IMPACT OF HUMAN LIKENESS ON ETHICAL DECISION MAKING ABOUT MEDICAL DILEMMAS

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Master's Thesis
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Dedicated to my boys, Brady and Will, and my beautiful wife, Erin.

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ABSTRACT

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Humans are often represented in computer interfaces as graphical characters. These characters, or embodied agents, are used to increase people's comfort level and humanize the interaction. While the impact of these characters has been studied in various ways, their influence on the ability of humans to make decisions of ethical consequence has yet to be explored. Interface designers have to make decisions in the design process that greatly influence how people interact with a system. If a seemly insignificant design decision could have a significant impact on how a human reacts to the system, then that warrants exploration.

This study presents online participants with an ethical dilemma delivered by a female conversational character, and explores the differences in decisions made based on the motion quality and human likeness of the character. In the five conditions, which vary in motion quality and human likeness, participants showed no significant difference in the ethical decision. However, the data indicated that male participants were significantly more likely to rule against the character when the motion quality was jerky or the visual appearance of the character was represented by a computer generated character instead of a real woman. These findings extend previous work on interpersonal judgment, indicating that a *virtual* person's appearance can influence supposedly impartial ethical decisions.

CHAPTER ONE: INTRODUCTION & BACKGROUND

As computers have evolved, their use has consistently broadened in variety and depth. Beyond the notion of the desktop PC, computers manifest themselves millions of ways in everyday life from automobiles to kitchen appliances. Modern computers have also facilitated increasingly human levels of interaction by improving design feedback, contingency, awareness, and prosody of speech. These interactions often use computerized, graphical human characters to display human qualities and make the computer seem more human. These conversational characters can communicate messages and facilitate a more natural interaction between the user and the computer.

Many studies have investigated the impact of computer graphics (CG) characters in conversational interfaces (Dehn & van Mulken, 2000). However, the ability for humans to make complex moral or ethical decisions based on input from a CG character has not been explored. Independent of HCI, variations in moral disposition, social background, and ethical constraints result in very distinctive approaches to moral decisions. Furthermore, highly situational and contextual factors play a major role in these decisions. This is important to note for designers, especially if those factors can be manipulated in the design process.

Very often, we trust individuals to make unbiased ethical or moral decisions based on extensive training and experience. For example, doctors, lawyers, and trial judges all have the responsibility of making unbiased judgments based on ethical principles that are a reflection of a society's mutually accepted moral code. Doctors, specifically, have a *prima facie* duty to assess patients based on the core ethical

constructs of beneficence, autonomy, and informed consent (Beauchamp & Childress, 1979).

In the context of ethics and moral decision making, one has to question the impact of assigning such agency to a technological artifact. It has been posited that computers may be better at making moral decisions as they are not bound by rationality or emotional constraints (Allen, Wallach, & Smit, 2008). However, as technology progresses to the point of facilitating stronger artificial intelligence, system designers need to be aware of unconscious implementation of personal value systems and attribution of existing ethical theories in the engineering process (Allen, Smit, & Wallach, 2006)

These issues have significant design implications for designers of 3D avatars, conversational characters, or other interfaces that represents a human-looking character. If a design factor, such as human photorealism, can impact how an ethical decision is made, then there needs to be a set of commonly accepted principles to avoid subconscious manipulation of humans by a given agent within an interface.

Doctors and judges are trained to make impartial decisions. However, the ability to have human behavior and judgment altered by seemingly unrelated or situational factors has many implications for how those professionals are trained. Our research proposes an exploration into these situational stimuli and its impacts on the ethical and moral constructs that drive behavior.

This study seeks to further define what effects are realized when presentational factors are manipulated. These presentational factors are examined on two dimensions: movement quality and human likeness. The character presents participants with a

quandary in the realm of medical ethics to which participants respond in the role of a consulting physician.

CHAPTER TWO: LITERATURE REVIEW

Moral philosophy and ethics have long been debated by scholars. Over the course of centuries, there have been thousands of writings about the nature of human thought and the various ethical codes to which those thoughts are modeled. Philosophers such as Kant or W. D. Ross subscribe to the deontological approach that posits the existence of a universal moral law or duty. Conversely, the consequentialist school of thought proposes that the morally right action is the one that produces the best outcome. Similarly, in the context of bioethics, there is a teleological school of thought that believes the ethics of a particular situation are derivative of its outcome.

These ideas have been further tested in experimental philosophy and social psychology and indicate a connection between emotions and morals (Prinz, 2006). For example, terror management theory has posited that our entire socially constructed reality and sense of identity can be threatened by those who believe differently than we do (Arndt, 1997; MacDorman, Vasudevan, & Ho, 2009). Furthermore, social science research has indicated that situational factors can have an overriding influence on ethical decisions (Doris, 2002).

Additional research has pointed to several instances where extraneous factors affect moral decisions. For example, one study indicated that an individual who had just found a coin in a phone booth is far more likely to help a stranger collect the pages of a dropped manuscript (Isen & Levin, 1972). In another case, coincidental factors such as the smiling of a bystander increased the probability of someone picking up floppy disks for a stranger (Gueguen & De Gail, 2003). The implication that situational factors could influence moral decisions raises concern for both the possibility of external manipulation

of situational factors and the effects of these factors on those trusted to make unbiased decisions on our behalf, such as medical professionals.

In technology, there has been much research on the perceived presence of human characters in an interface, but very little of that research has centered on the impact of the presentational qualities of the character on the moral agency of the viewer (Bailenson et al., 2005; Nowak & Biocca, 2003). Multiple studies have shown that humans are highly sensitive to realism in systems that are designed to exhibit humanness (Yee, 2007). Furthermore, various studies have explored how the qualities of characters that are nearly human invoke an effect known as the uncanny valley (MacDorman, Green, Ho, & Koch, 2009).

