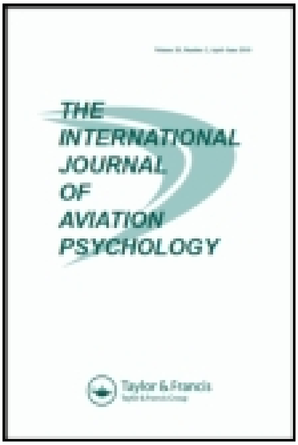

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Safety Locus of Control and Accident Involvement Among Army Aviators

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In this study we assessed the relationship between locus of control (LOC) and accident involvement among U.S. Army aviators. Two scales reflecting internality or externality were created based on a priori assignment of items. Items were also subjected to principal components analysis, and 6 empirical scales were identified from that analysis. Correlations were computed between the 2 a priori scales, the 6 empirical scales identified by the principal components analysis, involvement in hazardous events, and recent and total career accident involvement. Several of the LOC measures correlated significantly with recent accident involvement. However, only 1 measure was correlated with career accident involvement. Applications of the results in the development of safety training interventions and the evaluation of training programs are discussed.

Locus of control can be defined as a personality trait that reflects the degree to which a person generally perceives events to be under his or her own control (internal locus of control) or under the control of powerful others or other outside forces (external locus of control; Rotter, 1966). This construct of perceived personal control is derived from the social learning theory formulated by Rotter (1954). In that theory, behavior potential is expressed as a function of expectancy and reinforcement value. Expectancy is the subjective probability that a given behavior will lead to a particular outcome, and the reinforcement value refers to the desirability of that outcome. From this theory, Rotter (1966) developed his measure of generalized expectancy, usually called locus of control (LOC). Arguably, LOC is one of the most widely studied personality constructs. A recent

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review (Judge, Erez, Bono, & Thoresen, 2002) found 13,428 articles with locus of control as a keyword.

Although many researchers have attempted to use this generalized measure to predict specific behaviors, Rotter (1975) noted that the scale "was developed not as an instrument . . . to allow for a very high prediction of some specific situation, such as achievement or political behaviour, but rather to allow for a degree of prediction of behaviour across a wide range of potential situations" (p. 62). Rotter was very clear in referring to the scale as a *generalized* measure of internality–externality. However, he further noted that, "A narrower or more specific generalized expectancy should allow greater prediction for a situation of the same subclass" (p. 59). Many researchers have pursued that approach with the result that there is a plethora of LOC instruments tailored to specific situations (see Furnham & Steele, 1993, for a review).

Rotter's original scale was scored along a single dimension; however, subsequent factor analyses have presented strong evidence for a multidimensional interpretation of the internal–external control construct. These findings also hold for the various specialized LOC scales. Readers are directed to Ashkanasay (1985), Montag and Comrey (1987), and Collins (1974) for a discussion and review of the question of multidimensionality of the LOC construct.

Several researchers (e.g., Hoyt, 1973; Phares, 1976; Williams, 1972) have suggested that an external LOC is related to a lack of caution, which might result in failure to take precautionary steps to avoid the occurrence of unfavorable outcomes (Omizo & Michael, 1982). The relationship of LOC to various safety outcomes has been investigated in a variety of settings (e.g., Jones & Wuebker, 1993; Regis, 1990; Montag & Comrey, 1987), in which it has generally been found that individuals with more internal orientations tend to have fewer accidents than those with more external orientations. One meta-analysis (Arthur, Barrett, & Alexander, 1991) that utilized 13 independent studies of automobile accidents and a total of 1,909 participants found that the mean correlation between overall LOC and accident involvement was 0.20. In a study that used two specialized scales of driving internality (DI) and driving externality (DE), these two variables were found to correlate –.32 and .26, respectively, with a dichotomous accident criterion (Montag & Comrey, 1987).

Wichman and Ball (1983) explored LOC and self-serving bias (SSB) among general aviation (GA) pilots. They administered the original Rotter (1966) LOC measure along with four questions regarding SSB to three samples of GA pilots. As predicted, pilots felt their individual chances of having an accident were below average, that they were above average in flying skill, and that they were above average in how safe a pilot they were. Further, internals (as measured by the LOC scale) tended to hold stronger self-serving biases than externals. They concluded, "Aviators with more experience and exposure develop stronger self-serving biases. These people tend also to be more internal in LOC. So their way of handling dangers is not just to make light of them, but to actively do something about reducing the dangers" (Wichman & Ball, 1983, p. 509).

