Providing Objective Metrics of Team Communication Skills via Interpersonal coordination Mechanisms : A pilot study

Céline De Looze, Brian Vaughan, Finnian Kelly, Alison Kay
deloozec@tcd.ie
CrewFactors Ltd. / Trinity College Dublin

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Ireland's EU Structural Funds Programmes 2007 - 2013
Co-funded by the Irish Government and the European Union

crew FACTORS training analytics

Introduction

* Team communication skills highlighted as a core challenge in the operation of aircrafts, maritime vessels, medical interventions

* Ability to work with partners of a team enhances information exchange and improves team effectiveness and cohesiveness

Campione et al, 1996; Leonard et al (2004)

Introduction

* Increasing communication skills training programs in aviation (e.g. Crew Resource Management)

* Airline pilots required to have technical knowledge and non-technical knowledge (e.g. effective communication to operate in mission-critical environment)

* Avoiding operational errors due to a lack of understanding or communication deterioration

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Introduction

* What to evaluate?

Team performance

Behavioural, cognitive and affective processes

Team effectiveness

Result, success, outcome of the performance

Rosen et al, 2010

Introduction

* What to evaluate?

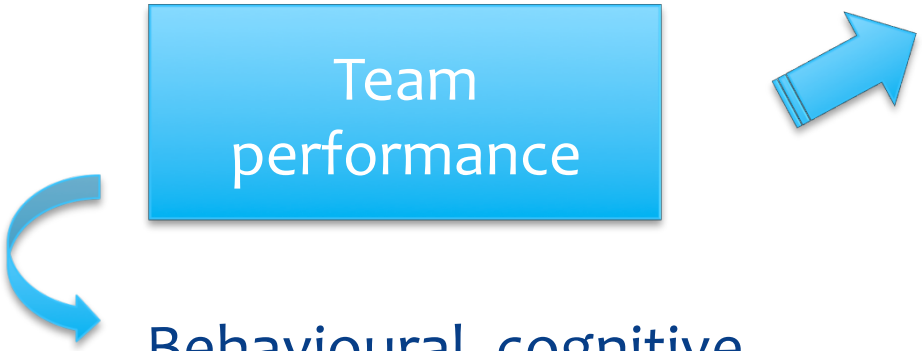
Team performance

Dynamic adjustments, coordination, cooperation between team partners

Behavioural, cognitive and affective processes

Introduction

* What to evaluate?



**Objective means

Interpersonal coordination

* Coordination mechanisms

Turn-taking organisation	Speech Adaptation
Who / When Speaks, listens, Takes / holds turn	*... to the interlocutor's speech style (convergence, synchrony, alignment)*

For a review. De Looze et al (2014)

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Interpersonal coordination

* Coordination mechanisms

Mutual understanding

Engagement, affinity

For a review. De Looze et al (2014)

Interpersonal coordination

* Coordination mechanisms

Mutual understanding

Engagement, affinity

Require cognitive, linguistic, physiological and psychosocial skills

For a review. De Looze et al (2014)

Interpersonal coordination

* Coordination mechanisms

Mutual understanding

Engagement, affinity

*** Deficit**

(e.g. stress/ linguistic knowledge)

Require cognitive, linguistic, physiological and psychosocial skills

For a review. De Looze et al (2014)

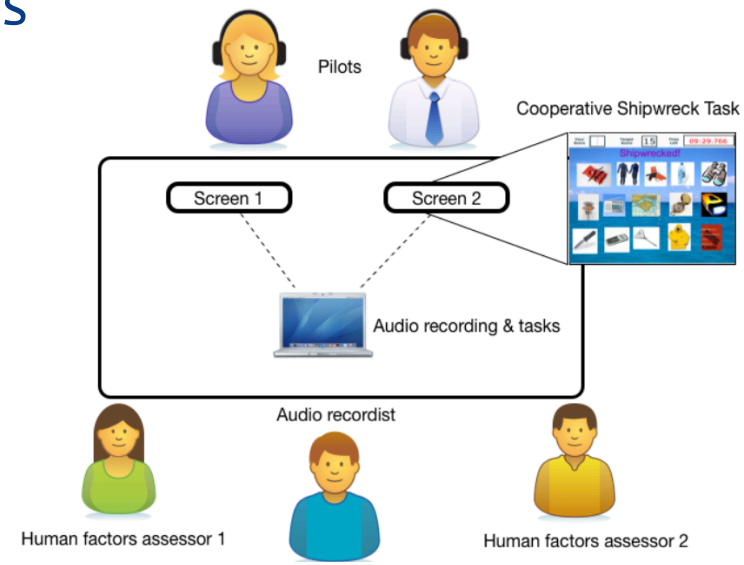
Objectives

* Exploring the relation between coordination mechanisms (turn-taking organisation and prosodic adaptation) and airline pilots' communication skills

