MEET US AT

TEAMING AT THE EDGE
JOINT COGNITIVE SYSTEMS

NDIA

Credit: U.S. Air Force photo/Staff Sgt. Samuel Morse

15- 16th June

NDIA 2022 *Human Systems Conference*

George Mason University, Arlington VA

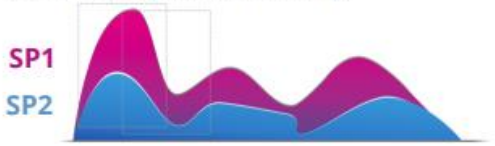
VOCAVIO technologies

MEASURING RESILIENCE IN TEAM COMMUNICATION SKILLS REMOTELY USING VR

Mr Conor McKenna, VP Product Engineering / Founder, Vocavio
Mr. Jerome Bresee FRAeS, VP Human Systems, Vocavio

Introduction

Vocavio, together with teammates PlayerThree and Affect In, developed and tested a VR based environment that placed various teams in a virtual C130 performing an unfamiliar loadmaster-flight engineer task requiring actions coordinated through voice communication only.



Prosodic adaptation

(De Looze et al, Trinity College Dublin 2014)

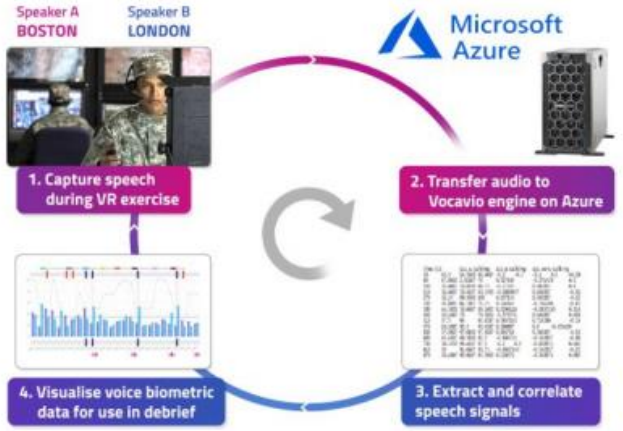
- Features: pitch, energy, tempo
- Tracks the correlation between median values of two speakers within a moving time window.

US PATENT #101528992

VOCAVIO
communication d

Technical process

Vocavio engine, which extracts and coorelates signal values from collaborative dialog (and not signals from wolves, yet), was used to evaluate communication, teamwork and situational awareness through measurement and analysis of speech characteristics and task performance data (control events) sourced from the game engine logs.



Performance Data

LEVEL	DROP ACCURACY	SA	TEAM	COMMS
1	.82	.47	.99	.50
2	.85	.65	.97	.47
3	.73	.28	.94	.51

Conclusions

Derived measures of situational awareness and resilience were shown to increase as number of trials increased. While these findings show promise in a research setting, future research is needed under field conditions to assess the impact of field stressors on teamwork, situational awareness and resilience as measured by communications data.

Acknowledgments

UK Defense
PlayerThree VR Studio
AffectIN Cognitive Science

Acknowledgment

Mr. Jerome Bresee FRAeS

Advisory board member - Vocavio

- Training industry professional with 40-year career in systems design and development with a focus on aviation and similar high-risk/high-cost tasks and professions.
- Jerry has supported a range of civil and military flight training programs.
- He has worked and published in courseware development, simulator functional design, job and task analysis, performance assessment and total training system design.
- His work helped shape the FAA's Advanced Qualification Program and flight data monitoring voluntary safety programs.
- Fellow of the Royal Aeronautical Society FRAeS.

