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# Risk Perception Of Turkish Helicopter Pilots And The Relationship Between Their Flight Experience and Decision Making Styles

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**ABSTRACT:***Aircraft and flight system accidents due to human error sare more common than accidents due to mechanical failure. This study aims to determine the risk perception of Turkishhelicopterpilots and the relationship between their flight experience decision making styles. In this context, the analyses are conducted among helicopter pilots flying in accordance with general aviation rules. In this context, analyses are conducted with the participation of helicopter pilots flying according to general aviation rules (n=308) in Turkey. In the light of these analyses, it is seen that there is a relationship between the risk perceptions and decision making styles of the pilots. Also, there are considerable differences found between the flight hours and decision making styles of the pilots. However, there are no significant differences between the ages and the decision making styles. The results are discussed in comparison to the studies in the literature.*
**KEYWORDS:** *Aviation risk perception, decision making styles, helicopter pilots, flight experience*.

## I. Introduction

"Errarehumanumest",[To err is human]. There is always a chance of failure for the systems designed and built by human beings (RAT, 2013). Today, aviation sector has developed rapidly with the technological advancements, yet fatal accidents have yet to be prevented completely. Especially recently, despite the high level of information and technology in the aviation sector, human error seems to be increasing in the accidents. (WiegmanandShappell, 2003). The latest sad example of this is the German Airbus owned by Germanwings Airlines, which crashed into the French Alps on 24th March 2014. After the examination of the black box recordings, it was revealed that the cause of the accident was completely human error.

In a technical conference held by the International Air Transport Association (IATA), pilot error was asserted as the most significant factor leading to accidents. It is thought that pilot error is the main factor in all the aviation accidents ever happened. The studies have shown that the effect of human error in aviation accidents accounted for 70-80% (Çetingüç, 2015; Howson, 2013; WiegmannandShappel, 2003). For these reasons, aviation industry has been working harder to decrease the number accidents caused by human errors. In parallel with this, scientific studies concerning human factor has gained acceleration (TsagandVidulich, 2003).

Studies conducted so far demonstrate that a safe flight in air lines and general aviation operations can only be possible through the pilot decisions that are timely and made according to the volatile flight conditions (Schriver, Morrow, Wickens, andTalleur, 2008). The accuracy of the pilot decisions depend on numerous factors such as his/her experience and the hardness of environmental conditions that change continuously and hard to estimate (FAA, 2009).

Onpilot decision making process, Martinusser and Hunter (2010) propose a model that explains the relationship between pilot's decision-making performance and riskassesment attitude is shown in Figure-1. In this model, risk management/perception, with its risk (propability) and hazard (effect) dimensions, is considered an important factor that affects pilots' decision-making perfromance. Another determinant that affects pilot's decision making behavior is the flight experience, which arethe total flight years and the total number of flight hours (You, Ji, and Han, 2013).

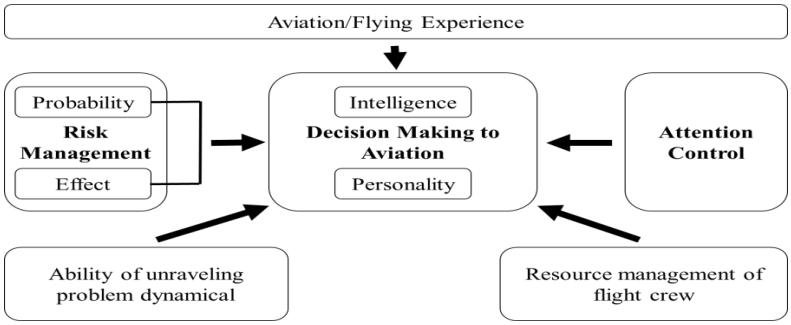


**Figure 1: Decision Making Model in Aviation**

The risk perception and the decision making styles used by the pilots differs with the total flight years and hours that show the flight experience (Drinkwater andMoleswort, 2010). The aim of this study isto explore the associations between the pilot's flight experience, risk perception tendencies and decision making styles. For this reason, in order to determine the said relation, this study was conducted with the participation of helicopter pilots who have to give immediate decisions more frequently than general aviation pilots and fly according to general aviation rules.

