Improving Online Learning

Bio-Sensing Interactive Conversational Agent

6/11/24

Team Accenture
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01 Project Summary

Project Summary

Problem to address: Employers are having a hard time upskilling their employees.

"Continually developing job skills is essential for organizations and individuals to stay relevant and competitive, but while 80 percent of employers offer upskilling benefits, only 51 percent of employees use them."—SHRM | Workplace News & Trends 2023

Goal: Design a conversational agent with bio sensing capabilities to improve the upskilling and training experience for employees.

Final Deliverables: Online learning platform with an interactive, bio-sensing conversational agent.

Research Questions:

1. What are significant pain points users experience concerning upskilling/evaluation in a corporate setting?
2. What current methods do/don't work?
3. How can incorporating a conversational agent help improve learning outcomes?

What we tackled this quarter: Investigating the problem space through surveys and interviews, identified pain points in training/upskilling - answering RQ's 1 and 2, using data to guide design concepts to answer RQ 3 in the summer (WoZ study)

02 USER RESEARCH

Investigating upskilling/training experiences of professionals

Methods

Literature Review

Read literature in the realm of conversational agents, cognitive load theory and measurement.

Surveys

We sent qualitative surveys through our recruitment posters to gather initial data on experiences on upskilling/training and relevant pain points.

Semi-Structured Interviews

Out of 60+ survey respondents, we interviewed 12 participants for in-depth perspectives on upskilling/training.

Thematic Analysis

We took qualitative data from our surveys and interviews to determine relevant themes and guide our design concepts.

Research Method #1: Literature Review

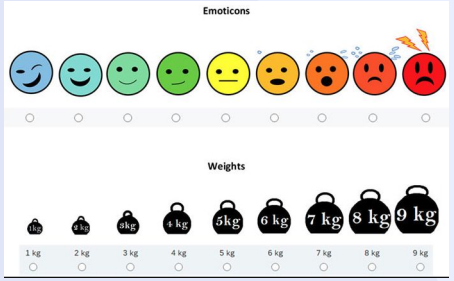
We reviewed literature that discusses how user expectations and expertise informs design features and criteria. We read papers on measuring cognitive load to better understand mental demand and engagement in users partaking in learning experiences. We also looked at digitally embodied conversational agents and their social interactions with human users.

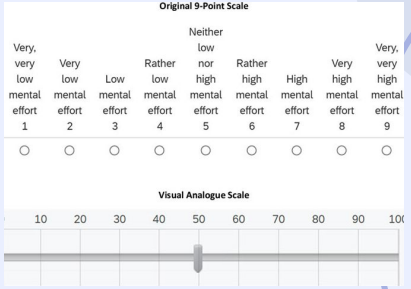
Measuring Cognitive Load: Are There More Valid Alternatives to Likert Rating Scales?

Cooking with Conversation: Enhancing User Engagement and Learning with a Knowledge-enhancing Assistant

ALEXANDER FRUMMET, University of Regensburg, Regensburg, Germany
ALESSANDRO SPEGGIORIN, University of Glasgow, Glasgow, United Kingdom
DAVID ELSWEILER, University of Regensburg, Regensburg, Germany
ANTON LEUSKI, University of Southern California, Los Angeles, USA
JEFF DALTON, University of Edinburgh, Edinburgh, United Kingdom

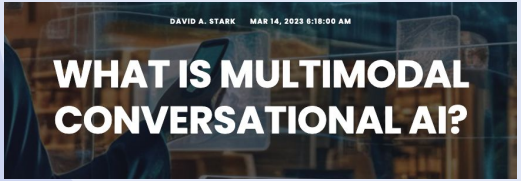
We present two empirical studies to investigate users' expectations and behaviours when using digital assistants, such as Alexa and Google Home, in a kitchen context: First, a survey (N = 200) queries participants on their expectations for the kinds of information that such systems should be able to provide. While consensus exists on expecting information about cooking steps and processes, younger participants who enjoy cooking





Research Method #1: Literature Review

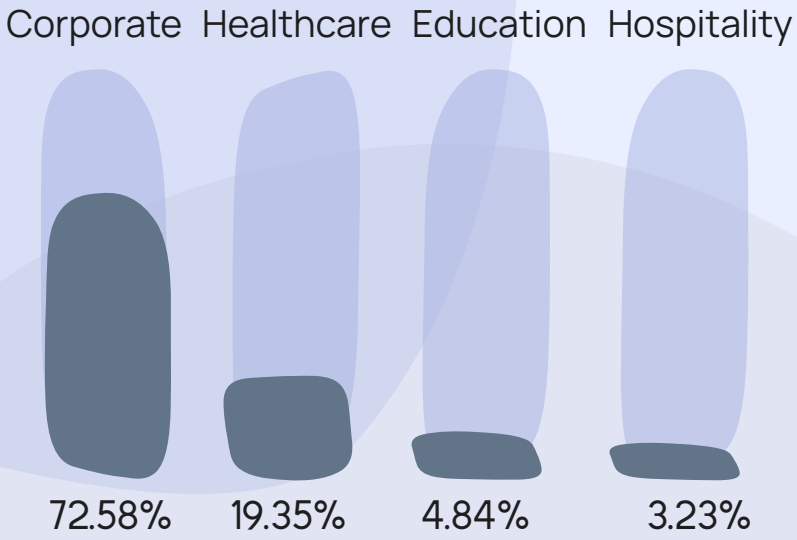
We also looked at literature that discussed the mechanisms of multimodal conversational agents with biosensing capabilities. As well as explored how cognitive and perceptual loads affect brain network efficiency and behavioral variability in individuals with Attention-Deficit/Hyperactivity Disorder (ADHD).



Cognitive and perceptual load have opposing effects on brain network efficiency and behavioral variability in ADHD

Participants

Industry



GENDER

44% Male

56% Female

Recruitment

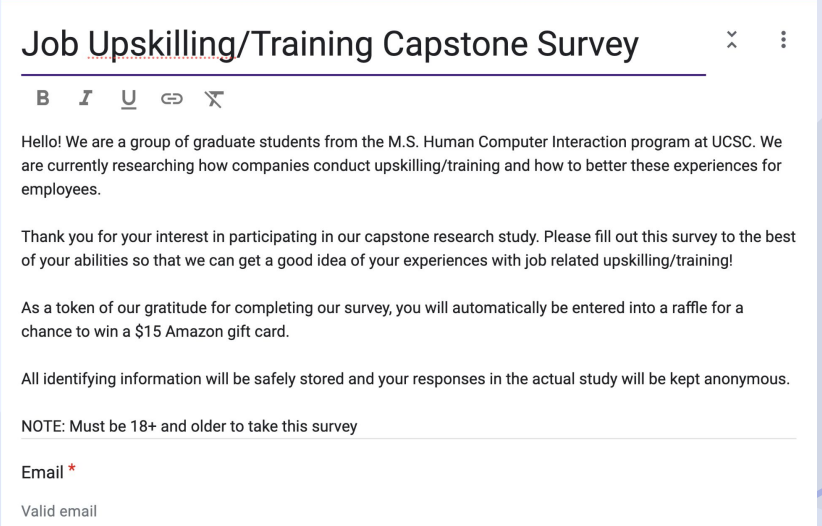
- Participants were recruited primarily through social media posts and internal connections
- Participants were chosen based on who had taken an upskilling/training course before
- Interview participants were chosen based on diversifying pool of interviewees and availability

Research Method #1: Surveys

To begin our research we decided to deploy an exploratory online survey that featured multiple-choice, short-answer, and likert scale questions. This method allowed us to source & categorize open-ended interview participants and inform the direction of further research.

