

Socializing a Social Robot with an Artificial Society

Erin Kennedy

Computer Science, Honors Program

Advisor: Dr. James Carroll

Associate Professor Electrical and Computer Engineering

Clarkson University, Potsdam NY

ABSTRACT

Social behaviours have been developing within our world for centuries. The balance of many variables simultaneously plus a history of social interaction shapes the way we interact with others. In order to allow robots to gain social behaviour in order to interact with others, a process whereby the robot undergoes the experience of socialization is necessary. Key factors of the socialization experience include the culture of the society, the updating and changing of beliefs, and determining favourable actions. These key factors were implemented in a software environment by creating an algorithm that mimics the Looking-Glass Self theory. Additional probabilistic methods were implemented to further extend the depth of the robo-culture within the artificial society. Results of the created algorithms show consistent patterns within the robot's behaviours.

INTRODUCTION

Our population is growing^[1] and aging, forcing the number of people Alzheimer's Disease to increase^[2]. Sometimes we cannot be entirely devoted to providing the necessary amount social interaction for those with the disease. A possible solution, a pet, could provide some of the needed social interaction. However, the burden of having a pet, as well as the possible tragic outcome of the animal if potentially forgotten, is a nonessential risk to the well-being of the patient.

One of the ways a patient can always have access to a source of social interaction is with the use of a personal robot that is capable of interacting with a human, where no new social skills will need to be acquired^[3]. A social and personal robot is traditionally recognized to be programmed with initial traits reflecting the culture in which the robot is going to be utilized. These traits are then updated and modified as it interacts with another being.

However, the initial source of social bias will always remain evident within the robot's interactions regardless of the number of times the traits are updated and modified. Additionally, the robot will never have a personal history of social interaction. The history of personal social

interaction is key to provide the robot with the wealth of interaction experience that we, as humans, are naturally introduced to within our society. The history of social interaction in a robotics environment can thereby be accomplished by socializing a social robot with an artificial society.

By socializing, we mean the process by which we learn how our society expects us to behave^[5]. Learning how a society expects us to behave is highly dependent on the culture that the robot is immersed in. We want the robot to be socialized within its own robo-culture so it can share a variety of similarities and differences between the cultures that we experience and exhibit in the world.

The problem arises here, when trying to encode a process that has been developed for centuries, and is always changing. As humans, we unconsciously balance an infinite amount of variables and a wealth of experiences to shape our behaviour that we use to interact with others.

To create this within a robot, we start by implementing the primary socialization stage in a software environment with two parent robots and one child robot. The main goal of the primary stage of socialization is to introduce the child robot to interacting with its parents. Through the interaction process, favourable, or good, actions

will be determined. The child robot's understanding of what is favourable within this robo-culture will affect how the child robot reacts to the actions that the parent robots have sent. Throughout the interaction between the child robot and its parents, the Looking-Glass Self^{[4][5]} theory is used.

The Looking-Glass Self is the core theory that we implement within this software environment. This sets out to achieve the updating and modification of beliefs and opinions that the child robot has about itself and about its parents.

By using theories and techniques from social psychology, we can ensure that the robot is being socialized in a similar fashion to the way we are socialized. Furthermore, by creating a social robot with an artificial society, a robo-culture is also produced. In the following sections we discuss how we implemented these techniques and theories, as well as describe the patterns they produce.

DESIGN

In the primary socialization stage, there are two parent robots interacting with a child robot (Fig 1). The basic architecture of the program is split into Beings and Actions. Where Beings are the class of the parent and child robots, and Actions are the class of the sent, response, and favourable actions.