## II. Literature Review

### 2.1Risk Perception

When the concept of risk first emerged, it was used to describe the inevitability of war (Yüce, 2014). From a philosophical point of view, it means "to dare, to make a choice" (Piccket, 2003). International Organization of Standardization (ISO) has described risk as "the effects of uncertainties on the target" (ISO 31000, 2009). Risk generally means "the probability of encountering with unwanted results." (Benligiray, 2005)

In the sector of aviation risk is described as the size ofprobability and hazardleading big accidents and downtimes in all the flight systems including aircraft and ground support. The probability of the existing hazard to happen and the damage it will cause describe two dimensions of risk in aviation sector (SHT, 2011). On the other hand, risk perception explains the recognition of risks and hazards regarding the possible alternatives emerging in decision making process.

The perception of risk and hazard related to the incident occuring during flight varies according to the pilot's character, abilities, and experience (Yeniçeri, Yaraş, and Akın, 2012). The risk perceived by a pilot authorized to fly through clouds without sight and that of a pilot who has to operate just by seeing will be at different levels according to their authorities and experiences. Apart from authority and experience, personal differences are also known to have an effect on rist perception. For example, a pilot, who regards his/her personal abilities above average, can fail in properly perceiving the risk regarding the hazardous situation he/she encounters,and this can harm the accuracy of the decision he/she make (Joseph and Reddy, 2013).

Hunter (2010) states that pilots' abilities of risk assessment and management are important factors in the process of decision-making. Researches indicate that risk perception and tolerance are influential on the decisions pilots make during flight, especially when they encounter bad weather conditions (Johnson, Wiegmann, Goh, andWickens, 2005).

When compared to airline flights, pilots flying with general flight rules are more at risk (Hunter, Martinussen, andWiggings, 2003). Research and rescue flights, transfer flights of sick and injured people, fire extinguishing and observation flights, aerobatics, naval surface flights to sea platforms, flights for checking powerlines and oil pipelines, and some military flight missions are regarded as within general flight status. Because such flights are usually made in unexpected times and generally in inconvenient weather conditions, they can pose more risk. The reason that the target group of the research is the helicopter pilots is that such flights include more risk compared to airline flights (carrying passengers).

### 2.1 Decision Making Styles

Decision making denotes selection (Koçel, 2011). In other words, it represents the selection among the alternatives that emerge in a situation (Luthans, 1992). Decision making style, on the other hand, indicates the main approach a person employs during the decision making process (Taşdelen, 2001). The varieties in decision making derives from the personal differences between individuals. Having different cognitive abilities such as intelligence, the degree of motivation about the topic and individual differences generate variationsin decision making styles (Galotti, Ciner, Altenbaumer, Geert, Rupp, andWoulfe, 2006). Examination of the decision making styles seems important to estimate the manner of approach that a person would choose in order to make a choice in different situations.

Scott and Bruce (1995) proposes a decision making styles classification that is affected by habits and individual differences in their study. Five different types of decision making styles are stated according to their model. First one is *rational decision making*in which the alternatives are evaluated rationally and decision is made through researches. Second one is *intuitive decision making*in which individual relies on his/herfeelings and intuitions, andwhile choosing between alternatives, perceived risk is focused. Third one is *dependent decision making:* in which individual tends to solve the uncertainty by listening to the other people's advice and suggestions and pays regard to respective directions and instructions showing the proper courses of actions. Forth one is *avoidant decision making*in which individual tends to demonstrate avoidant manners against decision making.And the last one is *spontaneous decision making*which is a fast decision making style where individuals decide without further thinking and evaluating alternatives.

