

Computational Cultural Understanding (CCU)

Dr. William Corvey
I20

Proposers Day

30 April 2021





Agenda

Start	End	Duration	Item
12:00 Noon	1:00 PM	1:00	Virtual Check-in
1:00 PM	1:05 PM	0:05	Security Briefing Mr. Tacuma “Dion” King
1:05 PM	1:20 PM	0:15	Human Subjects Research (HSR) Briefing Ms. Lisa Mattocks, I2O ADPM, DARPA HSR Action Officer
1:20 PM	2:05 PM	0:45	Computational Cultural Understanding (CCU) Presentation Dr. William Corvey, Program Manager, DARPA I2O
2:05 PM	2:30 PM	0:25	Contracts Management Office (CMO) Briefing Ms. Jennifer Mack, Contracting Officer
2:30 PM	2:35 PM	0:05	Submit Questions
2:35 PM	4:00 PM	1:25	PM Question Review and Informal Teaming Discussions
4:00 PM	6:00PM	2:00	Q&A Session (PM answers attendee questions)



Proposers Day Information

BAA Location

- Posted on FedBizOpps website (<http://fbohome.sam.gov>) and Grants.gov website (<http://www.grants.gov>)

Questions Today

- Questions can be submitted until 2:35 via CCU@darpa.mil. Please do not post questions in Zoom.
- Questions not answered verbally during today's Q&A session will be answered later on the Proposers Day website.

Proposers Day Website

- Proposers Day presentations will be posted.
- Q&A from today and those received later via CCU@darpa.mil will be posted.

Information precedence

- If anything said or addressed during this presentation or in the FAQ conflicts with the published solicitation, the BAA takes precedence. The Government may issue amendments to the BAA to effect any changes deemed necessary in response to the FAQ. Such amendments would be posted to FBO and Grants.gov prior to the solicitation closing date and would supersede previous versions of the solicitation.



Create cross-cultural language understanding technologies to improve a DoD operator's situational awareness and interactional effectiveness.

- Maximize operator performance in the absence of human cultural interpreters
- Minimize the amount of training data required to expand services to new languages and cultures



Situational Awareness



Interactional Effectiveness



Background

- The US government and its agencies, including the Department of Defense (DoD), operate globally and are in constant contact with diverse cultures.
- Communicative understanding, not simply of local languages, but also of social customs and cultural backgrounds, lies at the heart of Civil Affairs and Military Information Support Operations activities, which together comprise the vast majority of US counterinsurgency and stabilization efforts.
- Cross-cultural miscommunication not only derails negotiations, but also can be a contributing factor leading to war. The likelihood of communicative failure increases dramatically where significant social, cultural, or ideological differences exist.
- Operators benefit from the help of human interpreters. Automated systems would be a welcome force-multiplier for DoD interpreters, who require extensive training and may not always be available.
- Technologies developed in the program will be evaluated with respect to DoD-relevant scenarios in addition to annotated corpora.
- CCU will engage with DoD stakeholders throughout the program for scenario development and transition activities.
- CCU research and development will be unclassified. However, transition activities may require evaluation on classified data, to be facilitated by the evaluation team.

Current operator cultural preparation and interaction



Before mission
Hand-crafted
cultural training



During mission
Limited interaction with cultural
interpreters & speech-to-speech
machine translation*



After mission
Manual after-action
analysis of social interaction

- **Unlike human cultural interpreters, current multilingual communication technologies:**

- Cannot analyze communication to understand cross-cultural differences
 - Lack methods to automatically discover sociocultural norms in order to determine the social, cultural, and contextual factors that impact effective communication and rapport building.
 - Cannot generalize emotion recognition across cultures in order to interpret speaker emotions as influenced by sociocultural context.
 - Lack robust methods for detecting changes in communicative practice indicative of communicative failure or impending conflict.
- Cannot provide real-time assistance to operators during cross-cultural communication
 - Fail to generalize dialogue assistance to cross-cultural interaction and therefore cannot analyze conversations for evidence of cross-cultural misunderstanding or suggest remediation measures.