* Comparing dynamic model of interpersonal coordination mechanisms with Human Factors method for measuring communication skills, adaptability and teamwork

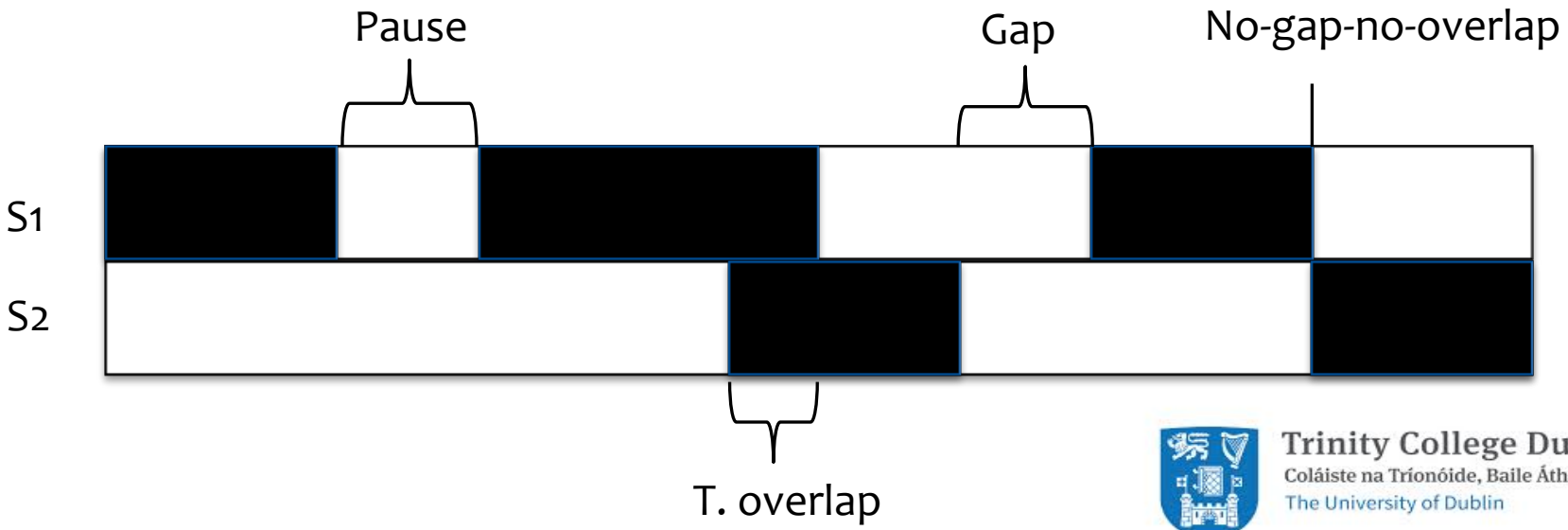
Method

* 12 airline pilots (IALPA, Irish Airline Pilots' Association)
* Shipwreck scenario game (10 minutes)
* Assessed by two human factor researchers on their CRM skills



