**Affective Computing**
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**Week - 09**
**Lecture - 03**
**Evoking Empathy**

So, when we want to talk about Evoking Empathy in these type of agents, then there are certain elements that we need to consider and most of the time.

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Source - Paiva, A., Leite, I., Boukricha, H., & Wachsmuth, I. (2017). Empathy in virtual agents and robots: A survey. ACM Transactions on Interactive Intelligent Systems (TiiS), 7(3), 1-40.

These are the elements that we would like to manipulate to obtain a particular type of empathetic response. Number one is of course, we need to look at the type of the behaviours, that these agents are going to exhibit. We need to look at the appearance and the features.

These 3 things, the type of the behaviour, appearance and the features are again coming from the by from being motivated by the anthropomorphic design. So, you want to see that what type of; what different types of behaviours your robot for example, is going to have is it going to speak, is it going to walk, is it going to gesture and so on so forth.

Appearance, is it going to have an appearance like a human, like an animal, like a toy or caricatured or so on so forth. Similarly, what type of features it is going to have, is it going to be for example, black in color, white in color, what is going to the type of the height. For example, if it is going to look like a human, what will be the height of this human, machine or the robot or the agent and so on so forth.

So, mostly these 3 things are already well understood and are being motivated by the anthropomorphic design that we just saw. Many a times of course, we also want to look into the context and the situation that is characterizing the occurrence of the event, which is leading to a particular type of emotion.

So, for example, you may want to look into that ok. If you are target trying to create a website for example, for a user and then you are having a embodied agent, as a chatbot for the user on the website. Then why exactly your user is going to show for example, a particular type of emotion towards the chatbot that you have, embodied agent that you have placed on the site.

Maybe the there could be a context that the agent was doing very well and it helped the user in a in a particular situation and accordingly a particular type of emotion can be evoked into the humans when they are interacting with this type of embodied agent. Other thing for example, then there are different types of mediating factors that also can be considered and can also be manipulated.

So, for example, we can also take into account for example, if there is a type of relationship between the observer and the target, for example, between the agent here and the human in which you are trying to evoke a particular type of emotion by looking at the this particular type of agent as simple as that.

So, for example, your user is a female, who is coming on the site for the some query. Accordingly, maybe you want to create an embodied agent, which is going to be more looking, more comfortable for this female user which could be a male, which could be a female; which could be I do not know like depending upon the characteristics that you want to; that you think can be helpful in making it more appealing to that particular user.

So, then there are other different types of mediating factors. So, for example, you may want to look into that, what is the mood of the observer itself, right. So, for example, if you are looking at the user, then how the user is going to behave while the how the user is behaving or what is the mood in general, the mood of the user when it is trying to access the particular service.

So, these are certain elements that you want to consider and manipulate even when you want to evoke empathetic response among the humans for example, or among other agents while they are observing a particular agent. Now, next we want to there is a very important question that how are we going to measure the empathetic responses that are going to occur in these or for example, in any other type of situation.

So, we are going to talk a bit in more detail about it in the upcoming slides. But in general, there are these are the 5 different things that you may want to look into while creating to while trying to evoke empathetical response.

## Empathy in VAs

- Social identity is critical as an explanatory variable in understanding bystanders response.
- Generally not possible to study such hypotheses experimentally for practical and ethical reasons.
- The more that participants perceived that the Victim was looking to them for help the greater the number of interventions in the in-group but not in the out-group.
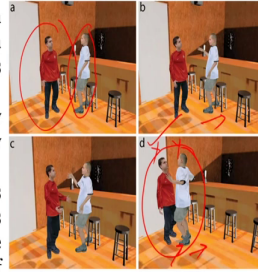
Source - Slater, M., Rovira, A., Southern, R., Swapp, D., Zhang, J. J., Campbell, C., & Levine, M. (2013). Bystander Responses to a Violent Incident in an Immersive Virtual Environment. PLOS ONE, 8(1), e52766.
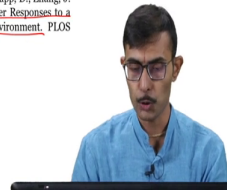
We will see some examples and it will become a bit more clear. First example that we may want to look into is the how are we going to generate empathetical response in virtual agents, right. So, for example, on the right hand side what you are looking at, this is a figure from a paper by Slater M and his group and their group, which is a paper on the bystander responses to a violent incident in an immersive virtual environment.

Now, the idea is quite simple here. We all know that we see lots of violent incidences when we are walking or passing through our daily life. But it is not it does not happen always that whenever there is a violent incident, we get into we do some intervention and we try to stop that intervention or the public gets into that intervention and tries to stop that particular type of intervention.

And it turns out that among many different things, the social identity is very very critical when we want to analyze the bystander's response in these situations. So, what it means that it has been shown that for example, if there is a conflict that is happening an among with a with a particular individual or with a particular group that you associate yourself to, then maybe chances are high that you are going to get involved.

So, for example, you as a student, if you are going to if you are passing on a street and then you see some other students being harassed, being bullied by a group of I do not know adults or something like that, then chances are high that maybe you are going to intervene because you associate yourself as a student there is an association of identity. There is a social identity that you both share of a student.

Similarly, it can be on the base of the race, religion and so on so forth. Of course, the thing is that its very, very hard to analyze and understand this particular type of response in a real settings. You cannot just create these settings and understand and analyze these it could be quite unethical.

So, then what they did in this scenario, in this paper that they created two different types of agents, so for example, there is one agent maybe you can see that there is some particular logo, that you can see here. So, this particular logo is signifying that this particular individual is a supporter of a particular football club for example.

Then I mean of course, this particular individual is supporter of a different football club. And that is what is the social identity that they are sharing and that is clearly visible on the type of the T-shirt that they are wearing. For example, you can think of one is the supporter of football club X, one is the supporter of football club Y.

Now, you can see that ok, this was the scenario that was given to the presented to the humans even and then you know now the scenario is very very simple, that how many times the humans are going to respond or intervene when there is a particular type this type of conflict

which is maybe resulting you know slowly from verbal, aggression to maybe you know very very physical aggression maybe where there is a pushing.