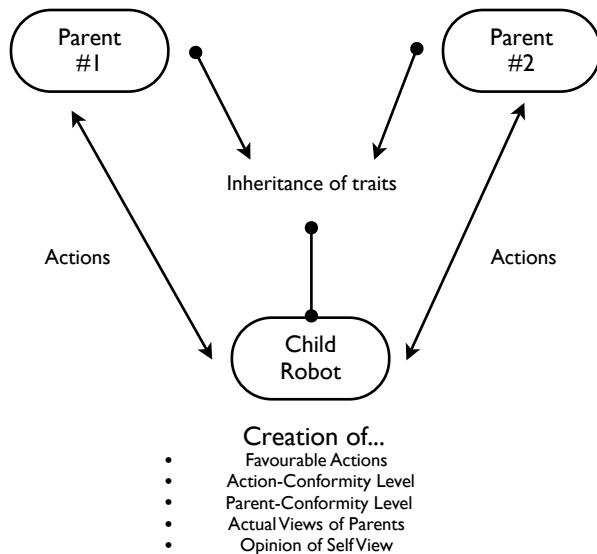


Figure 1: Basic flow of program

Beings have three traits associated with them: qualities, views, and values. Qualities are traits of behaviour, e.g. humourous, sympathetic and spontaneous. Values are biases of importance towards traits of character, e.g. gratitude, justice and loyalty. In this stage of the child robot's socialization, values and qualities do not impact the child robot's decision-making process. Each range from a level of 0-100. 0 is unsaturated, and 100 is very saturated. Views are basic appearance traits, e.g. hair style, make-up and number of piercings. Views greatly impact the child robot's decision making process, which will be discussed later.

Actions contain four main types: voice, eyes, presence and touch. Inside of these types are various items. For instance, 'loud' and 'quiet' are two action items inside of the voice action type. Action items are boolean variables, either they are the action item or they are not. Throughout this paper, when we say 'send an action', we mean that one action item is sent for each of the four action types.

The primary socialization process ties the Beings and Actions together. Inside of the process, there are many factors that need to be addressed. For this reason, the primary socialization was split into key steps.

1. Inheritance of traits

Inheritance plays a large role in any being's lifetime. Whether you are an animal, human, or robot, you are genetically predisposed to some traits rather than others^[4]. We first randomly generate all traits for Parents A and B in order to mimic this natural predisposition. This ensures that we do not initially introduce any social bias by selecting which traits have which values.

Afterwards, we use an AI algorithm that is specifically tailored for the inheritance of traits. The base AI algorithm that we use is the Discrete Bayes Filter Algorithm^[6], with an added roulette function^[6]. We send the difference of traits between the two parents to the AI algorithm, and receive a classification number with a probability associated with it. Depending on the classification number, different methods occur. Two of the several methods are 'inherit highest value' and 'inherit random number, within certain bounds'. We designed the methods to have varying degrees of randomness in order to ensure some mutations would occur.

2. Initial distribution of favourable actions

When experiencing different cultures, the norms and values are pertinent to illustrating the various differences. What is understood to be good in one culture, may not be good in another culture. Since we want the child robot to be socialized in its own ‘robo-culture’, we do not specify what is good/bad or favourable/unfavourable. This is a key aspect to the created primary socialization process.

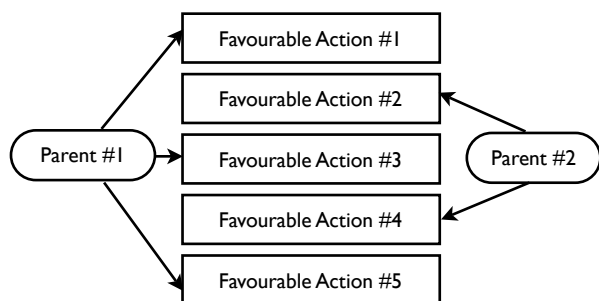


Figure 2: Initial distribution of favourable actions

The first five actions that the parents send are deemed favourable (Fig 2). Afterwards, Parent A and Parent B take turns sending actions, where Parent A is always first. These actions that are sent by the parents can be determined if they are suitable to replace an existing favourable action. The number of favourable actions is designed to be an odd number in order to impact the parent conformity levels, which are discussed later on.

3. Sending actions and formulating action favourability levels

The actions sent from the parents are randomly generated, and the parents alternate turns sending actions, starting with Parent A. Each action contains four main types, where one action item within the type is sent. When the child robot receives the action, the action goes through an AI filter, resulting in an action favourability level.

The AI filter is based on the Discrete Bayes Filter Algorithm^[6], but it is tailored to this specific task. In this case, to see how favourable a sent action is compared to the five favourable actions, we have to see how similar the sent action is to all of the favourable actions. In gauging how similar

an action is, we introduce social bias that signifies that the similar actions in the robo-culture will be similar actions in North American culture.

The similarity of an action item is easily calculated with reference to a truth table that deems if an action is similar to another action or not (Fig 3). If there are more than two action items that are similar, then it is said that the action is similar. A percentage of similarity between the actions is also created in the process, so even if the actions are deemed not similar, then there is a probability that the resulting state of the action will still be favourable.