We received:

- 60+ legitimate responses.



Job Upskilling/Training Capstone Survey

Hello! We are a group of graduate students from the M.S. Human Computer Interaction program at UCSC. We are currently researching how companies conduct upskilling/training and how to better these experiences for employees.

Thank you for your interest in participating in our capstone research study. Please fill out this survey to the best of your abilities so that we can get a good idea of your experiences with job related upskilling/training!

As a token of our gratitude for completing our survey, you will automatically be entered into a raffle for a chance to win a $15 Amazon gift card.

All identifying information will be safely stored and your responses in the actual study will be kept anonymous.

NOTE: Must be 18+ and older to take this survey

Email *

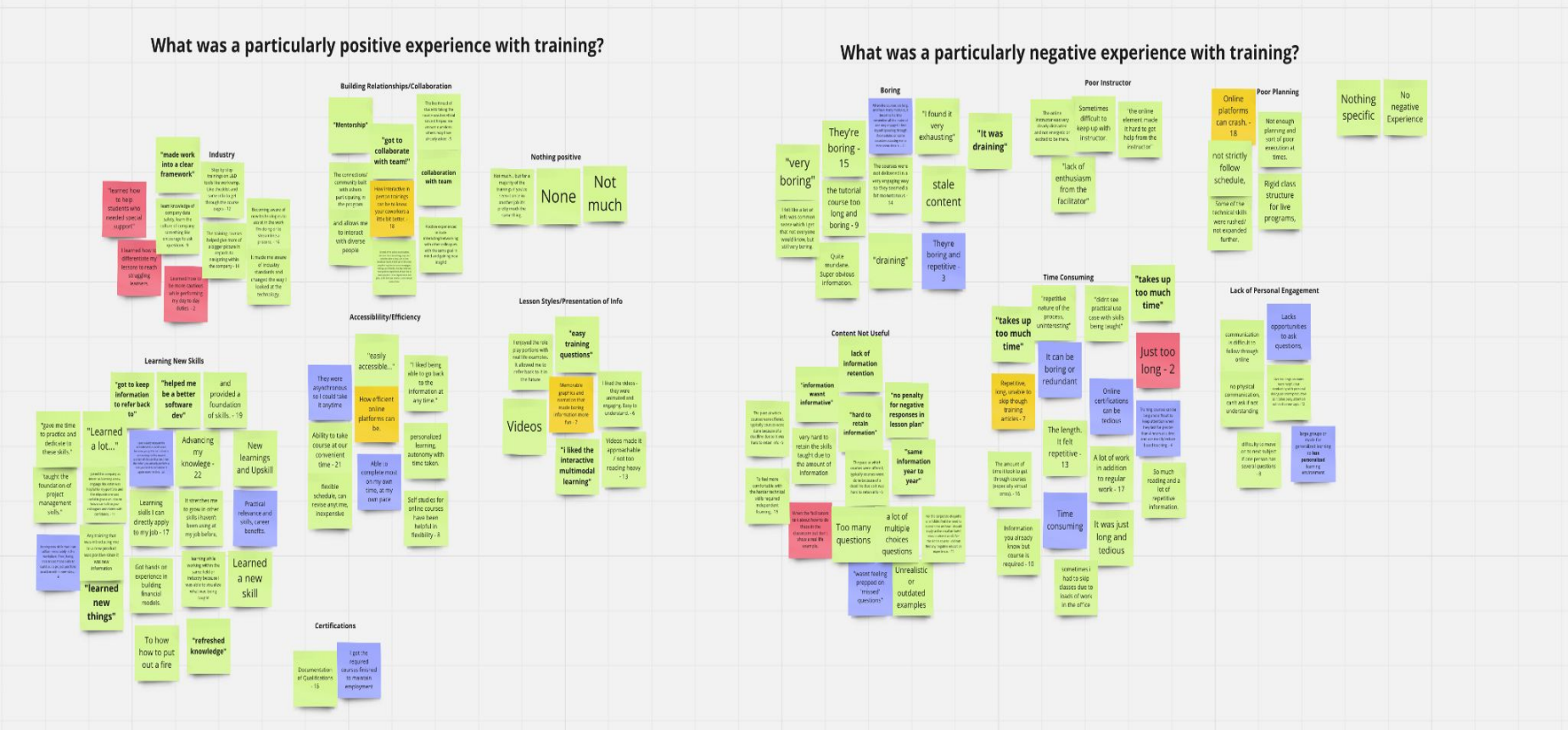
Valid email

Analysis: Surveys

Data Cleaning: We initially received hundreds of responses to our survey. We began our analysis by carefully reviewing responses and discarding data believed to be fraudulent–this left us with 60+.

Thematic Coding: Collaborating with Miro segmented insights into “positive” and “negative”. We were then able to identify recurring themes.

Timeline: This analysis was done in tandem with other research activities – our findings informed later research.