And then you know you would like to understand the end of they try to looked into that ok, how the participants when exactly will be the will the participants will be intervening. So, it turns out that you know for example, it turns out that you know the more the participants perceived that victim who was looking to them for help, the greater the number of interventions occurred in the in group rather than in the out group.

So, for example, if individual was a supporter of football club X, other individual was a supporter of football club Y and the X was being harassed and then the when the participant also identified itself as a supporter of X football club then maybe the participants showed more interest in intervening in the situation, rather than when it was belonging to the let us say to the other group.

So, so it clearly validated this hypothesis that you have, that you know social identity is critical as an explanatory variable in trying to understand the bystander's response. So, this is a very nice example of how the virtual agents they can evoke, empathy among the humans by trying to with their design with their appearance with their behaviour.

So, you can see therefore, example, in this case this particular agent it had an appearance, which is was making it look like a which was giving it a feeling which was making it a fan of a particular football club and if you are also going to identify yourself as a fan of a particular football club. Then you are going to intervene you are you are willing to help this particular agent and that is a type of the emotional response or the empathetic behaviour that you can you are going to show towards this virtual agent.
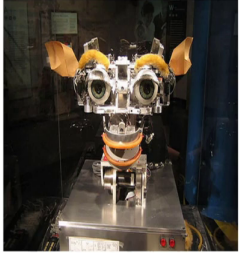
And the only reason you are able to do that, because virtual agent it evoked that particular response into you with its own particular type of design and the appearance and the behavior, right. So, for example, this is a very good example of how can the empathy; empathetic empathy be evoked in by the virtual agents.

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Here we have another very good example of how the empathetic can be evoked in the robots; by the robots. So, for example, a. so this this is for those who do not know about this particular robot. Its a Kismet robot. So, Kismet robot is its a very very it has a very very expressive mechanical phase with lots of anthropomorphic features.

And what we are going to do, is that we are going to look at the particular video of the Kismet robot, and then in which we can see that where the Professor Cynthia is going to talk about how this robot was invented and what are the different capabilities that it has.

And that will give you an idea that how by the expressions by its mechanical expression's the this Kismet can even evoke some sort of emotional responses among the observers or with the people that it is interacting with. So, let us try to look at the video now.
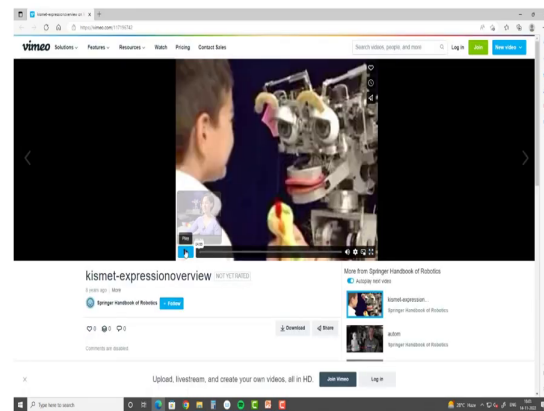
So, here we have the video. Kismet is an anthropomorphic robotic head that is specialized for face-to-face interaction between humans and this robot. Kismet can express in three modalities; one is through tone of voice. So, we can actually have the robot sound angry when it is angry, sound sad when it is sad and so forth.

Another is through facial expression which you have talked about so smiling when it is happy, frowning when it is sad and so forth. And body posture is also critical. So, approaching leaning forward when it likes something withdrawing when it does not like something.
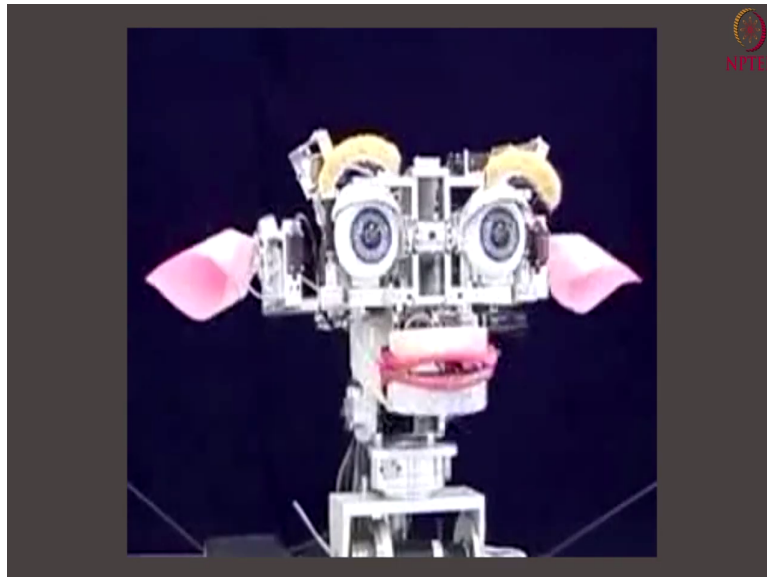
So, another important skill for the robot to be able to learn from people is being able to recognize communicative attempts. And the way we have done that with Kismet right now is to have the robot recognized by tone of voice. Are you praising it? Are you scolding it? So, we have to give the person expressive feedback for the case of praise the robot smiles.

Look at my smile. The case of prohibition the robot frowns. Yeah, I do. Where did you put your body? For intentional bid the robot perks up. Hey, kismet ok (Refer Time: 14:15) Kismet Do you like the toy?

So, again, to close the loop, its critical not only that the robot elicit this kind of porosity that people will naturally give. But then the people can actually see from the robot's expression and face that the robot understood. One very critical point of Kismet is that its responses have to be well matched to what people expect and to what is familiar to people. By doing so, we

make the robot's behavior understandable intuitively to people. So, they know how to react to it, shape the responses to it.

By following ideas and theories from psychology, from developmental psychology, from evolution, from all of the study of natural systems and putting these theories into the robot has the advantage of making the robot's behavior familiar, because it is essentially life like.

I like you Kismet you are pretty funny person

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Do you laugh at all I laugh a lot (Refer Time: 15:23) I laugh a lot.