The uncanny valley was first proposed by Masahiro Mori who noted that the more humanlike a robot appears, the more subtle differences are perceived as creepy or eerie (Mori, 1970). Mori also proposed that movement would increase these effects. While his original observations were specific to robotics, uncanny valley effects have also been attributed to video games and movies. Movies such as *The Polar Express* and *Beowulf* have used computer generated on-screen characters. However, these films have fallen short of creating photorealism in their characters (Geller, 2008). In doing so, viewing these characters can create the sense of creepiness or eeriness that has commonly been associated with the uncanny valley.

Despite the risks associated with the uncanny valley, studies have shown that incorporating CG figures into interfaces can make them more engaging (Takeuchi & Naito, 1995). Additionally, interfaces that incorporate CG characters with high levels of realism such as humanlike characters or lifelike gesturing exhibit higher task

performance than interfaces that use characters with less realism (Dehn & van Mulken, 2000). These advantages, as well as the capabilities enabled by the use of CG characters in video games and movies, encourage the development of embodied agents as interfaces and systems seek to connect humans in new ways.

Another risk posed by characters that fall into the uncanny valley is the elicitation of a fear of death. In MacDorman and Ishiguro's 2006 study, an uncanny android robot invoked heightened mortality salience as measured by an increase in death-related word completions and a shift in attitudes against those who threaten one's cultural worldview (MacDorman & Ishiguro, 2006).

This phenomenon has been attributed to terror management theory, which has shown that subconscious attitudinal shifts can occur when we are reminded of our own mortality (Rosenblatt et al., 1989). These attitudinal shifts are related to emotions ranging from love to disgust (Mikulincer, Florian, & Hirschberger, 2003; Royzman & Sabini, 2001). The most notable shift is a heightened tendency to favor those who support our cultural worldview relative to those who do not. For example, if your worldview does not accept homosexuality, then terror management theory posits that you would have a subconscious bias against homosexuals. The relation between a presentational factor such as realism and a subconscious shift in attitude is the basis for this study.

The impact of varying levels of realism has been the focus of previous studies. Van Mulken (1999) investigated the trustworthiness of humanlike characters in an interface. Vertegaal (2002) published a study that explored the effects of gaze on users of an interface containing an embodied agent. Although Yee (2007) concluded in a meta-

analysis of over 100 studies containing embodied agents that people have more positive interactions with agents that have higher realism, this effect was only found when subjective measures were used versus behavioral measures, which showed little effect.

This reinforces the relation between a presentational factor such as realism and a subconscious behavioral response such as a judgment based on morals or ethics. Additionally, from the perspective of interpersonal relations, it has been shown that humans act and react differently when they are perceived to be interacting with another human versus a computer (MacDorman, Minato, et al., 2005; Shechtman & Horowitz, 2003). Thus, as the uncanny valley suggests, the closer to human an embodied agent is perceived, the more sensitive we are to discrepancies between what we see and what we expect to see. This violation of expectations leads us to examine the interaction with greater scrutiny than we would an interaction with another human.

Bonito (1999) explored the relation between expectations and human reactions in an interface, noting most specifically that interfaces needed to be designed with perceived expectations in mind. In other words, if an interface was designed with the intent of eliciting a specific response, then the type of agent presented by the interface needs to be considered. Text-based interfaces are well suited to certain tasks such as chatting or email, and users have an established expectation for how those interactions occur. With the increasingly social nature of human-computer interaction, embodied agents with higher levels of anthropomorphism are better suited to human roles like comforting or advice-giving (Forlizzi, 2007). This was demonstrated in another study that established a framework for eliciting empathy through the use of avatars (McQuiggan, Robison, Phillips, & Lester, 2008).

These phenomena have also been disputed by a few studies. One study noted no significant effects on credibility, social agency, or uncertainty based on varying levels of anthropomorphism (Nowak, 2004). Also, Hanson (2006) posited that the uncanny valley could be avoided through careful design. These studies further reinforce the notion that human responses can be engineered through a design process that applies principles derived from the results of psychological studies.

Psychology researchers have explored the impact of attractiveness on our abilities to perceive, interact with, and judge other humans. Zeller (1999) cites that female students were able to alter the reactions of male students based on how attractively they were presented. In a meta-analysis of previous studies, Jackson (1995) concluded that physical attractiveness effects on perceptions were higher in male respondents. Physical attractiveness also had an effect on males' tactics of mate retention in the context of marriage (Buss & Shackelford, 1997). Symons (1995) points out standards of female attractiveness across cultures are linked to indicators of youth, health, symmetrical features, and features correlated with fertility such as low waist-to-hip ratio, whereas male attractiveness was attributed to indicators of status and the ability to provide external resources (Buss, 1989; Trivers, 1972). As these studies have shown, males are much more susceptible to the visual stimulus of physical attractiveness than females.

Methods Used in Previous Studies

Most previous studies in this area have involved the creation and inclusion of embodied agents within the context of a computer interface, measuring their presence in various ways. Experimental manipulations of presence have varied from something as simple as the inclusion of a face to varying the levels of movement and contingency

within the interaction (Yee, 2007). In a previous study of medical ethics, an online system called *MedEthEx* was developed to enable various types of interactions with human characters to assist in the training of medical students (Fleetwood, 2000). This system uses text-only, audio-only, still photography, and video stimuli for the character interactions.

Research Hypotheses

Based on previous work that indicates situational factors can manipulate ethical responses in addition to studies that show the effectiveness of designing stimuli in technology to elicit specific responses, we propose the following hypotheses in reference to a medical scenario requiring an ethical decision:

H1: Participants who are presented with a computer generated conversational character will be more likely to decide against the interests of the character than participants who are presented with a real human.

H2: Participants who are presented with a conversational character that has jerky movements will be more likely to decide against the interests of the character than participants who are presented with a conversational character that has fluid movements.

H3: Participants who are presented with a computer generated conversational character will have terror management response as indicated by increased death-related word completion.

H4: Participants who are presented with a conversational character with jerky movements will have a terror management response as indicated by increased death-related word completion.

CHAPTER THREE: METHODOLOGY

Participants

The participants in this study were recruited by email. A recruitment message was sent to a random selection of 40,000 Indiana University undergraduate students. This message provided participants with information regarding the study, the amount of time needed to complete the survey and a link to begin the online survey. The contents of this recruitment email are available in Appendix A. One thousand eighty-seven participants responded and participated in the survey.

