

**Stress, distress and air traffic incidents: Job dysfunction and distress in airline pilots in relation to contextually-assessed stress.**

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SUMMARY

This study used contextual stress measurement to look at the occupational sequelae of stress. 105 civil aviation pilots were interviewed. Events and difficulties were dated and rated for contextual threat; dating information was also obtained for distress symptoms and air traffic incidents. There were significant relationships between stress and air incidents, between stress and distress, and between distress and incidents. Some symptoms (sleep disturbances, loss of energy and tiredness) were more likely to be associated with reported incidents than others. The results are in line with previous suggestions that the effect of stress on job performance is via distress. Distress-related sleep disturbances may be particularly crucial. Further work using contextual stress measurement is needed to clarify the causal pathways involved.

Key words: contextual stress, distress symptoms, sleep disturbance, air traffic incidents.

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How and when does stress affect performance? The understanding and management of occupational and non-work stress is of particular importance for performance in occupations such as aviation, where performance decrements may result in heavy casualties and/or heavy financial losses.

Several researchers have investigated common sources of stress in pilots.<sup>1,2,3</sup> However these studies did not examine the relationship between stress and pilot work performance.

Other researchers<sup>4,5,6</sup> have investigated life-events in relation to air-traffic accidents, and have concluded that there is some relationship. However, their life-events measures were based on the assumption that an identical degree of stressfulness should be accorded to all events within a particular category, an approach which lacks the greater precision of the now widely-advocated<sup>7</sup> context-sensitive approach. Brown & Harris<sup>8</sup> have developed the Life Events and Difficulties Schedule (LEDS) to assess the contextual threat of an event, which is defined as the threatfulness of that event for anyone in those

circumstances and with the same biography. As yet, these more precise contextual threat ratings for life-events have not yet been widely used in occupational settings. The present study represents an advance on previous research in several ways. Firstly, life events were assessed in the more precise contextual fashion proposed by Brown & Harris.<sup>7</sup> Secondly, the effects of life events *and* of distress on pilots' job performance were both considered, rather than simply one or the other. Thirdly, several different aspects of job performance were considered. Fourthly, the collection of dating information partly overcomes the traditional objections to retrospective methodology, enabling stronger inferences about causality to be made, as in prospective studies. Thus although the measures were collected at one time, the use of dating information allows stronger causal inferences than a traditional cross-sectional methodology.

This study therefore looked at contextually-measured stress in relation to performance in civil aviation pilots, giving attention to dating of stress, distress symptoms and the occurrence of air traffic incidents.

## METHOD

## Design

The design was a multi-variate correlational design, involving measurement of stress, distress, job performance and selected other factors. Stress (life-events), distress (symptoms) and air traffic incidents were dated, and dates compared so as to exclude events that were not prior to symptoms and incidents, and symptoms that were not prior to incidents. The contextual stress measures, derived from the LEDES, were independent variables. Dependent variables were the measures of job performance (air-traffic incidents) and psychological distress.

*Participants*

Participants were 105 male civil aviation pilots, volunteering to participate during off-duty periods. There were 49 British pilots, mean age 40.0 years (s.d.=8.9), with 17.6 mean years' flying experience (s.d.=9.4), and 56 Israeli pilots, mean age 45.5 years (s.d.=6.4), with 20.1 mean years' flying experience. Only a minority of the British pilots had military flying experience (13/49), but almost all the Israelis (54/56) had such experience.

*Measures*

Information was obtained retrospectively about life events and difficulties, distress, air-traffic incidents and other job performance measures, for the 12 months prior to interview. The LEDS (Life Events and Difficulties Schedule<sup>8</sup>) was slightly modified to include questions and probes suitable for use in this occupational context. Prior to the LEDS interview a screening instrument (adapted from Andrews,<sup>9</sup> and from Costello & Devins<sup>10</sup>) was used to enable the interviewer to focus on events and difficulties reported in the screening. Events and difficulties were rated by a trained team working in liaison with Tirril Harris and the Medical Research Council team in the Social Policy Department at Royal Holloway (London University). LEDS procedures were followed for dating events, difficulties and air incidents. The measure of distress was a self-report list of symptoms based on Spitzer's Research Diagnostic Criteria (RDC). Presence, onset and offset were recorded for symptoms in the previous 12 months, which had lasted for more than two weeks, were of high intensity, interfered with other things, and were difficult to control. The job performance measures were self-reports covering the previous 12 months: self-rated overall flight performance (on a 0-10 scale); self-rated simulator

performance (0-10); number of shifts absent in the previous year; air-traffic incidents (near-misses or other; dates were recorded).

## RESULTS

*Qualitative aspects of stress*

The events and difficulties reported were related to difficulties in relationships with spouse or other partner, sometimes associated with rostering; extra-marital relationships; health problems, usually for a dependent; financial difficulties, and work-related difficulties such as promotion disappointments. Additionally some Israeli pilots reported events and difficulties connected with military service which is compulsory for several weeks every year in Israel for men up to the age of 65.

*Quantitative findings*

The inter-relationships among the various measures are shown in table 1. Since the numbers reporting incidents were small, and since the main features of the data and their relationships were similar in both samples, the British and Israeli data were combined to improve statistical power.

There were significant positive correlations between stress and distress (consistent with other work<sup>8,11</sup>), between stress and air incidents, and between distress and air incidents. Note that though the data are correlational, only stress occurring prior to distress and air incidents, and only distress prior to air incidents are included. This strengthens



the possibility that associations could imply causality.