(Refer Time: 15:27).

I kind of laugh a lot.

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Ok, it is very adorable.

Yeah, I do.

Who are you What are you?

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I want to show you something.

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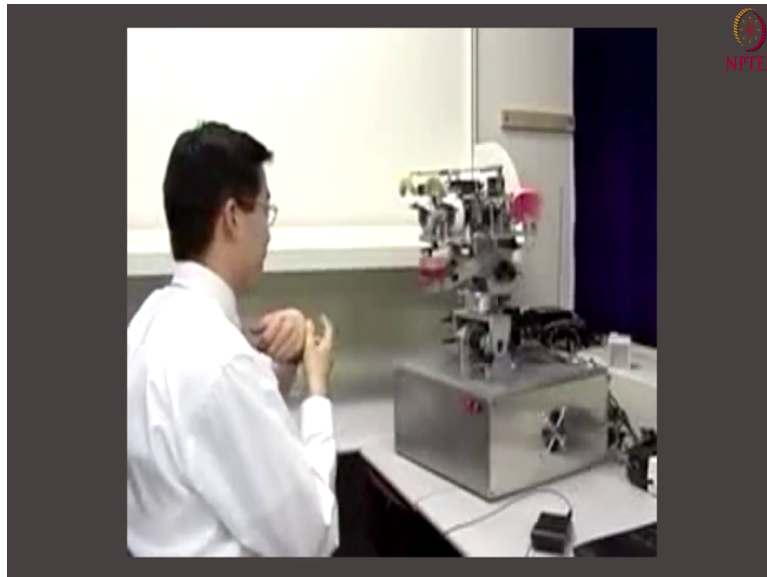
This is a watch that my; this is a watch that my girlfriend gave me.

Yeah, look, it is got a little blue light in it too. I almost lost it this week.

I do not know how you do that. You know what it is like to lose something?

We do not, too.

You can borrow.

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Oh, I think there is something here between us.

No.

Stop, you gotta let me talk. Shh, shh, shh. Kismet, I think we got something going on here.

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You and me. You're amazing (Refer Time: 16:31).

So, for example, now you can, you can; so this is; you can see that how the Kismet robot is interacting with the humans and how it is able to; you know, show some empathetic responses to the humans and in turn it is able to generate some empathetic responses from the humans. So, it is its quite kind of very mechanical, but it is very very anthropomorphic in this sense, right. So, this is how, for example, this is another example of how the robots, they can generate the empathy.

# Empathy in Virtual and Robotic Agents

So, now we first; so we looked into that ok, how the empathy can be evoked by the agents among the humans and how they can manipulate the emotional response of the humans in their own favour or as per the situation. Now, let us try to understand, that how can we generate the some empathetic in the virtual and the robotic agents as per our emotional state or as per the response of the humans.

Type II: Agents that respond emotionally to situations that are more congruent with the user's or another agent's emotional situation

So, this is the, we are going to talk about the second type of agents that are going to respond emotionally to the situations that are more congruent with the users or for example, other agents emotional situation. So, that is the second type of the robot that we are going to look into.

And here, we are going to look into, for example, one a very famous paper, very famous example of this empathetic companion, which is; was a paper that was by Helmut and Mitsuru, where they were talking about an empathetic companion, which is; here they talked about an character based interface, which can measure the affective information of the user and it can even address the user affect by employing some embodied characters.

So, this is on the right, I hope you can see this diagram. On the right, what you can see that there is a character based interface, where its a virtual interview scenario. And in this virtual interview scenario, there are certain questions, which are being presented to the candidate and at the same time, you of course, you; so you are the candidate and you as in candidate, you can answer the questions or whenever and while these questions are being presented to the candidate to you, to the humans.

Then the physiological data of the humans, of the user of the candidate, which includes in this case the skin conducts and the electromyography. So, skin conductance and the EMG is being analyzed in real time.

So, its being captured, its being processed, its being classified. And then in response to, and then with this, they are trying to understand what is the emotional state of the user and in as per the emotional state of the user, certain the character it is trying to give certain response or it is trying to generate certain empathy, empathetical response to that particular type of situation.

So, for example, maybe there is a question that was posed to you that how long you have been working or are you fresher or do you have some professional experience and then you have certain options, but of course, we all agree that this is not a very comfortable question, especially when you do not have a lot of relevant experience.

And in that situation, maybe your skin conductance and the EMG is going to indicate that you are experiencing a stress or a negative emotion. And identifying this thing, so for example, the character is able to respond with an empathetic character, character is able to give empathetic response by saying for example, it seems that you did not like this question so much or maybe you are under a stress or maybe let me change this question, let me ask a different question or as per the situation.

So, this was the type of the interaction that happened, in this character based interface and it turns out that whenever there was this empathetic empathic feedback that the character was providing to the user, it has a very positive; it has a positive feedback on the interviews stress level.

So, of course, you will have to go into the paper to read more about it, but what they showed that whenever they compared the empathetic feedback with the non empathetic feedback or when there was a no feedback and they showed that the overall interviews stress level was lower than in comparison to when there was no empathic feedback was being provided.

So again, a very good example of how an agent is observing your emotional state and how it is able to adapt to that emotional state in order to make you feel a bit less stressed. So, that is the empathic companion, I will definitely invite you to please go ahead and look at the paper in order to get more details of this thing.

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## Shimi

Image-Source: Georgia Tech
Video-Source:
https://www.youtube.com/watch?v=mDAmApNw5wo

Again, we have a very good example of another robot virtual agent and then the robot. So, now this robot is known as the Shimi robot is it is from the Georgia Tech and then we are going to look at again the video of this robot in order to understand that what this robot does.

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Hey, Shimi, can you sing Opera?

