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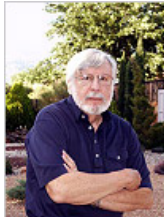



**Vol. 46, No. 4 • November-December 2010**

**Outside the Lines**

**Old Habits Die Hard: Part 2**

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by Ira J. Rimson and Ludwig Benner, Jr.

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Definition of *UNLEARN*:

1: to put out of one's knowledge or memory  
 2: to undo the effect of; discard the habit of  
 — Merriam-Webster.com

We raised concerns in our previous column<sup>1</sup> about the consequences of operators' reverting to old habits when systems performance becomes stressful. In this column, we address the need to counter risks of reversion to old habits. Reversions often arise when operators have difficulty adapting to stressed systems or crises with their newly learned behaviors. Replacing old habituated behavioral responses becomes especially critical when their use in new or modified systems can result in disasters.

Introduction of new or modified systems usually requires that operators replace some established behavior patterns with new ones, both for regular and emergency operations. Unfortunately, we have found no pertinent data — qualitative or quantitative — establishing what kind, or how much, retraining or practice is needed to reliably replace existing behavior patterns. From what we have learned, it appears to us that the likelihood of current behavior-changing efforts defeating undesired operator behavioral response habits, whether to restore equilibrium or avert disaster, now relies heavily on good luck.


Training is one of the more widely used ways to instill new behaviors required for successful operation of new or modified systems. Trainers employ many techniques to instill new operator behaviors. A common way to develop training syllabi adopts designers' assumptions of the performance of new or modified systems as a basis for developing new procedures and specific new operator behavior patterns. The new procedures are most often based on assumed performance of the new system before it begins operating in the real world. Basing new procedures and operator behaviors on assumed performance data does not guarantee achieving designers' objectives successfully until they prove so in real-world operation. No matter how realistic it might seem, training can only be programmed to address known performance parameters. Most critical mishaps cascade after their systems have initially exceeded the limits of the known performance parameters.

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<sup>1</sup> "Old Habits Die Hard," *Journal of System Safety*, V. 46, No. 4, pp. 4-6, July-August, 2010.

			
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A significant determinant in many major mishaps has been operator unfamiliarity with their system's design. Investigators traditionally have assumed that operator training fulfilled requirements for instilling new behavior that adequately replaced the old. Investigators have rarely delved into the adequacy of operators' behavioral training. The need to acknowledge the possibility of training program conceptual or design inadequacies is not a recent discovery. In October 1971, the investigation of the National Transportation Safety Board (NTSB) of an accident in which the emergency responders' training officer was killed led to major changes in previously generally accepted firefighter training for hazardous materials transportation emergency responders.<sup>2</sup>

In June 1972, American Airlines Flight 93 suffered the blow-out of an aft cargo door over Windsor, Ontario.<sup>3</sup> The accident stemmed from a poorly-designed latching system whose security was impossible for ground personnel to verify. Failure modes and effects analyses (FMEAs) by the designers had identified the likelihood for this deficiency to result in a catastrophic failure, yet it was never addressed by either the manufacturer or the FAA. Fortunately, one reason that Captain Bryce McCormick brought the flight to a successful conclusion was that he had recognized that an explosive decompression might cause the floor to collapse and disrupt controls for the center engine and empennage controls, and insisted on practicing simulations using only the No. 1 and No. 3 engines for flight path control — maneuvers that were not included in the airline's FAA-approved training program.<sup>4</sup>

The investigation of COMAIR/Continental Flight 3407 accident at Buffalo, N.Y., on Feb. 12, 2009, focused on training inadequacies of the flight crew and the captain's apparent reversion to an inappropriate former behavior pattern in response to the airplane's aerodynamic stall.<sup>5</sup> During investigation, NTSB investigators reported the following finding:

"FlightSafety personnel stated their belief that scenarios in which the airplane was flown to activation of the stick pusher and then recovered were within the capabilities of the simulator model but that fighting against the stick pusher and not recovering would cause the simulator to be outside of its capabilities."

Bombardier subsequently stated that the post-stall onset of the stick pusher was outside the bounds of the simulator data package the company provided to FlightSafety.<sup>6</sup> Nevertheless, the NTSB cited "pilot error" as its probable cause, and seemingly deliberately elected not to cite the apparent gross inadequacies of the training program.

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<sup>2</sup> NTSB Report RAR-72-6, "Railroad Accident Report: Derailment of Missouri Pacific Company's Train 94 at

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Houston, Texas, Oct. 19, 1971," National Technical Information Service, Springfield, VA.


