Do Cute Nursing Robots Get a Free Pass?

Exploring How a Robot's Appearance Influences Human Judgments on Forced Medication Decision

Nina Lukin

Helsingin yliopisto

Humanistinen tiedekunta

Kognitiotiede

Pro Gradu -tutkielma

Toukokuu 2020

HELSINGIN YLIOPISTO – HELSINGFORS UNIVERSITET – UNIVERSITY OF HELSINKI

Tiedekunta – Fakultet – Faculty	Koulutusohjelma – Utbildningsprogram – Degree Programme	
Humanistinen	Kognitiotiede	
Opintosuunta – Studieinriktning – Study Track		
Kognitiotiede		
Tekijä – Författare – Author		
Nina Lukin		
Työn nimi – Arbetets titel – Title		
Hyväksytäänkö söpöjen sairaanhoitorobottien toimia helpommin? Tutkimus söpöyden vaikutuksista hoivarobotin pakkolääkintäpäätöksen arviointiin		
Työn laji – Arbetets art – Level	Aika – Datum – Month and year	Sivumäärä– Sidoantal – Number of pages
Pro Gradu	Toukokuu, 2020	36

Tiivistelmä – Referat – Abstract

Tavoitteet. Sosiaalisten robottien ulkonäön vaikutuksia ihmisiin ei ole juuri tutkittu, vaikka sosiaaliset robotit yleistyvät jatkuvasti ammatillisessa, etenkin terveydenhuollon, kontekstissa. Tutkielman tavoitteena on tutkia ensin eroja ihmis- ja robottisairaanhoitajan suorittaman pakkolääkinnän moraalisessa tuomitsemisessa. Tämän jälkeen tarkastelen jatkotutkimuksella, onko sairaanhoitorobotin ulkonäöllä ja söpöydellä vaikutusta pakkolääkinnän moraaliseen tuomitsemiseen. Sairaanhoitorobotteja tarkastellaan söpöysskaalalla—söpöys valikoitui mielekkääksi muuttujaksi, koska suuri osa eri aloilla käytettävistä sosiaalisista roboteista on korostetun söpöjä. Aiempien tutkimusten perusteella viehättävä ulkonäkö ja söpöys vaikuttavat havaitsijan tekemään arviointiin ja päätöksentekoon. Tarkastelen tutkielmassa söpöyden ja ulkonäön vaikutuksia sosiaalisten robottien kontekstissa.

Menetelmät. Tutkielmaan kerättiin kaksi kokeellista aineistoa, toinen pääkaupunkiseudulta ja toinen Internet-tutkimuksena. Kokeissa oli 135 ja 214 osallistujaa. Tutkimuksissa koehenkilöt lukivat tarinanpätkän, joka päättyi sairaanhoitajan suorittamaan pakkolääkintään tai potilaan tahdon noudattamiseen. Tarinan toimijan (ihmissairaanhoitaja tai robotti) päätöstä arvioitiin kysymysten avulla (kuinka loukkaava tai epäinhimillinen päätös oli, oliko päätös oikea tai tarpeellinen). Koehenkilöt arvioivat kysymyksiä porrastetulla Likert-asteikolla (“Täysin eri mieltä” – “Täysin samaa mieltä”). Ensimmäisessä tutkimuksessa tarkasteltiin ihmis- ja robottisairaanhoitajan pakkolääkintäpäätöstä neljällä satunnaistetulla koeasetelmalla. Toisessa tutkimuksessa tarkasteltiin vain sairaanhoitorobottia ja tarinanpätkään oli liitetty robotin kasvokuva, joka vaihteli skaalalla “ei söpö, keskivertosöpö, söpö”. Tarinanpätkistä ja robottien variaatioista muodostui kuusi koeasetelmaa, jotka oli satunnaistettu järjestyksen ja koehenkilöiden sijoittamisen osalta.

Tulokset ja johtopäätökset. Ensimmäisen tutkimuksen perusteella havaittiin, että robotti- ja ihmissairaanhoitajiin kohdistuvat moraaliset arviot eroavat toisistaan paitsi silloin, kun sairaanhoitorobotti noudattaa potilaan omaa tahtoa. Toisen tutkimuksen perusteella suoraa ulkonäkövaikutusta moraalisiin arvioihin ei havaittu, joskin osa tuloksista oli lupaavia ja kiinnostavia lisätutkimusten kannalta.

Avainsanat – Nyckelord – Keywords

sairaanhoitorobotti, hoivarobotti, moraalipsykologia, söpöys

Säilytyspaikka – Förvaringställe – Where deposited

Helsingin yliopiston kirjasto – Helda / E-thesis (opinnäytteet) ethesis.helsinki.fi

Table of Contents

Introduction 5

Differences in Moral Judgment towards Humans and Robots 5

Robot's Appearance Affecting its Evaluation 6

Preference for Cuteness 7

Cuteness Triggering Anthropomorphism 8

Summary in Previous Cuteness and Social Robotics Research 9

Present Studies 9

Study 1 10

Method 10

Results of Study 1 13

Discussion for Study 1 14

Study 2 14

Method 14

Results of Study 2 16

Discussion for Study 2 17

General Discussion 17

Moral Human-Robot Interaction Research 18

Effects of Appearance 18

Limitations of the Research Design 20

Conclusions 22

References 23

Appendix A: Vignettes 29

Appendix B: Robot Faces Used in the Research 32

Appendix C: Example of a Research Questionnaire Layout 33

Appendix D: Research Questions **34**

Do Cute Nursing Robots Get a Free Pass? Exploring How a Robot's Appearance Influences Human Judgments on Forced Medication Decision

The world has experienced an incremental increase in the use of robotics in healthcare and elderly care among other industries, especially in Japan and some other Asian countries. (Arnold & Wilson, 2017; The Headquarters for Japan's Economic Revitalization, 2015). Robotics has provided an efficient solution for the deficit in the workforce in healthcare and elderly care, hence the usage of robots will increase in future (The Headquarters for Japan's Economic Revitalization, 2015). Previous research has been conducted in the area of social and service robotics in the contexts of health care and personal care. (Broekens et al., 2009; Wada et al., 2004; DiSalvo et al., 2002; Pollack et al., 2002; Siegel et al., 2009; Hara, 1998; Breazeal, 2000). However, the benefits of social robots are still widely under further research—moreover, the design of social robots has remained as an even more neglected area. (DiSalvo et al., 2002). As social robots emerge in professional contexts around us, the effects of the robots require more thorough examination. (The Headquarters for Japan's Economic Revitalization, 2015).

Differences in Moral Judgment towards Humans and Robots

Social robots belong to communities the moral norms of which dictate our behavior (Malle et al., 2015). Hence, these moral norms will also define the nature of robot-human relationships (Malle et al., 2015). However, people tend to set different social norms on robots than humans and judge robots differently in moral decision making (Malle et al., 2015; Lin, 2016; Bonnefon et al., 2016). People generally feel averse to machines making moral decisions as machines are not perceived to be able to fully think or feel, contrary to humans. (Bigman & Gray, 2018; Gray et al., 2007; Huebner, 2010).

The aversion towards robot-made decisions extends to the field of medicine as well. (Bigman & Gray, 2018). According to Bigman & Grey (2018), people feel more averse

towards moral decisions made by a robot even when the robot makes precisely the same decision with a similar outcome as a human doctor. Furthermore, the negative outcomes caused by a robot's actions receive greater blame than a human's when the context and actions are identical (Bigman & Gray, 2018).