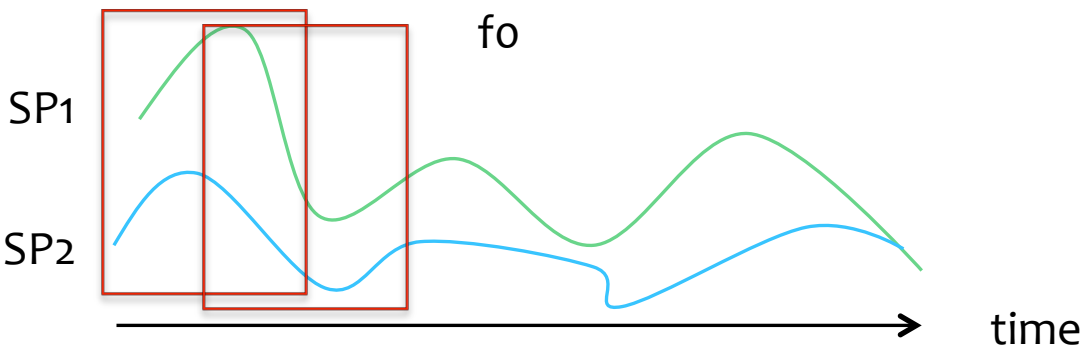
Feature extraction

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



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



CRM annotation

* CRM skills : cognitive and interpersonal skills that pilots need to manage the flight operations on the flight deck
* **Coordination Demand Analysis (CDA)**

Centre for Human Innovative Systems, TCD; cf. Kay et al 2014

CRM annotation

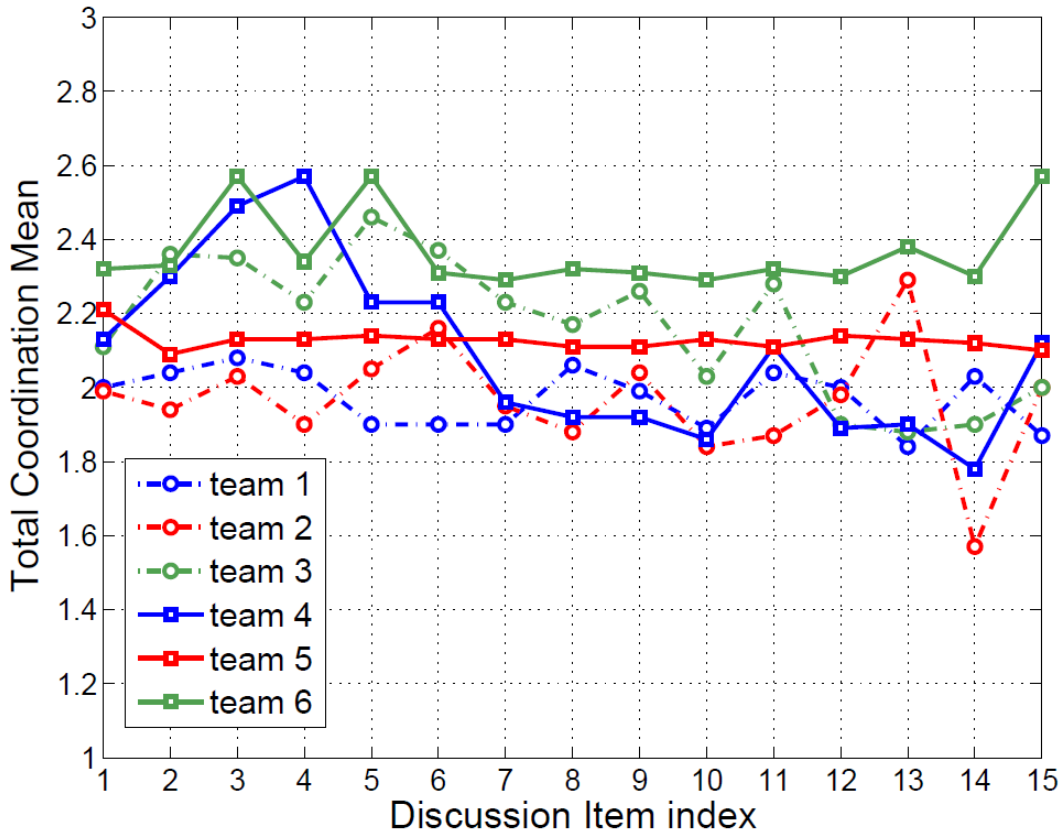
* CRM skills:
- **Communication (Comm)**,
- Situational Awareness, Decision Making,
- Mission Analysis, Leadership,
- Adaptability, Assertiveness,
- Global Score: **Total Coordination Mean (TCM)**

