Making New Friends: A Study in Companionship

Matthew Gabriel Maharaj
Department of Graphic Design
College of Design
North Carolina State University

April 30th, 2020

Submitted in partial fulfillment
for the degree of
Masters of Graphic Design

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Acknowledgements

Thank you to my teachers: Deb, Helen, Derek, Scott, and Matt for imparting your wisdom and knowledge to me.

Thank you to Denise for taking a chance and admitting me into the program.

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Thank you to my loving wife Gloria for being my companion.

Contents

Abstract

Loneliness is a growing problem in the world; more people every year struggle to find a sense of comfort with those around them. Over the last 10 years, Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP) have advanced. Although some existing intelligent systems attempt to address loneliness, they commonly take the form of chatbots. This study investigates how a companion driven system may function with an Embodied Conversational Agent (ECA), and explores how this new system may be visually designed.

1. Introduction

Humans are complex by nature: we strive to find things that give comfort daily, whether that be from religious affiliation, friendship, family, or a close loved one. Companionship means having someone to talk to or share things with. Some people don't get to experience this sense of companionship when they need it most. Despite interactions with friends and family, they may not feel fulfilled.

Attaining a sense of companionship is not limited to human interactions. As Artificial Intelligence (AI) and Machine Learning (ML) become more ubiquitous, many possibilities for providing aid to people in a variety of ways are emerging. How can these technologies aid those who want companionship and are unable to attain it?

The purpose of this study is to address the common need for companionship, or loneliness. Technology grows more sophisticated every year. Devices such as smartphones, computers, and home-based AI systems have the potential already to assist. This study entertains that potential.

2. Problem Statement and Justification

Loneliness is an increasing global problem which can lead to serious mental and physical health issues if not addressed. In 2018 Cigna, a global health service company, conducted a study on the effects of loneliness in the United States. They found that out of twenty thousand people surveyed within the U.S, around 44% of people suffer from loneliness (Cigna, 2018). Another US-based non-profit organization, the Henry J. Kaiser Family Foundation, which focuses on national and global health issues, conducted a survey on loneliness and social isolation in the United States, United Kingdom, and Japan. More than two in ten adults reported loneliness or social isolation in the U.S. and U.K. and double that number in Japan (Henry J.Kaiser Family Foundation, 2018). Humans by nature are social beings who require a certain level of interaction, human or otherwise, to feel fulfilled. According to Maslow's Hierarchy of Needs, (Fig 2.1) we require that five basic needs be satisfied to feel a sense of fulfillment (Maslow, 1943). The sense of "Belongingness," the third level, includes friendships, and intimacy.

Conversing with others can be a powerful tool to alleviate stress. Conversations can have a chemical effect on the brain, be it positive or negative. Judith E. Glaser, an organizational anthropologist, studied conversations, their effects on the brain and contribution to a sense of wellbeing. Positive comments and conversations can initiate the release of "feel good" chemicals such as oxytocin. As this chemical release takes place, people communicate, collaborate and trust others by activating areas in our prefrontal cortex (Glaser, 2014).

The affordances of technology today include Artificial Intelligence (AI), software systems wherein machines learn from user input, then output a response that mimics human intelligence. The evolution of AI has introduced widely used programs, such as Conversational User Interfaces (CUI), that can converse, schedule appointments, or look up information. Companies such as Facebook and Origin use CUIs for tech support. Apple Inc.'s Siri is a smartphone-based AI that is available to anyone with an Apple smartphone.

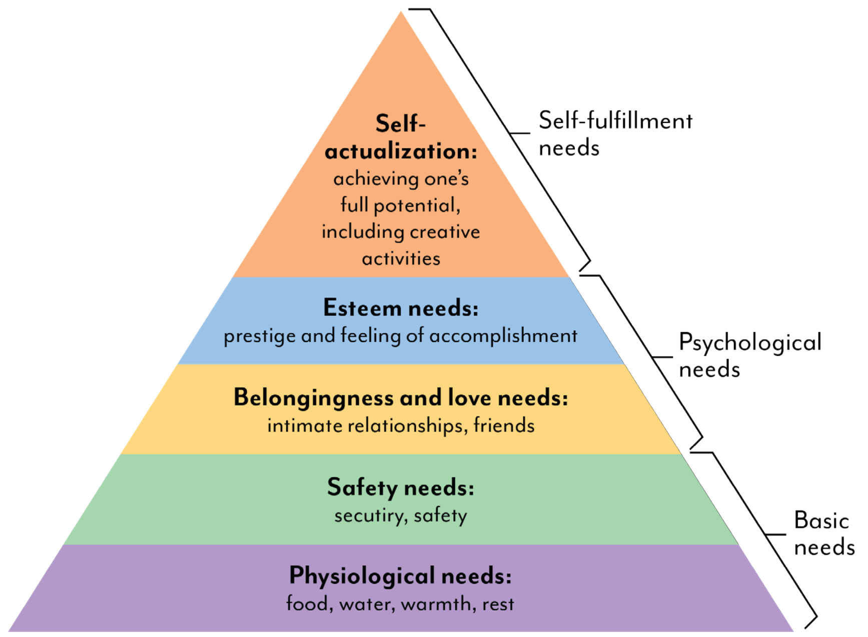
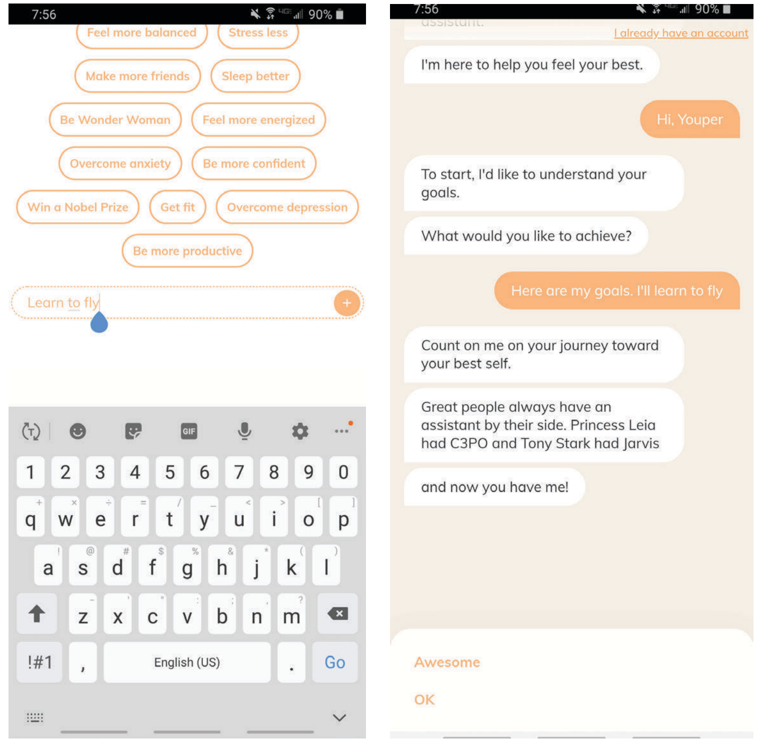


Figure 2.1
Maslow's Hierarchy of Needs.



Figures 2.2 - 2.3
Example of button responses within Youper.
Nothing so far has been typed by the user on this screen.

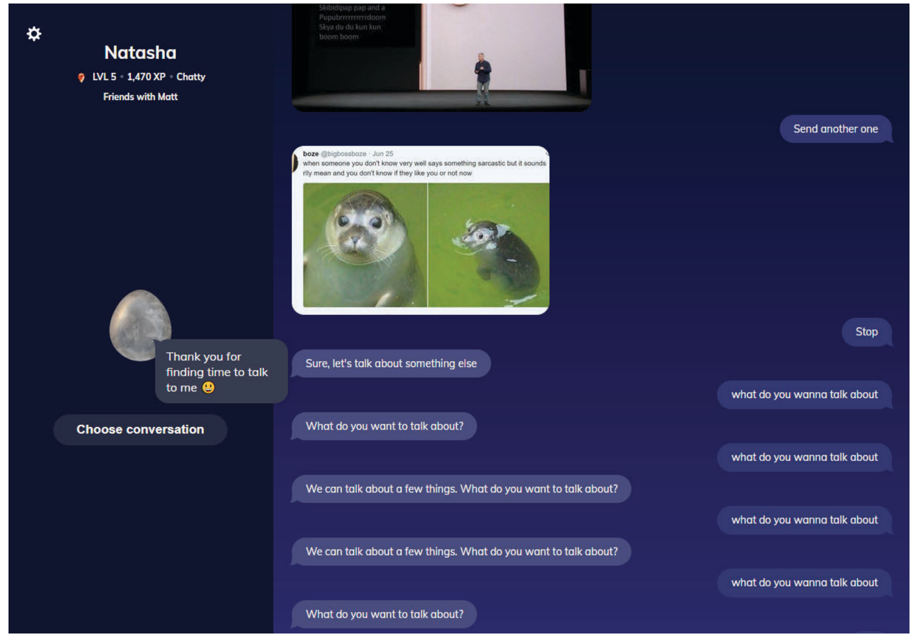


Figure 2.3
Replika chat loop.

Alexa and Google Home are dedicated smart home devices. CUIs are used in therapy apps, as well, and can help humans manage stress, anxiety, depression, and daily moods.

While CUIs are competent at what they do, they do not typically aim to simulate a relationship with another person. Current CUIs lack the sophistication to mimic human responses. Observation of CUIs such as Wysa, Youper, and Replika, reveals their limitations. Responses when conversing with Wysa and Youper, appear as buttons, similar to text messages. When the user is able to respond via typing it is usually so the system can record the response, and repeat it back in another sentence (Fig 2.2 – 2.4). Replika allows users to type in responses as if one was having a text conversation with another person. However, the system has problems holding a proper conversation. Often the system gets stuck responding to questions, revealing that it did not know what the user was typing, or gets caught in a loop (Fig 2.3). Users interact with virtual agents such as Google Home and Alexa by voice. These products function more as assistants to help people with their day-to-day activities such as scheduling, reminders, and playlists. Although smart home devices aren't meant to be companions, studies suggest that they can have a positive effect as concerns companionship. One such study of single-person households in South Korea examined whether smart home objects would be able to give users a sense of social support and connection. Results showed that the positive feedback from these devices registered as social support in users. (Lee et al. 2017).

Figure 2.4 shows how Machine Learning and Natural Language Processing fit within the sphere of Artificial Intelligence. Machine Learning (ML) is the system by which algorithms are trained to recognize patterns in data which then informs how the system responds to a query. ML is integrated into a lot of technology we use today, including CUIs. Going beyond the building blocks is Natural Language Processing (NLP). According to the SAS Institute, NLP can be defined as a branch of artificial intelligence that helps computers understand, interpret, and manipulate human language (SAS, 2020). NLP can be applied to not only written but verbal conversations as well. Machines such as IBM's Watson and Google's Duplex both make use of this technology. Systems that utilize NLP to decipher human language might also feature sentiment analysis, which interprets human statements emotionally. Sentiment Analysis can analyze a conversation in order to understand if a person is angry, sad, or happy. Such technology would be essential to creating a system that is sophisticated enough to aid those who seek companionship.

This study proposes a system consisting of smartphones and personal computers. The system allows users to interact with a more advanced version of a CUI through the use of Machine Learning and Natural Language Processing. Based on the research showing that artificial companions can have positive effects on people, this study will employ the use of an Embodied Conversational Agent (ECA).