Miro board with thematic analysis of survey responses

Research Method #2: Semi-Structured Interviews

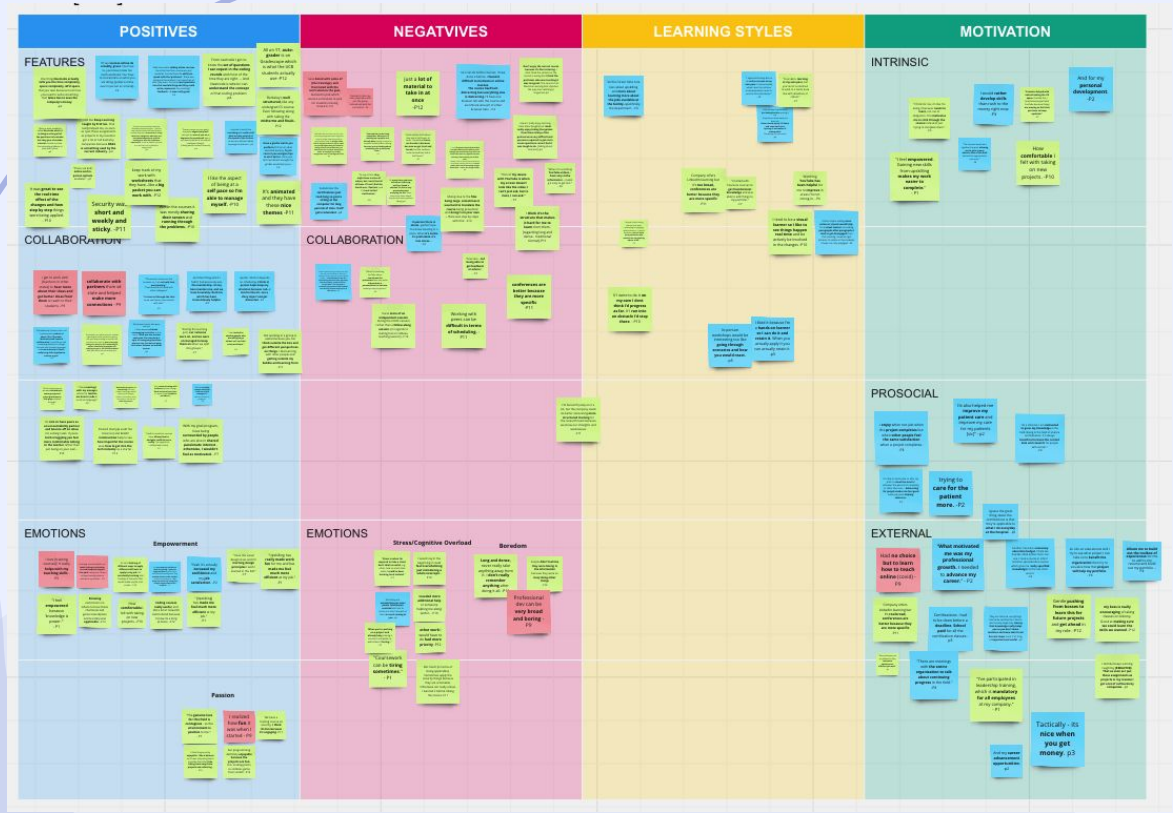
To gain deeper insights into the upskilling problem space and understand different learning materials' pro and cons, we conducted interviews with young working professionals.

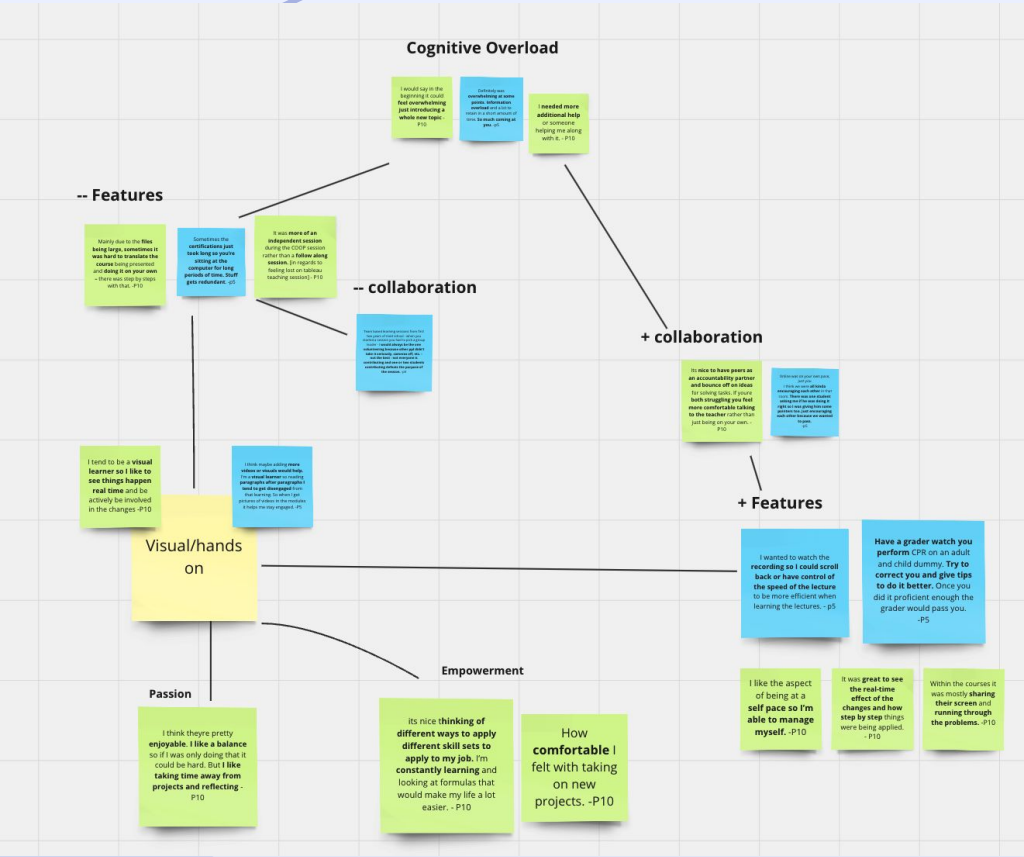
- 30 minutes video calls held over Google Meet
  - 12 participants
    - 25% tech, 30% healthcare, 20% graduate students, 25% other
- Semi-structured interviews allow us to go in depth and follow through with stories and ask follow up questions
- Data was analyzed using thematic analysis and affinity mapping.

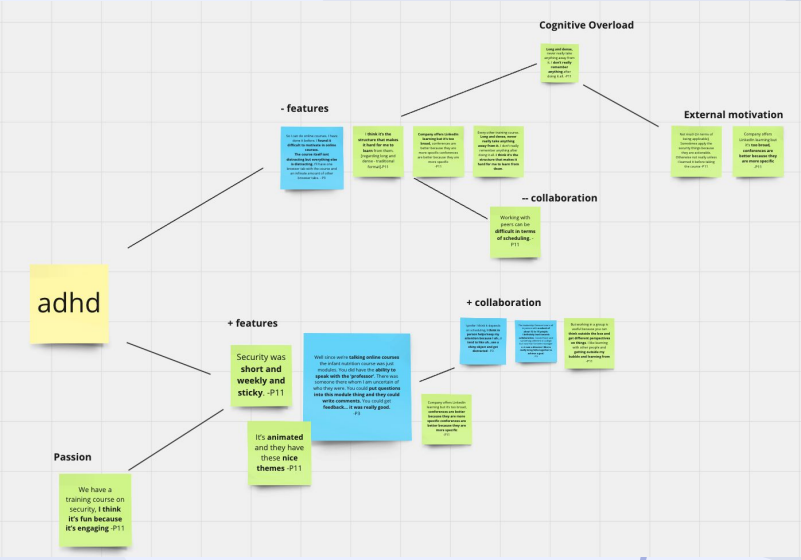
Research Method #2: Semi-Structured Interviews Analysis