		Voice #2									
		[0] Affection	[1] Disappoint	[2] Rant	[3] Approval	[4] Prohibition	[5] Comfort	[6] Attention	[7] Neutral	[8] Aggressive	
Voice #1	[0] Affection	TRUE	FALSE	FALSE	TRUE	FALSE	TRUE	TRUE	FALSE	FALSE	
	[1] Disappoint	FALSE	TRUE	TRUE	FALSE	TRUE	FALSE	FALSE	TRUE	TRUE	
	[2] Rant	FALSE	TRUE	TRUE	FALSE	TRUE	FALSE	TRUE	FALSE	TRUE	
	[3] Approval	TRUE	FALSE	FALSE	TRUE	FALSE	TRUE	TRUE	TRUE	FALSE	
	[4] Prohibition	FALSE	TRUE	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	TRUE	
	[5] Comfort	TRUE	FALSE	FALSE	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	
	[6] Attention	TRUE	FALSE	TRUE	TRUE	FALSE	FALSE	TRUE	FALSE	TRUE	
	[7] Neutral	FALSE	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	TRUE	FALSE	
	[8] Aggressive	FALSE	TRUE	TRUE	FALSE	TRUE	FALSE	TRUE	FALSE	TRUE	

Figure 3: The similarity action table

The probability of the resulting state of the action being favourable is calculated through the AI filter. This uses an averaged roulette function to ensure the probable result. The end probability is called the action favourability level.

In order for the sent action to replace a favourable action, it has to be different than all of the favourable actions. Meaning, there cannot be two of the same favourable actions. This is done in order to prevent the favourable actions from converging on one main definition of what is favourable. Instead, we make the favourable actions converge onto a fuzzy definition of what is favourable, since the root of the actions are similar.

A replacement number is calculated to determine if the sent action can replace one of the favourable actions. This number is calculated by finding the Euclidian distance of the average of the action favourability level, and the number of low action favourability levels. An action favourability level is classified as ‘low’ if it is less than or equal to 65%. This number is then mapped to 0-100. If the replacement number is greater than or equal to 80%, then a random favourable action will be replaced.

We choose to replace a random favourable action in order to not create any bias of what actions are better than other favourable actions. It is debatable as to whether this is the best way to do this, and is discussed in the Analysis section.

Furthermore, 75% of the time, even if no action is replaced, a random favourable action will be generated and will replace a randomly selected favourable action. This is done to mimic a lack of communication/lack of comprehension during the interaction within the primary socialization stage.

Sending an action from the parents to the child robot is one of the key steps of the program. If no actions were sent, no interaction would occur, thereby no socialization. This has been witnessed in numerous cases of feral children, notably Genie [7].

The difference between the lack of socialization of the robots created in this program and human beings is large. Since the degree of importance of social behaviour in computer programs is extremely low, there is no intrinsic difference of whether a piece of software has been socialized or not. This is different for humans, since there are very few tasks that do not require social interaction. The degree of importance for social behaviour in humans is greater, which makes not being socialized extremely detrimental for the human involved.

4. Calculating conformity levels

The conformity levels are what distinguishes this robo-culture version of primary socialization to that of cultures that we, as humans, have experienced. Instead of having levels that determine how much the robot mimics the parents, we say how much the robot conforms to mimic the parents. This introduces a slightly different way of thinking about the socialization process.

This slight difference is extremely note worthy. Pretend for a moment, that communication is initially destined to be that of a form of babbling, similar to that of a baby. When we learn a specific language for our first time, why does it take a long amount of time to conform to society's standards? The learning process of the language does not take a long period of time itself, but conforming to learn a language does. The key difference here is the emphasis on conforming to society, and how

difficult it initially is, given the amount of time it takes to learn a language for the first time.

In this stage of the socialization, we use two main conformity levels: parent conformity and action conformity.

The parent conformity level depends on the self view of the robot and the actual view of the parent. These two variables are passed into a calculation algorithm. The algorithm takes the Euclidian distance of the two variables, and they are mapped back to the scale of 0-100.

For the action conformity level, the action favourability level is fed into an AI algorithm. The backbone of this AI algorithm is the Discrete Bayes Filter algorithm^[6]. Since it is tailored for this specific purpose of finding the action conformity level given the action favourability, it does introduce some social-bias.

These two conformity values are greatly used in the response action that the child sends back to the sender parent, as well as the looking-glass self stage.

5. Child robot sending response action

In order for the child robot to send a response action back to the parent, the parent and action conformity levels have to be combined into a total conformity level. The goal is to hint the robot into acting in a particular fashion, rather than precisely telling the robot how to act. This enables the robot to act on its own accord, based on how it conforms to the action received and its parents.

