iSAT Snapshot

NSF AI INSTITUTE FOR STUDENT-AI TEAMING

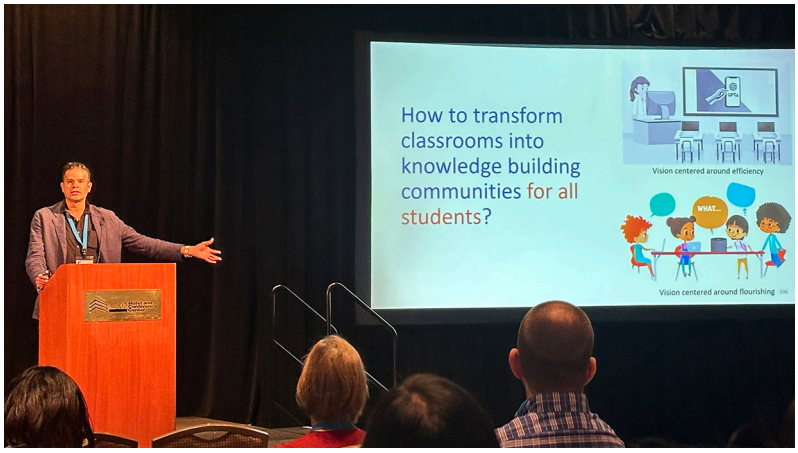
Fall 2023

iSAT PI Sidney D'Mello and Executive Director Peter Foltz Share All About Our Institute at the NSF AI Hill Day

In Brief . . .

A quick look at our activities this quarter!

1. iSAT has a revised Strategic & Implementation Plan (SIP v. 4.0) which has been submitted to the NSF.
2. We hosted our External Advisory Board Member, Dr. Karlyn R. Adams-Wiggins, who also gave a talk at CU's Institute of Cognitive Science's Colloquia Series.
3. Professor Tamara Sumner, Strand 3 co-lead, delivered the opening keynote at AI Education Symposium: Frontiers, Trenches & Guard Rails at the University of Technology in Sidney, Australia. Her keynote - Reimagining AI in Education at the Institute for Student-AI Teaming (iSAT) - focused on how iSAT's work is being guided and informed by the Responsible Innovation Framework.
4. iSAT team members Emily Doherty and Cara Spencer presented their paper "Using Speech Patterns to Model the Dimensions of Teamness in Human-Agent Teams" at the 25th ACM International Conference on Multimodal Interaction in Paris, France.
5. Strand 1 Theme Lead James Pustejovsky presented at the Workshop: Theoretical and Computational Approaches to Decomposition and Presuppositions at Saarland University in Saarbrücken, Germany.
6. PI Sidney D'Mello presented iSAT research to members of the Transdisciplinary Institute in Applied Data Sciences (TRIADS) at Washington University in St. Louis. He also shared iSAT research to the NSF's Advisory Committee for Environmental Research & Education.
7. PI Sidney D'Mello was interviewed for an article in the Coloradan Alumni Magazine where he talks about Responsible Artificial Intelligence and his vision for iSAT.



Top: PI Sidney D'Mello presents on iSAT at the NSF Summit for AI Institutes Leadership meeting (SAIL).

Bottom: Strand 3 Co-lead Tamara Sumner delivers the opening keynote at the AI Education Symposium in Sidney, Australia.

From the PI

iSAT's Year 4 is off to a great start. We spent the first two months updating our Y4 Research Plans to emphasize high-impact, cross-strand convergence research. We have an exciting list of 40 research projects spanning foundational AI and use-inspired research with 9 more projects focusing on our strategic impacts. To support this flurry of activity, we brought on Dr. Thomas Breideband as our new Interim Associate Director to lead the Community Hub and oversee day-to-day operations alongside our Large Grant Business Manager Kimberly Sandoval. Further, Dr. Alba Tuninetti (Associate Director of the Institute of Cognitive Science at CU Boulder), will serve as our Ombudsperson. Alba brings years of experience and dedication to promoting fairness, resolving conflicts, and ensuring the well-being of our Institute's members.

Looking outwards, iSAT has taken several steps to help students, parents, caregivers, teachers, principals, district leaders, and policy makers figure out how to navigate this new world of AI. For example, we shared our work with members of congress, painting a picture of optimism for the future of AI-enhanced classrooms while directly addressing the challenges and risks involved. We discussed practical applications of AI in fostering student curiosity, engagement, and voice with teachers, a refreshing perspective from what is portrayed in the daily headlines. And we have so much more planned. We are aiming for our fourth Learning Futures Workshop to be intergenerational where students and their parents conceptualize, contest, and co-negotiate the use of AI in their in-school activities. We're also launching an iSAT Blog Series where we aim to make topics related to AI in education accessible to the general public.

With nearly 50 projects and a host of external engagements, there is never a dull moment at iSAT!

Sharing, Engaging and Learning

The iSAT Team Showcases Our Progress Across the Country

Artificial Intelligence (AI) is revolutionizing many aspects of the world at a remarkable pace. Unsurprisingly, AI is the talk of the town, and our team at iSAT has been very busy over the last several months engaging with local and federal policymakers, exchanging insights and expertise with other education-focused research institutes, and showcasing our own progress as an Institute. In what follows, we provide a brief overview of major engagements.

