

The research leading to these results has received funding from the European Community's Seventh Framework Program (FP7/2007-2013) under grant agreement no. ICT-2011-287760

# THE DIGITAL TEMPEST



Superfast Cornwall Researcher Networking Day  
Plymouth 4<sup>th</sup> November 2014

Erik Geelhoed, Doug Williams, Ian Biscoe, Phil Stenton





DogBite - DogHouse Studio  
Superfast: 19/79  
Aprox: 7.5x6m (seating) + 7x5m (stage/infinity screen)



As engineers/researchers  
Josh: Camera Orchestration  
Dan: Audio and video  
Sam: Audio  
Andy: Tech-testing



DiGiTAL  
MiRacle

Additional photo's  
Kirstin Prisk



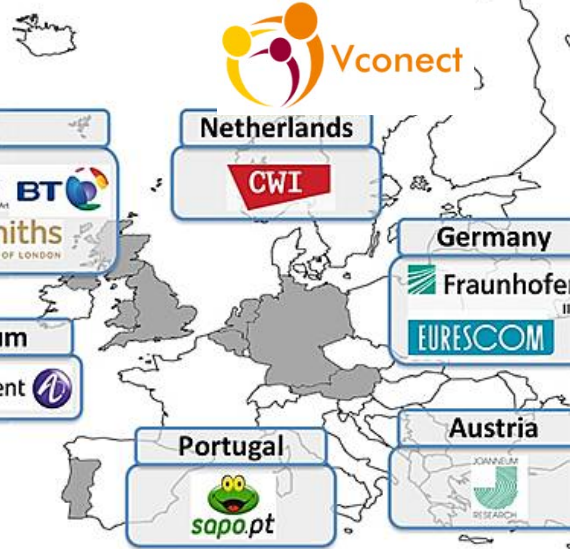
National maritime museum  
CORNWALL  
Maritime Museum - Learning Centre  
Superfast: 19/79  
Aprox: 14x10m

# Overview

- Vconnect – Connected Performance Spaces
- The Opportunity
- Prior art & research – whistle stop tour
- Digital Tempest
  - Process
  - Vconnect Technology
  - Audience research
- Conclusions
- On-going activities & Next Steps
- Video Clips of the Performance

# Vconnect: Connected Performance Spaces

Three Years STREP (4M Euros)



- Two strands: Video communication embedded in social media &
- A/V Connected performance spaces
- Service Aware Networks
- Studios, Village halls, Cinemas, Home
- Teaching, rehearsals, performances
- **Beyond National Theatre live**
  - Low cost, interactive



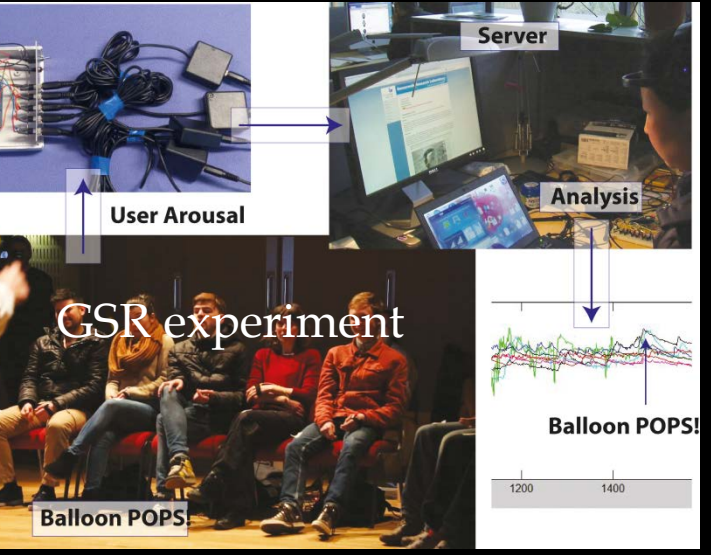
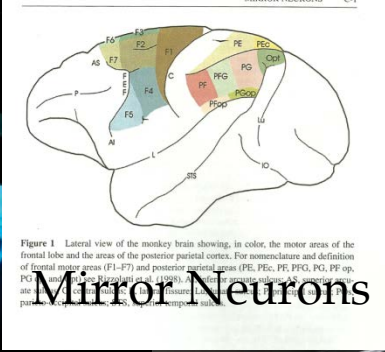
# The Opportunity