Consistent with the recommendation of Rotter (1975) noted earlier that the prediction of specific behavior requires measures tailored specifically for that behavior, Jones and Wuebker (1985, 1993) developed and validated a measure of LOC regarding safety in industrial settings. Hunter (2002) adapted the Jones and Wuebker scale to create an aviation safety locus of control (ASLOC) scale. The adaptations consisted primarily of minor changes in the wording, such as replacing "worker" with "pilot." For a sample of 176 civil pilots, a significant correlation ($r = -0.20$) was found between the number of hazardous events (i.e., close calls) experienced by pilots and the internality score from the ASLOC. Pilots who were lower in perceived internal control tended to experience more hazardous aviation events, compared to more strongly internal pilots. Hunter suggested that the scale might be employed as a self-awareness exercise for pilots wishing to explore potential aspects of their personality that could place them at greater risk for accident involvement.

Based on the general findings of significant relationships between LOC and accident involvement in a number of settings (e.g., driving, health behaviors, civil aviation), it was hypothesized that a similar relationship would hold for Army aviators. The results described in this report are one part of a research project sponsored by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) to develop a set of Web-based prototype scales that would assess LOC, hazardous events, safety-related attitudes, and risk orientation among U.S. Army aviators. Only that portion of the effort dealing with the LOC scale is described here; however, complete details on all the scales are available in an Army Technical Report (Hunter & Stewart, 2009).

Arguably, the ASLOC might have served for the measure of LOC; however, the items making up the ASLOC were limited to those that had originally appeared in the Jones and Wuebker (1985) scale. Therefore, rather than simply use the existing ASLOC, we chose to expand on that instrument by creating a number of new items and revising the ASLOC items, as necessary, to place them in a military context.

In this study we sought to (a) evaluate the dimensionality and psychometric characteristics of the new LOC instrument, and (b) examine the predictive validity of the new measure with regard to accident involvement and involvement in hazardous events.

HYPOTHESES

Hypothesis 1: Aviators who were lower in perceived internal control will have experienced more recent accidents.

Hypothesis 2: Aviators who were lower in perceived internal control will have experienced more accidents throughout their aviation career.

Hypothesis 3: Aviators who were lower in perceived internal control will have experienced more hazardous aviation events.

METHOD

Participants

Participants consisted of U.S. Army warrant officers and commissioned officers who currently held an Army rotary-wing aviation rating. The participants were randomly selected from the U.S. Army personnel system database, and invitations to participate in the study were sent via e-mail directly to them from the ARI Survey Office. Invitations to participate were sent to 1,000 warrant officers and 200 commissioned officers.

As of the closing date, 258 pilots (21.5% response rate)[1] had completed some or all of the scales. Because of missing data, the number of participants used in subsequent analyses varied from approximately 170 to 200. Warrant officers made up 84.8% of the respondents, and 15.2% were commissioned officers. These proportions closely matched the proportions of the invited sample (83.3% and 16.7% for the warrant officers and commissioned officers, respectively). All of the respondents held an Army rotary-wing rating, and 18% also held an Army fixed-wing rating. The modal position held by respondents was unit pilot. However, responses were spread fairly evenly among a number of responses to this question. Approximately 97% of the respondents were male, 3 respondents (1.5%) indicated that they were in the National Guard, and no respondents reported any outside employment as a pilot. Due to a programming error, data on the age of the respondents and their combat experiences were not captured.

Measures

Two prototype measures were administered, in addition to 21 questions that assessed the participants' military and civilian aviation experience and qualifications, their accident involvement, and other basic demographic information. The prototype measures consisted of a scale measuring their involvement in hazardous aviation events (Army Hazardous Events Scale [A–HES]), and an LOC scale consisting of 89 draft items.