Of the 1,087 participants, 59% (n = 641) were female and 41% (n = 446) were male. This represents an accurate sample of the Indiana University undergraduate population with a 3.86% error range at a 99% confidence interval. Based on the recruitment method, 93.3% (n = 1015) listed their country of origin as the United States, and 91.2% (n = 992) of the participants were either part-time or full-time students. Also, because undergraduate students were recruited, 69.1% (n = 752) of respondents were aged 18 to 25 with the mode range of 18 to 20 (n = 439). Additional discussion of the demographic data is available in Appendix B.

Stimuli

Each participant was shown a conversational character that was placed in the role of presenting an ethical scenario. There were seven videos accompanied by seven multiple-choice responses that were designed to guide the participant through the interaction. In total, five separate types of stimuli were shown in the videos. Each figure was varied in its degree of human likeness (human versus computer generated) or motion quality

(smooth versus jerky). The same audio track and computer generated background were used for all five video conditions. The videos were designed for a standard 4:3 aspect ratio at a size of 480 pixels wide by 360 pixels tall. At this size, the video occupies about half of the screen width at a native screen resolution of 1024 pixels by 768 pixels. The conversational character named Kelly Gordon was represented in the following five ways:

Condition 1: A human character lip-synched to a human audio track against a slightly out-of-focus computer generated background.

Condition 2: A computer generated character lip-synched to the same human audio track against the computer generated background.

Condition 3: This condition uses the video from Condition 1, but eliminates five of every six video frames to simulate jerky movement, presenting each remaining frame for six times its original length.

Condition 4: This condition uses the video from Condition 2, but eliminates five of every six video frames to simulate jerky movement, presenting each remaining frame for six times its original length.

Condition 4 (alternate): A computer generated character similar to Condition 4. The natural movement of the character was less refined, using fewer key frames, and was prone to CG motion artifacts like unnatural twisting of arms and envelope violations like arms or elbows passing through the sides of the body.

Figure 1. CG Character and Human Character

Procedures

The recruitment email directed participants to a web site that hosted the study (http://research.joecoram.com). The opening page of the site disclosed the purpose and procedures for the study. Once participants agreed to the study information sheet, they were directed to a page that tested their browser capabilities and prompted them to adjust the volume level, ensuring that each stimulus could be viewed and heard comfortably and in its entirety. Once the participants' viewing capabilities were validated, they were allowed to enter the first screen of the web-based survey. This first screen introduced the medical scenario, defined the role of the participant in the interaction, and defined some of the ancillary terms used to understand the medical scenario. For the full introductory text and informed consent form, see Appendix C.

Participants were then presented with the first video in the set of stimuli. The video displayed the character initiating the interaction. After each video, users selected a response from a set of options designed to enable the user to flow through the interaction. The table below displays the seven steps of the scenario:

Table 1.

Stimuli Scenario Presentation

Video	Text of scenario	Possible responses
1	I have been feeling anxious, especially since my test results were reported to the Department of Health. They contacted me about my partners, so I just told them Paul's stationed overseas. And then I remembered Paul is coming in for a physical tomorrow. I'm trying to cope with so many things right now, and I really don't need one more. I just want to make sure that you won't tell Paul about my condition.	-Anyone would be upset in your situation. -I'm here to help you. -I'm sorry about your test results. -Let's work together to find what's best for you both
2	I appreciate your concern, but what I really need right now is for you to promise me not to tell Paul anything.	-Do you know how you contracted genital herpes? -Do you think you might have contracted genital herpes from your husband? -Are you involved in any high-risk activities? -Why are you concerned about Paul finding out?
3	I'm sure Paul's not the source. He has traditional views on marriage. Even when we were just going out, he wasn't the type to date other girls. Okay, I've had a fling or two, but they were just one-nighters, and I wouldn't know how to contact the guys.	-Do you and Paul still have sex? -Are you sexually active right now? -Are you putting Paul at risk? -What steps are you taking to protect Paul?
4	Paul and I are still having sex. But I'm not seeing anyone else right now. Paul knows I have an IUD. If I stopped having sex or asked him to wear a condom, he'd know something's up. He'd soon find out what. I'm sure he couldn't handle it. He'd explode. I'd lose my marriage, the house, everything.	-Paul could contract herpes. -You're placing Paul at risk. -Paul has the right to know. -You should tell Paul.
5	You're not in a position to judge me. You really don't know how unstable my situation is right now. I realize he may be at risk, but that's a chance I have to take. I'm just asking you to keep my condition confidential.	-Let's tell Paul together. -You should tell Paul. -I'm concerned about your well-being, but I'm also concerned about Paul's. -I respect confidentiality, but even confidentiality has limits.
6	Look, I just can't tell Paul right now, and neither can you. If I didn't think I could trust you, I wouldn't have come to you in the first place.	-When you think about this carefully, you'll realize you need to tell Paul. -Confidentiality should not be used to put others in harm's way. -I also have a duty to protect Paul. -Paul trusts me too.
7	Really? Then there's nothing left to discuss. Just give me a couple months to get my life sorted out and figure out how to tell him. In the meantime, I'm counting on you to keep quiet about this. *The patient walks out of the office.*	No response required

After viewing seven videos, participants were prompted to respond to the scenario by answering a series of three questions that were designed to allow users to determine the fate of the character:

Question 1: When you meet Paul Gordon tomorrow, will you inform him of his exposure to genital herpes?

Question 2: If Kelly were to walk back into your office, would you inform her of the decision?

Question 3: If Paul Gordon has genital herpes, will you inform him that Kelly Gordon is a possible source?

The first question may be considered the most important in terms of its ethical consequence. Each question was followed by an 11-point scale, ranging from 0% to 100%, that allowed participants to rate their confidence in the decision.

After participants decided the fate of the character, they moved to the second phase of the survey in which they were presented with a word completion exercise. This exercise showed users a picture of a word with one or more missing letters with a question mark below one of the blanks. The subsequent screen displayed letter possibilities for the missing character. Seven of the 20 words were in place to determine whether a subconscious terror management effect had been elicited. In MacDorman and Ishiguro's 2006 study, some of these words were used in a similar exercise to determine whether a terror management effect was elicited after participants were shown an uncanny android robot.