* MFLTS System:
https://www.army.mil/article/195459/technically_speaking_making_language_less_foreign

Technical Approach

TA1: Sociocultural Analysis

- **Task 1: Sociocultural Norm Discovery**
Automatically discover sociocultural norms that impact effective communication.
- **Task 2: Cross-Cultural Emotion Recognition**
Generalize emotion recognition across cultures, in order to recognize speaker emotions as influenced by sociocultural context.
- **Task 3: Communicative Change Detection**
Detect changes in communicative practice indicative of communicative failure or impending conflict.

TA2: Cross-Cultural Dialogue Assistance

- Generalize dialogue assistance to cross-cultural interaction, in order to observe conversations for evidence of cross-cultural misunderstanding and generate alternative, socioculturally-appropriate utterances that improve interaction and negotiation.

Use Cases

Face-to-face interaction & pre-deployment preparation

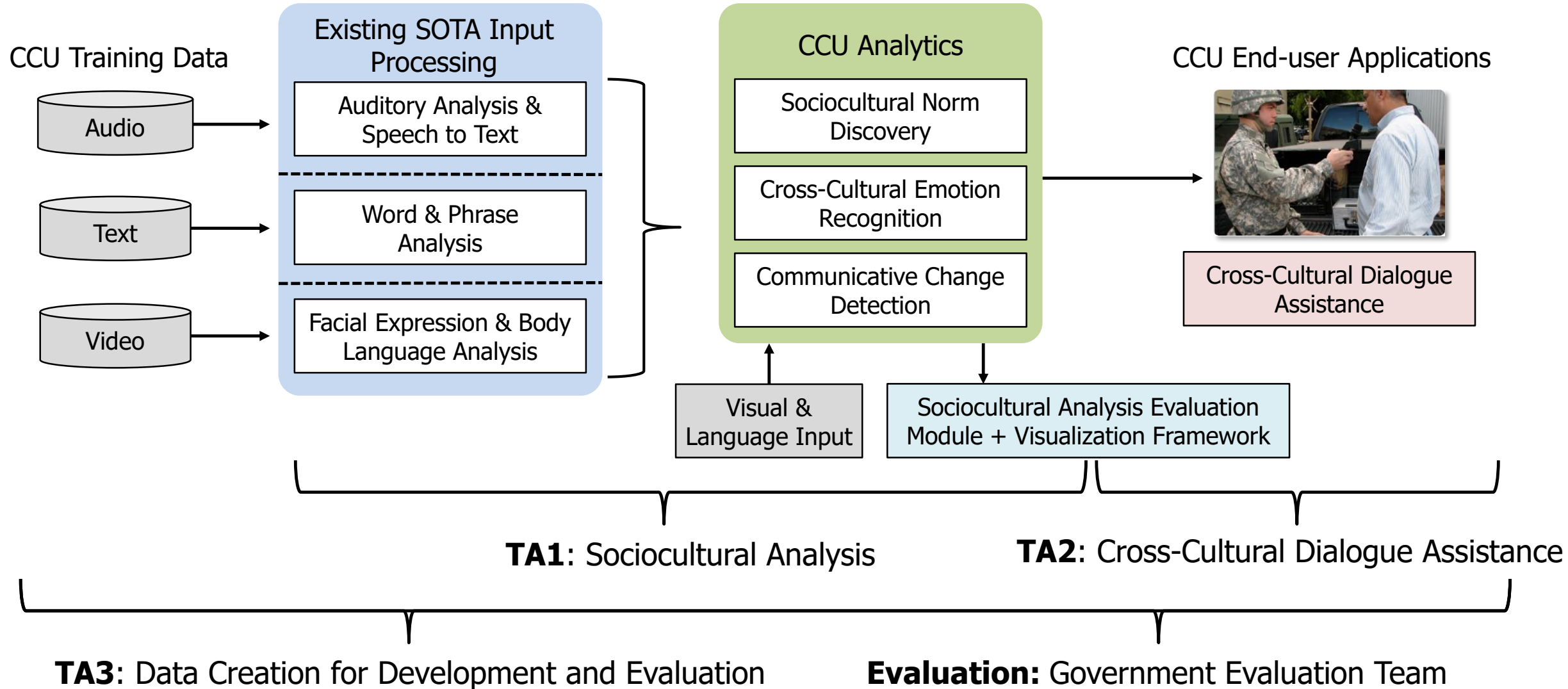
Provide just-in-time **dialogue assistance** to foot soldiers negotiating in diverse operational contexts



