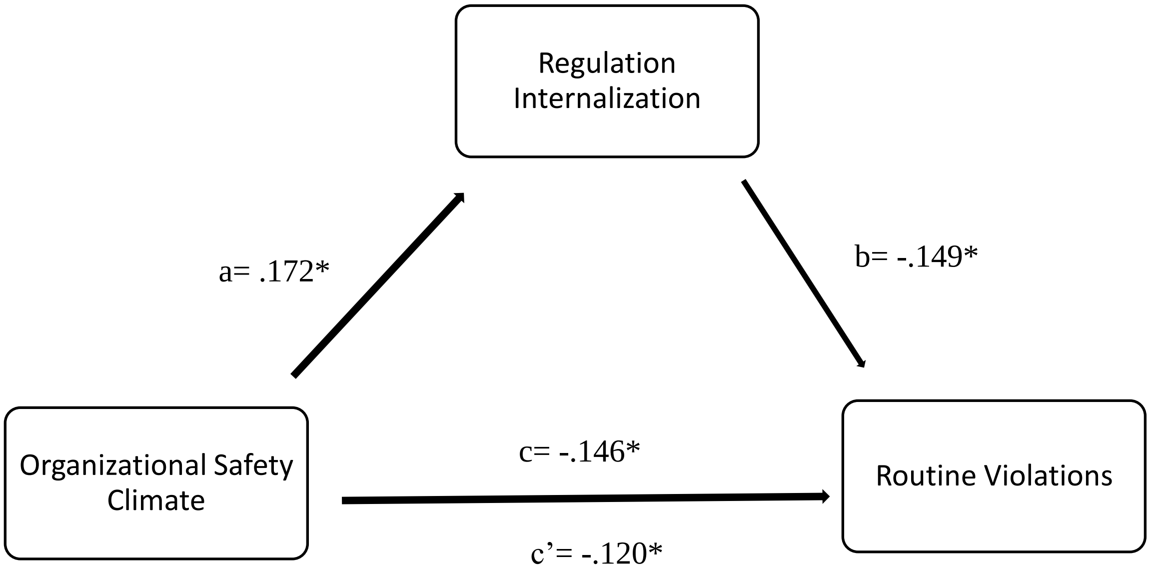


Table 6.1. *The Mediating Effect of Regulation Internalization on the Relationship between Organizational Safety Climate and Routine Violations*

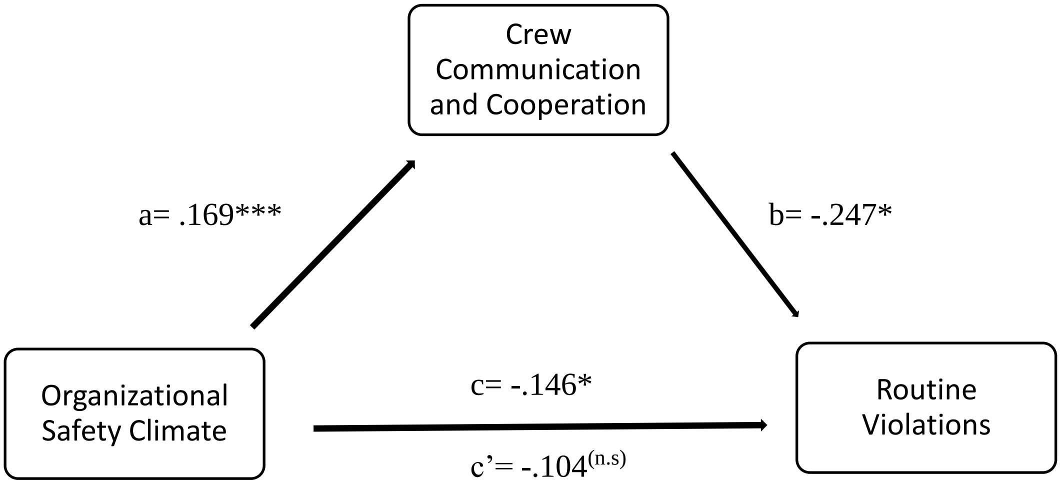
	B	**SE**	**t**	**p**
Mediation path a (Organizational Safety Climate on Regulation Internalization)	.172	.071	2.438	.016
Mediation path b (Regulation Internalization on Routine violations)	-.149	.065	-2.293	.023
Indirect Effect bootstrapped	-.026	.019		
95 % Confidence Interval [-.077, -.002]				
Total Effect, path c (Organizational Safety Climate on Routine Violation)	-.146	.057	-2.549	.012
Direct Effect, path c' (Organizational Safety Climate on Routine Violation with mediation)	-.120	.057	-2.087	.039
Covariates				
Age	-.003	.005	-.614	.541
Hours of Flight in a month	-.004	.003	-1.085	.280
Model R^2= .089, *F*(4, 149)= 3.624, *p*= .008				

In the last block of the mediation analyses, organizational safety climate, safety operation behaviors and sub-dimensions of APilotBI path was investigated. Results showed that the relationship between organizational safety climate and routine violations was mediated by crew communication and cooperation (R^2= .083, *F*(4, 149)= 3.383, *p*= .011). It was found that organizational safety climate was a significant predictor of both crew communication and cooperation (*B*=.169, *SE*=.039, *p*< .001) and routine violations (*B*=-.146, *SE*=.057, *p*=.012). Crew Communication and cooperation was also a significant predictor of routine violations (*B*=-.247, *SE*=.119, *p*=.039). Predictive power of organizational safety climate disappeared when the mediating effect of crew communication and cooperation was included into the model. Indirect effect of crew communication and cooperation was also significant when tested on indirect macro of Hayes with 5000 bootstrap (*B*= -.042, *SE*= .026, 95% *CI*[-.111, -.004]). Therefore, it was concluded that crew communication and cooperation fully mediated the relationship between organizational safety climate and routine violations (see Table 6.2 and Figure 3.2).

Table 6.2. The Mediating Effect of Crew Communication and Cooperation on the Relationship between Organizational Safety Climate and Routine Violation

	B	***SE***	***t***	***p***
Mediation path a (Organizational Safety Climate on Crew Communication and Cooperation)	.169	.039	4.343	.000
Mediation path b (Crew Communication and Cooperation on Routine violations)	-.247	.119	-2.085	.039
Indirect Effect bootstrapped	-.042	.026		
95 % Confidence Interval [-.111, -.004]				
Total Effect, path c (Organizational Safety Climate on Routine Violation)	-.146	.057	-2.549	.012
Direct Effect, path c’ (Organizational Safety Climate on Routine Violation with mediation)	-.120	.057	-1.732	.085
Covariates				
Age	-.001	.005	-.112	.911
Hours of Flight in a month	-.004	.003	-1.227	.222
Model R^2= .083, *F*(4, 149)= 3.383, *p*= .011				

Figure 3.2. The mediation effect of Crew Communication and Cooperation on the Relationship between organizational safety climate and routine violations.



3.3.3.2. Exploratory Analysis for Mediation Effects between Preconditions for Behaviors

Previous research suggested that the relationship between locus of control and safety operation behaviors was mediated by risk perception of pilots (You et al., 2009). Therefore, mediation effects between preconditions for behaviors were also examined in the current thesis study. Indirect macro of Andrew Hayes was used to test the indirect effects. Age and flight hours in a month were included as control variable in the model.

When the predictor variables were sub-dimensions of LOC and the outcome variables were sub-dimensions of SOB, risk perception for others scale did not significantly mediate the relationships.

When the mediator variables were risk perception for self, Altitude and fuel risk for self mediated the relationship between regulation internalization and crew and automation system management (R^2=.113, *F*(4, 148)= 4.704, *p*= .001). Regulation internalization significantly predicted altitude and fuel risk (*B*= -4.918, *SE*= 2.067, *p*= .019) and crew and automation system management (*B*= .136, *SE*= .045, *p*= .003). Altitude and fuel risk also predicted crew and automation system management (*B*= -.004, *SE*= .002, *p*= .017). Predictive power of regulation internalization on crew and automation system management was declined after the mediating effect of altitude and fuel risk was entered into the model (*B*= .115, *SE*= .045, *p*= .011). The indirect effect with 5000 bootstrap was also significant (*B*= .022, *SE*= .013, 95% *CI*[.003, .055]). Therefore, it was concluded that the relationship between regulation internalization and crew and automation system management was mediated by altitude and fuel risk (see Table 6.3 and Figure 2.3). In addition to this, altitude and fuel risk mediated the relationship between regulation internalization and crew communication and cooperation (R^2=.141, *F*(4, 148)= 6.082, *p*< .001). Regulation Internalization was a significant predictor of altitude and fuel risk (*B*= -4.918, *SE*= 2.067, *p*= .019) and crew communication and cooperation (*B*= .124, *SE*= .046, *p*= .008). Altitude and fuel risk was also a significant predictor of crew communication and cooperation (*B*= -.004, *SE*= .002, *p*= .025). The predictor power of regulation internalization on crew communication and cooperation was declined after the mediating effect of altitude and fuel risk was added into the model (*B*= .104, *SE*= .047, *p*= .027). Indirect effect was also tested with 5000 bootstrap and it was significant (*B*= .022, *SE*= .013, 95% *CI*[.003, .053]). Therefore, it was concluded that the relationship between regulation internalization and crew communication and cooperation was partially mediated by altitude and fuel risk (see Table 6.4 and Figure 3.4).

Table 6.3. *The Mediating Effect of Altitude and Fuel Risk on the Relationship between Regulation Internalization and Crew and Automation System Management*

	B	*SE*	*t*	*p*
Mediation path a (Regulation Internalization on Altitude and Fuel Risk)	-4.918	2.067	-2.380	.019
Mediation path b (Altitude and Fuel Risk on Crew and Automation System Management)	-.004	.002	-2.407	.017
Indirect Effect bootstrapped	-.022	.013		
95 % Confidence Interval [.003, .055]				
Total Effect, path c (Regulation Internalization on Crew and Automation System Management)	.136	.045	3.051	.003
Direct Effect, path c' (Regulation Internalization on Crew and Automation System Management with mediation)	.115	.045	2.582	.011
Covariates				
Age	.006	.003	1.699	.092
Hours of Flight in a month	-.001	.002	-.222	.824
Model R^2= .113, *F*(4, 148)= 4.704, *p*= .001				

Figure 3.3. The mediation effect of Altitude and Fuel Risk on the Relationship between Regulation Internalization and Crew and Automation System Management

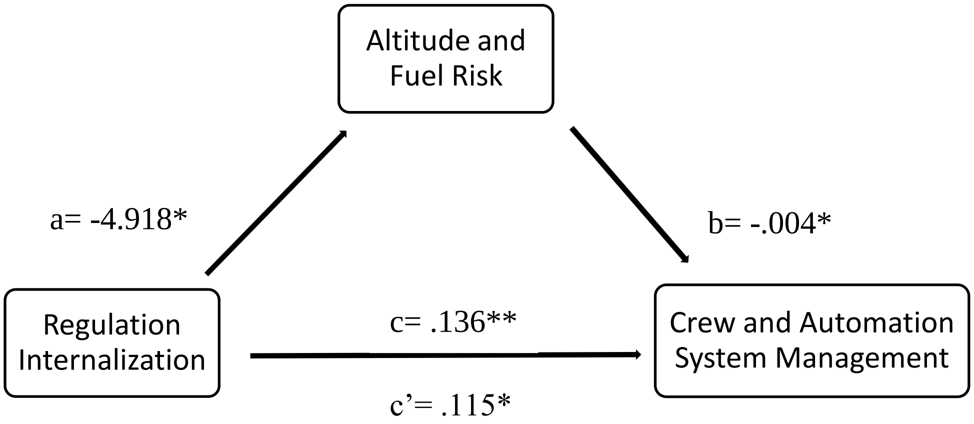
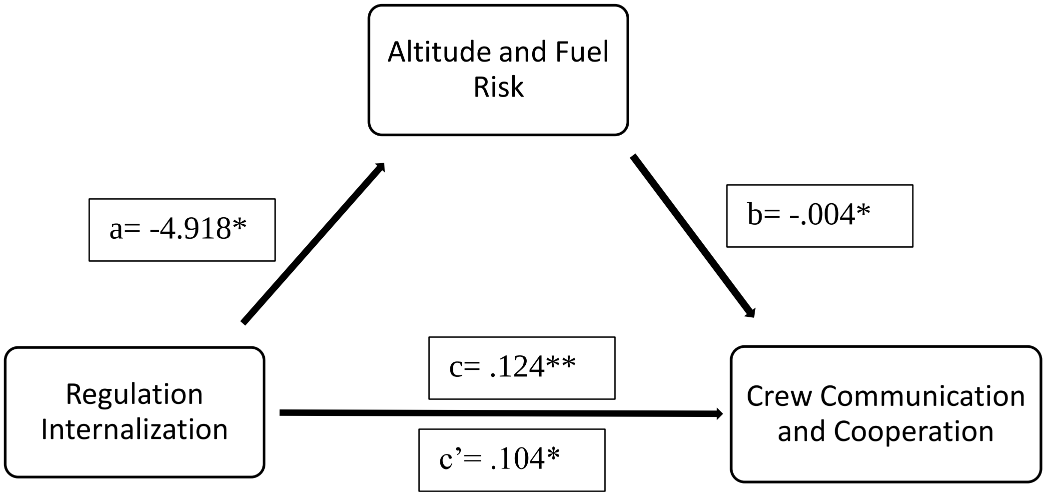


Table 6.4 *The Mediating Effect of Altitude and Fuel Risk on the Relationship between Regulation Internalization and Crew Communication and Cooperation*

	B	***SE***	***t***	***p***
Mediation path a (Regulation Internalization on Altitude and Fuel Risk)	-4.918	2.067	-2.380	.019
Mediation path b (Altitude and Fuel Risk on Crew Communication and Cooperation)	-.004	.002	-2.273	.025
Indirect Effect bootstrapped	-.022	.013		
95 % Confidence Interval [.003, .053]				
Total Effect, path c (Regulation Internalization on Crew Communication and Cooperation)	.124	.046	2.687	.008
Direct Effect, path c' (Regulation Internalization on Crew Communication and Cooperation with mediation)	.104	.047	2.239	.027
Covariates				
Age	.012	.004	3.282	.001
Hours of Flight in a month	-.001	.002	-.299	.766
Model R^2= .141, F(4, 148)= 6.082, p< .001				

Figure 3.4. The mediation effect of Altitude and Fuel Risk on the Relationship between Regulation Internalization and Crew Communication and Cooperation



CHAPTER IV

DISCUSSION

4.1 Overview

The current study, it is aimed to examine the relationship between organizational safety climate, precondition for unsafe acts and unsafe acts of commercial aviation pilots in Turkey. Before conducting main analyses, adaptations of Aviation Safety Climate Scale (ASCS), Aviation Safety Locus of Control scale (ASLOC), Risk Perception-Self and -Other (RP-Self and RP-Other), and Safety Operation Behavior scale (SOB), factor structure of the adapted scales and newly developed Airline Pilots Behavior Inventory (APilotBI), and differences between both pilots from different school background and Captain pilots (CP) and First Officers (F/O) in terms of study variables were examined. After that, the relationship between study variables were investigated based on the HFACS framework.

In the following section, evaluations of factor structures, of comparisons between groups and of the relationship between study variables will be discussed. Afterwards, the possible contributions, and limitations and suggestions for future researches will be presented.

4.2. Evaluations of Factor Structure Examinations

4.2.1. Evaluation of Airline Pilots Behavior Inventory Factor Structure

The factor structure of newly developed Airline Pilots Behavior Inventory (APilotBI) was examined firstly. Five-factor structure was found by using principal component analysis. The factor structure of APilotBI was consistent with unsafe acts classification of Shappell and Wiegmann (2000).

Shappell and Wiegmann (2000) classified errors and violations into sub-categories based on the investigation of aviation accident databases. They proposed that errors can be classified into three categories; perceptual errors, skill-based errors and decision errors. Violations also classified into two categories; routine and exceptional violations. Factor labels of APilotBI were given based on the classification of Shappell and Wiegmann (2000). Internal reliability coefficients of the factors were satisfactory.