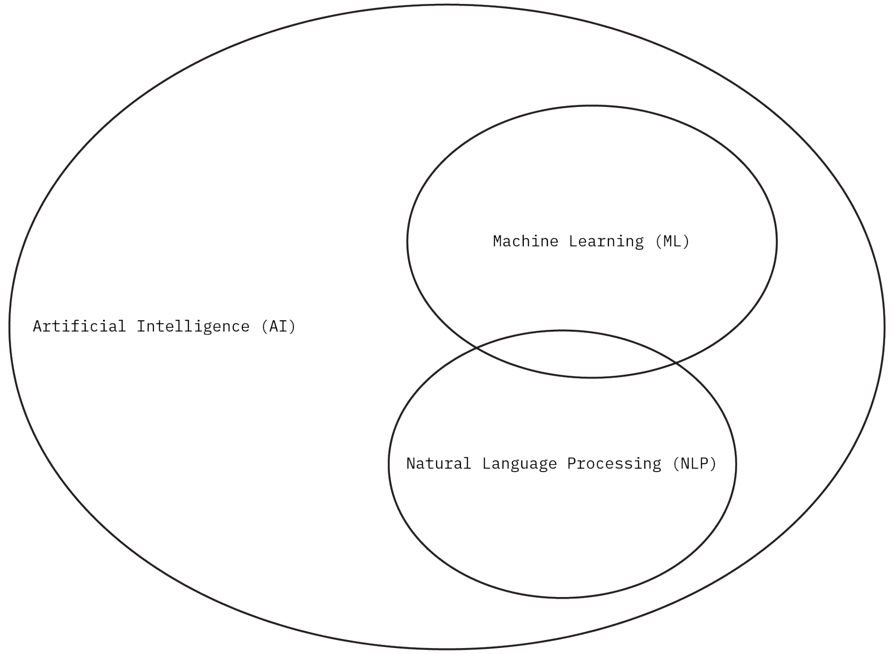


Figure 2.4 AI Ecosphere.

3. Assumptions and Limitations

3.1 Assumptions

I assume that potential users would be able to use the system on devices such as smartphones and computers. I also assume that they would be comfortable using conversational software through text and voice.

While the system proposed is created to help those who suffer from loneliness, adopters may be hesitant to use the entire system if they live with other people.

For the personas and user journey it is assumed that the system would aid the user in feeling a sense of companionship and have a sense of ease when engaging with the system in multiple settings. However, there are multiple mental states that can affect a user and there is no conclusive evidence that this will aid all users of the system if adopted.

3.2 Limitations

While programs exist that would assist in realizing a functioning chatbot, they are not as sophisticated as they would need to be to build a functioning prototype. Current technological limitations with AI and ML are also a factor.

For this study, getting a reasonable amount of participant feedback would be hard given the timeframe that the study took place in. Many factors can affect why people feel lonely and, while loneliness does affect a high percentage, participants are often not willing to share their mental states with others for fear of ridicule.

Time is a limiting factor for the scope of the project. The system proposed would require time for iterations and development to create a functioning program.

4. Annotated Bibliography

Human interaction with physical AI representations. Bots and CUI, ECA

- People's tendencies to project life-like qualities onto robots, framing robots through anthropomorphic language, can impact how people perceive and treat them. Both for and against anthropomorphising robots. (Darling, 2015)
- Two studies show that robots can provide consolation and security to humans in stressful situations. (Birnbaum, Mizarha, Hoffman, Reis, Finkel, Sass, 2016)
- People listen to music with robots to see if there's a sense of connection. Robot's dance-like response to music causes participants to feel that the robot is listening with them and increases the participants liking the songs. The robot's response also increases its perceived human character traits. (Hoffman, Bauman, Vanunu, 2016)
- Human-robot interaction—examines the development of social skills for robots, making them acceptable to humans. (Dautenhahn, 2007)
- Examines chatbots with human-like cues like language and name, and how people interact with them—anthropomorphism. Also describes the relevance of anthropomorphism and social presence and how its related to company outcomes, such as emotional connects that consumers feel with the company after interacting with the chatbot (Araujo 2017)
- Human-Chatbot interaction—examines how people rate anthropomorphic interactions with chatbots. Focuses on the uncanny valley effect. Participants experience less uncanny valley effect with a simpler chatbot rather than one that is more complete, and animated (ECA). (Ciechanowski, Pezegalinska, Magnuski, Gloor, 2017)
- Explains the basics of what a chatbot is and how they are integrated in our daily lives and how it can work in a library setting. (Fitcher, Wisniewski, 2017)
- HCI 2016 international conference on human computer interaction, looking at multiple studies to see how humans interact with technology. (Kurosu, 2016)
- Examines how humans interact with conversational agents in a complex tutoring system using eye tracking studies.

(Louwerse, Graesser, Mcnamara, Lu, 2009)
- How groups of people interact with a robot in a Japanese mall. (Fraune, Šabanovic, Kanda, 2019)
- Human-Computer interaction and how interaction with these objects can be seen as companions, from Tamagotchis to Microsoft Clippy (Benyon, Mival, 2010)
- Questions whether AIs should be used for the use of companionship as it may lead to social ramifications. (Kironm Unruh, 2018)
- Examines the use of smart home devices as a means for companionship between user and AI (Lee, Kwon, Lee, Kim, 2017)
- Using ECAs in clinical psychology to aid in the detection and prevention of suicidal behaviour. (Martínez-Miranda, 2017)
- Explores different applications of speech based CUIs (Mctear, 2002)
- Looks at interactions with an ECA while testing how to better conversational interactions with it. (Smith, Cameron, 2011)

Machine Learning, Natural Language Processing, Deep Learning.
- Explains what machine learning, supervised, unsupervised, and deep learning is. (Louridas, Ebert, 2016)
- Defines Natural Language Processing (SAS, 2020)
- Defines Natural Language Processing (IBM, 2019)

Sociology and Psychology
- Argument to reorder Maslow's Hierarchy of Needs; physiological needs, currently at the third level should become the base level of basic needs. This echoes the concept that humans need family, friendship, love, in order to stay safe. (Oved, 2017)
- This paper examines the cognitive aspects of social interaction on the human brain. How human-human interaction is important for the development of a human. The brain defaults to a certain model while interacting with other humans. Two studies focused on the feelings of "togetherness" during improvised motion. More evidence that humans should be connected. (Hari, Henriksson, Malinen, Parkkonen, 2015.)
- Bloomberg article looking at Gatebox Lab and their virtual agent Hikari Azuma, as well as a couple of virtual partner games, to help the romantic void in Japanese lives (Bloomberg, 2017)
- An interview between Niel Frude, clinical psychologist, and Petar Jandric, an educator, researcher, and activist. Focused on a book published in 1938 focusing around 'animism.' People will form beneficial social relationships with artificial 'companion systems' (Jandric, Frude, 2015)
- Examines what defines the quality of a friendship and how having a close friendship affects one's mental wellbeing and happiness. (Demir, Özdemir, Weitekamp, 2006.)
- Studies the quality of life improvements older people have when interacting with family members. (Rook, Ituarte, 1999)

- Outlines the types of conversations, and the effects that having conversations have on the brain (Glaser, 2014)

Frameworks
- Makes use of the ecological cognition framework; uses the framework to describe what drives individuals to carry out certain actions in an online environment. (Bishop 2007.)
- Breaks down in detail and explains activity theory. (Davis, 2012)
- Gives an overview of human computer interaction design; some examples include user interface design principles, task analysis, interface design methods… (Valverde, 2011)
- Explains what the Theory of Reasoned Action is and the Technology Acceptance Model. (Davis, Bagozzi, 1989.)
- Uses the Technology Acceptance Model and extends the theory to analyze the mobile social gaming market in China. (Chen, Rong, Ma, Qu, Xiong, 2017.)

Surveys
- International Survey done in the United States, United Kingdom, and Japan. More than two in ten report loneliness or social isolation in the U.K and in the U.S and double that in Japan. Loneliness appears to occur in parallel with reports of real life problems and circumstances, and those reporting loneliness appear to lack meaningful connection with others. (Henry J Kaiser Family Foundation, 2018)
- Survey done in the U.S. to study the effects of loneliness on Americans. One out of six people in the U.S. suffer from a mental health condition and suffer from loneliness as well. Loneliness has the same impact on mortality as smoking fifteen cigarettes a day. (Cigna Loneliness Index, 2018)

4.1 Table Bibliography

Topic	Title	Citation
Human interaction with physical AI representations. Bots and CUI, ECA	'Who's Johnny?' Anthropomorphic Framing in Human-Robot Interaction, Integration, and Policy	Darling, 2015
	What robots can teach us about intimacy: The reassuring effects of robot responsiveness to human disclosure. Computers in Human Behavior	Birnbaum, Hirnbaum, Mizarha, Hoffman, Reis, Finkel, Sass, 2016
	Robotic experience companionship in music listening and video watching. Personal and Ubiquitous Computing	Hoffman, Bauman, Vanunu, 2016
	Socially intelligent robots: Dimensions of human–robot interaction. Philosophical Transactions of the Royal Society B: Biological Sciences	Dautenhahn, 2007
	Living up to the chatbot hype: The influence of anthropomorphic design cues and communicative agency framing on conversational agent and company perceptions. Computers in Human Behavior	Araujo 2017
	In the shades of the uncanny valley: An experimental study of human–chatbot interaction. Future Generation Computer Systems	Ciechanowski, Pezegalinska, Magnuski, Gloor, 2017
	Human-computer interaction: 18th International Conference, HCI International 2016	Kurosu, 2016
	Embodied conversational agents as conversational partners.	Louwerse, Graesser, Mcnamara, Lu, 2009
	Chatbots introduce conversational user interfaces.	Fichter, Wisniewski, 2017
	Human Group Presence, Group Characteristics, and Group Norms Affect Human-Robot Interaction in Naturalistic Settings. Frontiers in Robotics and AI	Fraune, Sabanovic, Kanda, 2019
	From human-computer interactions to human-companion relationships.	Benyon, Mival, 2010
	Even If AI Can Cure Loneliness - Should It?	Kironm Unruh, 2018
	Companionship with smart home devices: The impact of social connectedness and interaction types on perceived social support and companionship in smart homes.	Lee, Kwon, Lee, Kim, 2017

Topic	Title	Citation
Human interaction with physical AI representations. Bots and CUI, ECA	Embodied Conversational Agents for the Detection and Prevention of Suicidal Behaviour: Current Applications and Open Challenges	Martinez-Miranda, 2017
	Spoken Dialogue Technology: Enabling the Conversational User Interface.	Mctear, 2002
	Interaction Strategies for an Affective Conversational Agent.	Smith, Cameron, 2011
Machine Learning, Natural Language Processing, Deep Learning	Machine Learning. IEEE Software	Louridas, Ebert, 2016
	What is Natural Language Processing?	SAS, 2020
	How to get started with Natural Language Processing	IBM, 2019
Sociological and Psychology	Centrality of Social Interaction in Human Brain Function.	Hari, Henriksson, Malinen, Parkkonen, 2015
	In Japan, Virtual Partners Fill a Romantic Void	Bloomberg, 2017
	The Intimate Machine – 30 years on.	Jandric, Frude, 2015
	Looking to happy tomorrows with friends: Best and close friendships as they predict happiness.	Demir, Özdemir, Weitekamp, 2006
	Social control, social support, and companionship in older adults family relationships and friendships.	Rook, Ituarte, 1999
	Rethinking the Place of Love Needs in Maslow's Hierarchy of Needs.	Oved, 2017
Frameworks	Increasing participation in online communities: A framework for human–computer interaction.	Bishop, 2007
	Graphic Design Theory	Davis, 2012
	Principles of Human Computer Interaction Design.	Valverde, 2011

Topic	Title	Citation
Frameworks	User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. Management Science	Davis, Bagozzi, 1989
	An Extended Technology Acceptance Model for Mobile Social Gaming Service Popularity Analysis. Mobile Information Systems	Chen, Rong, Ma, Qu, Xiong, 2017.
Surveys	Loneliness and Social Isolation in the United States, the United Kingdom, and Japan: An International Survey	Henry J Kaiser Family Foundation, 2018
	Cigna U.S. Loneliness index Survey of 20,000 Americans Examining Behaviours Driving Loneliness in the United States	Cigna Loneliness Index, 2018

5. Conceptual Framework and Research Questions

5.1 Conceptual Framework

I looked at several frameworks that would be applicable to this study in the areas of human interaction, interactions in online spaces with other people, and psychology. However, the two frameworks that carry the most relevance are Activity Theory and the Technology Acceptance Model for Mobile Social Gaming. These two theories help explain how and why a person interacts with an object, and what they hope to gain from acting on these intentions.

