

Neural correlates of unexpected events in aircraft pilots: how experience and emotions influence the startle response

Abstract

Unexpected events are among the main sources of risk in aviation safety: an unexpected noise, an instrument anomaly, or a sudden change in flight conditions can trigger an automatic alert reaction known as the startle effect. Although this physiological response may impair the pilot's ability to make rapid and accurate decisions.

This presentation will illustrate a study conducted at Sapienza University of Rome, aimed at investigating electrophysiological and behavioural differences associated with the resolution of cognitive tasks under startle and no-startle conditions. The study also examined how flight experience, emotional dysregulation, alexithymia, and traumatic life events may influence pilots' electrophysiological responses to unexpected stimuli.

The experimental protocol involved 21 airline pilots engaged in a cognitive task requiring continuous strategy shifting. During the task, some trials were preceded by brief and intense sounds, introduced unexpectedly to elicit the startle response. Brain activity was recorded using a 256-sensor EEG system.

Results showed that the unexpected stimulus elicited a stronger neural response across all processing phases and brain areas examined. Behaviorally, reaction times were significantly longer in the startle condition, indicating greater cognitive processing demands.

The study further revealed that more experienced pilots exhibited more similar neural activation patterns across startle and no-startle trials. Conversely, pilots with traumatic life experiences showed larger differences in neural processing between the two conditions. Higher levels of alexithymia and emotional dysregulation were associated with smaller differences in brain activation between startle and no-startle stimuli.

Overall, the findings highlight the importance of implementing interventions focused on processing traumatic experiences and enhancing emotional regulation. Such interventions may improve pilots' ability to respond effectively to unexpected stimuli, ultimately contributing to greater safety in flight operations.