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Recommended Training Practices to Prepare Pilots to Cope with Information Conflicts

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Background

- Pilots make decisions based on a range of different, at times redundant, information sources:
  - Certified systems in the aircraft, ATC, Co pilot, Electronic Flight Bag (EFB) Apps…
- Pilots must:
  1. Determine which pieces of information are accurate and relevant
  2. Integrate the information to create an accurate representation of the environment (Mosier & Fischer, 2010; Mosier, 2002).
- Challenge: What if information sources present conflicting information?

Goals of the Research Effort

1. Identify best practices from the literature, for preparing pilots to effectively respond to situations with redundant and potentially conflicting information
2. Operationalize these guidelines into specific training recommendations for the pilot training community
3. Provide use case examples of how these recommendations would be implemented in both commercial and general aviation contexts

Method to Identify Best Practices and Operationalize for Pilot Training

1. Literature review identified:
   - Individual, System, and Task/ Environmental Factors that influence decision making with conflicting information
   - Existing best practices to mitigate the effects of conflicting information through system/training design
2. Empirical data collection, including a questionnaire study (108 pilots) and a simulation study (40 B737 pilots) identified:
   - Pilot operational experiences with information conflicts on the flight deck and subsequent response
3. Based these results, transformed best practices into training guidelines for pilot community

Abstract Review	Publication Review	Analysis & Input
Approx. 300 Abstracts	98 Publications	<u>51 relevant publications:</u> 36 Empirical Studies (18 Aviation, 8 Military, 10 Other) 15 Theoretical (10 Aviation, 5 Other)

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Recommendations 1-3: Training Pilots to Cope with Information Conflicts

Best Practices Deduced from the Literature	References	Recommendations for Flight Training
1. Train functional system knowledge and system interaction skills	Woods & Sarter, 1998; Gilson, Deaton, & Mouloua, 1996; Richter & Maier, 2017	• Understand how systems work at a functional level • How to distinguish true/false alarms and causes • Recognize strengths and weaknesses of information from the system
2. Train specific techniques for dealing with conflicts in redundant information	Mosier et al., 2007; Woods & Sarter, 1998; Richter & Maier, 2017	• Thorough information search • Evaluation of redundant/conflicting cues • Inductive conflict resolution, such as envisioning missing information or alerts
3. Increase exposure to information conflicts through specific training	Bahner, Huper, and Manzey, 2008; Karaoguz, 2016	• Expose performers to rare false information that creates information conflicts • Utilize case studies and first-person accounts to help build pilot's mental model

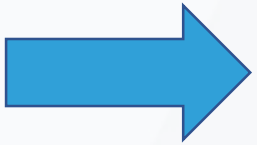
Recommendations 4-6: Training Pilots to Cope with Information Conflicts

Best Practices Deduced from the Literature	References	Recommendations for Flight Training
4. Train how to select decision-making strategies based on the conflict and type of information	Franke, 2011	• Train specific strategies to deal with specific information conflicts, and a high-level strategy to deal with novel conflicts • Practice selecting and utilizing decision strategies in simulator and debrief on strategy effectiveness and why
5. Train recognition of personal biases that effect decision making and mitigation strategies	Parasurman & Riley, 1997	• Educate on decision biases including take-action tendency bias, saliency bias, anchoring bias, sunken cost bias • Utilize sim practice scenarios or tactical decision games designed to elicit biases, debrief on biased response and why
6. Train how to use self-reflection during and after training	Martinez, 2006; Mosier & Fischer, 2010	• Teach use of mental simulation during performance, in which a potential solution is played through in one's head to identify critical risks and relevant situational factors • Train how to use self-reflection in debriefings to learn from information conflicts during training