[1]Response rates for ARI Internet surveys range from 15% to 30%. Higher rates are typically associated with strong support from a general officer and multiple contacts requesting participation (R. Floden, personal communication, August 18, 2010). Neither of those conditions were present in this study.

The items were administered via a secure Web server operated by ARI. The instruments were approved by the Army Survey Control Office, and the study protocol was approved by the ARI Human Use Committee. Participation was voluntary and anonymous. No personally identifying information was collected, and no data were reported at a level that might allow for the identification of individual respondents.

Army Locus of Control Scale (Army–LOC). A set of 89 draft items was created, using a Likert-scale format in which the responses ranged from 5 (*strongly agree*) to 1 (*strongly disagree*).

Each of the items consisted of a statement regarding the extent to which the outcome of events is determined by internal and external factors (e.g., skill vs. luck). The items from the ASLOC were modified as required (e.g., replacing "pilot" with "aviator") to make them appropriate for an Army setting. An additional 80 items were also drafted, roughly evenly divided between items indicating a general internal orientation and an external orientation. The items were written to address the dimensions of personal efficacy, influence by others, influence by fate, and the element of luck or chance.

Army Hazardous Events Scale. The use of hazardous events as a surrogate for actual accident involvement in research studies was suggested by Hunter (1995), who developed a civil aviation Hazardous Events Scale (HES). Hazardous events include instances of, for example (a) running so low on fuel that the pilot was seriously concerned about making it to an airfield or heliport or refueling point before running out; (b) making a precautionary or forced landing at an airfield or heliport other than the original destination; and (c) being forced to perform an abrupt maneuver to avoid an obstacle. Several studies (Hunter, 1995, 2002, 2003; Lubner, Adams, Hunter, Sindoni, & Hellman, 2003) have shown that the HES is significantly correlated with actual accident involvement (for a review of these studies, see Hunter & Stewart, 2011). One of the overall objectives of the ARI project was to develop a measure of aviators' involvement in hazardous events, comparable to the civil HES. In a previous survey, an initial set of potential items had been evaluated, and a prototype A–HES was created. This scale consisted of 36 items measuring a number of largely Army-specific hazardous aviation events. Participants indicated how often, over the preceding 24 months, each event had happened to them, when they were one of the pilots (regardless of status) of the aircraft at the time of the event. The response alternatives were none (0), 1 time, 2 times, 3 times, or 4 or more times. An overall A–HES score was computed by summing the responses for the 36 items. The coefficient alpha measure of internal consistency for the combined sample (all surveys in the overall ARI project; $N = 653$) was 0.90 (Hunter & Stewart, 2011).

In most of the previous civil studies, the HES was used as a surrogate for actual accident involvement. However, in this instance both HES and actual accident involvement were available. Therefore, in this rather unique situation, the A–HES could be used as either a predictor of accident involvement or as an outcome variable itself.

RESULTS

Participant Characteristics

The military and civilian flight experience of the participants is shown in Table 1, which also presents the descriptive statistics for the two accident criteria, the A–HES, and the several LOC scores.

Accident Involvement

Of the 195 respondents, 18 (9%) reported having been in an aviation accident in a military aircraft within the previous 24 months, and 68 respondents (35%) reported that they had been in such an accident at some point in their career. (Note that these are partially overlapping indexes.) No respondents reported having been in an aviation accident in a civil aircraft within the previous 24 months, and only 7 (3%) reported having been in a civil aviation accident at any time. Because so

TABLE 1
Descriptive Statistics for Demographic, Locus of Control, and Army-HES Variables

	M	*SD*	*N*
Military accident—recent[a]	.09	.29	195
Military accident—ever[a]	.35	.48	196
Army–HES	23.26	16.46	185
Internality (a priori)	54.94	6.92	191
Externality (a priori)	33.00	8.27	191
Component 1—Luck	33.15	8.40	194
Component 2—Externality	33.87	7.35	192
Component 3—Internality	56.06	6.69	198
Component 4—Accident causality	49.51	6.86	199
Component 5—Fate	24.50	5.46	192
Component 6—Resignation	30.32	4.09	192
Total military flight hours	2019.40	1377.07	197
Recent military flight hours	457.75	318.08	197
Years as an Army aviator	10.62	7.23	195

Note. HES = Hazardous Events Scale.
[a]Accident status coded 1 = yes, 0 = no.

few respondents reported having been in a civil aviation accident, those data were not analyzed further.