The initial APilotBI composed of 46 items. However, seven of the items were excluded from further analyses. Item 13 which is "After climbing transition altitude, setting all main and standby altimeters as 29.92 inHg/1013.3 (hPa) but skipping crosscheck" was excluded due to low loading than .30. Remaining six items which are item 5 "Forgetting to adjust seat before flight", item 7 "Feeling no need to do briefing for flight route before flight", item 22 "Not adjusting appropriate thrust/N1 value while turbulence", item 28 "Not mentioning system changes made vocally", item 29 "Focusing on takeoff traffic and forgetting to check engine instruments and speed indicators while takeoff", and item 38 "Using wrong taxi way in an airport that have not been before" were excluded because of loading more than one factor approximately equal. This means that these six items did not reflect the differences between factors. Therefore, these items were decided to be excluded from further analysis in order to eliminate confusion between factors.

4.2.2. Evaluation of Aviation Safety Locus of Control Factor Structure

The examination of Aviation Safety Locus of Control Scale factor structure were conducted by using principal component analysis. The results revealed three factor structure of ASLOC. Factors were labeled as fate, internality and regulation internalization.

In the original scale development study, Hunter (2002) stated that principal component analysis revealed 7 factor based on eigenvalues greater than 1.0. He proposed that failing to find a single dominant factor to show externality-internality continuum can be interpreted as externality and internality are distinct constructs rather than different poles of a continuum. Because he failed to find clear factor structure of ASLOC, he proposed two factors; externality and internality. However, as interpreted from the development article, this proposed factor structure is based on theory rather than based on component analysis results.

In the present study, three factor structure of ASLOC was revealed. Regulation internalization, contrary to Hunter, came up as a distinct factor after principal component analysis. The possible reason for this can be that aviation safety is mainly governed by rules and regulations. Pilots are taught these rules and regulations from the very beginning of their trainings. They are also expected to be committed to these rules and regulations during their flight careers. From the beginning of their career, they were expected to realize that these rules and regulations were formed to ensure flight safety. Therefore, pilots may think that following these rules and regulations can increase flight safety and help pilots internalize them.

4.2.3. Evaluation of Risk Perception-Self and Risk Perception-Other Factor Structures

In the original Risk Perception-Self scale (RP-Self), Hunter (2006) proposed five factor structure for RP-Self scale. Contrary to Hunter, four factor structure was revealed for RP-Self based on principal component analysis.

The problem of original RP-Self factor structure is that some items were located in more than one factors although Hunter proposed a clear factor structure. For example, item 2 “Jaywalk (cross in the middle of the block) across a busy downtown street” was located both in high risk and everyday risk factors in the original factor structure. Item 8 “Take a two-hour sightseeing flight over an area of wooded valleys and hills, at 3,000 above ground level” was also located both in general flight risk and altitude risk factors in the original form.

In the present study, item 18 “Start a light aircraft with a dead battery by hand-propping it” did not included in the questionnaire because this item did not appropriate in commercial aviation context. The data was collected with the remaining 25 items. The first factor was labeled as altitude and fuel risk because items related to flight altitude and remaining fuel after landing were highly loaded in this factor. This factor was similar to Hunter’s altitude risk factor. Different than original factor structure, items related to remaining fuel after landing were also loaded in the same factor with altitude risk items in the present study. The possible reason for this is that pilots might perceive the risks inherent in altitude situations and remaining fuel situations approximately equal. In the second factor, surprisingly, pilots rated the situations such as “Drive your car on a freeway near your home during the day, at 120 km/h in moderate traffic” and “Make a two-hour cross country flight with friends, without checking your weight and balance” similarly. The items loaded in this factor was mainly related to situations which one might easily lose the control of the vehicle or of the situation. Therefore, pilot might perceive similar risks in these situations. In the third factor, items related to both daily risks and general flight risk were loaded. What is surprising in this factor is that pilots perceive turning for final approach with a 45-degree bank and climbing 25th floor with an elevator approximately equal in terms of risks. This might be because pilots might get used to the risk in normal flight conditions and might perceive that normal flight risks are as low as climbing 25. floor with an elevator. VFR risks which Hunter did not mention as distinct factor was found as the fourth factor. In this factor, two items were loaded. This might be because low visibility is associated with not being aware of what is going around. Consequently, being not aware of what comes next might affect pilot perceptions of the risks inherent in the situations.

Risk Perception-Other scale was found to be suitable for three factor structure by using PCA. This factor structure was supports the original factor structure proposed by Hunter (2006). In his original development study, Hunter stated that high risk factor, the third factor, has low internal reliability coefficient. However, the internal reliability coefficient for third factor which is .85 was found sufficient.

4.2.4. Evaluation of Safety Operation Behavior Factor Structure

You et al. (2009) proposed four factor structure for Safety Operation Behavior scale (SOB). Contrary to You et. al., three factor structure was found in the present study. Although situation awareness and decision making and communication and cooperation factors are similar to original factor structure, items related to automation system understanding and leadership and management factors are loaded at the first factor in the present study. Consequently, this factor was labeled as crew and automation system management. The possible reason for this might be because CRM trainings are designed to improve managerial skills of pilots as well as social and inter personal skills (Flin et. al., 2003). Therefore, managerial skills for pilots might be perceived as both managing automation systems and management of crew duties.

4.2.5. Evaluation of Aviation Safety Climate Factor Structure

The original factor structure of Aviation Safety Climate Scale was proposed as three factors by Evans, Glendon and Creed (2007). Contrary to original factor structure, one factor was found among Turkish pilot sample in the present study.

The FAA (2006) emphasized the role of the top management to develop and sustain a strong safety climate in the organization. Managers are expected to actively participate in safety related issues. Moreover, they are expected to allocate sufficient amount of resources on pilots' trainings as well as equipment and maintenance. Consequently, one might think that safety climate factors proposed by Evans, Glendon and Creed (2007) are in the responsibility of management level. In Turkey, Directorate General of Civil Aviation (DGCA, 2012) stated that managers of commercial aviation organizations are responsible for developing and sustaining trainings and safety communication within organizations. It was emphasized that management personnel were responsible for setting safety standards, evaluating safety performances, developing safety trainings and openly communicate about safety issues. Thus, Turkish airline pilots might perceive these factors as a whole responsibility of manager and might not separate management commitment from safety training, and equipment and maintenance.

4.3. Evaluation of Comparisons between Groups on Study Variables

4.3.1. Comparison of Incident Recording based on Study Variables

Accidents are rare events, especially in aviation context. Therefore, analyzing incident records may give more explanatory results. For this purpose, the comparison of incident recording based on study variables was conducted.

Independent sample t-test was conducted to examine the differences between pilots with incident records and pilots with no incident records. The only significant resultwas found for routine violations. That is, pilots who experienced at least one incident in their careers reported engaging in more routine violations. This finding is in line with the accident literature. In their review, Stradling et. al. (1998) stated that violations were positively associated with accidents. In their meta-analysis of 70 studies, Winter and Dodou (2010) also found that violations were associated with accident history. In the aviation context, Shappel and Wiegmann found that 26.4% of the aviation accidents caused by violations. Although literature support comes from accident records, similar results was found based on self-reported incident recording in the present study. This might be a support for previous studies analyzing the relationship between unsafe acts and accidents.

4.3.2. Comparison of Pilots from Military Aviation School Background and Civil Aviation School Background on Study Variables

Because majority of current commercial aviation pilots in Turkey has military background, the comparison between pilots from different backgrounds based on study variables was examined.

The results showed that pilots from civil aviation school background reported more improper procedure error and high perceived VFR risk than pilots from military aviation background. However, pilots from military aviation background scored higher on situation awareness and decision making, and communication and cooperation. The possible reason for this is that military pilots might expected to take more risks, to be more aware of their surrounding and to respond situations more quickly. They might also be expected to follow procedures more strictly. Consequently, this might result in decreased improper procedure errors and also decrease in perception of VFR risks. Moreover, it was suggested that there is a much smaller margin for error in military than in civil aviation (Kanki, Helmreich & Anca, 2010). Therefore, pilots from military aviation background might reported less improper procedure errors because they were trained to operate in these smaller margins. It was also suggested that military aviation is philosophically different than civil aviation (Kanki, Helmreich & Anca, 2010). The main purpose of military aviation is mission accomplishment, not safety. Military pilots are expected to operate easily in tough conditions. This may help to understand why they reported lower risk in VFR conditions. In addition to these, crew communication and cooperation is expected to be maximized in order to improve mission effectiveness in military aviation. Thus, pilots from military background might transfer these skills into their civil aviation career where communication and cooperation was highly important for flight safety. To best of the knowledge, there is little research focusing on differences between pilots from different backgrounds. Therefore, these results might be a contribution to the aviation safety literature.

Literature suggests that civil aviation pilots showed more internal LOC than military aviation pilots (Joseph & Ganesh, 2006). However, there is no difference found between pilots from military background and civil aviation background in terms of LOC.

4.3.3. Comparison between Perceived Risk for Self and for Others

In the present study, it is found that pilots scored lower in RP-Self scale than RP-Other scale. This means that pilots evaluate the situations less risky for themselves than for others. This result supports the result of Hunter (2002). The possible reason for this might be that pilots might evaluate their skills more than actual, and this might create illusion on perceived risks.

4.4. Evaluation of the Findings from Main Analyses

4.4.1. Evaluation of the Prediction Relationship Between Study Variables

A total of 5 block hierarchical regression analysis were conducted to investigate the relationships between study variables based on HFACS framework. In every block of the analysis, age and flight hours in a month were added as control variables in the first step. In the second step, preconditions for unsafe acts i.e. stress, locus of control, risk perception- self and -other, and safety operation behavior was included into the model separately in each block. In the third step, safety climate was entered into the model. The dependent variable in these block of analysis was factors of APilotBI.

In the first block of hierarchical regression, the predictor power of perceived stress and safety climate on unsafe acts was examined. In their study, Dorn and Matthews (1995) found that high levels of stress were associated with higher errors. In the present study, the results provide a support for literature. It was found that perceived stress in normal flight conditions positively predicted both perceptual and judgmental errors and improper procedure errors in the second step, after the effects of age and exposure (i.e. flight hours in a month) were controlled. When pilots feel high levels of stress even in normal flight conditions (i.e. no emergency or threat conditions), they might fail to focus their attention on what they are engaging in and also fail to follow related procedures. High levels of stress might also create confusion in their mind. Consequently, they might be more vulnerable to make errors. Martinussen and Hunter (2010) proposed that stress resulted in perceptual and cognitive tunneling, reductive thinking and filtering, decision making without exploring all relevant information, decisions made in a hurry and applying old procedures. Therefore, when pilots feel highly stressed during flight, they might canalize their attention only into controlling the aircraft. As a result, they might fail to perceive relevant cues and commit perceptual and judgmental errors. In addition, because high stress makes pilots fail to explore all relevant information and make their decisions in a hurry, pilots might sometimes fail to apply proper procedures dictated by rules and regulations. Therefore, they might commit more improper procedure errors when they are highly stressed. Contrary to perceptual and judgmental errors and improper procedure errors, perceived stress did not predict skill-based errors, routine violations and procedural noncompliance. In the third step, organizational safety climate was entered into the model. The results showed that organizational safety climate negatively predicted skill-based errors, and improper procedure errors. Although the present study failed to show safety training as a distinct factor of safety climate. Evans, Glendon and Creed (2007) proposed that organizational safety climate was composed of three factors; management commitment and safety communication, safety training and equipment and maintenance. Shappell et. al. (2007) proposed that skills can be developed by appropriate trainings. Consequently, because safety training is an important part of the safety climate, perceived positive safety climate might associated increased effectiveness of safety training. As a result, pilots might commit less skill-based errors during flight operations. This indicates that positive safety climate may help to reduce the number of skill based errors, the leading cause of aviation accidents (Shappell et. al., 2007), committed by airline pilots which in turn increase the flight safety. In addition to effective safety training, positive safety climate might indicate that importance of following rules and regulations within organization is clearly understood by operators. This can be achieved by active communication and cooperation between management level and the operators. Thus, pilots who clearly understand why, how and when these rules and regulations should be applied might be more likely to follow procedures truly. Reason (1990) also suggested that positive safety climate within organization might prompt operators to comply safety practices, and reduce noncompliance. This indicates that positive safety climate can decrease the number of procedural noncompliance. The present study provides a support for this view. It was found that safety climate negatively predicted procedural noncompliance of Turkish airline pilots. That is, pilots who perceived safety climate within organization as positive committed less procedural noncompliance.

In the second block of hierarchical analyses, factors of ASLOC were entered into the model in the second step. The first step (i.e. age and flight hours in a month) and the third step (safety climate) were kept the same. The result showed that regulation internalization is the only predictor of perceptual and judgmental errors in this block. That is, pilots who internalize regulations more reported less perceptual and judgmental errors. Regulation internalization indicates the pilots' attitudes on increasing flight safety by following safety regulations. That is, when pilots think that increasing flight safety is in their hands and it can be achievable by following regulations, they might be more likely to internalize safety regulations. Consequently, internalizing the regulations might provide pilots a cognitive map about what should be given attention, when the attention is given on certain cues, and how these cues should be interpreted all of which might be important to reduce perceptual and judgmental errors. In this block, it is found that skill-based errors are only predicted by safety climate negatively. When the outcome variables were routine violations and procedural noncompliance separately, it is found that regulation internalization negatively predicted both routine violations and procedural noncompliance. The possible reason for this might be the responsibility felt by pilots about flight safety. Pilots who internalize safety regulations might believe that they are responsible for safety of passengers, crew and also aircraft. Therefore, this belief of responsibility leads them to avoid routine violations and procedural noncompliance. After controlling the effect of regulation internalization, safety climate negatively and significantly predicted both routine violations and procedural noncompliance. As stated before, positive safety climate is associated with compliance to rules and regulations (Reason, 1990). Therefore, it is not surprising that pilots who perceived positive safety climate in their organization reported less routine violations and procedural noncompliance. When the outcome variable is improper procedure errors, regulation internalization also negatively predicted improper procedure errors. The possible reason for this might be that regulations are most of the time a guidance for the pilots. Therefore, pilots might avoid applying wrong procedures by relying on this guidance provided by regulations. Organizational safety climate also negatively predicted improper procedure errors in the third step. As stated earlier, positive safety climate could be an indicator of the clear communication and cooperation between managers and operators. Therefore, pilots who clearly understand why, how and when these rules and regulations should be applied might be more likely to follow procedures truly. What is surprising for improper procedure errors is that internality positively predicted improper procedure errors. That is, when pilots think that the outcome of the situation was under their own control they are more likely to apply inappropriate procedures. Although research proposed a positive association between internality and the number of self-reported errors among driver sample (Özkan & Lajunen, 2005), aviation literature suggests that pilots' internality is associated with higher SOBs. However, the possible reason why the contradictory result is found in the present study is that when pilots believe their control over the situations they might not need to explore all relevant information. Therefore, lack of information might lead them to apply inappropriate procedures.

In the third block of hierarchical regression analyses, factors of risk perception-self scale were entered into the model as a second step. The first and the last step were kept the same. The results showed that altitude and fuel risk positively predicted perceptual and judgmental errors after controlling the effects of age and exposure. Shappell and Wiegmann (2000) suggested that perceptual errors mostly occur while flying at night, in an adverse weather or flying over featureless terrain that might lead pilot to misjudge the situation of the aircraft. When looking at the scenarios loaded on altitude and fuel risk factor, it is not surprising that altitude and fuel risk scenarios positively predicted perceptual and judgmental errors, and provide support for Shappell and Wiegmann's results (2000). In the present study, it was also found that VFR risk negatively predicted perceptual and judgmental errors. That is, if pilots operating in marginal VFR perceive the risk as high, they committed less perceptual and judgmental errors. Although literature suggests that the likelihood of perceptual errors occurrence is higher in adverse weather conditions, the present study found the contrary result. The possible reason for this might be that pilots operating in marginal VFR are aware of the deteriorating condition of the weather, thus, they might show high levels of vigilance. Also, they might be more attentive to detect relevant cues regarding the operation safety. Consequently, they may decrease the chance of committing perceptual and judgmental errors. In the third block, skill-based errors, routine violations, procedural noncompliance and improper procedure errors are only predicted by safety climate negatively.

In the fourth block of the hierarchical analyses, risk perception- other was entered into the model in the second step. None of the variables significantly predicted the unsafe acts after controlling for age and exposure. The possible explanation for this might be that risk perception other scale measures the perception of pilots about the risk inherent in the situations for other pilots. Therefore, when they think the situation was risky for other pilots, this might not affect their own behaviors. Moreover, in the fifth block of the hierarchical regression analysis, none of the factors of SOB did not significantly predicted the unsafe acts of the pilots suprisingly. Although CRM trainings were suggested to be effective for safety attitudes of pilots, behavioral markers of the CRM trainings did not predict unsafe acts of the pilots. Therefore, managers should be aware that developing safer attitudes might not guarantee the behavior change.