-> per item discussed and globally

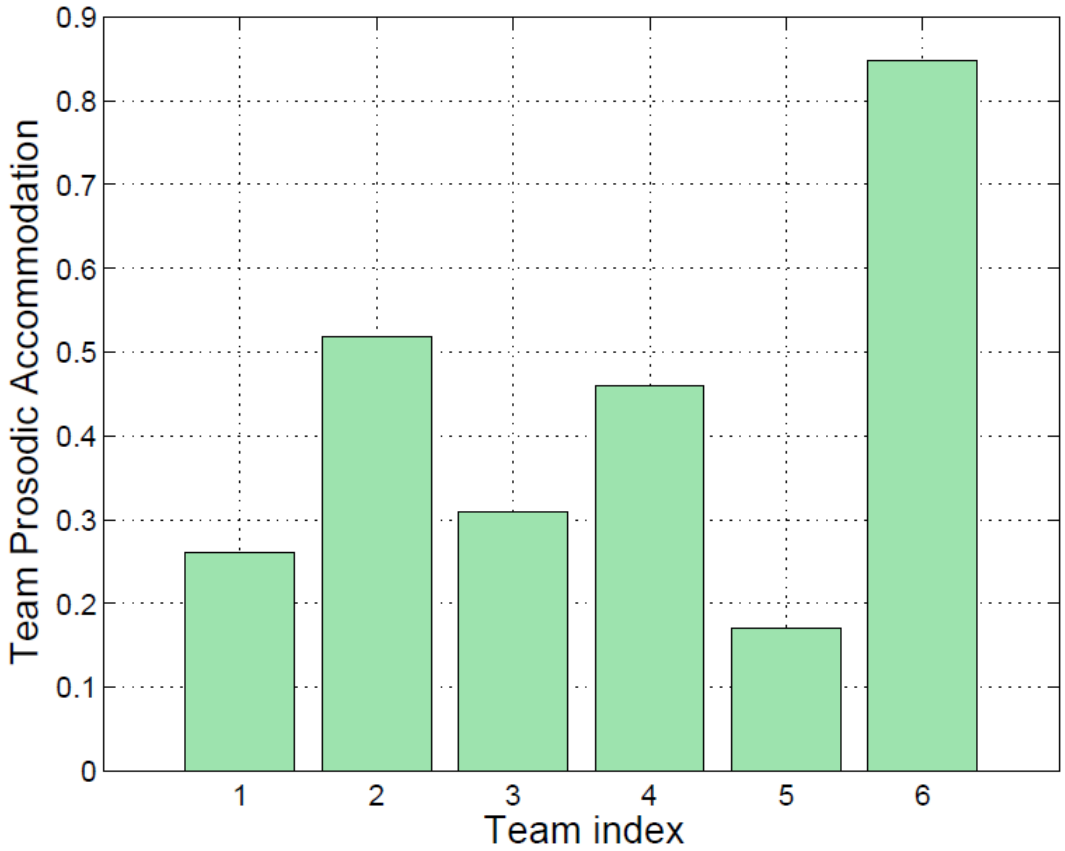
-> Likert scale : 1-Low, 2-Mid, 3-High

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Example of CRM data
Total Coordination Mean (TCM)