Mission planning & strategic training

Assist in **analysis** of communication with allies/adversaries from different social and cultural backgrounds







TA1: Sociocultural analysis

TA1 research consists of three tasks (detailed in the following slides):

- Sociocultural Norm Discovery
- Cross-Cultural Emotion Recognition
- Communicative Change Detection

Corpus Evaluation

- TA1 performers will provide a TA1 module compatible with CCU APIs and suitable for use in corpus evaluation.

Visualization:

- To facilitate development and demonstration, TA1 performers will display system outputs on corpora within visualization framework(s) to be determined by the program. The framework(s) will be required to interface with CCU-defined APIs.

TA2 Integration:

- Software source code, executables, and models compatible with CCU APIs will also be provided to TA2 performers for integration.



TA1 Task 1: Sociocultural norm discovery

Goal

- Automatically discover sociocultural norms that impact effective communication.

Technical Challenges

- Automatic discovery of the kind of sociocultural norms that humans ordinarily acquire tacit knowledge of through a lifetime of learning and interaction.
- Creation of new technologies able to discover and characterize sociocultural norms observed in unlabeled discourse.
- It is anticipated that technical approaches will draw from established computational techniques for unsupervised modeling, including graph and embedding techniques for clustering and neural network attention models for norm description and characterization, as well as be informed by findings from psychology, sociology, or other relevant disciplines.
- Algorithms must be able to leverage negative emotions detected by analytics developed for Task 2 in order to identify potential instances of norm violation.

Metrics

- System output correlation with gold-standard.

Outcomes

- Technologies able to discover and characterize sociocultural norms using unlabeled discourse.
- Software source code, executables, and models compatible with CCU APIs.



TA1 Task 2: Cross-cultural emotion recognition

Goal

- Generalize emotion recognition across cultures.

Technical Challenges

- Generalization of emotion recognition across cultures by improving the performance of continuous multimodal cross-cultural emotion recognition technologies, with the aim of overcoming the significant degradation of performance exhibited by current systems in cross-cultural settings.
- Creation of technologies capable of meeting or exceeding the performance of state-of-the-art, mono-cultural emotion recognition engines, while simultaneously minimizing or eliminating the need for labeled training data in the test culture, resulting in a capability for culture-general, universal emotion recognition.
- Task 2 frameworks should be capable of providing continuous emotion recognition outputs expressed as both (1) Valence-Arousal measurements and (2) category labels, within a taxonomy to be defined during the program.

Metrics

- System output correlation with gold-standard.

Outcomes

- Technologies able to correctly identifying emotions in cross-cultural test conditions.
- Software source code, executables, and models compatible with CCU APIs.



TA1 Task 3: Communicative change detection

Goal

- Detect changes in communicative practice indicative of communicative failure or impending conflict.

Technical Challenges

- Humans are naturally able to perceive crucial shifts in norms and emotions in discourse, while computers are currently much less capable of detecting these changes.
- Analysis of Task 1 and Task 2 outputs concerning a face-to-face interaction or a document (text (+/- image), audio, video) for the purpose of detecting changes at multiple timescales in order to identify impactful shifts
 - in emotional expression,
 - in the evolution of norms during an interaction (e.g. changes in formality, in cultural setting, in reactions to perceived social roles),
 - in long-term cultural trends.
- Task 3 algorithms must be capable of providing indications and warnings of failure points to support TA2's communication remediation.

Metrics

- System output correlation with gold-standard.

Outcomes

- Technologies able to identify impactful changes in TA1 outputs at multiple timescales.
- Integrated TA1 module compatible with CCU APIs and suitable for use in corpus evaluation and visualization.
- Software source code, executables, and models for integration by TA2 performers.



TA2: Cross-cultural dialogue assistance

Goal

- Generalize dialogue assistance to cross-cultural interaction.