Classroom Training: Use Case Examples

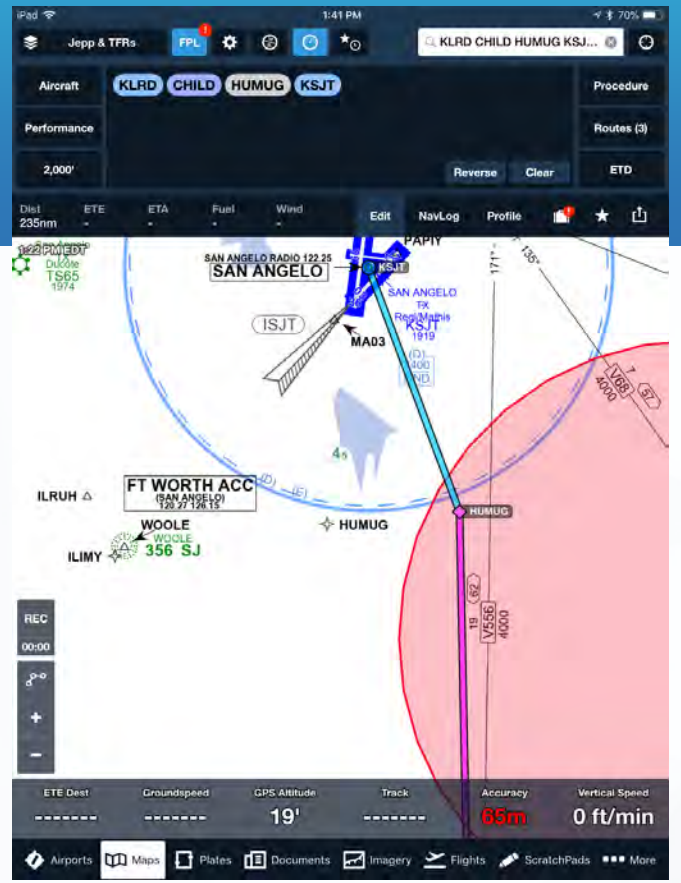
1. Present Tactical Decision Game (TDG) scenario to pilot in training.
2. Include information conflict in description/ materials provided.
3. Let pilot problem solve and determine how they would respond.
4. Conduct structured debrief:
   - Was conflict detected?
   - Was conflict investigated? How?
   - What are potential causes?
   - How did pilot ultimately respond?

Example Information Conflicts



- Student Pilot
  - Information for airport given in EFB app is different than that shown on Sectional
- Private Pilot
  - Weather on ATIS at destination airport is different from METAR shown on EFB app
- Commercial Pilot
  - Dimensions of TFR shown on EFB app are different than what is given in the NOTAM
- ATP Pilot
  - Weather shown on onboard radar is different than weather shown on EFB

Simulation Use-Case Examples: Previously Used in Research



- Simulation testbed:
  - High-end computer, large screen visuals and simulator hardware
  - Prepar3d Simulation Software, ForeFlight, and GPS VR with modification to create information conflicts
- Airspace conflict in light aircraft
  - Information Sources: ForeFlight and ATC
  - Conflict: ForeFlight indicates TFR along flight route; ATC indicates no conflict
  - Decision: Trust ATC and ignore TFR on Foreflight or ask ATC for vectors around TFR
  - Debrief: Debrief pilot on erroneous TFR presented on Foreflight/ATC mistake
- Aircraft location conflict in corporate aircraft
  - Information Sources: Navigation Display vs. Map on EFB
  - Conflict: EFB app shows aircraft ownship slightly off route; Nav display shows on course. Out of radar range so ATC no help; IMC conditions.
  - Decision: Trust ND and ignore EFB, investigate
  - Debrief: Debrief pilot on erroneous Ownship drift, when to/not trust the system

Live Training in Aircraft: Use Case Examples

- As an instructor, be on alert for real conflicts in information that appear during flight
  - Ghost traffic from TIS-B
  - Different traffic shown between EFB and panel-mount MFD
  - Errors on chart or in database
  - ATIS not updated, but newer METAR on EFB
  - NOTAM of change that trainee does not notice during planning
  - NexRad weather that doesn't agree with out-the-window weather
- Use the opportunity to teach in-flight skills for dealing with information conflicts

Conclusion

- There is an opportunity to leverage best practices derived from the literature to prepare pilots to operate in todays information-rich cockpits, by:
  - Increasing pilot knowledge related to information conflicts and why they occur
  - Providing opportunities to practice responding to information conflicts
  - Arming pilots with knowledge and skills to manage information conflicts

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Questions?

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