<sup>3</sup> See <http://libraryonline.erau.edu/online-full-text/ntsb/aircraft-accident-reports/AAR73-02.pdf> and Fielder, John H. and Douglas Birsch, Eds., *The DC-10 Case*. Albany, SUNY Press, Chapters 3-7, 1992.

<sup>4</sup> Faith, Nicholas. *Black Box*. London, Bxtree, 1996, Chapter 12, 1996. Feb. 12, 2009.

<sup>5</sup> NTSB Report AAR-10/01 PB2010-9 910401, "Loss of Control on Approach, Colgan Air, Inc., Operating as Continental Connection Flight 3407, Bombardier DHC-8-400, N200WQ, Clarence Center, New York,

<sup>6</sup> NTSB Report's footnote 102, p.37.

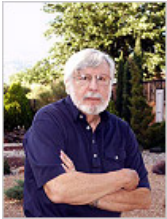

			
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More recently, Ford Motor Company has made available a digital interface that promises to change drivers' cognitive expectations drastically.<sup>7</sup> Mossberg had this to say after driving an exemplar vehicle: "... Ford's new user interface has so many options and functions that *I believe it presents a challenging learning curve*. Learning the new system can be distracting while driving, at least at first ... *I urge caution, because this is a very different dashboard than you may be used to.*" (Emphasis added). Ford might do well to develop simulators on which customers could practice the basic operations of these new systems prior to being turned loose in traffic.

Historically, training to meet new systems requirements was carried out on actual operational hardware, where the risk of error harming operators or equipment was always present. More recently, that transitional training has employed simulators that are representations of the real systems. For example, the FAA's training programs permit representation of real systems' operations by approved simulators, in which crews may be trained in desired behaviors before being introduced into actual aircraft operations.<sup>8</sup> Representational simulation training has been highly successful in achieving standardization among trainees, both procedurally and economically. It enables repetitive behaviors to foster habit formation, and behavioral experimentation with no risk of harm when erroneous behavior occurs.


However, the apparent "realism" of simulators makes it easy to forget that they are synthetic environments based on programmers' assumptions about how new systems will behave in actual operation. Simulators may mimic the actual physical systems from which they are derived, but their dynamics depend on best estimates of how the actual systems will perform. The data upon which their dynamic performance assumptions are based are initially speculative. Operators trained on those simulators may learn to expect that real systems will operate a certain way, yet can face unpleasant surprises when encountering system performance that differs from their expectations. Conflict can result in confusion between expected and actual dynamic performance. If operators distrust their trained behaviors, it paves the way for reversion to prior actions that may have been successful in dealing with former systems, but can lead to current disasters. Conflicts should have been overcome during training on current systems.

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<sup>7</sup> Mossberg, Walter S. "Ford Drives Digital Dashboards to Next Level," *The Wall Street Journal*, pp. D1-2, Oct. 7, 2010.

<sup>8</sup> E.g., 14CFR, §§121.407 & 121.409, *inter alia*.

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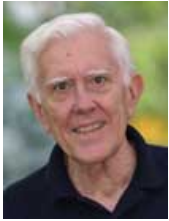
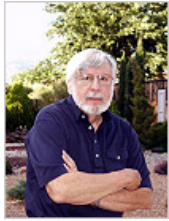
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Nevertheless, simulators have been the most successful method for instilling new, consistent operator behavior requirements quickly and accurately, with minimal risk. Other approaches are also used to try to bring about new behaviors, including recommendations from mishap investigations, supervisory implementation of new procedures; establishing task check lists; safety meetings; table-top exercises; apprenticeships; and changing codes, standards and regulations. Only subsequent real-world experience can demonstrate the reliability of new behaviors when adverse system performance is encountered.


To our knowledge, no training efforts to instill new or modified operator behavior include objective testing to assure that the new habits actually replaced old ones reliably under stress. In fact, we're not sure how you could go about testing that.

In summary, the objective of instilling new behaviors to respond to system operating excursions should not only be restoration of the system to its design performance, but also to avert disasters. If reversion to old habits could result in adverse system performance, training should address that risk.

We don't know how to design behavior changing training or procedures that would overcome inadvertent reversion to prior behavioral responses. If any of our readers have ideas about how that might be accomplished reliably, please let us know so we can share them. In the meantime, system safety practitioners have a challenge to include habit reversion in their system analyses, and bring potential uncertainties to the attention of those responsible for system design, training and project management.

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