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INSERT TABLE 1 ABOUT HERE

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There was an association between absenteeism and flying incidents. Other aspects of pilots' performance did not correlate with flying incidents or with other measures, except that self-ratings of general flight performance and simulator performance were associated.

To exclude possible confounded effects, a multiple regression analysis was conducted, in addition to the correlational analysis, using the variables in table 1, with air incidents as the outcome variable. This showed a marked effects of distress (symptoms) on air incidents (Beta=.390,  $t=3.90$ ,  $p=.0002$ ). The effects of stress were not significant. The only other significant "predictor" of air incidents was absenteeism (beta=.212,  $t=2.34$ ,  $p=.021$ ).

In order to examine more closely the relationship between distress and flying incidents, individual symptoms were compared among those reporting incidents and those not reporting incidents (table 2).

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INSERT TABLE 2 ABOUT HERE

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For the incident-reporting pilots, only those symptoms with an onset prior to the incident and still current at the time of the incident are included. The chief difference in symptomatology between the incident-reporting pilots and the non-incident-reporting pilots was with respect to sleep disturbances, and loss of energy and tiredness.

## DISCUSSION

The main findings of this study are that flying incidents in pilots were associated with stress, both directly, and more strongly via the distress resulting for some but not all those under stress. This suggests that it is the emotional reaction to life events and difficulties which is important rather than the existence of life events and difficulties *per se*. This is in line with conclusions about the causal relationships between life-events and distress symptoms in the case of road traffic accidents<sup>12,13</sup>. More specifically the evidence suggests that stress-related sleep disturbance and fatigue may be of particular importance as a factor in flying incidents. This suggestion accords with Green's<sup>14</sup> conclusions, that sleep disturbances are associated with reported air-traffic incidents. However it goes a step further by implying that it may be specifically *stress-related* sleep disturbance and fatigue that are crucial, and not shortage of sleep as such.

Causal associations between flying incidents and absenteeism could not be inferred, since we had insufficient information about the timing of absenteeism in relation to air incidents.

One possible interpretation of our findings would involve according anxiety central importance. It

is well-established that anxiety causes sleep disturbances (see Eysenck<sup>15</sup>), and the evidence indicates that anxiety can cause attentional malfunctioning and impaired performance.<sup>15,16</sup>

Thus the suggested causal pathway would be:

***STRESS→DISTRESS→SLEEP DISTURBANCE→ATTENTION  
DEFICIT→INCIDENT***

However further work is needed to distinguish the suggested causal pathways from other possibilities. Further work should firstly isolate the specific causal role played by anxiety, and distinguish its effects from those of sleep deprivation per se. This requires careful attention in data-collection and analysis, since rostering may be causally involved in sleep-deprivation, and may also impact on life circumstances to give rise to anxiety or other distress. Secondly, further research should distinguish the effects of anxiety from those of depression and other forms of distress. Both anxiety and depression are associated with sleep and attentional disturbances (though of different types). Since anxiety, depression and other forms of distress often co-occur, careful attention needs to be paid to assessment of specific distress symptoms. Finally, it would be desirable for further research to involve a prospective design, to enable greater confidence in the analysis of causal pathways.

This investigation indicates the value and applicability of contextual threat measurement in helping to elucidate the possible causal links between stress, distress and air-traffic incidents.

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Table 1: Correlation coefficients between measures of stress, distress and performance among pilots.

	Stress ****	Dist- ress	Inci- dents	Abse- nces	Flight Perfor- -mance	Simu- lator Perfor- -mance	Age
Stress ****	-						
Distress	.45***	-					
Incidents	.19*	.41***	-				
Absences	.11	.02	.22*	-			
Flight Perfor- -mance	-.08	-.05	-.04	-.03	-		
Simulator Perfor- -mance	-.08	-.02	-.10	-.17	.61***	-	
Age	-.13	.09	.18	-.06	.04	.04	-
Years Flying	-.16	.03	.15	-.04	.01	-.04	.72 ***

\* p<.05

\*\* p<.01

\*\*\* p<.001

\*\*\*\* The index of stress was the presence of a provoking agent, defined<sup>8</sup> as a prior event of at least high-moderate long-term contextual severity (and focused on the participant, singly or jointly with others), or an ongoing difficulty of at least two years duration, and of at least high moderate contextual severity. Where distress symptoms and/or flying incidents were reported, only prior provoking agents were included in the above analyses.

Table 2. Symptoms among non-incident-reporting pilots and incident-reporting pilots.

Brief description of symptom	Pearson $\chi^2$	Proportion and number of non-incident-reporting pilots reporting symptom in last 12 months. (N=96)	Proportion and number of incident-reporting pilots reporting symptom in last 12 months. (N=9)
Depressed mood	<1 n.s.	7% (7)	11% (1)
Poor appetite; weight loss or gain >7lbs.	<1 n.s.	5% (5)	0% (0)
Sleep disturbances (at least one hour less or more than usual).	68.6 p<.001	16% (15)	67% (6)
Loss of energy, tiredness.	68.6 p<.001	16% (15)	67% (6)
Agitation or slowing	<1 n.s.	3% (3)	0% (0)
Loss of interest in usual pleasures	<1 n.s.	8% (8)	11% (1)
Guilt	<1 n.s.	4% (4)	11% (1)
Loss of concentration	<1 n.s.	10% (10)	11% (1)
Suicidal thoughts	<1 n.s.	0% (0)	11% (1)