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Human Error: The Principal Cause of Skydiving Fatalities

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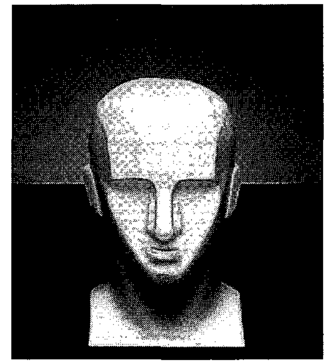

Between 1993 and 2001, 308 people died while participating in civilian recreational skydives in the United States. Using a database generated by the United States Parachute Association, the authors of the present study conducted an analysis to determine the proportion of fatalities that were due to human error. The results of the analysis indicated that human error was the principal cause in 86% of the cases. Methods for reducing human error fatalities are suggested.

Human error can be defined as any human action or failure to act that has the potential to degrade system performance. The role of human error in aviation mishaps and fatalities has been studied quite extensively (Li, Baker, Grabowski, & Rebok, 2001; Billing & Reynard, 1984; Conroy, Russell, Crouse, Bender, & Holl, 1992; Shapell & Wiegmann, 1996). Most analyses suggest that equipment or aircraft failures are responsible for far fewer accidents than human error. Indeed, current research indicates that human error contributes to well over half of aviation mishaps and fatalities in airplanes (Li et al., 2001; Shappell & Wiegmann, 1996), helicopters (Conry et al., 1992; Vyrnwy-Jones, 1985; Wiegmann & Shappell, 1999), hang-gliders (Margreiter & Lugger, 1978), hot-air balloons (Cowl et al., 1998; Frankenfield & Baker, 1994), and para-gliders (Schulze, Hesse, Blatter, Schmidtler, & Muhr, 2000). Despite the prevalent study of human error in the aviation domain, the role of human error in skydiving fatalities has received very little attention. In fact, a review of the literature reveals that there has not been a comprehensive analysis of the contribution of human error to civilian skydiving fatalities.

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Recreational skydiving is an inherently dangerous hobby. Skydiving involves jumping out of an aircraft while wearing a system consisting of a main parachute and a reserve parachute. The skydiver is required to deploy the main parachute at an appropriate altitude. In the event that the main parachute should fail to properly deploy, the skydiver must quickly disconnect the failed parachute and deploy the reserve parachute. It is important that the detachment of the main parachute and deployment of the reserve parachute be carried out in the correct order or an entanglement of both parachutes could result. After successfully deploying a parachute, the skydiver must steer the parachute to a designated landing area and land safely. During each stage of a skydive, there is potential for equipment failures and operator errors that could lead to a fatality. According to the United States Parachute Association (USPA), skydivers make over 3,250,000 recreational skydives in the United States each year (United States Parachute Association, 2002). However, approximately 34 U.S. skydivers are killed in the sport each year (Griffith & Hart, 2002).

In a previous report, these researchers developed a taxonomy for skydiving fatalities (Griffith & Hart, 2002). This taxonomy categorizes fatalities based on the specific principal cause of the fatalities. The Hart-Griffith taxonomy does not deal in general terms such as *human error*. Rather, accidents related to human error fall into a number of separate categories depending on other characteristics of the mishap. It seemed, however, that an analysis of human error in skydiving fatalities might be useful in highlighting the role that inappropriate or incorrect behavior plays in such accidents. Therefore, the aim of this study is to specifically identify the role of human error in skydiving fatalities.