The two conformity levels calculated in the previous section are used to make an overall total conformity level. This is done by finding the Euclidian distance of the two conformity levels and mapping them back to 0-100.

Afterwards, the total conformity level is classified as a number from 0-5. This is sent into the AI algorithm, which is based on the Discrete Bayes Filter algorithm^[6], but tailored for this specific need. The end result is the probability of a resulting action.

Based on the state of the largest probability, we assigned special response values. Some of these, especially the ones that are a similar action however many times removed, refer back to the action similarity tables (Fig 3).

The way the conditional probabilities are distributed for the Discrete Bayes Filter Algorithm^[6], we favour the states to be random

similar actions, for a different amount of times removed from the sent action. The chance that the child robot will respond in a similar fashion is much greater than responding with the exact same reaction. After all, what would be accomplished by sending the same action back in response?

By using AI algorithms with conditional probabilities tailored to the specific purpose, we do introduce some social bias. However, we do not choose the responding action for the child robot. The response action items are randomly selected from a subset of possibilities that the AI algorithm provided us with. Therefore, we are not forcing the robot towards choosing specific action items, rather we are hinting the child robot towards acting a particular way.

6. Formulating self views and actual views of parents

The final step is by far the most important and most significant. This is because the child robot formulates its own opinion about itself and about its parents. Formulating an opinion is crucial for the development of the mind in any being. This process is similar to the Looking-Glass Self^{[4][5]}, which will be discussed in more detail below.

The child robot only updates or changes its self views and actual views of the parents when a discouragement level is greater than a specific threshold. This discouragement level is incremented whenever the current action favourability is less than the average action favourability. The average action favourability is calculated and updated through all of the iterations of the current execution of the program.

Once the discouragement level is greater than the threshold, the robot formulates its opinions about its self views and the actual views of the parents with the use of a Discrete Bayes Filter Algorithm^[6] that is tailored for this specific purpose.

The input for the parent side of the AI algorithm is the Euclidian distance of the action favourability level and the parent conformity level, mapped back to a scale of 0-100. Based on the range of that number lying between specific boundaries, it is given a classification number.

That classification number is sent into the AI algorithm, and the result is a number from 0-3 representing how random the change of the actual view will be. Finally, a 'coin is flipped' to

determine if the change will be added or subtracted. We then map this back to a scale of 0-100. However, in order to maintain the value, we iterate the mapping back to 0-100.

The input for the robot self view side of the algorithm is determined based on the parent conformity level. The algorithm returns a number that represents the boundaries of how random the change will be. A coin is then flipped to see if the amount of change is added or subtracted. The final result is mapped back to a scale of 0-100. Again, we iterate the mapping process in order to maintain the value.

In summation, the parent's actual view depends on the action favourability level and the parent conformity level, which in turn depends on the robot's self view and the parent's actual view. This ties in the relationship between the action sent from the parent and how the robot formulates an opinion based on that action.

This approach is very similar to the sociological theory, Cooley's Looking-Glass Self^{[4][5]}. However, in the actual Looking-Glass Self, we first imagine what we appear to those around us, then we draw conclusions based on the reactions of others, thus continually developing our identity^[5]. In this primary socialization process, we do not use it to create the basis of the identity of the robot, but rather to create and update opinions about itself and its parents.

Overview of Design

While the program is running, steps 3-6 are repeated for however many iterations specified. Inside of these iterations, as discussed above in more detail, there are key factors involved that effect the socialization of the child robot. For instance, the child robot becomes aware of what is favourable/unfavourable in this robo-culture, similar to the way we become aware of what is good/bad in our cultures. The child robot is given feedback based on the actions it responds with, similar to the way we are given feedback through non-verbal symbols. By implementing a similar version of the Looking-Glass Self^{[4][5]}, we allow the child robot to have an opinion. All of these factors influence the basis of how the robot will behave in the long term, and how it will ultimately be a social robot.