4.4.2. Evaluation of Mediation Effects Between Study Variables

In order to examine the paths between safety climate, preconditions for unsafe acts and unsafe acts, mediation analyses were conducted. Four different mediation paths were found in the present study.

Literature suggests that attitudes regarding locus of control have an influence on people’s risk perceptions. It was proposed that pilots who had more internality scores were more likely to detect risks inherent in the situations (You, Ji & Han, 2013). It was also found that perceived risks were associated with committing SOBs. That is, pilots committed higher SOBs when they perceive higher risk inherent in the situations (Ji et. al., 2011). You, Ji and Han (2013) also stated that the relationship between internality and SOBs mediated by risk perception of pilots. However, the present study found contrary results. It was found that regulation internalization was negatively associated with altitude and fuel risk which, in turn, leads to decrease in crew and automation system management. That is, when pilots scored high on regulation internalization, they perceive the risk regarding altitude and fuel deficiencies less. Thus, they committed less SOBs regarding crew and automation system management although regulation internalization has positive direct relationship with crew and automation system management. Moreover, the present study also found that the relationship between regulation internalization and crew communication and cooperation was mediated by perceived altitude and fuel risk. That is, higher regulation internalization was associated with a decrease in perceived risk regarding altitude and fuel deficiencies which, in turn, result in decreased communication and cooperation among crew members. The possible reason for this contrary results is that previous results are related to internality factor of ASLOC. However, regulation internalization came up as a new factor in ASLOC. Therefore, future research should be conducted on regulation internalization in order to clarify the relationship between LOC, risk perception and SOBs.

Similar to hierarchical regression results, it was found that the relationship between safety climate and routine violations was partially mediated by regulation internalization. That is, positive safety climate lead to increase in regulation internalization which, in turn, result in decreased routine violations as well as the negative association between safety climate and routine violations. Because safety climate indicates operators’ perceptions and attitudes about safety related rules, regulations and procedures (Glendon, Clarke & McKenna, 2006), positive safety climate might result in the belief that pilots have the control of the situations when they apply the safety rules and regulations. This, as a result, might lead to decrease in the number of routine violations committed. Therefore, this finding of the present study provide some support for the idea that violations can be reduced by developing positive safety climate and consequently regulation internalization of workers.

Positive safety climate might also contribute to the development of open communication among operators. Literature suggests that crew might fail to warn each other or report the unsafe acts of each other (Ion, 2011). For instance, if violations were committed by experienced pilots, other crew members might think that “s/he knows the better”. This might result in decreased reporting of violations. The reverse condition is also possible. When less experienced pilots warn the experienced pilots regarding violations, the experienced pilots might ignore the warnings. Therefore, positive safety climate might open communication channels between crew members. Thus, warnings can be made and be taken into consideration regardless of the position and the experience. The present study provides some support for this. It was found that the relationship between safety climate and routine violations was fully mediated by crew communication and cooperation. Perceived positive safety climate leads to increase in communication and cooperation among crew members which, in turn, resulst in decreased routine violations. This indicates that in order to reduce routine violations and increase safety compliance, organizations should develop positive safety climate within organizations and encourage open communication and cooperation among crew member by sustaining positive safety climate.

4.5. Contributions of the Present Study

The present study provides some contribution to aviation safety research. The first contribution of the present study is the examination of the relationships between study variables withinthe framework of HFACS. Previous research has used the HFACS framework in order to analyze the causes of the accidents in the aviation accident databases. Moreover, HFACS was developed in order to provide a comprehensive framework for accident investigators (Shappell & Wiegmann, 2001). At the best of the knowledge, the present study is the first study that used HFACS framework in order to predict unsafe acts of the pilots. Therefore, the present study proposed that HFACS framework can also be used to investigate possible predictors and contributors of unsafe acts from individual level, supervisory level and organizational level. Moreover, the possible predictors and contributors of unsafe acts were revealed by the present study based on HFACS framework. Therefore, the results of the present study can be applied to increase flight safety.

The second contribution of the present study is the development of unsafe acts inventory for airline pilots which is Airline Pilots Behavior Inventory (APilotBI). Although pilot behaviors are the direct causes of aviation accidents and has got a lot of attention from aviation researchers, behavior measures are mainly focused on measuring or investigating the behavioral markers of CRM trainings. However, the investigation of pilot behaviors should also be focused on the direct causes of the accidents, not only focusing on the effective transfer of the trainings into behavioral practices. At the best of the knowledge, there was no tool to measure unsafe acts of the pilots. Therefore, the present study provides a reliable measurement tool for pilot behaviors. This tool, APilotBI, can be used as anonymous behavioral reporting within aviation organizations. Therefore, organizations can examine the behavioral patterns of their pilots and develop or enhance pilot trainings in order to reduce unsafe acts.

Another contribution of the present study is that it revealed regulation internalization, a new factor provided for the aviation literature, is more important factor than internality of the pilots in order to reduce unsafe acts. Thus, organizations can develop their safety climate and sustain a positive safety climate in order to increase the regulation internalization attitudes of their pilots. Managers of the aviation organizations might actively communicate and cooperate with their pilots while applying rules, regulations and procedure regarding flight safety, this might help pilots to understand why these are important to increase flight safety, how and when these should be applied and followed. Consequently, it might help pilots to internalize safety related rules, regulations and procedures, and to increase their safety performances.

The last contribution of the present study is that, the present study is the first study that investigates the predictors and contributors of the unsafe acts among Turkish airline pilots sample. Although there are some studies that investigates the aviation accidents, cultural differences among pilots in terms of CRM and the effectiveness of Safety Management Systems, there was no study conducted to examine possible predictors and contributors of unsafe acts from individual and organizational level among Turkish airline pilot sample. Therefore, the present study is important to show the profile of aviation safety-related factors among Turkish pilot sample.

4.6. Limitations and Future Suggestions of the Present Study

Although the present study makes some contributions in aviation safety literature, it is not without some limitations. First of all, self-reported measures were used to collect data in the present study. Literature suggests that self-reported measures are vulnerable to socially desirable responding. Because flight safety is crucial issue in aviation industry, the data of the present study might highly be affected by socially desirable responding. Especially for ASCS and APilotBI questionnaires, social desirability might be a real problem because pilots might show their behaviors and organizations safety climate better that the actual. Although social desirability questionnaire did not used to reduce drop-outs in the present study because of the length of the survey package, future researches can use social desirability questionnaire in order to ensure that the self-reported measures are affected by socially desirable responding. Moreover, future researches can use more objective measures such as in-flight observations or simulator observations in order to measure unsafe acts of the pilots.

The other limitation of the present study is the limited sample size. In the present study, the data was collected from 155 airline pilots. Especially for examining factor structure of the APilotBI, the limited sample size was a problem for the researcher. Although incomplete responses were used to eliminate this limitation, future researches may collect their data from larger sample and examine the results of the present study, especially the factor structure of APilotBI.

Another limitation of the present study is that the supervisory level did not include into the scope of the present study. However, literature suggests that supervisory influences had an effect on the accident causation (Shappell & Wiegmann, 2001). Therefore, future researches should include supervisory level in order to provide more comprehensive results as well as preconditions for unsafe acts and organizational influences.

References

Allsop, J., & Gray, R. (2014). Flying under pressure: Effects of anxiety on attention and gaze behavior in aviation. *Journal of Applied Research in Memory and Cognition,* 3, 63–71. doi:10.1016/j.jarmac.2014.04.010.

Amponsah-Tawiah, K., & Mensah, J. (2016). The impact of safety climate on safety related driving behaviors. *Transportation Research Part F, 40,* 48-55.

Clarke, S. (2006). The relationship between safety climate and safety performance: a meta-analytic review. *Journal of Occupational Health Psychology, 11*(4),315–327.

Cooper, G. E., White, M. D. & Lauber, J. K. (1980). *Resource management on flightdeck: Proceedings of a NASA/Industry Workshop* (Rep. No. NASA CP-2120). Moffett Field, CA: NASA-Ames Research Center.

Day, A. J., Brasher, K., & Bridger, R. S. (2012). Accident proneness revisited: The role of psychological stress and cognitive failure. *Accident Analysis and Prevention, 49*, 532-535.

DeJoy. D.M. (1992). An examination of gender differences in traffic accident risk perception. *Accident Analysis and Prevention, 24*(3), 237-246.

Directorate General of Civil Aviation. (2012). *SHY-SMS*. Retreived from http://web.shgm.gov.tr/documents/sivilhavacilik/files/mevzuat/sektorel/yonetmelikler/SHY_SMS_Rev.01.pdf

Directorate General of Civil Aviation. (2014). *SHT KOKPİT YOL BOYU*, retrieved from http://web.shgm.gov.tr/documents/sivilhavacilik/files/mevzuat/sektorel/talimatlar/SHT-KOKPIT_YOL_BOYU_14.11.2014.pdf

Dorn, L., & Matthews, G. (1995). Prediction of mood and risk appraisals from trait measures: Two studies of simulated driving. *European Journal of Personality, 9*, 25–42.

Evans, G. E., Palsane, M. N., & Carrere, S. (1987). Type A behavior and occupational stress: A cross-cultural study of blue-collar workers. *Journal of Personality and Social Psychology, 52*, 1002–1007.

Evans, B., Glendon, A. I., & Creed, P. A. (2007). Development and initial validation of an Aviation Safety Climate Scale. *Journal of Safety Research, 38*, 675-682.

Federal Aviation Administration. (2006). Advisory Circular No 120-92: *Introduction to safety management systems for air operators*. Washington, DC.

Flin, R., Martin, L., Goeters, K. M., Hörmann, H. J., Amalberti, R., Valot, C., & Nijhuis, H. (2003). Development of the NOTECHS (non-technical skills) system for assessing pilots' CRM skills. *Human Factors and Aerospace Safety, 3*(2), 95-117.

Flin, R., O'Connor, P., & Crichton, M. *Safety at the sharp end: a guide to non-technical skills.* Aldershot: Ashgate; 2008.

Fornette, M. P., Bardel, M. H., Lefrançois, C., Fradin, J., Massioui, F. E., & Amalberti, R. (2012). Cognitive-adaptation training for improving performance and stress management of air force pilots. *The International Journal of Aviation Psychology, 22*, 203–223. doi:10.1080/10508414. 2012.689208.

Glendon, A. I., Clarke, S. G., & McKenna, E. F. (2006). *Human safety and risk management*, 2nd ed. Boca Raton, FL: CRC Press/Taylor & Francis.

Helmreich, R. L., Foushee, H. C., Benson, R., & Russini, R. (1986). Cockpit management attitudes: Exploring the attitude–performance linkage. *Aviation, Space and Environmental Medicine, 57*, 1198–1200.

Helmreich, R.L., & Foushee, H.C. (1993). Why crew resource management? Empirical and theoretical bases of human factors training in aviation. In E.L. Wiener, B.G. Kanki and R.L. Helmreich (Eds.), *Cockpit resource management* (pp. 3-45). San Diego, CA: Academic Press.

Helmreich, R., Butler, R., Taggart, W. and Wilhelm, J. (1995). *The NASA/ University of Texas/FAA Line/ LOS checklist: A behavioral marker-based checklist for CRM skills assessment. Version 4*. Technical Paper 94-02 (Revised 12/8/95). Austin, Texas: University of Texas Aerospace Research Project.

Helmreich, R.L., & Davies, J. M. (1996). Human factors in the operating room: interpersonal determinants of safety, efficiency and morale. *Bailliére's Clinical Anaesthesiology, 10* (2), 277-295.

Helmreich, R. L., Klinect, J. R., & Wilhelm, J. A. (1999). *The line operations safety audit (LOSA) observer's manual, version 7.0* (Tech. Rep. 99-0). Austin: NASA/University of Texas/Federal Aviation Administration Aerospace Group.

Helmreich, R.L., Merritt, A. C., & Wielhelm, J. A. (1999). The Evolution of Crew Resource Management Training in Commercial Aviation. *Journal of Aviation Psychology, 9*(1), 19-32.

Hoggan, B. L., & Dollard, M. F. (2007). Effort-reward imbalance at work and driving anger in an Australian community sample: Is there a link between work stress and road rage? *Accident Analysis and Prevention, 39*(6), 1286–1295.

Hunter, D.R. (2002). Development of an aviation safety locus of control scale. *Aviation, Space, and Environmental Medicine, 73* (12), 1184–1188.

Hunter, D.R. (2006). Risk perception among general aviation pilots. *International Journal of Aviation Psychology, 16* (2), 135–144.

Ion, D. C. (2011). *Human Factors in Aviation: Crew Management* (pp. 367-373). AFASES.

Ji, M., You, X.Q., Lan, J.J., & Yang, S.Y. (2011). The impact of risk tolerance, risk perception and hazardous attitude on safety operation among airline pilots in China. *Safety Science, 49*(10), 1412–1420.

Jones J.W., & Wuebker L. (1993) Safety locus of control and employees' accidents. *Journal of Business & Psychology, 7*(4), 449-457.

Joseph, C., & Ganesh, A. (2006). Aviation safety locus of control in Indian aviators. *Indian Journal of Aerospace Medicine, 50*, 14–21.

Kanki, B. G., Helmreich, R. L., & Anca, J. M. (2010). *Crew Resource Management* (2nd ed.). Amsterdam: Academic Press/Elsevier.

Kern, L., Geneau, A., Laforest, S., Dumas, A., Tremblay, B., Lepage, S., & Barnett, T.A. (2014). Risk perception and risk-taking among skateboarders. *Safety Science, 62*, 370-375

Kontogiannis, T. (2006). Patterns of driver stress and coping strategies in a Greek sample and their relationship to aberrant behaviors and traffic accidents. *Accident Analyses and Prevention, 38*, 913–924.

Leung, M. Y., Chan, I. Y. S., & Yu, J. (2012). Preventing construction worker injury incidents through the management of personal stress and organizational stressors. *Accident Analysis and Prevention, 48*(1), 156–166.

Lin, Y. H. (2012). Knowledge brokering for transference to the pilot's safety behavior. *Management Decision, 50*(7), 1326-1333. doi:10.1108/00251741211247030.

Line Operations Safety Audit (LOSA) (1.st ed., Publication No. Doc 9803 AN/761). (2002). International Civil Aviation Organization.

Liu, X., Huang, G., Huang, H., Wang, S., Xiao, Y., & Chen, W. (2015). Safety climate, safety behavior, and worker injuries in the Chinese manufacturing industry. *Safety Science, 79*, 173-179.

Lu, C. S., & Tsai, C. L. (2010). The effect of safety climate on seafarers' safety behaviors in container shipping. *Accident Analysis and Prevention, 42*, 1999-2006.

Mearns, K. J., & Flin, R. (1999). Assessing the state of organizational safety—culture or climate? *Current Psychology, 18*, 5–17.

Martins, A. P. G. (2016). A Review of Important Cognitive Concepts in Aviation. *Taylor & Francis,* 20(2), 65-84. doi:10.3846/16487788.2016.1196559

Martinussen, M., & Hunter, D. R. (2010). *Aviation psychology and human factors*. Boca Raton: CRC Press/Taylor & Francis.

Maritime Coastguard Agency. 2007. *Fatigue in Seafarers*. MCA/181/2007.

Montag, I., & Comrey, A. L. (1987). Internality and externality as correlates of involvement in fatal driving accidents. *Journal of Applied Psychology, 72*, 339–343.

Moore, L. J., Vine, S. J., Wilson, M. R., & Freeman, P. (2012). The effect of challenge and threat states on performance: An examination of potential mechanisms. *Psychophysiology, 49*, 1417–1425. doi:10.1111/j.1469-8986.2012.01449.x.

Morrow, L. S., Koves, G. K., & Barnes, V. E. (2014). Exploring the relationship between safety culture and safety performance in U.S. nuclear power operations. *Safety Science, 69*, 37-47.

Motowidlo, S. J., Packard, J. S., & Manning, M. R. (1986). Occupational Stress: Its Causes and Consequences for Job Performance. *Journal of Applied Psychology, 71*(4), 618-629.

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91*(4), 946–953.

O’Connor, P., Hörmann, H.J., Flin, R., Lodge, M., & Goeters, K. M. (2002). Developing a method for evaluating crew resource management skills: A European perspective. *International Journal of Aviation Psychology, 12* (3), 263–285.

