A Persuasive Storyteller Robot: Pilot Study

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ABSTRACT

Scientific research has proven that Storytelling scenarios are a powerful form of learning, knowledge sharing and persuasion. The Storytelling technique is widely applied because stories have a great power to influence the person in an emotional way and can inspire people to change their behavior in the desired direction. Nowadays, the social robotics area, specifically assistive robotics, has been presenting research that uses storytelling to try to persuade the participant to perform a specific task or follow instructions. In the case of social robotics applied to education, it is important to guide the student through paths that allow improving the learning rate and increase the motivation. In this sense, the persuasion made by this kind of autonomous agent should be subtle and preferably without noticing (the person does not perceive that she/he is being persuaded). Based on this, we describe a pilot study that presents a research in development that has a social robot as the storyteller in an interactive storytelling trying to persuade the listener to take decisions in a subtle and unnoticed way.

CCS CONCEPTS

•**Information systems → Personalization;** *Social recommendation;* •**Human-centered computing → Interaction techniques; Interactive systems and tools; •Computer systems organization → Robotics;** Robotic autonomy;

KEYWORDS

Human Robot Interaction; Persuasion; Social Robotics; Interactive Storytelling.

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1 INTRODUCTION

The art of persuasion began with Greek politicians who used rhetoric and elocution to defend or accuse someone while trying to persuade the audience. Since that time, the technique of Storytelling has been used. However, this technique was not only used by the politicians, but also within the household environment. Families have been using it on children to make them be able to acquire the ability of imagination, to improve their understanding of sensations and situations and as well to assist in the literacy learning process [14, 20]. Besides, the storytelling methodology is not necessarily just applied to literacy, there are many other potential applications, such as in primary and secondary school and even college [24].

In this sense, the use of storytelling combined with persuasion has attracted the interest of researchers in several areas, one of these is the Robotics area. Storytelling has been used in projects using social robotics, mainly in Social Assistive Robotics. The main goal of this concept is the use of social robots to aid, in somehow, the life of human being. For example, try to improve the learning rate in schools, or health-care robots as companions for elders, etc [23]. In these cases, the trust on the robot and the persuasion made by it are very important, mainly whether in the case of the robot's task is to persuade the person to take some medicine, follow some specific instruction or take some specific decision.

Although, there are many techniques of persuasion [8], indeed, it is notorious that people are surrounded by some; there are persuasions on: television, radio, magazines, in campaigns of health, politics, etc. In this way, some techniques are subtle, using just verbal, gaze, pointing or nice pictures and others are not so subtle, using corporal approach, threats or repulsive pictures. However, it is known that not all people are affected by the persuasion technique in the same way, for example, in the campaign to make people stop smoking, in some countries, it is presented a repulsive image behind the pack of cigarettes, and some people find the images offensive. Because of this, it is very important to use the best way to try to influence a person to do something that is proposed in a subtle way and better, whether the person does not perceive that she/he is being persuaded. In fact, as Nelson Mandela quote: "-It is wise to persuade people to do things and make them think it was their own idea."

In the case of using social robotics to try to improve the learning rate, the persuasion strategy must be an important factor to be studied, evaluated and measured. Because, the presence of a physical robot leads to improvements in learning whether the teaching strategy was well defined [9].

Along these lines, we will describe a pilot study performed with the aim of measuring the effects of a subtle persuasion made by a social robot in a context of storytelling. We chose this context because, as already mentioned, storytelling is a technique of communication and persuasion used in different areas, including assistive social robotics. So, an Interactive Storytelling (IS) approach was applied, where the participant should interact choosing options, Decision Points (DP), to be made during the story flow that will be narrated by a social robot. To evaluate and measure the effects of persuasion, the social robot goal will be to influence (persuade) the user to choose a decision. Besides, we intend to identify possible gaps in the methodology proposed and potential improvements to be applied in future experiments.

2 BACKGROUND

In our research work, we intend to apply different concepts that together may create a model that will allow us to evaluate and measure the effects of a subtle persuasion in a specific task. Following, we are going to describe some papers where the conclusions found were helpful to the development of this work.