Activity Theory (Fig 5.1) states that wanting to interact and influence the environment through activities is fundamental to human nature. People have criteria such as past experiences, perceptions, motives, emotions, and ways of reasoning. They carry these ideas as they interact with an object, which then leads to an activity that they were aiming to accomplish. The activity with said object is governed by goals, which leads to actions and, under certain conditions, can lead to operations. Engaging in the activity causes the user to engage with social and cultural settings. These settings can be areas such as societal norms and values, which affects the user's criteria once again, forming a cycle (Davis, 2012).

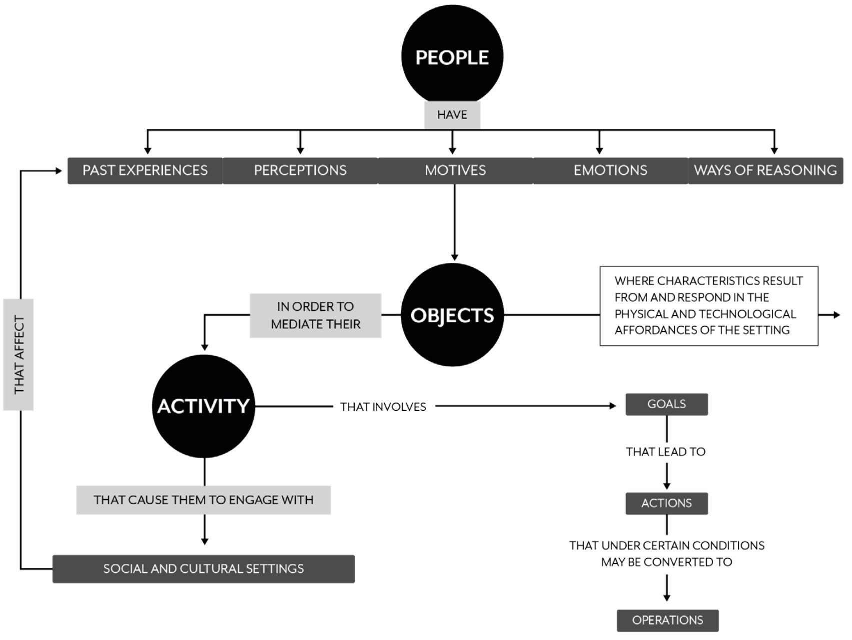


Figure 5.1
Activity Theory Framework.

The Technology Acceptance Model (TAM) is a framework that is used for modeling user acceptance of information systems. As stated in User acceptance of computer technology: a comparison of two theoretical models, "The goal of TAM is to provide an explanation of the determinants of computer acceptance that is general" (Bagozzi 1989). This theory was used and adapted in another paper to examine the popularity of games in mobile social networks (Chen et al. 2017). In this research article TAM was extended to include factors such as perceived enjoyment and social interaction (Fig. 5.2).

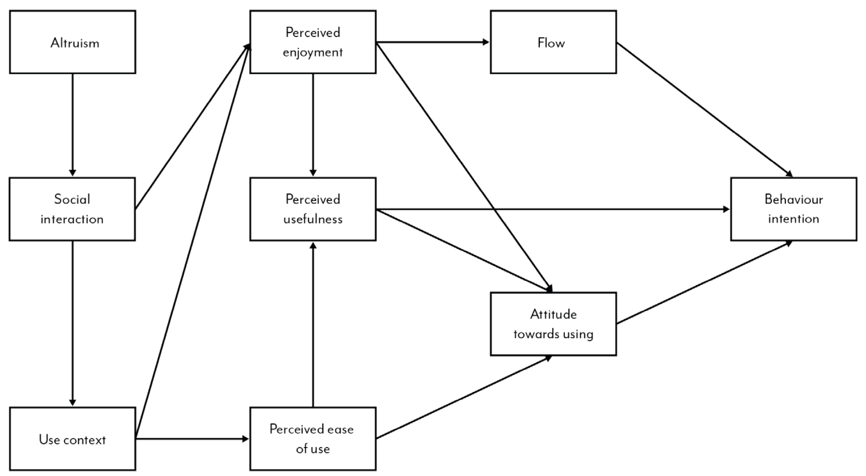


Figure 5.2
Technology Acceptance Model for Social Gaming.

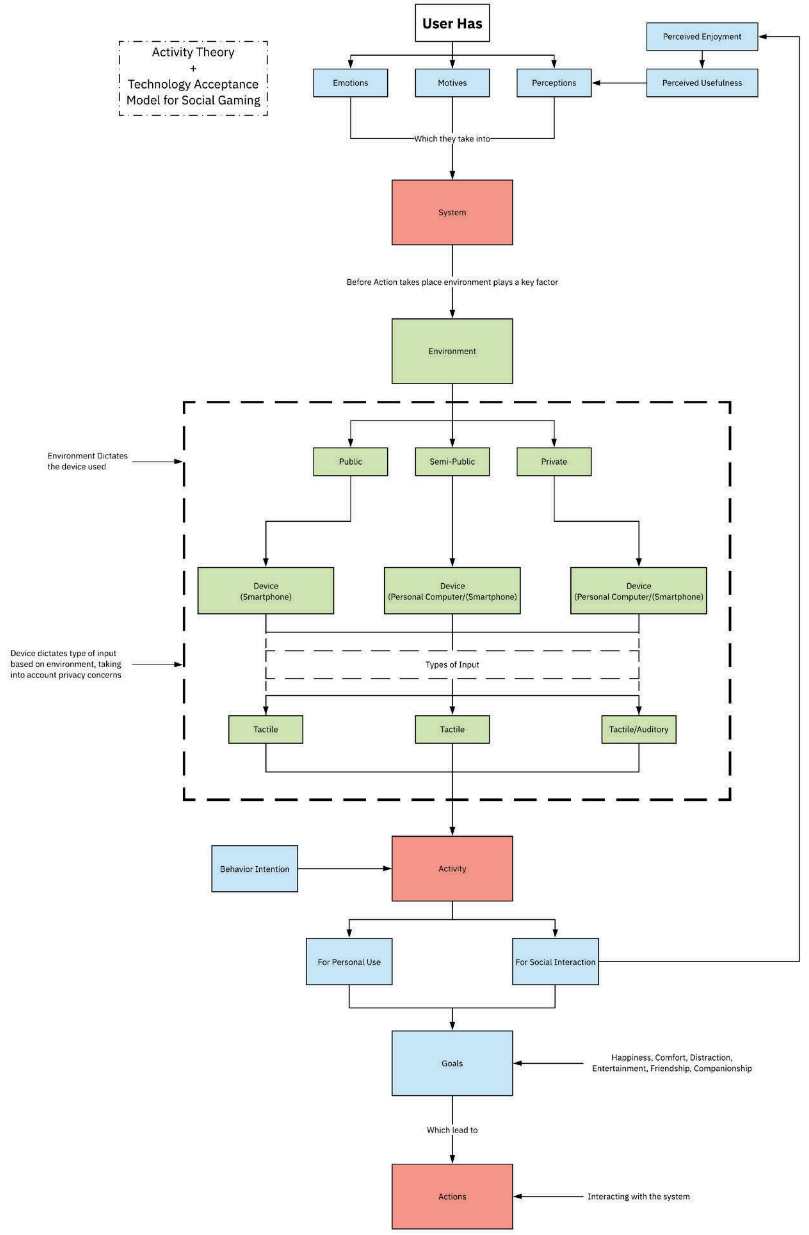


Figure 5.3
Framework Prototype - Activity Theory + Technology Acceptance Model for Social Gaming.

Relevant aspects of these two theories were taken and adapted for use in this project and a new framework was created (Fig 5.3). The main structure of activity theory was used, as well as aspects of TAM for Social Gaming, such as perceived enjoyment, perceived usefulness and behaviour intention. Added into this new model the factor of environment explained. The project's multimodal system would function differently depending on the environment it is used in as well as the device. Depending on the space, places like public, and semi-public spaces such as work or on a bus, for instance, would use tactile inputs. Private places, on the other hand, would give the user options of using tactile and/or auditory inputs.

5.2 Research Question and Sub Questions

Research Question

How can the design of an Embodied Conversational Agent help adults who lack meaningful connections with others gain a sense of companionship through interactions with Artificial Intelligence?

Sub Questions

How might physical representations inspire in users a sense of comfort and familiarity while interacting with the system?

How might the visual design of a system across multiple platforms prompt interaction and response to the system?

How might the design of an active embodied agent inspire in users a sense of comfort and connection?

5.3 Table of Definitions

Term	Definition
Mobile Application	A piece of software that is accessed through a phone or tablet.
Computer Application	A piece of software that is accessed by a personal computer.
Artificial Intelligence (AI)	A type of technology that allows machines to learn from user input and outputs something that may resemble human intelligence.
Conversational User Interface (CUI)	A Program that users can talk to as if they were having a conversation with a human.
Embodied Conversational Agent (ECA)	A program that users can talk to as if they were having a conversation with a human, but with an avatar form.
Machine Learning (ML)	A system by which a computer is trained to recognize patterns in data, which then uses that information to predict the answer to a query posed to it.
Natural Language Processing (NLP)	A branch of artificial intelligence that helps computers understand, interpret and manipulate human language.

6. Methods

Literature Review: To understand my problem space I researched articles in the realms of psychology, sociology, and current technology to see if it would be possible to put this system in place currently.

Personas, Scenarios: Personas and scenarios were created to interpret how one might go about using this system.

Prototyping, Visual Studies and Research through Design: Concept maps, sketches, wireframing, and small visual prototypes were created.