The consequences of pilots' decision making styles are considered as highly critical factors which trigger major accidents in aviation. A majority of general aviation accidents is related to factors that are the results of pilot performance rather than the mechanical or structural failures related to aircraft. A general reason behind these accidents is related to wrong decisions made by the pilots on board. Especially,pilot decision failures in fatal accidents outnumber the ones in minor accidents(Pauley, O'Hare, and Wiggins, 2008). The percentage of aviation accidents caused bypilots' wrong decisions is reported as 52%. (Martinussenand Hunter, 2010). Wiegmann and Shappell (2003) proposes three main categories after examining these errors, namely "errors that occur when procedures are not followed or applied", "errors that occur due to a lack of adequate performance during choosing between alternatives" and "problem solution errors".

Decision making process includes a risk analysis of alternatives. The last stage of this process is comprised of eliminating the riskiest situations and choosing the alternative that resides in the acceptable risk range of the pilot (Schriver et al., 2008). Thomson et al (2004) intheir research conducted on 38 experienced pilots with high flight hours and 28 pilot candidates with low flight hours in order to determine the associationsbetween pilots' flight experience, risk perception and attutudes towards risk,reports that more experienced pilots give lower points to the risks pertaining to some dangerous scenario compared to candidate pilots. Another study by Pauley et al (2009) with the participation of 32 pilots using a flight simulator, in which risk factor is regarded as tolerance towards the incidents during the flight, denotes that the pilots who give lower risk points for the incidents evaluatedhave a higher tendency to fly under bad weather conditions compared to the pilots who give higher points.

Joseph and Reddy (2013) in their research on risk perception and safe behaviors displayed during flight using the data collected from 275 military helicopter pilots in Indian Air Force, claims that experienced and trainer pilots display more risky behaviors than unexperienced ones and concludes that risk training can alter risk perception and behavior. On the basis of the aforementioned studies and the conceptual framework, the following research hypothesis is proposed:

*Hypothesis-1: There is a significant relationship between pilots' risk perception and decision making styles (rational, intuitive, dependent, avoidant, spontaneous).*

As the number of flights conducted under bad weather conditions increase, so do their decision making experiences. In this context, it is thought that there would be differences in decision making styles of the pilots who encounter meteorological conditions of different risk levels that could affect the safety of the flight. Flight experience has been calculated generally looking at flight hours and years of a pilot in many of the researches on risk perception and decision making skills. The relationship between decision making skills and risk perception among pilots with high flight hours and years and those with low flight hours has been examined along with other variables causing accidents in many studies. (Hunter, 2002; Hunter et al., 2003; Wiegmann, 2002; Schriver et al., 2008; Morrow et al., 2008). The following hypotheses will be tested in order to examine the relationship between decision making styles and the pilots' flight.

*Hypothesis-2: There is a meaningful relation between the flight hours of pilots and decision making styles (rational, intuitive, dependent, avoidant, spontaneous).*

*Hypothesis-3: There is a meaningful relationship between the ages of pilots and decision making styles (rational, intuitive, dependent, avoidant, spontaneous).*

## III. Method

### 3.1 Participants

General aviation accidents outnumber the airline accidents speaking in terms of percentages. While the airlines has a rate of 0.16 accident rate per 100.000 hours, the accident rate for general aviation is 6.49 per 100.000 hours (Martinussenand Hunter, 2010). This study aims to examine the relation between the risk perceptions and decision making styles of the helicopter pilots who follow the general aviation rules in which the uncertain and risky situations cannot be reduced due to its nature and the accident rate is 40 times higher compared to airlines. Within this context, the main participants of this study are helicopter pilots licensed by the General Directorate of Turkish Civil Aviation. The survey forms were sent to the licensed pilots via e-mail. After eliminating the

inappropriate surveys that are returned, the data obtained from the remaining 308 forms were included in the analysis. The demographical features of the pilots in the survey are given in Table-1.