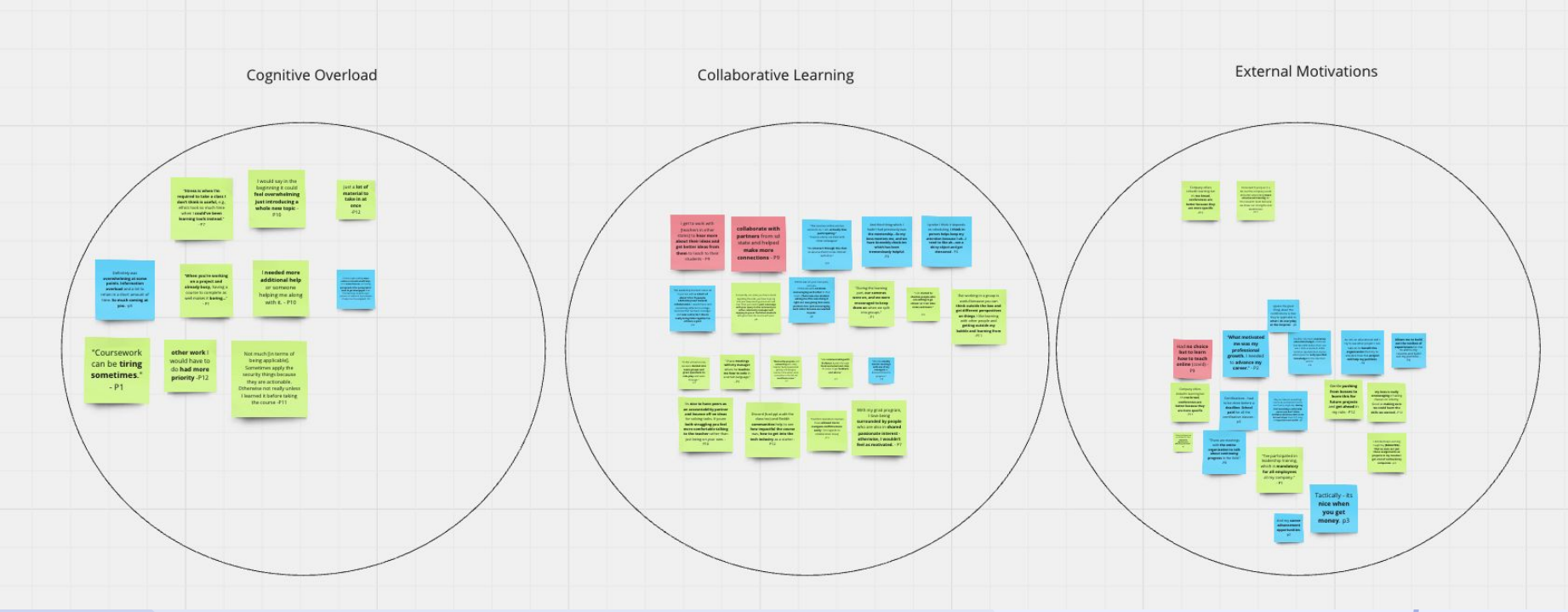
Data was analyzed using thematic analysis and affinity mapping.

- **Transcript Review:** Interview transcripts were coded and analyzed and debriefed to identify similarities and themes across participants.
- **Affinity mapping**: Standout quotes were highlighted and transferred into a miro board for a big picture - data analysis, where themes and findings were categorized into groups and themes.
- **Thematic analysis:** Data was analyzed and synthesized into a report of the top findings.


POSITIVES
NEGATVIVES
LEARNING STYLES
MOTIVATION
FEATURES
COLLABORATION
EMOTIONS
Empowerment
Passion
Stress/Cognitive Overload
Boredom
INTRINSIC
PROSOCIAL
EXTERNAL


Cognitive Overload
I would say in the beginning it could **feel overwhelming just introducing a whole new topic**. - P10
Definitely was **overwhelming at some point**, it felt **somewhat** overload and a lot to retain in a short amount of time. **So much coming at you**. -p5
I **needed more additional help** or someone helping me along with it. - P10
-- Features
Mainly due to the **files being large, sometimes it was hard to translate the course** being presented and **doing it on your own** – there was step by steps with that. -P10
Sometimes the **certifications just took long so you're sitting at the computer for long periods of time. Stuff gets redundant**. -p5
It was **more of an independent session** during the COOP session rather than a **follow along session.** [In regards to feeling lost on tableau teaching session] - P10
-- collaboration
Yeah I hated knowing someone from full-time years of street smart - what you know - I'm a complete idiot. Yeah, I hate that. **I would always let the** [illegible] **volunteering because other ppl didn't** [illegible] **I felt bad for them. I felt bad for** [illegible] **and everyone is overthinking and** [illegible] **and I felt bad for them. I felt bad for the** [illegible] **of the session**. -P
+ collaboration
Its **nice to have peers as an accountability partner and bounce off on ideas** for solving tasks. If you're **both struggling you feel more comfortable talking to the teacher** rather than just being on your own. - P10
"Ill let one of your own pace, Ill let you do it."
I think we were **all kinda encouraging each other** in that way. We were **all kinda** [illegible] **asking** [illegible] **the** [illegible] **doing it right** [illegible] **so** [illegible] **giving hints** [illegible] **each other because we were mainly in pairs**. -p5
I tend to be a **visual learner so I like to see things happen real time** and be actively be involved in the changes -P10
I think maybe adding **more videos or visuals would help.** I'm a **visual learner** so reading **paragraphs after paragraphs I tend to get disengaged** from that learning. So when I get pictures of videos in the modules it helps me stay engaged. -P5
Visual/hands on
+ Features
I wanted to watch the **recording so I could scroll back or have control of the speed of the lecture** to be more efficient when learning the lectures. - p5
Have a grader watch you perform CPR on an adult and child dummy. **Try to correct you and give tips to do it better.** Once you did it proficient enough the grader would pass you. -P5
Passion
I think theyre pretty **enjoyable**. **I like a balance** so if I was only doing that it could be hard. But **I like taking time away from projects and reflecting** - P10
Empowerment
its nice **thinking of different ways to apply different skill sets to apply to my job.** I'm **constantly learning** and looking at formulas that would make my life a lot easier. - P10
How **comfortable** I felt with taking on new projects. -P10
I like the aspect of being at a **self pace so I'm able to manage myself**. -P10
It was **great to see the real-time effect of the changes and how step by step** things were being applied. - P10
Within the courses it was mostly **sharing their screen** and **running through the problems**. -P10


Cognitive Overload
Long and dense, never really who **I don't really remember** everything. -P11
- features
External motivation
-- collaboration
adhd
+ features
+ collaboration
Passion


