

## Aviation safety locus of control in Indian aviators

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### ABSTRACT

The degree to which a person perceives that the outcomes of the situations they experience are under their personal control is a psychological variable known as Locus of Control (LOC). An Aviation Safety LOC Scale has been developed to specifically address the construct of internal and external LOC among pilots. An external LOC has been associated with resignation and an internal LOC with less involvement in hazardous aviation events. The aim of this study was to investigate whether there was a significant difference between the internal and external LOC scores in Indian aviators and to delineate whether LOC was correlated with any demographic variables. A group of 101 male pilots were administered the Aviation Safety LOC scale. Separate internal, external and combined scores were generated from the item responses and were statistically analysed. Results indicated that there was a significantly higher internal than external LOC score in aviators. These scores also had a significant negative correlation. Civil pilots had higher internal LOC scores and combined LOC scores than the military pilots. It was also found that transport pilots had the highest internal and combined LOC scores, the fighter pilots were the next highest and the helicopter pilots were the least. LOC was not associated with demographic variables such as age and flying hours. An external LOC was negatively correlated with years of education and service. Medically fit pilots had a higher internal LOC score than the unfit pilots. In Indian aviators, LOC appears to be a robust attribute related to type of flying, aircraft stream, education, service and medical fitness.

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The extent to which an individual regards control over events to be under his own influence is a psychological variable known as Locus of Control (LOC). LOC refers to the degree to which a person perceives that the outcomes of the situations they experience are under their personal control. Individuals with an internal LOC orientation perceive they can exert control over the outcome of the situation. They feel they have significant influence over the course of events; they are confident that their actions lead to predictable results. Individuals with an external LOC attribute outcomes to external factors such as luck, fate, chance, actions of other persons, the weather or other factors external to themselves.

In situational terms, the perception of control has long been recognized as an important mediator of stress. There is evidence that people object less to an aversive stimulus when they possess some type of control over its administration. This is true even when control is objectively lacking but perceived to be present. Possession of an external LOC has frequently been associated with greater vulnerability to stress. One mechanism for this is the association with helplessness. This is probably part of what lies

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behind the hazardous thought pattern termed “resignation” [1].

The LOC variable has also been linked to differences in mental functioning and performance. Internally controlled individuals are “cognitively more active”: they are better both at acquiring new information and applying it effectively. This effect seems to be especially pronounced in highly ambiguous situations. There is evidence that internal LOC is associated with greater awareness of environmental cues [1].

In a series of studies [2] the Rotter Internal External LOC Scale was administered to 200 general aviation pilots. In comparison to Rotter’s 1966 sample, these pilots were significantly more internal. Internal LOC and age were also found to significantly predict attendance at safety clinics. Pilots with higher internal scores were more likely to attend safety clinics indicative of safety orientation. The researchers suggested that for pilots who are more internal in LOC “their way of handling dangers is not just to make light of them, but to actively do something about reducing the dangers”.

There is some speculation concerning cause and effect [1]. It is unclear whether internally controlled pilots monitor their environment more actively because they are internally controlled or whether pilots who are in the habit of keeping track of external cues then develop an internal LOC, because of a positive track record of accomplishments.

In addition to the original Rotter scale, which assessed general LOC, scales have also been developed to assess the degree of perceived control over specific issues such as health [3]. It has been noted that “attempts to relate internality-externality to outside criteria have been more successful when the measures of this construct

were tailored more specifically to the target behaviour rather than using the more general I-E scale itself”.

The Safety Locus of Control scale was developed, and validated after being derived from Rotter’s LOC scale to predict employees’ accidents and injuries [4]. Jones and Wuebker found that there was only a moderate correlation ( $r = -0.41$ ) between the general LOC scale and the safety LOC scale [5]. They interpreted this finding as indicating, “the two scales...are measuring overlapping, yet different psychological constructs”[5]. A situation specific measure was created because “specific expectancies are assumed to play a greater role in determining one’s future behaviour in a specific situation than the more generalized expectancies” [4]. This assumption was later validated by researchers who showed that their situation specific measures were better predictors of situation specific behaviour than the generalized Rotter scale [3].