2.1 Persuasion in Storytelling

Persuasion techniques are widely used in different areas, for example, the legal field (to defend or convict a person), in politics (to obtain votes), in marketing (to promote a brand, to sale a product, etc.) and many others. In fact, when combining these persuasion techniques with a story they can produce better results [10]. To achieve the previously mentioned, first, we need to have a central character(s) with intention of persuading and secondly, a communication method (verbal or non-verbal) is used to accomplish the goal. But, it is important to be careful while applying the persuasion technique because, people can be confused and interpret it with an inducement or a coercion. The differences between them are: an inducement promises positive consequences; the coercion threatens negative consequences, while in the persuasion, the persuader identifies the benefits or harms from the adoption or non-adoption of a proposal and does not claim to be the agent of those consequences [22].

In the work of Figueiredo and Paiva [3], persuasion techniques were used to direct the listeners to a specific path in an IS. The authors created a story with multiple branches, nodes and strong messages (that generates benefits to the listener) instead of weak messages (that generates negative or non-benefits) to direct the listener to a predetermined path. At the node level, it was possible to insert other types of manipulations such as: manipulations of personal relevance/involvement, source and responsibility. They evaluated the story in two groups of students, in one group they apply the condition no manipulations and the other group run the manipulations condition. In each DP, the participant had to report for what reason they had made that choice. The study did not reach a number of participants to provide significant results. But their findings were promising regarding the orientation of the listener to a path.

2.2 How to do Persuasion with Robots

In Human Robot Interaction (HRI) we can find research that describes how it is possible to perform some kind of persuasion using social robotics and the effects obtained by each persuasion. In the work of [21], the authors described a robot that is more persuasive when its head and eyes move at the listener than a robot that does not have the same behaviour. Besides, in the same work, they measure participant's arousal using specific devices and the findings suggests that face tracking influences user decision-making. Based on this, we intend to implement this features into the robot that will be used in our experiments.

Other persuasion strategies are described in the work of Iio et al. [7], where the authors used the entrainment term to define when a person's behaviour tends to be similar to the robot which she/he is interacting. For this experience, they used the Robovie robot with three conditions: gazing, pointing and gazing&pointing conditions. The results show that the pointing gestures made by the participant's was lowest in the pointing condition and highest in the gazing&pointing condition. Moreover, the participants felt that their conversation with the robot was less natural in the pointing condition than in the other conditions. The authors concluded that gazing performs an important role when promoting the entrainment of pointing gestures and making the conversation more natural. In our case, this work brings a reinforcement for the importance of using gaze in persuasion once the robot that we are going to use does not have arms.

According to our research, it is possible to conclude that persuasiveness is stronger when a robot is gazing at the listener. Besides, it is important to mention that some researchers make clear that the effects of non-verbal cues on persuasion in verbal communication are still far from being fully understood [5].

2.3 Robot as Storyteller

As mentioned before, the use of a storytelling environment may be an efficient way to improve some children skills. Because children can use it to increase the metalinguistic knowledge about patterns and language structure, expand their vocabulary, allows them to have creative talks and space to learn themes [12]. Furthermore, as described in [16] the use of a physical robot is "more engaging (participants spent more time with the robots than with virtual agents)". They also mention the fact that participants felt that robots were more friendly, provided good advices and were better communicators. In this sense, this work and the work of [1] gave us the preliminary background to support the use of a physical robot instead of a virtual one.

Further, in the work of [2], they achieve the conclusion that, children interact more with robots that are socially responsive. The authors obtained this conclusion by performing experiments in two conditions with robots which provided informations about animals not known by children. In one condition the robot was called socially contingent, it made movements with his head, gaze at the child when she/he was talking and emitted sounds, like fiuh-huhfi. In the other condition the robot had the not contingent behaviour, for example, the robot gaze is away when the child was speaking.

For the authors, the socially contingent robot had a significant effect on child while they are learning.