Cognitive Overload
"Knowledge is where the required to take a class I don't think is useful, e.g. ethics back in depth time when I could've been learning tools instead." - P7
I would say in the beginning it could feel overwhelming just introducing a whole new topic - P10
just a lot of material to take in at once -P12
Definitely was overwhelming at some points. Information overload and a lot to retain in a short amount of time. So much coming at you. - p5
"When you're working on a project and already busy. Having a course to complete as well makes it feeling... - P1
I needed more additional help or someone helping me along with it. - P10
"Coursework can be tiring sometimes." - P1
other work I would have to do had more priority -P12
Not much (in terms of being applicable). Sometimes apply the security things because they are actionable. Otherwise not really unless I learned it before taking the course -P11
Collaborative Learning
I get to work with [teachers in other states] to learn more about their ideas and get better ideas from them to teach to their students - P9
collaborate with partners from all state and helped make more connections - P9
Everyone is in your corner, and they want you to succeed. Everyone is right on! Jumping from class to class, I felt like I was starting over, and was encouraged to keep done as areas are split into groups? - P1
During the learning process, I felt like I was alone, and was encouraged to keep done as areas are split into groups? - P1
I've stated to myself goals after enrolling in go [illegible] - P1
But working in a group in work (because you can decide the time and get different perspectives on things) also learning with other people and getting outside my habits and learning from - P11
Yes, meetings with other students helped me feel less lonely - P6
Yes, more to have peers as an accountability partner and lessons off on those for solving tasks. If [illegible] [illegible] - P7
Discord (And ppl in all the classes) and Reddit - [illegible] - P12
With my grad program, I love being surrounded by people who are also in shared passionate interest - otherwise, I wouldn't feel as motivated. - P7
External Motivations
Company offers [illegible] - P9
[illegible] - P9
Not be choice but to learn how to teach online [illegible] - P9
"What motivated me was my professional growth. I needed to advance my career." - P2
[illegible]
[illegible]
Company offers [illegible] - P9
Certifications - I had to be done before a deadline. School paid for all this - P1
[illegible]
On-Go- pushing from lessons to learn this for future projects and get ahead - P1
my data is really encouraging [illegible] - P12
[illegible]
"There are meetings with the senior organizations talk about the progress in the [illegible] - P1
"I've participated in leadership training, which is mandatory for all employees at my company" - P1
Tactically - its nice when you get money - p3
[illegible]
[illegible]

User Personas

MAYA LOPEZ

AGE: 34

GENDER: Female

LOCATION: San Francisco, California

ABOUT

Maya is a corporate employee working as a Project Manager at a Fortune 500 company. She regularly undergoes professional development. She is currently L3 Project Manager

GOALS

- Maya hopes that she can steadily earn promotions at work as she has regular performance reviews.
- Maya wants to be able to invest a large sum of her income, so having higher earning capability is very important.

PAIN POINT

- Most upskilling courses are uninteresting to Maya as her boss usually encourages her to partake.
- Maya feels overwhelmed with her regular workload and unable to fully engage in upskilling work.

JOSH DE LA CRUZ

AGE: 29

GENDER: Male

LOCATION: San Jose, California

ABOUT

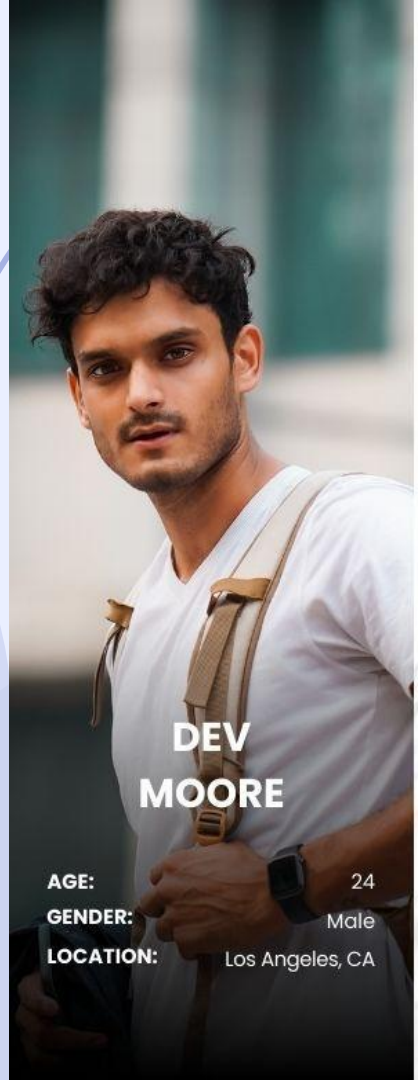
Josh is an occupational therapist based in San Jose, California. He works at several clinics and typically works with geriatric patients. Outside of work, he enjoys spending time with friends and family.

GOALS

- Josh wants to maintain his skills to continue providing the best care possible to his patients.
- Josh has been thinking about switching jobs to work with a more diverse set of patients, so he can meet and provide care to more people.

PAIN POINT

- Josh finds it dfficult to sit through long and dense training courses to recieve all the certifications he needs to stay employed
- Josh has a hard time fitting re-certification courses into his busy work schedule becausethey take so long to complete



DEV MOORE

AGE: 24
GENDER: Male
LOCATION: Los Angeles, CA

ABOUT

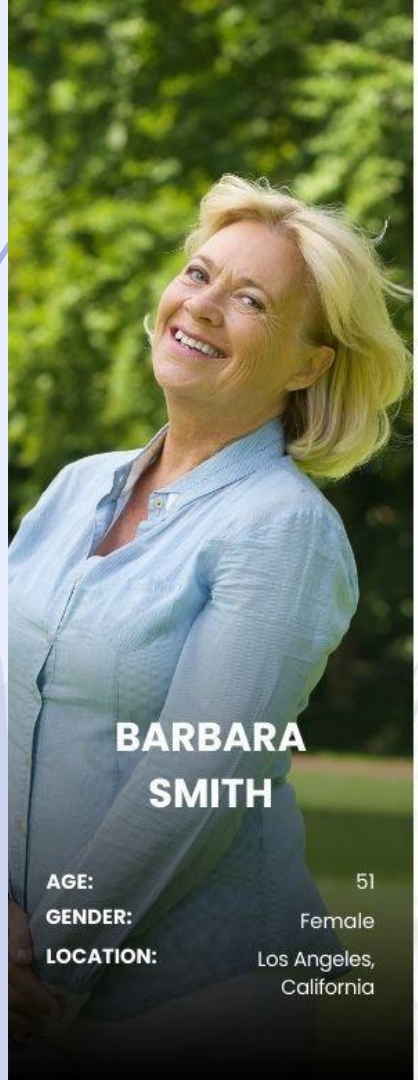
Dev is a student studying machine learning at UCLA. In his free time he enjoys climbing and gaming. Beyond his university coursework Dev regularly takes on additional work to stand out to recruiters.

