



# Multi-Modal Measurement for Intelligence Analyst Cell Size Optimization

07 November, 2018

ICCRTS, Pensacola, Florida

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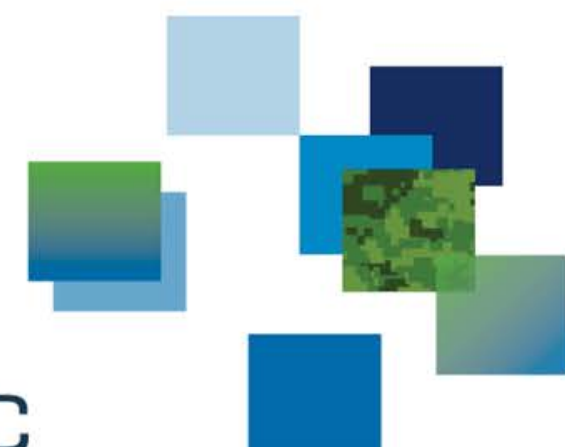
Lisa Tripp, PhD – AFRL



AFRL



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# Background

- Increase in asymmetrical warfare, low-contrast enemies
- Need for massed intelligence, surveillance and reconnaissance to aid SOF and UAS prosecution
- Increased use of real-time full-motion video for ISR to provide integrated intelligence to C2:
- Canadian Defence Policy: Strong, Secure Engaged → UAS capability
- Canadian FMV analysts train for all roles, no explicit collective training
- Canada has small, agile military: crew-size optimization is critical



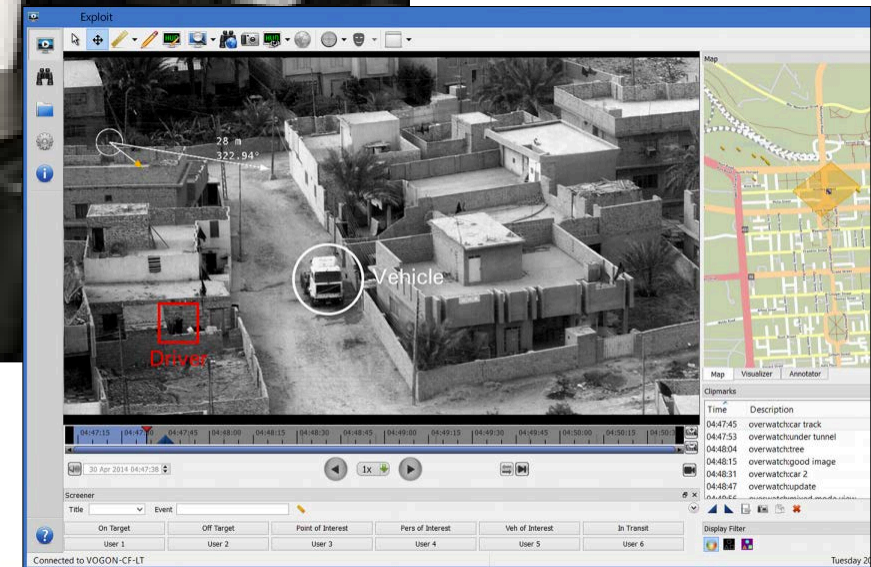
# Development

- DRDC/AFRL Project arrangement (contract support from Aptima)
- Defined 12 PED mission types
  - Helicopter Landing Site (HLS) soak, Route Study, Counter IED, Source Follow, Wide Area Search, Domestic Search and Rescue, Convoy, HLS Infil/Exfil, Troops in Contact (TIC), Weapons Employment, Collateral Damage Estimate (CDE), Battle Damage Assessment (BDA)
- Identified 11 PED mission difficulty parameters
  - Search Geometry, Tasking Type, Recognizability, Specificity of Essential Element of Information, Product Timing, Team Cohesion, Priority Match, Communication Clarity, Weather, Airspace Restrictions, Environment
- Developed 8, 75-minute simulation scenarios of differing anticipated difficulty levels (crawl, walk, run)
- DRDC animated the scenarios on the Testbed for Integrated Ground Control Experimentation and Rehearsal (TIGER) simulation platform

# Pilot Study Objectives

- Characterize 2 and 3 person crews under increasing workload
- Validate scenario content and presentation
- Estimate scenario difficulty levels using established workload measures (e.g. NASA TLX)
- Develop scenario-linked performance and outcome measures

