VOCAVIO
communication dynamics

Beyond freeze and reset:

Assessing Team Communication Performance in Dynamic Tasks without Interrupting Performance

The Case for Automated Communication Analytics

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J.S. Bresee
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Assessment and Aviation

- Evaluation: A career-long constant
- What we evaluate:
  - Knowledge
  - Intellectual skills
  - Performance
- How we evaluate:
  - Knowledge and Intellectual Skills
    - Method: Written tests and oral examinations
    - Media: CBT, paper, and the instructor
  - Performance
    - Method: observation, review and critique of Individual and crew task proficiency
    - Media: Performance in the simulator and aircraft

Assessing Crew Performance

- Necessarily after the fact
  - Interrupting a task destroys its performance
- Observation, review and critique method needs supporting techniques:
  - Prodigious memory
  - Note-taking
  - Recording

Methods and Issues in Assessing Team Performance

- Method:
  - Prodigious memory
    - Most of us are not nearly good enough
  - Note-taking
    - Diverts attention from performance, even momentarily
    - Necessarily cryptic, incomplete, and useful only as a memory aid
  - Recording
    - Captures aspects of complete performance
    - Must be reviewed and interpreted
- Typically, Final Score has been a judgement call
  - Often non-numeric
  - Never ratio-scale data

Aspects of Flight Crew Performance

- Procedures
  - Checklists
  - Memorized emergency/abnormal procedures
- Operational tasks
  - Flight planning /Flight guidance configurations
  - Aircraft control
- Crew coordination and resources management
  - Communication
  - Shared situational awareness
  - Decision-making

Communication – essential to team performance

- To perform effectively, crews must communicate
  - The more effective the communication, the more effective – and safer - the crew
- Crews interact primarily through speech
  - Within the cockpit
  - Within the aircraft
  - Within the Air Traffic Control environment
- Speech is made up of both verbal and nonverbal elements – Semantic and ***Prosodic.***

Speech Prosody: What is it?

- Significant speech prosodic characteristics:
  - Pitch and intonation contours
  - Voice intensity level
  - Speech rate
  - Speech timing
  - Overlap
  - Turn-taking
- Speakers tend to accommodate the prosodic characteristics to one another when communicating effectively.
- Speech prosodic characteristics can all be measured and numerically represented.
- This happens in any language

Speech Prosody: Unobtrusive and Objective

- Team speech can be recorded and analyzed without interrupting task performance
- Prosodic characteristics are biomarkers: physical phenomena that can be measured directly
- Represented as numerical data, speech signal analysis does not rely on observation or judgment calls for collection.

Application to Flight Crew Training

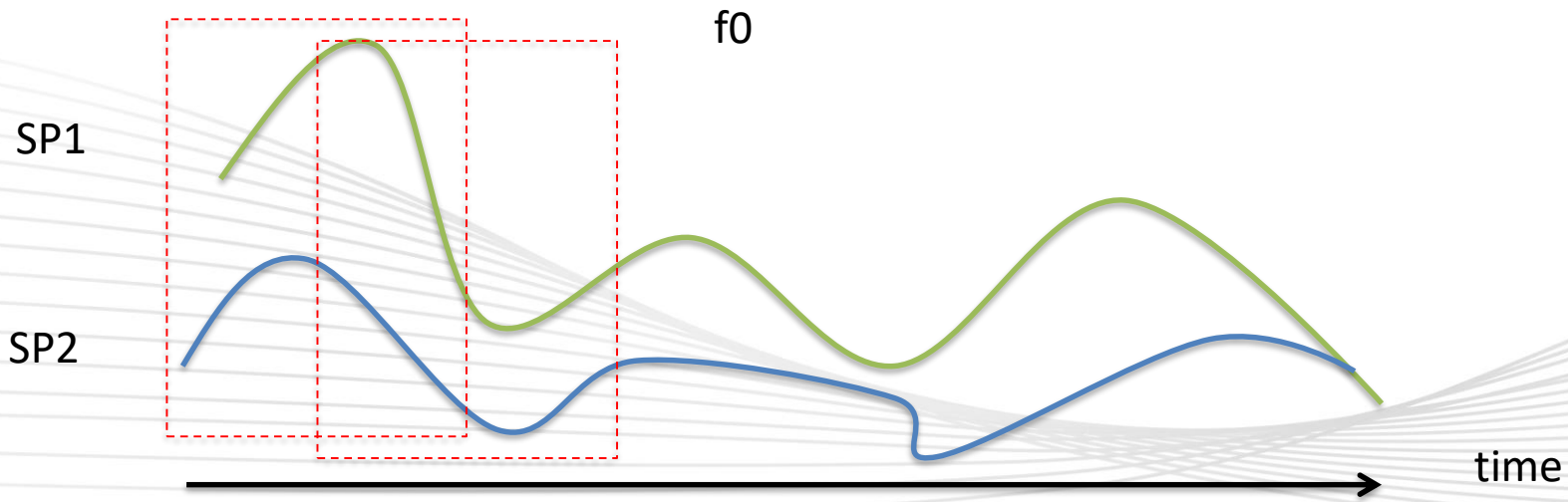
- Directly assesses team interaction
  - Team speech characteristics converge when partners are effectively communicating
  - Diverging speech becomes a reliable event marker
- Uses sounds, not words
  - Language-agnostic
  - Superior accuracy
  - Noise-tolerant
- Speech is converted to data
  - Can be fully de-identified
  - Team member confidentiality is maintained

