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Aviation Weather Products in General Aviation: Interpretability and Usability Research Trends

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HCII 2019 Abstract

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As a result of advances in weather forecasting and technology, today's General Aviation (GA) pilots have access to a wealth of aviation weather information. During pre-flight planning, GA pilots may access weather radar images, satellite pictures, winds, and forecast maps. During flight, pilots can access in-cockpit weather displays, as well as, handheld portable weather devices. Despite the increasing advancement and accessibility of weather displays, there is limited research addressing the interpretability of both in-cockpit and preflight weather displays. This is particularly concerning considering that preflight planning and poor product interpretability have been cited as possible contributing factors for GA weather related accidents. The purpose of this presentation is to describe and discuss the trends revealed from a series of studies that examined weather display interpretability (e.g., Blickensderfer et al., 2017; King et al., 2017; Ortiz et al., 2017).

One important consideration of any display is its general interpretability or the ability of users (in this case GA pilots) to understand the significance of the information. Recently, our research team developed and validated an exam to assess pilots' ability to interpret aviation weather product displays (Blickensderfer, Lanicci, Guinn, King, Ortiz, & Thomas, 2017). Overall, results indicated that most aviation weather displays have poor product interpretability. Further

research was conducted using a larger and more generalizable sample (n = 837 pilots). Results of these studies indicated similar trends:

Trend 1: Flight experience has a limited effect on pilots' ability to interpret weather displays. The studies revealed that student pilots and non-instrument rated private pilots scored the lowest in interpreting aviation weather products. Interestingly, however, the scores of instrument rated pilots, commercial pilots, and flight instructors were still relatively moderate (below 80% correct on average). This would seem to indicate that flight experience may not have a direct correlation with the ability to interpret aviation weather products and aviation weather experience. Furthermore, the weather product displays' *learnability* may be low.

Trend 2: Pilots do not understand Weather Radar displays. Previous research warned that GA pilots may have difficulty interpreting weather radar correctly. In fact, results from Berringer and Ball (2004) suggested that pilots exhibited even more hazardous behavior with radar displays than without. The Blickensderfer et al. studies echo these results, as radar display interpretation scores ranged from 60-70%. Considering that radar products are widely used amongst GA pilots, poor interpretability scores might also provide insight into Visual Flight Rules(VFR) into Instrument Meteorological Conditions (IMC) incidents.

Trend 3: Some categories of aviation weather products yielded higher scores than others. Interpretability scores on Winds Aloft were high. In contrast, scores on a variety of other weather products (including but not limited to METARs, Satellite, Ceiling Visbility Analysis, and Station Plots were quite low. For example, pilots struggled with METARs, a weather product that is considered fundamental to GA flight planning. The low interpretability scores on Satellite, CVA and Station Plots are even more troubling as these products appear in new overlaid displays (e.g., Defilippis et al., 2017).

Trend 4: The interpretation scores align with results from usability assessments.

Some prior research has assessed the usability of weather products. For example, Remy (2017) used a modified System Usability Scale to evaluate aviation weather products on the Aviation Weather Center website (Remy, 2017). The System Usability Scale (SUS) assesses perceived usability on a 10-item questionnaire, presented as a score out of 100. Scores below 68 are considered "below average." The Remy (2017) results indicated that "winds and temperature aloft" received a usability score of 74, "enroute forecast" received a 68.63, and "adverse conditions" received a 64.13. These usability scores trended in the same direction as the previously reported interpretability scores (Blickensderfer, 2017), as that low-rated usability products also had low performance scores.

Summary and Future Research

GA flights that encounter hazardous weather typically end in fatalities. Recent research results indicate that pilots struggle to interpret aviation weather displays (Blickensderfer et al., 2017), which can result in an inadequate understanding of current and forecasted weather. Trends reveal that while student pilots and non-instrument rated private pilots fare the worst at display interpretation, even pilots with high flight hours as well as advanced flight certificates and ratings also struggle to interpret the displays. While some usability assessments have occurred, future research needs include additional usability analyses of the weather products and websites (e.g. the AWC website). Furthermore, the aviation weather displays may lack learnability, meaning that despite practice, pilots' capability to interpret the displays remains low. Thus, future research should also assess the display learnability.