Table-1 Demographic Variables

| Demographic Variables | Frequency |
|---|---|
| **GENDER** | |
| Male | %99 |
| Female | %1 |
| **AGE** | |
| 20-25 age | %14 |
| 26-35 age | %39 |
| 36-45 age | %41 |
| 46 age and more | %6 |
| **HOUR OF FLIGHT** | |
| 0-500 hours | %15 |
| 501-1000 hours | %12 |
| 1001-2500 hours | %16 |
| 2501-3500 hours | %33 |
| 3501 hours and more | %24 |
| **PILOTS' STATUS** | |
| First Pilot | %44 |
| Second Pilot | %28 |
| Instructor Pilot | %28 |

N=308

**3.2 Measures**

In this study, Risk Perception Scale which is used to analyze validity and reliability, developed by Hunter (2006), is used to measure risk perception. This scale measures 4 different aspects: high maneuver risk (HMR), altitude risk (AR), fuel risk (FR) and daily life risk (DLR). The questions are prepared according to 9 point Likert scale (1=definitely disagree, 9=definitely disagree) and there are a total of 26 questions in the scale. In order to measure the decision making styles of the pilots, decision making styles scale, developed and tested for validity and reliability by Scott and Bruce (1995), was used. This scale measures five different aspects: rational (RDM), intuitive (IDM), dependent (DDM), avoidant (ADM), spontaneous (SDM) decision making styles. This scale includes 25 questions which are prepared according to 5 point Likert scale, tested for validity and reliability and translated into Turkish by Taşdelen (2001). In order to test the construct validity of the scales employed in this study, Confirmatory Factor Analysis (CFA) was conducted and maximum likelihood estimation method of this scale was used. In CFA's modelling, error terms that were constructed to measure the same factor were modified. Since this situation is supported theoretically, it was deemed that model's construct validity would not be harmed (MeydanandŞeşen, 2011). Confirmatory Factor Analysis (CFA) for the sampling used in these scales are shown in Table 2 and the factor construct of the scales are shown in Figure 2. When the findings in Table 2 are examined, it can be said that models are 95% reliable and as a result of values obtained from fit indices, the structures determined by the scales applied to samples.

**Table 2: The Results of Confirmatory Factor Analysis (CFA)**

| Parameters | | Acceptable Fit* | Scales | |
|---|---|---|---|---|
| | | | **Risk Perception** | **Decision Making Style** |
| **Fit Index** | **GFI** | 0,90≤ ***GFI***≤ 0,95 | ***0,925*** | ***0,927*** |
| | **AGFI** | 0,85≤ ***AGFI*** ≤ 0,90 | ***0,887*** | ***0,901*** |
| | **CFI** | 0,95≤ ***CFI*** ≤ 0,97 | ***0,966*** | ***0,960*** |
| | **NFI** | 0,90≤ ***NFI*** ≤ 0,95 | ***0,938*** | ***0,902*** |
| | **RMSEA** | 0,05≤***RMSEA***≤0,10 | ***0,059*** | ***0,044*** |
| | **CMIN/SD** | 2≤***CMIN/SD***≤3 | ***2,069*** | ***1,600*** |
| **$\chi^2$ Test** | **N** | ≤0,05 | ***308*** | ***308*** |
| | **SD** | | ***102*** | ***155*** |
| | **$\chi^2$** | | ***211,057*** | ***247,954*** |
| | **p** | | ***$p_1$=0,000*** | ***$_{p2}$=0,006*** |

(*):Schermelleh, Moosbrugger, andMüler (2003); Hu andBentler (1999: 77); Steiger (1990); Marsh andHocevar (1985); Ullman, (2001: 654).