Since the character in the scenario was committing a moral transgression by

cheating on her husband, there needed to be a control in place for any preconditioned religious beliefs that could impact a participant's judgment of the character. A 9-point Likert scale was used to allow users to rate their agreement with 12 different religious statements (Altemeyer, 2004). Lastly, optional demographic data was collected which included a self-assessment of colorblindness and vision strength.

Data Analysis

Data was collected from the online survey to a MySQL database with the capability of exporting data to CSV format. This was imported to SPSS for analysis using various statistical methods including regression analysis and chi-squared. Of the 20 word completions, only the 7 terror management words were used in the final analysis. The religiosity scale was coded to a numeric range of −4 indicating very strongly disagree to 4 for very strongly agree. Judgment of the character was coded both for the binomial yes/no response as well as for consideration of the confidence level. Yes answers were assigned a 1 and no answers were assigned a −1. For analysis of the confidence level, percentages were converted to decimal numbers and multiplied by their positive or negative response (e.g. a "no" answer with 80% confidence would be −.8).

A 95% confidence interval was used for determination of two-tailed statistical significance in all reported data.

CHAPTER FOUR: RESULTS

The experiment was conducted in multiple phases of testing. The first phase consisted of the four variations on the stimuli: Human Smooth, Human Jerky, CG Smooth, and CG Jerky. The second phase involved only the draft quality version of the CG stimuli that was the least humanlike of all the conditions. This stimulus was CG and had jerky movement quality; however, it also contained artifacts such as unnatural movement and envelope violations (e.g., an arm passing through the body) that had been cleaned up as the CG stimuli was developed.

Table 2 displays the aggregate number of participants who viewed each stimulus across both rounds of testing.

Table 2.
Number of participants viewing each stimulus

		Human Likeness	
		Human	CG
Motion Quality	Jerky	173	189
	Smooth	166	154
	Draft	-	405

In analysis of the decisions made by participants, Question 1 was used as it demonstrates the first impression of the participant on the character, and therefore represents the most accurate judgment of the scenario, free from the bias of the following questions. A "No" response represents favoring the character.

H1 posited that participants would rule against a CG character more than a human character, while H2 made the same prediction based on whether the character had jerky motion quality. Table 3 shows the aggregate results from both rounds to demonstrate that based on the motion quality and human likeness of the character, there was no significance.

Table 3.
Favoring Character based on Motion Quality

		Question 1: Will you inform Paul Gordon of his exposure to genital herpes?	
		Yes	No
Motion Quality	Jerky	424	343
		55.30%	44.70%
	Smooth	189	131
		59.10%	40.90%
Human Likeness	Human	138	201
		59.30%	40.70%
	CG	336	412
		44.90%	55.10%

Note. $p = .252$ (Motion Quality); $p = .200$ (Human Likeness)

H3 and H4 proposed that the presentation of a CG character and a character with degraded motion quality, respectively, would relate to an increase in mortality salience as indicated by word completion responses. The CG treatment and degradation in motion quality did not result in a significant increase in mortality salience word completions. Table 4 displays the percentage of mortality salience word completions by participant gender as well as stimuli.

Table 4.
Mortality Salience Word Completion

		Mortality Salience Words	
		Death-Related	Eerie-Related
Participant Gender	Female	.16$^{\triangle}$	.43
	Male	.19	.41
Human Likeness	CG	.17	.42
	Human	.18	.42
Motion Quality	Jerky	.17	.42
	Smooth	.17	.44

Note. $^{\triangle}$ $p < .1$ * $p < .05$ ** $p < .01$ *** $p < .001$

Comparison of Responses by Gender

Despite the lack of statistical support for the research hypotheses, the results yielded a significant difference in how the gender of the participants affected their perception of the character ($p < .05$). The gender data isolates the change in decision between Question 1 and Question 3, as these indicate the participant's sympathy for the character in the scenario. The "No-Yes" responses were excluded because it would be incoherent and unrealistic to answer "No" to whether or not to inform Paul of his exposure, and "Yes" to informing him that Kelly was the likely source of his exposure. This exclusion eliminated 88 of the 1,087 responses in the data set, but it did not alter the statistical significance.

As seen in Table 5, male participants were significantly impacted by differences in presentational factors across all the stimuli ($\chi^2 = 25.522$, $p = .000$).

Table 5.
Decisions by Gender for All Stimuli

		Decision Change from No. 1 to 3		
		Yes-Yes	Yes-No	No-No
Participant Gender	Female	91	163	331
		15.6%	27.9%	56.6%
	Male	119	101	194
		28.7%	24.4%	46.9%

Note. $p = .000$

Additionally, males were most impacted when they were presented with the least humanlike stimuli, the CG Jerky condition. Table 6 displays the differences between gender groups for this condition ($\chi^2 = 32.192$, $p = .000$).

Table 6.
Decisions by Gender for CG Jerky Stimulus

		Decision Change from No. 1 to 3		
		Yes-Yes	Yes-No	No-No
Participant Gender	Female	47	92	183
		14.6%	28.6%	56.8%
	Male	78	55	89
		35.1%	24.8%	40.1%

Note. $p = .000$

As shown, in stimuli with less human photorealism like the CG character with jerky motion, male participants showed that they were much less likely to empathize with the character as shown in the increase in "Yes" responses from Question 1 to Question 3. While participants were divided on whether or not to tell Paul about his exposure to genital herpes, male participants were much more likely to tell Paul that Kelly was the source. However, this was only true for the CG Jerky stimuli.

The effect size for the CG Jerky condition was calculated using Cramer's V as a post-test to determine the relation between the decision change and stimulus. Using the

χ^2 value of 32.192 and the N value of 544, the calculated effect size was .24, which is considered small.

As a comparison, Table 7 displays the same analysis for the most realistic stimulus, the Human Smooth condition. As the statistical significance demonstrates, there were fewer differences between how male and female participants responded (χ^2 = 2.372, p = .305).