The safety LOC scale was later modified to create an Aviation Safety LOC Scale that would specifically address the construct of internality-externality among pilots [3]. The items constituting this scale were worded so as to pertain to issues relevant to aviation safety. It was then administered to 480 pilots. Results showed that pilots exhibited substantially higher internality than externality. The two subscales exhibited acceptable internal consistency and were negatively correlated ( $r = -0.419$ ,  $p < 0.001$ ). Construct validity was assessed by comparison of the combined and separate scales with the resignation score from the Hazardous Attitudes Inventory (HAI)[6,7] and with a measure of involvement in hazardous aviation events. The combined scale score showed a significant correlation with involvement in hazardous events. The internality score was found

to be significantly and negatively correlated with involvement in hazardous aviation events. The externality score was found to be significantly and positively correlated with the resignation score from the HAI. Pilots who held a greater external orientation tended to have a higher resignation score, while pilots who were more internal tended to have experienced fewer hazardous aviation events. Externality did not relate to hazardous aviation events nor did internality relate to resignation score. The construct validity of the scale was thus supported.

There has been no study on these psychological attributes among Indian aviators. This study was therefore carried out to investigate (a) if there was a significant difference between the internal and external LOC in Indian aviators (b) whether the LOC was correlated with demographic variables such as age, education, service and flying hours and (c) if LOC was related to variables such as medical fitness, marital status, present aircraft stream and military/civil flying.

### Material and Methods

A group of 101 male pilots participated in this study from March-June 2005. They all had

visited IAM either to attend various aircrew indoctrination courses or for their medical evaluation. The demographic characteristics of different groups are shown in Tables 1A and 1B. Within the civil pilots group, 35 were holding an Airline Transport Pilot's License, 12 had Commercial Pilot's License and 4 had Commercial Helicopter Pilot's License. The majority of aviators in the study were fully fit (86%) and a small percentage (14%) was medically down graded. The medically unfit group were down graded because of disease/disability in various systems; 4 each from the spinal and musculoskeletal systems, 3 because of the cardiac system, 2 because of the gastrointestinal system and one because of the endocrine system.

### Test Administration and Scoring

A good rapport was first established with the pilot, after which an informed consent was taken and then the questionnaire was handed out to be filled by him. This Aviation Safety LOC Scale is a 20-item questionnaire with two scales (internal and external) each with 10 items. The subjects were requested to complete the questionnaire as a part of a research study. They were instructed that the test consists of 20 statements pertaining to aviation safety outcomes. The subjects were

**Table 1: Demographic characteristics of the aircrew population**

Characteristic	Group	No.	%
Marital status	Single	33	33
	Married	68	67
Type of flying	Military	50	49
	Civil	51	51
Present aircraft stream	Fighter	30	30
	Transport	56	55
	Helicopter	15	15

**Table 1B: Average Mean (SD) values of demographic characteristics of the different groups of aircrew**

Characteristic	Military Pilots	Civil Pilots	Med Unfit Pilots	All Pilots
Age (yrs)	28.66 (6.72)	45.78 (9.95)	35.00 (8.60)	37.31 (12.07)
Education (yrs)	15.27 (0.67)	15.37 (0.97)	15.00 (1.04)	15.32 (0.83)
Service (yrs)	7.14 (7.27)	22.41 (12.20)	12.50 (7.20)	13.32 (12.13)
Flying hours	1222.7 (1383.87)	7142.55 (4963.01)	1899.07 (1551.46)	4211.93 (4701.2)
Number	50	51	14	101

told to indicate how much they agreed or disagreed with each statement on a five point Likert scale from “strongly agree”, “agree”, “neutral”, “disagree” and “strongly disagree”, and mark the point in the scale. They were instructed to give their first and natural response to the statements and answer them carefully and truthfully. The subjects were then told that if they did not understand any statements, they could note down the numbers and the examiner would clarify the unanswered questions at the end of the test, since no statements should be left unanswered. However, all subjects understood the statements.

The responses were then hand scored using the following method. Separate internality and externality scores were generated from the item responses using a scoring key [3]. The internal and external subscale scores were computed as the sum of the responses to the 10 keyed items for each subscale. The summed scores were then reversed by subtraction from 60 so that each subscale score had a possible minimum value of 10 (lowest level of agreement) and a maximum value of 50 (highest level of agreement) resulting in two subscale scores. A combined scale score was also derived for each individual, using the author’s method. Items identified as externally

oriented were left in the original response orientation (i.e. strongly agree = 1, strongly disagree = 5) while items identified as internally oriented were reversed (i.e. strongly agree = 5, strongly disagree = 1). This resulted in a score with a possible range of 20 (most external) to 100 (most internal).