NSF AI Day and AI Hill Day

iSAT's PI Sidney D'Mello and Executive Director Peter Foltz headed to Washington DC for a very exciting two days on Capitol Hill! NSF AI Day and AI Hill Day brought together 25 institutes funded by the National Science Foundation (NSF) to showcase their research, progress and accomplishments to federal policymakers. They also visited the offices of Colorado senators Michael Bennet and John Hickenlooper, and local representative Joe Neguse.

D'Mello commented "It was so uplifting to share our vision and accomplishments with the leadership at the NSF and with our representatives. There was widespread support for our work and the appreciation of the challenges - both technical as well as social - that we are trying to solve. A particular highlight was sharing our work with the NSF Director Dr. Sethuraman Panchanathan and Information and Intelligent Systems Division Director Dr. Michael Littman."

CoBi Demonstration at the 26th ACM Conference on Computer-Supported Cooperative Work And Social Computing (CSCW 23)

iSAT PI Sidney D' Mello demoed our Community Builder AI Parter, CoBi, at the 26th ACM Conference on Computer-Supported Cooperative Work And Social Computing (CSCW 23) in Minneapolis, Minnesota, in late October. CSCW 23 brought together top researchers and practitioners from academia and industry who are interested in both the technical and social aspects of collaboration.

D'Mello had a great response to his demonstrations, summing it up by saying "The CoBi demo and a live demo of the iSAT multimodal processing pipeline was a hit! I had non-stop action for the entire two hours of the demo session. Conference attendees were particularly intrigued by the multimodal components including gaze tracking and person re-identification."

NSF Summit for AI Institutes Leadership (SAIL)

iSAT team members (Sidney D'Mello, Peter Foltz, Thomas Breideband, Rui Zhang, and Jim Martin) attended the NSF Summit for AI Institutes Leadership (SAIL) meeting in Atlanta, Georgia. The meeting included 1) a panel discussion from the seven inaugural AI Institutes, with a presentation by Sidney on iSAT, 2) a workshop co-organized by iSAT and the five education institutes where each shared infor-

Sidney D'Mello shares the work iSAT is doing with NSF Director Dr. Sethuraman Panchanathan and Information and Intelligent Systems Division Director Dr. Micahel Littman at NSF AI Day.

mation about goals and approaches and found common ground, and 3) an AI Institutes Expo where each institute had a table to present their work and show demos to the NSF and the general public.

This was a great opportunity for iSAT team members to collaborate with other institutes. All of the AI institutes are grappling with how to best deal with the new climate created by ChatGPT, which means that there is a need for more cross-institute collaboration in regards to sharing best practices. The iSAT attendees felt that one of the highlights of the conference was the AI Expo, where each AI institute interactively exhibited its research and applications. It provided excellent engagement opportunities for researchers, along with the general public, to experience the cutting edge of AI progress.

CIRCLS 23 Convening - Shaping AI and Emerging Technologies to Empower Learning Communities

iSAT's Executive Director Peter Foltz and Post-doctoral researcher Michael Chang attended the Center for Integrative Research in Computing and Learning Sciences (CIRCLS.org) 23 convening held in November. CIRCLS is a network for researchers conducting research on emerging technologies for teaching and learning. The convening brings together researchers with educational practitioners to discuss these technologies, advances in learning sciences and approaches to equity, ethics, and responsible design for education. Peter presented in a session hosted by three of the NSF education institutes, iSAT, EngageAI and INVITE. The session focused on painting a picture of the future of AI-enhanced learning and incorporated commentary from four educational practitioners who have been integrating technologies into their school districts.

Michael Chang also co-led a session that brought together experts to discuss co-design for educational technologies. The session focused on navigating and understanding the critical tensions of working in partnership with communities to allow the CIRCLS research community to continue to move forward with co-design.

Social & Emotional Learning Exchange 2023 (SEL Exchange)

Our Interim Associate Director Dr. Thomas Breideband attended the 2023 Social & Emotional Learning (SEL) Exchange in Atlanta, Georgia. Hosted by the Collaborative for Academic, Social, and Emotional Learning (CASEL), the SEL Exchange is the nation's largest forum on SEL. This year's theme was "Leaders as Learners: Building the Village Our Children Need." His featured session titled "Tech-Hearted: Discover Practical Applications of Artificial Intelligence in Fostering Student Curiosity, Engagement and Voice" and co-led with Kelsey Behringer, CEO of Packback (a Chicago-based startup that designs AI-powered writing tutors), explored how AI can enhance students' social, emotional and academic learning. The attendees, a diverse group of learners, educators, and school administrators, were introduced to the practical applications that can help students and adults to relate, empathize, and reflect on their own learning.

We look forward to attending more engagements in the coming months - collaborating with other institutes and sharing iSAT's progress in developing and improving our AI partners.

Thomas Breidebrand gives a demonstration of our AI Partner, CoBi, at the AI Institutes Expo.

Jim Martin, Peter Foltz and Thomas Breideband answer questions at the iSAT booth at the SAIL conference.