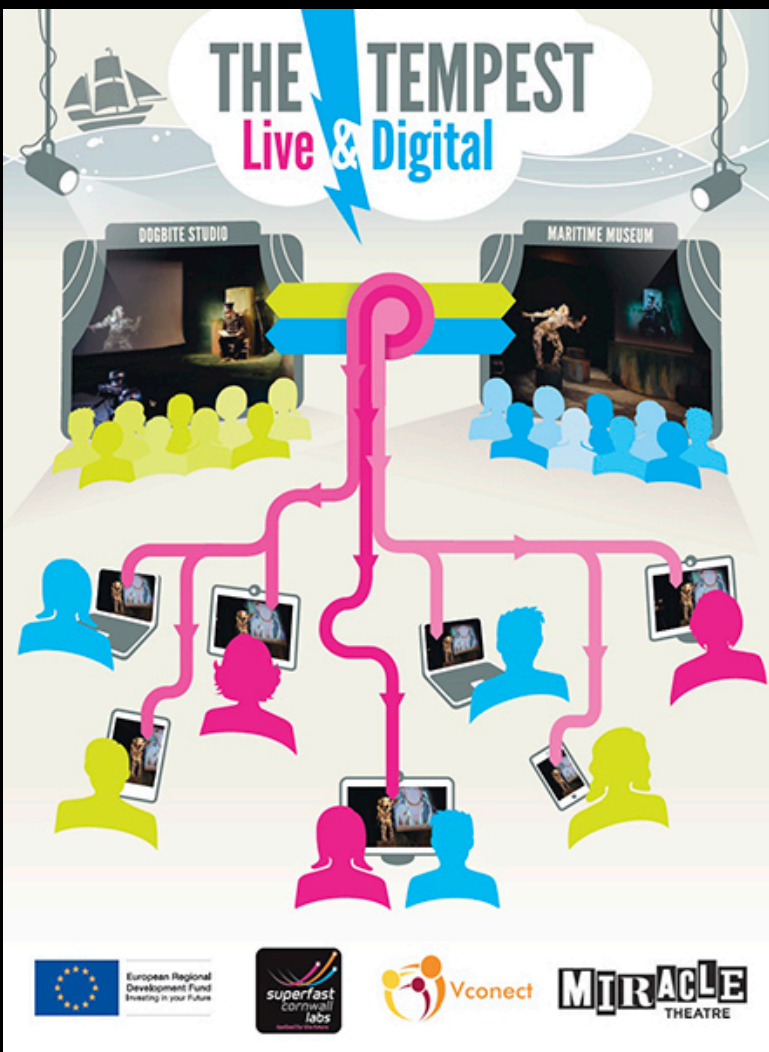
- Where the money is
  - Streaming live performances is a growing area (NT Live, NY opera)
    - Audiences pay
    - Extends brand
  - Interactivity remote audiences with theatre of origin is still poor
    - Multiply & Engage your live (remote) audiences (laugh instead of smile)
    - Sense of community / excitement of live-ness
    - Also for TV (e.g. sport, beyond social media)
- Where we can learn something
  - Last two decades of distributed performances
    - **Immersive Design** – producers, set designers, audio, lighting
    - Often bespoke and/or expensive solutions
    - Low cost/pervasive solutions => poor quality
    - No money to be made
- This Experiment – The Digital Tempest
  - Showcase for Vconnect Technology
  - Exemplar of how such technologies could be applied



# Previous Research: Whistle Stop Tour

- Telepresence research at HP labs Bristol
  - Halo: HP + Dreamworks
    - Telepresence: how you come across in (synchronous) mediated communication
    - Film discipline (light, cameras, audio, **immersive design**) as important as Technology
    - Conversational Analysis
    - Mirror Neuron theory (same pre-motor cortex neurons firing in making & perceiving movement/posture/facial language)
- Extended Theatre
  - HP labs, Bristol Old Vic, Pervasive Media Studio
    - Comparing Live, Edited with wearable POV cameras and home viewing (latter a lesser experience)
- Literature Review – Connected Performance Spaces
  - E.g. Steve Dixon, Susan Kozel (Telematic Dreaming, 1993)
    - **Immersive Design**
- Vconnect Performance Research: Getting Closer
  - **Immersive Design**
    - Design Requirements: Dancers & Actors
    - Vconnected CAVE's (Computer Aided Virtual Environments), Disklavier
    - Audience research using GSR (Galvanic Skin Response, engagement)
    - Value of connecting remote Audiences
    - Distinction : individual-, group-, **Theatre-Telepresence**
  - Miracle, Dogbite, Falmouth University (NESTA funded)
    - Streaming Waiting for Godot
    - Audience Research (co-present experience (at least) 30% higher than remote)
    - Opportunity: adding interactivity to **immersive design**





Marian Ursu: PI Vconnect

Bill Scott: Director Miracle Theatre

Ian Kegel: System Engineer/ Architect BT



'Island' split between:

Doghouse: Prospero's lair: Prospero & Ariel & pre-recorded Caliban

Maritime: Washed up mortals & Ariel & Caliban

Sent to homes via HowlRound





# Digital Tempest - Process

- Doug Williams (BT – Vconect) & Ranulf Scarborough (BT – SFBB) initiate
- Falmouth University work with Miracle on NESTA funded research
- Steps on the way:
  - Streaming Waiting for Godot (Performance Centre => 3 remote locations)
  - Falmouth ⇔ Vilnius ICT (6000 visitors) – Inter-actor-ivity
    - *Michael Hesseltine was impressed*
  - Collaboration intensified from April 2014
    - Theatre & Technology weekly meetings
    - Vconect attends Tempest Stage show (Tremenheere)
- Develop Technology Pipeline
  - Bill (Director Miracle, film background ) works on script with Michael Frantzis (Goldsmiths, TV background)
  - Michael works with Vconect technologists & JointEffort – semi-automated camera-orchestration
  - JointEffort have recorded and edited stage performance Tempest
    - deep knowledge
    - Bill's camera direction coincides with JointEffort edit
- Eight intensive days of preparation:
  - Technology set up
  - Stage and lighting set up
  - Camera positioning
  - Rehearsals