These kinds of moral dilemmas about robots' and humans' decision making have also been researched in the context of self-driving cars when there is a question of life or death (Lin, 2016; Bonnefon et al., 2016). According to Malle et al. (2015), robots generally receive blame for not taking action whereas humans receive blame for taking action in such situations. Moreover, robots are expected to make choices that sacrifice one in order to save many (Malle et al., 2015). When robots don't make this kind of decisions, they are blamed more harshly than humans making exactly the same decisions (Malle et al., 2015). Henceforth, robots are likely to receive blame for not taking action to save someone, and when they do, they are judged more harshly than humans despite the outcome of the decision. To sum up, robots and humans are judged differently, and different kinds of decisions are expected to be made by humans and robots.

Robot's Appearance Affecting its Evaluation

A robot's physical appearance influences the interpretation of its qualities (Siegel et al., 2009; Walters et al., 2008; DiSalvo et al., 2002). The appearance can affect how human-like we consider the robot is or how pleasant we think the interaction with it is (DiSalvo et al., 2002; Walters et al., 2008). A robot's appearance influences even the interpretation of suitable applications of the robot (Hegel et al., 2009). For instance, human-like robots are considered suitable for healthcare, caregiving, personal assistance, security work, business, teaching and public assistance (Hegel et al., 2009). Moreover, the perceived attractiveness of the robot affects people's judgments on whether they like the robot, could consider using the robot,

how enjoyable they consider the robot is and whether they would like to own the robot (Hegel et al., 2009).

Attractive appearance biases the perceiver's decision making—this is called attractiveness bias and it has been studied also in social robotics (Hosoda et al., 2003; Hegel et al., 2009). Extending positive internal features into agents with attractive external appearance applies to lifeless objects in like manner, hence robots perceived as more attractive are evaluated more positively in general (Dion et al., 1972; Norman, 2004; Hegel et al., 2009; Hosoda et al., 2003). Attractiveness bias is reversed when unpleasant external traits are generalized into the negative overall evaluation of an agent (Duffy & Joue 2004). An example of this effect is the uncanny valley effect, which refers to negative feelings raised by almost human-like appearance (Mori, 1970; Duffy & Joue, 2004). This effect is present in extremely human-looking robots (Mori, 1970; Duffy & Joue, 2004). Based on these findings, the appearance of an agent has an effect on perceiver and this effect is replicable in humans and robots. Hence, the robot's appearance should be considered when applying robots into interactive roles with humans.

Preference for Cuteness

The appearance of an individual affects our overall judgments of the individual even when the judgments should not be driven by the appearance at all (Zebrowitz & Montepare, 2008). Facial appearance resembling baby-like features in individuals has been observed to affect criminal justice decisions biasing the outcome of trials (Eberhardt et al., 2006; Zebrowitz & McDonald, 1991). For instance, defendants with more noticeable baby-face features were more likely to win cases involving intentional actions by the defendant (Zebrowitz & McDonald, 1991). Furthermore, defendants with more matured or adult-like faces were required to pay larger monetary awards to baby-faced prosecutors (Zebrowitz & McDonald, 1991). Facial cues are overgeneralized to the individuals whose appearance

resembles baby-like features which biases the decision making. (Zebrowitz & Montepare, 2008).

Baby schema refers to specific child-like features that appeal highly to most humans, affect cuteness perception and trigger caretaking and protective behavior (Borgi et al., 2014; Kringelbach et al., 2016; Darwin, 1877; Sherman & Haidt, 2011). Some general "cuteness" features have been discovered by previous research which include round face, large head compared to rest of the body, full cheeks, high forehead and eyebrows, big eyes, small nose, chin and mouth. Faces with the aforementioned features are perceived cuter than faces without these features (Borgi et al., 2014; Alley, 1981, 1983; Gross, 1997; McCabe, 1988; Berry & McArthur, 1985). Cuteness invites positive social behavior such as smiling, laughter and other more complex interactions that aim to keep up the cycle of positive social interactions (Nittono et al., 2012).

From early on in the development, preference for baby schema influences cuteness perception and gaze allocation towards childlike features—an effect that is extended beyond human faces. (Borgi et al., 2014). People prefer cute objects and agents and perceive faces including baby-like traits as cute and pleasant (Sanefuji et al., 2007; Sternglanz et al., 1977; Hildebrandt and Fitzgerald, 1979; Alley, 1981; Glocker et al., 2009). Cuteness as a feature can be transferred into non-living objects like cars, toys and cartoons (Hinde & Barden, 1985; Archer and Monton, 2011; Gould, 1979).

Cuteness Triggering Anthropomorphism

According to Horowitz & Bekoff (2007), baby schema (cuteness) could be a physical prompt for triggering anthropomorphism in lifeless objects. Anthropomorphizing enables social connections to objects—this increases pleasantness of technological objects that would not be subject to social feelings otherwise (Nass et al., 2000; Nass et al., 1995). For example, images of cute baby animals can trigger anthropomorphism and increase the likelihood of

attaching anthropomorphic features (naming, talking, using gendered pronouns) into gadgets such as robot vacuum cleaners, compared to people watching adult animal images (Sherman & Chandler, 2012). According to Golle et al. (2013) there is a common mechanism coding cuteness in human and non-human faces. Based on these findings, a cute external appearance is likely to trigger social feelings and increase the chances of attaching social qualities to objects. This effect is likely generalizable to social robots as well.

Summary in Previous Cuteness and Social Robotics Research

The preference for cuteness in living and lifeless agents has been repeatedly observed in earlier research. Based on these findings, cuteness is affecting the perceiver, biasing decision making and altering perceiver's overall judgments towards an agent. Thus, it is reasonable to assume the effects of cuteness to be observed in contexts which involve cute-faced nursing robots. Cuteness is already being exploited in the elderly care industry, where for example Paro the stuffed baby seal robot is keeping the elderly company (Bemelmans et al., 2015).

The hypothesis in this thesis suggests cuteness bias is present in situations involving cute or baby-faced robots and the cuteness features affect judgments on a robot nurse's decisions. As studied earlier, an agent's cute appearance affects the judgments towards its actions and this transference effect is expected to be found in cute robots as well. This topic has not been studied earlier, hence it is important to gain an understanding of whether this effect is present in interaction situations involving social robots. In medical and caregiving industries the usage of social robots is increasing, and not enough research has been conducted so far.

Present Studies

Two studies were conducted to examine whether a robot or human receives greater blame in moral decision making in the healthcare context and whether the appearance of the robot has

an effect on moral judgments. As there is theoretical support for humans and robots being judged differently in moral decision making, the hypothesis of Study 1 is:

H1: Robots and humans are judged differently in a professional healthcare context when they make a moral choice.

Due to theoretical implications of the agent's appearance affecting the evaluations of the agent and cuteness affecting the perceiver's decision making, Study 2 focuses on exploring the effects of a robot's appearance affecting moral judgments made on the robot's actions. Hence, the hypothesis for Study 2 is:

H2: Cuteness features on the robot's appearance affect moral judgments on its decisions.

Study 1

Method

Participants and Design. Research participants (N=135, 56 female, $AgeM$ = 37.10; SD = 17.64; *range* = 18–80) were recruited from a large public library in the Helsinki capital area. 58 of the participants had at least a bachelor's degree. Recruitment was performed by informing library visitors (see below) about the possibility to participate in a psychological experiment which would take approximately 30 minutes. Recruitment was performed without interfering with the visitors and was based on a voluntary approach by the participants.