Listen, Understand, and Connect

Strand 1

Strand 1 is guided by the foundational question: What advances in Artificial Intelligence (AI) are needed to facilitate collaborative learning conversations? The three research themes identified to help Strand 1 reach this goal are: Speech Processing & Diarization, Content Analysis & Dialog Management, and Situated Grounding.

Speech Processing & Diarization

Classrooms are noisy places and this theme is dedicated to developing ways for filtering out unwanted noise when the AI partners are used in classrooms. Several team members are hard at work at this. Worcester Polytech Institute (WPI) PhD student Jiana Wang has been exploring how to harness the angular speech direction, as estimated from a 2-microphone array that is standard in laptops and mobile phones, so as to improve speaker diarization accuracy. She is also comparing the speaker verification accuracy of different speaker embedding models such as ECAPA and WavLM. WPI Postdoctorate Viet Anh Trinh is leading a project to develop a novel neural network architecture that can both recognize and generate speech. The goal is to train such a model in unsupervised fashion so as to harness the large quantities of unlabeled iSAT data that are available. He is collaborating on this project with Rosy Southwell and Zhiyong Wang at CU Boulder.

WPI PhD student Xinlu He is analyzing the conditions under which person re-id systems fail in the challenging conditions of school classrooms. One interesting confound she is investigating is that re-id embedding systems may implicitly harness background information (e.g., a wall or a window that a student is in front of, or even another student in close proximity to the student) to determine the presence and location of students at different points in time. While this can superficially increase accuracy, it also exposes the system to a kind of bias whereby performance is good only if the student's position remains static. Moreover, she is exploring the potential benefits of "masking" the student from their background to avoid this confound. Another of our WPI PhD students, Yiwen Guan, is performing experiments on active learning and pseudo-labeling for Automatic Speech Recognition (ASR). The goal is both to harness the large quantities of unlabeled data that are available in iSAT, and to find ways to reduce the amount of annotation required for supervised learning.

Research faculty Dr. Wayne Ward is exploring whether a neural network can be trained to filter out unwanted noise and background speech from non-target speakers. The network is trained on noisy inputs (the superposition of a target speaker, a background speaker, and extraneous noise) and designed to estimate the signal of just the target speaker alone.

Speech-aware Baseline for Abstract Meaning Representation (AMR)

The Content Analysis and Dialog Management theme team has been investigating how ASR errors impact downstream Natural Language Processing (NLP) tasks, and finding significant decreases in performance. Abstract Meaning Representation (AMR) performance drops from mid 60's to around 40 while TalkMove discourse classification only drops from .72 to .64 (Cao, et. al., 2023). The team is testing whether adding synthesized speech from a Text to Speech OTS system to the training data can improve the robustness of the models' performance. Using two TTS systems (Tacotron 2 and Bark), they generated augmented speech data for two publicly available text-only AMR corpora (The Little Prince and the LDC AMR 3.0 release) and one internal classroom dataset. Altogether, the team generated 63,137 audio-text pairs for the two different versions of TTS speech, and retained real-world classroom data for a comparative analysis. For AMRs this approach gave much better results, only decreasing 3-7 points compared to the performance on the original text. However, the synthesized speech is much cleaner than the classroom data so, though promising, this is not directly comparable. They hypothesize that additional noise perturbation can better simulate the classroom data and will have potential for providing a controllable testbed for supporting multimodal AMR parsing that combines audio and text. Next, they aim to develop speech-aware models that can at least partially mitigate the performance gap in spite of the small amounts of available classroom training data.

The AMR annotation team has been diligently working on instructional materials for the Sensor Immersion class. This endeavor is geared towards furnishing verifiable resources that will enable the AI Partner to provide knowledge support in the classroom. To achieve this goal, they processed the documents using bounding boxes, streamlining the abstract meaning representation of written text, which often consists of incomplete sentences, as well as images and videos. This approach enhances the versatility of AMRs, allowing team members to extract multimodal information from various types of documents.

In addition, an exciting development is that their newly designed and developed AMR editor, CAMRA (Copilot for AMR Annotation), has been accepted for a system demonstration at the EMNLP conference in December (Cai et. al 2023). CAMRA takes a novel approach by treating AMR annotation as a programming task and offering AI suggestions to simplify some of the more tedious annotation processes, significantly enhancing the efficiency of AMR annotation. Furthermore, CAMRA has the potential to serve as an educational tool, allowing students to explore the realms of NLP and linguistics interactively.

Dependency Dialogue Acts

In addition to this theme's work on AMR, Strand 1 researchers have made significant strides in Dependency Dialog Act (DDA) annotation. After successfully annotating preliminary data, they are currently in the process of drafting a data schema and making minor adjustments to facilitate the sharing of annotations with iSAT's broader collaborators.

They are also gearing up to annotate Sensor Immersion dialogs, with the added support of videos, and working on integrating both DDA and AMR into the CoBi system. This integration will provide comprehensive content analysis support to the classroom, enhancing the educational experience.