Streaming Godot



Inter-actor-ivity  
Falmouth ↔ Vilnius



Vilmos, Doug, Rene  
Larking about



Setting up at the Maritime Museum



Josh, Andras, Rene  
camera-orchestration



Kat / Ariel Bill

# Deep Engagement & Drink: Key to Success

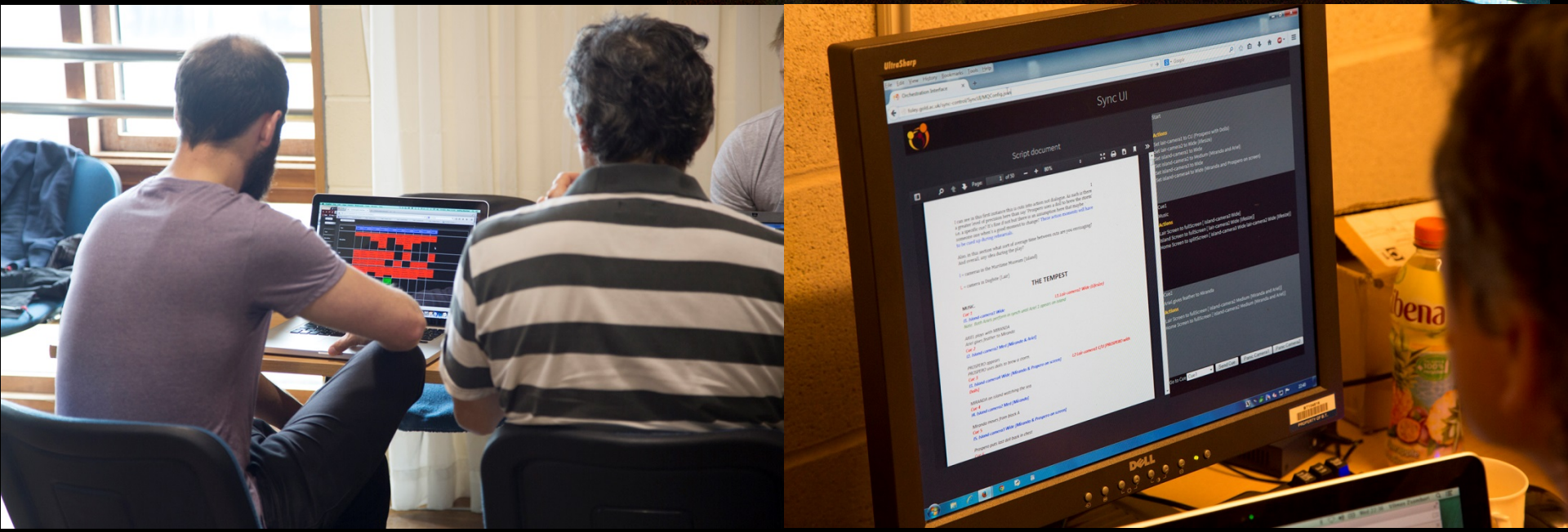


# Vconnect technologies

- Camera-orchestrator
  - Semi-automated camera control script
- Composition
  - Arranging multiple video streams on screen
- Audio
  - That orphan of the mediated media
- Network
  - Server & Clients
- Effort focused on making the technology work
  - Less focus on audience & audience evaluation
    - No screens to show remote audience
    - No use of GSR

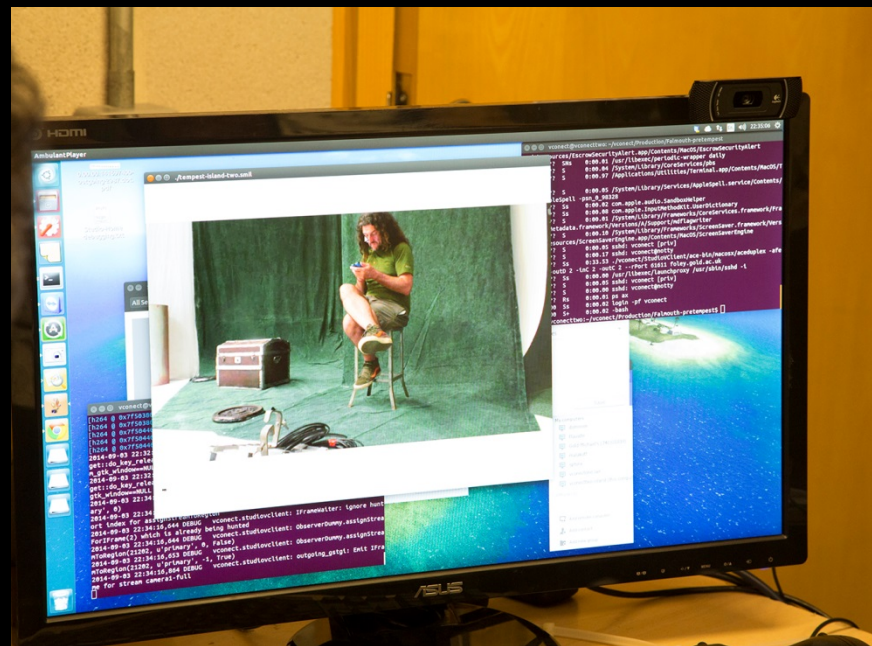
# Camera Orchestrator

- Digital script drives Pan Zoom Tilt cameras
- Depending on 'scene' camera state changes
- Based on Bill & Michael's script
- Programmed by Rene and Andras (Joaneum Research, Graz, Austria) & Manolis (Goldsmiths)
- (Sync UI) Interface operated by Josh



# Composition

- Video Reproduction of streams produced by orchestrator
- Jack (CWI, Amsterdam) composition architecture
- Manipulation of multiple video streams across the network
  - Including pre-recorded video footage



# Audio

- ACE – Fraunhofer: Yaroslav & Niko
- Problems
  - Double talk - Simultaneous bi-directional stereo audio
  - Suppressing Stereo-Echo
- Good for theatre dialogue
  - Explicit turn-taking
- Close mic-ing / Wireless mics
  - Ships pirating our frequency
- Pre-recorded audio not optimal
- Dan, Sam