Locus of Control Scale Construction

As noted earlier, respondents completed 89 items constructed to assess several dimensions surrounding sense of personal control. The principal purpose of this administration was to obtain data to allow for an initial assessment of the items, with the goal of creating one or more short scales, suitable for use in future research in combination with other measures. Two general approaches to achieving this goal were taken: (a) an a priori approach in which two experienced aviation psychologists assigned each item to the internal or external category prior to the administration, and (b) an empirical approach in which various methods, including correlation of the items with each other, correlation with the A–HES, and principal component analysis were used to determine the number of scales and their constituent items.

Both the a priori and empirical scale development approaches were taken because the ASLOC was constructed primarily using an a priori scale construction process (Hunter, 2002), whereas principal components analyses conducted on the ASLOC confirmed the two-component structure. However, in this study the addition of a large number of new items, written to address a broad spectrum of personal control aspects, raised the possibility that other factors, in addition to internality and externality, might be observed. It was felt that these new factors could best be identified empirically, using principal components analysis.

A priori scale construction. Prior to the administration of the items, two experienced aviation psychologists independently reviewed all the draft items and assigned them to one of the two categories: internal or external. The two reviewers agreed completely on all items, and assigned 38 items to the internal category and 48 items to the external category. For three items neither reviewer could determine an appropriate category, and those items were excluded from the analyses.

To construct shorter, more parsimonious scales, an internality sum score and an externality sum score were created by summing the responses to the 38 items assigned to the internality category and the 48 items assigned to the externality category. Then, each individual item was correlated with the corresponding sum score. These correlations were sorted, and the 15 items with the highest item-total correlations were chosen to form the a priori Internality and Externality scales.[2] The 15 items comprising the Internality and Externality scales were summed

[2]The choice of 15 items was arbitrary, and represented a balance between having enough items in the scale to assure good reliability and not placing too much burden on respondents in subsequent studies. The issue of scale length might be addressed using more formal methods in future research.

TABLE 2
Items Comprising the A Priori Internality Scale

Item No.	*Item-Total Correlation*	*Item Text*
LC41	0.72	If I take the right actions, I can avoid accidents.
LC65	0.45	If I have an accident, it's because I was not careful enough.
LC70	0.56	If I have a close call, it just means I have to work harder next time.
LC67	0.57	Safety is due to effort, not luck.
LC37	0.58	If I take care of myself, I can avoid accidents
LC46	0.46	It is my ability and determination that will determine whether I am in an accident.
LC11	0.55	Most accidents that result in injuries are largely preventable.
LC33	0.52	I am in control of my life.
LC50	0.51	I believe I have control over my own destiny.
LC63	0.50	You are responsible for the things that happen to you in your life.
LC81	0.47	There are no problems that cannot be overcome with enough effort.
LC38	0.44	The main thing that affects my safety is what I myself do.
LC1	0.43	If aviators follow all the rules and regulations, they can avoid many aviation accidents.
LC6	0.46	Most accidents and incidents can be avoided if aviators use proper procedures.
LC19	0.44	There is a direct connection between how careful aviators are and the number of accidents they have.

to create the scale scores. The 15-item Internality scale had $\alpha = .83$ and the 15-item Externality scale had $\alpha = .92$. The items making up these scales, with their item-total correlations, are shown in Table 2 for Internality and Table 3 for Externality.

Principal component analysis of item responses. In addition to the a priori scale approach described earlier, a principal components analysis was also conducted. Inspection of the scree plot suggested a six-component solution that accounted for 40.8% of the variance was appropriate. These six components were extracted and rotated, using Varimax to simple structure. A complete listing of all items for each of the six components is given in the Appendix A.