# TIGER



# Design

Mission 1 = pre, Mission 8 = post  
2 between conditions (2 vs 3 crew) x 6 within (trials)

Trial	Difficulty
1	Moderate
2	Easy
3	Easy
4	Moderate
5	Moderate
6	Difficult
7	Difficult
8	Moderate

# Independent Variables

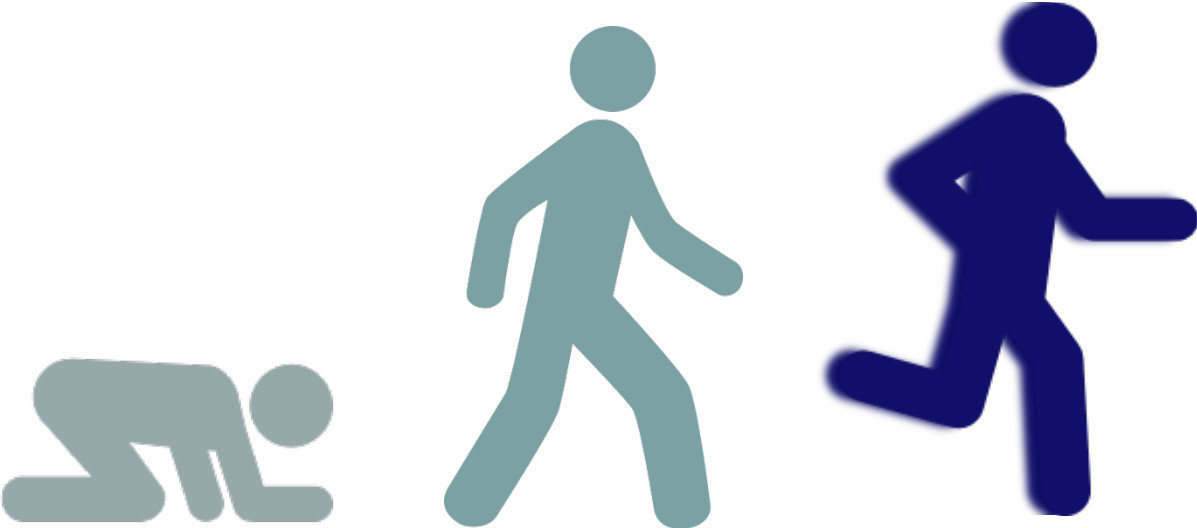
## Crew size



Two

Three

## Mission Difficulty

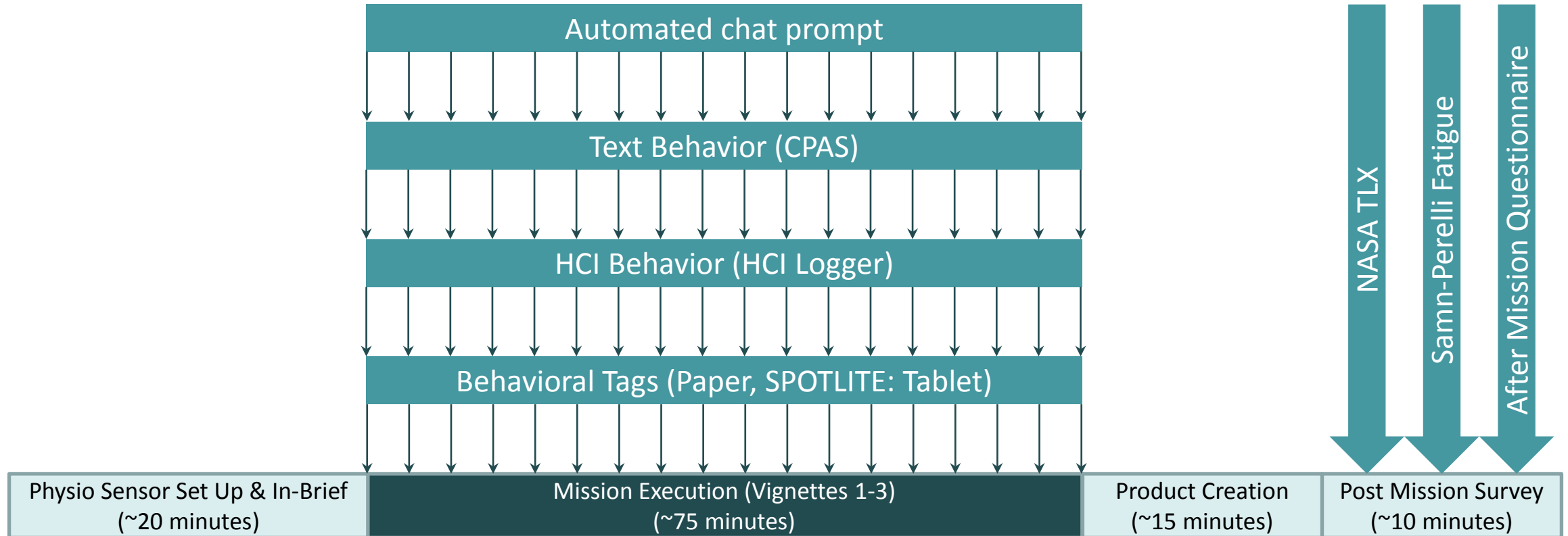


Crawl

Walk

Run

# Dependent Variables







# Constructs

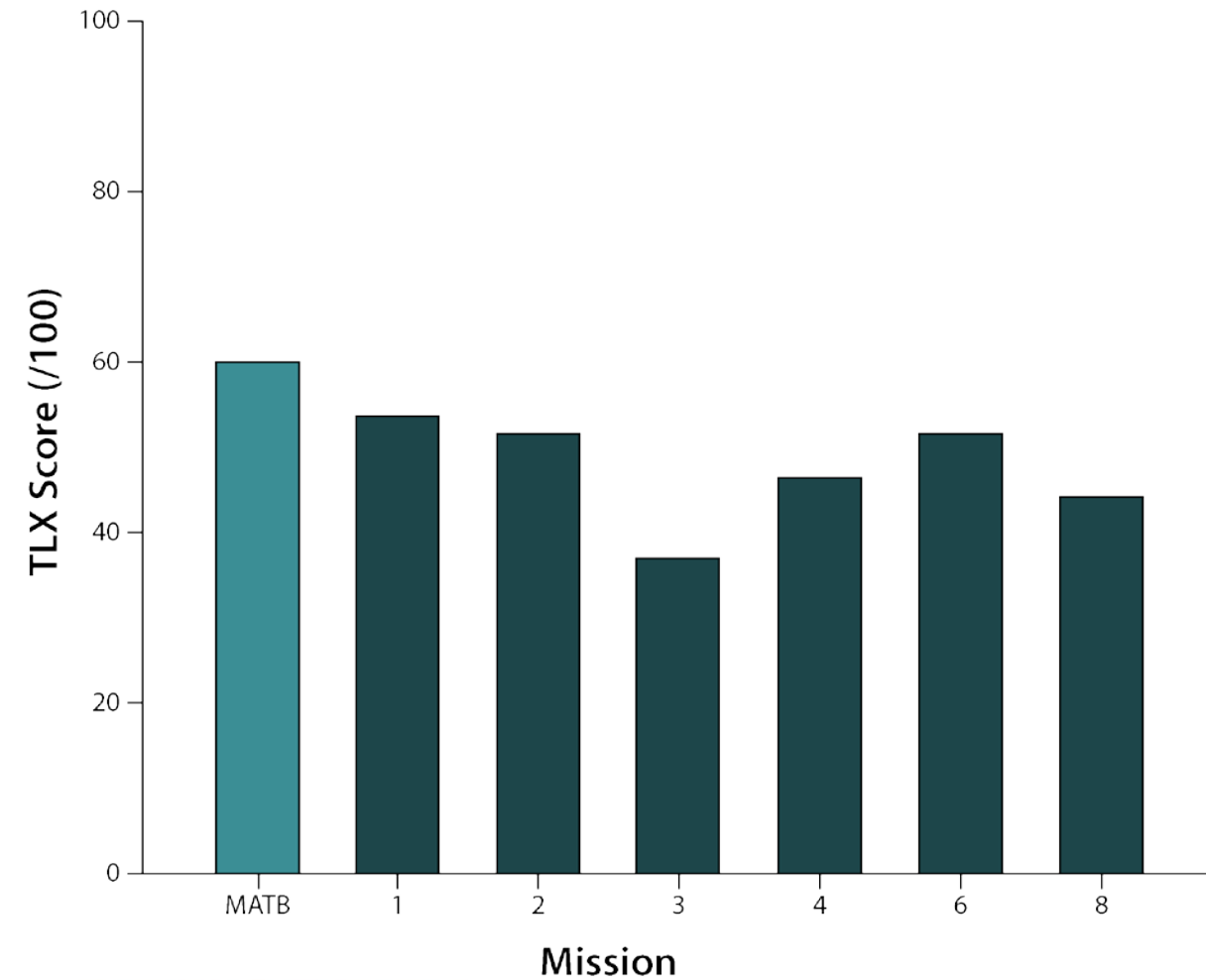
	Constructs				
Modalities	Workload	Workload Distribution	Communication	Situational Awareness	Performance
Self-report	NASA-TLX; Validated Role Overload measure; experiential workload item	Validated measure	Validated measure	Validated measure	
Behavioral observation	SME observed ratings				SME observed ratings
Human-Computer Interaction	Validated tool used to record interactions with computer		Chat Behavior; CPAS		
HRV	Equivalant vest (data unavailable)				