# Network

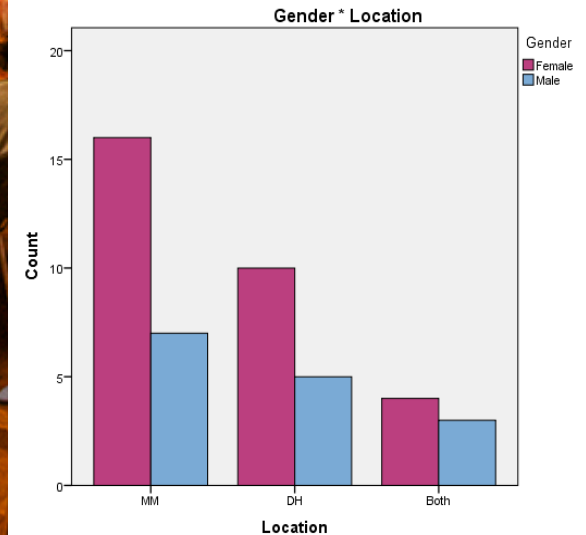
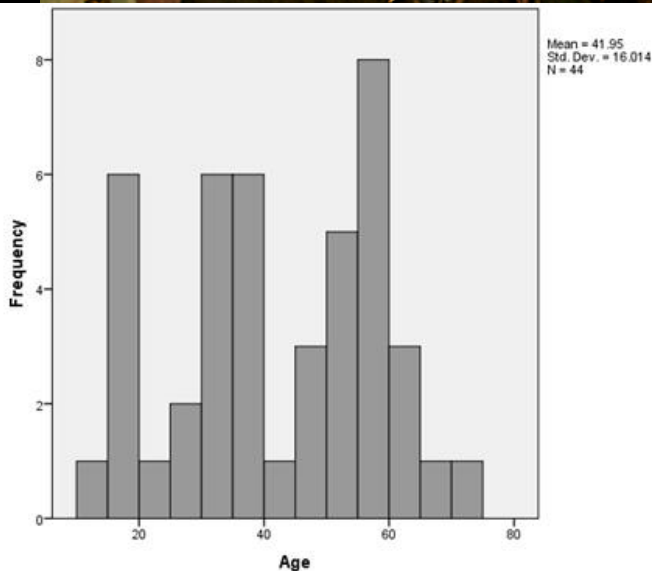
- BT Super Fast Broad Band – FTTP 80/20
  - MM - no local cross traffic - Up: 20Mbits/sec, Down: 60Mbits/sec
  - DH (shared but not noticeable in the evening) Up: 20Mbits/sec, Down 70Mbits/sec
- Connection between performance spaces and export to Howlround => people watching elsewhere in the world
- Vconnect Server/Client architecture video/audio routers, optimisers
- Vilmos, Jack, Ian K., Yaroslav, Ian B., Andy





# Audience Research

- Pen & Paper Questionnaires after Performance
  - Mean age just under 42
  - Maritime Museum (N = 23, 16 females)
  - Doghouse (N = 15, 10 females)
  - Both (N = 7, 4 females)
    - Swapped in break
- On-line Questionnaire
  - Howround audience (N = 19)
  - Analysis in progress



# Questionnaire

- Graphic Rating Scale (not at all – very much)
  - General
    - Enjoyment, clapping loud, flow action between locations
  - Co-present action
    - Close to actors, audience, immersed
  - Remote action
    - Close to actors, audience, immersed
    - See, hear

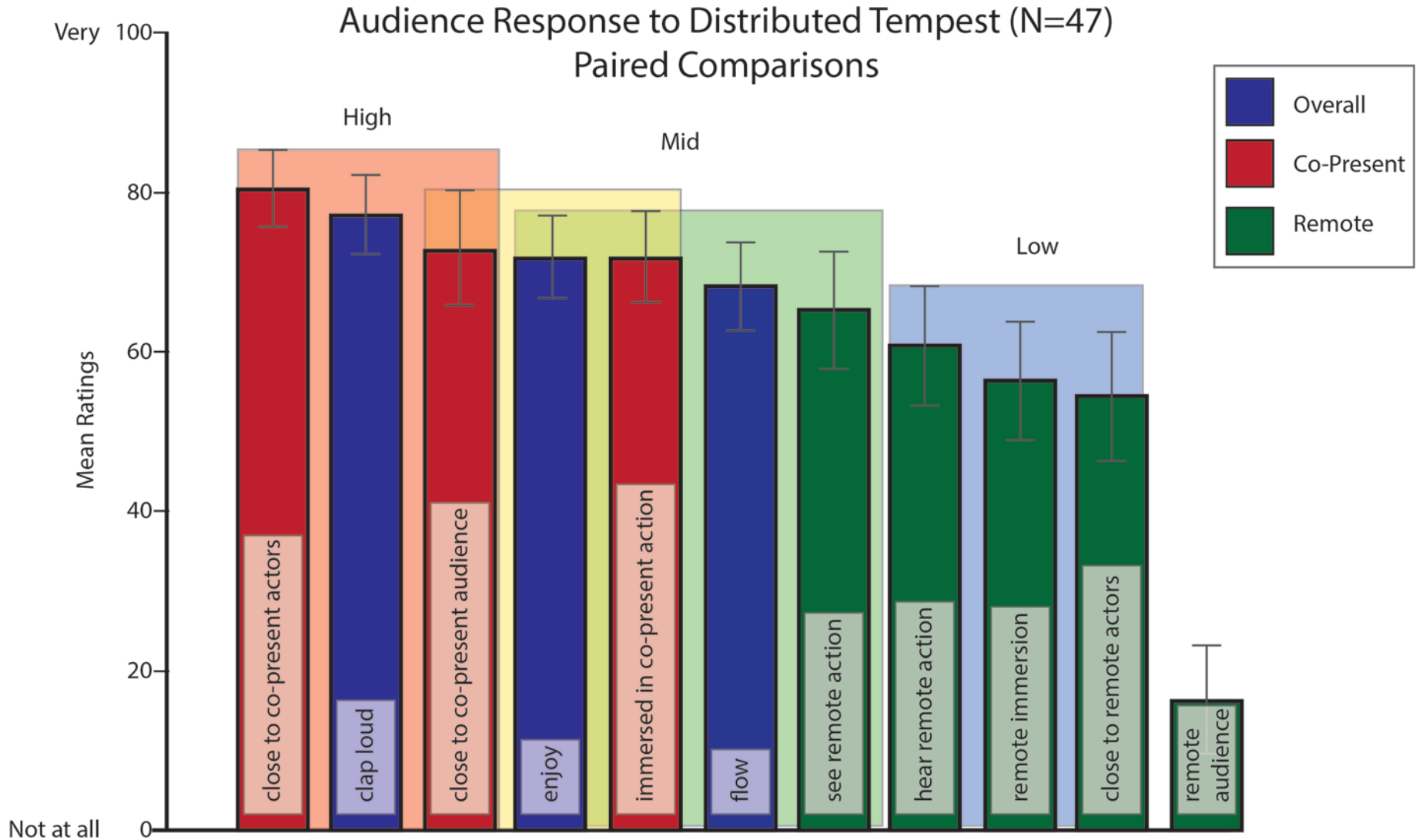
Overall: How much did you enjoy the performance?