Scores for each of these components were generated by unit-weighted summation of the responses for the items that defined the components. If more than 15 items defined a component, then only the 15 items with the highest loadings were used in computing the component scores. All of the component scores were based on 15 items, except for Component 5 (Fate) and Component 6

TABLE 3
Items Comprising the A Priori Externality Scale

Item No.	*Item-Total Correlation*	*Item Text*
LC52	0.76	Whether or not I get into an accident is mostly a matter of luck.
LC35	0.68	Luck plays a big part in determining whether you will be in an accident.
LC61	0.65	If something is meant to happen there is nothing you can do to change it.
LC85	0.72	In flying, what will be, will be.
LC84	0.68	In a tight situation, I trust to fate.
LC87	0.65	Sometimes you just have to depend on luck to get you through.
LC57	0.71	Chance has a lot to do with avoiding accidents.
LC60	0.69	Bad luck is what gets many pilots into trouble.
LC58	0.58	Being at the wrong place at the wrong time is what causes accidents.
LC56	0.68	My success is mainly a matter of chance.
LC39	0.48	No matter what I do, I'm likely to have an accident.
LC78	0.65	A person's destiny determines what happens to them.
LC88	0.54	Successful flying is partly a matter of good luck.
LC49	0.695	Much of the time when I am successful, it is because I am lucky.
LC36	0.52	My success in aviation is largely a matter of good fortune.

(Resignation), each of which contained only 9 items. Reversed scoring was used for the items that had a negative component loading. Subtracting the item value from 6 effected the reversal. Means and standard deviations for these six scores and for the other variables used in the study are given in Table 1. The coefficient alpha reliability indexes for these six scales were .89, .87, .85, .82, .81, and .60, for the Luck, Externality, Internality, Accident Causality, Fate, and Resignation components, respectively. Inspection of the items making up the Resignation component failed to disclose a reason for the markedly lower reliability value obtained for that scale. This difference might be due, at least in part, to the lower number of items making up the scale (i.e., 9 items vs. 15 for most of the other scales); however, the Fate scale also had only 9 items, and its reliability was substantially higher.

Correlation of Measures and Accident Involvement

Pearson product–moment correlations were computed among the a priori LOC scores, LOC component scores, the two accident status variables, the A–HES, and the demographic variables. These correlations are shown in Table 4. Generally,

TABLE 4
Intercorrelations of the Measures

	Military Accident—Recent	*Military Accident—Ever*	*A–HES*	*Internality (A Priori)*	*Externality (A Priori)*	*Luck*	*Externality*	*Internality*	*Accident Causality*	*Fate*	*Resignation*	*Total Military Flight Hours*	*Recent Military Flight Hours*
N	195	195	183	188	188	191	189	188	189	189	189	195	195
Military accident—ever	.44**	—											
A–HES	.26**	.18*	—										
Internality (a priori)	−.19**	−.14	−.12	—									
Externality (a priori)	.04	.09	.10	−.51**	—								
Component 1—Luck	.01	.05	.06	−.47**	.93**	—							
Component 2—Externality	.09	.12	.19**	−.53**	.82**	.72**	—						
Component 3—Internality	−.16*	−.14	−.11	.88**	−.40**	−.34**	−.40**	—					
Component 4—Accident causality	−.14*	−.07	−.08	.76**	−.28**	−.29**	−.37**	.55**	—				
Component 5—Fate	.03	.07	−.07	−.33**	.69**	.62**	.50**	−.23**	−.15*	—			
Component 6—Resignation	.23**	.26**	.13	−.39**	.37**	.31**	.38**	−.33**	−.26**	.22**	—		
Total military flight hours	−.08	.14	.08	.09	−.12	−.07	−.17*	−.04	.09	−.15*	−.11	—	
Recent military flight hours	.22**	.05	.37**	−.04	−.02	.01	.08	−.06	−.03	−.03	−.05	.27**	—
Years as an Army aviator	−.14	.08	−.11	.12	−.08	−.02	−.19**	.03	.12	−.10	−.13	.82**	−.03

Note. Accidents status coded 1 = yes, 0 = no. A–HES = Army Hazardous Events Scale.
*Correlation is significant at the .05 level (2-tailed). **Correlation is significant at the .01 level (2-tailed).

the various measures predicted recent accident status better than career accident status. Recent accident status was significantly correlated with the a priori Internality score ($r = -.19$), the Internality component ($r = -.16$), the Accident Causality component ($r = -.14$), and the Resignation component ($r = .23$). However, career accident status was significantly correlated only with the Resignation component ($r = .26$). Both recent accident status ($r = .26$) and career accident status ($r = .18$) were correlated significantly with the A–HES. The A–HES was also significantly correlated ($r = .19$) with the Externality component.