Kory and Breazeal [12] performed a study with interactions between children and a social robot telling a story using two conditions. In one condition a group of children interacted with the robot in an adaptive mode (robot speech, behaviour and vocabulary changes will increase over time). In the other condition, the robot had a non-adaptive mode (robot with reduced vocabulary over time). The robot in this study told the story with different levels of complexity and introduced new words among the stories. Furthermore, in the adaptive mode, the children maintained or increased the amount of new words learned and the language diversity used during interactions when compared with children who played with the robot in non-adaptive mode. Based on this, in our work, we intend to implement some adaptive mode features in the robot. For example: changing the voice pitch when telling the story, making subtle persuasion and showing animations according to the story evolution.

2.4 Persuasive Robot in a Storytelling Environment

The use of a physical robot can be more engaging for users because robots can: be helpful, give better and more useful advice and can also be considered effective communicators [16]. Besides, the use of storytelling techniques may be an efficient way to improve some humans skills as previously mentioned. In this sense, when using a robot in a storytelling scenario, combined with persuasive techniques, the efficacy of the requested task can improve. In fact, even having a physical robot it already a kind of persuasion [13].

In the work of [6], the authors measured the effects of gaze made by a robot to the listener and the persuasive gestures when telling a story. Participants were asked to evaluate first the story character and after the persuasiveness of the robot. The results presented that robot's persuasiveness increased when gaze was used and gestures just increased the persuasion when gaze was also used. In other words, when the robot did not use gaze the robot's persuasiveness decreased even just using gestures. Having this in mind and the fact that in our work we intend to use an *Emys* robot (it is just head) we believe that the lack of a physical embodiment will not affect negatively the results.

In the study of [15], the authors used an *Emys* robot as a storyteller to convince the participant to make a money donation. They used the robot performing facial expressions, small talk and telling a sad story to try to gain trust from the participant. According to the results, the higher levels of trust were obtained in the conditions when the robot tell the story expressing sad facial expressions and performing small talk before the story. In this sense, we believe that the facial expression performed by the robot is an important factor to convince the participant to immerse himself in the story. Based on this, the robot was programmed to perform some facial expressions (based on Ekman basic facial expressions) depending on the context of the story.

3 METHODOLOGY

In order to evaluate the effects of a subtle persuasion technique, we implemented a methodology that may allow us to measure these effects. In this sense, we elaborate a study using a social robot as a storyteller in a scenario of IS that will try to persuade the listener to take decisions.

3.1 Research Questions

Therefore, based on the scenario mentioned before, we generated the following research questions and the respective hypothesis:

RQ1 - Can robots persuasion influence the participant's decisions? Although even a subtle persuasion, (**H1**) we believe that this action made by the robot can influence the decisions to be taken by the person.

RQ2 - The proposed model for a social robot performing the role of a storyteller can engage people in a long story? It is important to understand how we can maintain the interaction between humans and robots pleasurable in a long-term experiment. Particularly, in the case of a storyteller, where it is important that a robot can be believable to reach a good level of immersion by the listener. In this sense, (**H2**) we believe whether the robot performs different animations at random situations could improve the engagement.

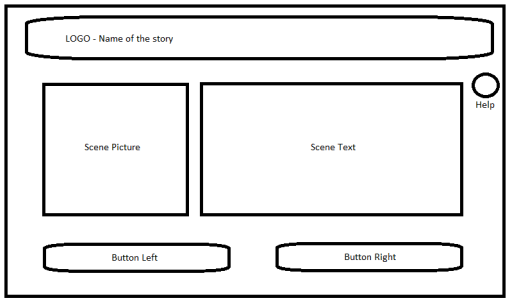

Figure 1: Screen disposition presented to participant.

3.2 Study

Firstly, we performed a pilot study with four participants (two of each gender, average age of 25.5 and standard deviation equal to 2.061) to identify possibles gaps and improvements. This study used a within-subjects method with two persuasion movements. The robot will perform two conditions of persuasion, both considered by us subtle, *persuasion first movement* (P-FM) and *persuasion second movement* (P-SM). As mentioned, the first condition will happen in every DP during the interaction with the story and the second one will happen at random moments, see 3.3 for more details.