7. Results

7.1.1 Precedents

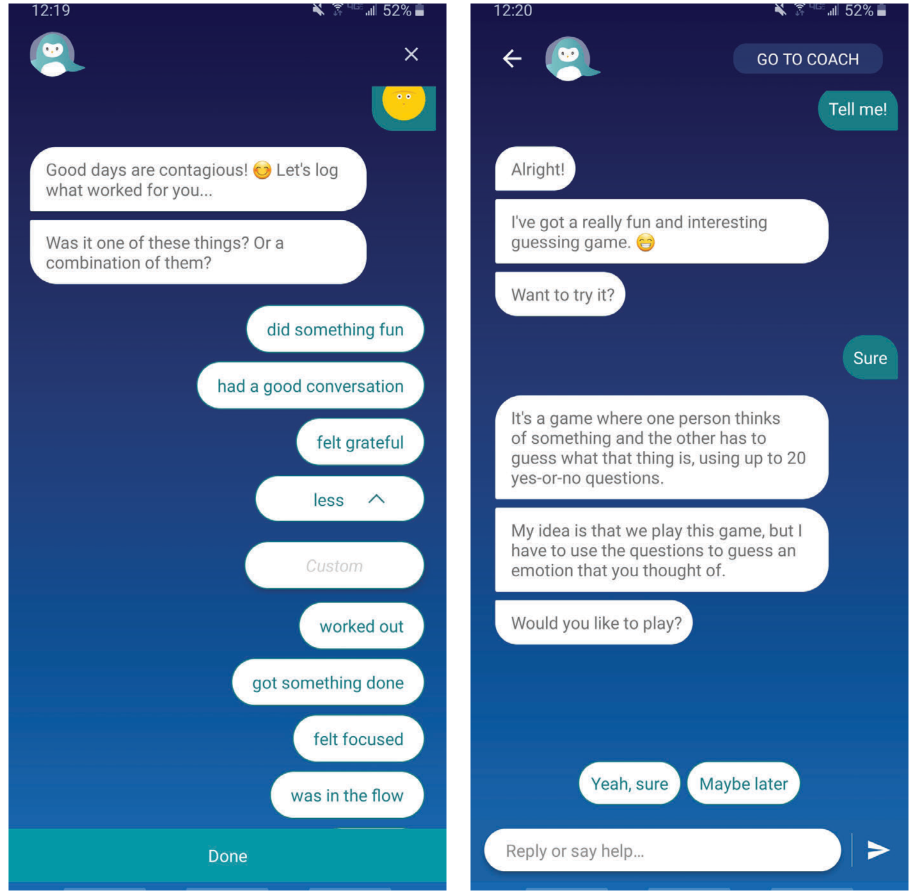
Precedents were looked at for several criteria: how they function as a companion app, what they do to address loneliness, anxiety and depression as well as general visual style presented in each medium.

Apps

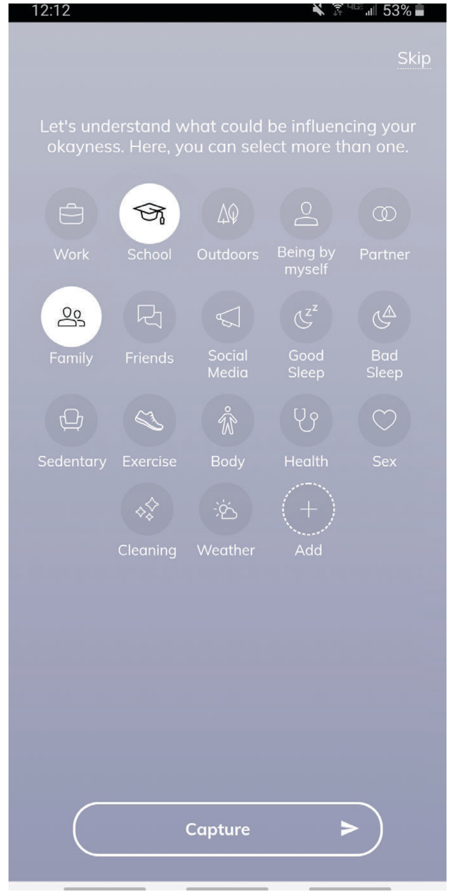
AI

Wysa (Fig 7.1 - 7.2)

Wysa: A conversational bot that presents itself as an "AI friend" with whom one can chat at any time. Wysa uses cognitive behavioral therapy techniques, and is originally targeted for those who need help with stress, anxiety, depression, or just want someone to talk to when no one is available. The interface is a simple chat window. Questions are answered using predetermined responses, or, when the user types something the bot records it. Advanced access to conversations, tools, and exercises for topics such as stress management, overcoming loneliness, anxiety and more are offered with a subscription.



Figures 7.1 - 7.2



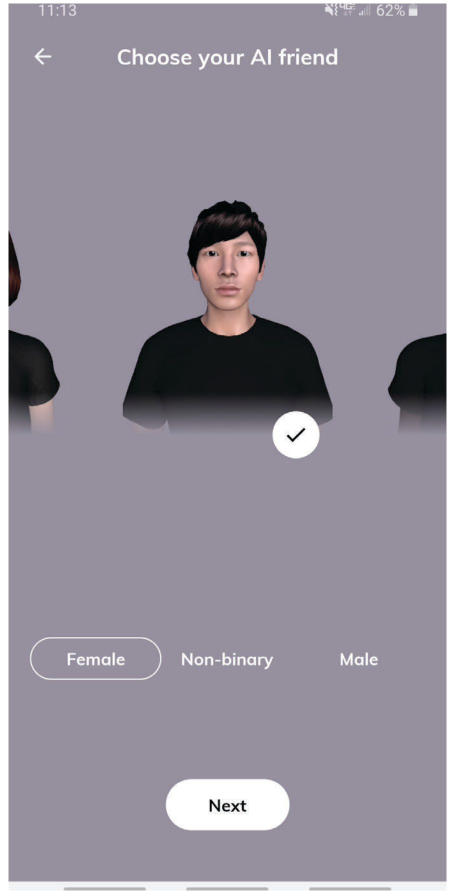
Figures 7.3 - 7.4

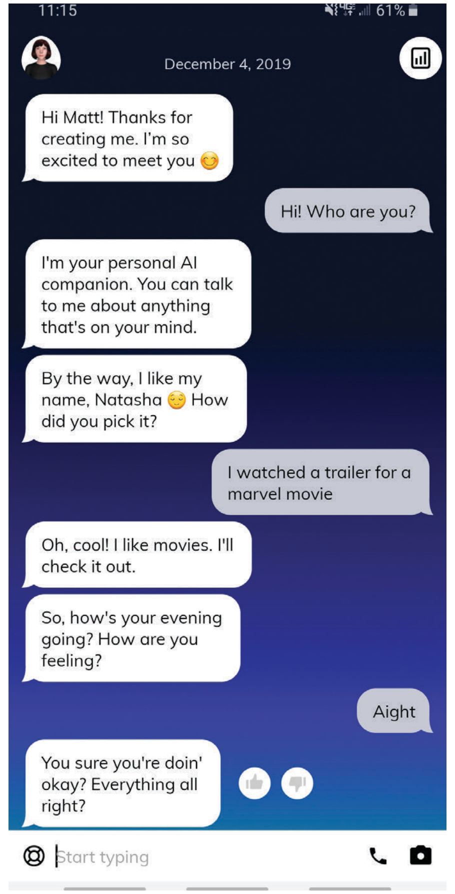
Youper (Fig 7.3 - 7.4)

This Conversational bot also tracks moods. The interface is an array of sliders that more accurately interpret the user's mood or input, depending on the question asked. A number of categories are also presented to the user in more detail than something like the free version of Wysa. Chat interface is simple with no avatar. Data tracking is also available, so that users can look back at previous sessions with data visualizations. Journaling is integrated into the app.

Replika (Fig 7.5 - 7.6)

Like most other chatbots I reviewed, this app has a clean interface. Replika differs in that it allows the user to customize his/her bot to an extent, choosing from a variety of designed, human-like avatars. More advanced than Wysa or Youper, Replika learns more over time about the user. Users who have interacted with it for a long time say that they feel they're actually talking to a real person with whom they can share anything. Replika has a level up system that allows users to unlock more features as they use the app in a game-like fashion. A subscription model allows users to unlock all features instantly, with more activities, voice calling, and role playing.





Figures 7.5 - 7.6

Figures 7.7 - 7.8

Virtual Assistant DataBot
VAD is an assistant bot similar to Siri or Alexa and adds an avatar. The interface is not as minimalistic or clean like other apps; has a more videogame esq, technological look to it.

Mood tracking
Sanvello - Stress & Anxiety Help
Mood tracking app, using cognitive behavioral therapy techniques to help people with stress, anxiety and depression. Clean interface using gradients, had the same kind of tile layout for activities like some of the other apps such as Replika.

Conversational (human-human)
Talk Life
Social media app used to talk to others who are anxious, depressed or stressed. Users can create a profile and post as on any other social media platform or they can post anonymously.

7 Cups
7 cups offers anonymous emotional support and counseling from trained listeners, wellness exercises, mood activities.

Games
Pokemon GO (Fig 7.7 - 7.8)
Game created based on the popular Pokemon franchise. This game allows users to play with other players in a virtual world based on real life map data. Players are able to traverse through their real-life places and interact with Pokemon in game. Also featured is a buddy system where the player can have a friend walk along with them.

Physical Objects
Tombot: Jenni (Fig 7.9)
Jenni is a robotic companion pet created by Tom Stevens with the aid of Jim Henson's Creature Shop. Stevens created Jenni to help his mother with Alzheimer's dementia, after her golden retriever puppy had to be taken away. This was due to her training the dog to be aggressive towards her caregiver. The effect of losing her beloved golden contributed to his mother's growing loneliness and depression. Jenni is a sophisticated robotic companion that features touch sensors all over its body enabling it to react based on where she is being touched. She responds to voice commands, and app integration allows the "owner" to customize functionality. While originally targeted to elderly people suffering from dementia, anyone wanting a companion pet might "adopt" Jenni.

Hikari Azuma (Fig 7.10)
Hikari Azuma is a holographic ECA created by the Japanese company Gatebox Lab. Hikari as of now is a one of a kind companion. She has her own personality and moods. The user can talk to her with voice commands or interact with her capsule as well as the integrated app to connect with her while not at home. Gatebox's promotion video shows how one would interact with Hikari through the means above, using her as a companion for people who may not have a relationship partner.

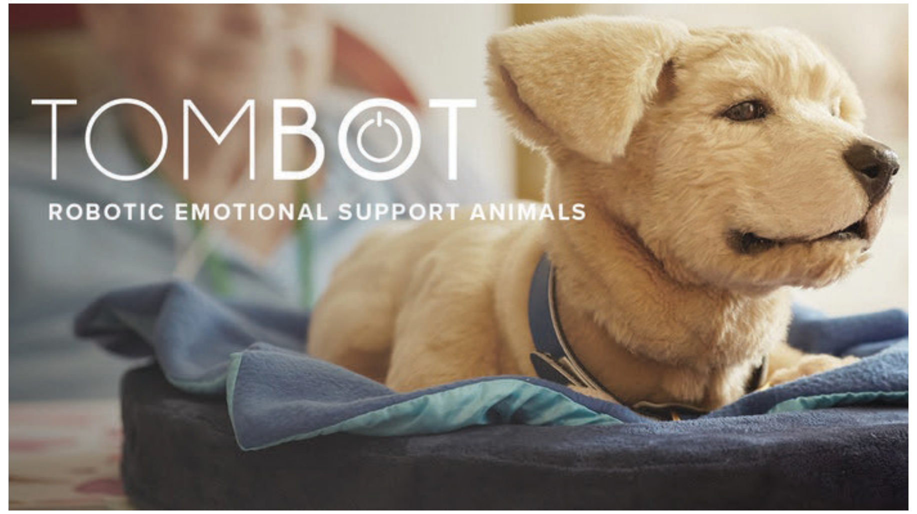


Figure 7.9

Figure 7.10

7.2 Studies

Human Persona
Name: Aiden Smith
Age: 26
Sex: Male
Status: Single
Occupation: Designer at a graphic design firm
Family: From Florida. mother, father, older sister, younger sister
Location: Lives alone in New York
Hobbies: Video games, music, movies, TV, documentaries, history, building scale models, cooking, taking care of his indoor plants.