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Method

A database of 1993-2001 U.S. skydiving fatalities generated from USPA accident investigation reports was used for this study. This data set was obtained directly from the USPA. The database contains information on the events, behaviors, and conditions that preceded the individual fatalities. For some cases information concerning the age and experience of the victim and the specific gear were mentioned, however this information was incomplete or not present for most cases, making an analysis of those details impossible. No federal agency monitors skydiving accidents, so the USPA data is the most comprehensive source of information on skydiving fatalities. According to these data, there were 308 recreational skydiving fatalities in the U.S. between 1993 and 2001. For the present study, fatalities were either categorized as being principally due to human error or principally due to other factors. The Human Error category encompassed mishaps in which errors, inappropriate actions, inattention, or omission of important actions were the principal cause of the accidents. The Other Factors category captured causal factors not related to human error such as various mechanical failures, medical conditions, and obvious cases of suicide. The categorization of fatality reports was completed by two USPA-licensed skydivers who served as independent raters. In cases of disagreement between raters, a third USPA member arbitrated decisions. Both primary raters had extensive experience as skydivers and were very familiar with the study of skydiving fatality mishaps.

Results and Discussion

The initial inter-rater reliability of categorization was high with 97% agreement. Of the 308 fatalities that were reported between 1993-2001, 264 (86%) were categorized as Human Error, indicating that human error was deemed to be the principal causal factor in the mishaps. The remaining 44 (14%) fatalities were categorized as Other Factors, indicating that human error did not play a principal role in those mishaps. Therefore, human error appears to be the principal causal factors in the great majority of skydiving fatalities. These results are similar to those found in other studies examining the role of human error in aviation accidents and fatalities. Whether examining mishaps in airplanes, helicopters, balloons, paragliders, or hang-gliders, human error consistently accounts for 55-85% of the accidents or fatalities (Conry et al., 1992; Cowl et al., 1998; Frankenfield & Baker, 1994; Li et al., 2001; Margreiter & Lugger, 1978; Schulze et al., 2000; Shappell & Wiegmann, 1996; Vyrnwy-Jones, 1985; Wiegmann & Shappell, 1999).

The types of errors made in many of the human error skydiving fatality cases suggest that inattention, decision errors, and action errors play a prominent role in these mishaps. For instance, the mishaps typically stem from using incorrect emergency procedures, failing to deploy the parachute at a reasonable altitude, landing errors, and midair collisions. A previous report by the current authors provides a systematic summary of the specific causal factors involved in skydiving fatalities and their relative frequencies (Griffith & Hart, 2002). The skydiving environment likely plays a contributory role in these human error accidents. Skydivers must often act under extreme time pressure while experiencing a state of high anxiety and arousal. These factors are known to contribute to human error in other domains (Wickens, 1992). A study of other possible factors such as training habits, equipment design, risk management, and organizational influences might reveal additional factors that contribute to the high proportion of human error accidents in skydiving. Unfortunately, the archival data used in the present study do not support such further analyses of the human error fatalities.

Military parachuting groups might also benefit from an analysis of the relative contributions of human error to fatal accidents. Recent studies of military parachuting accidents and fatalities fail to address the issue of human error directly (Bricknell & Craig, 1999; Craig & Lee, 2000; Mellen & Sohn, 1990). However, the overwhelming use of static-line parachuting techniques rather than free-fall techniques may greatly reduce the occurrence of human error accidents within the military parachuting community.

Given that human error plays such a prominent role in skydiving fatalities, any attempt to decrease the overall fatality rate should endeavor to reduce human error. A systems approach to reducing human error has been applied to other segments of the aviation domain (O'Hare, 2000; Wiegmann & Shappell, 2001), so it may be helpful to apply such an approach within the skydiving community. Within skydiving training and education programs, specific attention should be given to human error, and training should be deliberately aimed at reducing human error mishaps. In the design of parachuting equipment, attention should be given to designing systems that increase skydiver situation awareness and increase the probability of correctly carrying out deployment and emergency procedure while under stress and time pressure. From an organizational standpoint, the USPA and individual dropzones should initiate programs aimed at increasing risk management and reducing skydiving practices such as low-altitude deployments, high speed landings, and other behaviors that increase the probability of human error mishaps. By taking such action, the skydiving community might be able to reduce the overwhelming proportion of fatalities attributable to human error.

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