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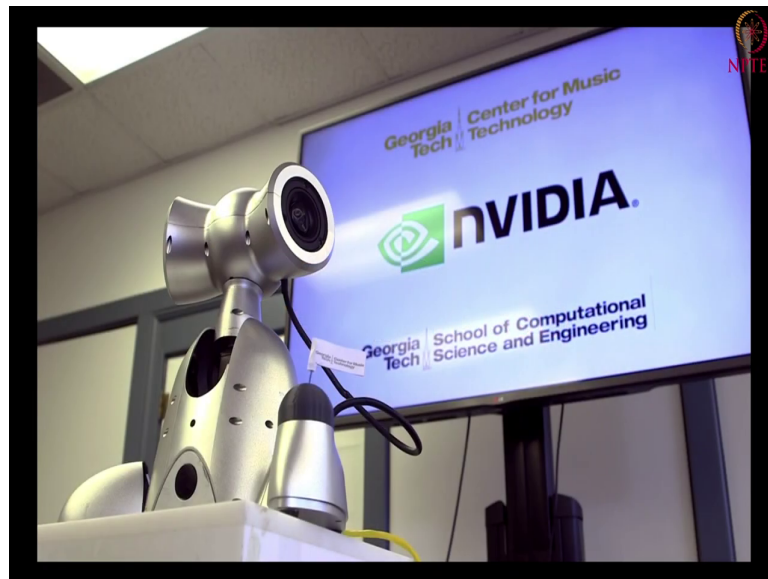


Right (Refer Time: 21:52).

So, Shimi is a personal robots that can communicate with humans, but its communication is driven by music. Everything we do here is a center for music technology erotic is driven by music and the way he communicates both verbally, with audio and with gestures is based on deep learning analysis of music datasets and motion datasets, that allows him to analyze the emotions in our speech and actually respond in an emotional way to us.

Hey, Shimi, I had a great day of work today, I got a promotion and I am feeling so good.

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Hey, Shimi, I am feeling really down in the dumps today, I am pretty sad.

Shimi will understand your emotion based on how to speak and respond with this kind of emotion response both in gestures and in voice. Allowing you to have a companion, a companion that is driven by music. What we did in order to let him understand emotions and project emotion and we analyzed datasets of musicians playing angry music, sad music, happy music and we put it into a deep learning system powered by NVIDIA.

That will try to capture features from this kind of musical phrases and this is what is driving Shimis contour and prosody and rhythmic and the way he actually moves and speak because we feel that music is a great medium for projecting emotions. And if Shimis communication is abstract like music, but also emotional like music, we feel that this can avoid the uncanny valley and allow for great interaction.

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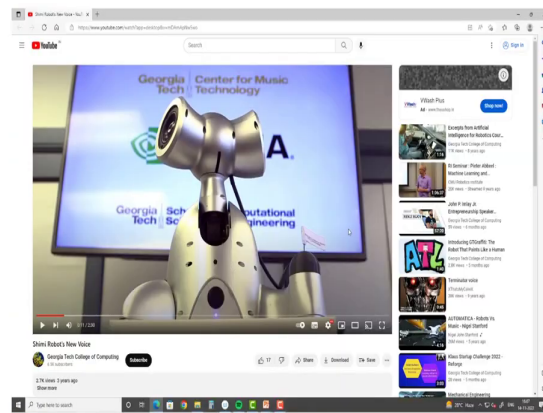


Ok. So, I hope that you enjoyed the video of the robot.

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**Shimi**

- Valence is determined by semantically analyzing spoken language, looking for words that represent positive and negative feelings.

Image-Source: Georgia Tech
Video-Source: https://www.youtube.com/watch?v=mDAmApNw5wo

So, if you look at this Shimi robot what it does? It tries to understand the emotionally state of the human which is interacting with the Shimi robot and then it tries to respond accordingly to that particular emotion. And one interesting thing about this Shimi robot that it does not it is not; it does not use a verbal language that we use. But rather it uses a musical language, which has been based, which is based on some native languages, indigenous languages in from Australia.

And now you can see that, what the type of the musical response that the robot had. And while doing so, as of now the Shimi robot's capabilities are a bit limited, in the sense that it is it only looks at the balance and the arousal and by looking at the balance and the arousal, it only tries to, it is able to classify or understand only four different emotional states on the valence arousal scale.

So, now you can quickly try to figure it out that you know the valence, it tries to analyze the valence by semantically analyzing the spoken language and it tries to look for the words that represent positive and the negative feelings. So, for example, I had a bad day. I had a bad day, ok there is a bad word in it and; so on and so forth.

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## Empathy Beyond Emotional States

And then while looking, ok. So, now we already talked about that how the emotions can be evoked by the virtual agents and how the virtual agents can respond to the emotions that are being evoked in the humans both. Now, let us try to look into that how can we have more empathetic response, which is beyond the just the analysis of the emotional states.

## Creating Synthetic Emotions

- The agents ability to perceive the "beliefs, desires, and intentions" could be limited.

- Focus is on representing basic emotional states which are quickly active, short and focused e.g. Ekman's basic emotions.

- Other affective states are mood, personality, emotional intelligence etc.

So, we have to first understand that whenever we are talking about the emotions, we usually the emotions are beyond just the basic emotions. And in this sense the agent's ability to perceive for example, things which are beyond emotions such as "belief, desires and intentions" can be quite limited. And they do have a very important role on the emotion, emotional responses that are being evoked or that are being generated.

So, but as of now, most of the focus of the affective computing community is on the representing the basic emotional states, which are quickly active, short and quite focused. And the example is could be the immense basic emotions or for example, the way we saw in the case of the Shimi robot.
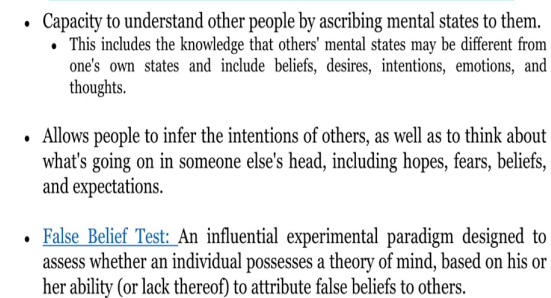
And then there are other affective states such as; mood, personality, emotional intelligence, etcetera. And which are also which plays also very very important role on the evoke in evoking the emotions among the humans or in evoking a empathic response.

And now what we want to do definitely we want to understand that can we look into any of these factors also, while we are trying to evoke emotional response or while we are trying to provide a empathic feedback.