Not at all

Very

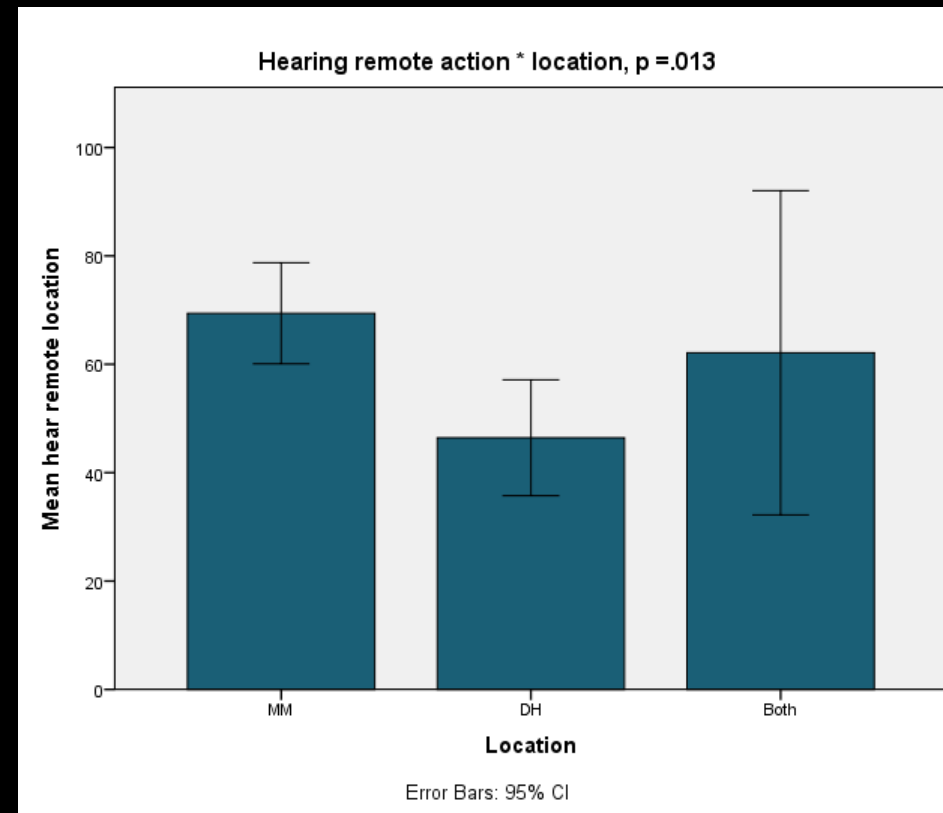


# Paired Comparisons (both venues)

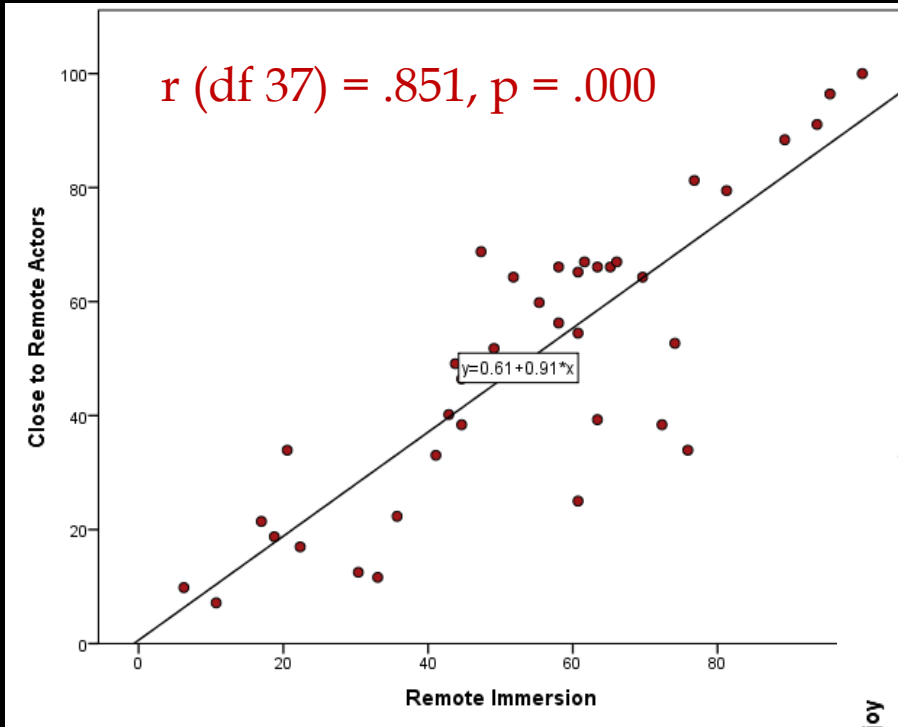


# Audio

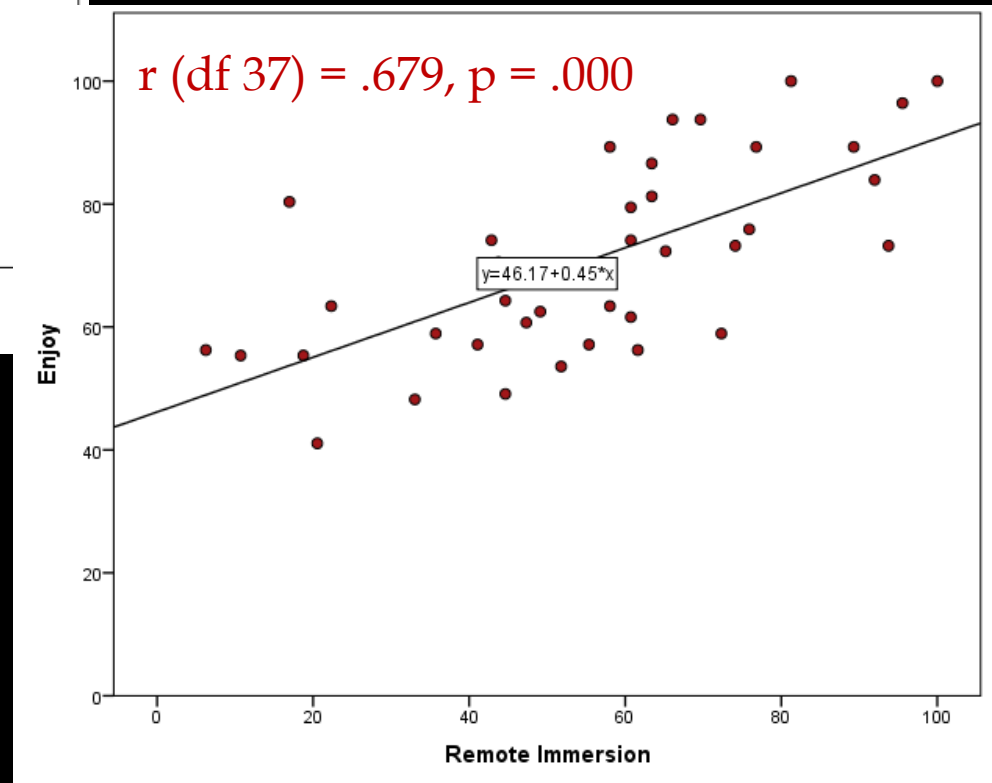
- Could hear better in Maritime Museum
- In Maritime Museum
  - Listening to only 1 remote person