After deciding to participate in the experiment, participants entered a temporary research laboratory in the library. Participants were using a laptop computer in an office desk for the experiment. Participants could not see each other due to insulating office walls between desks. All participants were randomized into one of four possible experiment conditions by experiment software. The study had a 2×2 factorial design. The first factor had two levels: forced vs. not forced medication as did the second factor: human nurse vs. robot nurse. Research participants were blind to the randomization of the conditions.

Procedure and Materials. Research data was collected from participants who were recruited based on the participant's own willingness to approach the stand. Participants were blinded for peer review. In the library lobby the research group had a table with a sign stating: 'Participate in Psychological Research'. Possible participants could approach neutrally dressed research assistants standing behind the table if they wished to do so. Participants were recruited voluntarily, and research assistants made sure all of them were at least 18 years old. Participants were required to read an informed consent form and sign it before entering the research laboratory. Informed consent included general information about the research and emphasized participants had the option to opt-out from the research at any moment if they wished to do so. After signing the consent, participants were escorted into specifically designed temporary research laboratory by a research assistant.

The research laboratory was equipped with four notebook computers with 15" screens positioned to give maximum privacy for the participants. Moveable office walls were used to divide laboratory space in individual research stations. Participants were asked to use headphones playing pink noise at a steady pleasant volume level. The research experiment program was programmed using Python's Social Psychology Questionnaire Library (Laakasuo, in preparation), which is built on top of Pygame version 1.96. The research experiment started by blindly randomizing participants into one of the research conditions (forced vs. not forced medication, human vs. nurse robot). In addition, the experimenters were blind for the randomization of conditions presented to research participants. The experiment started with a questionnaire of exploratory measures and continued with the experiment questions.

Vignette/Experimental Task. In the experiment the participants read a short science fiction story about an event in 2035. The event takes place in a hospital in Southern Finland where a reluctant patient has refused to take their medication. The senior doctor has ordered

the patient to receive the medication, otherwise, the patient's life might be in danger. In the story the nurse (a human nurse or advanced medical nurse robot) has to make a decision considering medicating the patient. The mental capacity of the nurse robot was not described in the story, neither whether the medication would be essential in the long-term medical routine. The nurse (human/robot) in the story knows the medication is not absolutely essential for the patient's well-being based on their own knowledge. The story ends on the note stating either 1) the nurse decides to defy the senior doctor's orders, following the patient's own will in not wanting to receive medication or 2) The nurse obeys the senior doctor's orders by giving the medication to the reluctant patient forcefully, despite knowing the medication is not absolutely needed. The consequences of the nurse's decision were not described in the vignette (see Appendix A).

Participants had one minute to read the story and after reading the vignette, the dependent variable questions emerged below the story chapter one by one. Participants answered the Likert-scale questions on the screen with a computer mouse. After giving answers to dependent variables, the participants answered the manipulation check questions and provided Mind Perception estimates of the nurse (human/robot). The vignette did not specify whether actions of the nurse or nurse robot were legal (forcing the medication) and whether there would have been consequences for not following doctor's orders.

Moral Judgement Measure—Main Dependent Variable. The main dependent variable, the experiment questionnaire, consisted of 16 items averaged together. Four items were removed due to factor analysis results. The final scale of 16 items had good internal consistency (Cronbach's Alpha = 0.92). Questions were presented in a Likert scale from 1 to 7 (”Completely disagree” – ”Completely agree”). The scale included questions such as ”The nurse's/nurse robot's action was X” (examples of X: offensive, right, the best decision for the patient's health, inhumane) and items like ”In my opinion the nurse/ nursing robot X”

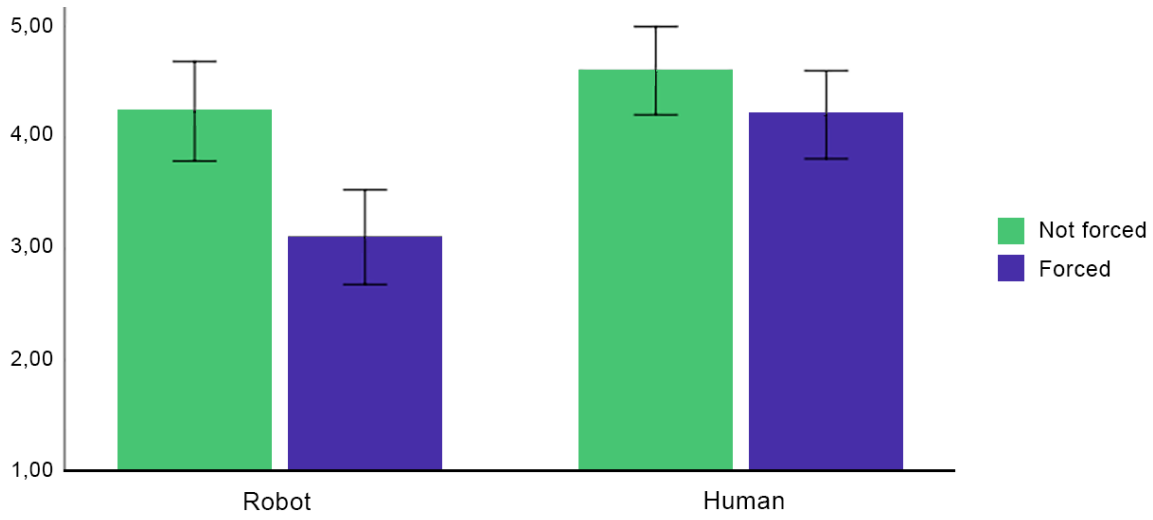
(examples of X: is trustworthy, is only doing her job, is rude, should be fired). Item listings are presented in Appendix D.

Results of Study 1

The data was analyzed with standard two-way ANOVA for Moral Judgement Measure. Both experimental factors were included in the analysis (Nurse: Human vs robot; Forced medication: Yes vs. No). Results of the analysis are presented in Figure 1. Both main effects were statistically significant: F (1,131) > 12, p <.001 and the interaction was leaning towards significance: F (1,131) = 3.06; p <.01. According to contrast analysis results, the robot nurse obeying the senior doctor's orders and forcefully medicating patient was an action condemned much more harshly than the human nurse defying the senior doctor's orders to give medication (B = 1.49 95% CI: [0.91, 2.07], p < .001, F (1,131) = 25.93). Moreover, the robot forcing medication on the patient was judged more harshly than a robot who does not force medication and defies senior doctor's orders (B = 1.10 95% CI: [0.51, 1.68], p < .001 F (1,131) = 14.03).

Figure 1

Judgment towards nurse's actions (mean). Judgment scores for the two experimental conditions in Study 1.



Error bars represent 95% CIs

Discussion for Study 1

Based on the results from Study 1, the robot nurse's decision to force the medication on the reluctant patient and obey the senior doctor's orders was judged more harshly than the same decision made by the human nurse (See Figure 1). Furthermore, the robot nurse forcing medication on the patient was judged more harshly than a robot nurse acting according to the patient's will and not following the senior doctor's orders to medicate the patient. Hence, the results support the hypothesis *H1* of humans and robots being judged differently based on their moral decisions.

Study 2

Methods

Participants and Design. In total, 214 ($N = 214$; 128 female) participants ($AgeM = 28$; $SD = 10{,}58$; *range* = 19–78) were recruited from Finnish University mailing lists and Facebook groups. 179 of participants were studying for or had accomplished a bachelor's degree or in higher education.