Implementing the Technology – How Does It Work?

- Crew speech is recorded to two channels using headset or lapel microphones
- Software tools process digital recordings or crew speech
- Tools strip away the words, save only the prosodic measures
- Results delivered via instructor dashboard for use in debriefing.

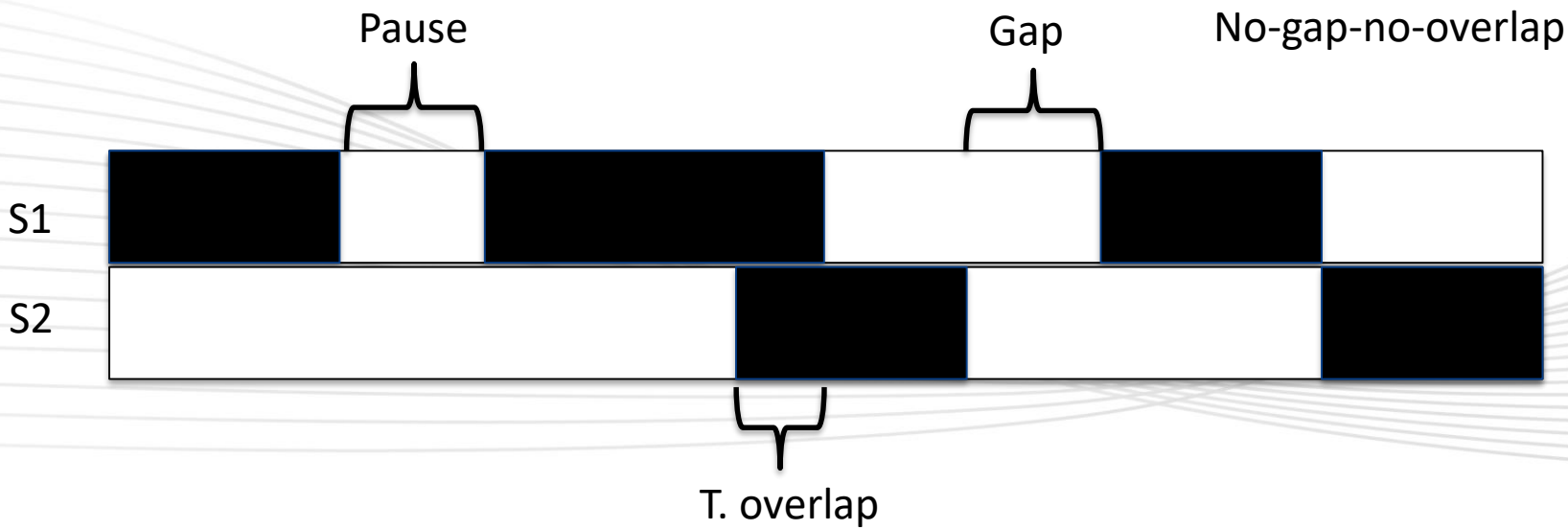
Prosodic feature extraction

- Prosodic adaptation *(De Looze et al, 2014)*
  - Features: pitch, energy, tempo
  - Tracks the correlation between f0 median values of two speakers with a moving window