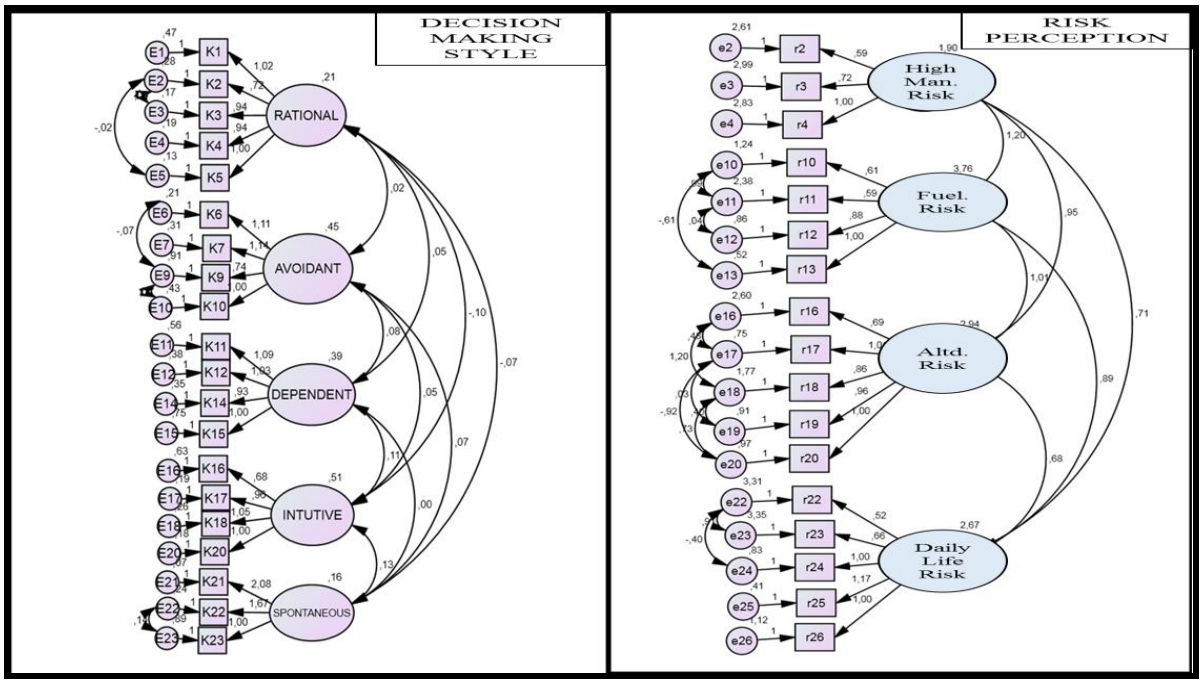


**Figure 2. The Structure Model of the Scales (Risk Perception-Decision Making Styles)**

One of the most common methods in evaluating the reliability of the scales (internal consistency) is Cronbach's Alpha test, and it needs to be checked whether this coefficient is larger than 0.70 (BülbülandDemirer, 2008). In this context, when Cronbach's Alpha coefficients are examined, internal consistency of both these scales were calculated with the sub dimensions and since all these values are $\alpha > 0.70$, it was concluded that the scales and the

### 3.3 Analyses

SPSS 20.0 and Amos 20.0 packaged software were used in analyzing the data obtained within the context of the study. For the internal consistency of the scales Cronbach Alpha coefficient was examined and for the construct validity, confirmatory factor analyses are applied. Finally, the relations between correlation analyses and variables were determi

## IV. Results

In this part of the study, whether research hypotheses are verified or not by evaluating the relationship between the variables. In order to determine the appropriate analysis method, first Kolmogorov-Smirnov test was employed to see it fits the normal distribution. At the end of the analysis, it was determined that $p<0.05$ and the data do not have a normal distribution. Spearman'sRho Correlation test is one of the methods that are used in order to determine the relations between the data that do not have normal distribution (İslamoğluandAlnıaçık, 2014). In this context, Spearman'sRho Correlation is used to determine the associations between the variables. The summary of the analyses of the correlations are presented in Table 3.