Table 7.
Decisions by Gender for Human Smooth Stimulus

		Decision Change from No. 1 to 3		
		Yes-Yes	Yes-No	No-No
Participant Gender	Female	13	22	51
		13.8%	25.6%	59.3%
	Male	17	15	36
		23.6%	22.1%	52.9%

Note. p = .305

Interestingly, the gender groups responded most similarly to the Human Jerky stimuli. There was not a clear progression between most human to least human in how males differed in their responses. The most humanlike condition, Human Smooth, showed more differences than Human Jerky (χ^2 = .781, p = .677), which is shown in Table 8.

Table 8.

Decisions by Gender for Human Jerky Stimulus

		Decision Change from No. 1 to 3		
		Yes-Yes	Yes-No	No-No
Participant Gender	Female	16	20	47
		19.3%	24.1%	56.6%
	Male	12	23	44
		15.2%	29.1%	55.7%

Note. $p = .677$

Figure 2 visualizes how the decisions made by male participants varied across the stimuli; whereas the variations in stimuli had little effect on female participants. Responses to the CG Jerky stimuli were the most variant, while differences among the other stimuli were not as substantial.

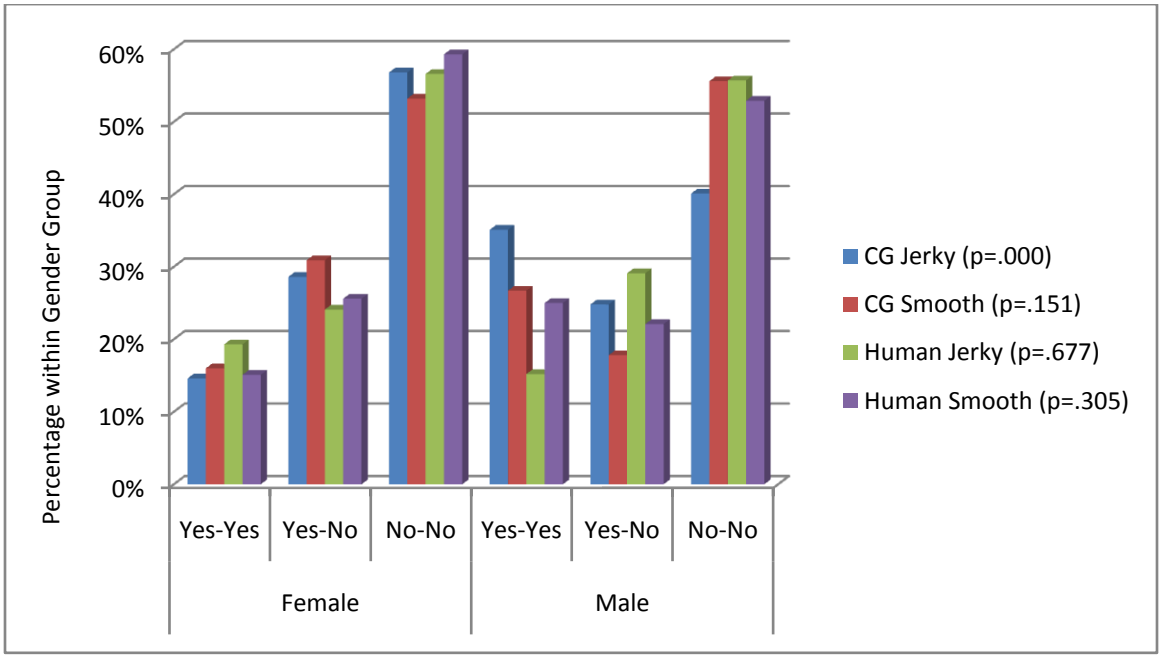

Figure 2. Decision Comparison between Question 1 and Question 3 by Gender

An ANOVA test was run within each of the answer groups to determine the statistical significance within the stimuli. This was to determine the level of variance across the stimuli. For example, males who exhibited the lowest level of sympathy towards the character as shown by answering "Yes" to both Questions 1 and 3, had the most significant difference across the stimuli ($p = .007$). Table 9 displays these differences to highlight how male participants vary greatly across stimuli groups compared to female participants.

Table 9

Within Group P-Values Across All Stimuli

		P-Values within Answer Groups		
		Yes-Yes	Yes-No	No-No
Participant Gender	Female	.772	.792	.872
	Male	.007	.527	.030

CHAPTER FIVE: DISCUSSION

Effects of Movement Quality

Overall, the quality of movement of the stimuli had little impact on how participants favored the character. Based on the idea that jerky movement in the CG context could evoke similar reactions to jerky movement in robotics, H1 predicted that the being presented with a CG-based conversational character would adversely impact the perception of the character. H2 predicted that further degradation of the stimuli through the alteration of motion quality would also have adverse effects on how the character was perceived in the context of the ethical scenario. On the surface, these factors alone did not produce a significant difference in how the character was perceived. Thus, H1 and H2 were not supported by the results.

H3 and H4 posited that a terror management response would be elicited based on the presentation of a CG character or a character with jerky motion quality. MacDorman and Ishiguro's 2006 study showed how an uncanny robot was able to elicit terror management responses from participants through their answers to a word completion exercise (MacDorman & Ishiguro, 2006). A similar word completion exercise was given to participants in this study; however the stimuli did not elicit a significant terror management response. Additionally, H3 and H4 were not supported by the results.

The results did uncover a significant (p = .000) difference in how males and females responded to the CG Jerky stimuli. The most drastic differences were evident in the decision changes across stimuli when the gender data were separated. Both male and female participants made similar decisions for the Human Smooth and Human Jerky

conditions. However, the CG Smooth data started to uncover differences in the decisions made for the character. This effect has been supported by research both in social science as well as computer science. Studies have shown that the color of a dress can enhance men's attraction to females (Elliot & Niesta, 2008). Furthermore, the mere presence of a robot in a social facilitation task has elicited varying levels of sympathy depending on the gender of the participant (Schermerhorn, Scheutz, & Crowell, 2008).