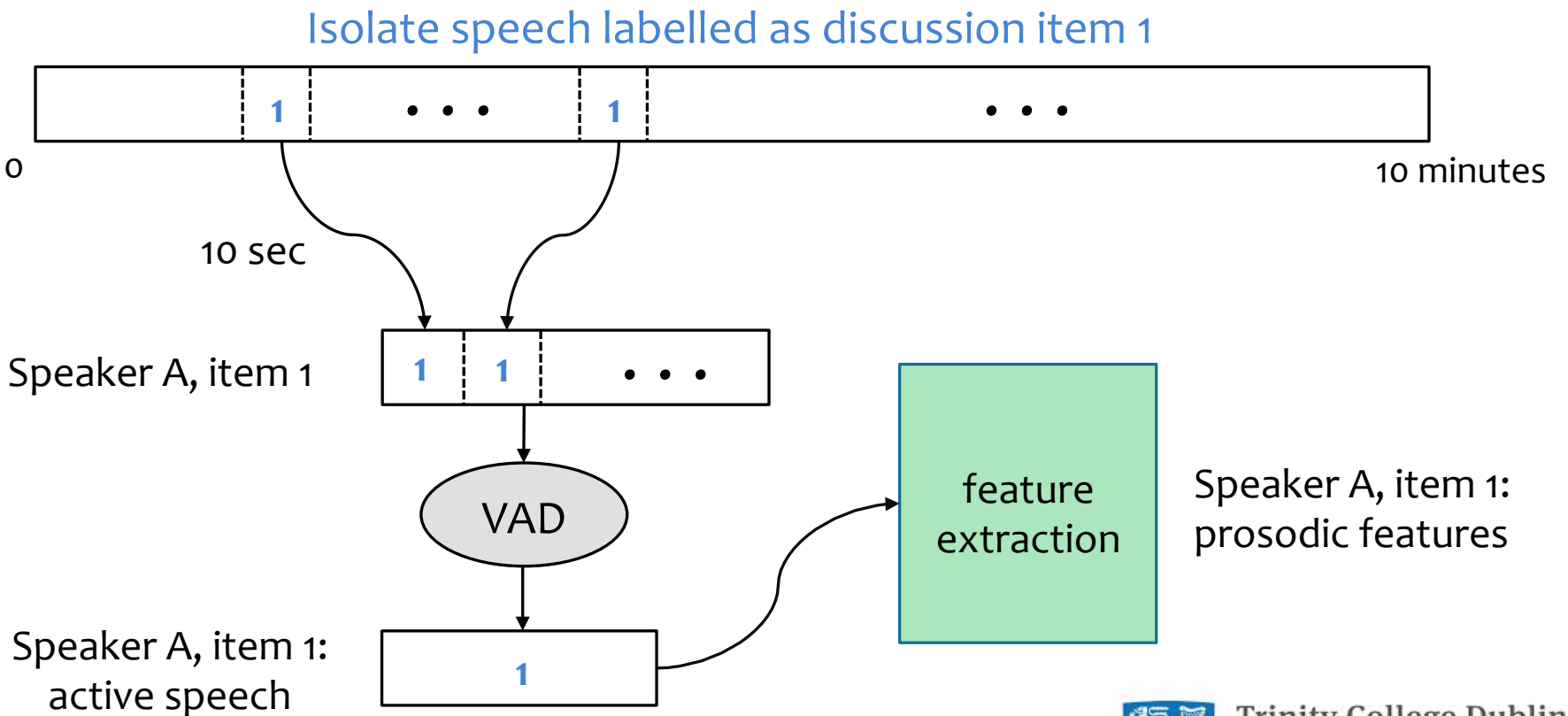


Example of prosodic features: Pitch Adaptation

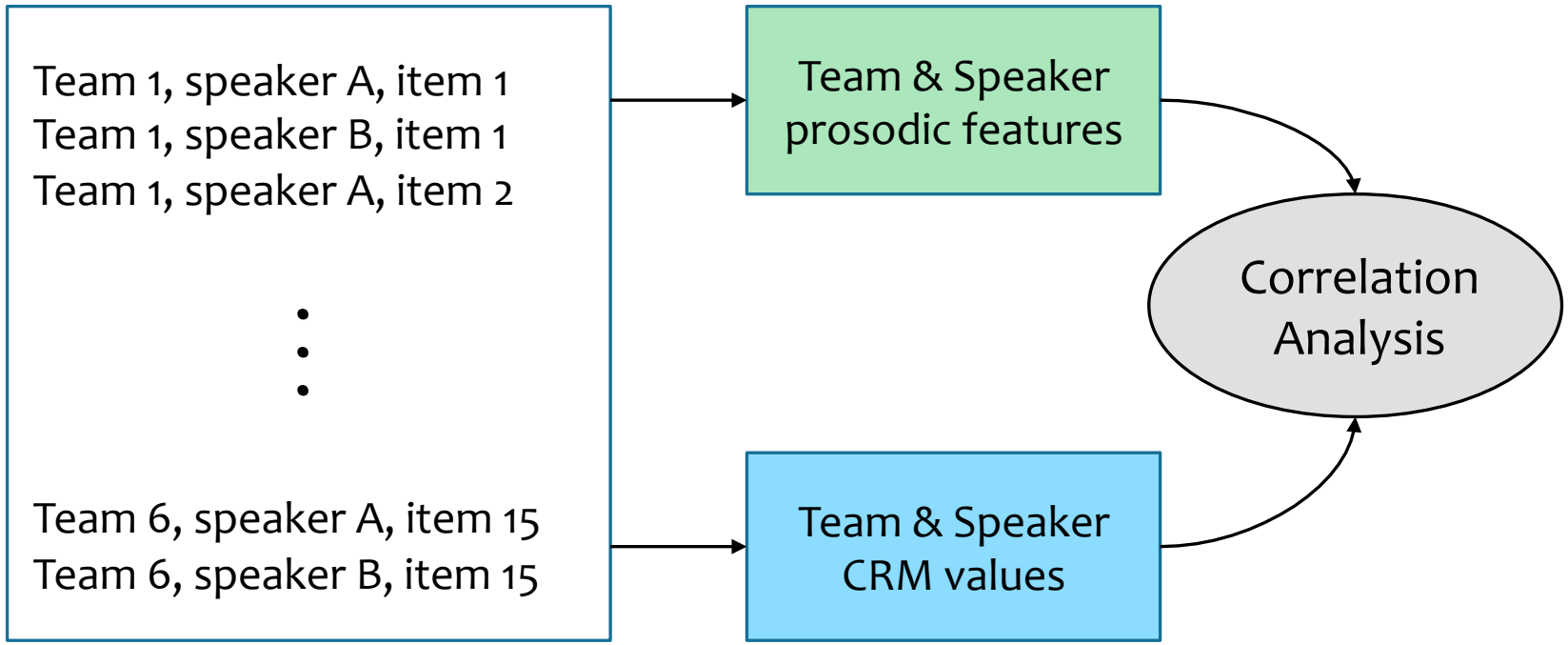


Comparison of prosodic and CRM features

Example: recording of Team 1, Speaker A



Comparison of prosodic and CRM features cont.



Correlation Analysis

Spearman Rank correlation between corresponding prosodic and CRM features:

	PA	TLK	OL
Comm	0.73	0.64	0.71
TCM	0.70	0.63	0.75

- Statistically significant (two-tailed T-test, α=0.05) correlations in red
- Sample size = 9 (due to minimum duration requirement of 30 seconds post-VAD)
- However, samples based on long-term averages -> number of 10 sec speech 'chunks' >> 9

Discussion

* New quantitative speech-based approach for objectively assessing communication skills of team members via interpersonal coordination mechanisms

* Limits : Data sample, number of CRM evaluators, CRM Likert scale, other speech features

* Application: Assessment of team communication in high-stress environment (aviation/ medicine)

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Thanks & Acknowledgments

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Ireland's EU Structural Funds Programmes 2007 - 2013

Co-funded by the Irish Government and the European Union

References

* M. Campion, and E. Papper and G. Medsker, "Relations between work team characteristics and effectiveness: A replication and extension," *Personnel psychology*, vol. 49, no. 2, pp. 429–452. Wiley Online Library. 1996.