**Table 3: Means, Standard Deviations, Correlations and Reliabilities**

| Variables | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.Age | 34,6 | 7,46 | - | | | | | | | | | | |
| 2.Hour of Flight | 2643 | 2184 | 0,855** | - | | | | | | | | | |
| 3.HMR | 3,85 | 1,61 | 0,274** | -0,033 | (0.73) | | | | | | | | |
| 4.AR | 4,26 | 1,68 | 0,312** | -0,034 | 0,226** | (0.91) | | | | | | | |
| 5.FR | 3,85 | 1,61 | -0,03 | 0,005 | 0,274** | 0,312** | (0.87) | | | | | | |
| 6.DLR | 5,56 | 1,56 | 0,209** | 0,186** | 0,148** | 0,266** | 0,209** | (0.84) | | | | | |
| 7.RDM | 4,17 | 0,47 | 0,106 | 0,145* | 0,217** | 0,118* | 0,028 | 0,226** | (0.78) | | | | |
| 8.ADM | 3,10 | 0,75 | -0,069 | 0,112* | 0,022 | -0,001 | 0,016 | -0,048 | -0,033 | (0.79) | | | |
| 9.DDM | 3,49 | 0,73 | 0,044 | 0,054 | 0,006 | 0,063 | 0,083 | 0,149** | 0,155** | 0,179** | (0.75) | | |
| 10.IDM | 2,02 | 0,71 | 0,039 | 0,013 | -0,053 | -0,050 | 0,068 | -0,105 | 0,284** | 0,055 | 0,176** | (0.84) | |
| 11.SDM | 2,30 | 0,74 | 0,056 | -0,010 | -0,081 | -0,027 | -0,056 | -0,042 | 0,293** | 0,271** | -0,054 | 0,280** | (0.76) |

N=308; *p<0,05; ** p<0,01; Cronbach's alphas presented in parenthesis.

When the findings in Table-3 are examined, the average age of the pilots are seen to be 34.6; and the average of flight hours, 2643. It was seen that there is a positive relation between the age and the high maneuver, altitude risk and daily life risk while there is not a significant relationship with the fuel risk. Also it was observed that there is not a significant relationship between the ages and the decision making styles. Furthermore, it was found that there is a significant and positive relationship between the flight hours of the pilots and the daily life risk. When the relationship between flight hours and decision making styles is taken into consideration, it was found that there is a positive relationship between flight hours and rational and intuitive decision making. However, there is no significant relationship with the other decision making styles. When the relation between the risk perception of pilots and the decision making styles are considered, it was determined that high maneuver risk, altitude risk and daily life risk had a positive and significant relationship with risk perception. In addition, it was found that there is a positive and significant relationship between daily life risk and dependent decision making style. In the light of the findings, Hypothesis 1 is accepted in the context of rational decision making style and rejected for all the others. Hypothesis 2 is accepted for rational and intuitive decision making styles while rejected for the other styles. Hypothesis 3, however, is rejected for all.

## VI. Discussion

The aim of this study is to present the relation between the risk perception levels that pilots display in response to possible flight scenario and the decision and the maneuvers to be made by the pilots during the flight. Some of the scenarios given in this study are considered risky in terms of general aviation flight maneuver and can lead to accidents. In this study, the pilots are asked to appoint a risk value between 1 and 9 to the given flight maneuvers. The obtained data has showed that the pilots perceive the risks of the same flight maneuver in different levels. This difference can be considered as a result of pilot seeing the result of this flight action as "correctable", or the positive/negative experiences or their trainer's attitude during the training. Especially, according to the results of this study it can be said that the flight maneuvers or scenarios that pilots appoint lower values should be paid attention by the pilots. Furthermore, a scenario with a low point can be considered normal. This situation might mean that in a real flight situation, the pilot may delay taking necessary precautions or performing corrective action. The pilots who appoint low points to several flight maneuvers are assessed as more inclined to accidents than other pilots.