O'Connor, P., Campbell, J., Newton, J., Melton, J., Salas, E., &Wilson, K. A. (2008). Crew resource management training effectiveness: A meta-analysis and some critical needs. *International Journal of Aviation Psychology, 18*, 353–368.

O'Connor, P., O'Dea, A., Kennedy, Q., & Buttrey, S. E. (2011). Measuring safety climate in aviation: A review and recommendations for the future. *Safety Science, 49,* 129-139.

O'Hare, D. (1990). Pilots' perception of risks and hazards in general aviation. *Aviation, Space, and Environmental Medicine, 61* (7), 599–603.

Orasanu, J. (1997). Stress and naturalistic decision making: Strengthening the weak links. In *Decision making under stress. Emerging themes and applications*, ed. R. Flin, E. Salas, M. Strub, and L. Martin, 43–66. Aldershot, England: Ashgate.

Orasanau, J., Fischer, U., & Davison, J. (2002*). Risk Perception: A Critical Element of Aviation Safety* (pp. 49-58). Elsevier.

Öz, B., Özkan, T., & Lajunen, T. (2010). Professional and non-professional drivers' stress reactions and risky driving. *Transportation Research Part F, 13,* 32-40.

Öz, B., Özkan, T., & Lajunen, T. (2013). An investigation of professional drivers: Organizational safety climate, driver behaviors and performance. *Transportation Research Part F, 16,* 81–91.

Öz, B., Özkan, T., & Lajunen, T. (2014). Trip-focused organizational safety climate: Investigating the relationships with errors, violations and positive driver behaviors in professional driving. *Transportation Research Part F, 26,* 361-369.

Özkan, T., & Lajunen, T. (2005). Multidimensional traffic locus of control scale (T-LOC): factor structure and relationship to risky driving. *Personality and Individual Differences, 38,* 533–545.

Pousette, A., Larsson, S., & Törner, M. (2008). Safety climate cross-validation, strength and prediction of safety behavior. *Safety Science, 46,* 398-404.

Rankin, W. (2007). MEDA Investigation Process. *Aero, QTR_02*(7).

Rby, G. E., Dischinger, P. A., Kufera, J. A., & Read, K. M. (2006). Risk perception and impulsivity: Association with risky behaviors and substance abuse disorders. *Accident Analysis and Prevention, 38,* 567-573.

Reason, J. (1990). *Human error*. New York: Cambridge University Press.

Reason, J. (1998). Achieving a safe culture: theory and practice. *Work & Stress, 12*(3), 293-306.

Rotter, J.B. (1954). *Social Learning and Clinical Psychology*. Prentice-Hall, Englewood Cliffs, NJ.

Rundmo, T. (1999). Perceived risk, health and consumer behavior. *Journal of Risk Research, 2,* 187–200.

Rundmo, T. & Iversen, H. (2004). Risk perception and driving behavior among adolescents in two Norwegian counties before and after a traffic safety campaign. *Safety Science, 42,* 1-21. doi:10.1016/S0925-7535(02)00047-4.

Salas, E., Burke, C. S., Bowers, C. A., & Wilson, K. A. (2001). Team training in the skies: Does crew resource management (CRM) training work? *Human Factors, 43*, 641–674.

Salas, E., Wilson, K. A., Burke, C. S., & Wightman, D. C. (2006). Does Crew Resource Management Training Work? An Update, an Extension, and Some Critical Needs. *Human Factors, 48*(2), 392-412.

Salminen, S., & Klen, T. (1994). Accident locus of control and risk taking among forestry and construction workers. *Perceptual and Motor Skills, 78,* 852–854.

Schein, E. H. (1990). Organizational culture. *American Psychologist, 45,* 109–119.

Schein, E. H. (1996). Culture: The missing concept in organization studies. *Administrative Science Quarterly, 41*, 229–240.

Shappell. S, A.. & Wiegmann. D, A. (1997). A human error approach to accident investigation: The taxonomy of unsafe operations. *International Journal of Aviation Psychology. 7*, 269-291.

Shappell, S.A., & Wiegmann, D.A. (2000). *The human factors analysis and classification system (HFACS).* (Report Number DOT/FAA/AM-00/7). Washington DC: Federal Aviation Administration.

Shappell, S.A., & Wiegmann, D.A. (2001). Applying Reason: The human factors analysis and classification system (HFACS). *Human Factors and Aerospace Safety, 1*(1), 59-86.

Shappell, S., Detwiler, C., Holcomb, K., Hackworth, C., Boquet, A., & Wiegmann, D. A. (2007). Human Error and Commercial Aviation Accidents: An Analysis Using the Human Factors Analysis and Classification System. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 49*(2), 227-242. doi:10.1518/001872007x312469

Statistical Summary of Commercial Jet Airplane Accidents. (2016, July). Retrieved from http://www.boeing.com/resources/boeingdotcom/company/about_bca/pdf/statsum.pdf .

Stradling, S. G., Parker, D., Lajunen, T., Meadows, M. L., & Xie, C. Q. (1998). Normal behavior and traffic safety: Violations, errors, lapses and crashes. In H. von Holst, Å. Nygren, & Å. E. Anderson (Eds.), *Transportation, traffic safety, and health. Human behavior* (pp. 279−295). Berlin, Heidelberg, New York: Springer-Verlag.

Thomson, M., Önkal, D., Avcıoğlu, A., & Goodwin, P. (2004). Aviation Risk Perception: A Comparison Between Experts and Novices. *Risk Analysis*, 6(2), 1585-1595.

Turkish Statistical Institute (2015). Aviation Accident Statistics 2014. Retrieved from http://www.tuik.gov.tr/PreTablo.do?alt_id=1051.

Vallee, G., (2006). Perception of risk and hazards among general aviation pilots. M.Sc. thesis. Cranfield University, School of Engineering.

Warner, H. W., Özkan, T., & Lajunen, T. (2010). Can the traffic locus of control (T-LOC) scale be successfully used to predict Swedish drivers' speeding behavior? *Accident Analysis and Prevention, 42*, 1113-1117.

Wickens, C., & Flach, J. (1988). Information processing. In E. Wiener & D. Nagel (Eds.), *Human factors in aviation* (pp. 111–155). San Diego, CA: Academic.

Wickens, C. D.; Gordon, S. E.; Liu, Y. 2004. Stress and Workload, in C. D. Wickens, S. E. Gordon, Y. Liu (Eds.) *An introduction to human factors engineering*. New York, NY: Longman, 324–350.

Wichman H., & Ball J. (1983). Locus of control, self-serving biases, and attitudes towards safety in general aviation pilots. *Aviation, Space, Environment, Medicine, 54*(6), 507–510.

Wiegmann, D.A., & Shappell, S.A. (1997). Human factors analysis of post-accident data: Applying theoretical taxonomies of human error. *The International Journal of Aviation Psychology, 7*(1), 67-81.

Wiegmann, D.A., & Shappell, S.A. (1999). Human error and crew resource management failures in Naval aviation mishaps: A review of U.S. Naval safety center data, 1990-96. *Aviation, Space, and Environmental Medicine.* 1147-1151.

Wiegmann, D., Shappell, S., Cristina, F., & Pape, A. (2000). A human factors analysis of aviation accident data: An empirical evaluation of the HFACS framework. *Aviation Space and Environmental Medicine, 71*,328.

Wiegmann, D.A., & Shappell, S.A. (2001). Human error perspectives in aviation. *The International of Aviation Psychology, 11*, 341-357.

Wiegmann, D., & Shappell, S. (2001). *A Human Error Analysis of Commercial Aviation Accidents Using the Human Factors Analysis and Classification System (HFACS)* (Rep. No. DOT/FAA/AM-01/3). Springfield, Virginia: National Technical Information Service.

Wiegmann, D. A., & Shappell, S. A. (2003). *A human error approach to aviation accident analysis: The human factors analysis and classification system*. Aldershot, Hants, England: Ashgate.

Wiener, E., & Nagel, D. (1988). *Human Factors in Aviation*. Academic Press.

Wilson, M. R. (2012). *Anxiety: Attention, the brain, the body and performance*. In S. Murphy (Ed), *The Oxford handbook of sport and performance psychology* (pp. 173–190). New York, NY: Oxford University Press.

Winter, J. C. F., & Dodou, D. (2010). The Driver Behavior Questionnaire as a predictor of accidents: A meta-analysis. *Journal of Safety Research, 41*, 463-470.

Wise, J. A., Hopkin, V. D., & Garland, D. J. (2010). *Handbook of aviation human factors*. Boca Raton: CRC Press.

Wolk, S., & DuCette, J. (1974). Intentional performance and incidental learning as a function of personality and task dimensions. *Journal of Personality and Social Psychology, 29*, 90–101.

You, X., Ji, M., & Han, H. (2013). The effects of risk perception and flight experience on airline pilots' locus of control with regard to safety operation behaviors. *Accident Analysis and Prevention, 57*, 131-139.

Zhang, L., Zhang, C., & Shang, L. (2016). Sensation-seeking and domain-specific risk-taking behavior among adolescents: Risk perceptions and expected benefits as mediators. *Personality and Individual Differences, 101*, 299-305.

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology, 65*(1), 96–102.

APPENDICIES

Appendix A: Ethical Permission

SOSYAL BİLİMLER ENSTİTÜSÜ
GRADUATE SCHOOL OF SOCIAL SCIENCES

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TURKEY

Sayı: 28620816 /430

04 ARALIK 2015

Gönderilen: Doç.Dr.Türker ÖZKAN
Psikoloji Bölümü

Gönderen: Prof. Dr. Canan SÜMER
İnsan Araştırmaları Komisyonu Başkanı

İlgi: Etik Onayı

Sayın Doç. Dr. Türker ÖZKAN danışmanlığını yapmış olduğunuz Gizem SERİN'in "Kurum Güvenlik Kültürü, Kontrol Odağı ve Risk Algısının Pilotların Güvenli Operasyon Davranışlarına Etkisi" isimli araştırması İnsan Araştırmaları Komisyonu tarafından uygun görülerek gerekli onay 01.12.2015-30.04.2016 tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Canan SÜMER
Uygulamalı Etik Araştırma Merkezi
İnsan Araştırmaları Komisyonu Başkanı

Appendix B: Informed Consent Form

Gönüllü Katılım Formu

Bu çalışma Orta Doğu Teknik Üniversitesi öğretim üyelerinden Doç. Dr. Türker Özkan danışmanlığında Trafik ve Ulaşım Psikolojisi yüksek lisans öğrencisi tarafından tez çalışması olarak yürütülmektedir. Çalışmanın amacı; kurum güvenlik kültürü, kontrol odağı ve risk algısının pilotların güvenli operasyon davranışları üzerindeki etkisini araştırmaktır. Çalışmada fiziksel veya psikolojik rahatsızlığa neden olacak sorular bulunmamaktadır ancak, böyle bir rahatsızlık hissettiğinizde istediğiniz zaman çalışmayı bırakabilirsiniz.

Elde edilen bilgiler sadece bilimsel araştırma ve yayınlarda kullanılacaktır. Çalışma kapsamında hiçbir kişisel veri ya da kurum bilgisi istenmeyecek ve kullanılmayacaktır. Çalışma hakkında daha fazla bilgi edinmek için aşağıda iletişim bilgileri verilen araştırmacılar ile iletişime geçebilirsiniz. Bu araştırmaya katıldığınız ve verdiğiniz destek için çok teşekkür ederiz.

Doç. Dr. Türker Özkan (E-posta: ozturker@metu.edu.tr ; Tel: 0312 210 5118)

Psk. Gizem Serin (E-posta: gizemsrnn@gmail.com; Tel: 0546 840 0770)

Bu çalışmaya tamamen gönüllü olarak katılıyorum ve istediğim zaman yarıda kesip çıkabileceğimi biliyorum. Verdiğim bilgilerin bilimsel amaçlı yayımlarda kullanılmasını kabul ediyorum.

Ad Soyad/Rumuz: Tarih: İmza:

Appendix C: Demographic Information From

1) Yaşınız:________
2) Cinsiyetiniz: ☐ Kadın ☐ Erkek
3) Eğitim durumunuz:
    a. İlkokul
    b. Lise
    c. Üniversite
    d. Yüksek Lisans
    e. Doktora

4) Mesleki eğitiminizi aldığınız okul:
    a. Askeri Havacılık Okulu
    b. Sivil Havacılık Okulu

5) Çalıştığınız pozisyon:
    a. Kaptan Pilot
    b. 2. Pilot (Yardımcı Pilot)

6) Kaç yıldır sivil ticari havacılık alanında profesyonel olarak uçuyorsunuz?_____
7) Sivil ticari havacılık alanında saatlik uçuş deneyiminiz:____________________
8) Bir yılda ortalama kaç saat uçuyorsunuz?________________________________
9) Bir yılda ortalama kaç kilometre uçuyorsunuz?___________________________
10) Şuan kullandığınız uçağın tipi nedir? ___________________________________
11) Şuan kullandığınız uçağın yolcu kapasitesi nedir? _________________________
12) Uçuş sırasında hissettiğiniz stresin seviyesini belirtiniz:

Stressiz									**Çok Stresli**
0	1	2	3	4	5	6	7	8	9

Appendix D: Airline Pilot Behavior Inventory

Pilot Davranış Ölçeği

Aşağıda pilotların uçuş öncesi, sırası ve sonrasında sergilediği bazı davranışlar verilmiştir. Bu davranışları "ne sıklıkla" sergilediğinizi belirtiniz.

1= Hiç bir zaman

2= Nadiren

3= Bazen

4= Oldukça sık

5= Sık sık

6= Neredeyse her zaman

7= Uygun değil

	1 Hiçbir Zaman	2	3	4	5	6 Neredeyse Her Zaman	7 Uygun değil
1) Uçağın başına gelindiğinde gerekli teknik kontrolleri eksiksiz yerine getirmek	1	2	3	4	5	6	7
2) NOTAM'lar/ AIS/ MET brifing dokümanlarının uçaktan mevcut olup olmadığını kontrol etmek	1	2	3	4	5	6	7
3) Fark etmeden yanlış flap açısı set etmek	1	2	3	4	5	6	7
4) Kalkıştan sonra bir süreliğine iniş takımlarını kapatmayı	1	2	3	4	5	6	7

unutmak							
5) Uçuş öncesi koltuğu sabitlemeyi (ayarlamayı) unutmak	1	2	3	4	5	6	7
6) Fark etmeden, uçulacak rota için kalkış brifingi yapmamak	1	2	3	4	5	6	7
7) Uçuş öncesi, uçulacak rota için kalkış brifingi yapmaya gerek duymamak	1	2	3	4	5	6	7
8) Kalkış için piste gelirken dış ışıkların açık olmadığını fark etmemek	1	2	3	4	5	6	7
9) Taksi sırasında bütün izinleri tekrar kontrol etmeye gerek duymamak	1	2	3	4	5	6	7
10) Normal şartlarda, taksi yaparken hız limitlerini aşmamak	1	2	3	4	5	6	7
11) Checklistleri tamamlarken, bir ya da birden çok maddeyi unutmak	1	2	3	4	5	6	7
12) Kalkış sırasında, önden kalkan trafiğin türbülansını önemsememek	1	2	3	4	5	6	7
13) Transition (TA) irtifası geçilince tüm ana ve yedek altimetreleri 29.92	1	2	3	4	5	6	7

inHg/1013.3 (hPa) olarak ayarlamak ancak çapraz kontrolünü atlamak							
14) Omuz bağlarını 10.000 feete ulaşmadan çözmek	1	2	3	4	5	6	7
15) Hedef irtifaya 1000 feet kaldığında call-out yapılmadığını sonradan fark etmemek	1	2	3	4	5	6	7
16) 10.000 feet aşıldığında “FASTEN SEAT BELT” ışıklarını kapatmayı bir süreliğine unutmak	1	2	3	4	5	6	7
17) Hedef irtifaya ulaşınca düz uçuş brifingi yapmamak	1	2	3	4	5	6	7
18) Dış etkenler müsaade etse de optimum düz uçuş irtifasında uçmamak	1	2	3	4	5	6	7
19) İlgili hava alanlarının ATIS ve VOLMET’leri almamak	1	2	3	4	5	6	7
20) Buzlanma beklendiğinde “Engine Anti-iceing” veya “wing anti ice”	1	2	3	4	5	6	7