- In Doghouse
  - Listening to 6 remote persons
- This might explain the difference



# Correlations (two examples)



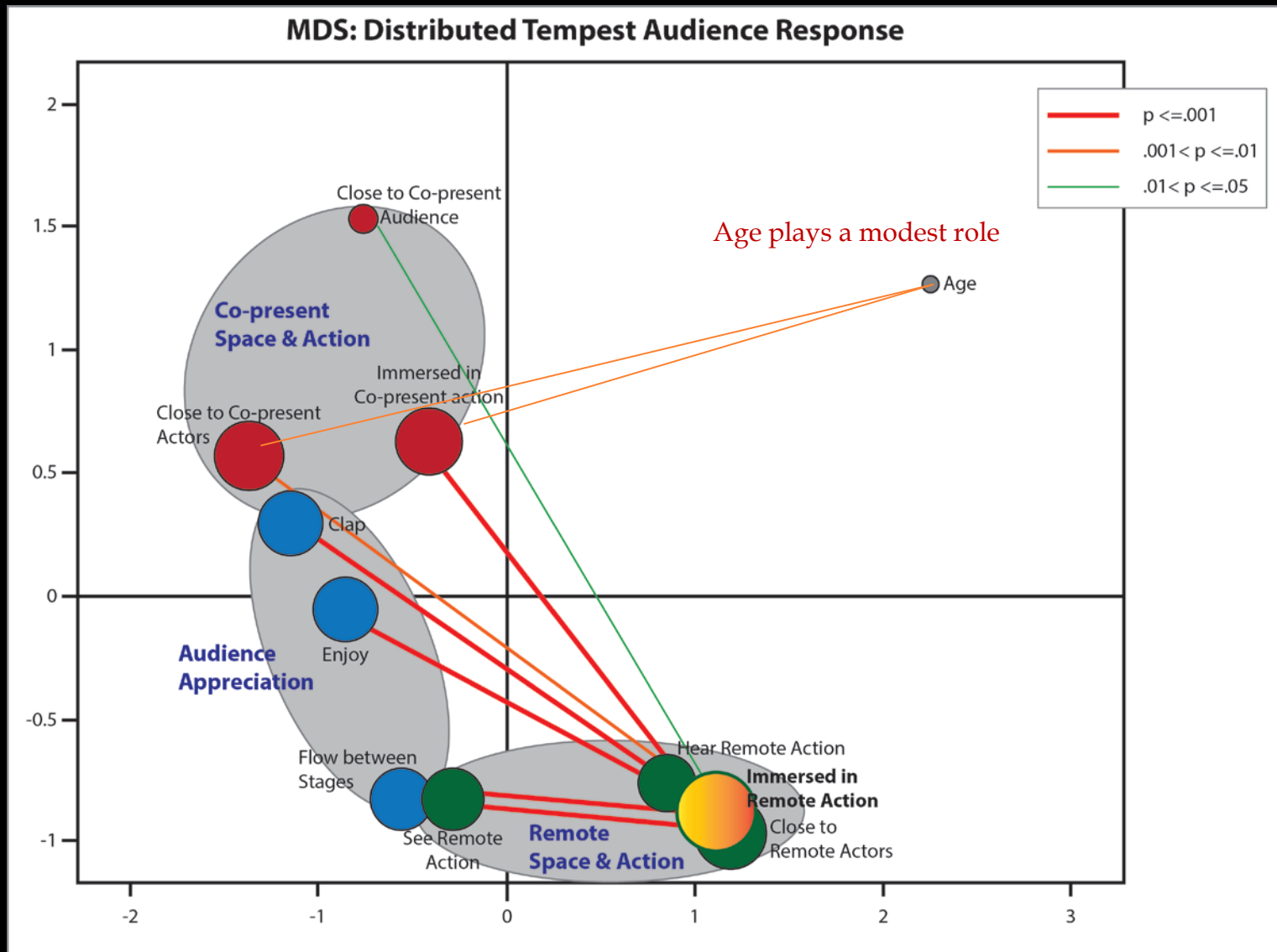
Correlation ranges from:  
**+1 = perfect positive relation**  
to  
**-1 = perfect negative relation**