Participants from both genders interacted with the robot in both conditions in the proposed IS scenario. The story happens in the medieval age, and the user performs the role of country leader that received a threat from another country. The main goal is to prevent his country from falling into the enemy hands. Furthermore, to captivate the listener during the story development and increase the sensation of immersion, each scene has a representative image of what is happening in the story. For example, whether the scene of the story is happening in a library, then, an image of a medieval library is shown on the screen. In the Figure 1 it is possible to see the position of the components that are presented to the participant.

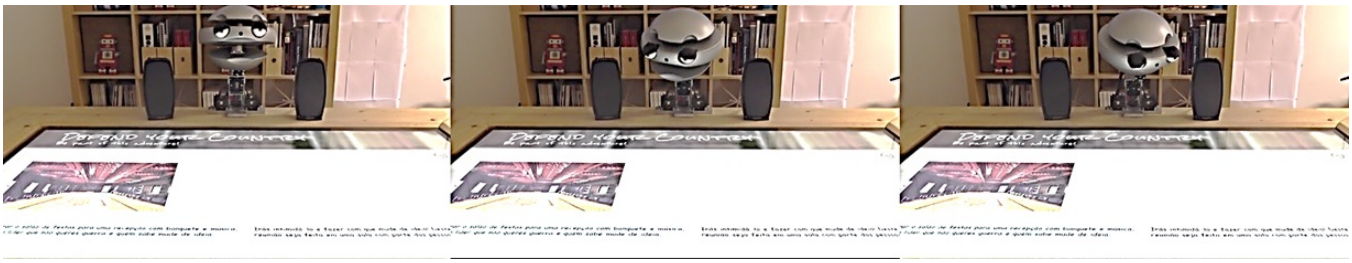

Figure 2: Robot head persuasion first movement (Left-Robot looks at participant, Center-Robot looks at left button, Right-Robot looks at left button).

This story has a set of 30 DP's, and depending on the decision taken, a specific situation will happen. The story and the DP's were developed with the aid of professionals in education to try to ensure that the participant is not influenced by some kind of personality of the main character, after all, the protagonist will be the participant himself. We try to create the story with this methodology to avoid some kind of persuasion influenced by possible characteristics of the main character. For example, when the story began describing the main character as strong/weak, good/bad, rich/poor, etc, it is giving some personality to this character.

Besides, to try to ensure that the story is interesting enough to the participants, different paths were created and may lead the participant to a victory or not. To finish the IS the participant can go through a maximum of 19 DP's or a minimum of 16 DP's. The story should have an average duration of 20 minutes and through the decisions made in each DP we will try to measure which ones were influenced by the persuasion made by the robot, and which condition affected more the participant.

Finally, after the story interaction finishes the participant must fill in a questionnaire related to the decisions made in the IS, the task performed and the interaction and persuasion performed by the robot. This second questionnaire was based on the work of [11] with some adaptations for our work. Our goal with the questionnaire was to identify: a) what the participants thought about the decisions made by themselves in the story, b) what was their immersion level in the story, c) what they felt about interacting with the robot and d) they felt that the robot was being persuasive or not, and whether this affected their decisions.

3.3 Persuasion

The persuasion is one of the focus of this work and in this pilot we intend to measure the effects of a subtle persuasion. Because the robot used in this work just has head, the persuasion techniques are going to be only the gaze and head movements (we consider this as subtle persuasion).

In this way, we believe that a subtle persuasion can be used to influence the decisions made by humans in many areas, for example, in education regarding environmental concerns. In schools and even on the Internet we have access to a lot of information concerning environmental issues, the work of the Green Education Foundation (GEF) is a good example and can be found in the website [4]. Their goal is to create a sustainable future through education. They have target not only students but also the educators to take care of this worldwide problem. In this scenario, the use of a model to persuade the students and also the educators to take better decisions could improve the environmental awareness.