The research form could have been opened with a computer, tablet or mobile phone. Participants were randomized into one of six conditions. The study had a 2×3 factorial design. The first factor had two levels: forced vs. not forced medication. The second factor: robot nurse's cuteness had three levels. Research participants were blind to the randomization of the conditions.

Procedure and Materials. The online research form was opened voluntarily by participants with no external reward for opening the research link. Participants were collected from the University of Helsinki, Aalto University, Jyväskylä University and University of Eastern Finland mailing lists in addition to technology and artificial intelligence-related Facebook groups. After opening the link to the research form, participants were provided the informed consent screen, which described the study on a general level (how much time would

the study takes, confidentiality of data etc.) and stated their right to opt-out whenever they felt like it.

The experiment started by randomizing the participant into one of the six conditions (listed previously). Participants were blind to the randomization. Participants started the experiment by reading the vignette and answering research questions after which they continued by answering in exploratory measures.

Vignette/Experimental Task. Experiment task consisted of the same vignette as in Study 1, where participants read a short science fiction story describing an event taking place in the year 2035. The only difference in the vignette was the presence of advanced nursing robot while human nurse was left out of the study. Some wordings in the vignette were altered to fit the robot nurse context better instead of the human nurse context. Different research questionnaires (1–6) included different images of a robot on the cuteness scale (cute, semi-cute and not cute). One of the three robot variations was presented to the participant. The experiment questionnaire was the same as in Study 1, except the word "nurse" was replaced with "nurse robot" in research questions.

Cuteness in the robot's faces was not altered according to a specific cuteness scale but robot images were generated based on cuteness features defined in literature review articles (Borgi et al., 2014; Alley, 1981, 1983; Gross, 1997; McCabe, 1988*;* Berry & McArthur, 1985). The image set was tested for whether the robot faces were perceived to fit in a cuteness scale: 11 people in public co-working spaces and cafes in Helsinki city center were asked what kind of scale they thought the images were variations of. If the answer was close to cuteness, childlikeness, prettiness or similar the images were considered acceptable for the experiment.

Moral Judgement Measure / Main Dependent Variable. The main dependent variable was the same as in Study 1 (described above). The same 20 questions were used in

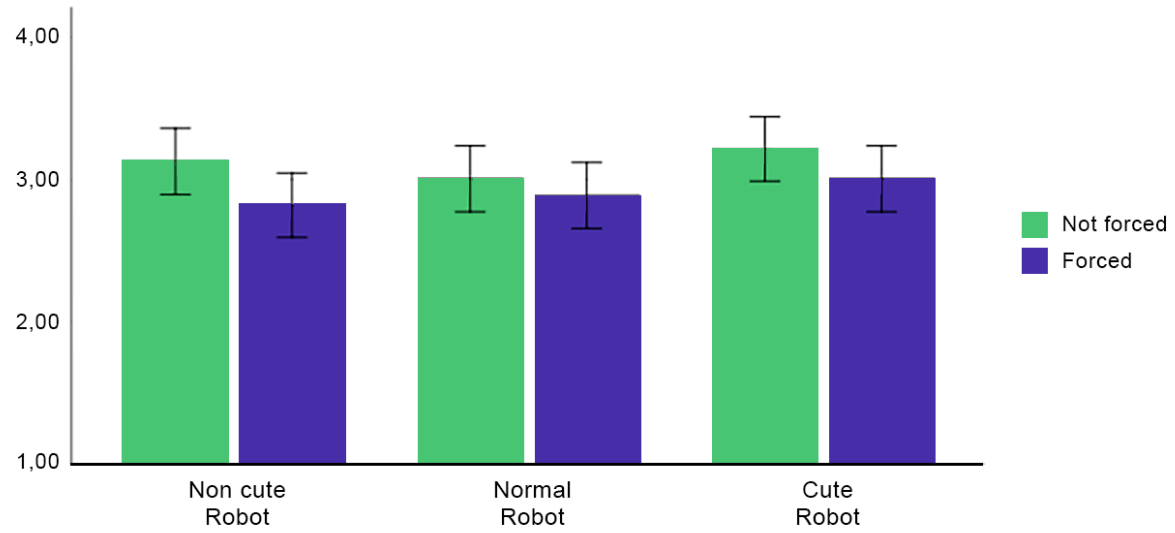
the research and 16 of them were averaged together to form the final scale. All questions were anchored from 1 to 5 (”Disagree” – ”Agree”).

Results of Study 2

The data was analyzed with standard two-way ANOVA for Moral Judgement Measure. Both experimental factors were included in the analysis (Nurse robot: Robot 1: Non-cute vs Robot 2: Average cute vs Robot 3: Cute; and Forced medication: Yes vs. No. See Figure 2 for results. The main effect was found in Forced medication factor F (1, 208) = 4,93 p <.05, other effects were not found. The effect of the robot's appearance affecting judgements was not statistically significant: F (2,208) = 1,134 p = n.s. Contrast analysis was applied to examine whether in the Robot 1: Non-cute class there would be a statistical difference, but no difference was found (B=0.31 Cl: [-0.016–0.631] F (1,208) = 3.50 p = n.s.). However, p = 0.063 is leaning towards significance.

Figure 2

Judgment towards nurse robot's actions (mean). Judgment scores for the three experimental conditions in Study 2.



Error bars represent 95% CIs

Discussion for Study 2

Based on the results from Study 2, the appearance of the robot is not significantly affecting the moral judgments on the nurse robot's actions (See Figure 2). Hence the results from Study 2 do not support hypothesis *H2* and the theoretical implications of cuteness features on the robot's appearance affecting judgment on the robot's decisions. However, in contrast analysis results, the difference in the "un-cute" robot class was approaching statistical significance ($p = 0.063$), which indicates more examination on the topic would be justified in the future.

General Discussion

Based on the results from Study 1, the nurse robot's decision to force the medication on the reluctant patient was judged more harshly than the same decision made by the human nurse (See Figure 1). However, the nurse robot respecting the patient's will was not judged more harshly than the human nurse doing the same moral decision. The nurse robot forcing medication on the patient was judged more harshly than a robot respecting the patient's will about medication. Findings from Study 1 are partially in line with earlier research about humans setting different norms on robots as they do on humans, as well as judging robots differently in moral decision making. (Malle et al., 2015; Lin, 2016; Bonnefon et al., 2016).

The results of Study 2 indicate there is no significant cuteness effect affecting the moral judgments on robot's decisions and hence the hypothesis of cuteness affecting moral judgments is not supported (see Figure 2). However, the contrast analysis results revealed a difference inside the "un-cute" robot class which was approaching statistical significance ($p = 0.063$). This implies more research on the area should be conducted in order to discover whether the difference in judgments is more distinctive. Furthermore, there are rather strong theoretical indications of cuteness and attractive appearance affecting evaluations and judgment towards an agent, hence more research is needed to explore this effect in social

robotics. It is assumable that the research design affected the research results of Study 2 to some extent (see below).

Moral Human-Robot Interaction Research

Fields of Moral Human-Robot Interaction (HRI) and Persuasive Robotics are exploring the questions of how people attribute morality to machines and how to design robots ethically according to their intended purpose. (Siegel et al., 2009; Kool & Agrawal, 2016). Persuasiveness can be used to enhance interaction—for example social robots aimed at saving human lives should establish different kinds of credibility than robots developed for helping tourists. (Siegel et al., 2009). Hence, the requirements and preferences concerning the robot's appearance differ according to the task the robot is accomplishing, and the robot's appearance could be altered for the desired interaction outcomes. (Walters et al., 2008; Siegel et al., 2009). It is noteworthy that the robot's external features always have an effect on the perceiver whether the features are purposefully designed or not (DiSalvo et al., 2002).

