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Sending an Avatar to Do a Human's Job: Compliance with Authority Persists Despite the Uncanny Valley

Abstract

Just as physical appearance affects social influence in human communication, it may also affect the processing of advice conveyed through avatars, computer-animated characters, and other human-like interfaces. Although the most persuasive computer interfaces are often the most human-like, they have been predicted to incur the greatest risk of falling into the uncanny valley, the loss of empathy attributed to characters that appear eerily human. Previous studies compared interfaces on the left side of the uncanny valley, namely, those with low human likeness. To examine interfaces with higher human realism, a between-groups factorial experiment was conducted through the internet with 426 midwestern U.S. undergraduates. This experiment presented a hypothetical ethical dilemma followed by the advice of an authority figure. The authority was manipulated in three ways: depiction (digitally recorded or computer animated), motion quality (smooth or jerky), and advice (disclose or refrain from disclosing sensitive information). Of these, only the advice changed opinion about the ethical dilemma, even though the animated depiction was significantly eerier than the human depiction. These results indicate that compliance with an authority persists even when using an uncannily realistic computer-animated double.

1 Introduction

Both human–computer and human–human interaction can be mediated by human-like computer interfaces, including avatars (virtual representations of humans) and embodied conversational agents (Ahn, Fox, & Bailenson, 2012; Bailenson & Blascovich, 2004; Cassell, Sullivan, Prevost, & Churchill, 2000). Besides enabling communication with computers and people, human-like interfaces can also influence our social behavior (Beck, 2012; Yee, Bailenson, Urbanek, Chang, & Merget, 2007). The degree to which human-like interfaces influence behavior may depend on presentational factors like appearance (Baylor, 2009), and the most realistic human representations may be the most persuasive (Bailenson & Yee, 2005; Blascovich et al., 2002).

Human-like interfaces influence human behavior in economics (Bélisle & Bodur, 2010; Keeling, McGoldrick, & Beatty, 2010; Oullier & Basso, 2010;

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Wood, Solomon, & Englis, 2005), the military (Wark & Lambert, 2007), and healthcare (Bickmore, Gruber, & Picard, 2005), among other fields. In all these examples, presentational factors supporting the credibility of a human source likewise support the credibility of a computer-animated double. Human-like interfaces help or replace humans in interventions for conditions such as social anxiety and autism spectrum disorder (Kandalaft, Didehbani, Krawczyk, Allen, & Chapman, 2013; Kang & Gratch, 2010). The efficacy of these virtual interventions relies on the extent to which the human-like representations persuade users to behave in ways deemed socially desirable by their designers. Given that the enterprise of modifying social behavior has already been challenged on ethical grounds (e.g., for those diagnosed with autism or Asperger's syndrome, Ortega, 2009), virtual interventions introduce additional ethical issues.

Persuasive communication involving realistic human-like interfaces may be affected in unknown ways by the underlying technology (Patel et al., 2014). This presents two ethical concerns: First, manipulating presentational factors to mislead audiences may be unethical, especially should it cause them to act against their own interests (MacDorman, Coram, Ho, & Patel, 2010). Second, ignoring the effects of presentational factors may be unethical if it renews stereotypes or promotes one group's values over the values of other groups (Brey, 1999; Pace, Houssian, & McArthur, 2009). The potential for misuse increases with the ease of creating realistic animations and distributing them widely. Consequently, the purpose of this research is to identify the mechanisms affecting the processing of persuasive messages from realistic virtual humans.