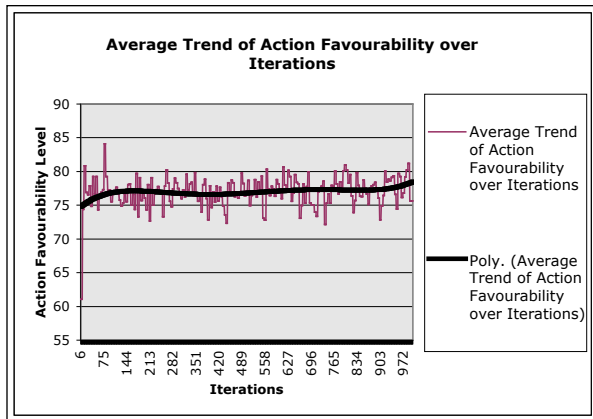
RESULTS

In order to observe the data while the program is running, we executed the program 10 times, for 1,000 iterations each. Throughout these trials, we logged all of the variables over the iterations. We focussed our attention on the following areas:

- 1) Action favourability
- 2) Conformity levels
- 3) Discouragement level
- 4) Similarities between actions
- 5) Views of the robots

We found that the raw graphs of the data did not represent any trends on the whole. When we take the moving average of five iterations at a time, we begin to see a more general trend. Discussions of these trends will be in the following sub-sections.

1. Action Favourability



Action Favourability Graph

(Zoomify version available at: <http://robotgrrl.com/socialrobotics-graphs>)

The graph of the action favourability over 1,000 iterations shows us how favourable the sent actions from the parents are in comparison to what the child robot currently believes as being favourable.

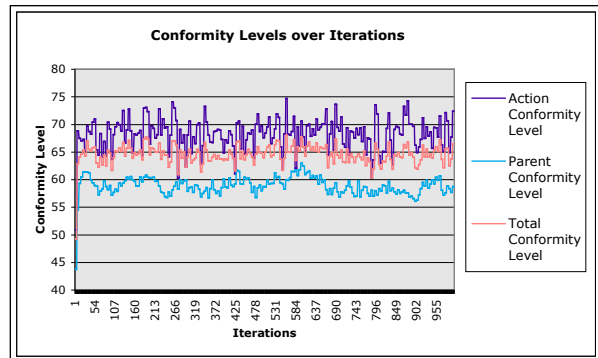
The general shape of the line for this graph that we want to see is one with a regular varying amplitude, but subtle enough to be generalized as stable, neither increasing nor decreasing.

This shape would symbolize that the child robot is never receiving favourable and/or unfavourable actions 100% of the time. Rather,

sometimes some actions are favourable, and others are not. Essentially, this shifts the child robot into becoming independent, since it is reliant on the content of the actions, rather than the source of the actions.

In summation, the action favourability graph shows us how favourable the parent's actions are in comparison to the child's understanding of favourable actions. The shape of the graph shows us that the parents are not always sending favourable actions, thereby forcing an independence on the child robot to not become entirely reliant on the source of the actions.

2. Conformity Levels



Conformity Levels Graph

(Zoomify version available at: <http://robotgrrl.com/socialrobotics-graphs>)

The graph of the conformity levels represents how the child robot is conforming towards the actions that the parents are sending, and how the child robot is conforming towards its parents based on factors described previously, as well as the child robot's opinion of its parents. These two conformity levels, combined together, are used to make the total conformity level.

Essentially, for the parent conformity level line we would like to see a varying amplitude. We would like to see this since it would signify that the child robot goes through periods of like and dislike towards its parents. From this observation, we could say that the child robot is undergoing a similar socialization fashion that is comparable to some of the cultures that we experience in our world.

To elaborate on this observation, if a child in North American culture does something bad, then the parents will discourage the child through

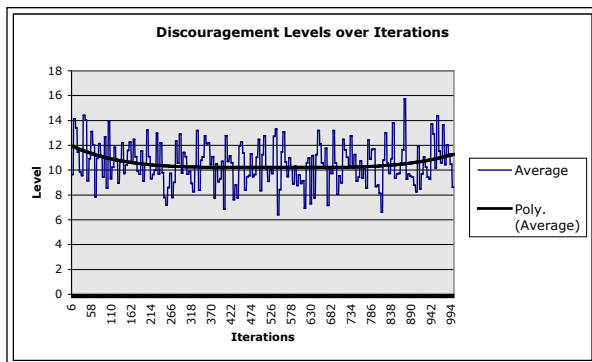
numerous means to signify that the action was wrong, and to discourage the child from performing such an action again. With these discouragements, the child does not feel the same way towards its parents as if it were being praised.

In the case of the action conformity line, we would expect to see a fluctuating amplitude to reinforce the action favourability data. Since the action-conformity levels are simply the result of an AI algorithm with the action favourability numbers fed into them, this can be expected. Since not all of the actions are favourable, then the action conformity level will also vary in amplitude.

The total conformity level, as mentioned previously, is the combination of the parent conformity level and the action conformity level. This combination is done through a Euclidian Distance algorithm. Thereby, we see a line that shows characteristics of both the action and parent conformity levels.