What you will hear about today

1. Signals /Cues and their role in communication.
2. Provenance for this technology (TCD)
3. TeamDX loadmaster; remote multi-crew VR training tool.
4. How ‘derived metrics’ are generated from signals and game log data.
5. Lessons learned


```
{
"sessionId": "3/72",
"globalScore": 56.97850096258018,
"globalScoreGrade": "Good",
"teamScore": 55.55261687463227,
"teamScoreGrade": "Good",
{
"time": 20.0,
"communicationPerformance": -0.28988551782622409,
"pilotASpeaking": 17.916666666666669,
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"overlapPercentage": 4.166666666666667
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```

Signals and Communication

Naturally occurring phenomenon in human dialog.
We adapt to each other to convey a message.

Biometrics is the measurement and statistical analysis of people's unique physical and behavioural characteristics

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How it started - 2012

How its going - 2022

+Maritime
+Helicopter
+Fastjet
+Vehicle
+Medical

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Extracting and correlating signal values

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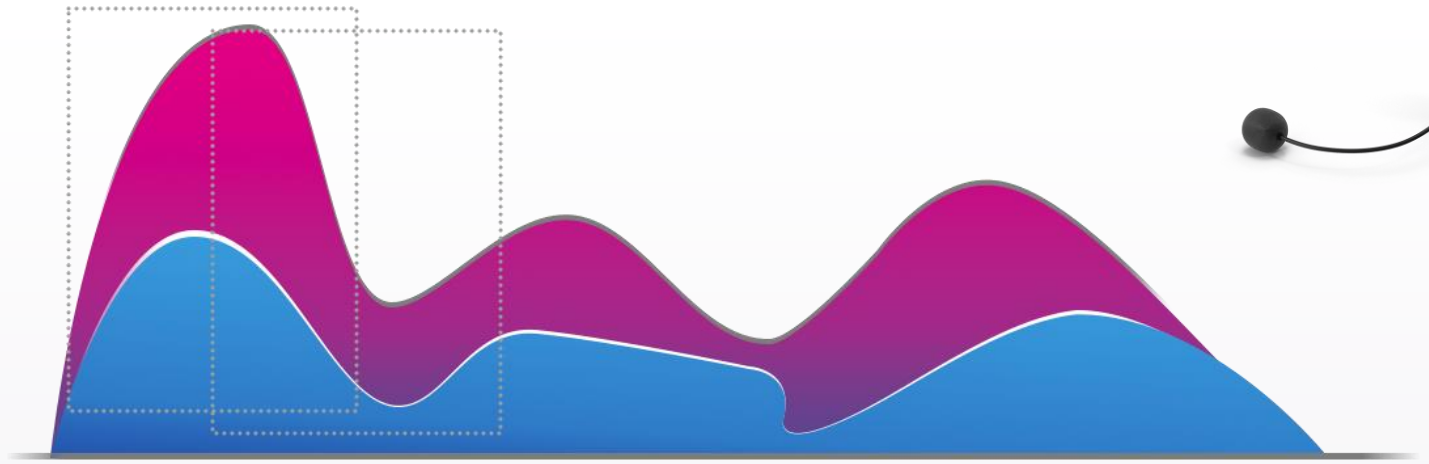