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In order to do so, we would like to look at a very interesting term which is a theory of mind. Now, theory of mind is basically the capacity to understand the other people by ascribing mental states to them. So, basically this is the idea that we do not only know about ourselves,

but we also want to have the knowledge that others mental states could be different from our own.

And hence their desire, their belief, their intentions, their thoughts, their emotions can also be a bit different from our. And their knowledge set in general is different from our knowledge set and this acknowledgement itself is known as the theory of mind. And why is it helpful?

So, the theory of mind is helpful, because it allows you to infer the intention of the others and it allows you to understand that what is exactly going on in someone else's head, mind including; what are they hopeful about, what are their beliefs, what are their expectations and what they fear about maybe.

And is its a very very interesting and important paradigm in the psychology and to test this particular theory of mind, there is a very influential experiment which is known as the false belief test that is usually done, for the kids and to understand that to what, to what aspect extent they possess this theory of mind.
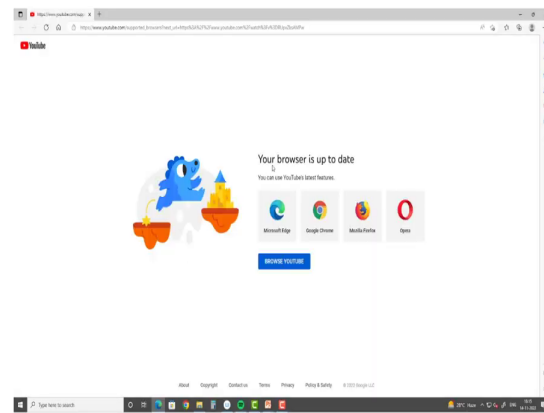
So, basically, I will let this video play and then I will let you go through this false belief test in order to understand that what this test is all about. So, I hope that you enjoyed the video.

Now, in the false belief test, essentially what you saw that these two characters, while one character, one individual, one kid is able to; while one kid is able to understand that what the others are going to will be thinking or do think, other kid is not able to understand or apprehend that what the other kid will do in that situation. What the other kid will think about that for example, where the trolleys.

**Mind Reading by Affective Agent**

- Mindreading skills play an important role in this plan recognition scenario where the robot must observe in real time.

  - To infer human's beliefs and misconceptions and

  - To recognize the human's intentions which may be valid or invlid actually invalid.

  - To reason how to best help human to obtain object/goal of desire.

And now motivated by this thing what we can do? We can create an agent which is an affective agent, which also possesses this theory of mind and with this it can sort of you know have a mind reading skills. And why we want to give this sort of mind reading skills to the agent, because it is going to understand not that ok apart from what is my belief and desires and intentions, what for example other humans beliefs and misconceptions may be are.

What are their intentions, which could be valid which could be invalid. And then accordingly it can come up with the logic that how to best help humans in for example, obtain their object or the goal of the desire. If I understand that what their beliefs are, what their intentions are, then accordingly the robot can help to the humans to obtain the particular object or the your goal of desire accordingly.
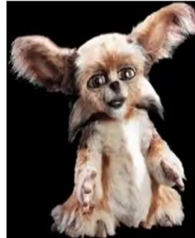
## Shared Mental Attention IID



Source: C. Breazeal, A. Brooks, J. Gray, G. Hoffman, C. Kidd, H. Lee, J. Lieberman, A. Lockerd, D. Chilongo: Tutelage and collaboration for humanoid robots, Int. J. Humanoid Robotics 1(2), 315–348 (2004)

And for this they need to of course, share the mental attention between these two and then there is again a very good nice paper by Cynthia Breazeal, Breazeal and her group which talks about this Leonardo the robot the humanoid robot and basically, I would like to again play a video. So, that you can understand what I am talking about.

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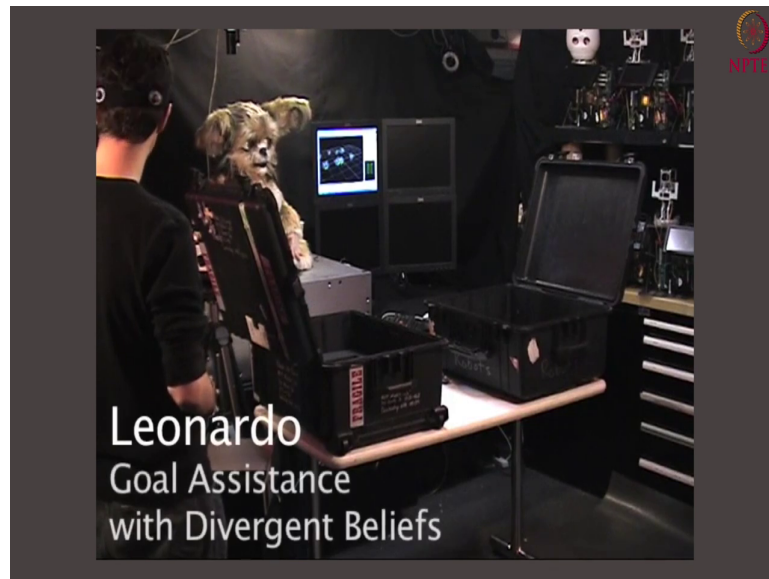


In this video the robot Leonardo demonstrates his ability to recognize the intentions of his human partners. Even when their actions are based on incorrect information. Leo keeps track of objects in his environment based on data from his sensors.

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At the same time Leo also models the individual perspectives of his human partners. Here everyone watches as Jesse places cookies in the box on the right and chips in the box on the left. Since both people are present everyone's beliefs are the same.