The conformity level graph, much similar to the action favourability graph, shows us a varying amplitude, never ceasing to be stably increasing or decreasing, symbolizing that the child robot goes through periods of like and dislike towards its parents.

3. Discouragement Level



Discouragement Levels Graph

(Zoomify version available at: <http://robotgrrl.com/socialrobotics-graphs>)

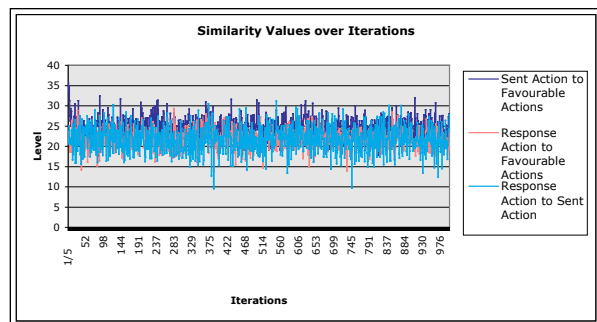
The discouragement level controls how quickly and when the child robot updates and modifies its self views and actual views of its parents. The discouragement level is incremented only when the current action favourability of the

action sent by the parent is less than the average action favourability.

In the graph of the discouragement level, we would expect to see a varying amplitude, since this would represent the discouragement level is being filled and then emptied. However, the data collected shows a parabolic trend, where the discouragement level 'fills up' more quickly near the end of the 1,000 iterations. This leads us to wonder what would happen over 10,000 iterations, and how the pattern would continue.

In summation, the discouragement graph illuminated how quickly the child robot was to update its self-views and its views about its parents. There is a surprising parabolic trend that was unexpected.

4. Similarities Between Actions



Similarity Values Graph

(Zoomify version available at: <http://robotgrrl.com/socialrobotics-graphs>)

The similarities between actions graph is formatted differently than the other graphs presented within this paper. This graph aims to show the amount of differences/similarities between each of the five favourable actions and the sent action from the parent. For this reason, the scale of the graph is in fifths of an iteration, for each of the five favourable actions.

With regards to the sent action to favourable actions line, in coordination with the action favourability graph, we expect to see a varying amplitude, yet remaining stable, neither increasing or decreasing. However, the scale of the graph allows us to have better insight as to how the similarities between the sent action and each of the five favourable actions impact the action favourability graph.

With regards to the response action to favourable actions line, we would hope to see a level that is higher than that of the previous line. We imagine that the child robot would be sending actions that it would conceive to be as favourable. However, within the program, the basis of the child robot's response action is the conformity level. The conformity levels are shaped by the favourability of the sent action from the parents. In essence then, the similarity levels of the response action, that the child sends back to its parents, to the favourable actions do not have to be similar.

There is a myriad of imaginative reasons as to why this can be true. Perhaps the child robot is 'rebellious' and wants to cause its parents a 'headache' by sending actions that are not the most favourable. In this stage of the program, robots cannot have headaches, nor can they be aware that they can be rebellious.

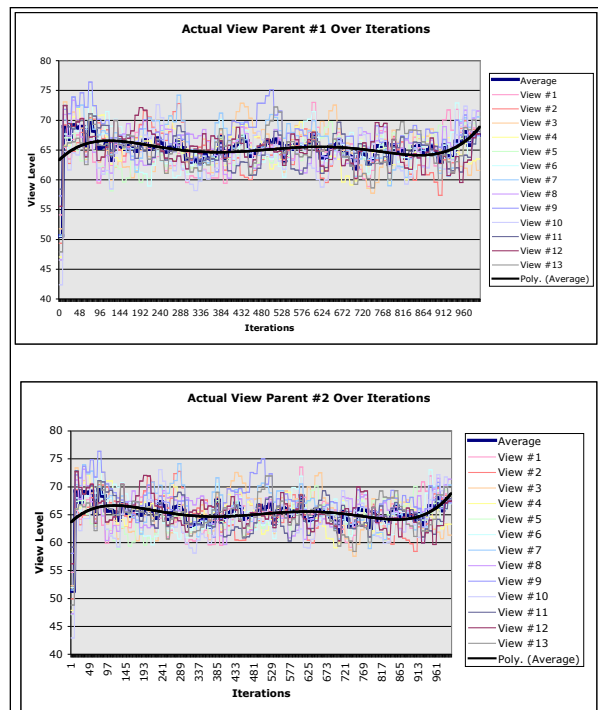
The similarity between the sent action and the response action illustrate the point that is trying to be made here. The actions do not have to be similar to each other in order for the robot to be socialized. The similarity between the sent action and the response action is extremely jumpy, which shows that the parent and child robot often have different ideas as to which actions are favourable or not.