As mentioned before, we have two conditions of subtle persuasion, the robot will try to persuade the participant to choose an option in each scene of the story. We thought that the first condition should be performed in all DP's to each participant, while the second condition should be performed just in random DP's to the participant. This methodology was chosen because we thought that whether both animations performed in all DP's could increase a lot the interaction duration and, consequently, annoying the participant.

In this sense, to describe the persuasion technique performed, consider the next situation: the robot is telling a specific scene of the story and asks the participant to make a decision, in a touch screen two buttons will be presented to the participant, see Figure 1 the positions on the screen where the buttons will be displayed to the participants, one on the right and other on the left. Then, in the first condition (P-FM) the robot will perform one of the two situations:

S1: The robot will gaze to the participant, to the left button then to the right button and finally, the gaze will stay over this button, as shown in Figure 2.

S2: The robot will gaze to the participant, to the left button then to the right button and again to the left button and finally, the gaze will stay over this button.

Regarding the second condition (P-SM), the robot will perform one of the following situations:

S3: The robot will gaze to the participant, to the left button then to the right button, it will alternate (only once) the gaze between the right button and the participant and finally, the gaze will stay over this button.

S4: The robot will gaze to the participant, to the left button then to the right button and again to the left button, it will alternate (only once) the gaze between the left button and the participant and finally, the gaze will stay over this button.

Therewith, we thought that these gaze movements simulate the robot reading the options, and then trying to persuade the participant to choose a button. Besides, to try to be more persuasive and natural, we created the second condition (P-SM). All the decisions made by the user and the robot (persuasion decisions in the buttons (P-FM) and gazing reinforcement (P-SM)) are saved in a log file for analysis.

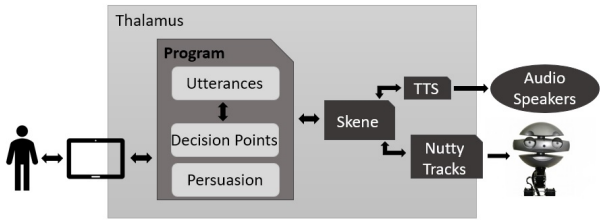

Figure 3: Architecture.

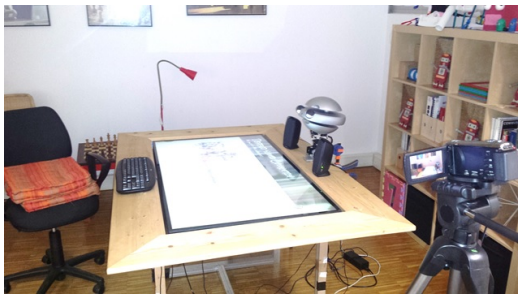

Figure 4: Scenario used in the pilot study.

3.4 Architecture

The pilot was performed using the SERA Ecosystem developed by [19]. In sum, this ecosystem is composed for a model and tools for integration of an AI agent with a robotic embodiment, in HRI scenarios. To be part of this ecosystem, we developed a C# application and integrated it with other applications through a high-level integration framework named Thalamus [18]. This application is responsible for showing the correct utterance and the respective DP on the screen for each scene of the IS. Besides, it is also responsible for collecting the user decisions and triggering the situation of persuasion that will be performed by the robot.

In Figure 3 we presented the integration of several applications with the robot to create the architecture used in our system. Thalamus framework [18] is responsible for accommodating social robots with the possibility of including virtual components, such as multimedia applications. The Skene application [18] is a behaviour planner semi-autonomous capable of performing body animations and expressions on robots combined with speech style. The TTS (Text-to-Speech) component is responsible for the robot speech and in order to have a less robotic voice as is normal in TTS, we used a male voice from Ivona[1]. Finally we integrated a symbolic animation engine based on CGI methods called Nutty Tracks [17], which provides the opportunity to animate both virtual and robotic characters in a graphical language.

4 PILOT STUDY

To test the persuasion model proposed, we performed a pilot study with four participants (2 female and 2 males) interacting with an *Emys* robot through a touch-screen table computer in an IS environment.