Question 1 asked participants if they would inform Paul of his exposure to genital herpes. A "No" answer to this question would indicate the participant's desire to both distance themselves from the situation and maintain status as an objective medical professional. The answer is also consistent with the wishes of the character, which has made her case for not telling Paul through the course of the interaction.

Question 2 asked if the doctor would inform Kelly of the decision made in Question 1. This question essentially asks if the doctor would disclose to the patient whether the doctor is going to comply with the patient's wishes; something that the doctor is not required to do.

Question 3 asked the participant whether he or she would inform Paul that Kelly was the likely source of his exposure to genital herpes. It was the comparison between Question 1 and Question 3 that displayed the greatest variation in responses between male and female participants across the stimuli, with CG Jerky having the largest difference.

In the CG Jerky condition, 28.7% of male participants ruled against the character in both Question 1 and Question 3, compared to just 15.6% of females. This indicates that males were so affected by the presentational quality of the character that they were

almost twice as likely to breach doctor-patient confidentiality to not only inform Paul that he has been exposed, but also inform him that Kelly is the likely source of that exposure.

Male participants' empathy for the character significantly increased with its human likeness. By answering "No" to both Question 1 and Question 3, participants are empathizing more with the character by agreeing to not tell Paul anything about Kelly or his possible exposure to genital herpes. Male participants empathized with the character over 50% of the time in both Human Smooth and Human Jerky conditions. However, in the CG Jerky condition, male participants favored the character only 37.6% of the time.

The difference was not as drastic for the CG Smooth condition; however, it is likely that exposure to computer animation, especially in forms of entertainment such as movies and cartoons, has lessened sensitivity to discrepancies in the reproduction of human movement and appearance. Particularly, in this study, the synching of lip movement to the audio was not entirely accurate. This did not have any apparent effect as this was the same for all of the conditions.

Implications of Results

There are intriguing design implications for how CG characters are included in interfaces considering the differences observed in this study. Males have a heightened sensitivity to presentational factors, whereas females seem to align more with the intangible aspects such as details of the story or situation. There was no evidence that female participants were affected by presentation and seemed to favor or disfavor the character for other reasons. While these reasons may have been similar for male

participants, it is apparent that the visual presentation of a situation does play a key role in how that situation is judged.

What cannot be ignored is the fact that despite being in the role of an impartial medical professional, female participants were faced with judging the actions of another female. This is naturally going to introduce some bias. The scenario is about sex, which has moral, religious, and cultural overtones that introduce a wealth of personal opinions and experiences that cannot be controlled for and can affect how a female perceives another female. For example, an unmarried female who is the child of divorced parents may judge the character more harshly than a married female who has faced some of the challenges of marital life. The lens through which the character is viewed is highly personal and highly contextual.

The same issue applies to male participants. While the experiment controlled for how religious the participants were, this excludes the substantial variances in personal experience as well as factors that were not considered, such as evolutionary biology. It is possible that male participants view a sexual scenario involving the opposite sex as a rejection of a potential mate. By framing the judgment in the context of a subconscious acceptance or rejection of a potential mate, then the male reaction would naturally be different from the female reaction.

While this does not explain the differences across the stimuli, it does lend to the conclusion that the male perception may be biased by human biology, regardless of presentation quality. Making an impartial decision that impacts the opposite sex is something that could be difficult for most males based on evolutionary biology. The

average male may view all females as possible mates and potentially misjudge them from a subconsciously clouded viewpoint.

Studies have shown that both men and women who are perceived as more attractive are treated differently (Jackson, 1995). If the character in this study was perceived as attractive or unattractive by a participant, this could have impacted how the character was treated. This assessment of perceived attraction is one that is often completed in a pre-cognitive split second, varying by gender, and independent of the subsequent conscious processing of such factors as context (Townshend, 1998).

CHAPTER SIX: CONCLUSION

Limitations

The experimental design and crafting of the ethical scenario were some of the strong points of this study's execution. The scenario was a true ethical dilemma that evenly split the judgments of the participants overall. This was important as it allowed us to focus on the intricacies of the stimuli as the primary factors that drove the differences observed. However, some minor components of the stimuli were limitations of the study.

The CG condition was not as lifelike as it could have been if it were designed professionally. Furthermore, the human condition introduced differences in presentation that could be exploited. For example, the CG character used in the CG condition was a female character whose short shirt displayed her midsection. It is possible that this style could be perceived negatively by some participants, causing them to judge her on that component of her appearance. The individual who was filmed for the human condition was wearing the same colored shirt, but the shirt did not show her midriff.

An additional limitation in the context of the stimuli was the positioning of the character in the scene. The CG character was turned slightly so that she was not directly facing the camera, while the human character was facing the camera directly. This introduced a difference in gaze. The human character's gaze was directed at the camera, and the CG character's gaze was slightly below and left of the camera. Gaze and its derivative lack of emotional expression have been observed as one of the deficiencies in modern virtual characters and could also have affected a participant's judgment of the character (Lance, 2008).

The human condition was filmed after the CG character was designed. If we were to repeat the study, we would likely set out to design the character based more on the filmed human. The CG character was also limited to a selection of stock characters. Additional funding and resources would have afforded the study the capacity to develop a character based on the human model.

Another weakness in the presentation of the stimuli was the syncing of the audio to the character. The audio was developed and altered separately from the CG character so pitch and expression could be manipulated. Subsequently, the human who was filmed needed to lip sync to the existing audio. Also, the CG character used a stock design tool to sync the audio to the character. These issues with syncing audio were minor presentational factors that were not controlled for in the study.

Finally, a remaining weakness of the stimuli was the alteration of the motion quality. In this study, frames were removed from the smooth motion stimulus to create a jerky stop motion effect. The effect created was less deliberate and could be attributed to inadequacies in the transmission media. For example, the stop motion effect could also be indicative of a slow connection or poor video compression. Also, it was more natural than some of the jerky movements exhibited by robots and androids. These have created terror management responses and assessments of eeriness or creepiness related to the uncanny valley (MacDorman & Ishiguro, 2006). Those effects were not observed in this study.