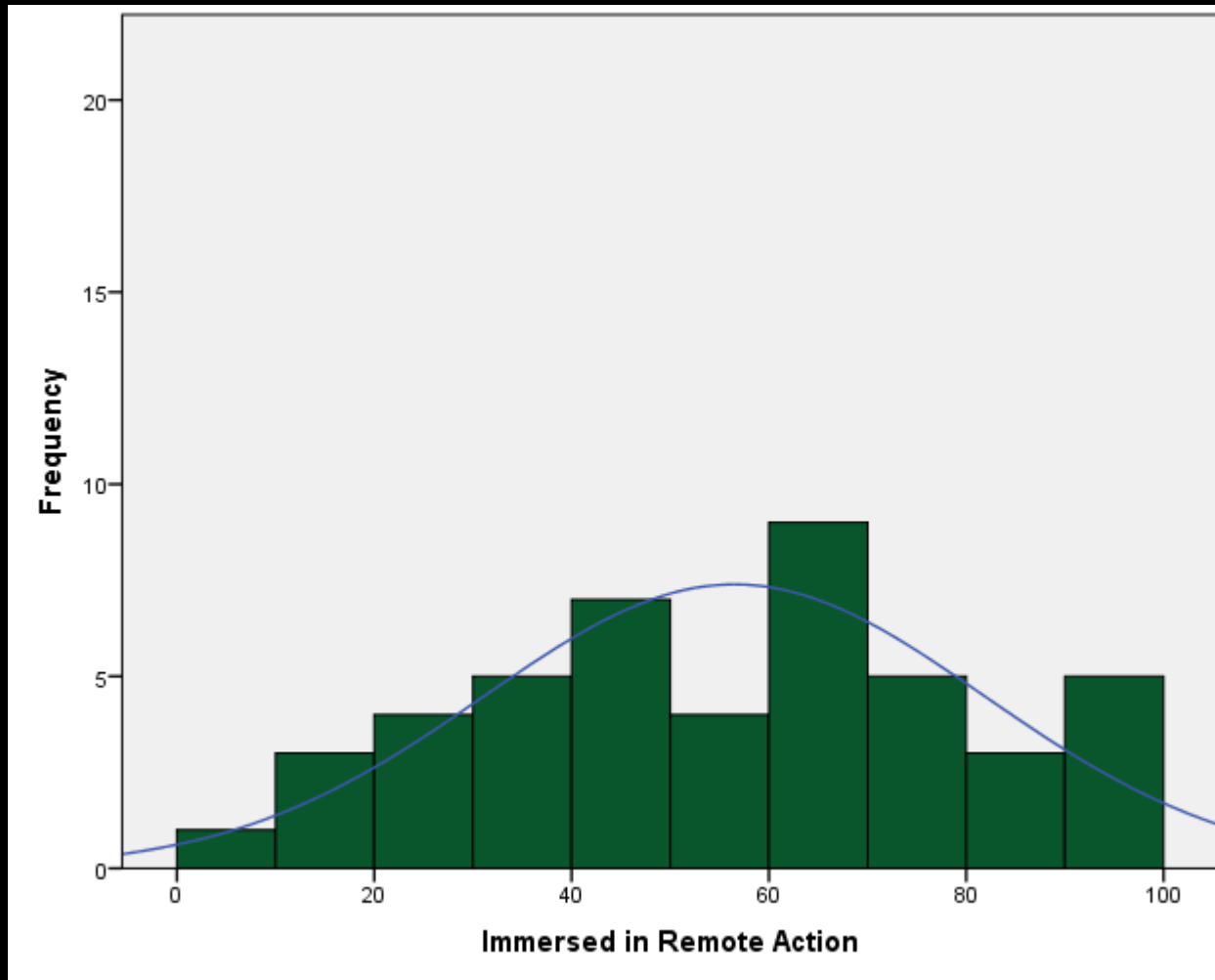
# Significant Correlations

	Age	Enjoy	C-imm	R-imm	C-actors	R-actors	C-aud	Flow	R-See	R-hear	Clap
Enjoy											
C-imm	.009	.000									
R-imm		<b>.000</b>	<b>.000</b>								
C-actors	.009	.005	.000	<b>.006</b>							
R-actors		.000	.002	<b>.000</b>	.012						
C-aud			.083	<b>.017</b>	.025	.013					
Flow		.007	.065	<b>.000</b>	.011	.000	.017				
R-See		.005	.012	<b>.000</b>	.004	.000	.054	.000			
R-hear		.016	.016	<b>.001</b>	.001	.000		.009	.002		
Clap	.073	.000	.000	<b>.001</b>	.004	.016	.038	.003	.021	.045	
p<=.001		4	4	<b>7</b>	2	5		3	3	3	3
p<=.01	2	3	2	1	5	1		3	3	2	2
p<=.05		1	2	1	3	3	5	2	2	3	4
p<=.1	1		2			1	2	1	1		1