Previous experimentally controlled comparisons tend to use interfaces that are less human-like, such as text-based conversation partners and stylized or cartoonish human characters (e.g., Galanxhi & Nah, 2007; Holzwarth, Janiszewski, & Neumann, 2006; Khan & Sutcliffe, 2014). Results of these comparisons show both the benefits and drawbacks of realism. For example, although nonmoving characters that appear human are perceived as more credible than those that appear abstract, abstract avatars elicit greater self-disclosure than

their human controllers (Bailenson, Yee, Merget, & Schroeder, 2006; Nowak & Rauh, 2008). Computer characters can be more persuasive than a real person while being perceived as less credible (Burgoon et al., 2000). Abstract-looking characters can be perceived as more credible and more socially attractive than somewhat human-looking characters (Nowak, 2004). Comparisons using realistic human characters are rarer and typically had either conflicting results or methodological limitations: conflicts between subjective and objective measures (Raij et al., 2007), uncontrolled visual differences between the human and the virtual double (Kang & Watt, 2013; MacDorman et al., 2010), a focus on real-time interactivity instead of photorealism (Kang & Gratch, 2010), or the exclusion from comparison of a human reference (McDonnell, Breidt, & Bülthoff, 2012). To address limitations in previous research, this study directly compared a human character with a photorealistic double.

Higher levels of human realism usually require more complex three-dimensional computer models and greater texture detail (Cheetham, Suter, & Jancke, 2014; MacDorman, Green, Ho, & Koch, 2009). However, when the human-like interface is delivered through a computer network, network bandwidth serves as a practical constraint for both model complexity and texture detail. Problems with delivery as well as with modeling, texturing, lighting, and animation can cause a mismatch in the level of realism among a character's different features and movements. A character that looks human but violates our expectations of how a real person should look or behave is predicted to cause aversion identified with the uncanny valley (MacDorman & Ishiguro, 2006). The resulting violations of the observers' expectations may render the character eerie or less liked (Hodgins, Jörg, O'Sullivan, Park, & Mahler, 2010; MacDorman, Green, et al., 2009; Mitchell, Szerszen, et al., 2011). Mori (1970/2012), who proposed the concept, compares the character with a corpse or the undead. Further complicating matters, the effects of these presentational factors is mediated by whether observers believe the character is acting autonomously or is controlled by a person (Guadagno, Swinth, & Blascovich, 2011; MacDorman et al., 2005). In the latter case,

it is unknown whether a realistic representation of an identifiable person would be more or less persuasive than the actual person.

Another presentational factor with potential effects on persuasive communication is the quality of the character's motion (Ehrlich, Schiano, & Sheridan, 2000; Weyers, Mühlberger, Hefele, & Pauli, 2006). Like the level of detail, motion quality is limited by the reliability of the network. Delays can cause jerky motion in facial expressions and other gestures. Although jerky motion attracts attention, its effect on behavior is mediated by the observer's traits (MacDorman et al., 2010; MacDorman & Entezari, 2015; Patel et al., 2014).

In this paper, two competing mechanisms are proposed to explain differences in persuasiveness between a virtual human and a recording of the real human on which it is modeled. These mechanisms are derived from theories of the uncanny valley: One mechanism predicts that the uncanny valley decreases persuasiveness (e.g., through outgroup derogation, MacDorman, Coram, et al., 2010; MacDorman, Green, et al., 2009; MacDorman & Ishiguro, 2006; Mitchell, Ho, et al., 2011), and the other mechanism predicts that it increases persuasiveness (e.g., through increased message-relevant attention, Cheetham et al., 2014; Moore, 2012; Patel et al., 2014). The corresponding predictions were tested in the experiment presented here. Its results indicate that, although a computer-animated representation seems eerier and less human than a video recording, computer animation does not decrease the representation's persuasiveness—at least when the representation is presented as an authority. Compliance, which was operationalized as stated agreement, was high for both the recorded and the animated representations.

Besides addressing a knowledge gap in computer-mediated communication, the experiment's results raise ethical concerns about identity misuse and social influence in virtual environments. A person's virtual double, created regardless of the source's knowledge or consent, could be used to manipulate the behavior of others with the same effectiveness as the original. These results are interpreted further in the Discussion and Conclusion

sections, and subsequent research and applications are suggested.