# Results: Self-report

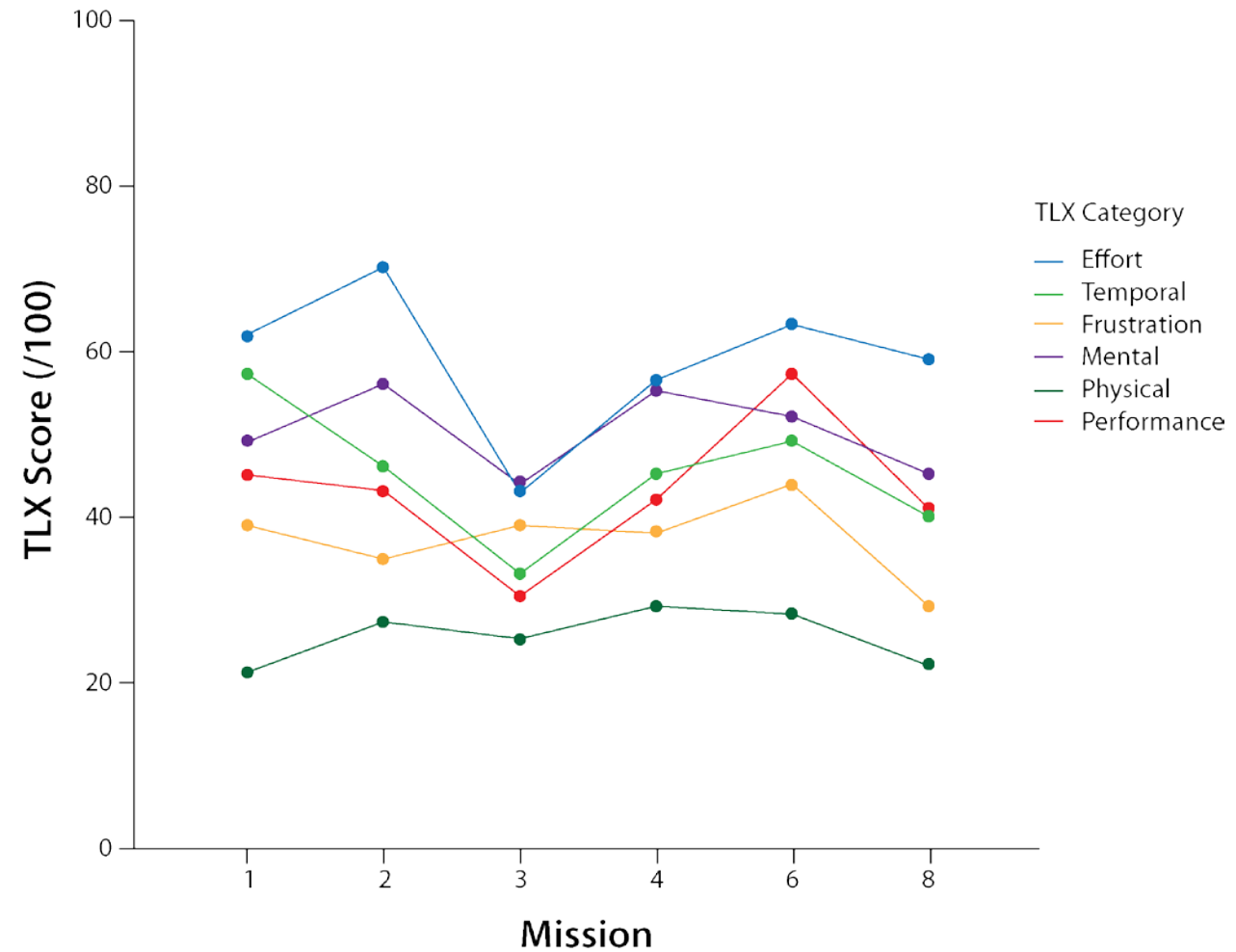
	Mission	1	2	3	4	6	8	Avg	SD
	Mission Difficulty	1-2-3	1	2	2.5	1.5	1-2-3		
	Workload								
Automated Chat Prompt	Experiential Wrkld: /3								
	2-person team	1.50	1.56	1.55	1.78	1.63	1.53	1.60	0.10
	3-person team	1.47	1.20	1.28	1.44	1.64	1.91	1.49	0.26
Post-Mission NASA-TLX	NASA-TLX Workload: /100								
	2-person team	55.83	60.00	47.83	52.50	58.83	50.33	54.22	4.82
	3-person team	51.89	46.33	29.56	42.00	46.67	40.33	42.80	7.64