GOALS

- Score an internship as a Data Scientist.
- Complete certificates to include on resume.
- Use upskilling to become competitive to employers.

PAIN POINT

- Solo upskilling online can be a hard resource when Dev needs questions answered quickly.
- He finds long modules boring and easily gets disengaged.
- Dev has had trouble knowing what skills he should exactly be upskilling



BARBARA SMITH

AGE: 51

GENDER: Female

LOCATION: Los Angeles, California

ABOUT

Barbara is a middle school science teacher based in LA. She enjoys teaching her students and is passionate about sharing her love of science. She likes to collaborate with her fellow teachers to discover better ways to teach her students.

GOALS

- Barbara needs to take re-certification course to continue teaching science to middle schoolers
- Barbara wants to use training courses as a way to also discover new teaching styles that she can apply to her own job

PAIN POINT

- The text on online courses can be really small, and Barbara sometimes has a hard time reading text and finding the settings to change font size
- Online courses can be boring because she has no one to bounce ideas off of, unlike teaching conferences she attends

02 Findings

Themes and Insights found from data analysis

TL;DR: Cognitive Overload

Material is less engaging when learners experience **Cognitive Overload**

Cognitive Overload refers to a state where the amount of information a person is trying to process exceeds their cognitive capacity.

- Introduce an interactive and social conversational agent that perceives users' emotions, gestures, and behavior to gauge when to assist, along with a structured interactive learning curriculum, can help users process information better and ease any confusion, mitigating fatigue and cognitive overload.

TL;DR: Collaborative Learning & Mentorship

Learners get more out of **collaborative learning** and mentorship.

Collaboration not only includes working alongside peers but also entails having an instructor or mentor supporting your learning at every stage of the course.

- Introducing a social conversational agent or a virtual tutor that promotes collaboration and mentorship by having features like an instant dialogue for instant feedback and to ease any confusion.

TL;DR: External Motivation

Externally motivated learners were more prone to cognitive overload.

Extrinsic motivation is behavior driven by external pressures and rewards such as work requirements, compensation, deadlines, etc.

- Utilizing a biosensing tool that triggers a conversational agent in intervene and re-engages learners when they begin to show signs of cognitive overload.

Theme 1: Material is less engaging when learners experience **Cognitive Overload**

Cognitive Overload refers to a state where the amount of information a person is trying to process exceeds their cognitive capacity. Some participants talked about stress they felt when undergoing some of their trainings under the pressure of a deadline, juggling other tasks, or being introduced to a topic they have never seen before.

Definitely was **overwhelming at some points**. **Information overload** and a lot to retain in a short amount of time. **So much coming at you.** -p5

I would say in the beginning it could **feel overwhelming just introducing a whole new topic** - P10

just a **lot of material to take in at once** -P12

Lack of autonomy and personalization → Cognitive overload

Participants also highlighted the features in the learning experiences that promote cognitive overload such as not having enough support, not enough personalization and autonomy, the lack of structure in courses, and the massive amounts of text blocks that can be intimidating to digest, and does not fit into their learning styles.

I think maybe adding **more videos or visuals would help.** I'm a **visual learner** so reading **paragraphs after paragraphs I tend to get disengaged** from that learning. So when I get pictures of videos in the modules it helps me stay engaged. -P5

I **needed more additional help** or someone helping me along with it. - P10

Cognitive Overload Takeaways and Recommendations

Participants experience cognitive overload in their upskilling experience due to various factors such as structure of the learning material, environment, and external motivations.

- Introduce an interactive and social conversational agent that promotes **collaboration and mentorship** can help users process information better and ease any confusion they may have.
- With the support of a **behavior detection or biosensing tool** that can perceive user's emotions, gestures, and behavior can help gauge when a CA can step in to help users.
- A **structured interactive learning curriculum** can also mitigate fatigue and cognitive overload by ensuring that content promotes examples, engaging activities, and autonomy to personalize video speed and include captions.

Theme 2: Learners get more out of **collaborative learning and mentorship**

Collaborative Learning

Participants valued collaboration when learning because it allowed them to think outside of the box, learn different perspectives, and bounce ideas off of others - thus enhancing overall learning.

collaborate with partners from out of state and helped **make more connections** - P9

But working in a group is useful because you can **think outside the box and get different perspectives on things**. I like learning with other people and **getting outside my bubble and learning from [others]** -P11

Theme 2: Learners get more out of **collaborative learning and mentorship**

Mentorship

Participants valued mentorship because this allowed them to refer to a knowledgeable agent whilst learning. Participants were guided through their learning and maintained motivation through external support.

And third thing which I hadn't had previously was **the mentorship...So my boss mentors me, and we have bi-weekly check-ins which has been tremendously helpful.**
-P3

"I have **meetings with my manager** where he **teaches me how to code** in a certain language."
- P6

Theme 2: Takeaways and Recommendations

- Overall, collaborative learning and mentorship was valuable due to having access to **external resources and knowledge**
- Collaborative learning and mentorship also provided participants with **motivation** by providing **external support systems**
- **Instant feedback** was important and both collaborative learning and mentorship provided this
- Participants valued having a **knowledgeable agent** at hand to work with ask questions at any time

Recommendation: Introduce a social conversational agent or a virtual tutor that promotes collaboration and mentorship by having features like an instant dialogue for instant feedback and to ease any confusion.

Theme 3: Externally motivated learners reported cognitive overload at a higher rate.

Our research found a correlation between participants who reported their primary motivations as external(career promotion, pay increase, etc.) and experiencing stress while undertaking professional development.

"**Stress is when I'm required to take a class I don't think is useful,** e.g., [this class] took so much time when I **could've been learning tools instead**."
- P7

"**When you're working on a project and already busy,** having a course to complete as well makes it **boring...**"
- P1

Theme 3: Takeaways and Recommendations

- A user's *"why"* plays a significant role in retaining knowledge from upskilling.
- Participants felt compelled to continue learning when it appealed to their internal sense of motivation.
- **Active learning** was more likely have a positive impact on participants.

Recommendation: Utilize a biosensing tool that triggers a conversational agent in intervene and re-engages learners when they begin to show signs of cognitive overload.

Accessibility in UXR and Design Methods

Cognitive Load and ADHD

Reduction in cognitive load has shown increase in learning outcomes in those with ADHD. Reduction in cognitive load will be done through an assistive AI conversational agent. Assistive features help guide learning and reduce cognitive load when digesting information. Cognitive load will also be reduced by separating text blocks and modules into shorter and more readable segments.