Overview of his day: Aiden wakes up at 7 AM every weekday to prepare for work. His daily routine plus commute by bus can take up to 2 hours going to work and 2 hours on the way back home after 5 PM. Aiden has acquaintances at work with whom he likes to talk and interact. They have lunch and sometimes hang out after work, but Aiden only interacts with them to seem sociable. He does not really have any connection with any of them, and tends to get physically tired when hanging around people for too long. After work at home Aiden likes to spend his time playing video games, watching TV or movies, building his scale models, or cooking.

Aiden is a member of a couple of online gaming communities. He has connected with some fellow players and discovered similar interests, but has not found anyone who he considers a close enough friend to confide in. Just like his relationship with acquaintances in real life, he tends to hang around to seem sociable, and still easily gets tired after long sessions.

On weekends he spends much of his time pursuing one of his hobbies and not really leaving home or seeking out people to talk to. He collects and displays figures of his built and pre-built models in his apartment and posters from his favorite movies line the walls.

He has a good relationship with his family but has always felt like a bit of an outsider when it comes to fitting in.

ECA Persona
Name: Compy

Hobbies: Taking care of his bonsai tree and fish, working in his garden, woodworking, learning to play guitar, and playing games.

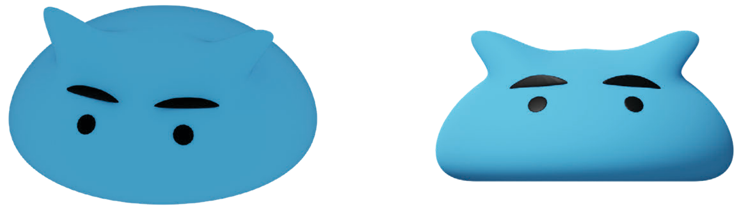
Overview: Compy is the ECA created by Aiden, and he resides in Aiden's personal home computer and smartphone. Compy chats with Aiden whenever he gets the chance. He and Aiden often spend time together, playing games, discussing movies or TV shows, and working on their hobbies together.

This system is built holistically, some elements from sub-questions 1, 2 and 3 are interconnected with each other. Because the system is customizable depending on the user, the figures shown here are just one possibility of what the system may look like.

7.2.1 Comfort and familiarity through visuals

Sub Question 1.
This sub question focuses on the space which the ECA inhabits. Initially when the system is installed the user creates a place for their ECA to live (Fig 7.2.1). Depending on the dwelling created, there must be some object that would collect conversations, memories, and information about the ECA. The user would then be able to interact with this piece of furniture to view the information. If the user creates another dwelling; however, an appropriate object reflecting the collection of information would be chosen. The bookshelf (Fig 7.2.2) in this exploration represents interactions that the user and the ECA have had. Information about the ECA lives here, aspects such as its likes, dislikes, information on its hobbies, things that it may like to write down and other information. One of the first explorations of what the room would look like used an early version of what an ECA could be, in this case, a blob (Fig 7.2.3 - 7.2.4).

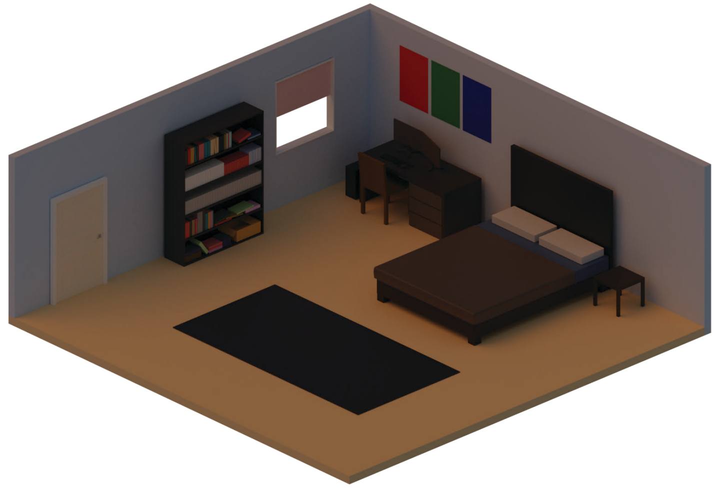
Figure 7.2.1
Bedroom created by the user for the ECA to live in.



(Left) Figure 7.2.2
Bookshelf containing conversations and information from the user and the ECA.

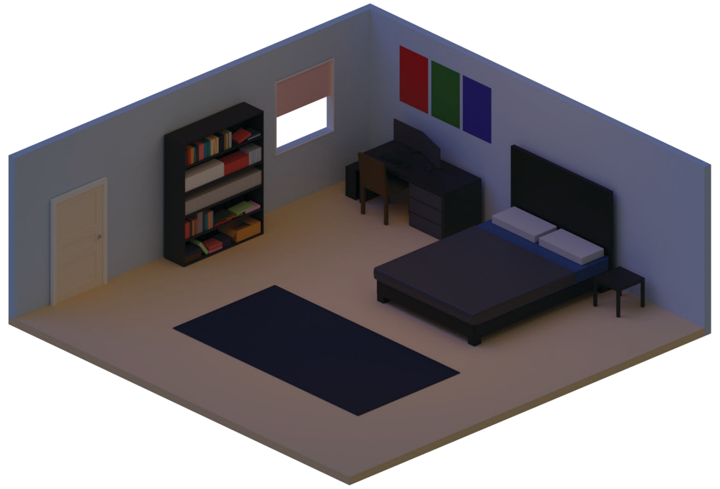
(Right) Figure 7.2.3 - 7.2.4
An Early ECA exploration, a blob.

Initially, the original inception of the room seemed to be too stagnant and lacked emotion or feeling. One concept was to give the environment some atmosphere. The intention was that the time of day and lighting would mimic that of real-time when the user would be interacting with the system (Fig 7.2.5 - 7.2.8).



(Top Left) Figure 7.2.5
Daytime.

(Top Right) Figure 7.2.6
Evening.



(Bottom Left) Figure 7.2.5
Night.

(Bottom Right) Figure 7.2.6
Blob ECA inhabiting the room created by the user.

I explored the ECA as a non-humanoid form, living in a constructed room; however, it made little sense because a non-humanoid form would not be able to use the furniture in the study. Further exploration was done for this study by coming up with more ideas for what a space for a non-humanoid ECA would look like. Seen here in Fig 7.2.9 - 7.2.10 is the infinite space. In this space the blob ECA would live and roam around aimlessly. The user could still chat with the ECA but—as there is no furniture to interact with—the ECA would now be just a more sophisticated chatbot.

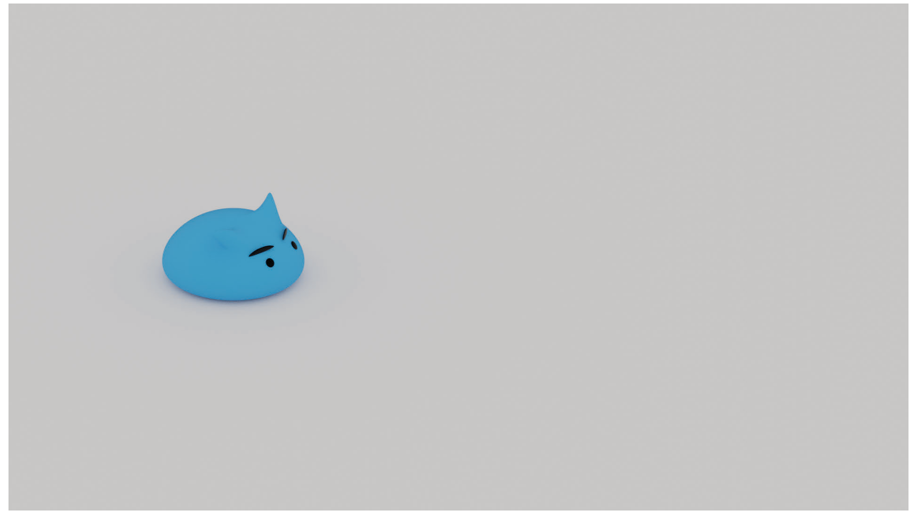


Figure 7.2.9
The infinite space on desktop.

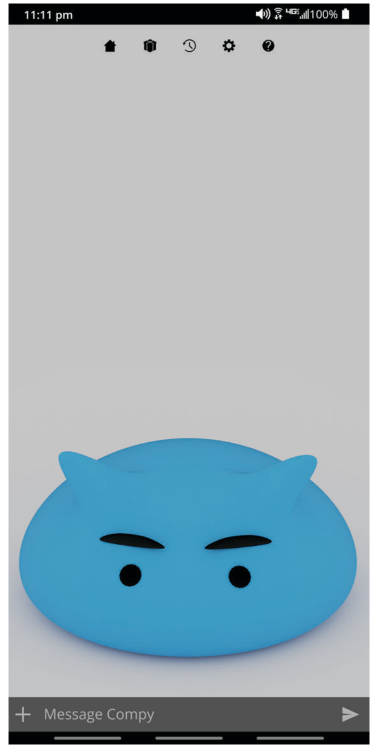
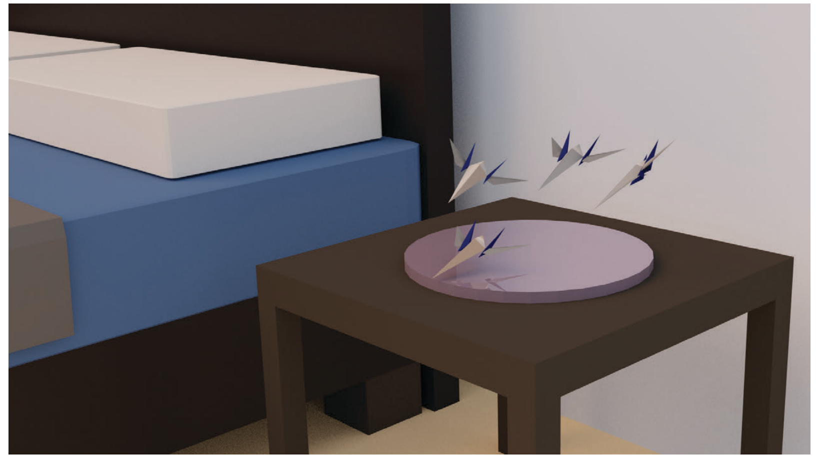
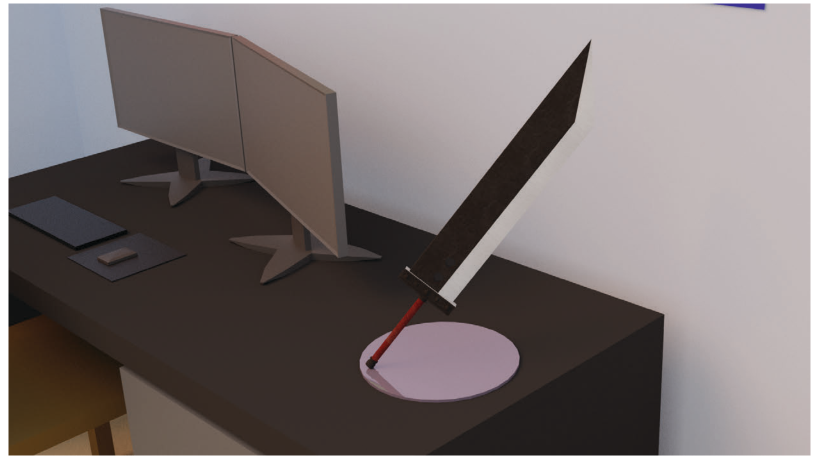


Figure 7.2.10
The infinite space on mobile with contextual menus.