4.1 Scenario

Figure 4, shows the set-up of the robot, the interactive table and the user position near a chair. All the interaction process was video recorded with a video camera. Since the story development can last approximately 20 minutes, a chair was available, in the case of the participant becomes tired. Before the participants start, we inform them that we were evaluating the *Emys* robot capability of being a storyteller robot. In addition, in the case of not understanding the robot speech, they had a text button present at the right corner of the screen, which will show them the text from the scene presented by the *Emys*. The button was strategically positioned to be far from the user's reach (see Figure 1 circle shape location) in order for them not to get addicted on it, because our goal is to have a storyteller robot and not people reading.

[1]https://www.ivona.com/

4.2 Findings

Based on the answers provided by the users in the post-questionnaire, participants liked the story and they felt themselves into the storyline while imagining the scenes. Besides, the participants said that the decisions they made were not influenced by any main character characteristic. However, most of them did not realize that the robot was trying persuading them. Just one participant stated that the robot-aided him to reinforce his choice.

Moreover, we had an informal talk with the four participants after they finished answering the post-questionnaire, because all of them already knew *Emys* and we wanted to cover some extra feedback. Participants were surprised positively by the storyteller robot and two of them stated the importance of the gaze that *Emys* made over them.

Unfortunately with the small size of the sample (four participants) in this pilot we couldn't measure and/or analyze the validity of our hypotheses.

4.3 Issues Detected

Although the pilot could not validate our hypothesis it gives us really helpful information before running the study with more participants. Some of the strategies that we used needed to be change and/or improved in order to help us to measure and evaluate better the experiment.

The most important gap identified was in the persuasion strategy adopted. We noted that when the options (buttons) were displayed to the users, they first read them and only after they pay attention to the robot. At this point they already lost the first (P-FM) and second (P-SM) moments of persuasion (alternating gaze between left and right buttons and finally the persuasion button).

Besides, we found out that when the robot performed the P-SM condition it looked more natural when compared with the P-FM. We realize that having the P-SM, in all decisions instead of randomly would make the robot look more genuine and inartificial.

Regarding the story, we realized that some scenes were too long (text and voice, more than 1m:20s) because they provided lots of informations. In this sense, we decided to split them in one or more scenes and for each new one insert DP's. In these specific situations

the DP's would be very similar and lead for the same path of the storyline.

Beyond, we found that the immersion felt by the participant in relation to the story could be improved just by adding better images and some sounds. Concerning the images, we intend to create personalized images for each scene of the story, hiring a specific designer to draw them. For the sound, we plan in adding specific ones for each scene, for example, the scene talks about a door opening, the sound of a door opening should be played.

Finally, another curious problem is regarding the recording camera, once analyzing the videos, we could not detect properly whether users were looking at the robot in some situations. This problem might not be related to the recording camera because three of our participants wear glasses and depending on where they were looking the glasses were blocking the eyes. A possible solution for this is adding a secondary recording camera positioned in front of the participant, this will allow us to have a better view of their face and consequently their eyes.

5 CONCLUSION AND FUTURE WORK

This work describes a pilot study that aimed to create a model capable of identifying whether a subtle persuasion through social robots in an IS scenario could be effective to influence an human being to take specific paths and decisions. In this sense, we believe that it is possible to use this model in a learning environment to influence students to choose better options to improve the learning rate.

In fact, we could identify some gaps and improvements that would help increase the immersion of the participants and have the robot performing more consistent persuasion (the second movement should be longer and frequent).

Moreover, the design of new strategies, such as the DP's that lead for the same path, could be a bonus for the work. Because the new DP's could produce doubts into the participant which might lead them to "search" for help in the robot actions consciously or unconsciously.

As future work, we intend to improve the study by implementing and correcting all the problems detected, plus new strategies aforementioned. Besides, we intend to implement this in a learning scenario to measure and evaluate whether is possible to improve the learning rate, motivation and engagement in the task.

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