However, there are also times when the similarity level is higher, representing that a common idea was shared. In reality, this could be attributed to miscommunication factors within primary socialization, such as vocabulary level, comprehension, focus, and many more.

In summation, the similarities between the actions allow us to have a deeper analysis of the distribution and variance of the favourable actions and how key they are to the primary socialization stage.

5. Views

Inside of this section are two distinct categories: the self view of the child robot, and the actual view of the parents. The self view of the child robot is how the child robot thinks it appears to the world around it. Contributing factors to the child robot's opinion of itself include the parent conformity level, and the AI algorithm. As for the actual view of the parent robots, contributing factors are the action conformity level as well as the parent conformity level.



Actual View of Parents Graph

(Zoomify version available at: <http://robotgrrl.com/socialrobotics-graphs>)

With regards to the actual view of the parents, we would expect to see a varying amplitude for both parents, as this has been the common theme between the parent conformity and action favourability graphs. However, the two graphs of the parents are immensely similar, which does not provide us with the insight of which parent the child robot prefers.

ANALYSIS

The primary socialization process that was created only skims the vast amount of factors involved. Some of the factors that were not included were the use of values in accordance to the actions, both parents having an awareness level of the actions sent, the conveyed intent of the sent action, siblings, activities, objects, gender and more.

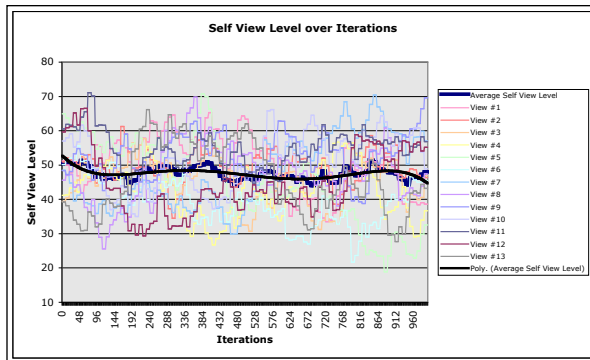
At this point, the interaction between the child robot and its parents is non-symbolic^[8]. This is because the child robot has no objects or symbols to attach meaning to. Symbolic interaction, where actions are recognized as symbols^[8], will become crucial for the child robot to be fully socialized. Although this is not present in the current stage of the project, it is worth noting as it will be required for the child robot, in later stages of socialization, to be able to attach meaning to symbols.

We used random numbers heavily in this stage of the project. However, the random algorithm that we used was trivial. We intentionally did this in order to provide us with the baseline understanding that there will be some consistency among the trials as there was a general pattern of the random numbers.

Since we use random numbers, a robo-culture emerges. We would not be able to have this robo-culture had we used pre-determined input variables, as there would be a social bias to the culture of which those pre-determined numbers were from. Additionally, by the random numbers allowing the initial description of good/bad to be set, we do not interfere with the development of this robo-culture. We believe that this will help us strongly in the future so that some interactions between a human and robot can pertain to various cultural norms.

In the next steps of this project, we plan to add a secondary level of socialization, and a method to adapt to the current interaction and reflect on past experience. Additionally, if we want to deploy this on a tangible and physical robot, we will have to be able to gather sensor data and parse it so that it matches the non-verbal action items in the program.

In the secondary level of socialization, there would be groups of robots sending actions to the child robot (Fig 4). Inside of these groups, there would be a random bias applied to sending specific action items. It will be interesting to see which groups the child robot will conform to, and



Self View Level Graph

(Zoomify version available at: <http://robotgrrl.com/socialrobotics-graphs>)

The self view of the robot differs from all of the other graphs as it is focused primarily on the child robot. The child robot wants to be different from what it perceives its parents as if the parent conformity level is low. If the conformity level is high, the child robot wants to change very little.

In the self view graph, we can see that the individual averages of the views are somewhat unrelated to each other. Yet, the average of the averages shows us that the child robot's self views have moments of increasing and decreasing with different rates. The 5th degree polynomial curve allows us to see that the child robot's self views are overall decreasing. Yet, there is the possibility that the child robot was in the middle of a downturn, and was going to start increasing shortly after.

In summation, observations of the child robot's self view were made, illustrating the trend of the opinion that the child robot has about itself. The actual views of the parent robots show that the child robot does not see a significant difference between the two parents.