As fundamentally interactive devices, social robots are not only evaluated in terms of speed or accuracy of the actions, but also in terms of the interaction with humans—feelings of comfort, pleasantness and "human-likeness" evoked in the interaction among other aspects. (Wada et al., 2004; Hegel et al., 2009). However, interaction studies on social robotics are widely conducted on computer screens with imagined situations that need explaining—the real-world interaction is almost completely absent. (Hegel et al., 2009). Indirect research on human-robot interactions provides interesting indications and results but might leave some crucial aspects out. The access to realistic situations with robots doing moral decisions in the medical context is very limited which poses challenges to moral HRI research.

Effects of Appearance

There are theoretical implications of cuteness and attractive appearance affecting the perceiver's decision making and judgments (Sanefuji et al., 2007; Hegel et al., 2009;

Eberhardt et al., 2006; Zebrowitz & McDonald, 1991). Furthermore, previous findings suggest the robot's appearance has an effect on the perceiver (Siegel et al., 2009; Walters et al, 2008; DiSalvo et al., 2002; Hegel et al., 2009).

As discussed earlier, cuteness has a variety of possible effects—from triggering anthropomorphism (Horowitz & Bekoff, 2007) and enabling social connections to objects (Nass et al., 2000; Nass et al., 1995) to setting a preference towards cute agents and objects over their non-cute counterparts (Hinde & Barden, 1985, Sanefuji et al., 2007; Sternglanz et al., 1977; Hildebrandt and Fitzgerald, 1979; Alley, 1981; Glocker et al., 2009a). Furthermore, cuteness extends positive overall evaluation to individuals with pleasant appearance (Dion et al., 1972) and biases the decision-making towards the individuals with cute appearance, even when the appearance should explicitly not guide the judgments. (Zebrowitz & Montepare, 2008). Cuteness effects are present in the everyday as well as professional contexts and several different mechanisms could be causing those.

We are not familiar with all the effects of cute or attractive appearance, especially in the context of machines and social robots. Hence, applying cuteness features to social robots should be approached with caution. Can pleasant appearance reduce aversion towards robots? Could cuteness give nurse robots a free pass when forcing medication on patients or even in malpractice? Could cuteness cause less judgment in the perceiver in otherwise harshly judged situations? Since the usage of robots in medical and other professional contexts is increasing, industries are coping with—or exploiting— the possible effects in humans caused by the robot's appearance. Since the effects of appearance are rather unknown in social robotics, neutral appearance should be advised until further findings develop in contrast to the favoring of cute appearance in robotics production.

Limitations of the Research Design

There are some limitations in Study 2 which may be causing non-significant results. One such limitation is sample size. 214 participants were collected in a limited amount of time; hence the participant amount is likely to affect the generalizability of the result. Also, the majority of participants being university students or people interested in artificial intelligence could affect the result. Since the research was conducted online with participants' own electronic devices, the test environments could not be controlled. Hence, it is impossible to make sure all participants were fully focusing on the vignette and paying attention to the robot's appearance enough.

The lack of specific cuteness scale could have affected the effectiveness of the research design as cuteness in robot's faces was altered based on cuteness features defined in the literature review articles and testing with people. (Borgi et al., 2014; Alley, 1981, 1983; Gross, 1997; McCabe, 1988*;* Berry & McArthur, 1985). Different methods of creating and testing the suitableness of images could have also altered the research results. Moreover, there was moderate variation on robot images—more explicit variations on robot faces could have altered research results. Robot images clearly differ once compared against each other, but the difference might not be as significant as only one image is present at a time (See Appendix B and Appendix C). The cuteness scale could have been tested in the research questionnaire after the experiment questions to measure the scale's effectiveness. Moreover, some aspects in the vignette could have been described more clearly; Stating the nurse or nurse robot knows the medication is not necessary for the patient indicates the senior doctor has conducted a false diagnosis. This identification of the doctor's false diagnosis could have altered the moral dilemma, as in the current situation it is not absolutely clear who, if anyone has actually conducted a false diagnosis.

Another factor causing only a slight indication of cuteness effects could be the layout of the research form in Study 2: The rather big picture of a robot face was presented at the beginning of the screen and the vignette and experiment questions below the robot image. This research form design causes the robot to not be visible to the participant at all times, unless they decide to look at the robot again which might be unlikely (See Appendix C). According to some feedback, two of the participants didn't immediately connect the picture of the robot to the robot described in the short story. This could have caused some test subjects to answer only based on the vignette description and ignore the appearance of the robot.

Yet another aspect possibly affecting the results is the fact that the robots used in the experiment represent the rather popular social robot 'Pepper' and variations of it on the cuteness scale. Using Pepper could have affected test subjects familiar with the robot as they might have existing judgments or emotions towards it. Pepper was selected as there were suitable images of Pepper's face available for image warping and cuteness features altering. As Pepper is a Japanese robot, test subjects living in Asia or those heavily influenced by Asian culture could react to the robot's cuteness differently due to the special role of cuteness in Japanese culture. (Nittono et al., 2012). Cuteness features are more familiar in Japanese culture, where many objects have cuteness and infant-schema features. (Nittono et al., 2012). The test subjects answered to a few questions whether they have been heavily influenced by Japanese popular culture like manga and anime or if they have been living in East Asian countries. However not enough test subjects filled the criteria in order to make a conclusion of the cultural effects.

Despite possible limitations in research design, the experiment results were clear and provide a further understanding of the effects of robot's appearance, especially cuteness, on moral judgments caused by the nurse robot's actions.

Conclusions

The goal of this thesis was to explore how moral judgments towards the robot and human nurses differ in the contexts in which a nurse has to make a moral decision of medicating a reluctant patient. As found in Study 1, in forced medication situation there is a difference in how human and robot nurses' actions are being judged. Hence, a follow-up study was conducted on whether the judgments towards nurse robots are affected by the nurse robot's appearance. Cuteness was selected as the independent variable due to the fact that many existing social robots in the healthcare industry have rather a cute appearance. Robots' appearances were varied on the cuteness scale to find out which kind of appearance affects people's moral judgments on robots' actions. The results indicate the robot's appearance does not directly affect moral judgments; however, contrast analysis results indicate that further research should be conducted in this area.

All in all, this thesis was an initiative to discover differences in moral judgments on humans and robots as well as the robot's appearance affecting the judgments. Study 2 was an experimental research inquiry exploring whether cuteness is affecting moral judgments on the robot's actions. Since the area is rather unknown to current robotics research, it was crucial to conduct the first step in exploring the effects of a robot's facial design and cuteness in social situations including moral decision making. As a new research area with interesting results, more research should be conducted in the future about the effects of social robots' appearance design.

References

Alley, T. R. (1981). Head shape and the perception of cuteness. *Developmental Psychology*, *17*(5), 650. https://doi.org/10.1037/0012-1649.17.5.650

Alley, T. R. (1983). Infantile head shape as an elicitor of adult protection. *Merrill-Palmer Quarterly (1982-)*, 411–427.

Archer, J., & Monton, S. (2011). Preferences for infant facial features in pet dogs and cats. *Ethology*, *117*(3), 217-226. https://doi.org/10.1111/j.1439-0310.2010.01863.x

Arnold, D., & Wilson, T. (2017). What doctor? Why AI and robotics will define new health. PwC.