Dialogue Management + Interaction for JIA

CU PhD Student Maggie Perkoff has been reviewing the Computer Supported Collaborative Learning (CSCL) literature for the interactive component of the Jigsaw Interactive Agent (JIA). The resulting dialog system design will incorporate a dialog policy to constrain the output of the conversational agent in a way that mimics the actions that a teacher would take in a given scenario. In order to create this dialog policy, she is working alongside PhD Student Emily Doherty from Strand 2. They created an initial dialog policy and facilitated a collaborative session alongside Dr. Sadhana Puntambekar, Dr. Jamie Gorman, Dr. Peter Foltz, Dr. Martha Palmer, Dr. Leanne Hirschfeld, and PhD student Michal Bodzianowski. The result of this collaborative session is a mapping between a set of dialog states representing the current status of the collaborative effort between students and dialog actions that the conversational agent can take. They have associated these states and actions with concrete dialog features including DDAs and CPS annotations so an agent could identify them during a JIA session and respond appropriately. The output dialog actions and their corresponding DDA will be used as input to a controllable response generation model.

Situated Grounding

Understanding the common ground teachers and students establish when interacting with one another, such as their behavioral and verbal cues, as well as prior goals, expectations, and beliefs they bring into the classroom, is the job of the Situated Grounding team. Currently, they are performing experiments and developing models to help track engagement and both individual and group sentiment in classroom interactions. But speech is only one of multiple channels employed in such interactions, which include gesture, gaze, facial expressions, body pose, and the actions performed by the students. For this reason, in order to identify and attribute mental states such as beliefs (true or false), desires, and intentions to the students (and thereby predict and explain behavior), they have been performing multi-channel annotation over the Weights Task (multi-student multimodal task-oriented dialogues), to collect data for training a Common Ground Tracking (CGT) algorithm. CGT identifies the shared belief space held by all of the participants in a task-oriented dialogue.

They annotate a dataset of multimodal interactions in a shared physical space with speech transcriptions, prosodic features, gestures, actions, and facets of collaboration, and operationalize these features for use in a deep neural model to predict moves toward construction of common ground. Model outputs cascade into a set of formal closure rules derived from situated evidence and belief axioms and update operations. Then, they empirically assess the contribution of each feature type toward successful construction of common ground relative to ground truth.

The team is also developing methods for gesture and action recognition in group contexts, primarily focusing on detecting deictic gestures (pointing), and then extrapolating the targets of those deixes using the semantics of "pointing cones" previously developed by the gesture semantics community. Being able to determine the targets of pointing in real time is an important step toward determining items in the scene that are likely to be the focus of attention and therefore collaborative acts. Additionally, they expect their methods to detect pointing to provide an important starting point for detecting other types of gestures and actions in context.

Here are some of our hardworking Strand 1 team members.

Orchestrating Effective Interactions

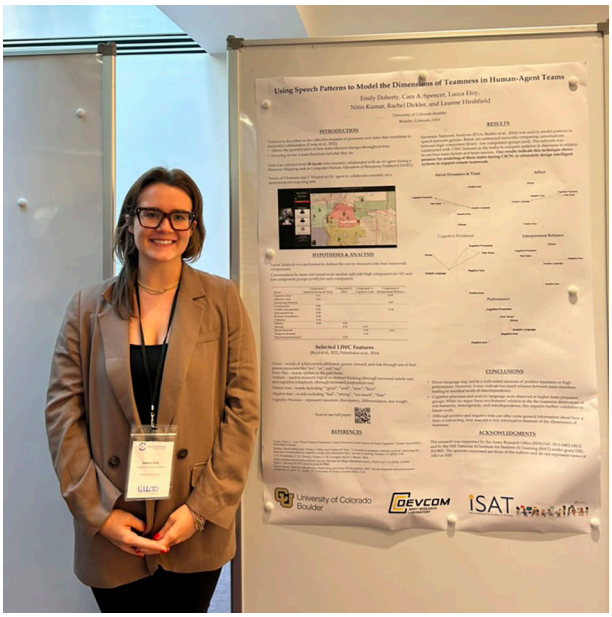
Strand 2

Strand 2 is guided by the foundational question: What advances in theories, interaction-paradigms, and frameworks are needed to orchestrate effective student and teacher interactions with AI partners? The three research themes identified to help Strand 2 reach this goal are: Dynamic Framework & Measures of Collaboration, Collaborative Learning (non-verbal and verbal communication; peer scaffolding), and UX Design & Multimodal Modeling.

Dynamic Measures of Collaboration

Team members have been hard at work to bridge the gap between researcher and student perspectives by incorporating student perceptions of event boundaries between collaborative stages into the framework.

They are currently focused on three projects. First, using data from the Year 3 Data Jam, Strand 2 researchers are developing a multimodal measure of influence, defined as the degree to which individual team members can change the pattern at the team level. This work is motivated by the proposition that in social interactions, influence is a generalizable coordination mechanism that flows through speech, direction of eye gaze, and gesture. They are currently using eye gaze and speech (who is talking and when) to measure multimodal influence on collaborative problem solving (CPS) at the team level to predict performance outcomes in two of the iSAT Laboratory tasks, MakeCode and Weights. Second, working with Strand 3, the team is validating the existing communication-based influence measure using students' perceptions of collaborative learning to understand which aspects of influence are measured by the real-time influence metrics.