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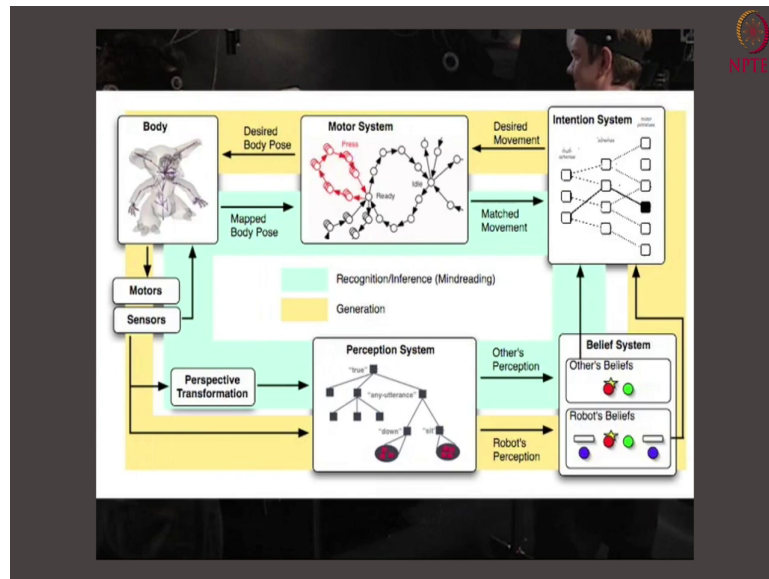


Leo's cognitive architecture based on ideas from psychology known as simulation theory, reuses its own core mechanisms of behavior generation to understand and predict the behavior of others.

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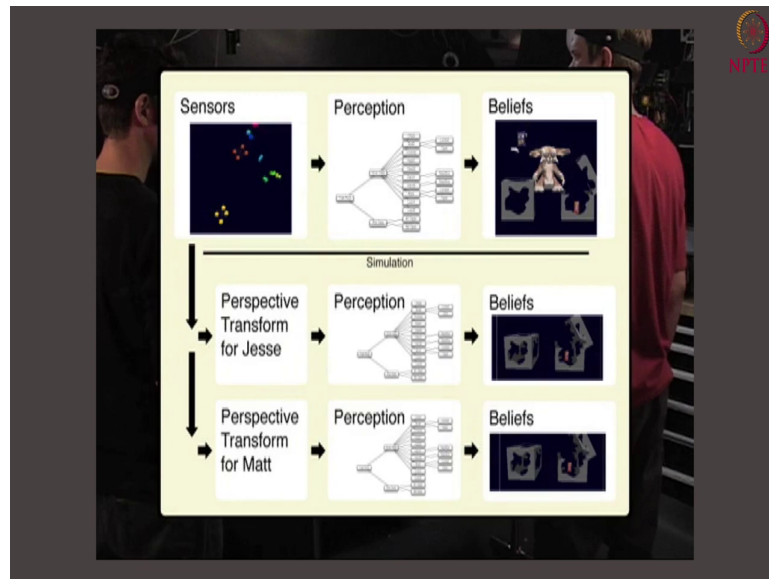


In this demonstration Leo tracks sensory data from an optical motion capture system. This same data is presented to duplicate systems, which represent the unique visual perspectives of his human partners. Now, as Matt leaves the room Jesse decides to play a trick on him and switches the locations of the two snacks.

Since Matt is absent Leo only updates his model of Jesse's beliefs. Now, Jesse seals the boxes with combination locks, preventing easy access to the snacks. When Matt returns hungry for a bag of chips, he tries to guess the combination to the box where he remembers seeing the chips. As Leo watches Matt reaching for the lock, he tries to infer Matt's intention by searching for an activity.

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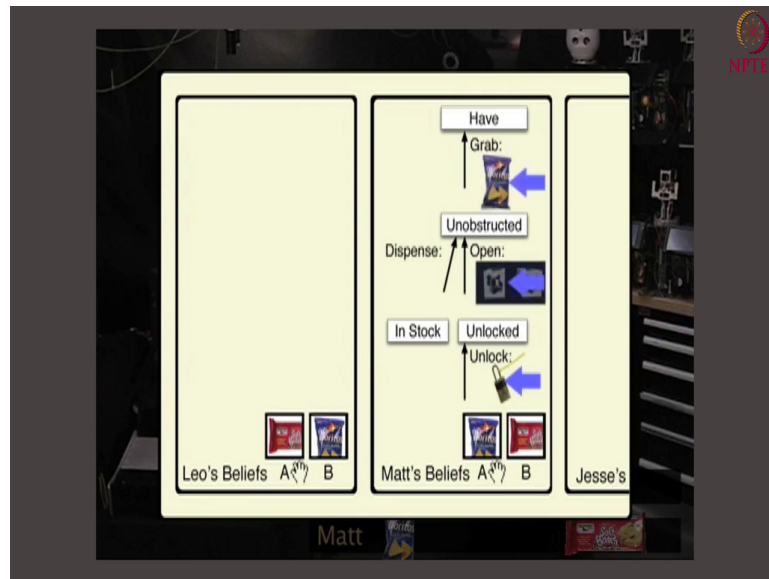


Model that matches the observed motion and task context. Once a matching activity is found, Leo uses his model of Matt's beliefs to predict what Matt's goal might be.
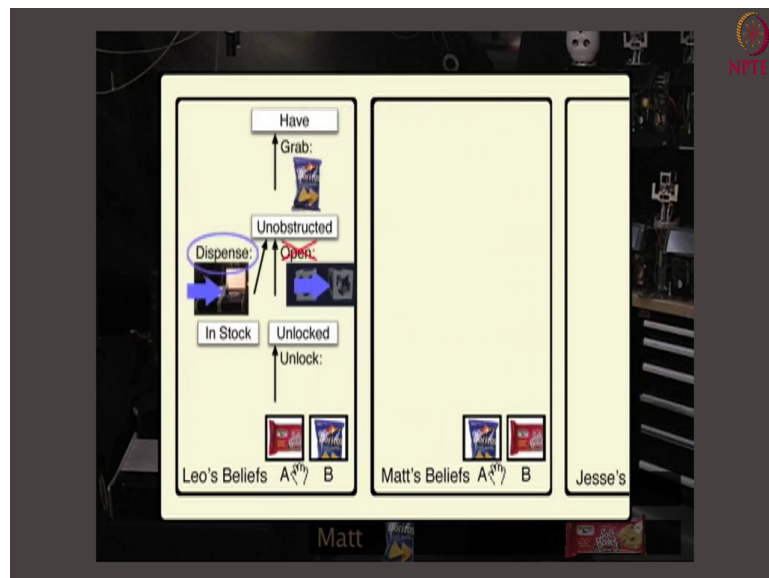
Then Leo uses his own model of the true state of the world to search for a way to help Matt achieve his goal. Having correctly inferred Matt's intention, Leo assists him by opening a box connected to his control panel providing Matt with the chips he desires. Thanks Leo.