Future Research

These weaknesses provide ample opportunity for considerations of future work. The results of the study warrant further exploration. This exploration could focus on potential differences in gender perception. For example, the use of a male character in a similar scenario could be used to determine whether similar results were produced. In the context of the current character, Kelly Gordon, the experiment could involve her husband Paul more. Rather than simply mentioning him as part of Kelly's back story, Paul could be added to the scenario as either a character or some other visual representation like a photo or still image.

Adding more detail to the scenario such as the inclusion of Paul could draw the participant into the story, much like a good novel or movie. Doing this would elicit more emotion such as empathy from the participant. There has been previous work in the area of how emotions impact moral decisions, but little has been done in the area of HCI to see how a computer-based stimulus could be manipulated to alter those emotions (Prinz, 2006). Could presentational factors like those presented in this study elicit different emotions in each gender?

Other presentational factors could also be explored based on gender. Perhaps the stimuli could be wearing a blue shirt for female participants and a red shirt for male participants. This study was able to isolate human likeness as a factor in how an ethical scenario is judged. Human likeness was measured on a very rigid binary selection. The character was either human or CG and smooth or jerky. However, future work could try to isolate other attributes that may contribute to or detract from how the character is perceived, especially along gender lines.

These could include multiple degrees of human likeness to explore the possibility of a threshold for perceived acceptability as human. Additional information could be gathered from participants that shed more light on their computer gaming experience, or their perception of realism across multiple samples of CG characters. Likewise, a rating of attractiveness of the character used in the scenario would allow for greater control and accuracy in narrowing the scope of observable differences by gender groups.

Future work could build on the results of this study by eliminating some of the limitations. A different ethical scenario, voice, human or CG character could be used to recreate the difference between genders identified in this study. Those differences would also add to the collective understanding of what affects human perception in the HCI context.

Summary

Overall, this study discovered that some of the perceptual differences that exist in human-human interaction are also evident in human-computer interaction. The fact that males and females react differently to minor adjustments in visual presentation speaks to greater HCI design implications, especially with moral or ethical situations of consequence. These HCI design implications could impact future systems created to facilitate interactions within these situations (Fleetwood, 2000). For example, systems designed to facilitate doctor-patient consultation, or allow judges to consult attorneys or litigants before a ruling, could have substantial effects on human lives if small presentational factors are not considered. These people are tasked with making objective

moral and ethical decisions based on their knowledge and interpretation of very domain-specific concepts and principles.

In many cases, those interpretations are based on context. For example, the interpretation of a law may determine the sentencing in a case, or the interpretation of past illnesses may determine the treatment of a current condition. If extraneous presentational factors prove capable of subconscious influence, careful consideration of character presentation should be a key component of a system's design. In light of this, a deeper understanding of the relation between humans and their virtual counterparts should be relevant long before systems like these become reality.

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APPENDICES

Appendix A – Recruitment Email Sent to Potential Participants

Dear [participant]:

Have you ever been invited to participate in a study that let you make life changing decisions about another person? From the comfort of your home, you get to be doctor in this Internet-based video interaction with a pretend patient. It's all about handling the kinds of sex-related ethical dilemmas doctors face every day.

http://research.joecoram.com/ <- start here

This presentation is followed by a word completion exercise and a brief survey of religious beliefs. The exercise should take about 10 minutes, and you are free to start now.

Please excuse this intrusion into your e-mail inbox. This study's purpose is to determine the effects of confronting ethical dilemmas in an electronic context. Your e-mail address was selected randomly from a provided list of Indiana University undergraduates. The IUPUI/Clarian Research Compliance Administration has approved this project (No. EX0805-32B). The results will be used for research purposes only, and no personally identifiable information will be gathered.

If you have questions about the study, please write me at jacoram@iupui.edu.

Thank you,

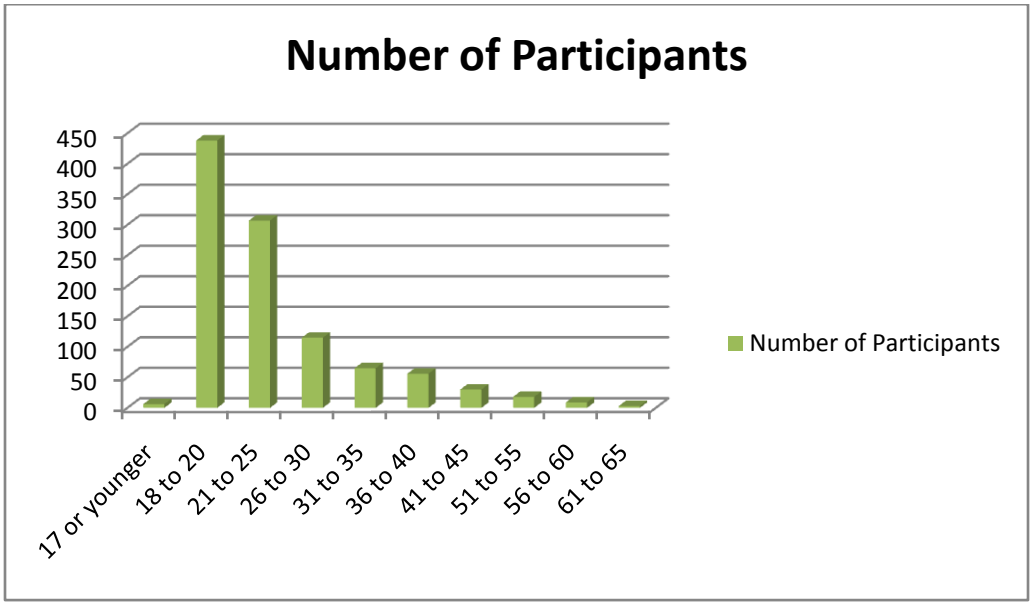
Joe Coram

IU School of Informatics at IUPUI

Appendix B – Demographic Data

There were 1087 responses to the online survey. Participants were asked but not required to disclose their age, sex, level of education, nationality at birth, and ethnicity. All 1087 respondents provided demographic data. Of the 1087 respondents, 641 (58.9%) were female and 446 (41.1%) were male. Age ranges were defined and users selected their age from a pre-specified range. That data is provided in the figure below:

Figure: Number of Participants per Age Group

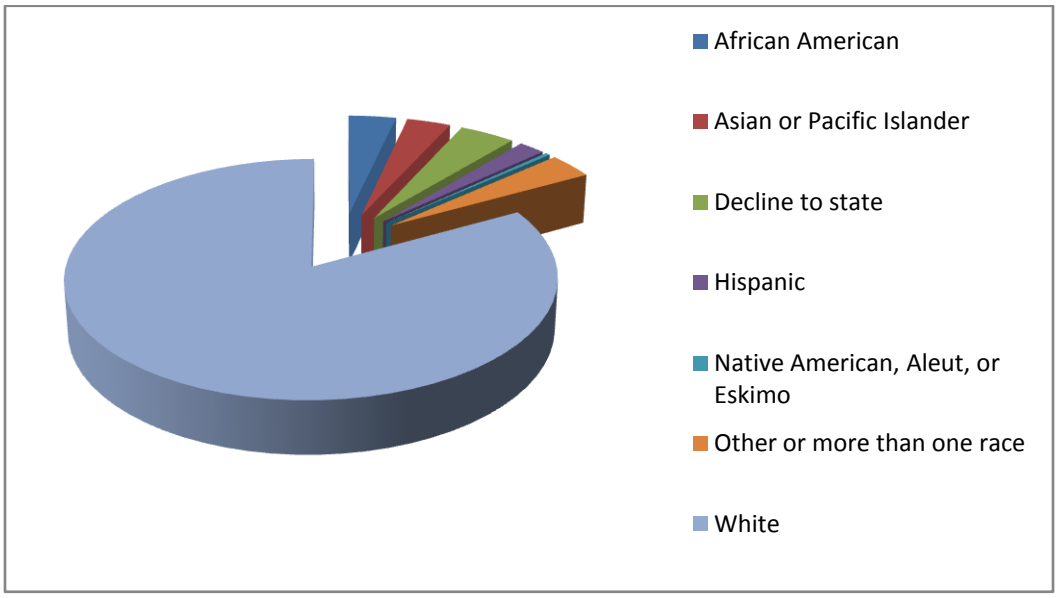


As shown, the number of participants is heavily skewed toward the average undergraduate age group, which was the primary target of the recruitment email. 866 (79.8%) of participants were below the age of 30. Employment status was evenly split between full-time (309, 28.4%), part-time (401, 36.9%), and unemployed (377, 34.7%).

Participants were largely born in the United States with 1,012 (93.1%) participants listing the United States as their nationality at birth. Additionally, 902

(83%) of participants reported their ethnicity as White. This breakdown is illustrated in the figure below:

Figure: Self-reported Ethnicity of Participants



Appendix C – Informed Consent

Participants in this study were asked to consent to the following:

I am at least 18 years old; I understand and agree to the following conditions; my questions have been answered satisfactorily; and I have printed a copy of this study information sheet for my records.

The IUPUI/Clarian Research Compliance Administration has approved the following study: "The Impact of Human Likeness on Ethical Decision-Making in Online Interactions" (No. EX0805-32B)

Approval date: May 28, 2008

Expiry date: May 27, 2009

1. *Purpose:* The purpose of this study is to determine the effects of confronting ethical dilemmas in an electronic context.
2. *Benefits:* The data gathered may contribute to an understanding of how medical ethics are or can be communicated electronically.
3. *Procedure:* You will take the role of doctor in an office consultation with a patient. You will reply to the patient by selecting an appropriate response from a list. The situation will present an ethical dilemma. After the consultation, you will make a decision on the dilemma. Finally, there is a word completion task and survey on your religious beliefs.
4. *Time required:* About 15 minutes
5. *Participation:* Participation is voluntary. You may refuse to participate at any time. No disadvantage will arise from refusing. Incomplete results are retained.

6. *Age restriction:* You must be at least 18 years old to participate.
7. *Compensation:* You will not be paid for participating.
8. *Confidentiality:* Your personal information will not be identified or shared or used for another purpose. Reported results will not contain information that may be used to identify you.
9. *Risks:* While we do not anticipate any risks from participating, you must stop participating and notify the principal investigator if at any time you feel your mental or physical well-being, personal values, or dignity is being harmed.
10. *Dissemination of results:* Results may be reported in talks, documents, and publications of the principal investigator, experimenter, and their co-authors.
11. *Questions:* If you have any questions or concerns about the study, feel free to contact the principal investigator, Prof. Karl F. MacDorman. If you have any questions about your rights as a research participant, or unresolved problems, complaints, or concerns about a study, contact the IUPUI/Clarian Research Compliance Administration. Contact details are provided on the contact webpage.

Appendix D – Introductory and Background Text for Participants

Instructions

You will take the role of a doctor in an office consultation with a patient. The situation presents you with a dilemma that requires you to weigh competing ethical principles. In giving your answers, ignore laws, regulations, and legal precedents, which vary by jurisdiction, and are often conflicting or ambiguous on this dilemma.

After the patient leaves your office, you will be asked to make one or more decisions about this dilemma. Make your decisions solely according to what you feel is proper. There is no "wrong" or "right" answer.

Medical Information

Most people who have genital herpes do not know it, because the symptoms go unnoticed or are mistaken for something else. The risk of transmission is highest during outbreaks. Once transmitted, incubation requires from 2 to 10 days. While a herpes vaccine is under development, it has shown no effectiveness in men.

An intrauterine device (IUD) is a small part, made of plastic or copper, that is inserted into the uterus to prevent pregnancy.

Scenario

You're a family doctor who has been treating Kelly Gordon, 27, since her marriage to your patient Paul Gordon, 33, five years ago. Last week you visually diagnosed Kelly with genital herpes and provide her with educational material and counseling. She phoned in for her lab results, which came out positive for genital herpes. You are scheduled to examine Paul tomorrow for his annual physical, and Kelly asked to be squeezed in for an appointment before Paul's visit.

Click next to begin consultation

VITA

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