As a result of the analyses, first it was determined that there is a positive and meaningful relation between rational decision making styles and pilots' risk perception levels, except for fuel risk. This finding generally supports the decision making model in aviation presented by Martinussen and Hunter (2010). However, since there haven't been found any significant association between other decision making styles and risk perception, it is thought that this subject should be supported by further studies. Also, the findings that are obtained as a result of this study shows parallelism to the studies of Thomson et al. (2004), Pauley et al. (2009), and Joseph and Reddy (2013).

As a result of the analyses, secondly, flight hour which is one of the most important indications of experience for pilots is examined. According to the findings obtained, there is a positive relation between flight hour and rational decision making styles, and a negative and a meaningful relation between flight hour and intuitive decision making styles. Flight, because of its nature, contains biological processes that will mislead pilot's perception and intuitions (Pratt, 2000:Hf10-Hf14). Especially information that is evaluated by eyes and ears contains brings along numerous illusions that will affect decision making negatively. Especially visual illusions cause pilots to face dilemma between what they see and their intuitions. Obtained in this study, the positive correlation between the flight hour and rational decision making may point out the improvement of the awareness of acknowledging the possible errors and illusions of the intuitions, as the level of experience increases. The real flight experience and the training received during piloting show that pilots should rely more on the actual information rather than their intuitions. The accuracy of the correlation that is obtained is explained by the relation between the increase of flight hours and pilot's incline towards more rational data.

As a result of the analyses conducted, thirdly the age of the pilots is examined. It is thought that the age of the pilots demonstrates experience as much as flight hour does. Although there was not any positive relation found between flight hour and flight risks, it is observed that there is a positive relation between the age of the pilot and flight risks (High Maneuver Risk and Altitude Risk). This situation reveals that the experience of the pilots who have less flight hours yet are older is worthy of note. It is seen that flight experience should not only be evaluated by the number of hours flown but also by the age factor. Moreover, as a result of the findings of this study, it is seen that daily life risk has a positive relationship with the other three flight risks (high maneuver risk, altitude risk, fuel risk). This result shows the close relation between the flight and the pilot's risk evaluation of the threats that they face in everyday life. For example, a pilot that always exceeds the speed limit while driving in their daily life can be thought to disregard some flight rules while flying as well. This criterion can be especially useful in choosing pilot candidates. We can think that if a person perceives the risk levels of daily threats as low, that person will perceive the risk levels of flight threats as low when they become pilots. It

would be incomplete if we restrict the relation between age and perceived risk only to choosing pilots. For a flight operation to be conducted, generally two pilots are needed. Chief pilot and co-pilot share all the responsibility of the flight of the aircraft. Matching these two pilots is the responsibility of the flight organization. In order to reduce the flight crew-induced risks, it is always important to choose and match the proper chief and co-pilot. When choosing the pilots for the operation, the management should not only take the flight consideration into account. But, the age of the pilots should also be taken into consideration in order to choose and match the proper flight crew.

Before starting the research, it was thought that as the number of flight hours increased, the risk perception of the pilot would also increase and pilots would appoint higher values to the situations by perceiving them as risky. However, as a result of this study, flight hour is only found to have a positive relation with the daily life risk. The fact that Flight hour, which is seen as the indication of flight experience, does not have a relation with flight risks can be seen as an explanation for pilots with different number of hours who has been in an accident. This result asserts the importance of the risk training not only during the pilotage training but also during actual flying period.

When a pilot appoints a low grade to a flight maneuver that involves high risk and that could lead to an accident if continued, it may be considered that under certain circumstances the pilot can perform this maneuver. In other words, this may mean that if needed, the pilot may perform the risky maneuvers in ascent and descent profiles. These evaluations in question have importance in terms of aviation safety.

For future studies on this topic to give more realistic results, it is important that the described scenarios are tested in a flight training simulation. The data obtained from the studies with a training simulation will be more realistic and will be in touch with the correlation of various factors. Trying to estimate the stressful atmosphere created by the nature of flight on paper will always bring forward limitations in these types of studies. Moreover, the study conducted covers helicopter pilots and before deducing from the results of this study, this aspect should be evaluated as a limitation.

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