Perceptual Load and ADHD

In combination with increasing perceptual load, ADHD learners are more likely to have an easier time digesting content. Perceptual load will be increased through more complex visual stimuli, such as the presence of an AI avatar as the conversational agent. Higher perceptual loads force users to focus more on important content, helping guide the attention of ADHD learners.

Other accessibility features

We plan on having the AI conversational agent accessible through using both text and audio as the medium of communication - thus making it accessible to both those hard of hearing and those with visual impairments. We also plan on screen readers and font-size options being available for the actual course content.

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10727773/#def3

04 Design Concepts

1. Collaborative Mentor
2. Interactive Learning
3. Behavior Detection

Collaborative Mentor

Concept:

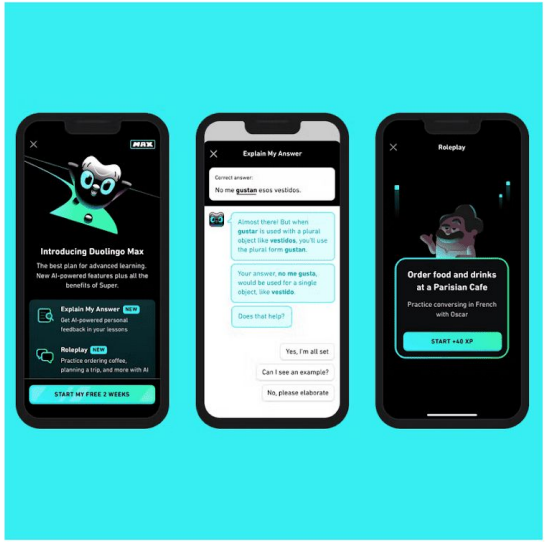
A virtual tutor that acts like a collaborative mentor while users are going through courses on the training platform. This virtual tutor will help guide learners through online modules and provide relevant information when necessary or when asked. The virtual tutor will also respond to the user in a humanistic and empathetic way, like a mentor would. This feature can fill the desire of users to learn collaboratively with a knowledgeable actor through the use of an AI trained with data relevant to the online course.

Collaborative Mentor

Inspiration

Khan Academy

Khan Academy explores the potential for GPT-4 in a limited pilot program.



Duolingo

GPT-4 deepens the conversation on Duolingo.

source:https://www.classcentral.com/report/chatgpt-on-duolingo-khan-academy/

Interactive Learning

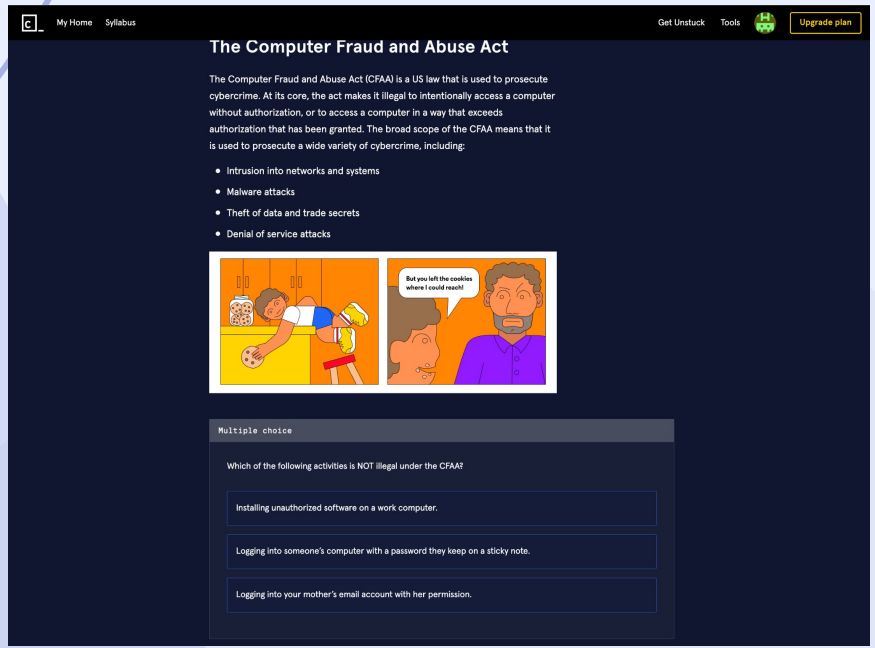
We ***cannot*** rely on sheer passion to sustain user engagement.

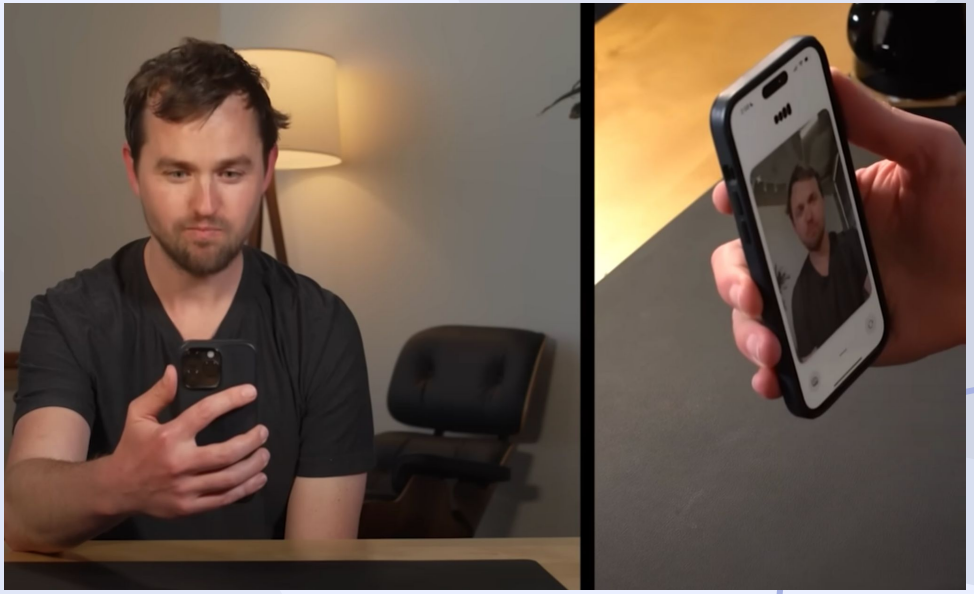
Our research found that **external motivations** in upskilling was correlated with higher levels of **cognitive overload** by participants.

Concept:

Multimodal **interactive learning features** are imperative to ensure user retention and maximize value-add. Hands-on projects, consistent in-platform quizzes and **voice activated role play simulations** are all examples of interactive learning considered for the design.