sistemlerinin çalıştırılmadığını bir süreliğine fark etmemek							
21) Türbülans sırasında ATC bilgilendirmesi yapmayı unutmak	1	2	3	4	5	6	7
22) Türbülanstayken uygun sürat ve thrust/N1 değeri kullanmamak	1	2	3	4	5	6	7
23) Türbülans sırasında yolcu anonsu yapmayı unutmak	1	2	3	4	5	6	7
24) Omuz bağlarını, 10.000 feet altına indikten sonra da bir süre takmamak	1	2	3	4	5	6	7
25) Kalkıştan sonra, normal şartlarda, iniş takımlarını kapatmayı bir süre ertelemek	1	2	3	4	5	6	7
26) İniş sırasında kuyruk rüzgârı limitlerini dikkate almayarak, uçağı inişe zorlamak	1	2	3	4	5	6	7
27) İnişten önce, yolcu emniyet kemeri ışıklarını yakmayı unutmak	1	2	3	4	5	6	7
28) Sistemlerde yapılan değişiklikleri sesli olarak dile getirmemek	1	2	3	4	5	6	7
29) Kalkış sırasında, trafiğe odaklanıp motor	1	2	3	4	5	6	7

enstrümanlarını ve hız göstergelerini kontrol etmeyi unutmak							
30) Park sırasında, park freni yerine başka bir uygulamayı (örneğin nose wheel lock) çalıştırmak	1	2	3	4	5	6	7
31) İniş veya kalkış için, yanlış yaklaşma sırasına girmek	1	2	3	4	5	6	7
32) Yoğun kalkış trafiği nedeniyle, taksi yaparken acele etmek	1	2	3	4	5	6	7
33) Checklistleri “ezbere” tamamlamak ve sadece “önemli” görülen maddeleri sesli olarak kontrol etmek	1	2	3	4	5	6	7
34) Checkklistlerdeki maddelerin bazılarının (örneğin, flap settings) doğru ayarlarını okumak ancak ayarları set etmeyi unutmak	1	2	3	4	5	6	7
35) ATC izni olmadan sürat değişikliği yapmamak	1	2	3	4	5	6	7
36) Uçuş	1	2	3	4	5	6	7

bilgisayarına fark etmeden yanlış havaalanının bilgilerini girmek							
37) Görerek şartlarda yaklaşırken yaparken, uçağı autopilot'tan çıkarmakta geç kalmak	1	2	3	4	5	6	7
38) Daha önce bulunulmayan bir hava alanında, yanlış taksi yolunu kullanmak	1	2	3	4	5	6	7
39) Kalkış sırasında, yanlışlıkla uçağın burnunu dik bir açıyla kaldırarak, kuyruğun piste sürtmesine neden olmak	1	2	3	4	5	6	7
40) Uçağın teknik kontrollerini yaparken, bir süreliğine flaşör giymeyi unutmak	1	2	3	4	5	6	7
41) Yanlış radyo navigasyon frekansı kullanmak	1	2	3	4	5	6	7
42) Aletli iniş sistemi (ILS) ile iniş yaparken, indikten sonra uçağın kontrolünü geç ele almak	1	2	3	4	5	6	7
43) Tamamlanan bir checklistten sonra tamamlandığını sözlü olarak dile	1	2	3	4	5	6	7

getirmemek (“complete” olarak belirtmemek)							
44) Yolcu almak için yanlış kapıya yanaşmak	1	2	3	4	5	6	7
45) Hava Trafik Kontrolü’nden gelen değişiklik ya da izinleri bir süreliğine (tekrar teyit edene kadar) yanlış anlamak	1	2	3	4	5	6	7
46) Uçak park halindeyken “parking-brake”i aktive etmeyi unutmak	1	2	3	4	5	6	7

Appendix E: Aviation Safety Locus of Control Scale

Aşağıdaki cümlelere ne kadar katıldığınızı belirtiniz.

	Kesinlikle katılmıyorum		Ne katılıyorum Ne katılmıyorum		Kesinlikle katılıyorum
1) Eğer pilotlar bütün kural ve düzenlemeleri takip ederse, birçok uçuş kazasından kaçınabilir.	1	2	3	4	5
2) Kazalar çoğunlukla güvenli olmayan ekipmanlardan ve zayıf güvenlik düzenlemelerinden kaynaklanır.	1	2	3	4	5
3) Eğer periyodik olarak mevzuatın gerektirdiği güvenlik araçlarını (emniyet kemeri, kontrol listesi vb.) kullanmayı reddederlerse, pilotlar lisanslarını kaybetmelidir.	1	2	3	4	5
4) Kazalar ve yaralanmalar, pilotların güvenliğe yeterli önemi vermemesinden meydana gelir.	1	2	3	4	5
5) Kazalardan kaçınma şans işidir.	1	2	3	4	5
6) Eğer pilot uygun prosedürleri kullanırsa, çoğu kaza ve olaylar önlenebilir.	1	2	3	4	5
7) Çoğu kaza ve yaralanmalar önlenemez.	1	2	3	4	5
8) Çoğu kazalar pilotların dikkatsizliğindendir.	1	2	3	4	5
9) Çoğu pilot uçak hasarına ya da fiziksel yaralanmayla sonuçlanacak kaza ya da olaylara karışacaktır.	1	2	3	4	5
10) Eğer “vakit öldürürken” bir kaza ya da olay yaşarlarsa, pilotlara para cezası	1	2	3	4	5

kesilmelidir.					
11) Yaralanmayla sonuçlanan çoğu kazalar büyük ölçüde önlenebilir.	1	2	3	4	5
12) Pilotlar, çalışırken ufak çaptaki olayları önlemek için çok az şey yapabilir.	1	2	3	4	5
13) İnsanların yaralanıp yaralanmaması kader, şans ya da ihtimal işidir.	1	2	3	4	5
14) Pilotların kazaları ya da yaralanmaları kendi yaptıkları hatalardan kaynaklanır.	1	2	3	4	5
15) Çoğu kazada zayıf FAA yönetimi suçlanabilir.	1	2	3	4	5
16) Çoğu yaralanmalar, insanların kontrolü dışındaki tesadüfi olaylardan kaynaklanır.	1	2	3	4	5
17) Eğer dikkatli ve potansiyel tehlikelerin farkında olurlarsa, insanlar yaralanmaktan kaçınabilir.	1	2	3	4	5
18) Uçuşu tamamlamak, daha çok zaman alan bir güvenlik tedbirini tamamlamaktan daha önemlidir.	1	2	3	4	5
19) Pilotun ne kadar dikkatli olduğu ile geçirdiği kaza sayısı arasında direkt bir bağ vardır.	1	2	3	4	5
20) Çoğu kazalar kaçınılmazdır.	1	2	3	4	5

Appendix F: Risk Perception-Self Scale

Aşağıda, hem uçuş ile ilgili hem de günlük hayat ile ilgili bazı senaryolar verilmiştir. Belirtilen senaryoları, yarın gerçekleştireceğinizi düşünerek, KENDİNİZ için içerdiği riski 1'den 100'e kadar değerlendiriniz. Uçuş ile ilgili senaryoları, uçuş okulunda kullandığınız gibi küçük bir uçakla gerçekleştireceğinizi düşününüz. Verdiğiniz risk değerini, senaryonun yanındaki çubuğu kaydırarak seçiniz.

1= Çok düşük riskli;   100=Çok Yüksek Riskli

1) Gündüz, açık bir havada, yerel havaalanından 150 mil ilerideki başka bir havaalanına bakımı yapılmış bir uçakla uçmak	
2) Şehir merkezindeki kalabalık bir caddede dikkatsizce yürümek (Caddenin ortasında karşıdan karşıya geçmeniz gerekiyor)	
3) Ağırlık ve denge kontrolü sağlandıktan sonra, arkadaşlarınızla 2 saat cross-country uçuşu yapmak	
4) Yerden 500 feet yükseklikte büyük bir gölün ya da körfezin üzerinden uçmak	
5) Gece, iniş yaptığınızda 1 saatten fazla idare edebilecek kadar yakıtınızın kalacağı bir cross-country uçuşu yapmak	
6) Dışarıdaki ampulü değiştirmek için 10 basamaklı merdivene tırmanmak	
7) Açık bir havada, birbirinden 25 mil uzaktaki 2 tane gök gürültülü fırtınanın arasından, 6.500 feette uçmak	
8) Yerden 3.000 feet yüksekte, ağaçlık vadi ve tepelerle kaplı bir alanda turistik uçuş yapmak	
9) Gündüz, iniş yaptığınızda 30 dakikalık yakıtınızın kalacağı cross-country uçuşa çıkmak	
10) Final dönüşünü 45 derecelik açıyla yapacak şekilde uçuş yolu çizmek	
11) Gece, ortalama bir trafikte, evinizin akınındaki otoyolda 65 kilometre hızla araba kullanmak	
12) Amerika'nın başlıca hava taşıyıcılarının birinin üzerinde 2 saat boyunca bir jetle uçmak	
13) Gündüz, iniş yaptığınızda yarım saatten fazla yetecek yakıtınızın kalacağı cross-country uçuşu yapmak	
14) Gündüz, hava şartları VFR sınırındayken, bakımı yapılmış bir uçakla yerel havaalanından 150 mil uzaktaki bir havaalanına uçmak (Görüş mesafesi: 3 mil, Kapalılık: 2000 foot)	
15) Yerden 1500 feet yüksekte, büyük bir gölün ya da körfezin	

üzerinden uçmak	
16) Uçuş yolunu, final dönüşünde 30 derecelik açı yapacak şekilde ayarlamak	
17) Yoğun yağışlı bir günde, ortalama bir trafikte, evinizin yakındaki otoyolda 65 kilometre hızla araba kullanmak	
18) Ağırlık ve denge kontrolü yapmadan, arkadaşlarınızla 2 saatlik cross-country uçuşa çıkmak	
19) Gündüz, ortalama bir trafikte, evinizin akınındaki otoyolda 65 kilometre hızla araba kullanmak	
20) Gece, iniş yaptığınızda 30 dakikalık yakıtınız kalacak şekilde cross-country uçuşa çıkmak	
21) Yerden 1000 feet yüksekte, ağaçlın vadi ve tepelerle kaplı bir alanda 2 saatlik turistik uçuşa çıkmak	
22) Gece, açık bir havada bakımları yapılmış bir uçakla yerel havaalanından 150 mil uzaktaki diğer bir havaalanına uçmak	
23) Yerden 3500 feet yüksekte, büyük bir gölün ya da körfezin üzerinden uçmak	
24) Asansörle 25. Kattaki ofisinize çıkmak	
25) Gece, hava artları VFR sırındayken, bakımı yapılmış bir uçakla yerel havaalanınızdan 150 ilerideki başka bir havaalanına uçmak (Görüş mesafesi:3 mil, Kapalılık:2000 foot)	

Appendix G: Risk Perception-Other Scale

Aşağıda, eğitim uçuşunda kullanılan tipte küçük bir uçakla gerçekleştirilen bazı senaryolar verilmiştir. Bu senaryoları, DİĞER PİLOTLAR (low-time general aviation pilot) için içerdiği risk açısından 1'den 100'e kadar değerlendiriniz. Verdiğiniz risk değerini, senaryonun yanındaki çubuğu kaydırarak seçiniz.

1= Çok düşük riskli; 100=Çok Yüksek Riskli

1) Final dönüşü sırasında, pilot mikrofonunu yere düşürüyor. Almak için eğildiğinde yanlışlıkla kontrol kolunu hareket ettiriyor ve uçak keskince yan yatıyor.	
2) Pilot kalkış için acele ediyor ve koltuğunu, emniyet kemerini ve omuz kemerlerini dikkatli kontrol etmiyor. Dönüş sırasında koltuk geriye doğru kayıyor. Koltuk kayarken, pilot kontrol kolunu geriye çekiyor ve uçağın burnu yukarı kalkıyor. Hava hızı düşerken, pilot kontrol kolunu nötr pozisyona getirmek için ileri atılıyor.	
3) Fırtınadan oluşan bir hat uçuş rotasının önünü kesiyor, ancak pilot iki fırtına hücresi arasında 10 millik bir boşluk görüyor. Fırtına hattının arkasındaki açık havaya kadar ki yolu da görebiliyor ve fırtına hücrelerinden birinin genişlemiş örs bulutunun altından geçecek olmasına rağmen, rota boyunca yağış gözükmüyor. Pilot, iki fırtına arasından geçmeye çalışırken, aniden şiddetli bir türbülansa giriyor ve uçak dolu yağışıyla dövülmeye başlanıyor.	
4) Alçak tavanlı dağların tepeleri belirsiz ancak pilot, dağ sırtlarının diğer tarafındaki açık havayı görebileceğini düşünüyor. Gittikçe daralan geniş bir vadiye giriş yapıyor. Geçide yaklaştıkça, ara sıra diğer taraftaki gökyüzü görüşünü kaybettiğini fark ediyor. Yola doğru yaklaşarak geçitte ilerlemeye devam ediyor. İlerledikçe tavan seviyesi alçalmaya devam ediyor ve pilot, kendini bir anda bulutların içinde buluyor. Geçitteki rotasını ve irtifasını koruyarak en iyisinin olmasını umuyor.	
5) Kalkışın hemen ardından pilot, uçağın yolcu kısmından bir gürültü duyuyor. Yolcu tarafına baktığında emniyet kemerlerinden birinin takılmadığını fark ediyor. Uçağı, uçuş seviyesine ayarlayıp kontrolü bırakıyor ve emniyet kemerini takmak için kapıyı açmaya çalışıyor.	
6) 2 saatlik bir cross-country uçuş planlaması sırasında pilot, yakıt tüketim hesabını yanlış yapıyor. İniş sırasında 1 saatten fazla yetecek yakıtının kalacağına inanıyor ancak aslında sadece 15 dakika yetecek kadar yakıtı kalacak.	
7) Bütün gün çalışan bir iş kadını evine gitmek için 3 saat uçmak üzere	

havaalanına gidiyor. Kadın, yorgun ve güneş batıyor ancak hava tahminleri açık bir hava olduğu ve görüş mesafesinin iyi olduğu yönünde. Kalkıştan 1 saat sonra aşırı yorgun ve uykulu hissetmeye başlıyor. Yanına kahve almadığı için pişman oluyor ve biraz temiz hava alabilmek için kokpitin havalandırmasını açıyor.	
8) İkindi vakti ve VFR, pilot batıya batan güneşe doğru uçuyor. Son saatte, görüş mesafesi istikrarlı bir şekilde düşüyor ancak varış havaalanı 4 mil görüş mesafesi ve hafif sis ile VFR kalıyor. Bu, doğu batı yönlü tek bir pisti olan yoğun ve kontrolsüz bir havaalanı. Pilot direkt yaklaşmaya karar veriyor.	
9) Bir saat kadar önce havalandığında, yaklaşık 15 knot hızla esen bir yan rüzgâr vardı. Havalanmayı başardı ancak sarsıntılı bir kalkıştı ve küçük havaalanındaki diğer pilotların fark etmemiş olmasını umdu. Şimdi, iniş için rüzgâr altı bacağına girdiği sırada rüzgâr tulumunun aynı hızda, neredeyse direkt bir yan rüzgârı gösterdiğini fark ediyor. İnişte, pist orta hattından sapmayı engellemek için geniş bir krap yapıyor ve palyeye geçmeye başladığında pistin kenarına doğru sürükleniyor.	
10) Yerel bir turistik uçuşta, pilot havanın batıya doğru giderek kötüleştiğini fark ediyor. Bulut kümeleri onun yönüne doğru hareket ediyor ancak hala 20 mil uzaktalar. Pilot, uçuşu kısa kesmeye karar veriyor ve şu anki pozisyonundan 25 mil doğudaki ana havaalanına geri dönüşe geçiyor.	
11) Eğitmen pilot soğuk algınlığından mustarip ve sabah kalktığında, akan burnunu kontrol etmek için reçetesiz satılan bir antihistaminik alıyor. Uçuş simülatöründe ders verdiği bir sabahtan sonra, COM sertifikası için çalışan bir pilotla öğleden sonraya planlanmış bir dersi var. Biraz uyuşuk (uykulu) hissediyor ancak hava güzel ve kısa-alan inişler için çalışacaklar, bu nedenle dersi iptal etmiyor.	
12) Pilot, güzel bir havada yaklaşık 1 saat uzaklıktaki varış havaalanına doğru düz uçuş halindedir. Öğlen saati ve uçakta 3 saat yetecek yakıt vardır.	
13) Tecrübeli bir pilot, tarifeli yolcusuyla birlikte kalkış için taksi yapıyor. Radyo frekanslı yer kontrolü olan kontrollü bir havaalanındalar. "Taksi yap ve 31. Pist için bekle" izni aldılar ve bekleme sırasına doğru ilerliyorlar.	
14) IFR uçuş planında aletli uçuş yetkisi olan bir pilot, 4000 foot kalınlığındaki bulut tabakasına henüz tırmanmıştı. Buzlanma tahmini olmamasına rağmen, ön camın köşelerinde az miktarda buz olduğunu fark ediyor. Uçak, bilinen ya da tahmin edilen buzlanma durumu için donatılmamış. Varış havaalanına yaklaştıkça, Hava Trafik Kontrolü izin için yaklaşık 15 dakika bulut tabakası içinde beklemesi gerektiğini belirtiyor.	