* M. Leonard and S. Graham and D. Bonacum, "The human factor: the critical importance of effective teamwork and communication in providing safe care," *Quality and Safety in Health Care*, vol. 13, no. 2, pp. i85–i90. BMJ Publishing Group Ltd. 2004.
* M. A. Rosen, and S. J. Weaver, and E. H. Lazzara, and E. Salas and T. Wu and S. Silvestri, ... and H. B. King, "Tools for evalu- ating team performance in simulation-based training," *Journal of Emergencies, Trauma and Shock*, vol. 3, no. 4, pp. 353, 2010.
* C. De Looze and B.Vaughan and S.Scherer, "Investigating automatic measurements of prosodic accommodation and its dynamics in social interaction," *Speech Communication*, vol. 58, pp. 11–34. Elsevier. 2014.
* A. M. Kay and P. Liston and S. Cromie, "Measuring Crew Re- source Management: Challenges and Recommendations," *Proceedings of Engineering Psychology and Cognitive Ergonomics - 11th International Conference, EPCE 2014, Held as Part of HCI International 2014*, pp. 22–27. Heraklion, Crete, Greece. 2014.
* T. Kinnunen and H.Li, "An overview of text-independent speaker recognition: From features to supervectors," *Speech Communication*, vol. 52, no. 1, pp. 12–40. 2010.
* R.L. Helmreich and H.C. Foushee, "Why CRM? Empiricaland Theoretical Bases of Human Factors Training," *Kanki, B., Helmreich, R. and Anca, J. (2010) Crew Resource Management*, 2nd Edition, Elsevier, San Diego, U.S. 2010.