Strand 2 team member Emily Doherty presents her paper at the 25th ACM International Conference on Multimodal Interaction in Paris, France.

This project utilizes existing SEET data from Sensor Immersion to tie the algorithmic detection of communicative influence to students' feelings of their influence during team collaboration. PhD student Julie Harrison is using Event Segmentation Theory to address the question of whether events detected in CPS measurements are perceived from the perspective of the collaborating team members. This project serves as the cornerstone of Julie's PhD dissertation that is examining a three-level measurement framework combining first-person event cognition, the temporal dynamics of team communication, and CPS measurement to advance a multilevel theory of CPS measurement.

Collaborative Learning

This theme focuses on identifying verbal and non-verbal modes of collaborative engagement and identifying peer scaffolding moves, as well as understanding how peers support each other during collaborative learning. Over the past few months, the team has been applying Social Network analysis to examine verbal and non-verbal interactions among group members to classify an instance as reciprocal or transitive, by using a moving window to account for the temporal nature of the interactions. Additionally, they are also applying the Non Verbal Interactions in Collaborative Environments (NICE) framework to videos to discern nonverbal interactions at the individual level, and to gain a more comprehensive understanding of the process of collaboration and the nature of interactions among all group members, at any particular point in time.

In the iSAT Lab

The lab team continues to lead iterative design sessions with stakeholders across iSAT to develop the Jigsaw Interactive Agent (JIA) AI Partner. The goal of these lab studies is to develop a 'Jigsaw AI agent' to support multiple groups while they collaborate during Jigsaw activities, to achieve the outcomes for which Jigsaw was originally intended, with a focus on: Improving collaborative problem solving, increasing equity during group interactions by uplifting on-topic dialogue of voices that have low influence in the group, and increasing student motivation and self-confidence. They have also started experiments in the iSAT Lab where they have Wizards playing the role of the JIA AI Partner while study participants work on Sensor Immersion-based Jigsaw activities. Strand 3 classroom experts are playing the role of the Wizards, and those data collections will be used to develop an initial dialog policy that can inform the JIA agent from Strand 1.

Engaging Youth

Strand 3

Strand 3 is guided by the foundational question: In what ways can inclusive co-design processes empower stakeholders with diverse identities to envision, co-create, critique, and apply Artificial Intelligent learning technologies for their schools and communities? The three research themes identified to help Strand 3 reach this goal are: Learning Futures Workshop, Games Unit, and Sensor Immersion Unit.

Learning Futures Workshop

After the Learning Futures Workshop (LFW) team hosted the third installment of its annual spring workshop, they came away with three key points. First, when youth speculate about worlds that do not yet exist, there often seems to be a substantial gap between values and world building. Second, the technical imagination can get in the way of the critical imagination surrounding the purpose and role of schools. And third, alternative but familiar social institutions (such as cooperative living spaces) can help facilitate expansive dreaming about ideal futures. Building upon these findings, the LFW team has been developing a comprehensive program around engaging youth and their family members in surfacing hopes and concerns about the use of Artificial Intelligence (AI) in schools. The team has worked with iSAT interns from local high schools to co-design a novel curricular routine that supports youth and their parents in learning about AI; LFW researchers have also coordinated with iSAT's Self-Driving Cars team to integrate this routine into the unit. In December, they will run a Professional Learning session with teachers from partner schools to further co-design the routine, and hope to enact the routine in classrooms this Spring. The team is also in the process of building partnerships with youth organizations that most commonly partner with historically minoritized youth from local schools. The goal is to engage parents of those youth in a focus group activity, and then further engage youth and student organizations as part of the next spring LFW in 2024.

iSAT high school interns present to iSAT team members.

Games Unit

The Games Unit team guides the implementation of the Games Unit curriculum - a sequence of nine lessons designed to focus on teaching AI through investigating causes of racism in gaming and what to do about it - as well as holds Professional Learnings for iSAT's partner teachers. The team recently revised the curriculum unit, with input from district partners and cross-strand iSAT researchers. The purposes of the revisions were to improve implementation, address AI learning goals that students were having trouble meeting, and prepare for integration with the AI partners. One of the challenges to the implementation has been that AI education is not part of any tested academic standards. To help resolve this, the team created a tighter alignment of the unit to engineering practices emphasized in the Next Generation Science Standards (NGSS; NGSS Lead States, 2013). In addition, to align with district goals, they constructed better alignment with the district's Culturally Responsive Mindsets for educators for the Professional Learning workshop associated with the unit. They also shortened the unit and created multiple pathways throughout to support teachers' future adaptations to the disciplinary subject areas that they teach, as well as tightened the driving questions and key outcomes of the unit to be focused on designing a solution to the problem of moderating online communities to be more inclusive and welcoming, using human moderators collaborating with AI. This sharper focus has allowed the team to strengthen the lessons about algorithmic bias. It also prepared them for a smooth integration of a set of routines for developing and revisiting classroom agreements for collaboration where teachers and students would use the AI partners. Now, the focus on rules and expectations for how students will interact with one another in the classroom mirrors the focus of the unit on how an online gaming community can moderate itself.