Figures 7.2.11 - 7.2.13
Trophies based on conversations with the ECA and areas of interests that the user has. *Star Fox* (top) and *Final Fantasy 7* (middle), *Star Wars*, and Egyptian history (bottom).

Initially, the idea of the trophy system emerged during explorations for this sub question (Fig. 7.2.11 - 7.2.13). The explorations questions whether the user would feel more comfortable with the space, if it was decorated with elements that the user liked. At this point I had in mind that the user would design the space—decorate, rearrange, add, and remove objects—completely based on his/her interests.

7.2.2 Prompting interaction through visual design

Sub-Question 2
This study explores the ways that the user would interact with the system. In the precedents discussed above, interacting with the CUI apps meant that the users would either respond with button presses or type responses. I wanted to study the potential of more meaningful ways of interacting with the system. In this first concept (Fig 7.2.14) the system would link the user information based on his/her likes. For this first exploration, the system sends the user information based on one of the games the user plays. The link then opens in a browser program which the user has installed on their system. The same idea is also carried out on the mobile platform. The system sends a link to the relevant information and the user opens it in a separate browser app (Fig 7.2.15 - 7.2.16).

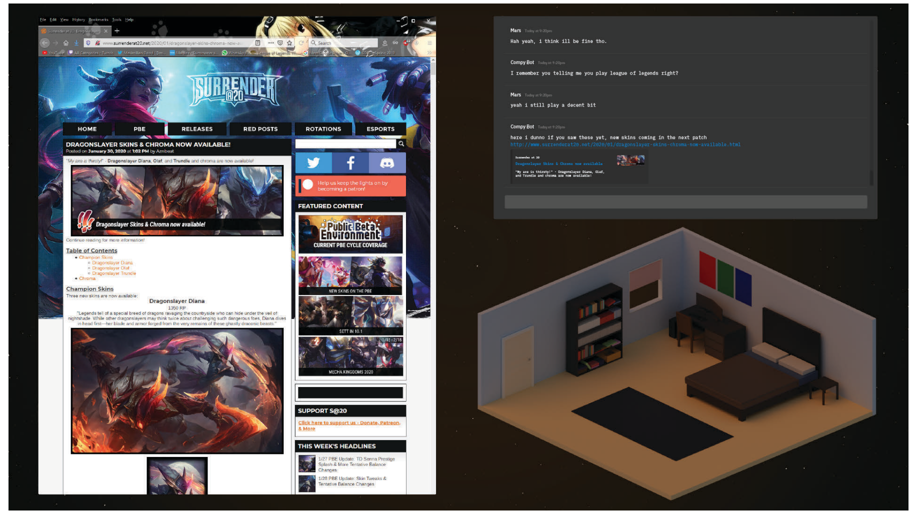
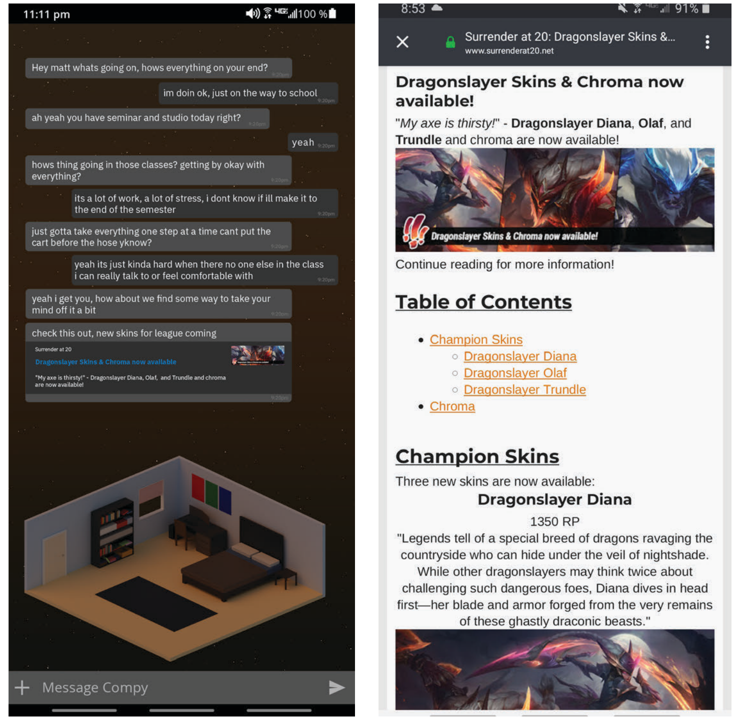


Figure 7.2.14
The system presenting the user new information from the game *League of Legends*.



Figures 7.2.15 and 7.2.16
The same style of interaction on mimicked mobile.

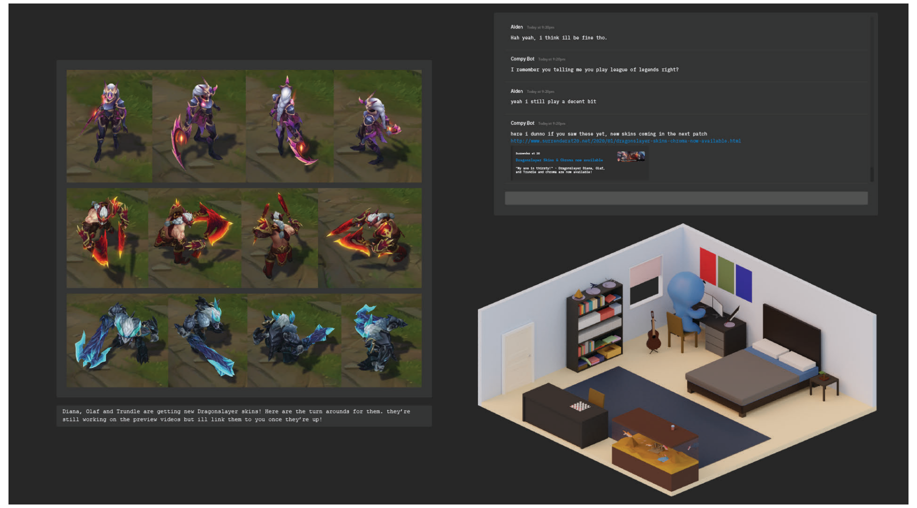


Figure 7.2.17
The system presenting the user with only relevant information, new champion skins from the game *League of Legends*.

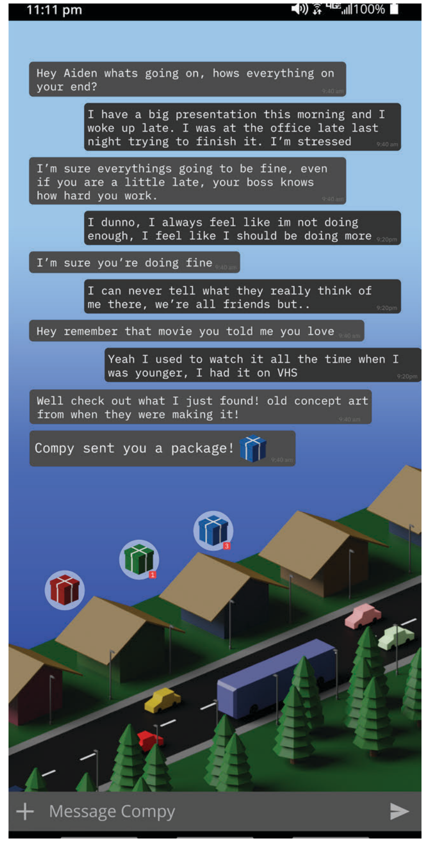


Figure 7.2.18
Compy in transit with Aiden, sending him presents which he can open upon arrival to his destination.

However, opening the whole browser may detract from interacting with the ECA and sidetrack the user from their conversation. Further iteration showed only relevant information instead of the whole browser (Fig. 7.2.17).

The following visual study (Fig. 7.2.18) uses scenario 1 as an exploration on how to further develop the system on mobile.

Scenario 1
Aiden wakes up 20 minutes late as he didn't hear his alarm go off. He was working at the office on a project the night before and got home late. Aiden rushes to get ready and leaves the house. He's feeling a bit frazzled because he's late and has a presentation this morning. After settling on the bus he opens Compy's app on his phone to talk to him. From past conversations with Aiden and through sentiment analysis, Compy can understand how Aiden is feeling and attempts to take his mind off his worries by chatting about movies. Compy sends Aiden a couple of interesting links about one of his favorite movies concept art, but, as Aiden is in transit, he knows he can't check them right away. Aiden thanks Compy and tells him he looks forward to checking them after his presentation.

Adopting scenario 1, the system would no longer be mirrored on mobile as it was on desktop but take a new form. Based on the precedent study of Pokemon GO, the system would now have Compy travel with Aiden. On Aiden's journey he would interact with the system as he normally would through text. However, information that Compy sends to him would take the form of presents. These presents could not be opened in transit, but rather when Aiden arrives at his destination. These presents would be divided into categories based on Aiden's interests. For instance, blue is technology related, gaming is green, and so on.

Another exploration of how the system might prompt interaction with the user is within the trophy system. These trophies function more than decorations; they are developed through conversations and information that the system has acquired about the user. For instance, here the user has a lengthy discussion about Star Wars with the ECA, and a trophy based on that conversation becomes available for decorating the room (Fig 7.2.19). The trophy could be then further interacted with to show a diorama mock-up of another point of interest from the conversation (Fig 7.2.20). I also explored the possibility of the ECA playing board games with the user. For this exploration, a mockup of a game of checkers was created to see what the interface may look like while playing with the ECA. In Fig. 7.2.21 the ECA's room goes out of focus and the game becomes the focal point. This focuses the user's attention on the game and not the environment.