Now, Jesse returns and tries to open the same box. Leo correctly infers that Jesse wants the cookies, since Jesse is aware of the actual contents of the boxes. Matt and Jesse both perform the same physical action, but Leo's ability to model their individual beliefs, allows him to correctly assist them in achieving their different goals.

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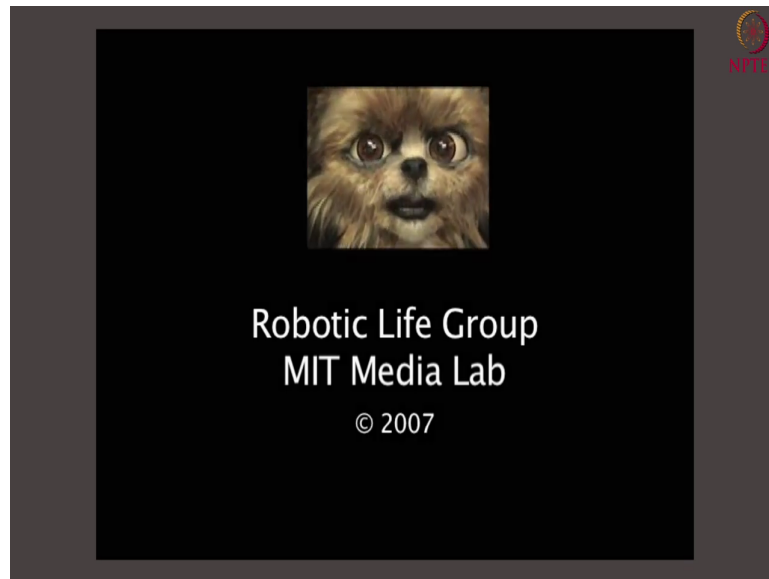
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## Shared Mental Attention

- The robot reuses its belief-construction systems from the visual perspective of the human to predict the beliefs the human is likely to hold to be true given what he or she can visually observe.
- This enables the robot to recognize and reason about the beliefs held by a person, even when they diverge from the robot's own beliefs of the same situation.

Source: C. Breazeal, A. Brooks, J. Gray, G. Hoffman, C. Kidd, H. Lee, J. Lieberman, A. Lockerd, D. Chilongo: Tutelage and collaboration for humanoid robots, Int. J. Humanoid Robotics 1(2), 315–348 (2004)

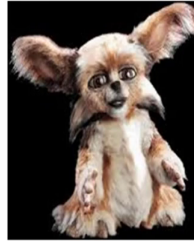So, basically you saw in the video that how the Leonardo was able to understand that what was the desire of the human. Of course, humans this particular individual was looking for a packet of the cookie and then the again since Leonardo knew that ok where the cookie was, packet was it was able to help the human obtain that particular cookie.

So, in that sense this how this how this robot is able to do so. So, this robot is able to you know look at reuse its belief construction systems by from the visual perspective of the human. And it is predict predicting actually it is predicting that ok, what the humans are believing that particular time of point of time and whether that belief is true or not.

And it is doing by looking at all the visual sensors that it has and it is applying theory of mind behind it and in doing so what it is able to do, it enables the robot to recognize and reason

about what it exactly the individual wants. At this particular point of time and accordingly help the user to obtain that particular goal. In this case getting a packet of the cookie

And hence it is really important if we can enable the robot with such a type of capability, then the robot can not only generate an empathetic response, but it will be able to generate a response which is also going to take into account the beliefs or the desires or the intentions that the humans have perfect.

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### Evaluation of Empathetic Response

So, that was about the how can we generate or evoke the emotional responses beyond the emotional empathetic response, beyond the emotional states. Now, we will be talking about how can we assess these empathetic responses.

And its not an easy question. The basic idea is of course, we want we now we know that ok how to create an empathetic agent, we know what are the different types of empathetic agent, why we want to create them and so on so forth

But unless and until there is a performance metric, we do not know that how can we measure the success in building these affective agents. In general, its really hard problem and there is no consensus yet in the community and how to assess these empathic responses. And more so in interactive settings in online settings, in real time settings, it can be really difficult to judge the implications of the empathy or the evocation of this empathy.

One thing that can be done for example, I briefly talked about mentioned this word turing test in the beginning that what can be looked into that ok, how well a system is imitating the human behavior? While trying to generate the empathy, the idea is very simple that by

providing by doing making anthropomorphic design, we want the agents to imitate the human behavior.

And if we are able to create a system which is able to imitate the human behavior its as good as the humans, then maybe it has passed the Turing test. And this is the best for example, that as a agent or as a machine it can do. So, that can be one criteria that ok. Is the agent able to evoke an empathetic response to the extent that for example, a human could have been do, could have been done. And if it is able to do so, ok it has already passed the Turing test and that is a very good measure of the test; of testing the effectiveness of it.

But then that can be a bit really hard and before even we go that of course, we will stuck in the Turing test sorry in the uncanny valley if itself and then so on. So, then there are different psychological benchmarks that we can look into. For example, we can look into the how autonomous the agents are no matter what type of agents we are talking about, before even looking at their empathetic responses, first thing we may want to look into that ok.

Whether the agents are autonomous or the empathetic responses that they are generating are non-autonomous are being controlled by other humans, because of course, if it is being controlled by other humans then maybe they are not very empathetic, right. This is very artificial the response

But of course, in while doing. So, you may have to answer, the question that whether the humans themselves are autonomous. And again, without going too much into the psychology of this thing, but then you may want to look into that ok for example, sociobiologists, they have one theory about it, moral researchers they have one theory about it where for example, the sociobiologists they say that ok.