# Results: Self-report NASA TLX

NASA TLX: All missions combined index



NASA TLX: All missions by category



# Results: Self-report

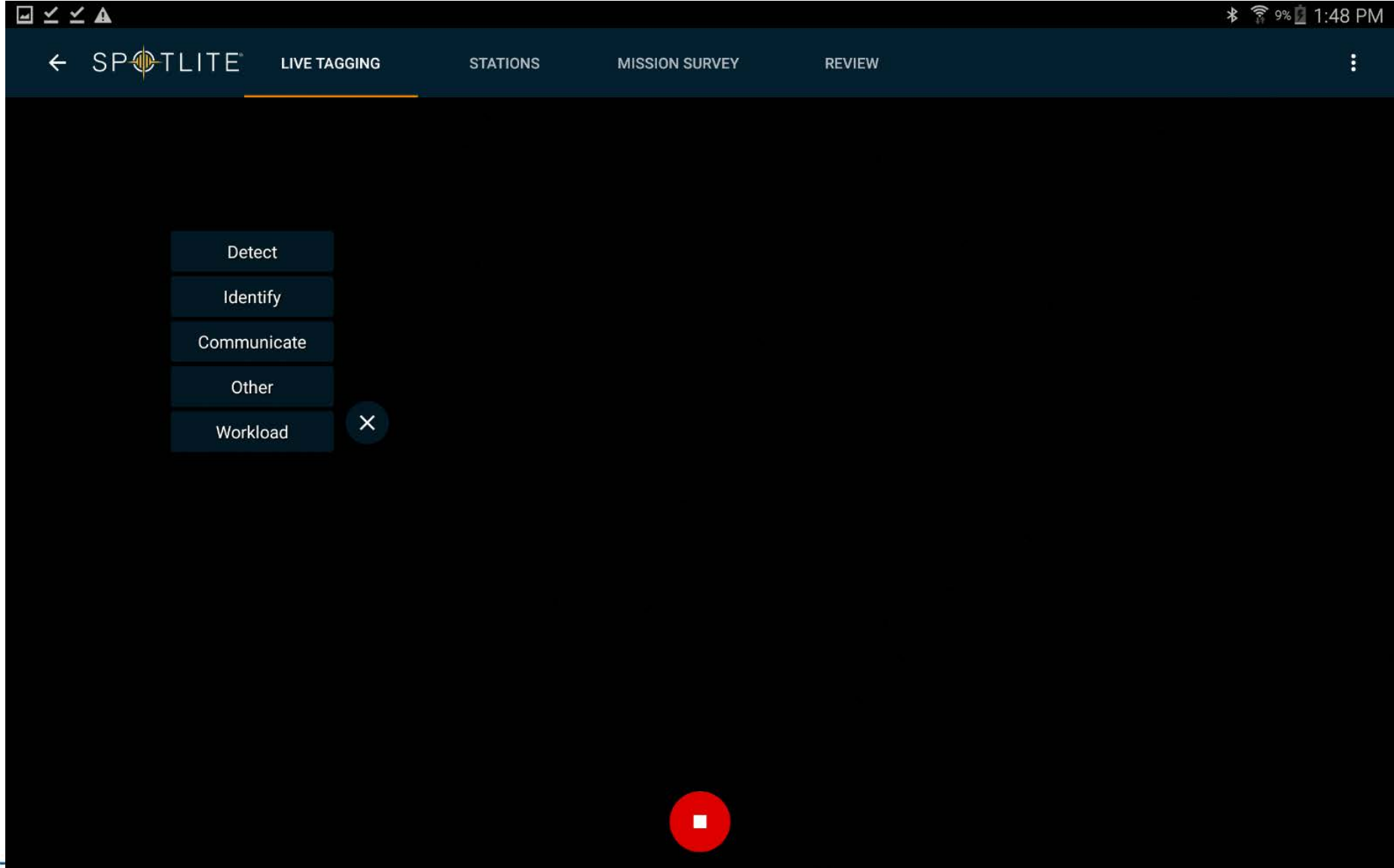
	Mission	1	2	3	4	6	8	Avg	SD
	Mission Difficulty	1-2-3	1	2	2.5	1.5	1-2-3		
Post-Mission Survey	Workload /5								
	2-person team	3.25	3.50	2.50	3.50	3.25	3.00	3.17	0.38
	3-person team	2.17	2.00	2.50	2.33	3.33	2.67	2.50	0.47
	Wrkld. Distribution /5								
	2-person team	2.83	3.33	3.17	3.67	4.33	4.33	3.61	0.62
	3-person team	2.94	3.33	3.22	3.33	3.56	3.44	3.31	0.21
	Communication /5								
	2-person team	3.83	3.67	4.33	4.33	3.83	4.50	4.08	0.35
	3-person team	3.11	4.33	4.11	3.67	3.67	3.89	3.80	0.42
	Sit. Awareness /5								
	2-person team	4.00	4.00	4.50	4.50	4.50	4.50	4.33	0.26
	3-person team	2.67	3.50	3.33	4.00	3.33	4.00	3.47	0.50