Overview of Results

The graphs of the data obtained provide us with both intended and unintended results. Since we use random numbers heavily in this stage of primary socialization, it is to be expected. In some of the graphs, it became evident that a larger amount of iterations would have been beneficial to see more patterns, ultimately deepening our understanding of the robo-culture.

if the child robot will still conform towards its parents. Will the child robot be able to have multiple roles? Furthermore, will the child robot handle this role conflict in a similar fashion that we, as humans, do?

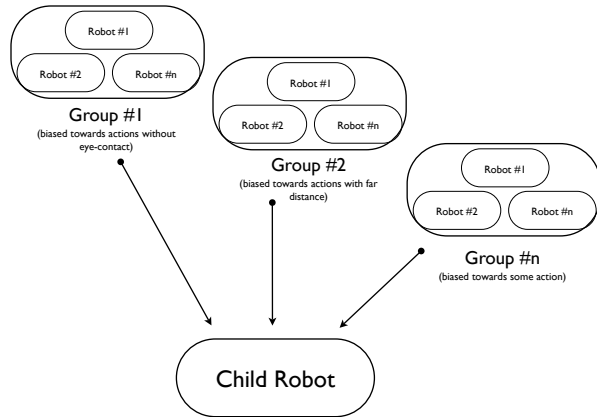


Figure 4: Groups in secondary socialization

There is the possibility that a third level of socialization would be required. This third level would not rely on randomized numbers, instead it would be customized to the target audience's culture. By doing so, we would ensure that the robot is aware of what are the values and norms of that culture. Will the child robot undergo culture shock, if the targeted culture and the robo-culture are juxtaposed? Additionally, will we have to tailor the third level of socialization so that the robot will not have a bad reaction to this culture shock?

It is worth asking the question whether the robot should be actively engaged with the human all the time, or if there will be times of disengagement. Furthermore, which agent would be the 'disengager', the human or the robot? Disengaging from interaction could be as important as engaging in interaction. Even as humans, we have difficulty knowing when we should attach ourselves to a task and detach ourselves from it^[9]. By asking questions about how to create a social robot from a sociological perspective, we enable ourselves to create a more nature-inspired robot that will be adept at handling social interactions.

CONCLUSION

In order to create a social robot that has prior experience of social interaction, it has to undergo a similar experience of socialization that most of us have had. In order to socialize a robot in terms of its own robo-culture, an artificial society can be used. Since the socialization depends on random numbers filtered through various AI algorithms, we used the fact that there will be some consistent distribution of the random numbers to find patterns in the robo-culture. These patterns shared some similarities with 'real life' cultures, as well as exhibited some of their own traits.

By analyzing the sociological questions that we raise, and following with the next steps, a social robot can be created that has the ability to engage humans to interact with it, and have a very deep conversation that can easily transcend to tangent ideas. The target audience for such a robot would be those with lightly developed Alzheimer's Disease, as well as those who are classified as potentially at risk for the disease. With the ability to have access to a source of social interaction at any time, without any risks or burdens, the potential outcome is very promising. Furthermore, by using a social robot that is socialized with an artificial society, we will learn more about our cultures and how we ourselves are socialized.

REFERENCES

- [1] Kinsella, Kevin, and Wan He. "An Aging World: 2008." U.S. Government Printing Office, June 2009. Web. 20 July 2009. <<http://www.census.gov/>>.
- [2] "2007 Progress Report on Alzheimer's Disease." U.S. Department of Health and Human Services, 2009. Web. 20 July 2009. <<http://www.nia.nih.gov/>>.
- [3] Breazeal, Cynthia L. Designing Sociable Robots (Intelligent Robotics and Autonomous Agents). New York: The MIT, 2004. Print.
- [4] Cooley, Charles Horton. Human nature and the social order. New Brunswick (U.S.A.): Transaction Books, 1983. Print.
- [5] Kimmel, Michael S., and Amy B. Aronson. Sociology Now. Boston: Allyn & Bacon, 2009. Print.
- [6] Thrun, Sebastian. Probabilistic robotics. Cambridge, Mass: MIT, 2005. Print.
- [7] "NOVA | Transcripts | Secret of the Wild Child |." PBS. Web. 16 Aug. 2009. <<http://www.pbs.org/>>.
- [8] Blumer, Herbert. Symbolic Interactionism Perspective and Method. New York: University of California, 1986. Print.
- [9] Goffman, Erving. Behavior in Public Places. New York: Free, 1966. Print.