More senior aviators tended to be less external, as measured by the Externality component score. Years as an Army aviator correlated $r = -.19$, and total military flight time correlated $r = -.17$. The corresponding correlations for the a priori scale were in the same direction (negative), but smaller, and nonsignificant. The results for the Externality component score are close to the results reported by Hunter (2002), who found a correlation of –.213 between the ASLOC externality score and age. However, he reported a correlation of only –.01 between total flight time and externality.

DISCUSSION

We hypothesized that a measure of LOC, generally modeled after the ASLOC, would correlate significantly with accident involvement and with the A–HES. The results support Hypothesis 1 with respect to recent accident involvement. Specifically, aviators who were lower in perceived internal control, as measured by both the a priori Internality scale and by the Internality component, reported significantly more recent accidents than those who were higher in internal control. However, we failed to find support for Hypothesis 2 with respect to career accident involvement. Although one of the component scores (Resignation) was significantly correlated with accident status, neither the a priori nor component internality scores achieved statistical significance.

Weak support was observed regarding the hypothesized relationship of the LOC measures and the A–HES. A significant correlation was only obtained between the A–HES and the Externality component score. However, the direction of the relationships for the a priori Internality scale and the Internality component are both in accord with our expectations, as the negative correlations between these two scores and the A–HES indicate that aviators who were lower in perceived internal control experienced more hazardous events.

The results from both the a priori and component analyses are in agreement that aviators who had a more internal orientation were less likely to have been in a recent accident. This was also true of aviators who indicated that the causes of accidents lay primarily with their actions. However, aviators who agreed with the items indicative of resignation tended to have more accidents. The Resignation component is particularly interesting, as it demonstrated significant correlations with both recent and career accident status. Inspection of the correlation matrix suggests that this component captures elements of both internality and externality, as it correlates significantly (but in opposite directions) with both those variables. Clearly, this construct merits further attention in future studies. At a minimum, improvements to the reliability of this measure could result in higher correlations with the accident criteria.

Arguably, the a priori scale development process was unnecessary, because the empirical scales developed through principal components analysis seem to have identified not only the conventional internality and externality components (with correlations with the accident criteria similar to those observed for the a priori scales) but also identified other components (specifically, Resignation) that demonstrated even stronger relationships with the criteria. Although we have presented the results from both analyses for the sake of replicating the previous development process, and it is reassuring, to some degree, that the results from the principal components analysis confirm the existence of the two a priori components, in the future such a step is probably not necessary.

APPLICATION OF THE RESULTS

This was the first study of the Army LOC scale, and although the results with respect to the relationship of the scale to accident involvement are encouraging, additional research is needed to perform a more thorough construct validation and to substantiate these initial findings. Should future research confirm the results of this study, the Army LOC scale might be used to develop self-awareness among aviators of their personal risk factors stemming from these maladaptive attitudes. Further, it might be argued that one goal of military training (especially aviation training) is to instill in trainees a belief that on the completion of the training they are able to proactively influence the outcome of the military situations that they will subsequently encounter. However, changes in LOC resulting from this type of training have not been studied, and would make an interesting topic for future research.

More generally, an assessment of changes in LOC resulting from civil flight training would also be illuminating. The literature on the malleability of LOC is limited, with some studies demonstrating changes as a result of training (e.g., Diamond & Shapiro, 1973; Hase & Douglas, 1987; Pender, 1985), whereas other studies report no change (Omizo & Michael, 1982; Smith, 1989; Wolfe & Robertshaw, 1982). Wichman and Ball (1983) found that pilots were significantly more internal than the general population on the Rotter LOC scale. It would be interesting to determine whether individuals who seek pilot training are higher in internal LOC before beginning training, or whether aviation training produces the increase in internality.