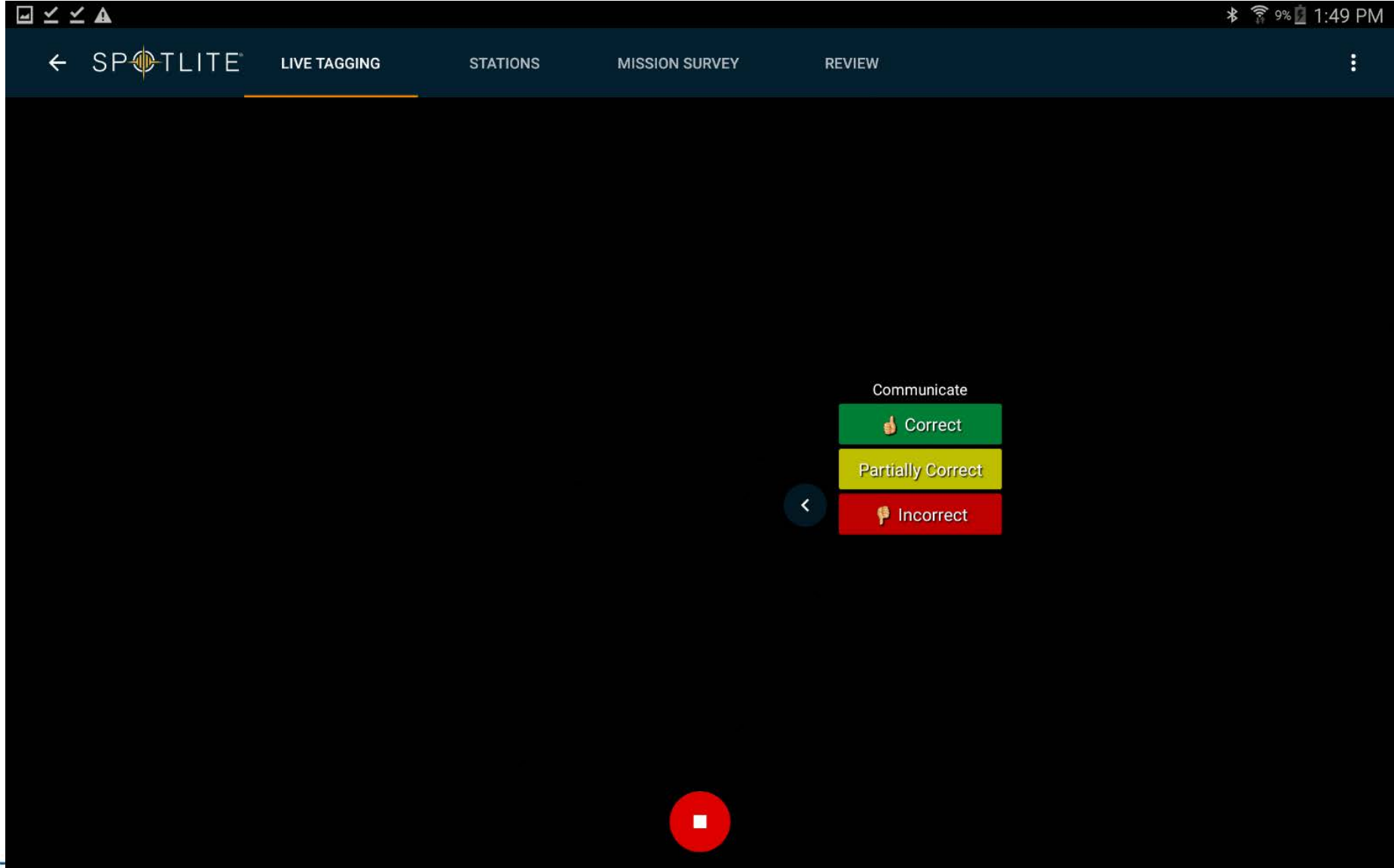
# Results: Paper Observations

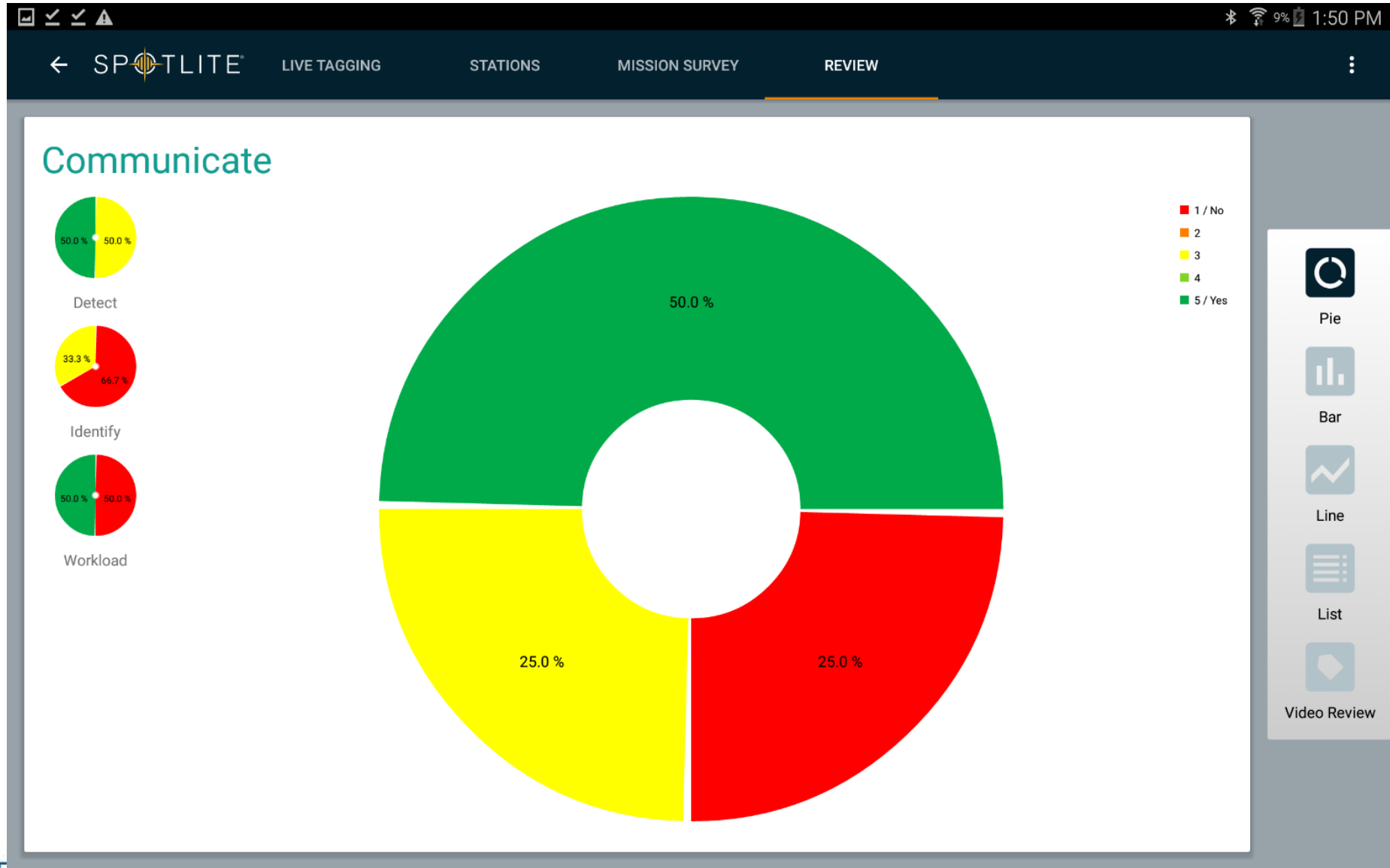
Mission	1	2	3	4	6	8	Avg	SD
Mission Difficulty Level	1-2-3	1	2	2.5	1.5	1-2-3	-	-
Detect: $\alpha$ correct								
2-person team	0.83	0.84	0.80	0.97	0.56	0.92	0.82	0.14
3-person team	0.84	0.74	0.79	0.63	0.58	0.78	0.73	0.10
Identify: $\alpha$ correct								
2-person team	0.76	0.86	0.83	0.88	0.74	1.00	0.84	0.09
3-person team	0.72	0.67	0.68	0.88	0.69	0.83	0.74	0.09
Workload: /3								
2-person team	3.00	2.88	1.75	3.00	1.63	2.13	2.40	0.64
3-person team	2.00	1.75	2.00	1.88	1.25	1.75	1.77	0.28