Sensor Immersion

The Sensor Immersion team has continued to work with iSAT's partner teachers to co-design the Self-Driving Car curriculum. Teachers met in after-school Professional Learning sessions to engage with the latest version of the curriculum, improve on the design, and practice the technical aspects of the curriculum in preparation for implementation this coming semester. They have also been coordinating with the LFW team to plan a family engagement routine to co-design with Sensor Immersion teachers and (eventually) pilot with the Self-Driving Cars curriculum. This planning involves bringing together activities that teachers can use as editable puzzle pieces to assemble lessons where students engage with their families about how AI can support collaboration, how classroom experience with AI can be responsive to the local needs of families and communities, and what it means to engage with AI ethically and responsibly.

To support the Sensor Immersion team, the Moments of Support Analysis in Collaboration (MOSAIC) group has been hard at work finishing protocol validation and video coding, which consisted of analyzing over 600 key moments where student groups working in the Sensor Immersion curriculum received some form of support. The analysis revealed a predominance of support focusing on task instructions, with collaboration-focused support being notably less frequent. Employing both quantitative and qualitative methods, they explored the factors that influenced the support that students received, especially the kind of support that focuses on meta-collaboration; they found that both the activity design and the conditions of support play a crucial role in shaping both the nature and consequences of the support provided.

Data Collection, Architecture & Implementation

Institute-wide

The Institute-Wide team provides resources (data, annotations, technology) to guide iSAT's core research. The three themes are: Classroom Data Collection and Coordinated Analysis, Technical Architecture, and AI Partner Design, Implementation, and Testing.

Classroom Data Collection and Coordinated Analysis

A major goal of this team has been to improve and streamline the data collection process. To help achieve this, data collectors underwent field notes training so that their efforts can shift to focusing on taking classroom notes as students and teachers engage with the AI partners. Another ongoing question for the team is how to improve the data transcription process. This fall, they tried a new classroom video transcriber that utilized HappyScribe for providing a base transcript, which researchers then edited, resulting in improved efficiency. This has now become protocol moving forward. For improving our Collaborative Problem Solving (CPS) Annotation, data collectors transcribed a small set of jigsaw videos from the 2022-2023 school year and adapted a coding scheme to the jigsaw activity in the Sensor Immersion curriculum unit, coding these transcriptions. The team is currently preparing a longitudinal study from the Sensor Immersion data.

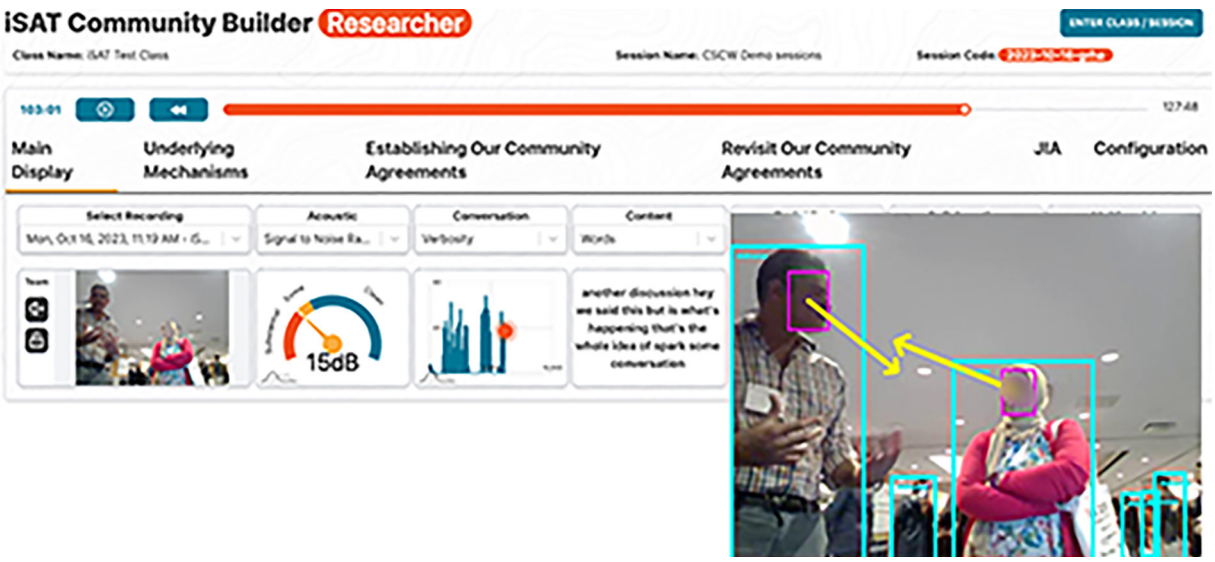
Technical Architecture

This team develops the core infrastructure and components for our AI partners CoBi and JIA, supports secure data storage and access to data collections from the classroom and lab, configures and operates cloud infrastructure all the while supporting iSAT's any and all computing needs. One of the most exciting updates over the last few months has been the implementation of version 1 of the Jigsaw Interactive Agent (JIA) - our interactive agent designed to help students share knowledge to build common ground and use that knowledge for project planning. A pilot version of JIA is slated to be tested in classrooms at the beginning of next year. The team has also implemented a cloud infrastructure for the JIA web-based user interface including Wizard of Oz functionalities (to test user interactions), and the JIA agent itself; a cloud infrastructure for Abstract Meaning Representation analysis is slated to be completed by the end of the year. Collaborating with iSAT's development partner Curve 10, the Technical Architecture theme also updated the iSAT Recorder to deploy and operate in the cloud using "Infrastructure as Code", greatly simplifying deploying, operating, and maintaining the Recorder. This paves the way for sharing the Recorder technology with others, which is a significant milestone!