The how

- Extract Features: pitch, energy, tempo (signal values)
- Tracks the correlation between median values of two speakers within a fixed or moving time window



US PATENT #10152899B2

CAN PATENT #2919762

- **Behavioural indicators**
- **Mitigate risk**
- **Provide assurance**

Trinity College Dublin
The University of Dublin

Using VR to remotely measure resilience

Project requirements

- Remote access (multiple team member locations)
- Accessible VR device (Oculus)
- Develop 3 critical competencies
  - Communication
  - Teamwork/coordination
  - Situational awareness **
- Data driven debrief/ AAR
- Variable levels of task load
- Coaching component (AI)

unity

oculus

Microsoft Azure

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Development Partners and Technologies

VOCAVIO technologies

playerthree

VOCAVIO technologies

AFFECT IN Human Sciences

Microsoft Azure

unity

oculus

Tasks and new dervived metrics

The task:

- A two-person crew must prepare and drop cargo packages.
- Packages must
  - include specific contents
  - be within weight limits
  - be loaded within a time limit
  - be dropped at a specific point in time.
- **The cargo drop requires simultaneous control actions coordinated by voice.**
- Be situational aware to changes in the drop schedule / aircraft height (on the fly)


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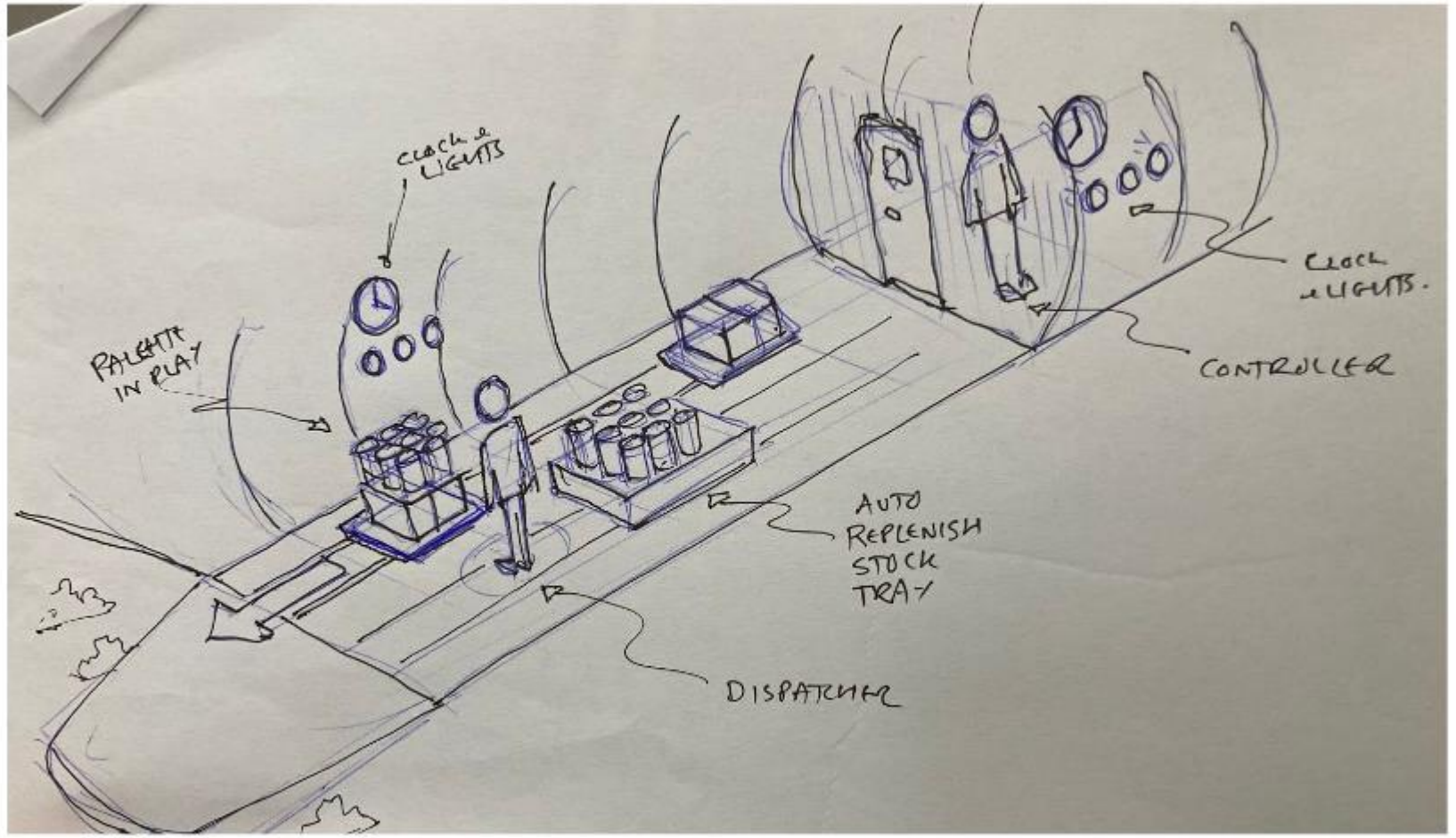
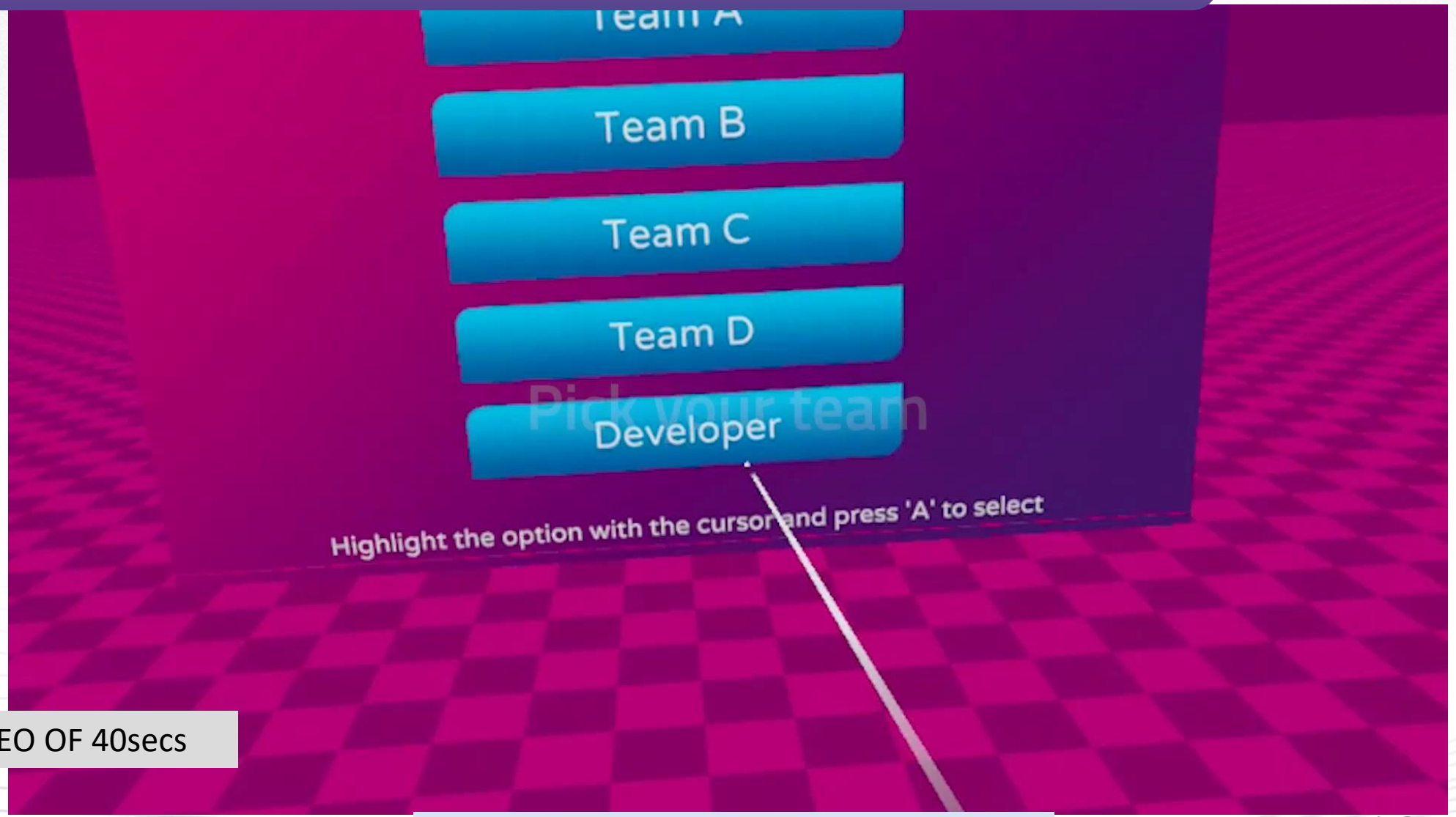
Vocavio engine outputs + Game performance log data = Derived performance metrics

Designing for measurable resilience



Showcase VR tool to develop resilience



VIDEO OF 40secs

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How performance data is generated

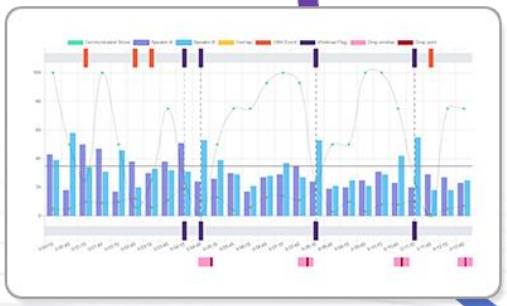
Speaker A
BOSTON

Speaker B
LONDON

Microsoft Azure

1. Capture speech during VR exercise

2. Transfer audio to Vocavio engine on Azure



time (s)	SIG.A.talking		SIG.B.talking		SIG.Words.talking	
30	62.5	34.5833	66.6667	-0.2	-0.1	0.5
90	67.0833	2.91667	70	0.927634	-0.371429	0.2
150	51.6667	20.8333	68.75	-0.27429	0.942857	0.6
210	31.6667	35.4167	63.3333	-0.0809657	0.142857	-0.31
270	51.25	99.5833	100	0.657143	0.942857	-0.02
330	46.6667	84.7667	71.75	0.144983	-0.314286	-0.82
390	44.5833	56.6667	69.1667	0.0294118	-0.0857143	0.314
450	20.1667	75	79.5833	-0.579771	0.142857	0.028
510	37.5	95	95.4167	0.0857143	0.714286	-0.14