# SPOTLITE DEMO



# SPOTLITE DEMO









# Results: SPOTLITE Tablet Observations

Mission	3	4	6	8	Avg	SD
Mission Difficulty	2	2.5	1.5	1-2-3		
Communicate /5	0.79	0.89	0.89	0.95	0.88	0.06
Detect /5	0.74	0.74	0.72	0.85	0.76	0.06
Identify /5	0.89	0.92	0.77	0.98	0.89	0.09
Workload /5	1.00	1.00	2.42	2.19	1.65	0.76



# Results: SPOTLITE Tablet vs Paper observations, 3 person

Mission	3	4	6	8	Avg	SD
Mission Difficulty	2	2.5	1.5	1-2-3		
Communicate	0.79	0.89	0.89	0.95	0.88	0.06
Detect /5	0.74	0.74	0.72	0.85	0.76	0.06
Detect	0.79	0.63	0.58	0.78	0.70	0.11
Identify /5	0.89	0.92	0.77	0.98	0.89	0.09
Identify	0.68	0.88	0.69	0.83	0.77	0.10
Workload /5	1.00	1.00	2.42	2.19	1.65	0.76
Workload	2.00	1.88	1.25	1.75	1.72	0.33



# Results: HCI – Number of Interactions

Mission	1	2	3	4	6	8	Avg	SD
Mission Difficulty	1-2-3	1	2	2.5	1.5	1-2-3	-	-
Total Activity Count								
2-man team	10440	16019		10074	12214	12451	12239.60	2109.86
3-man team	11327	10733	11035	12785	14214	14819	12485.50	1583.24
Chat Activity Count								
2-man team	6168	7658		7219	7866	7822	7346.60	632.16
3-man team	5987	5790	7018	9628	9932	10357	8118.67	1904.14



# Conclusions

- Workload was higher across all modalities for 2-person team, consistent with NASA TLX and chat prompts
- Workload distribution improved over missions for both teams, but at a higher rate for the 2-person team
- SA was better for the 2-person team
- Less communication for 2-person team, but better communication
- For detection and identification, 2-person team performed better
- Mission 3 was less complex than intended by researchers

# Strengths/Limitations

- Use of multi-modal measurement
- Thorough, realistic simulation exercises with varying workload
- International collaboration
- Two person team had most experienced/qualified participant
- Only one participant was from the target community
- $N$  was very small – prohibited statistical analysis

# Future Research

- Larger sample
- Better/clearer understanding of behavioural construct by raters
- Consistent use of tablet or paper based behavioural assessment tool
- Addition of HRV and evaluation of intelligence products

**Comments or Questions?**

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