Interactive Learning





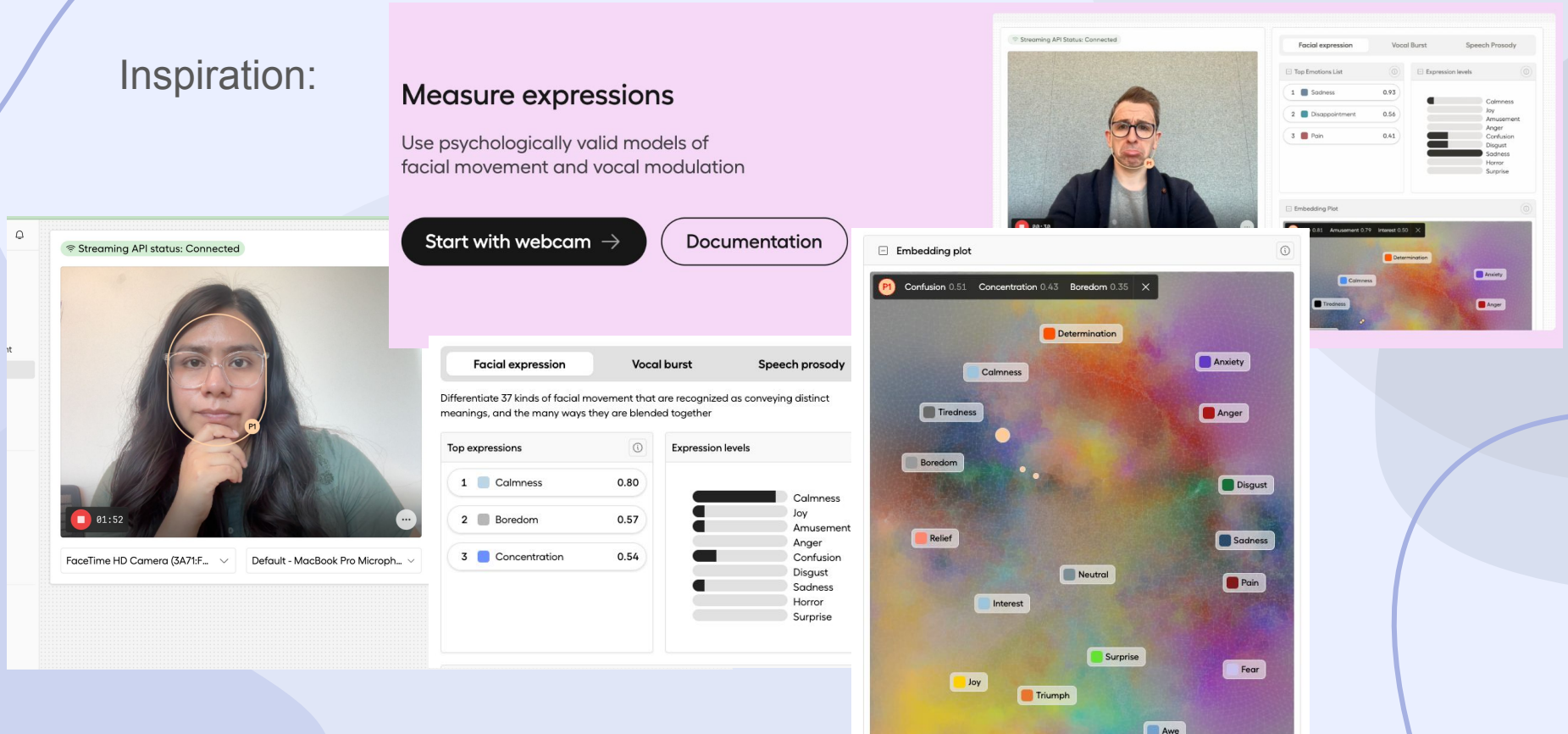
Behavior Detection

Concept:

A bio-sensing tool that detects users' emotions, gestures, and behaviors to identify when a conversational agent should intervene and interact with users during the learning process. This feature can help prevent cognitive overload by triggering the conversational agent to intervene whenever a user needs support or appears to show signs of distress and other negative emotions. A bio-sensing tool would also promote mindfulness, and work alongside the conversational agent to encourage collaboration and mentorship.

Behavior Detection

Inspiration:



05 Limitations & Blockers

Investigating upskilling/training experiences of professionals

Limitations

- **Age representation:** only spoke with predominantly young working professionals who identify as millennial or gen Z, thus perspective and experiences might have niched to this age group.
- **Industry professional representation:** interviewees all had very distinct roles which made it challenging to compare across different roles and upskilling experiences.
    - Lack of representation working professionals working outside of corporate or healthcare jobs.
- **Limited funding:** Did not run any marketing campaigns to promote recruitment and had small funding incentives to partake in the various studies.

Blockers

- Flyer permission and requirements in public spaces such as libraries and community centers.
  - Emailed and met with managers to determine flyer requirements and approval.
- Hundred of Bots spamming the survey section of the study.
  - Filtered out bot responses based on validity and incohesiveness of responses.

06 Shout Outs & Future Work

Shoutouts

We'd like to thank our sponsor, **Accenture** and our capstone advisor, **Adolfo G. Ramirez-Aristizabal**.

We are also grateful to our research participants who were eager to give us insights about their experiences with upskilling.

Last, we'd like to vocalize our appreciation for faculty in the HCI department - **Young Na**(TA), **Dr. Yassi Moghaddam** & **Dr. Norman Makoto Su**.

Amina - Thanks for organizing the Google Calendar, making sure we are on the same page during meetings, and being on top of note taking for every meeting!

Bia - Thanks for organizing the Asana, keeping track of tasks for the group, and kicking off summer research initiatives!

Cindy - Thanks for helping keep us on track for our long-term project goals, recruiting a majority of our participants, and helping us stay on track during meetings!

Future Work

Over the summer, we will be working on our Wizard of Oz study, where we will investigate further the impact of a conversational agent on cognitive load. In the fall, we will iterate through prototypes, conduct usability testing, and create demo videos using different bio-sensing tools and a conversational AI in an online learning platform

Summer

Develop initial prototypes on conversational agent

Summer

Conduct WoZ study on how interactive conversational agents affect cognitive load

Fall

Film demo videos of using bio-sensing tools during learning

Fall

Conduct usability testing and iterate through prototypes of the conversational agent and learning platform

THANKS!

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Appendix

Digital & Physical Recruitment

Hello everyone! Are you interested in contributing to the development of the future of work? Have you taken part in an upskilling or training program at your workplace?

Our team of graduate students at UC Santa Cruz is conducting research to gain a better understanding of the experiences of professionals with upskilling and training courses within their organizations. We welcome feedback from individuals with a variety of career backgrounds. Your participation in our 5-minute survey would be greatly appreciated and would provide us with valuable insights.

As a token of our gratitude, respondents will be entered into a raffle for a chance to win a $15 gift card.

Your input will help shape the future of training tools, and all personal information will be kept confidential.

NOTE: Must be 18+ and older to take this survey

📍Survey here ----> https://lnkd.in/gRsufZ42