Everything that is being, done is being controlled by the genes is the result of the evolution and hence for example, they may not be autonomous and they are being controlled by everything, but then comes the moral researchers and philosophers like Aristotle and Socrates for example, even those who say ok.

If everything is result of a gene and the evolution, then then of course, then humans cannot have an autonomy and if the humans cannot have an autonomy, then they cannot be held morally accountable. But nevertheless, without going into the discussion of the psychology here may want to see that ok whether the response is that the agents are generating, whether they are autonomous or not autonomous one criteria.

Sorry. So, other thing for example, that we can do is we can look into the imitation as well. So, imitation this turns out that ok, is as simple as that if we like a particular character, if we like the behavior of a particular character even from the movies, from the series we start imitating them. Maybe some consciously and then this can be a very good criteria to look that ok.

Whether the humans are imitating the humanoid robots or the machines or the services that you are creating for example, and if so then how is that can be compared with respect to the human to human imitation and whether the imitation is of the same extent or less and then this can give a very good; this can become a very good criteria of trying to judge. How affective how affective the empathetic response was or the empathetic interaction was or is of the agent.

And of course, all this can be evaluated in terms of for example, a Likert type scale where you can have you know I do not know. Maybe 1 to 9 score of you can give a score of 1 to 9, where for example, 9 may represent completely autonomous, 1 may represent 0 autonomy, 9 can represent that they are imitating 100 percent, 1 can represent they are imitating 0 percent and so on.

Similarly, for example, we can look into the moral values. So, the question is ok, when we are the humans are interacting with these agents, would they like to ascribe the intrinsic moral values to these humanoid robots or the agents. And if so, then to what extent, and again we can have a scale of 1 to 9.

Because if they are ascribing if they are willing to ascribe the moral values to these robots. Then then maybe they are thinking that ok, the robot is very very human like is very very empathic and maybe that is where maybe it is very successful in giving this making this interaction very very human like.

Similarly, you can look into the moral accountability that for example, when we are ascribing some moral values whether the robot is just, whether the for example, the robot is fair and so on so forth. In its adaptive interaction's can it be held accountable as well.

And for example, when it is doing a positive feedback can or vitamin something is going wrong, can by say that ok you know it was the agent is should be held accountable for it, because the agent made a emotional adaptation that was not supposed to be done for example, right and it is causing the human harm.

So, the idea is to what extent the people can hold this agent responsible. And on the basis of this moral accountability itself, again on a scale of 1 to 9 it can be evaluated. Again, for example, when we are talking about this emotional adaptation or this empathetic interaction, we can look into the privacy also that for example, to what extent it is invading the privacy of the humans.

For example, in order to understand the emotions, is it looking at the facial emotions, it is looking at the identity of the human. It is looking at the race of the human and so on so forth. And in that sense, I mean is it getting the information that it should not maybe get. And in that sense you know like the to what extent people are comfortable in sharing that particular type of information with the robot or with the machine.

So, privacy could be one aspect on which, on the basis of which this particular agent can be evaluated or this empathic responses can be evaluated. Another very important criteria could be reciprocity. So, reciprocity is as simple as that, so usually it happens that you know when someone is being empathetic with you, you would like to become empathetic with that individual.

So, is like you know you behave with an individual, to the same extent that particular individual behaves with you, right. And in that sense, so are the people willing to reciprocate the this behavior with the humanoids as well, with the robots as well. And if so, then maybe you know the robot is quite successful, in generating empathetic response because the humans

are treating it like humans for example, could be agents, could be machines or could be robots as I said before.

And it turns out of course, it can be a bit tricky again to make use of this all the psychological benchmarks. And then in that sense then you can simply you know use some self-reported question ads such as for example, you may want to list down the properties of the social robots.

The agents or the machines and you may want to get this rated by the humans, which could be all the psychological benchmarks or for example, as simple questions like as simple as that did you like the empathetic interaction that you had with the agent as simple as that.

And then based on this questionnaires or you can also do the content analysis. So, for example, if there is a conversational agent, which is chatting with the humans you may want to look at the transcript and you may want to see what type of content is being generated and see to what extent it was empathetic and to what extent it was successful.

So, that is for example, these are the few ways, in which you can evaluate in general the empathetic responses of the agents its a very very fascinating area, there has been a limited work in this so far. And accordingly, the assessment can be a bit tricky, but this is what we have. So, far and hopefully you know it will improve down the line or in the future.

Perfect. So now, we come to the conclusion of the class. To conclude in this module, we talked about the empathy and the empathetic agents. How can we evoke empathy among virtual agents? How by virtual agents among humans and how can empathy be generated in virtual and robotic agents for humans? We also talked about how the empathy can be generated beyond the expression of the emotional states and we also looked at briefly how can we do the assessment of the empathetic responses.

Now, when we talk about the empathy and empathetic agents, then we understood that we want to have the empathetic agents because presence of these empathetic responses by agents it leads to a better more positive and appropriate interactions. And that is where we also learned about the anthropomorphic design, uncanny valley and so on so forth.

When we were talking about how can we evoke the empathy by the virtual agents and by the humans we looked into that the appearance and the function of a particular agent it plays a very very crucial role on how the people are going to perceive it. And accordingly, how they are going to interact with it. So, this again is coming from the anthropomorphic design, that you really want to look into the appearance, the functions and the interaction of the machine the agent the services with the humans.

When we while talking about the empathy beyond emotional states, we understood that just by analyzing the basic emotional states, we may not be able to generate a very empathic reaction reactions and interactions and hence we want the agents to have the ability to perceive beliefs desires and the intentions of the humans, which can really help them to align their empathetic responses with the goals and the desires of the humans.

And we also looked into that how the evolution of this empathetic responses can be done. And while there are no general agreements on about it, but then we looked into how for example, some of the psychological benchmarks can be used on the Likert scale for example, of any 1 to 9, 0 to 5 or something like that to do the assessment of the empathetic responses and in trying to understand how they were helpful, how successful they were in being empathetic.

So, with that we finish this module and we will see you in the next module. Great learning.