# Cluster Analysis



# Immersed in Remote action (histogram)



- Quotes of top 25% (their likes) and bottom 25% (their dislikes)



## Those who were immersed in remote action

- *“Novel experience to highlight real possibility & remote theatre being experienced as close to live as possible. “*
- *“Really great idea, loved how seamlessly the characters transferred between on screen and real life. Amazing how it all worked out looking at the amount of tech. Great!”*
- *“Exciting, innovative, captivating, unexpected. Marvelled at the skill of the direction & acting as it was so slick despite the many technical elements. **Atmospheric lighting. Great set.** Adored the delightful puppets. Dazzled by the clever technical/visual tricks. All the different camera angles kept your attention, so that it was impossible to drift. I feel kids would hugely benefit from this facet of the experience. A lot going on, so hard to get bored!”*

## Those for whom it did not work

- *“Film less engaging - did not always join together smoothly & therefore disrupted the narrative. Prospero's reading from the script detracted from the fantasy & upset the eye contact between him & the players.”*

From Doghouse

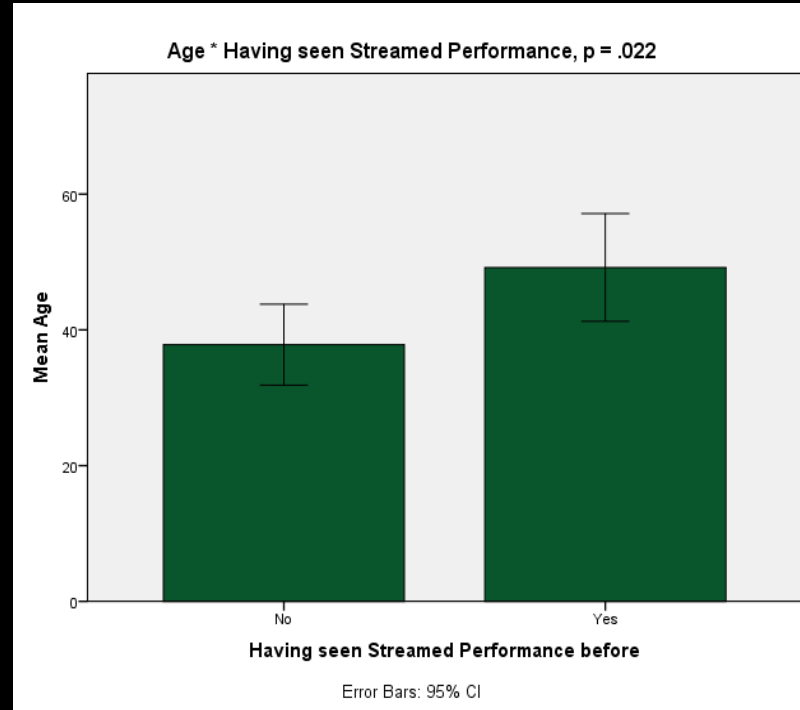
- *“The engagement between characters off screen to on screen, very disjointed & difficult for the actors to truly connect. Voice delay was a little distracting. Music & sound from other venue very distant. Story lost its strength, difficult to engage with the performance as a whole. I sense that the experiment probably had more strength in the other venue. Good luck xxx”*

From Maritime Museum and then Doghouse

- *“The sound quality - that prevented a sense of immersion more than any disparity between visuals. Get the sound quality up and it would be truly brilliant (but I'm sure you know that!!)”*

# (interim) Conclusions

- Technology
  - It was alright on the night (phew!) – no glitches
  - Audio is still not optimal
  - Round trip delay time (RTT) higher than usual in previous Vconect experiments (partly to do with rendering)
  - Vconect Legacy – re-use & develop system elements further
- Performance
  - Actors performed a Tempestuous Miracle (or vice versa)
  - Projection resembled 17<sup>th</sup> Century Dutch painting
  - Immersive design worked well
  - Eye gaze across the divide worked for the most part
- Audience Research
  - Overall, audience enjoyed the performance
  - A much more cohesive experience than streamed
  - Co-present experience still better than remote
  - The more you are immersed in the remote action the better the experience
  - Remote audience awareness is low
  - Age plays a modest role
  - Older audience have more experience with streamed performances



# On-going activities & Next Steps

- JaNet Grant
  - Connection Falmouth University – Manchester Contact Theatre
    - Contact centre of excellence for on-line performance
    - Dance Performance between Falmouth & Manchester
- On-line orchestra – AHRC funded
- H2020 submitted –
  - Make audience of live streamed performances interactive & immersive
  - Learn from last two decades of on-line performances
  - if successful:
    - Falmouth University Lead, 4M Euros over 3 years
    - Technology, Performance Organisations, Social Science
    - Develop semi-automated camera controller further
      - Bespoke prototype => product
- More to come
  - interest from e.g. SFBB/BT, Goonhilly, BBC

**Thank You**



# Three video clips

- Translating stage performance to distributed performance
  - Outdoor => Maritime Museum, Doghouse
- Ariel's Transcendental action
  - From Doghouse to Maritime Museum
- Dialogues across the digital divide