Other accomplishments this fall include updating the custom iSAT MakeCode interface to capture student coding progressions in the Blocky programming language and being able to host it on the web, along with implementing an architecture for performing ASR and diarization on-device to increase response time for the real-time AI Partners.

AI Partner Design, Implementation & Testing

After going through several upgrades over summer, an improved version of CoBi was ready for teachers and students this fall. The Implementation & Testing team updated the user interfaces (UIs) in terms of functionality - allowing teachers, students and researchers to enter the class code and / or session code themselves to access CoBi. Teachers are now much more involved with navigating the UIs and the team will soon be testing the efficacy of CoBi and whether it improves learning. They have also developed a sentence cloud visualization to complement the CoBi tree and the radar displays. This is designed to serve two purposes: first, it provides a type of qualitative visualization that may be more immediately familiar and second, it directly communicates CoBi's noticings to the class. The aim is to increase the transparency and explainability of how CoBi goes about its analysis of small group student talk.



Sidney D'Mello does a live demo of iSAT's computational modeling pipeline at the 2023 ACM Computer Supported Collaborative Work Conference in Minneapolis, MN.

Member Spotlight

Learn more about our members!

Meet Nikhil Krishnaswamy, a Strand 1 member and also the PI of the Colorado State team, who focuses primarily on multimodal AI, including integrating language, visual, gestural, and other signals, for a complete scene and interaction understanding.

Q: What does your research focus on?

A: My research (within iSAT and beyond) broadly focuses on 1) studying language by building computer system that use language in different ways and studying how humans interact with those systems, and 2) examining the mathematical and geometric properties of AI models that represent language other modalities, and studying how those representations align (or not) with representations we observe in humans.

Q: What is the coolest thing about your research?

A: NLP is hot right now, and for better or for worse, this is thanks to ChatGPT and other large language models. This has come at a great time in my career because it's given me ample opportunity to talk about my research to public media and other outlets, which has given me the chance (and obligation) to talk about deep technical problems to multiple different audiences at multiple levels.

Q: What has been a turning point or defining moment in your career?

A: One was the Great Recession of 2008-09 which really crystallized my decision to go to graduate school. There, working with James Pustejovsky (also iSAT Strand 1), I realized how much I loved both studying language and the process of doing research, and steered me into an academic career. The second might be right now. AI and NLP specifically are changing the world in ways we don't quite yet know how. This could be a great benefit to society or cause great problems. Most likely it'll be a bit of both. I feel lucky to be in a position in which I have a voice and some standing to shape the terms of that discussion, and hope to steer developments in a positive direction for all, as much as I am able to.

Q: What do you like to do outside of work?

A: Outside of work I spend time with my family, playing with my kids and our two cats. My wife and I both really like to travel so we do that when we can. I also play the guitar and I'm an avid runner, coming up on my tenth marathon!

Meet Emily Doherty - a Strand 2 PhD Student & Research Assistant who is advised by Leanne Hirshfield. Her research focus is Human-AI interaction using multimodal measurements including neurophysiological signals (fNIRS, eye-gaze, galvanic skin response, etc.), behavioral survey measures, and objective performance.

Q: What are you working on?

A: Currently I'm working on developing the JIA WoZ study in the iSAT lab and controllable response generation for our future JIA agent. I'm also working with Peter Foltz on modeling discourse on the individual and team levels in small group collaboration. My interests are in creating equitable and responsible AI with special consideration of historically underrepresented populations in research (children, people with disabilities, non-native English speakers).

Q: How does your research contribute to iSAT?

A: My research contributes to iSAT as a whole because much of the basic experimental research takes place in the iSAT lab which allows us to test agent prototypes, study collaboration in a controlled environment, and reiterate the research process.

Q: What is a fun fact about you?

A: I'm learning German and I love to tap dance!

New Quarter, New Faces!

Growing our team and our impact.

We're excited to welcome new members to our team! Here are four featured below.

Marissa Chitwood is an Institute-wide Graduate Student Research Assistant who uses her background in Psychology and Neuroscience to support interdisciplinary research conducted in each Strand. Her research is centered on supporting innovative research methods to work towards improving ecological validity and reliability of research findings within cognitive science. Before joining iSAT, Marissa was a Graduate Design Researcher in W. Geoffrey Wright's Motion-Action-Perception Lab at Temple University.

Sean von Bayern is a Natural Language Processing Engineer with Strand 1. He received his undergraduate degree in Communications from Evergreen State College and is currently working toward his MS in Computational Linguistics at University of Colorado Boulder.