15) Gece geç saatteki uçuşun ilk bölümü için düşük zamanlı VFR, pilot 25 mil görüş mesafesi ile 8500 feette düz uçuş halindeyken, yıldızların muhteşem görüntüsünün tadını çıkarıyor. Büyük bir gölün uzak tarafında konumlanan varış havaalanına yaklaştıkça, zemine yakın sis yüzünden görüş mesafesinin düştüğünü fark ediyor. 2500 feette gölü geçmeye başlayınca kıyıdaki ışıkların görüntüsünü kaybediyor ve yerde parlayan loş ışıklar yıldızlardan ayırt edilemez görünüyor.	
16) Yağ değişim zamanı geldi ve pilot/mal sahibi, bunu kendi başına yapmaya karar veriyor. Uçak bakım teknisyenine danışıyor ve onun yönergelerini takip ediyor. Sonrasında işi kontrol edilmiyor ve seyir defterine uygun kaydı kendi yapıyor.	
17) Yerden 4500 feet yüksekte düz uçuş halindeyken tek motorlu uçağın motoru boğuluyor ve duruyor. Pilot, yakıt ayarlarını kontrol ediyor ve motoru tekrar çalıştırmayı deniyor ancak başaramıyor. Süzülüş uzaklığı içinde bir seviye alanı (level field) görüyor ve ona doğru dönüyor. Rüzgârın içine doğru iniyor olacak.	

Appendix H: Safety Operation Behavior Scale

Son olarak da, lütfen aşağıda yer alan durumları kendi uçuşunuz öncesi, uçuş sırası ve sonrasındaki operasyonları düşünerek hem kendinizi hem de uçuş ekibinizi düşünerek değerlendiriniz.

	Zayıf	Asgari Beklentide	Standard	Çok iyi
1) Açık iletişim için ortam kuruldu ve/veya devam ettirilir. Mürettebat sabırla dinler, gerekli şekilde göz teması kurar.	1	2	3	4
2) Uygun ve güzel bir grup ortamı var. Mürettebat bilgilendirme sırasında söz kesmiyor, çok konuşmuyor ya da acele etmiyor.	1	2	3	4
3) Yeni personel, hatlar, havaalanları ve diğer durumlarda mürettebat, inisiyatif alarak operasyonel bilgi ve tecrübelerini paylaşabiliyor.	1	2	3	4
4) Kabin mürettebatı uygun görüldüğü şekilde takımın bir parçası olarak bilgilendirme toplantısına dahil ediliyor ve yönergeler, kokpit ve kabinin koordinasyonuyla oluşturuluyor. Yolcular, gecikme, hava vs. konularında bilgilendiriliyor ve gerektiğinde bilgiler güncelleniyor.	1	2	3	4
5) Görevli mürettebat, net bir çözüm veya karar alınana kadar uygun bir kararlılıkla düşüncelerini açıkça dile getirir ve bilgilerini beyan eder.	1	2	3	4
6) Görevler ve iş yükü, diğer mürettebat tarafından da kabul edilen şekilde açıkça dağıtılır ve yeterli zaman sağlanır.	1	2	3	4
7) Kaptan liderlik gösterir ve kokpit aktivitelerini koordine eder. Kabin görevlilerinin katılımı ve otorite arasında denge kurar ancak gerektiğinde kararlılıkla hareket eder.	1	2	3	4
8) Mürettebat, kendilerinin ya da diğerlerinin aşırı iş yükü durumunu tespit edebilir ve bunu rapor edebilir.	1	2	3	4

9)Mürettebat yorgunluk durumunu fark edebilir ve yüksek seviyede dikkat göstermek için etkili önlemleri alır. Örneğin; konuşma, kafein, hareket etme vs.	1	2	3	4
10)Birincil uçuş görevlerinin etkili şekilde yerine getirilmesinde yeterli kaynağın sağlanması için operasyonel görevlere öncelik verilir.	1	2	3	4
11) Operasyonel planlar ve kararlar diğer mürettebat görevlilerine açıkça belirtilir, kabul edilir ve gerektiğinde kabin mürettebatı ve diğerleri de eklenir.	1	2	3	4
12)Bilgilendirmeler, operasyonel olarak ayrıntılıdır, ilginçtir. Mürettebat koordinasyonuna ve reddedilen kalkış, kalkış sonrası motor arızaları ve varış noktası çevresinde dolaşma gibi potansiyel problemlerin planlamasına değinilir.	1	2	3	4
13)Kaptan pilot etkili bir bilgilendirme yapabilir ve normal bir operasyon boyunca oluşabilecek yanılmaları öngörebilir.	1	2	3	4
14) Otomatik sistemler uygun seviyede kullanılır. Programlama yükleri durumsal farkındalığı azalttığında ve aşırı iş yükü oluşturduğunda otomasyon seviyesi azaltılır veya devre dışı bırakılır, ya da otomasyon aşırı iş yükünü azaltmak için etkili bir şekilde kullanılır.	1	2	3	4
15) Otomasyon sitemlerinin operasyonu için yönergeler takip edilir. Sistemler devre dışı bırakıldığında, PF ve PNF görevlidir.	1	2	3	4
16)Mürettebat, otomasyon sistem parametrelerine girilenleri ve değişiklikleri sözlü olarak ifade eder veya kabul eder.	1	2	3	4
17)Mürettebat, FMC kapasiteleri, kısıtlamaları ve operasyonları hakkında bilgi alışverişinde bulunur.	1	2	3	4
18)Uçak otomasyon sistemleri düzenli olarak gözden geçirilir ve teyit edilir. Örneğin; en iyi seyir koşulu, doğru pist profilleri vs.	1	2	3	4
19)Uçak otomatik pilota geçirildiğinde ve sistem parametreleri modifiye edildiğinde mürettebat, birbirini zamanında uyarır.	1	2	3	4

20)PF ve PNF görevleri belirlenir ve uygulanır. Örneğin; girdi tarihleri ve onaylanmış karşılıklı etki vs.	1	2	3	4
21)Mürettebat, hem yüksek hem de düşük iş yükü durumlarında yüksek seviyede dikkat gösterir.	1	2	3	4
22)Mürettebat yaklaşmalar, hava durumu vb. gibi beklenen ya da beklenmeyen durumlara karşı hazırdır.	1	2	3	4
23)Mürettebat, kritik bilgi ve/veya durumları uygun bir inatçılıkla dile getirir.	1	2	3	4
24)Tarafsız olarak, işin geribildirimi değiştirmeden kabul edilir.	1	2	3	4
25)Tartışma durumunda mürettebat, yine de güncel problemlere ya da durumlara odaklanabilir ve aktif olarak öneri ve yorumları dinleyebilir, hataları düzeltebilir; dolayısıyla tartışmaların fikir birliği ve çözüme ulaşmasını sağlayabilir.	1	2	3	4
26)Mürettebat, mürettebat işleri ve kararlarıyla ilgili sorular sorar. Örneğin; klerans limitlerindeki belirsizlikle ilgili etkin inceleme, muğlak bir durumu açığa kavuşturma, belirsiz ATC yönergeleri hakkında.	1	2	3	4
27)Bütün mürettebata direkt öğrenme deneyimi açısından uygun zamanda olumlu ya da olumsuz geribildirim verilir. Örneğin; iniş veya kalkışla ilgili yorumlar vb.	1	2	3	4

Appendix I: Aviation Safety Climate Scale

Aşağıdaki cümleleri kurumunuzun güvenlik kültürü açısından değerlendiriniz.

	Kesinlikle katılmıyorum		Ne katılıyorum Ne katılmıyorum		Kesinlikle katılıyorum
1)Güvenliği artırıcı öneriler teşvik edildi.	1	2	3	4	5
2)Yönetim, gerçekten güvenlik konularıyla ilgilendi.	1	2	3	4	5
3)Güvenlik konularında pilotlara danışıldı.	1	2	3	4	5
4) Pilotlar, güvenlik problemleriyle ilgili süpervizörler veya yöneticilerle açıkça konuşabilirdi.	1	2	3	4	5
5)Pilotlara, uçak şirketi dâhil, güvenlik olaylarıyla ilgili geribildirim verildi.	1	2	3	4	5
6)Yönetim, uçuş güvenliğini etkileyecek operasyonel konularda iyi bir anlayışa sahipti	1	2	3	4	5
7)Yönetim, güvenliği firma operasyonlarının önemli bir parçası olarak ele alırdı.	1	2	3	4	5
8)Yönetim, güvenlik olaylarına dâhil olan insanları suçlamak yerine olayların altında yatan faktörleri araştırdı.	1	2	3	4	5
9)Yönetim, pilotları güvenliği uçuş programına uymaktan daha önemli olduğunu düşünmeye teşvik etti.	1	2	3	4	5
10)Yönetim, güvenliğe yeterli kaynak sağladı.	1	2	3	4	5
11)Bilgileri tazelemek ve güncellemek için düzenli eğitim alındı.	1	2	3	4	5
12)Bir dizi acil durum için düzenli eğitim sağlandı.	1	2	3	4	5
13)Şirket eğitimi normal operasyonları güvenli bir şekilde	1	2	3	4	5

sürdürmek için yeterli beceri ve deneyimi sağladı.					
14)Yeni prosedürler ya da ekipmanlar uygulanıldığında eğitim alındı.	1	2	3	4	5
15)Uçak, güvenlik standartlarını sağladı.	1	2	3	4	5
16)Gerektiğinde ekipmanlar güncellendi veya değiştirildi.	1	2	3	4	5
17)Bakım yapmak için yeterli kaynak sağlandı.	1	2	3	4	5
18) Güvenliği etkilen ve rapor edilmiş hatalar düzeltildi.	1	2	3	4	5

Appendix J: Turkish Summary/ Türkçe Özet

1959 ve 2014 yılları arasında toplam 1890 uçak kazası meydana gelmiştir. Bunların 616 tanesi, toplam kazaların yaklaşık yüzde 33'ü, ölümcül kazalardan oluşur. 1274 tanesi ise, tüm kazaların yaklaşık yüzde 67'si, ölümcül olmayan kazalardan oluşmaktadır. Ayrıca, 2005 ve 2014 yılları arasında toplan 404 uçak kazası meydana gelmiş, bunların 72 tanesi ölümcül kazalar olurken kalan 332 tanesi ölümcül olmayan kazalardır.

Ölümcül kazalar incelendiğinde, bu kazaların %10'u taksi, yükleme/boşaltma ya da park sırasında, %13'ü kalkış ve ilk tırmanış sırasında, %7'si tırmanış sırasında, %13'ü düz uçuş sırasında, %3'ü alçalma sırasında, %8'i ilk yaklaşma sırasında ve %48 'i son yaklaşma ve iniş sırasında yaşandığı görülmektedir (Boeing, 2015).

Türkiye de ise 2001 ve 2014 yılları arasında 104 uçak kazası meydana gelmiştir. Bu kazalarda, 255 kişi ölmüş, 81 kişi yaralanmış ve 96 uçak zarar görmüştür (TUİK, 2014).

Havacılık tarihinin başlangıcında, kazaların %80'i mekanik arızalara atfedilmiştir. Bu nedenle, araştırmalar ve geliştirmeler, bu mekanik arızaları azaltmaya yönelik olmuştur. Uçaklardaki mekanik arızaların giderilmesi ve otomasyon sistemlerinin geliştirilmesi ile 30'lu yılların sonlarına doğru insan kapasitelerine ilişkin problemler baş göstermeye başlamıştır. Sonuç olarak ilk insan faktörü araştırmaları insan yetenekleri kapasiteleri ve limitasyonlarına odaklanmıştır (Wise, Hopkins & Garland, 2010). Özellikle jet uçakların sektöre girişi ve otomasyon sistemlerindeki ilerlemeler havacılık sektöründe yeni bir çağ açmış ve bu çağla birlikte uçuş sırasında uçaklarda bulunması gereken ekip küçülmesine rağmen zihinsel iş yükü artmıştır. Bunun ile birlikte araştırmalar, kazalardaki insan faktörü oranının %80' e kadar yükseldiğini göstermiştir (Wiegmann & Shappell, 1997). Bu nedenle, havacılıkta insan faktörünü anlamaya çalışsan araştırmacılar farklı bakış açıları ve modeller geliştirmişlerdir. Zihinsel Bakış Açısı, Ergonomik ve Sistem Tasarımı Bakış Açısı, Havacılık Tıbbı Bakış Açısı, Psiko-sosyal Bakış Açısı, Organizasyonel Bakış Açısı bunların başlıcalarıdır. Organizasyonel Bakış açısı içinde en fazla dikkati çeken model James Reason tarafınsan geliştirilen İsviçre Peynir Modelidir.

Bu model, 4 ana seviyeden oluşmaktadır. Bu seviyeler sırasıyla emniyetsiz davranışlar, emniyetsiz davranışların önkoşulları, emniyetsiz süpervizyon ve kurumsal etkiler olarak isimlendirilmiştir. Reason'a göre (1990) emniyetsiz davranışlar kazaya neden olan aktif aksaklıklardır. Ancak bu davranışlar, kazaların tek nedeni değildir. Diğer seviyelerdeki örtük aksaklıklar, aktif aksaklıkların oluşmasına neden olmaktadır. Reason'a göre kazaları incelerken sadece kazanın oluşmasına neden olan davranışlara odaklanmak, kazaların oluşmasına neden olman çoğu sebebin bulunamamasına neden olmaktadır. Daha sonra, Shappell ve Wiegmann (1997. 1998, 1999, 2000, 2001), Reason'ı bu örtük ve aktif aksaklıları tanımlamamakla eleştirip İsviçre Peynir modeline dayandırdıkları ve bu modelde önerilen aktif ve örtük aksaklıkları tanımladıkları İnsan Faktörü Analizi Ve Sınıflandırma Sistemi modelini geliştirmiştir. Binlerce uçak kazası raporunu inceleyerek Reason'ın 2 kategoriye ayırdığı emniyetsiz davranışları alt kategorilere ayırmışlardır. Buna göre, hataları, yetenek bazlı hatalar, algısal hatalar ve karar hataları olarak 3'e; ihlalleri is rutin ve istisnai ihlaller olarak 2'ye ayırmışlardır. Yine bu kaza raporlarını baz alarak, emniyetsiz davranışların önkoşullarını operatör koşulları, çevresel faktörler ve personel faktörleri olarak 3'e ayırmışlardır. Bu ayrımı daha da detaylandırarak operatör koşullarını olumsuz mental durumlar, olumsuz fizyolojik durumlar ve fiziksel/mental limitasyonlar olarak 3'e; çevresel faktörleri fiziksel ve teknolojik çevre olarak 2'ye; ve personel faktörleri ekip kaynak yönetimi ve bireysel hazırlık olarak 2'ye ayırmışlardır. Emniyetsiz süpervizyon da Shappell ve Wiegmann tarafından alt kategorilere ayrılmış ve bu kategoriler, yetersiz süpervizyon, uygunsuz planlanan operasyonlar, bilinen problemleri düzeltmedeki başarısızlık ve süpervizyonsal ihlaller olarak isimlendirmişlerdir. Son olarak da kurumsal etkileri kaynak yönetimi, kurumsal iklim ve kurumsal süreçler olarak 3'e ayırmışlardır.

Bu modeli temel alarak incelenen 119 uçak kazasında, bu kazaların %60.5 inin yetenek bazlı hatalardan, %28.6'sının karar hatalarından, %26.4'ünün ihlallerden ve %14.3'ünün algısal hatalardan kaynaklandığını göstermişlerdir (Shappell & Wiegmann, 2007). Daha önce de belirtildiği üzere, sadece kazaya yol açan davranışlara odaklanmak kazaların asıl sebeplerini anlamayı zorlaştırmaktadır. Bu nedenle, emniyetsiz davranışlara neden olan durumların araştırılması ve anlaşılması uçuş emniyetini artırmaya yardımcı olacaktır. Bazı araştırmalar, stresin (Orasanu, 1997), kontrol odağının (Wickman & Ball, 1983), risk algısının (Hunter, 2006), ekip kaynak yönetiminin (Helmreich & Davies, 1996) ve güvenlik ikliminin (Zohar, 1980; Griffin & Neal, 2000) emniyetsiz davranışların bazı öncülleri olduklarını savunmuşlardır.