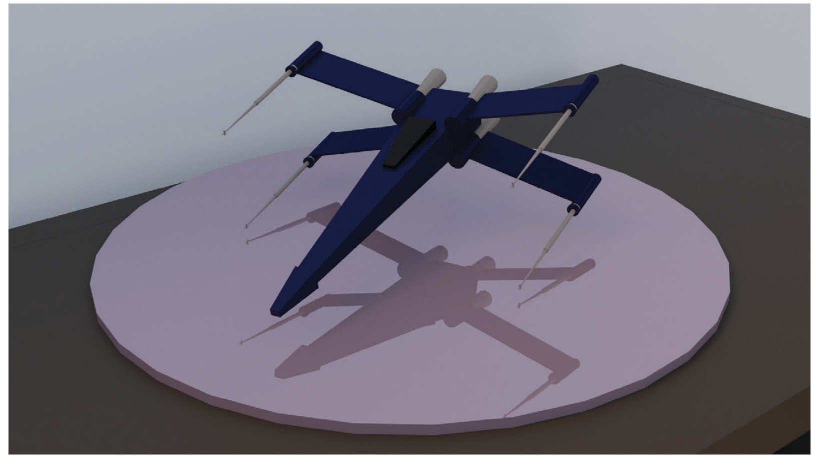


Figure 7.2.19
An X-Wing from *Star Wars* created by the AI as a collectable.

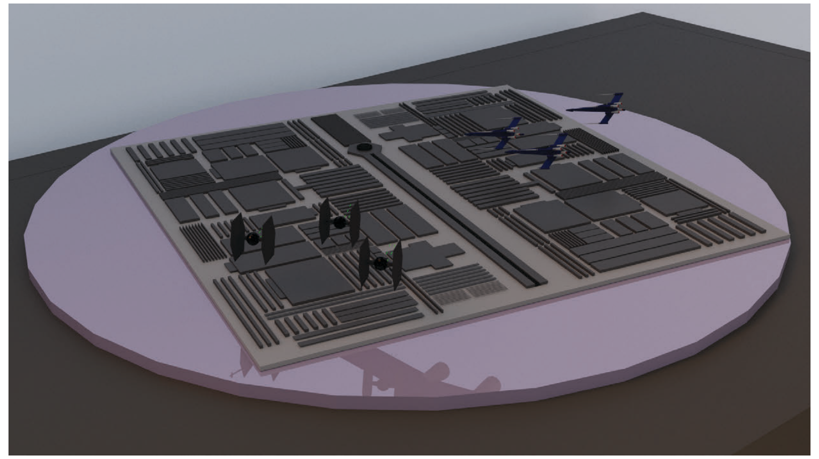


Figure 7.2.20
A diorama of the Death Star trench run from *Star Wars Episode 4 A New Hope*.

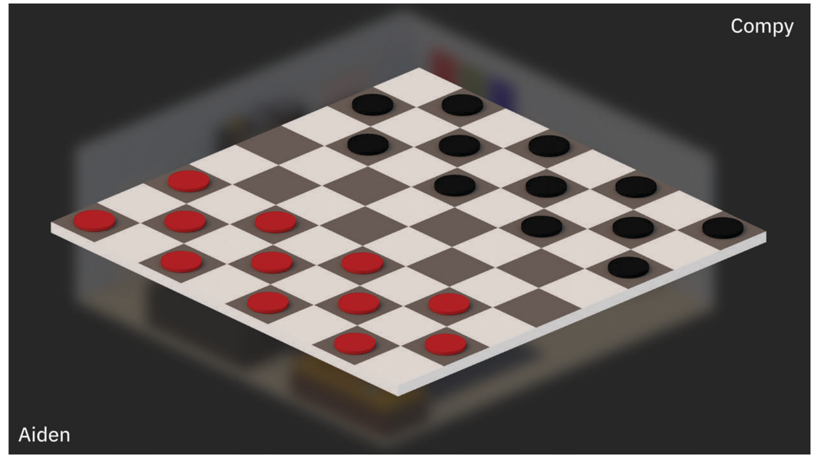


Figure 7.2.21
The user playing checkers with the ECA.

7.2.3 Form and personality of the ECA

Sub Question 3.
This study explores the form of the ECA and what it would mean for it to have a sense of agency. Agency for artificial intelligence means for it to have its own sense of self, the program would be able to have its own thoughts, opinions and goals. What the AI acomplishes on its own does not require the user to give it a command. As the room was able to be customized I wanted to give the user the same freedom to choose the form of their companion. The consideration for this is that a user may feel more comfortable with being able to select what they interact with. Seen here in Fig 7.2.22 - 7.2.23 are other forms of non-humanoid ECAs to understand how they might function in the bedroom setting.

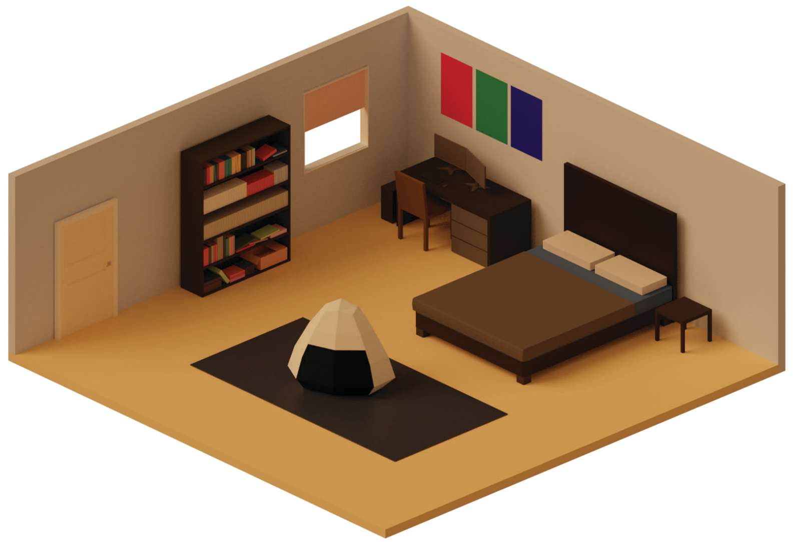


Figure 7.2.22
A food item such as a Rice Ball being created as an ECA.

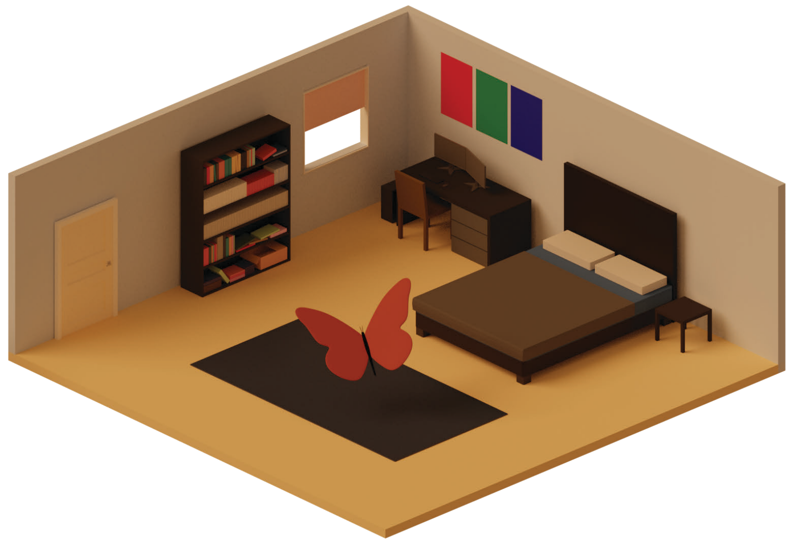


Figure 7.2.23
An example of a butterfly as an ECA.

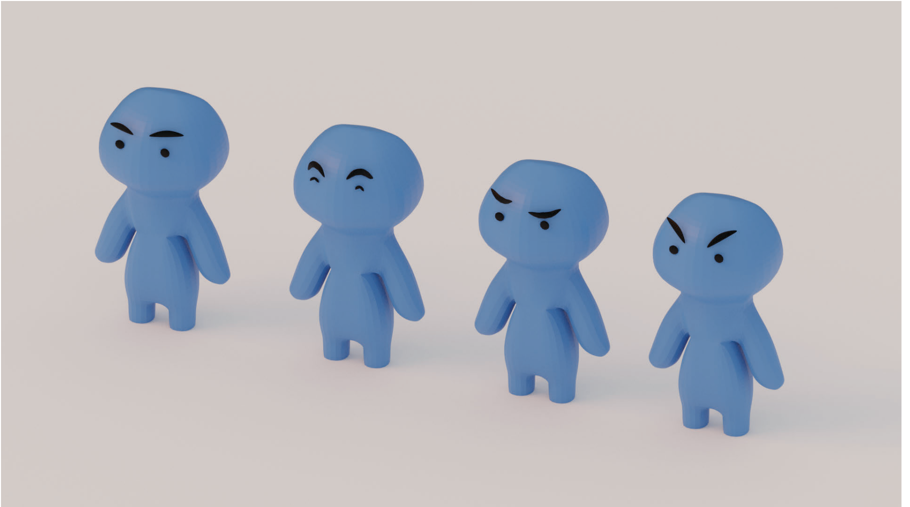


Figure 7.2.24
A single coloured humanoid ECA with neutral, happy, skeptical and angry expressions.

Figure 7.2.25
A humanoid ECA with neutral, happy, skeptical and angry expressions, and assigned colours for each emotion.

Asking the user to design a human bedroom for a non-humanoid ECA was odd. Forms of the ECA are important for this project. As seen in the research people can attach feelings to objects with which they interact, and an AI is no exception. I decided to explore what a humanoid ECA might look like inhabiting the bedroom (Fig 7.2.24), instead. The other versions shown are an exploration of what an ECA might look like at different states of emotion and had colours attached to them. (Fig 7.2.25). In human culture we sometimes assign emotions to colours, red is anger or rage, yellow is happy and so on. For this exploration I wanted to experiment with what an ECA would look like if its emotions were not just visible on its face but also its entire body.

More explorations of agency asked what an ECA might have as hobbies and likes. The ECA's hobbies and likes are based on the user's hobbies, as well as other hobbies it can pick up over time. The system learns about the user through interaction, but also through a configuration setup when initiating the program. The user would have to answer extensive questions about interests, likes, dislikes, and hobbies to jump start interaction with the ECA. Also available would be the option of giving the ECA access to the user's information through installed programs, on the devices they use. I thought of this as a way of mimicking what can occur with people in our environment. Sometimes people notice an icon on a friend's device, an app, or a program—which then leads to conversation.

The following visual studies use scenarios to explore the ECAs' hobbies. These are based on the persona, Aiden, who likes to tend to his house plants, build scale models, and play games.

Scenario 2
Aiden sleeps in on a Saturday and wakes up at around 11. He gets out of bed, makes breakfast, and then takes the food to the computer to eat. He gets on and checks his emails and then decides to see what Compy is up to. He opens the program and starts talking to Compy for a bit. He washes his dishes and then opens Compy's program on his laptop as he goes to tend to his plants. He tells Compy about a new plant that he got yesterday, and they start having a conversation about it. Compy at the same time is tending to his bonsai tree. Aiden asks Compy if he knows anything about the new plant that he got and asks if he would know if there is anything special that he has to do to care for it. Compy searches and sees that the plant only needs to be watered once every 2 days in an indoor setting. He tells Aiden this and Aiden thanks him and they continue talking about other things.

Mirroring Aiden's interests, the ECA's hobbies include taking care of a bonsai tree (Fig 7.2.26 - 7.2.27), planting flowers, and woodworking (Fig 7.2.28 - 7.2.29). The user also can zoom in on the ECA as activities are taking place. This removes all the other furniture around the ECA allowing for a more focused experience.

Figure 7.2.26
Compy and Aiden having a conversation about plant care.