Speech feature extraction

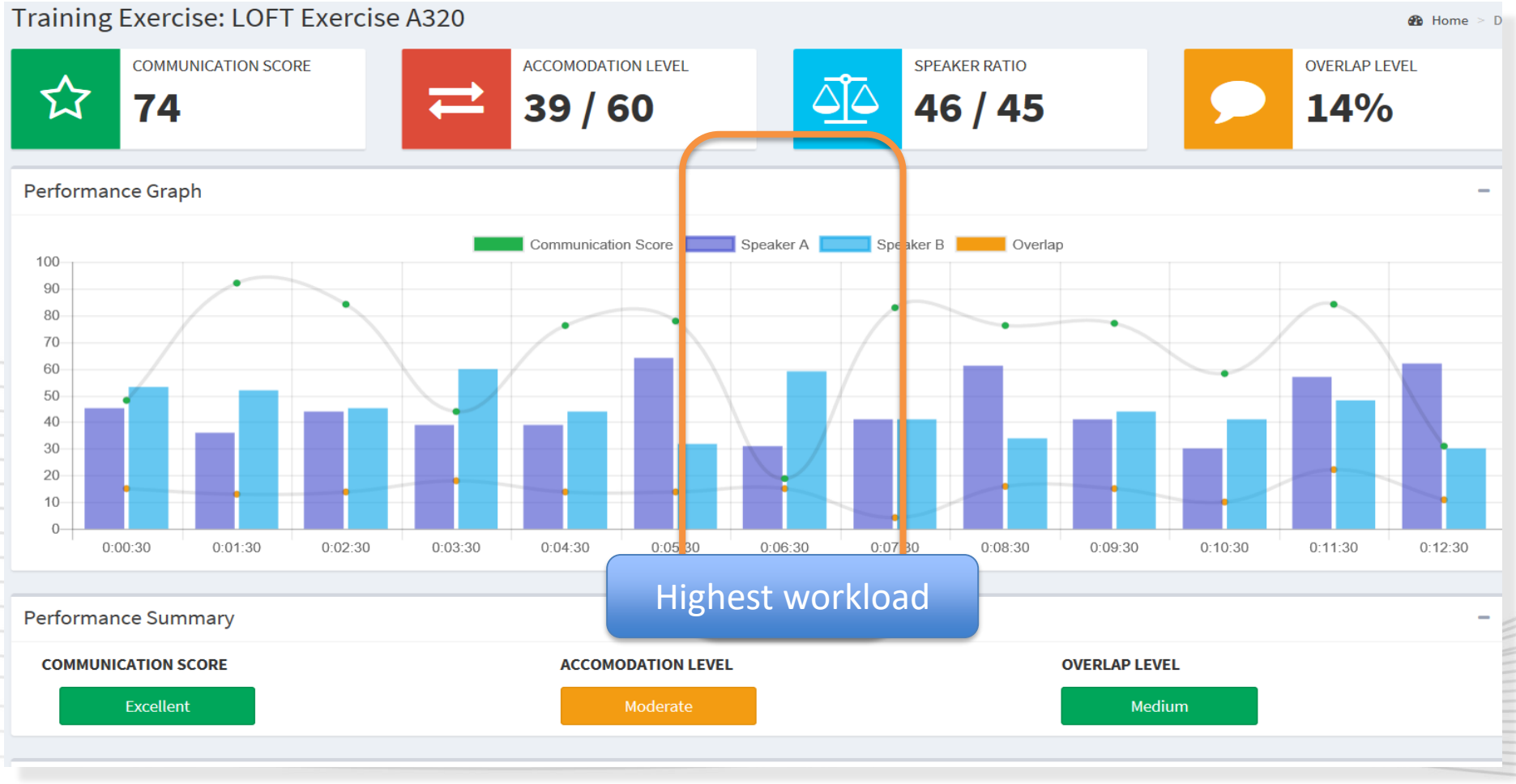
- Turn-taking temporal features
  - Amount of time talking/ silent/ overlap
  - Number and duration of pauses, gaps, T. overlaps, speech units, turns



Speech Prosodic Analysis for Performance Assessment:

- ✓Directly assesses team interaction
- ✓Unobtrusive
- ✓Does not interrupt performance
- ✓Generates numerical, scalar data
- ✓Applicable to both training and operational environments

Results, Implications and Applications

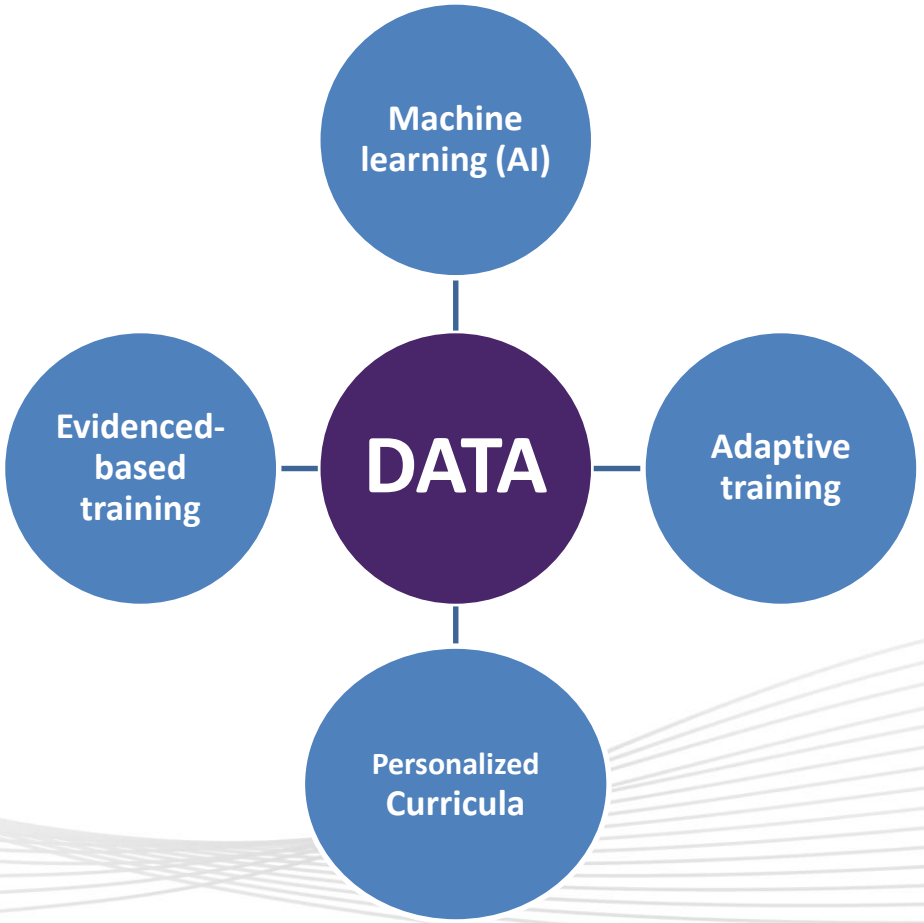


Sample use case – A320

Sample use case – tactical aircraft

The Path Ahead

- Gather speech signal data, other bio-signal data and associated flight data in significant quantities
- Apply Big Data techniques to identify useful trends for assessment-driven adaptive learning
- Support evidence-based assessment and training of crew communication skills
- Deploy AI to account for cultural nuances in communication.



About Vocavio

- Speech technology company with offices in Dublin and Washington DC.
- Focus on integrating speech analysis tools to augment simulation experience
- Strong technology development and academic team with significant expertise in emerging technologies, speech science and neuroscience
- Deployed in air and land training systems
- Patented technology (US, EUR, CAN) that was initially developed and validated at Trinity College Dublin *(with assistance of military and commercial pilots)*
- Industry achievements
  - Modsim entrepreneur award 2016 by NDIA (Virginia Beach, USA)
  - Top 20 UK Cloud technology company 2016 & 2017 (Clearwater M&A, UK)

Contact us

VOCAVIO
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United States & Canada

Jerry Bresee
Jerry@vocavio.com

Europe, Middle East, Africa.

Conor Mc Kenna
Conor@vocavio.com

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Technology options for integrating speech analytics

vLAB	• Webtool for your research phase
vConnect	• API to integrate into your virtual or physical simulation experience
vSIM	• On-premise solution for simulators
vSENSE	• EDGE solution for connected vehicles