Stresin etkilerinin araştırıldığı çalışmalar, insanların stresli hissettiklerinde daha çok hata yaptıklarını göstermiştir (Orasanu, 1997). Ayrıca, sürücü örneklemi ile çalışan araştırmalarda stresin ihlal ve hataları artırdığı ve kazaya karışma ile ilişkili olduğu bulunmuştur (Evans et al., 1987; Dorn & Matthews, 1995). Pilot örnekleminde yapılan çalışmalarda ise stresin pilot hatalarına yol açtığı (Fornette et al., 2012), algılamayı düşürdüğü, görsel taramayı azalttığı, gerekli bilgiyi edinmeden karar vermeye yol açtığı, aceleyle karar alınmasına neden olduğu, eski prosedürlerin uygulanmasına neden olduğu gibi bulgular rapor edilmiştir (Martinussen & Hunter, 2010).

Yapılan çalışmalarda kontrol odağının da riskli davranışlarla ilişkili olduğu görülmüştür. Örneğin, sürücülerle yaptıkları çalışmalarda Özkan ve Lajunen (2005) içsel kontrol odağı yüksek olan sürücülerin daha çok risk aldığını göstermiştir. Diğer çalışmalarda da, içsel kontrol odağı yüksek olan sürücülerin daha çok hız yaptıkları ve daha çok kazaya karıştıkları görülmüştür (Warner, Özkan & Lajunen, 2010). Pilotlarla yapılan çalışmalarda ise içsel kontrol odağı yüksek olan pilotların daha az riskli durumlar yaşadıkları bulunmuştur (Hunter, 2002). Aynı zamanda, Hunter (2002) deneyim arttıkça pilotların içsel kontrol odağının da arttığını göstermiştir. Yapılan çalışmalar, kontrol odağının kişilerin risk algısıyla ilişkili olduğunu göstermiştir. Yani, içsel kontrol odağı yüksek olan kişilerin çevredeki riskleri algılamada ve bu risklere verdikleri tepkilerde dışsal kontrol odağı yüksek kişilerden daha başarılı olduğu görülmüştür (Wolk & DuCette, 1974). Bunun yanı sıra, You, Ji ve Han (2013), içsel kontrol odağı yüksek olan pilotların operasyonel riskleri daha kolay saptadıklarını göstermişlerdir. Yine aynı çalışmada, içsel kontrol odağı yüksek olan pilotların ekip kaynak yönetimi eğitiminin davranışsal belirteçleri olan emniyetli operasyon davranışlarını daha çok sergilediklerini göstermişlerdir. Risk algısının bu ilişkide aracı değişken olduğu da saptanmıştır (You, Ji & Han, 2013).

Araştırmalar kişilerin risk algının da davranışlarla ilişkili olduğunu göstermektedir. Hunter (2002) risk algısını "durumlar içerisinde var olan riskleri analiz edebilmek için gerekli olan önemli bir bilişsel yetenek" olarak tanımlamıştır. Risk algısı üzerine yapılan çalışmalar, risk algısının sürücülerin riskli davranışlarıyla ilişkili olduğunu göstermiştir. Düşük risk algısına sahip sürücülerin emniyet kemeri kullanmadığı, heyecan amaçlı hız yaptığını ve alkollü araç kullandığını bulmuştur (Rby, Dischinger, Kufera & Read, 2006). Aynı zamanda, O'Hare (1990) pilotların uçuş risklerini doğru algılamada başarısız olabileceğini öne sürmüştür. Hunter (2002, 2006) yine düşük risk algısı olan pilotların daha çok riskli durumlarda bulunduğunu göstermiştir. Helikopter pilotları ile yapılan bir çalışmada ise deneyimli pilotları uçuş risklerini gerçekte olduğundan daha az algıladıkları bulunmuştur (Thompson, Önkal, Avcıoğlu & Goodwin, 2004). Bu da deneyimle birlikte risk algısının azalabileceğini göstermektedir. Risk algısının emniyetli operasyon davranışları ile de ilişkili olduğu çalışmalarla gösterilmiştir. Buna göre, risk algısı arttığında pilotlar ekip kaynak yönetimi eğitiminin davranışsal belirteçleri olan emniyetli operasyon davranışlarını daha çok sergilemektedirler (You, Ji & Han, 2013, 24).

Son yıllarda teknik yeteneklerin pilotların hatalarını azaltmada yeterli olmadığının görülmesiyle pilot hatalarını azaltacak etkenleri anlamanın önemi ortaya çıkmıştır. Uçuş kazalarının başlıca nedenlerinin başında kişiler arası iletişimin, karar verme süreçlerinin ve liderliğin gelmesi kokpit kaynak yönetimi teriminin de ortaya çıkmasını sağlamıştır. Daha sonra kokpit kaynak yönetimi eğitimlerinin geliştirilmesi ile diğer uçuş personelleri de bu eğitime dahil edilmiş ve kokpit yerine ekip kaynak yönetimin önemi vurgulanmaya başlamıştır (Helmreich, Merritt & Wilhelm, 1999). Ekip kaynak yönetimi ya da diğer bir deyişle teknik olmayan yetenekler "teknik yetenekleri tümleyen ve operasyonların emniyetli ve verimli yürütülmesine katkı sağlayan bilişsel, sosyal ve kişisel yetenekler" olarak tanımlanmaktadır (Flin, O'Connor, & Cricton, 2008). Yapılan çalışmalar ekip kaynak yönetimi eğitimlerinin çalışanlarda olumlu tutumları ve emniyetli davranışları artırırken insan hatalarını azalttığı bulunmuştur (Helmreich, 1995). Ekip kaynak yönetimi eğitimleri uçuş güvenliğini artırmada kullanılan önemli bir araç olsa da yapılan çalışmalar genel olarak ekip kaynak yönetimi eğitimlerine verilen reaksiyonlara ve bu eğitimlerin tutum ve davranış değişimine olan etkisine odaklanmıştır. Bu nedenle, ekip kaynak yönetiminin pilotların emniyetsiz davranışları üzerindeki rolü henüz araştırılmamıştır.

Özellikle 1986 da yaşanan Çernobil faciasından sonra işyeri güvenliği konusundaki araştırmalarda artış olmuştur (Martinussen & Hunter, 2010). Ekip kaynak yönetimi eğitimleri ile birlikte çalışanların kurum içerinse takım olarak görülmeye başlanması, kurum içerisindeki güvenlik iklimi de önemli bir konu olarak ortaya çıkmıştır. Federal Havacılık İdaresi (2006) emniyet konularındaki sorumluluğun üst yönetimin sorumluluğunda olduğunu savunmuş ve yöneticilerin operasyon güvenliği ile ilgili sorumluluk alması gerektiğini ve çalışanların emniyetli operasyon süreçlerini devam ettirdiğinden emin olmaları gerektiğini vurgulamıştır. Aynı zamanda, uçuş emniyeti sistemlerinin başarılı olabilmesinin üst yönetiminin güçlü bir güvenlik iklimi kurma ve devam ettirme yeteneğiyle ilişkili olduğu belirtilmiştir. Bu nedenle, güvenlik iklimi uçuş emniyeti açısından önemli bir kurumsal etki olarak karşımıza çıkmaktadır. Güvenlik iklimi "çalışanların, çalışma ortamı ile alakalı paylaştıkları kitlesel algıların bir özeti" olarak tanımlanmaktadır. Literatürde iklim ve kültür terimleri aynı anlamda kullanılsa da bu iki terimin aslında farklı yapılar olduğu savunulmaktadır (Mearns & Flin, 1999). Kültür, bir gruba ait ve o grubun çeşitli durumları nasıl algıladığını, nasıl düşündüğünü ve nasıl tepki verdiğini belirleyen örtük varsayımlar olarak tanımlanırken iklim, kültürün dışa vurulan ve ölçülebilen yönü olarak görülmektedir (Schein, 1996). Güvenlik iklimi ise çalışanların güvenlik ve risk ile ilgili tutumları, algıları ve inançları olarak tanımlanmaktadır (Zohar, 1980). Tutumlar, algılar ve inançlar davranışların önemli birer yordayıcısı olduğundan (Glendon, Clarke, & McKenna, 2006) güvenlik iklimi pilotların emniyetsiz davranışlarını yordamada ve bu davranışların oluşmasını önlemede kullanılabilir. Güvenlik iklimi pek çok endüstri alanında oldukça çalışılan bir değişken olarak karşımıza çıkmaktadır. Özellikle iş güvenliğinin önemli olduğu endüstrilerde güvenlik iklimi ile çalışanların emniyetli davranışları arasındaki ilişki çokça çalışılmıştır. Örneğin, güvenlik ikliminin çalışanların emniyet prosedürlerine uyumuna ve bunlara katılımına olumlu katkı yaptığı görülmüştür (Clarke, 2006). Aynı zamanda olumlu güvenlik ikliminin daha az kazaya karışma ile ilişkili olduğu bulunmuştur. Morrow, Koves ve Barnes (2014) yaptıkları çalışmada güvenlik ikliminin nükleer enerji santrallerinde çalışan kişilerin emniyet performanslarıyla ilişkili olduğunu bulmuştur. Profesyonel sürücüler ile yapılan çalışmalarda da kurumdaki pozitif güvenlik ikliminin sürücülerin daha az hız ve kural ihlali yaptığını göstermiştir (Amponsah-Tawiah & Mensah, 2016). Aynı zamanda, Öz, Özkan ve Lajunen (2010, 2013, 2014) Türk profesyonel sürücüler ile yaptıkları çalışmalarda pozitif güvenlik ikliminin sürücülerin daha az hata ve ihlal yapmasıyla ilişkili bulunmuştur. Güvenlik iklimi ve emniyetli davranışlar arasındaki ilişkileri gösteren çalışmalar olsa da havacılık endüstrisinde güvenlik iklimi çalışmaları genellikle güvenlik ikliminin faktörlerini belirlemeye odaklanmıştır. Örneğin, bu amaçla Evans, Glendon ve Creed (2007) pilotların güvenlik iklimi algılarını ölçmek amacıyla Uçuş Güvenlik İklimi Ölçeğini geliştirmiş ve ölçeğin 3 faktörlü olduğunu göstermişlerdir. Bu faktörleri yönetimsel bağlılık ve iletişim, güvenlik eğitimi ve ekipman ve bakım olarak isimlendirmişlerdir. Güvenlik ikliminin güvenlikle alakalı çıktılarla oldukça ilişkili olduğu farklı endüstrilerde gösterilmiş olsa da havacılık endüstrisinde güvenlik iklimi ve emniyetsiz davranışlar arasındaki ilişki henüz çalışılmamıştır.

Literatürdeki bilgiler ışığında, bu çalışmanın amacı, kurum güvenlik iklimi, emniyetsiz davranışların önkoşulları, özellikle stres, kontrol odağı, risk algısı ve ekip kaynak yönetiminin davranışsal belirteçleri, ve pilotların emniyetsiz davranışları arasındaki ilişkinin İnsan Faktörü Analizi ve Sınıflandırma Sistemi temelinde araştırılmasıdır.

Bu çalışmada, toplan 165 hava yolu pilotundan veri toplanmış ancak 10 katılımcı çeşitli nedenlerle analizden çıkarılmıştır. Katılımcıların yaş ortalaması 39.01, deneyim ortalaması 7.216 yıl ve ticari hava yollarındaki toplam uçuş saati ortalaması 5,185.35

saattir. Katılımcı pilotları aylık uçuş saati ortalaması 75.10 olup son 3 yılda yaşadıkları kritik olay sayılarının ortalaması ise 0.77'dir. Veri toplama sürecine başlamadan önce, Uçuş Emniyeti Kontrol Odağı Ölçeği, Risk Algısı-Kendi ve -Diğerleri Ölçekleri, Emniyetli Operasyon Davranışları Ölçeği ve Uçuş Güvenlik İklimi Ölçeği Türkçeye çevrilmiştir. Ayrıca, Hat Operasyonları Emniyet Denetimi (LOSA, 1st Ed., 2002) kılavuzu ve Sivil Havacılık Genel Müdürlüğünün SHT-KOKPİT YOL BOYU (2014) yönetmeliği baz alınarak Hava Yolu Pilotları Davranış Envanteri geliştirilmiştir. Davranış envanterinin geliştirilme sürecinde Reason'ın (1990) önermiş olduğu insan faktörü algoritması temel alınmış ve ölçek maddeleri bu algoritmaya dayandırılarak oluşturulmuştur. Daha sonra, hem yeni oluşturulmuş Hava Yolu Pilotları Davranış Ölçeği ve hem de Türkçeye adapta edilmiş olan Uçuş Emniyeti Kontrol Odağı, Risk Algısı-Kendi ve -Diğerleri, Emniyetli Operasyon Davranışları ve Uçuş Güvenlik İklimi ölçekleri, Türkiye Havayolu Pilotları Derneği eski başkanı Kpt. Plt. Gürcan Mantı tarafından incelenmiş ve gerekli görülen terimsel düzeltmeler bu inceleme sonrasında yapılmıştır. Veri toplamaya başlamadan önce gereken bütün izinler alınmıştır. Veri toplama, pilotların yoğun çalışma koşulları göz önüne alınarak İnternet üzerinden yapılmıştır. Pilotlara, Türkiye Hava Yolu Pilotları Derneği web-sitesinden ve sosyal medya üzerinde kurulmuş olan, çoğunlukla pilotların üye olduğu gruplar üzerinden ulaşılmıştır. Veri toplama süreci Aralık 2015 ile Nisan 2016 ayları arasında devam etmiştir.

Çalışma değişkenleri arasındaki ilişkiyi incelemeden önce Türkiye'de çalışmada kullanılan ölçeklerin Türkçeye ilk defa uyarlanması nedeniyle hem yeni geliştirilen ölçek için hem de uyarlanan ölçekler için faktör analizi yapılmıştır. Sonuçlara göre, yeni geliştirilen Hava Yolu Pilotları Davranış Envanterinin 5 faktörlü yapıya uygun olduğu bulunmuş ve faktörler İnsan Faktörü Analiz ve Sınıflandırma Sistemi modeline göre (1) algısal ve yargısal hatalar, (2) beceriye dayalı hatalar, rutin ihlaller, yöntemsel itaatsizlik ve uygunsuz yöntem hataları olarak isimlendirilmiştir. Uçuş Emniyeti Kontrol Odağı ölçeği ise orijinal faktör yapısından farklı olarak 3 faktörlü yapı göstermiş ve bu faktörler, (1) kadercilik, (2) içsellik ve (3) yönetmeliklerin içselleştirilmesi olarak isimlendirilmiştir. Risk algısı-Kendi ölçeği de orijinal 5 faktörlü yapısının aksine, bu çalışmada 4 faktörlü yapı göstermiş ve bu faktörler (1) İrtifa ve Yakıt riski, (2)Günlük riskler, (3) Genel Düşük riskler ve (4) Görerek Uçuş Kuralları riskleri olarak adlandırılmıştır. Risk Algısı-Diğerleri ölçeği ise orijinal faktör yapısıyla uyumlu olarak 3 faktörlü yapı göstermiştir. Bu faktörler (1) Gecikmeli risk, (2) Nominal risk ve (3) Yüksek risk olarak isimlendirilmektedir. Emniyetli Uçuş Davranışları ölçeği orijinal olarak 4 faktör olarak önerilse de bu çalışmada 3 faktör yapısı bulunmuş ve bu faktörler (1) Ekip ve Otomasyon Sistemleri Yönetimi, (2) Durumsal Farkındalık ve Karar verme, (3) Ekip İletişimi ve İşbirliği olarak adlandırılmıştır. Son olarak, Uçuş Güvenlik İklimi ölçeğinin faktör yapısı incelenmiş ve orijinal geliştirme çalışmasında 3 faktörlü yapı görülmesine rağmen bu çalışmada, tek faktörlü bir yapı görülmüştür. Bu faktör genel olarak “Kurum Güvenlik İklimi” olarak isimlendirilmiştir.