570	18.1667	92.5	95.4167	0.260487	0.4	-0.371429
630	37.9167	97.0833	97.9167	0.885714	0.542857	-0.52
690	40.4167	89.5833	92.5	-0.695725	-0.542857	-0.88
750	38.3333	95.4167	97.5	-0.2	-0.828571	0.142
810	30	96.6667	93.75	-0.0857143	-0.542857	-0.25
870	39.1667	92.9167	94.5833	0.428571	-0.428571	0.085

3. Extract and correlate speech signals

4. Visualise voice biometric data for use in debrief

We separate speech communication and speech signals to determine levels of accommodation, energy and interaction.

We generate data relating to communication performance during the task.

We specifically focus on examining accommodation levels in pitch, rhythm, tone and energy.

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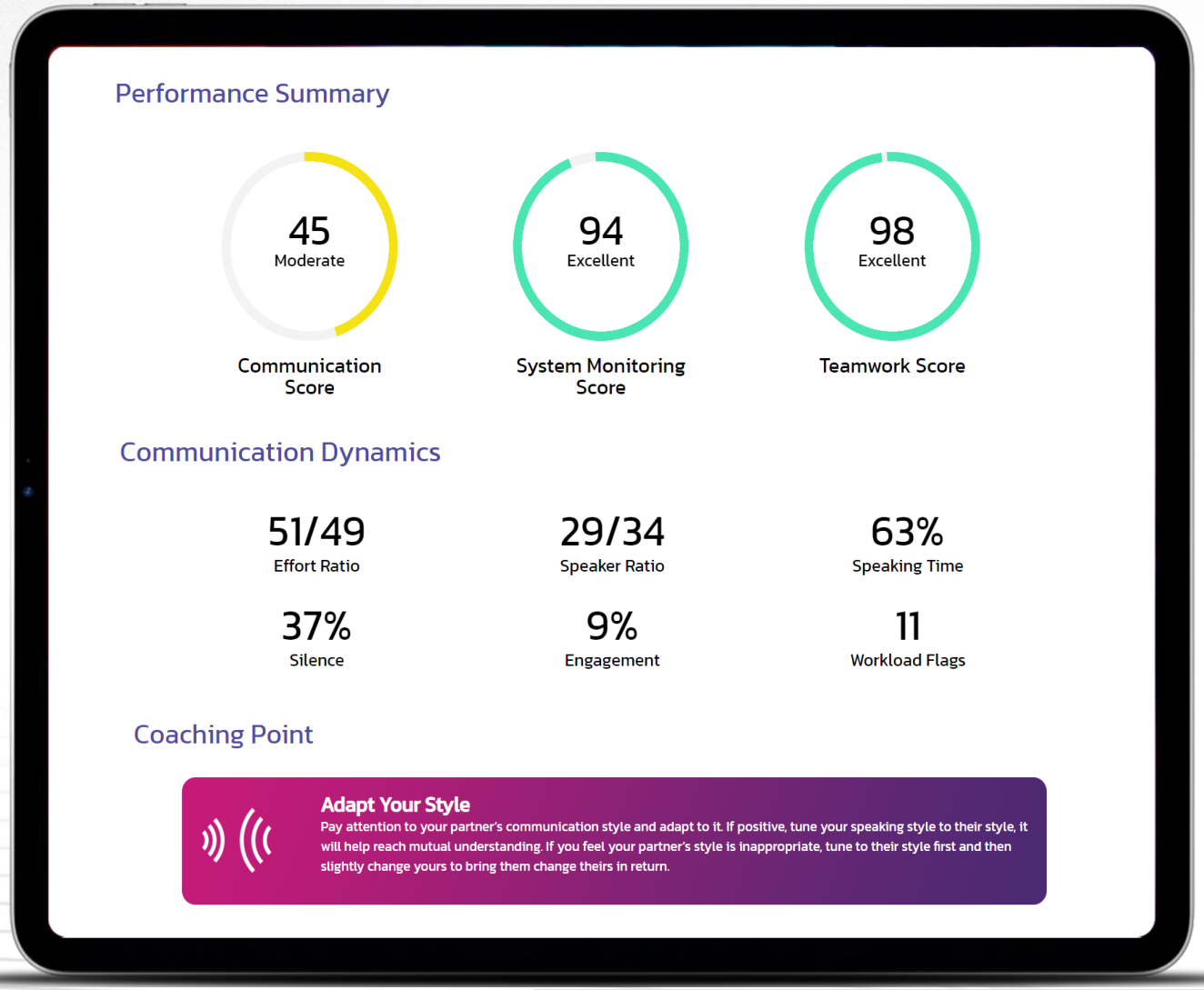
Automatically generated debrief



Crew can only function with effective communication

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powered by TeamDX

After Action Review
Team Communication Debrief

Team One / Player A / Level 1

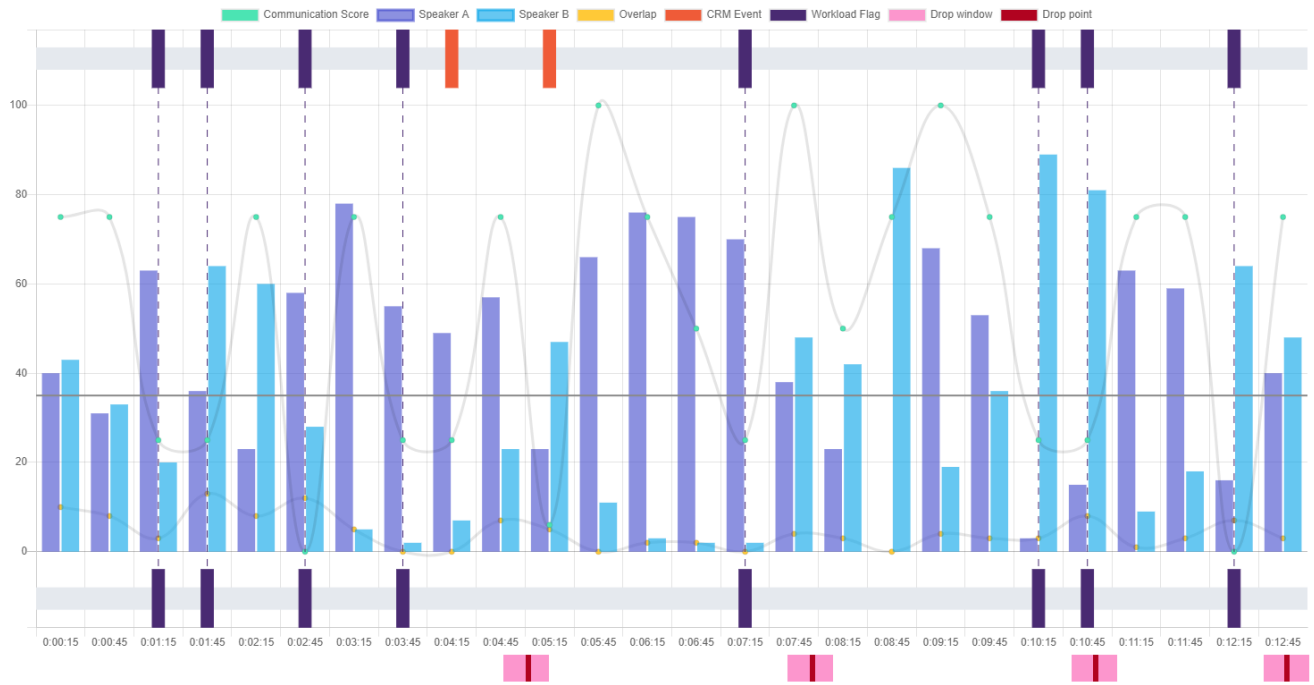
Performance | Action Data | Leaderboard

Drop Performance Metrics

	PARCELS DROPPED		PALLET RELEASE TIME (%)
DROP 1		7/7	
DROP 2		10/10	
DROP 3		8/12	
DROP 4		5/12	