Bemelmans, R., Gelderblom, G. J., Jonker, P., & de Witte, L. (2015). Effectiveness of robot Paro in intramural psychogeriatric care: a multicenter quasi-experimental study. *Journal of the American Medical Directors Association*, *16*(11), 946–950. https://doi.org/10.1016/j.jamda.2015.05.007

Berry, D. S., & McArthur, L. Z. (1985). Some components and consequences of a babyface. *Journal of personality and social psychology*, *48*(2), 312. https://doi.org/10.1037/0022-3514.48.2.312

Bigman, Y. E., & Gray, K. (2018). People are averse to machines making moral decisions. *Cognition*, *181*, 21–34. https://doi.org/10.1016/j.cognition.2018.08.003

Bonnefon, J. F., Shariff, A., & Rahwan, I. (2016). The social dilemma of autonomous vehicles. *Science*, *352*(6293), 1573–1576. https://doi.org/10.1126/science.aaf2654

Borgi, M., Cogliati-Dezza, I., Brelsford, V., Meints, K., & Cirulli, F. (2014). Baby schema in human and animal faces induces cuteness perception and gaze allocation in children. *Frontiers in psychology*, *5*, 411. https://doi.org/10.3389/fpsyg.2014.00411

Breazeal, C. L. (2000). *Sociable machines: Expressive social exchange between humans and robots* (Doctoral dissertation, Massachusetts Institute of Technology).

Broekens, J., Heerink, M., & Rosendal, H. (2009). Assistive social robots in elderly care: a review. *Gerontechnology*, *8*(2), 94-103.

Darwin, C. (1877). A biographical sketch of an infant. *Mind*, *2*(7), 285–294.

Dion, K., Berscheid, E., & Walster, E. (1972). What is beautiful is good. *Journal of personality and social psychology*, *24*(3), 285. https://doi.org/10.1037/h0033731

DiSalvo, C. F., Gemperle, F., Forlizzi, J., & Kiesler, S. (2002, June 25–26). All robots are not created equal: the design and perception of humanoid robot heads. In *Proceedings of the 4th conference on Designing interactive systems: processes, practices, methods, and techniques* (pp. 321-326). ACM. https://doi.org/10.1145/778712.778756

Duffy, B. R., & Joue, G. (2004, March 10–13). I, robot being. In *Intelligent Autonomous Systems Conference (IAS8), Amsterdam, The Netherlands*.

Eberhardt, J. L., Davies, P. G., Purdie-Vaughns, V. J., & Johnson, S. L. (2006). Looking deathworthy: Perceived stereotypicality of Black defendants predicts capital-sentencing outcomes. *Psychological science*, *17*(5), 383–386. https://doi.org/10.1111/j.1467-9280.2006.01716.x

Glocker, M. L., Langleben, D. D., Ruparel, K., Loughead, J. W., Gur, R. C., & Sachser, N. (2009). Baby schema in infant faces induces cuteness perception and motivation for caretaking in adults. *Ethology*, *115*(3), 257-263. https://doi.org/10.1111/j.1439-0310.2008.01603.x

Golle, J., Lisibach, S., Mast, F. W., & Lobmaier, J. S. (2013). Sweet puppies and cute babies: perceptual adaptation to babyfacedness transfers across species. *PLoS One*, *8*(3), e58248. https://doi.org/10.1371/journal.pone.0058248

Gould, S. J. (1979). Mickey Mouse meets Konrad Lorenz. *Natural History*, *88*(5), 30-36.

Gray, H. M., Gray, K., & Wegner, D. M. (2007). Dimensions of mind perception. *Science*, *315*(5812), 619–619. https://doi.org/10.1126/science.1134475

Gross, T. F. (1997). Children's perception of faces of varied immaturity. *Journal of Experimental Child Psychology*, *66*(1), 42–63. https://doi.org/10.1006/jecp.1997.2373

Hara, F. (1998). Personality characterization of animate face robot through interactive communication with human. Proc. IARP98, *Tsukuba*, IV-1

Hegel, F., Lohse, M., & Wrede, B. (2009, September 27–October 2). Effects of visual appearance on the attribution of applications in social robotics. In *RO-MAN 2009-The 18th IEEE International symposium on robot and human interactive communication* (pp. 64–71). IEEE. https://doi.org/10.1109/ROMAN.2009.5326340

Hildebrandt, K. A., & Fitzgerald, H. E. (1979). Facial feature determinants of perceived infant attractiveness. *Infant Behavior and Development*, *2*, 329-339. https://doi.org/10.1016/S0163-6383(79)80043-0

Hinde, R. A., & Barden, L. A. (1985). The evolution of the teddy bear. *Animal Behaviour*, *33*(4), 1371-1373.

Horowitz, A. C., & Bekoff, M. (2007). Naturalizing anthropomorphism: Behavioral prompts to our humanizing of animals. *Anthrozoös*, *20*(1), 23–35. https://doi.org/10.2752/089279307780216650

Hosoda, M., Stone-Romero, E. F., & Coats, G. (2003). The effects of physical attractiveness on job-related outcomes: A meta-analysis of experimental studies. *Personnel psychology*, *56*(2), 431–462. https://doi.org/10.1111/j.1744-6570.2003.tb00157.x

Huebner, B. (2010). Commonsense concepts of phenomenal consciousness: Does anyone care about functional zombies? *Phenomenology and the cognitive sciences*, *9*(1), 133–155. https://doi.org/10.1007/s11097-009-9126-6

Kool, V. K., & Agrawal, R. (2016). Psychology of Technology in the Twenty-First Century. *In Psychology of Technology* (pp. 305–335). Springer, Cham. https://doi.org/10.1007/978-3-319-45333-0_7

Kringelbach, M. L., Stark, E. A., Alexander, C., Bornstein, M. H., & Stein, A. (2016). On cuteness: Unlocking the parental brain and beyond. *Trends in cognitive sciences*, *20*(7), 545–558. https://doi.org/10.1016/j.tics.2016.05.003

Laakasuo, M., Research experiment script on social psychological questionnaire, manuscript in preparation

Lin, P. (2016). Why ethics matters for autonomous cars. *In Autonomous driving* (pp. 69–85). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-45854-9_4

Malle, B. F., Scheutz, M., Arnold, T., Voiklis, J., & Cusimano, C. (2015, March 2–5). Sacrifice one for the good of many?: People apply different moral norms to human and robot agents. In *Proceedings of the tenth annual ACM/IEEE international conference on human-robot interaction* (pp. 117–124). ACM. https://doi.org/10.1145/2696454.2696458

McCabe, V. (1988). Facial proportions, perceived age, and caregiving.

Mori, M. (1970) Bukimi no tani [the un-canny valley]. *Energy, Volume 7*, pp.33–35.

Nass, C., Isbister, K., & Lee, E. J. (2000). Truth is beauty: Researching embodied conversational agents. *Embodied conversational agents*, 374–402.

Nass, C., Moon, Y., Fogg, B. J., Reeves, B., & Dryer, C. (1995, May 7–11). Can computer personalities be human personalities? In *Conference companion on Human factors in computing systems* (pp. 228-229). ACM. https://doi.org/10.1006/ijhc.1995.1042

Nittono, H., Fukushima, M., Yano, A., & Moriya, H. (2012). The power of kawaii: Viewing cute images promotes a careful behavior and narrows attentional focus. *PloS one*, *7*(9), e46362.

Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things*. Basic Civitas Books.

Pollack, M. E., Brown, L., Colbry, D., Orosz, C., Peintner, B., Ramakrishnan, S., Engberg, S., Matthews, J. T., Dunbar-Jacob, J., McCarthy, C. E., Thrun, S., Montemerlo, M., Pineau, J. & Roy, N. (2002, August). Pearl: A mobile robotic assistant for the elderly. In *AAAI workshop on automation as eldercare* (Vol. 2002, pp. 85–91).

Sanefuji, W., Ohgami, H., & Hashiya, K. (2007). Development of preference for baby faces across species in humans (Homo sapiens). *Journal of Ethology*, *25*(3), 249–254. https://doi.org/10.1007/s10164-006-0018-8

Sherman, G. D., & Chandler, J. (2012). Cuteness cues elicit anthropomorphism. *Unpublished manuscript, Harvard University.*

Sherman, G. D., & Haidt, J. (2011). Cuteness and disgust: The humanizing and dehumanizing effects of emotion. *Emotion Review*, *3*(3), 245–251. https://doi.org/10.1177/1754073911402396

Siegel, M., Breazeal, C., & Norton, M. I. (2009, October 11). Persuasive robotics: The influence of robot gender on human behavior. In *2009 IEEE/RSJ International Conference on Intelligent Robots and Systems* (pp. 2563–2568). IEEE. https://doi.org/10.1109/IROS.2009.5354116

Sternglanz, S. H., Gray, J. L., & Murakami, M. (1977). Adult preferences for infantile facial features: An ethological approach. *Animal Behaviour*, *25*, 108-115. https://doi.org/10.1016/0003-3472(77)90072-0

The Headquarters for Japan's Economic Revitalization (2015). New Robot Strategy: Japan's Robot Strategy—Vision, Strategy, Action Plan.

Wada, K., Shibata, T., Saito, T., & Tanie, K. (2004). Effects of robot-assisted activity for elderly people and nurses at a day service center. *Proceedings of the IEEE*, *92*(11), 1780–1788. https://doi.org/10.1109/JPROC.2004.835378

Walters, M. L., Syrdal, D. S., Dautenhahn, K., Te Boekhorst, R., & Koay, K. L. (2008). Avoiding the uncanny valley: robot appearance, personality and consistency of behavior in an attention-seeking home scenario for a robot companion. *Autonomous Robots*, *24*(2), 159–178. https://doi.org/10.1007/s10514-007-9058-3

Zebrowitz, L. A., & McDonald, S. M. (1991). The impact of litigants' baby-facedness and attractiveness on adjudications in small claims courts. *Law and human behavior*, *15*(6), 603–623. https://doi.org/10.1007/BF01065855

Zebrowitz, L. A., & Montepare, J. M. (2008). Social psychological face perception: Why appearance matters. *Social and personality psychology compass*, *2*(3), 1497–1517. https://doi.org/10.1111/j.1751-9004.2008.00109.x

Appendix A

Vignette Used in Study 1

It is 2035. Leena is a 35-year-old nurse with extensive experience. She is working at the Central Finland University Hospital. Her work includes following doctor's orders in patient treatment. In case she does not follow the doctor's orders, the lives of the patients might be at risk. One of Leena's responsibilities is giving the right dosage of medicine to the patients by following the doctor's instructions.

One day Leena has to take care of a reluctant patient who has been brought to involuntary treatment. The patient refuses to take their medication. The doctor responsible for the treatment has told Leena it is extremely important for the patient to take their medication. Based on her extensive experience, Leena knows the medication is not absolutely necessary in regard to the patient's wellbeing.

Alternative Endings:

Following Patient's Will: She decides to resist the doctor's orders and follow the patient's own will, hence she does not give the medication to the patient.

Forced Medication: She decides to follow the doctor's orders and forces the medication on the patient against their will.

Vignette Used in Study 1 In Finnish (Original Vignette Used in the Research)

On vuosi 2035. Leena on 35-vuotias kokenut sairaanhoitaja, joka työskentelee Keski-Suomen yliopistollisessa sairaalassa. Hänen työtehtäviinsä kuuluu noudattaa lääkärin antamia ohjeita potilaiden hoidossa. Mikäli hän ei noudata lääkärien ohjeita saattaa potilaiden henki olla vaarassa. Leenan vastuulla on huolehtia mm. potilaiden lääkityksen annostelusta noudattamalla lääkärin antamia ohjeita.

Eräänä päivänä Leenan vastuulla on vastahakoinen pakkohoitoon tuotu potilas, joka kieltäytyy ottamasta lääkkeitään. Hoidosta vastaava lääkäri on kertonut Leenalle, että on

ehdottoman tärkeää, että potilas syö lääkkeensä. Leena kuitenkin kokemuksensa puitteissa tietää, ettei kyseessä ole täysin välttämätön lääkitys potilaan hyvinvoinnin kannalta.

Alternative Endings:

Following Patient's Will: Hän päättää uhmata lääkärin ohjeita ja noudattaa potilaan omaa tahtoa ja jättää lääkkeet antamatta.

Forced Medication: Hän päättää noudattaa lääkärin antamia ohjeita ja annostelee lääkkeet potilaalle voimakeinoja käyttäen potilaan tahdon vastaisesti.

Vignette Used in Study 2

It is 2035. Heljä is a nurse robot working at the Central Finland University Hospital. Heljä's work includes following doctor's orders in patient treatment. In case Heljä does not follow the doctor's orders, the lives of the patients might be at risk. One of Heljä's responsibilities is giving the right dosage of medicine to the patients by following the doctor's instructions.

One day Heljä has to take care of a reluctant patient who has been brought to involuntary treatment. The patient refuses to take their medication. The doctor responsible for the treatment has told Heljä it is extremely important for the patient to take their medication. Based on Heljä's database and applied analysis Heljä knows the medication is not absolutely necessary in regard to the patient's wellbeing.

Alternative Endings:

Following Patient's Will: Heljä decides to resist the doctor's orders and follow the patient's own will, hence Heljä does not give the medication to the patient.

Forced Medication: She decides to follow the doctor's orders and forces the medication on the patient against their will.

Vignette Used in Study 2 in Finnish (Original Vignette Used in the Research)

On vuosi 2035. Heljä on sairaanhoitorobotti, joka työskentelee Etelä-Suomen yliopistollisessa sairaalassa. Hänen työtehtäviinsä kuuluu noudattaa lääkärin antamia ohjeita potilaiden hoidossa. Mikäli Heljä ei noudata lääkärien ohjeita, saattaa potilaiden henki olla vaarassa. Heljän vastuulla on huolehtia mm. potilaiden lääkityksen annostelusta noudattamalla lääkärin antamia ohjeita.

Eräänä päivänä Heljän vastuulla on hyvin vastahakoinen pakkohoitoon tuotu potilas, joka kieltäytyy ottamasta lääkkeitään. Hoidosta vastaava lääkäri on kertonut Heljälle, että on ehdottoman tärkeää, että potilas syö lääkkeensä. Heljä kuitenkin tietää tietokantansa ja soveltavan analyysinsa perusteella, ettei kyseessä ole täysin välttämätön lääkitys potilaan hyvinvoinnin kannalta.

Alternative Endings:

Following Patient's Will: Heljä päättää uhmata lääkärin ohjeita. Heljä noudattaa potilaan omaa tahtoa ja jättää lääkkeet antamatta.