Faktör yapıları belirlemek için yapılan analizlerden sonra gruplar arasındaki farklılıkları belirlemek adına bağımsız gruplar t testi kullanmıştır. Sonuçlar şöyledir. Son 3 yılda bir ya da daha fazla kritik olay yaşayan pilotlar kritik olay yaşamayan pilotlara göre daha fazla rutin ihlal rapor etmişlerdir. Sivil havacılık ve askeri havacılık mezunu pilotlar arasında yapılan karşılaştırmada ise sivil havacılık mezunu pilotların askeri havacılık mezunu olan pilotlara göre daha fazla uygunsuz yöntem hataları rapor ettikleri ve görerek uçuş şartlarıyla ilgili riskleri askeri havacılık mezunu pilotlara göre daha yüksek algıladıkları görülmüştür. Bu durumun olası nedenlerinden biri askeri pilotların daha çok risk almalarının beklenmesi ve askeri havacılık kariyerleri boyunca daha fazla riskli durumla karşı karşıya gelmeleri olabilir. Ayrıca, askeri havacılıkta emniyet önemli bir faktör olsa da asıl amaç görevin başarıyla tamamlanmasıdır. Bu nedenle, askeri pilotların görerek uçuş şartlarıyla ilgili riskleri sivil havacılık mezunu pilotlardan daha az algılamaları bununla ilişkilendirilebilir. Ancak, askeri pilotların daha fazla risk almaları beklenirken aynı zamanda prosedürleri de katı bir şekilde uygulamaları beklenmektedir. Çünkü askeri havacılık sivil havacılığa göre çok daha az hata payına tolerans göstermektedir (Kanki, Helmreich & Anca, 2010). Aynı zamanda, askeri pilotlar görevlerini başarıyla tamamlayabilmek için çevrelerini daha iyi analiz edebilmeli, daha hızlı karar verebilmeli ve ekiple daha iyi bir iletişim ve iş birliği içinde olabilmelidir. Bu nedenle, bu çalışmada askeri havacılık mezunu pilotların sivil havacılık mezunu pilotlara göre daha fazla durumsal farkındalık ve karar verme ile daha fazla ekip iletişimi ve işbirliği rapor etmeleri bahsedilen durumla açıklanabilir. Literatürde, sicil havacılık pilotlarının askeri havacılık pilotları arasında içsellik açısından fark olduğu gösterilmiş olsa da bu çalışma da böyle bir fark bulunmamıştır. Ayrıca, Hunter (2002) pilotların risk algısı-kendi ölçeğindeki skorlarının risk algısı-diğerleri ölçeğindeki skorlarından daha düşük olduğunu bulmuştur. Yani, pilotlar, durum içerisindeki riskleri kendileri için diğerlerine göre daha az riskli olarak değerlendirmişlerdir. Bu çalışmada da Hunter ile benzer sonuçlar bulunmuş, hava yolu pilotları risk algısı-kendi ölçeğinde risk algısı-diğerleri ölçeğine göre daha az skorlar rapor etmişlerdir.

Çalışma değişkenleri arasındaki ilişkileri incelemek için hiyerarşik regresyon analizi yapılmıştır. Bu analizlere göre; hissedilen stresin yüksek olması ve irtifa ve yakıt riskinin yüksek olarak algılanması yüksek algısal ve yargısal hatalarla ilişkili bulunmuştur. Ancak, görerek uçuş kuralları riskinde ve yönetmeliklerin içselleştirilmesi faktörlerinde yüksek olan pilotların daha az algısal ve yargısal hata rapor ettikleri görülmüştür. Yetenek bazlı hatalar ise sadece kurum güvenlik iklimi tarafından yordanmıştır. Yani, kurum güvenlik iklimini olumlu algılayan pilotlar daha az yetenek bazlı hata rapor etmişlerdir. Rutin ihlallerinin de yönetmeliklerin içselleştirilmesi ve kurum güvenlik iklimi ile pozitif olarak ilişkili olduğu bulunmuştur. Yani, yönetmelikleri uyguladıkları sürece oluşabilecek olayların sonuçlarının kendi kontrollerinde olduğunu düşünen ve kurumun uçuş emniyetine gereken özeni gösterdiğini düşünene pilotların daha az rutin ihlal yaptığı gösterilmiştir. Yöntemsel itaatsizlik ise yine yönetmeliklerin içselleştirilmesi ve pozitif kurum güvenlik iklimi ile pozitif ilişkilidir. Reason (1990) tarafından da önerildiği gibi pozitif güvenlik iklimine sahip kurumlarda ihlallerin oluşmasını caydırıcı bir atmosfer oluştuğu ve bunun da ihlal sayılarını azalttığı düşüncesine bir destek oluşturulmuştur. Son olarak da, uygunsuz yöntem hatalarının hissedilen stres ve içsellikle pozitif, yönetmeliklerin içselleştirilmesi ve kurum güvenlik ilkimi ile negatif olarak ilişkili olduğu bulunmuştur.

Değişkenler arasında aracılık ilişkisi incelendiğinde ise yönetmeliklerin içselleştirilmesinin irtifa ve yakıt risk algısıyla negatif ilişkili olduğu bunun da ekip ve otomasyon sistemleri yönetimini azalttığı bulunmuştur. Ancak literatürde bu sonuç ile çelişen sonuçlar bulunmaktadır. Yaptıkları çalışmada, You, Li ve Han (2013) içselliği yüksek pilotların risk algısının yüksek olduğunu, bunun da pilotların daha çok emniyetli operasyon davranışları sergilemesiyle ilişkili olduğu gösterilmiştir. Ancak, You, Li ve Han'ın yaptığı çalışmada uçuş emniyeti kontrol odağı ölçeğinin içsellik faktörü kullanılmıştır. Bu çalışmada ise aynı ölçekte yeni bir faktörün, yönetmeliklerin içselleştirilmesi, varlığı gösterilmiştir. Yani bu iki çalışmada bulunan sonuçların çelişkili olması ilişki içerisindeki kontrol odağı faktörlerinin farklı olması olabilir. Aynı şekilde, irtifa ve yakıt risk algısının yönetmeliklerin içselleştirilmesi ve ekip iletişimi ve işbirliği arasındaki ilişkiye de aracılık ettiği bulunmuştur. Yani, yönetmeliklerin içselleştirilmesi irtifa ve yakıt risklerinin algılanmasındaki düşüşlerle ilişkili olup bu da ekip içerisindeki iletişim ve işbirliğindeki düşüşle ilişkili görülmüştür. Bir diğer aracılık ilişkisi güvenlik iklimi, yönetmeliklerin içselleştirilmesi ve rutin ihlaller arasında bulunmuştur. Sonuçlara göre, pozitif güvenlik ikliminin yönetmeliklerin içselleştirilmesindeki artışlarla ilişkili olduğu ve yönetmeliklerin içselleştirilmesindeki artışın da rutin ihlallerin azalmasını yordadığı gösterilmiştir. Daha önce de belirtildiği gibi, güvenlik iklimi çalışanların güvenlikle ilgili kurallara, yönetmeliklere ve prosedürlere karşı olan tutumları ve algılarıyla ilişkilendirilebilir (Glendon, Clarke & McKenna, 2006). Böylelikle, kurum içerisindeki pozitif güvenlik iklimi algısı pilotlarda bu emniyet kural ve prosedürlerini uyguladıkları sürece oluşabilecek olayların sonuçlarının kendi kontrollerinde olduğu inancına yol açarak rutin ihlallerin azalmasına yardımcı oluyor olabilir. Bu da bu çalışmada bulunan güvenlik iklimi, yönetmeliklerin içselleştirilmesi ve rutin ihlaller arasındaki ilişkinin bir açıklaması olarak görülebilmektedir.

Kurum içerisindeki pozitif güvenlik iklimi algısı çalışanlar arasındaki açık iletişimin oluşturulmasına da katkı sağlamaktadır. Literatüre bakıldığında, pilotların ekip arkadaşlarının yaptığı hataları ve ihlalleri uyarmada eksik oldukları görülmektedir (Ion, 2011). Örneğin, eğer deneyimli bir pilot tarafından bir ihlal yapılırsa diğer ekip üyeleri deneyimli pilotun “en iyisini bildiğini” düşünerek onu uyarma ya da bu durumu rapor etme gereksinimi duymayabilir. Ayrıca, bu durumun tam tersi de mümkündür. Eğer daha az deneyimli bir pilot kendisinden daha fazla deneyimi bulunan bir pilotun yaptığı ihlallere karşı bir uyarıda bulunursa daha deneyimli olan pilot bu uyarıyı dikkate almayabilir. Böyle bir durumda kurumdaki pozitif güvenlik iklimi algısı ekip içerisinde açık iletişim kanalları oluşturmaya yardımcı olabilmektedir. Böylelikle, ekip üyeleri herhangi bir hata ya da ihlal durumunda birbirini uyarabilir ve bu uyarılar daha çok dikkate alınabilir. Böylelikle pilotların hata ve ihlal sayılarında azalma sağlanabilir. Bu çalışmada da kurum güvenlik iklimi ve rutin ihlaller arasındaki ilişkiye ekip iletişim ve işbirliği tarafından aracılık edildiği görülmüştür. Yani, kurum içerisindeki pozitif güvenlik ikliminin ekip içerisindeki iletişimi ve işbirliğini artırarak rutin ihlallerde azalmayla ilişkili olduğu bulunmuştur. Bu bulgu, belirtilen duruma bir destek niteliği taşımaktadır.

Yürütülen tez çalışmasının literatüre bazı katkıları bulunmaktadır. Öncelikle, bu çalışmada incelenen değişkenlerin birbirleriyle olan ilişkileri İnsan Faktörü Analiz ve Sınıflandırma Sistemi modeli temel alınarak yapılmıştır. Bu model, başlangıçta uçuş kazalarının nedenlerinin araştırılması amacıyla geliştirilmiştir. Daha önceki araştırmalar da belirtilen modeli kaza araştırmalarında, kazaların nedenlerini belirlemek amacıyla kullanmışlardır. Aynı zamanda, bu model geliştirilirken kaza incelemecileri için bir çerçeve oluşturması amaçlanmıştır (Shappell & Wiegmann, 2001). Bilindiği kadarıyla bu model, daha önce pilotların emniyetsiz davranışları ve bunlara neden olabilecek faktörleri araştırmak amacıyla kullanılmamıştır. Bu nedenle, yapılan tez çalışması bu modelin emniyetsiz davranışları yordayan ya da bu davranışların oluşmasına katkı sağlayan faktörlerin araştırılması amacıyla da kullanılabileceğini göstermiştir. Aynı zamanda, bu model çerçevesinde bulunan sonuçlar uçuş emniyetini artırmak amacıyla da kullanılabilecektir.

Yapılan çalışmanın bir diğer katkısı hava yolu pilotlarının emniyetsiz davranışlarını ölçen davranış envanterinin geliştirilmesidir. Daha önce pilot davranışlarının kazaların direkt neden olduğu bilinse de davranışsal ölçümler genel olarak ekip kaynak yönetimi eğitiminin davranışsal belirteçlerini ölçmeye ve araştırmaya odaklanmıştır. Ancak, pilot davranışlarının araştırılması sadece ekip kaynak yönetimine değil kazaların direkt nedenlerine de odaklanmalıdır. Bilindiği kadarıyla, daha önce pilotların emniyetsiz davranışlarını ölçmeyi amaçlayan bir ölçek geliştirilmemiştir. Geliştirilen bu ölçek, Hava Yolu Pilotları Davranış Envanteri, pilotların emniyetsiz davranışlarını araştırmayı amaçlayan çalışmalarda kullanılabilecektir. Aynı zamanda, bu ölçek, hava yolu işletmeleri tarafından pilotlarının davranış desenlerini anonim olarak araştırmak ve bu desenleri değiştirmeyi amaçlayan eğitimler planlamak amacıyla da kullanılabilecektir.

Daha önce geliştirilen ve geçerliliği test edilen kurum güvenlik iklimi ölçekleri ağırlıklı olarak içsel kontrol odağı ve dışsal kontrol odağı faktörlerine odaklanmıştır. Ayrıca, bu ölçeklerle yapılan çalışmalar içsel kontrol odağının pilot davranışları üzerindeki önemli etkilerini göstermişlerdir. Ancak, yapılan bu çalışma literatüre pilotlar için önemli olan bir diğer kontrol odağı faktörünü, yönetmeliklerin içselleştirilmesi, kazandırmıştır. Aynı zamanda, bulunan sonuçlar, yönetmeliklerin içselleştirilmesi faktörünün pilotların emniyetsiz davranışlarını yordamakta içsellik faktöründen daha önemli olduğunu göstermektedir. Böylelikle, hava yolu işletmeleri, yönetmeliklerin içselleştirilmesi faktörünün pilot davranışları üzerindeki etkisinin farkında olarak bu konu üzerine yoğunlaşabileceklerdir. Özellikle hava yolu işletmelerinin yöneticileri, pilotların kuralları, yönetmelikleri ve prosedürleri uygulamaları ve bu uygulamaların uçuş güvenliği üzerindeki etkisi hakkında pilotlarla iletişim ve işbirliği içinde olarak pilotların bu uygulamaları içselleştirmesine ve gerektiğinde bu uygulamaların geliştirilmesine katkı sağlayabilirler.

Son olarak, yapılan bu çalışmada, Türk hava yolu pilotları örnekleminden veri toplanmıştır. Daha önce, Türk hava yolu pilotlarının kültürel farklılıklarının ekip kaynak yönetimine etkisini, ve Emniyet Yönetimi Sistemlerinin etkililiğinin araştıran çalışmalar olsa da bilindiği kadarıyla, bu çalışma Türk hava yolu pilotlarının emniyetsiz davranışları ve bu davranışlara yol açan faktörleri araştıran ilk çalışma olmuştur. Bu nedenle, yapılan bu çalışma, Türk hava yolu pilotlarının uçuş emniyeti ile ilişkili faktörlere ilişkin profilini göstermesi nedeniyle önemlidir.

Yapılan bu çalışmanın literatüre yaptığı katkılar olsa da, bazı sınırlamaları da mevcuttur. Öncelikle, bu çalışmada beyana dayalı ölçekler kullanılmıştır. Beyana dayalı ölçümlerin güvenilirliği üzerine yapılan çalışmalar, beyana dayalı ölçümlerin sosyal istenilir cevaplara yatkın olduğunu göstermektedir. Hava yolu şirketlerinde de uçuş güvenliği oldukça kritik bir konu olduğundan yapılan bu çalışmada toplanan verilerde sosyal istenilirliğe dayalı cevaplar verilmiş olabilir. Bu nedenle, gelecek araştırmalarda sosyal istenilirlik ölçeğinin de kullanılması elde edilen verinin güvenilirliğini daha da artırmaya yardımcı olabilir. Ayrıca, gelecekte yapılacak araştırmalarda uçuş sırasında gözlem yapmak ya da simülatörde gözlemlemek gibi daha objektif ölçümler kullanılarak da sosyal istenilirliğin etkisi azaltılabilir.

Bu çalışmanın bir diğer sınırlaması ise örneklemin sınırlı olmasından kaynaklanmaktadır. Bu çalışmada, 155 pilottan veri toplanmıştır. Özellikle Hava Yolu Pilotları Davranış Envanteri'nin faktör yapısının incelenmesi sırasında örneklin sınırlı olması problem olmuştur. Araştırmacı, bu problemi çözmek için tamamlanmayan verileri de analize dâhil ederek faktör yapısı incelese de gelecek araştırmaların daha büyük bir örneklem grubuyla hem çalışma sonuçlarını araştırması hem de Hava Yolu Pilotları Davranış Envanteri'nin faktör yapısını incelemesi önemli olacaktır.

Son olarak, bu çalışmadan süpervizyonun etkisi çalışma kapsamına dahil edilmemiştir. Ancak, literatüre bakıldığında süpervizyonsal faktörlerin de kaza oluşumuna etkisi olduğu bulunmuştur (Shappell & Wiegmann, 2001). Bu nedenle, gelecekti çalışmaların süpervizyonsal faktörleri de çalışma kapsamına dâhil etmesi daha da kapsamlı sonuçlar elde edilmesini sağlayabilecektir.

Appendix K: Tez Fotokopisi İzin Formu

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ■

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : Serin

Adı : Gizem

Bölümü : Trafik ve Ulaşım Psikolojisi

TEZİN ADI (İngilizce) :Organizational Safety Climate, Precondition for Unsafe Acts and Unsafe Acts of Turkish Commercial Airline Pilots

TEZİN TÜRÜ : Yüksek Lisans ■ Doktora ☐

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. ■

2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullancılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ■

3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin Fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

Yazarın imzası .... Tarih ....