Data of 14 variables for 101 subjects were entered into the Statistical Package for Social Sciences (SPSS) worksheet on computer. Eleven of these variables were demographic characteristics including personal, flying and medical history. Three variables were LOC variables.

The paired ‘t’ test was done to statistically compare the group’s internal and external LOC scores. The internal, external and combined scores were correlated using Pearson’s Product Moment Correlation. Demographic characteristics such as age, education, service and flying hours were also correlated with LOC scores. Student’s ‘t’ test was done to compare groups based on type of aircraft flown, type of flying (military/civil) medical fitness and marital status. “Transport pilots” included mostly civil pilots. Separate analysis of military transport pilots could not be carried out because of the very small number i.e. six.

## **Results**

Results indicated that there was a significantly higher ( $t=15.08, p>0.0001$ ) internal (Mean= 35.54, SD= 4.69) than external (Mean= 25.08, SD= 4.08) LOC scores in aviators. The group mean combined LOC was 70.45 (SD=6.97). The internal and external LOC scores also had a significant negative correlation ( $r = -0.26, p<0.008$ ). The LOC combined score showed a significant negative correlation ( $r = -0.76, p<0.0001$ ) with the external LOC score and a significant positive correlation with the internal LOC score ( $r = 0.83, p<0.0001$ ).

There were no significant correlations between the demographic variables such as age, and flying hours and internal, external and combined LOC scores in this group. There were significant negative correlations between years of education ( $r = -0.23, p<0.02$ ) and service ( $r = -0.24, p<0.02$ ) and the external LOC. With an increase in years of education and service there was a decrease in the external LOC.

When groups based on demographic characteristics such as type of aircraft flown, type of flying (military/civil) medical fitness and marital status were compared using Student's 't' test, there were a few significant differences. Single pilots were more internally oriented (Mean=36.69, SD=3.86) than married pilots (Mean=34.99, SD=4.97), but this difference was not statistically significant. When type of flying was compared the civil pilots had significantly higher ( $t=2.40, p<0.02$ ) internal LOC scores (Mean= 36.63, SD= 5.00) than the military pilots (Mean= 34.44, SD= 4.10). The combined LOC scores were also significantly higher ( $t=2.07, p<0.04$ ) in civil pilots (Mean= 71.84, SD=6.79) than in military pilots

(Mean= 69.02, SD=6.93). Medically fit pilots had significantly higher ( $t=1.97, p<0.05$ ) internal LOC scores (Mean= 35.91, SD=4.72) than medically unfit pilots (Mean= 33.29, SD=3.95).

The external LOC score was lower and the internal and combined scores were higher in transport pilots as compared to fighter pilots. All three scores were lower in helicopter pilots when compared to fighter pilots, with the internal LOC score being significantly lower ( $t=1.98, p<0.05$ ) in the helicopter pilots (Mean= 32.60, SD= 4.82) as compared to the fighter pilots (Mean= 35.26, SD= 3.95). The external LOC score was higher and the internal and combined scores were lower in helicopter pilots as compared to transport pilots. The internal LOC score showed significance ( $t=2.80, p<0.007$ ) with a lower internal LOC in helicopter pilots (Mean=32.60, SD=4.82) as compared to transport pilots (Mean=36.48, SD=4.75). The combined LOC also showed a significant difference ( $t=2.23, p<0.03$ ) with helicopter pilots again showing a lower score (Mean= 67.53, SD= 7.57) than the transport pilots (Mean= 71.78, SD=6.26).

## **Discussion**

Results indicated that there was a significantly higher internal than external scores in this group of aviators. This is in line with previous studies by Wichman et al. and Hunter [2,3]. However, when the overall group mean internal, external and combined LOC scores are compared to a previous study [3], the external scores are higher and the internal and combined LOC scores are lower in this study. This could be because of a cultural difference between the two samples. While the U.S. tends to place high value on internal LOC, Asian and other collective cultures tend to value an external LOC. Asian

Americans and Asians in Asia both report lower levels of perceived control than non-Asians [8].