Hunter (2002) reported that pilots become more internally oriented as they grow older, but not as they become more experienced. From those results, he concluded that, "the mere accumulation of flight hours is not sufficient to bring about a change in the pilot's orientation. Rather, it is their total life experience that leads to such a change" (Hunter, 2002, p. 5). This is consistent with the general view of LOC as a stable personality variable. However, some authors (cf. Andrisani & Nestel, 1976; Lefcourt, 1982) have suggested that personal experiences, directed cultural teaching, and therapeutic interventions can influence the development of internality. Clearly, the issue is in need of additional research.

If such research were undertaken, then the Army LOC scale might be used (in an aviation setting) to test the effectiveness of training in meeting that goal by administering the scale both before and after completion of training. Comparison of these scores should reveal whether a shift in the trainees' beliefs occurred.

Understanding the psychological factors that influence behavior in safety-critical situations provides a basis for the development of methods to alter that behavior by addressing the underlying psychological influences. This study has demonstrated that, congruent with the results from the civil studies, LOC is related to accident involvement, at least for recent accidents. Recommendations for action must be made cautiously, as the correlational nature of this study precludes firm statements of causality. However, the results of this study, in concert with the body of literature on the relationship between LOC and accident involvement, suggest that efforts should be made to intervene with pilots who are substantially below the norm on internality. At a minimum, this could take the form of self-awareness; however, should future research indicate that focused training could increase the level of internality among pilots, then that should also be undertaken.

Limitations to Generalizability

Although the samples were drawn randomly from the pool of Army aviators, the respondents are still best described as self-selected samples of aviators who chose to participate in the studies. They are therefore convenience samples and might not be representative of the total population of pilots. Further, the data presented are based on self-report and are therefore subject to inaccuracies resulting from respondent forgetfulness, bias, differences in self-disclosure, or misinterpretation of the questions. Perhaps more seriously, correlations obtained between psychological measures and previous events might not be good estimates of correlations of those measures with future events (Hunter, 2001). Thus, although these results are encouraging, they should be replicated with a prospective design. Further, these results might not be generalizable outside the Western culture. Recent research using the ASLOC with Indian pilots has reported substantially different mean scores for Indian and American pilots (Joseph & Ganesh, 2006), which raises the possibility that the relationship between the constructs measured by the scale and accident involvement might be different for these groups.

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APPENDIX A: COMPONENT LOADINGS FOR THE LOC SCALES

TABLE A.1
Loadings for Component 1 (Luck)

Item No.	*Component Loading*	*Item Text*
LC88	.68	Successful flying is partly a matter of good luck.
LC87	.67	Sometimes you just have to depend on luck to get you through.
LC55	−.66	I do not really believe in luck.
LC82	.64	If I had an accident, it would be the result of bad luck.
LC57	.62	Chance has a lot to do with avoiding accidents.
LC52	.59	Whether or not I get into an accident is mostly a matter of luck.
LC35	.59	Luck plays a big part in determining whether you will be in an accident.
LC74	.56	I am superstitious.
LC49	.56	Much of the time when I am successful, it is because I am lucky.
LC62	−.53	The idea that luck determines what happens to you is ridiculous.
LC26	.52	I'd rather be lucky than good.
LC79	.52	At some point a person must accept the inevitable and face their fate calmly.
LC78	.51	A person's destiny determines what happens to them.
LC60	.51	Bad luck is what gets many pilots into trouble.
LC56	.50	My success is mainly a matter of chance.

TABLE A.2
Loadings for Component 2 (Externality)

Item No.	*Component Loading*	*Item Text*
LC86	.62	Most of the time accidents are caused by things beyond the aviator's control.
LC39	.61	No matter what I do, I'm likely to have an accident.
LC36	.56	My success in aviation is largely a matter of good fortune.
LC52	.53	Whether or not I get into an accident is mostly a matter of luck.
LC16	.52	Most injuries are caused by accidental happenings outside people's control.
LC5	.52	Avoiding accidents is a matter of luck.
LC60	.51	Bad luck is what gets many pilots into trouble.
LC20	.50	Most accidents are unavoidable.
LC53	.49	Whether or not I get into an accident depends mostly on other people.
LC7	.48	Most accidents and injuries cannot be avoided.
LC31	.48	No matter what I do, if I am going to have an accident, I will have an accident.
LC12	.48	Aviators can do very little to avoid minor incidents while flying their missions.
LC54	.47	Whether or not I get into an accident depends mostly on things that I cannot control, like the weather.
LC13	.46	Whether people get injured or not is a matter of fate, chance, or luck.
LC42	.46	Regarding safety, I can only do what the Army tells me to do.