Technical Challenges

- TA2 algorithms must be capable of detecting sociocultural settings from language and image inputs, of revising operator utterances to increase interactional effectiveness, and of incorporating culture-independent techniques that enable generalization to approximately six culture + language pairs by program completion.
- Specific Challenges:
 - Automated detection of sociocultural context (e.g., communicants' social roles, relative ages, genders, etc. as well as specifics of the social setting).
 - Automated identification of the need for operator assistance.
 - Dialogue generation, including in conditions incorporating program-external machine translation components.

Metrics

- Communicative Failure Detection: Correlation with human behavior in ceiling condition.
- Negotiation Success: Correlation of success rate with that of ceiling condition.

Outcomes

- Integrated TA1/TA2 prototype for evaluation
 - Able to process visual and audio input from selected input mechanisms.
 - Executable within the mobile environment to be chosen by the program.
 - Interoperable with program-external machine translation component to be chosen by the program.



TA3: Data creation for development and evaluation

Goal

- Create data for development and evaluation in multiple culture + language pairs that support research and evaluation for TA1 and TA2.

Technical Challenges

- TA1 (development and corpus evaluation data):
 - Approximately 50,000 documents per culture + language pair for use in development and evaluation (20% annotated, remaining unlabeled). Please see BAA for document (text (+/- image), audio, video) length requirements.
 - Video (with accompanying audio) should comprise 75% of the development and evaluation data set with the remaining 25% distributed across audio and text.
 - All data must demonstrate a variety of sociocultural norms, as well as evidence of emotion.
 - At least half of the documents must also demonstrate changes in either the sociocultural norms or the emotion of the communication participants.
- TA2 (development data only):
 - Supply examples of simulated interpreter-mediated interactions that require knowledge of sociocultural norms
 - Assemble appropriate participants, record interactions, and annotate the resulting video for TA1 analysis.
 - Interpreter corrections will serve as gold-standard remediation for the participants' utterances.
 - Scenarios will be defined in collaboration with the government evaluation team.
 - Data support for the TA2 evaluation will be provided by the FFRDC/UARC.

Outcomes

- Data provided to program according to the schedule defined.



Evaluation (Government team)

Goal: Evaluate Cross-Cultural Dialogue Assistance with respect to operationally-relevant negotiation scenarios.

Selected mission-relevant scenarios are tested across four conditions:

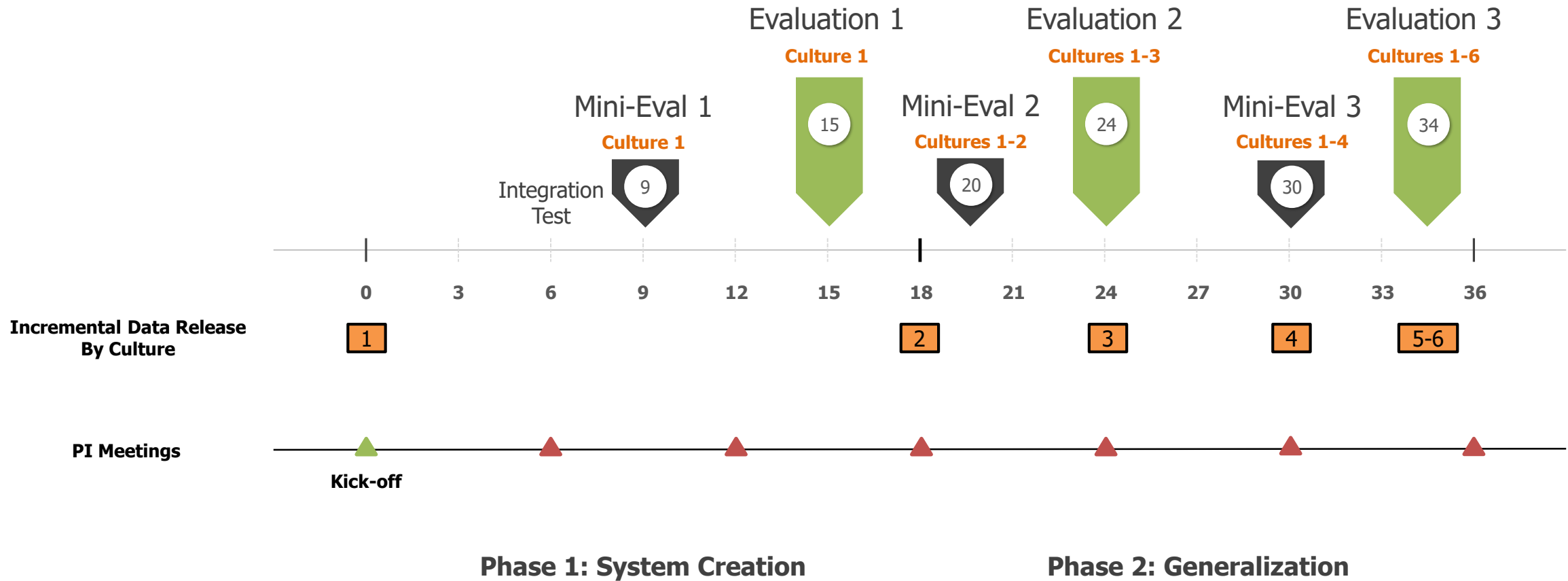
Selected Mission Resources Utilized for Scenario Design	Condition	Participant 1	Assistant Role	Participant 2	
	Ceiling	Culturally-uninformed operator (actual, or represented by SME)	limited language ability or no language ability	Native interpreter (actual, or represented by SME)	Native speaker (actual, or represented by SME)
	Operational Condition 1		limited language ability	TA2 System	
	Operational Condition 2		no language ability	TA2 System, with machine translation input	
	Baseline		no language ability	Machine translation only	