Previous research has found the internality score to be significantly and negatively correlated with involvement in hazardous aviation events. The externality score was found to be significantly and positively correlated with the resignation score from the HAI [3]. Even though this is the case, these relationships with internality and externality scores need to be verified on the Indian population and in military flying before implications for flight safety can be speculated about. If these relationships still hold for our population, and for military flying, pilots who are at greater risk for accident involvement might be identified beforehand and the LOC scale might be employed as a self awareness exercise for pilots who want to explore potential aspects of their personality that could place them at greater risk for accident involvement.

Presently LOC could be viewed as trainable because some authors have suggested that personal experiences, directed cultural teaching and therapeutic interventions can influence the development of internality [9,10]. Therefore attempting to teach pilots to become more internal (and hence safer) could also form part of the training in crew resource management, which is prevalent in the aviation industry.

There were no significant correlations between demographic variables such as age and flying hours and internal, external and combined LOC scores in this group of pilots. Previous reports have shown that there was an association between age and LOC. One study [2] found that LOC and age were two variables, which predicted attendance at a safety clinic. The more internal the pilot was and the older a pilot was, the more

likely he was to attend a safety clinic. Another study [3] showed that there were significant correlations between age and internal and external subscale scores. Their study demonstrated that pilots become more internal and less external, as they grow older. This difference between this study and previous ones could be because of the younger mean age group measured here, which did not bring out this difference. Also different was the constituents of the group which included only general aviation civil pilots in previous studies but included other military pilots and pilots from different streams in this study. There was no significant correlation was found between flying experience and LOC [3]. However, years of education and service had a negative correlation with the external LOC. This suggests that an increase in education and service experience is associated with a reduction in the external LOC score. Therefore in this study, LOC does not appear to be associated with age and flying experience, but an increase in years of education and service is associated with a reduction in the external LOC score.

Medically fit pilots were found to be more internally oriented than the unfit pilots. The fit pilots possibly felt more in control of themselves than the unfit ones, who were suffering from some disease/disability and felt less in control. It also could be because of demographic characteristics such as lower age, education and service of the unfit pilots. When type of flying was compared the civil pilots had higher internal LOC scores and combined LOC scores than the military pilots. This difference is not likely because of the large differences in age, service and flying hours between the two groups, because age and flying experience did not show a correlation with LOC. Also an increase in service was associated with a

reduction in LOC, whereas in this case the civil pilot group had higher LOC scores than the military group. It was also found that transport pilots had the highest internal and combined LOC scores, the fighter pilots were the next highest and the helicopter pilots were the least. In military aviation, a large number of unpredictable situations give rise to many unplanned events and uncertainties. This is more applicable to helicopter and fighter operations. In peacetime operations, helicopter operations are more unpredictable as compared to even fighter operations. Transport operations are more true to planning and normally routine events take place. This could be the reason for a higher external LOC and a lower internal LOC in helicopter and fighter pilots as compared to transport pilots and the LOC differences between civil and military groups; because the transport group consisted mostly of civil pilots.

### **Conclusion**

The degree to which a person perceives that the outcomes of the situations they experience are under their personal control is a psychological variable known as LOC. An Aviation Safety LOC Scale was developed to specifically address the construct of internal and external LOC among pilots [3]. An external LOC has been associated with resignation and an internal LOC with less involvement in hazardous aviation events.

The aim of this study was to investigate whether there was a significant difference between the internal and external LOC scores in Indian aviators and to observe if there was any relationship between LOC and some demographic variables. A group of 101 male pilots were administered the Aviation Safety LOC scale. Separate internal, external and combined scores were generated from the item responses.

Results indicated that there was a significantly higher internal than external LOC score in aviators. These scores also had a significant negative correlation. Civil pilots had higher internal LOC scores and combined LOC scores than the military pilots. It was also found that transport pilots had the highest internal and combined LOC scores, the fighter pilots were the next highest and the helicopter pilots were the least. LOC was not associated with demographic variables such as age and flying hours. An external LOC was negatively correlated with years of education and service. Medically fit pilots had a higher internal LOC score than the unfit pilots.

In Indian aviators LOC appears to be a robust attribute, however its relevance as a construct in military flying and in the Indian population needs to be further substantiated by future research. Additional research is required to improve the reliability of the Aviation Safety LOC scale and to further assess the validity.

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