TABLE A.3
Loadings for Component 3 (Internality)

Item No.	*Component Loading*	*Item Text*
LC33	.66	I am in control of my life.
LC50	.64	I believe I have control over my own destiny.
LC30	.64	If I get in a difficult situation, it is my own behavior that determines if I make it out OK.
LC45	.62	If I get what I want, it is because I worked for it.
LC37	.61	If I take care of myself, I can avoid accidents.
LC71	.57	I feel completely in control, all the time.
LC63	.53	You are responsible for the things that happen to you in your life.
LC66	.47	If I try hard enough, I can get out of any situation.
LC41	.47	If I take the right actions, I can avoid accidents.
LC32	.46	Getting regular training and practice is the best way for me to avoid an accident.
LC47	.45	I am careful to check everything on the aircraft before I depart on a mission.
LC46	.44	It is my ability and determination that will determine whether I am in an accident.
LC34	.42	When I make a mistake, I am to blame.
LC70	.40	If I have a close call, it just means I have to work harder next time.
LC67	.40	Safety is due to effort, not luck.

TABLE A.4
Loadings for Component 4 (Accident Causality)

Item No.	*Component Loading*	*Item Text*
LC8	.62	Most accidents are due to aviators' carelessness.
LC65	.58	If I have an accident, it's because I was not careful enough.
LC4	.58	Accidents and injuries occur because aviators do not take enough interest in safety.
LC14	.57	Aviators' accidents and injuries result from the mistakes they make.
LC64	.57	If I have an accident, it's because I didn't try hard enough.
LC11	.54	Most accidents that result in injuries are largely preventable.
LC68	.47	Accidents could be eliminated, if pilots made more of an effort.
LC19	.45	There is a direct connection between how careful aviators are and the number of accidents they have.
LC46	.43	It is my ability and determination that will determine whether I am in an accident.
LC15	.43	Most accidents can be blamed on poor command oversight.
LC6	.40	Most accidents and incidents can be avoided if aviators use proper procedures.
LC10	.38	Aviators should be punished if they have an accident or incident while "horsing around."
LC1	.37	If aviators follow all the rules and regulations, they can avoid many aviation accidents.
LC17	.37	People can avoid getting injured if they are careful and aware of potential dangers.
LC41	.35	If I take the right actions, I can avoid accidents.

TABLE A.5
Loadings for Component 5 (Fate)

Item No.	*Component Loading*	*Item Text*
LC83	.73	I'll die when it's my time to go, but not before.
LC89	.69	You don't go until your number is up.
LC80	.60	I feel that there is some higher power looking out for me.
LC78	.46	A person's destiny determines what happens to them.
LC61	.46	If something is meant to happen there is nothing you can do to change it.
LC85	.45	In flying, what will be, will be.
LC84	.38	In a tight situation, I trust to fate.
LC79	.37	At some point a person must accept the inevitable and face their fate calmly.
LC25	.37	If you keep your wits about you, success is always possible.

TABLE A.6
Loadings for Component 6 (Resignation)

Item No.	*Component Loading*	*Item Text*
LC21	.55	No matter how hard aviators try to prevent them, there will always be accidents.
LC66	−.46	If I try hard enough, I can get out of any situation.
LC22	.44	There are so many dangers in this world that you never know how or when you might be in an accident.
LC81	−.43	There are no problems that cannot be overcome with enough effort.
LC10	.40	Aviators should be punished if they have an accident or incident while "horsing around."
LC3	.37	Aviators should be reprimanded if they periodically neglect to use safety devices (for example, seat belts, checklists, etc.) that are required by Army regulations.
LC27	.33	Sometimes you get the bear, sometimes the bear gets you.
LC9	.33	Most aviators will be involved in accidents or incidents which result in aircraft damage or personal injury.
LC28	.31	Stuff just happens.