26406
Total Score

Team Communication and Drop Timeline



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What are derived metrics ?

The task:

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Vocavio engine outputs + Game performance log data = Derived performance metrics

Resilience developing? Here's the data

Vocavio engine data (json)

Name	Value	Value	Value
sessionId	26/1613	26/1614	26/1615
globalScore	50.29868761	46.56732133	50.77639792
globalScoreGrade	Moderate	Moderate	Moderate
teamScore	49.21130985	44.74688779	46.84689591
teamScoreGrade	Moderate	Moderate	Moderate
teamAccommodation	0.005973752	-0.068653573	0.015527958
accommodationScore	1.182390399	2.212978281	15.44098606
accommodationScoreGrade	Excellent		
pilotABalance	49.408804		
pilotBBalance	50.591195		
globalSpeaking	43.8133445		
globalListening	56.1866554		
globalTalkingA	16.550327		
globalTalkingB	29.1571442		
overlap	1.89412758		
overlapGrade	Low		

Game log data (pts systems)

expected_drop_time"":300.0 actual_drop_time"":301.3611 lever_time_offset"":0.7383423 points"":6809}

expected_drop_time"":300.0 actual_drop_time"":304.64672 lever_time_offset"":0.174560547 points"":5442}

expected_drop_time"":300.0 actual_drop_time"":300.27954 lever_time_offset"":0.751709 points"":6961}

expected_drop_time"":300.0 actual_drop_time"":301.044 lever_time_offset"":0.377349854 points"":7833}

239.31942 lever_time_offset"":11.5661926 points"":7891}

102.54174 lever_time_offset"":1.77453613 points"":6745}

299.88208 lever_time_offset"":0.2987671 points"":6983}

Level	Drop Accuracy	SA	TEAM	COMMS
1	82%	47%	99%	50%
2	85%	65%	97%	47%
3	73%	**28%**	76%	51%
Av	80%	47%	94%	49%

Sample Insight: The performance of the crew deteriorates in some key competencies of system monitoring (SA) and teamwork, but communication improves even when more stress, workload and pressure is applied.

Findings & Lessons Learned

- **VR devices;** not all devices store, transfer, process audio the same way.
- **Pilot test** an early version
- **Gather more data from** a bigger population of trainees and validate against human factors frameworks e.g. NasaTLX / SART.
- **Reinforce collaborative tasks** to avoid an individual going solo in solving problems (and not talking)
- **Compare results** achieved against other training data available from instructors/observers.

THANK YOU

Any questions?

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