Objective	Metric	Month 9 Mini-Eval	Month 15	Month 24	Month 34	
Number of Cultures Evaluated		1	1	3 (1 surprise)	6 (2 surprise)	
TA2	Negotiation Success	Correlation of Success Rate with Ceiling Condition	Baseline established	20% improvement over baseline	Performance relative to ceiling	Performance relative to ceiling
	Communicative Failure Detection	Correlation of Failure Detection with Ceiling Condition	Baseline established	20% improvement over baseline	Performance relative to ceiling	Performance relative to ceiling
TA1	Cross-Cultural Fluency*	Correlation of TA1 Outputs for Scenario with SME Ground Truth	Baseline established	20% improvement over baseline	Performance relative to ceiling	Performance relative to ceiling

* TA1 components are further evaluated using TA3 corpora, relative to SOTA where available.



Program Schedule





Proposal Deadline

June 16, 2021, 12:00 noon (ET)

Don't wait until the last minute! Submissions received after this date and time may not be reviewed.



Miscellaneous Proposal Information

Intellectual Property

- The program will emphasize creating and leveraging open source technology and architecture. Intellectual property rights asserted by proposers are strongly encouraged to be aligned with open source regimes.

Teaming

- It is DARPA's desire to receive comprehensive, quality responses to this solicitation. To facilitate strong, collaborative teaming efforts and business relationships, a utility is provided by the Teaming page on the Proposers Day website.
- Proposals should describe the teaming strategy, where applicable.

Non-US Entities

- Non-U.S. organizations and/or individuals may participate to the extent that such participants comply with any necessary nondisclosure agreements, security regulations, export control laws, and other governing statutes applicable under the circumstances.

Travel

- Principal investigator (PI) meetings will be held approximately every six months, in addition to a kick-off meeting.
- Because CCU PI meetings are expected to include working sessions on specific engineering, standards, and interoperability issues, performers are expected to include, in addition to the PI, appropriate technical personnel (software developers, graduate students, etc.) in PI meetings as needed to address meeting agendas.



TA1 and TA2

- Multiple awards.
- A proposal may address either a single technical area or a combination of TA1 and TA2.
- Performers selected for TA1 or TA2 may not perform in TA3.
- Combined proposals for TA1/TA2 must ensure that the budget is well delineated so that partial awards are possible.

TA3

- Single award.
- Proposals addressing TA3 should not be combined with any other TA.
- Performer selected for TA3 may not perform in TA1 or TA2.



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