Rui Zhang is a Strand 2 Research Associate who focuses on the development of efficient AI teammates in education. She is interested in creating interactive student-AI teaming environments with high transparency and high trust, as well as exploring how to equip students with individual and team trainings to better collaborate with AI agents. Rui received her PhD in Human-Centered Computing with a focus on human-AI collaboration from Clemson University, where she studied AI ethics and AI communication in human-AI teams.

Gregory Benedis-Grab is a Strand 3 Research Scientist focusing on the translational impact of the project's research findings. His research focus is on student and teacher learning, professional learning, and teacher agency. Before joining iSAT, Greg worked in schools as a teacher and administrator for 25 years. He led professional learning sessions for teachers in Science, STEM and Computer Science globally. In 2010 he received the Presidential Award for Excellence in Science & Mathematics Teaching from Barack Obama.

Welcome Marissa, Sean, Rui and Greg!

Marissa Chitwood
Institute-wide
Research Assistant

Sean von Bayern
Natural Language Processing
Engineer

Rui Zhang
Strand 2
Research Assistant

Gregory Benedis-Grab
Strand 3
Research Scientist

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info.ai-institute@colorado.edu

www.colorado.edu/research/ai-institute/

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iSAT Publications and Outreach

Published / Accepted

Andrews-Todd, J., Jiang, Y., Steinberg, J., Pugh, S. L., & D'Mello, S. K. (2023). Investigating collaborative problem solving behaviors and outcomes across academic domains. Computers & Education.

Cai, J. Z., Ahmen, S. R., Bonn, J., Wright-Bettner, K. Palmer, M., Martin, J. H. (2023). Copilot for AMR Annotation. In Proceedings of the 2023 Conference on Empirical Methods in Natural Language Processing: System Demonstrations.

Chandler, C., Reitman, J., Breideband, T., Chitwood, M., Howard, A., Leonhart, S., Foltz, P., Penuel, W. R., D'Mello., S.K. CoBi AI Partner: Computational Modeling of Collaborative Discourse to Enable Feedback and Reflection in Middle School Classrooms Proceedings of Learning Analytics and Knowledge Conference 2024 (LAK 24).

Demszky, D., Bush, J. B., D'Mello, S. K., Jacobs, J., Hau, I., Hill, H., Liu, J., Loeb, S., Maples, B., Peppler, K., Pokorny, R., Rascoff, M., Robinson, J., Yeager, D., & Wentworth, L. (2023). Empowering Educators via Language Technology.

D'Mello, S. K., Duran, N., Michaels, A., & Stewart, A. (2023). Improving Collaborative Problem Solving Skills via Automated Feedback & Scaffolding: A Quasi-Experimental Study with CPSCoach. User Modeling and User-Adapted Interaction.

Submitted / Under Review

Cao, J., Cai, J., Trinh, V., Southwell, R., Whitehill, J., Flanigan, J., Martin, J., Palmer, M. Speech-aware AMR Parsing. In Proceedings of The 2024 Joint International Conference on Computational Linguistics, Language Resources and Evaluation (LREC-COLING 2024).

Chang, M. A. and Philip, T. M. Caught between Expansive Dreaming and the Status Quo: Using Figured Worlds to Understand World-Building in Co-design Contexts. Journal of the Learning Sciences.

Chang M. A., Tissenbaum, M., Philip, T. M., D'Mello, S. Co-designing AI with Youth Partners: Enabling Ideal Classroom Relationships through a Novel AI Privacy Framework. Computers & Education.

Hoang, N., Bush, J., Dey, I., Watts, E., Clevenger, C., Penuel. W. Lessons Learned from Applying the Moments of Support Analysis in Collaboration (MOSAIC) Protocol to Videos of Middle School STEM Classroom Student Group Work. In Proceedings of the International Society of the Learning Sciences (ISLS 2024).

Khebour, I., Brutti, R., Dey, I., Dickler, R., Sikes, K., Lai, K., Bradford, M., Cates, B., Hansen, P., Jung, C., Wisniewski, B., Terpstra, C., Hirshfield, L., Puntambekar, S., Blanchard, N., Pustejovsky, J., Krishnaswamy, N. When Text and Speech are Not Enough: A Multimodal Dataset of Collaboration in a Situated Task. Journal of Open Humanities Data.

Khebour, I., Lai, K., Bradford, M., Zhu, Y., Brutti, R., Tam, C., Tu, J., Ibarra, B., Blanchard, N., Krishnaswamy, N., Pustejovsky, J. Common Ground Tracking In Multimodal Dialogue. In Proceedings of The 2024 Joint International Conference on Computational Linguistics, Language Resources and Evaluation (LREC-COLING 2024).

Konigari, R., Ganesh, A., Palmer, M., Kann, K. Evaluating Transition Sentences in Conversational AI Systems. In Proceedings of The 18th Conference of the European Chapter of the Association for Computational Linguistics (EACL 2024).

Lai, K., Bradford, M., Brutti, R., Khebour, I., Tam, C., Zhu, Y., Krishnaswamy, N., Pustejovsky, J. Modeling Theory of Mind in Multimodal HCI. In Proceedings of the 26th International Conference on Human Computer Interaction (HCII 2024).

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