Forced Medication: Heljä päättää noudattaa lääkärin antamia ohjeita ja annostelee lääkkeet potilaalle voimakeinoja käyttäen potilaan tahdon vastaisesti.

Appendix B

Robot Faces Used in the Research Questionnaire

Cute robot

Average cute robot

Non-cute robot

Appendix C

Example of Research Layout

On vuosi 2035. Heljä on sairaanhoitorobotti, joka työskentelee Etelä-Suomen yliopistollisessa sairaalassa. Hänen työtehtäviinsä kuuluu noudattaa lääkärin antamia ohjeita potilaiden hoidossa. Mikäli hän ei noudata lääkärien ohjeita, saattaa potilaiden henki olla vaarassa. Heljän vastuulla on huolehtia mm. potilaiden lääkityksen annostelusta noudattamalla lääkärin antamia ohjeita.

Eräänä päivänä Heljän vastuulla on hyvin vastahakoinen pakkohoitoon tuotu potilas, joka kieltäytyy ottamasta lääkkeitään. Hoidosta vastaava lääkäri on kertonut Heljälle, että on ehdottoman tärkeää että potilas syö lääkkeensä. Heljä kuitenkin tietää tietokantansa ja soveltavan analyysinsa perusteella, ettei kyseessä ole täysin välttämätön lääkitys potilaan hyvinvoinnin kannalta.

Heljä päättää uhmata lääkärin ohjeita. Heljä noudattaa potilaan omaa tahtoa ja jättää lääkkeet antamatta.

Seuraavat kysymykset liittyvät juuri lukemaasi tarinanpätkään. Ole hyvä ja vastaa kaikkiin kysymyksiin.

	Eri mieltä	Jokseenkin eri mieltä	En osaa sanoa	Jokseenkin samaa mieltä	Samaa mieltä
* Sairaanhoitorobotin toiminta oli asianmukaista	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli oikein	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli potilaan omien etujen mukaista	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli tämän tehtävänkuvan mukaista	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli tarpeellista	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli tunteetonta	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli loukkaavaa potilasta kohtaan	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli potilaan oikeuksia kunnioittavaa	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli epäinhimillistä	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli potilaan terveydentilan kannalta paras mahdollinen ratkaisu	○	○	○	○	○
* Sairaanhoitorobotin toiminta oli asiallista, jotta potilaan henkisen hyvinvoinnin tarpeet täytettäisiin	○	○	○	○	○
* Mielestäni sairaanhoitorobotti tekee vain työtään	○	○	○	○	○
* Mielestäni sairaanhoitorobotti pitäisi erottaa	○	○	○	○	○
* Mielestäni sairaanhoitorobotti työskenteli kiireessä	○	○	○	○	○
* Mielestäni sairaanhoitorobotti on tilanteeseen tarvittava tunneäly / tarvittavat vuorovaikutustaidot	○	○	○	○	○
* Mielestäni sairaanhoitorobotti tekee vain mitä on käsketty	○	○	○	○	○
* Mielestäni sairaanhoitorobotti on taitava siinä mitä tekee	○	○	○	○	○
* Mielestäni sairaanhoitorobotti on luotettu hoitohenkilökunnan jäsen	○	○	○	○	○
* Mielestäni sairaanhoitorobotti on sympaattinen tai “kiva”	○	○	○	○	○
* Mielestäni sairaanhoitorobotti on töykeä tai epäkohtelias	○	○	○	○	○
* Uskoisin henkeni sairaanhoitorobotin käsiin	○	○	○	○	○
* Uskoisin perheeni hengen sairaanhoitorobotin käsiin	○	○	○	○	○
* Uskoisin rakastettuni hengen sairaanhoitorobotin käsiin	○	○	○	○	○

Appendix D

Research Questions

Questions in the research questionnaire were presented in a Likert scale. In Study 1 the Likert scale varied from 1 to 7 and in Study 2 from 1 to 5 (”Completely disagree” – ”Completely agree”). The same set of questions was used in Study 1 and Study 2 with the difference of Study 1 questions concerning human nurse’s or nurse robot’s actions while Study 2 included questions only about nurse robot’s actions.

The scale included questions (nurse robot question set):

1. Nurse robot’s actions were appropriate / Sairaanhoitorobotin toiminta oli asianmukaista
2. Nurse robot’s actions were right / Sairaanhoitorobotin toiminta oli oikein
3. Nurse robot’s actions were aligned with patient’s best interest / Sairaanhoitorobotin toiminta oli potilaan omien etujen mukaista

*4. Nurse robot’s actions were suitable considering the job description / Sairaanhoitorobotin toiminta oli tämän tehtävänkuvan mukaista

5. Nurse robot’s actions were necessary / Sairaanhoitorobotin toiminta oli tarpeellista
6. Nurse robot’s actions were insensitive (inverse) / Sairaanhoitorobotin toiminta oli tunteetonta (käänteinen)
7. Nurse robot’s actions were insulting towards the patient (inverse) / Sairaanhoitorobotin toiminta oli loukkaavaa potilasta kohtaan (käänteinen)
8. Nurse robot’s actions were respectful towards the patient’s rights / Sairaanhoitorobotin toiminta oli potilaan oikeuksia kunnioittavaa
9. Nurse robot’s actions were inhumane (inverse) / Sairaanhoitorobotin toiminta oli epäinhimillistä (käänteinen)

10. Nurse robot's actions were the best possible solution considering patient's health / Sairaanhoitorobotin toiminta oli potilaan terveydentilan kannalta paras mahdollinen ratkaisu

11. Nurse robot's actions were appropriate considering patient's needs regarding mental wellbeing / Sairaanhoitorobotin toiminta oli asiallista, jotta potilaan henkisen hyvinvoinnin tarpeet täytettäisiin

*12. To my mind the nurse robot was only doing their job / Mielestäni sairaanhoitorobotti tekee vain työtään

13. To my mind the nurse robot should be dismissed (inverse) / Mielestäni sairaanhoitorobotti pitäisi erottaa (käänteinen)

*14. To my mind the nurse robot was working in a hurry / Mielestäni sairaanhoitorobotti työskenteli kiireessä

15. To my mind the nurse robot had the needed emotional intelligence or social skills in the situation / Mielestäni sairaanhoitorobotilla oli tilanteeseen tarvittava tunneäly / tarvittavat vuorovaikutustaidot

*16. To my mind the nurse robot is only doing what they have been told / Mielestäni sairaanhoitorobotti tekee vain mitä on käsketty

17. To my mind the nurse robot is skilled in what they are doing / Mielestäni sairaanhoitorobotti on taitava siinä mitä tekee

18. To my mind the nurse robot is a trusted member of the hospital personnel / Mielestäni sairaanhoitorobotti on luotettu hoitohenkilökunnan jäsen

19. To my mind the nurse robot is sympathetic or "nice" / Mielestäni sairaanhoitorobotti on sympaattinen tai "kiva"

20. To my mind the nurse robot is rude or impolite (inverse) / Mielestäni sairaanhoitorobotti on töykeä tai epäkohtelias (käänteinen)

*21. I would trust the robot nurse with my life / Uskoisin henkeni sairaanhoitorobotin käsiin

*22. I would trust the robot nurse with my family's life / Uskoisin perheeni hengen sairaanhoitorobotin käsiin

*23. I would trust the robot nurse with my loved one's life / Uskoisin rakastettuni hengen sairaanhoitorobotin käsiin

*items excluded from the final scale