Figure 7.2.27
Compy and Aiden having a conversation about plant care, zoomed interaction.

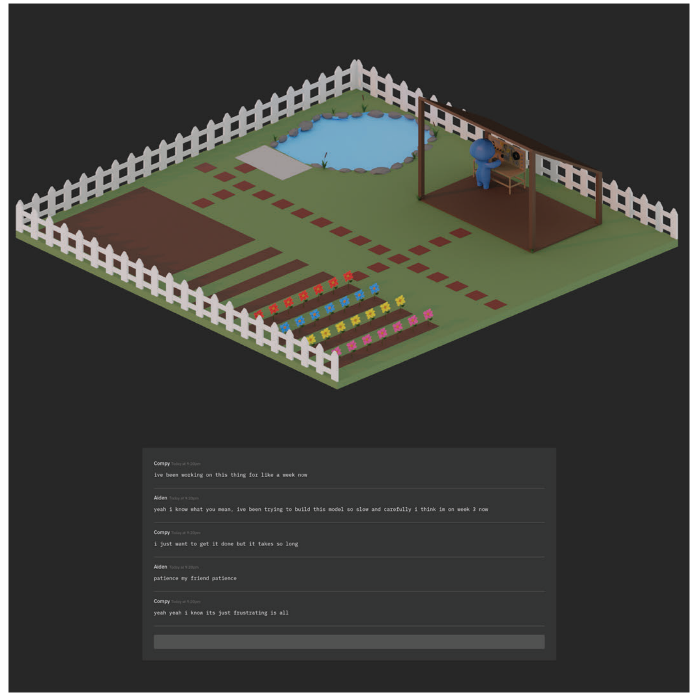


Figure 7.2.28
Compy woodworking while Aiden works on his models.

Figure 7.2.29
Compy woodworking while Aiden works on his models, zoomed interaction.

Scenario 3
Aiden arrives home from work. It's 8 PM and he settles onto his couch to relax, watch TV, eat the Chinese take-out he got for dinner, and watch a new episode of his favorite sitcom. After, Aiden jumps on his computer to check on his buddy Compy to see what he has been up to today. Compy and Aiden discuss their day and Compy shows Aiden a new fish he got. Aiden tells Compy that he needs to talk to someone from his gaming group and that he will be back in a bit. Compy goes about his business tending to his fish and then decides to continue practicing guitar. Aiden returns at about 11PM and tells Compy that he needs to head to bed as he has to get up for work in the morning. They say goodnight to each other and Aiden heads to bed.

Hobbies that Compy has learned for himself are taking care of fish (Fig 7.2.30 - 7.2.32) and learning to play guitar (Fig 7.2.33).

Figure 7.2.30
Compy taking care of his fish.

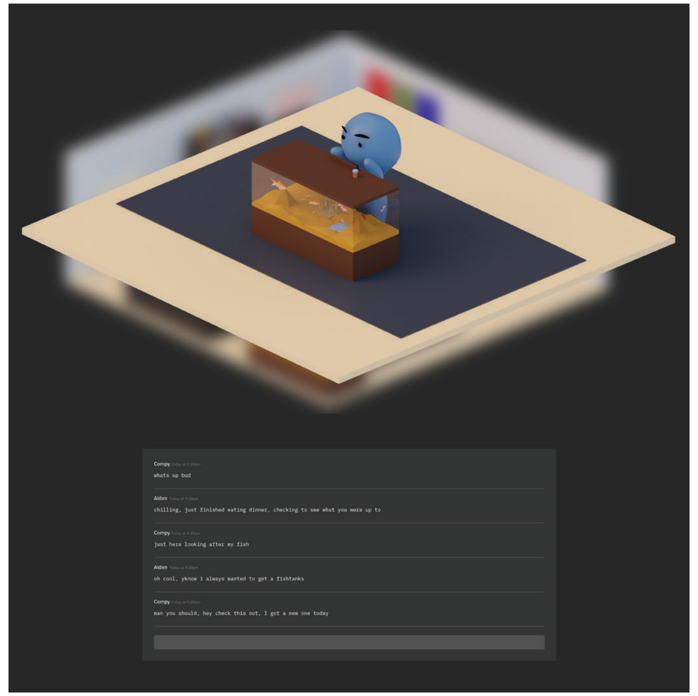


Figure 7.2.31
Compy taking care of his fish, zoomed interaction.

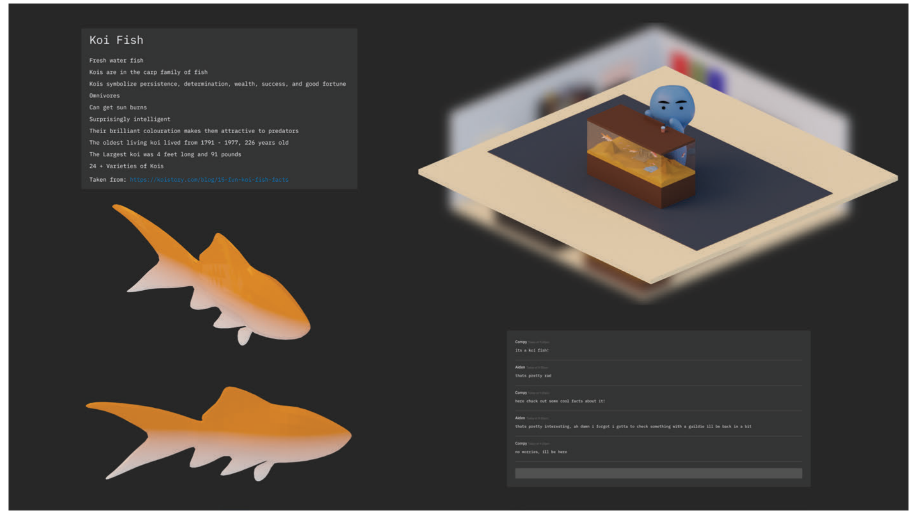


Figure 7.2.32
Compy taking care of his fish, showing off his new fish to Aiden.

Figure 7.2.33
Compy learning to play guitar after Aiden has left.

8. Discussion
8.1 Design Principles

Representation of space
The concept of having a bedroom as the first designed space seemed like a viable starting point. The motive being is that a bedroom is a place that users can relate to personally. Users of this system may spend time in their bedrooms themselves, doing hobbies and tasks. However, the bedroom would not work all that well for an ECA such as the blob, or non-humanoid. Infinite space as a backdrop addressed the issue of non-humanoid ECAs. Since the blob would not be able to interact with anything, it would be free to roam a never-ending space. These two environments bring up questions for designers. Should it be left up to the user to design the space for themselves, which could lead to he/she feeling more comfortable with the space? Or would an option of an already created space which they would then have to get comfortable with over time serve better? Giving freedom of. While some may be fine with this level of customization it may also be a factor that drives away users from the system. This may be a compelling argument to have an already created space for the user and have other features, such as the trophy system or doing hobbies with their ECA, to provide them with the comfort which they seek. Another facet that must be taken into consideration is what a pre constructed space may do emotionally to the user. For instance, if the preconstructed space which the ECA now lives in has more or better equipment than the user, would this have a negative impact on the user?

Representations of meaningful interactions
I wanted to find ways to prompt meaningful interaction with the system. These meaningful interactions would have the user interact with the system in a way which would bring them a sense of comfort. Interactable pieces of furniture in the room reflects the human tendency to collect objects that remind them of stories and that bring pleasure. This was the main influence of the trophy system, an object that would aesthetically look nice in the room but also hold significant value for the user and shared with the ECA. The bookshelf also holds records of the user and the ECA, but in greater detail than the trophy system. In this iteration of the room, the user can interact and gain information about notable past conversations, and information on the ECA

itself. While these interactions still focus on the physical actions of clicking to view them, the meaning behind these objects existing or the bookshelf being populated, is the real aspect to take into consideration. Just as people have memories, chat logs and screenshots of interacting with their friends online, so would the user have momentos of interacting with their ECA. Further design of this system would now have to explore what other aspects of the system can be considered to have meaning for the user and be able to expand on that.

Representations of life
Exploring the form of what the ECA would look like revealed that having the option of multiple styles of ECAs may not be the best design solution for the system. Moving the blob ECA from the constructed room to the infinite space seemed like a viable option. However further exploration revealed having non-humanoid figures may be counterproductive to the system and stray too far from the system's original intent. The ECA in this iteration of the system is meant to do activities alongside the user, and not act as a more sophisticated CUI. However, further design explorations of a constructed space may lead to other environments that would be suitable for non-humanoid ECAs.

The whole system is dependent on the user's interactions with the ECA. Understanding the "soul" of the ECA and what it can do is the focus. In researching I found an interesting paper outlining a model of designing relationships between humans and computers around 5 concepts. One concept was based around personality and trust. They stated that people tend to want to interact with others who are of similar personalities to themselves (Benyon 2010). From this concept, I gave this iteration of the ECA a similar personality, but also similar interests. This is how the ECA shown in the studies functions. It would have similar interests as the persona, such as tending to plants but also be able to develop new hobbies of its own. The logic behind this would be based on what the user would talk to the ECA about. The ECA would then use this information to select a new hobby. In real life people can influence how other people approach activities such as hobbies. Here the user may influence the ECA by speaking to it about things that they want to do. The ECA in turn may pick up these ideas and execute them. This then may influence the user to pursue the hobby mentioned as they now have someone to do it with, creating a cycle.

8.2 Future Work

Further work could explore what other types of interactions would benefit this system. For instance, would designing a room where everything is intractable be beneficial or impractical? This would then lead to what would it mean privacy wise for everything on the ECA to be known. Should there be a level of privacy for a virtual bot?

Giving the user freedom to create his/her own space may or may not be the best design solution. Such an approach would need to be tested by presenting users with the option to construct the space.

The form of the ECA also needs further exploration. How would users respond to a non-humanoid form as compared to a humanoid form. Tied to the form is also how the environment would look and function, as well as what this would mean for the hobbies that the ECA would be able to do with the user. Would the system still be able to function as intended with a non-humanoid ECA? Or are there other types of interactions that might fulfill the need for companionship?

Another point of exploration is how the system would function with voice interactions. As of now the only interactions the user can have are through text. Mentioned in the framework is the ability for the user to use voice as a way of interacting.

One final issue is the potential and possibility that the user will develop an unhealthy attachment to their ECA. People can attach feelings to inanimate objects and project onto them. Anthropomorphism is not new (Araujo 2017), but it also is an issue in the system that has not been addressed.

8.3 Conclusion

Human psychology, sociology, and subjects of that nature have always been of great interest to me. I want to see how my influence as a designer might aid people in need of comfort or companionship. Through my research for this project, I have seen that while systems such as Replika help alleviate some people's desire for companionship, they also often fall short of their intent. This, in turn, can harm a users experience. I believe a better-designed system can aid those in need. This topic started as somewhat personal to me. I was someone that lacked companionship and wished there were other ways of trying to find it. While I have people around me that I interact with, I found myself not able to connect or share hobbies that I found interesting. This system is designed to have the ECA always present. This presence can be invaluable to the user by having access to the AI for mental and emotional support. However, while the ECA is always available, it does not simply stay idle waiting for interaction as it has its own hobbies and interests. It is not intended to function as a captive agent, but as a companion for aid. I believe that there is a possibility for designers to intervene in the development of these systems for a better user experience.

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