2 Background

Both physical and virtual representations of humans vary on three main dimensions of realism: behavior, form, and interactivity (Bailenson et al., 2006). Within this three-dimensional space, an example of a virtual representation with high behavioral realism, high form realism, and no interactivity is a recorded video of human actors. Such a recording can serve as a direct reference for a second kind of virtual representation: a computer animation. Because these two representations resemble television programming, the most relevant literature involves persuasion in advertising and other forms of mass communication. Common factors in this domain are the *source, message, channel, receiver*, and *destination* (McGuire, 2001).

This study focuses on the first factor, the source. Traditionally, sources are perceived on three main traits: power, credibility, and attractiveness (McGuire, 2001). We accentuate these three traits to make a recording and a matching animation persuasive. Applying the threshold model of social influence in virtual environments, both a recorded person and matching animation are assumed to exert at least some social influence (Blascovich et al., 2002). Persuasiveness is increased by making expertise salient (Wilson & Sherrell, 1993) and through appropriate attire (Bassett, Staton-Spicer, & Whitehead, 1979; Shao, Baker, & Wagner, 2004).

A source's persuasiveness can be increased indirectly by manipulating the message (Pornpitakpan, 2004). For an already credible source like the one devised for this study, two key manipulations are early self-identification and the presentation of strong arguments (Bohner, Ruder, & Erb, 2002; Homer & Kahle, 1990; Mills & Harvey, 1972). In this study, through these manipulations of both the source and message, the recording of a person and that person's computer-animated double are assumed to be persuasive. Differences in persuasiveness between these two human representations, then, may depend on how receivers interpret differences in visual depiction.

2.1 Responses to Uncanny Representations

Research on the uncanny valley has covered variations on the same basic claim: Nonhuman features in more realistic human characters are disproportionately unsettling as compared with less realistic characters (MacDorman, Green, et al., 2009; Mitchell, Szerszen, et al., 2011; Mori, 1970/2012; Seyama & Nagayama, 2007). Characters in the uncanny valley most commonly elicit fear, anxiety, shock, and disgust (Ho, MacDorman, & Pramono, 2008). The cause of the uncanny valley is largely unknown, and its status as a distinct phenomenon has been disputed (Bartneck, Kanda, Ishiguro, & Hagita, 2007; Burleigh, Schoenherr, & Lacroix, 2013; Cheetham, Suter, & Jancke, 2014; Tinwell, Grimshaw, & Williams, 2011). Moreover, a consensus has not been reached on what causes the associated negative feelings. Some explanations of uncanny valley responses are grounded more in perception, whereas other explanations are grounded more in cognition (MacDorman, Green, et al., 2009). Two perceptual explanations for the uncanny valley are self-preservation and tension arising from features belonging to different kinds of entities (MacDorman, Green, et al., 2009; Moore, 2012); two cognitive explanations are uncanny characters serving as reminders of personal mortality and as a source of cognitive dissonance (MacDorman & Entezari, 2015; MacDorman & Ishiguro, 2006; MacDorman, Vasudevan, & Ho, 2009; Tondu & Bardou, 2011). Applying these explanations to realistic computer-mediated human representations produces two seemingly opposing interpretations.

One interpretation is that, owing to the visual and interpersonal nature of the medium, flaws in these representations are expected to affect perceptions of the message source (Chaiken & Eagly, 1983; Pfau, 1990; Reeves & Nass, 1996; Reeves & Voelker, 1993; Sundar & Nass, 2000). Uncanny characters are less identifiably human, less attractive, and less relatable (Ho & Mac-Dorman, 2010; MacDorman, Green, et al., 2009). Generally, unattractive and unrelatable sources are less persuasive (Chaiken, 1979; MacKie, Gastardo-Conaco, & Skelly, 1992; McGarty, Haslam, Hutchinson, &

Turner, 1994). If an uncanny representation resembles a conspecific with a contagious illness, likely responses include fear and disgust to motivate avoidance of a potential source of pathogens (Curtis, Aunger, & Rabie, 2004; Fessler & Navarrete, 2005; Ho et al., 2008; MacDorman, Green, et al., 2009; MacDorman & Ishiguro, 2006; Moosa & Ud-Dean, 2010). Aversive responses are measured indirectly through self-reported increases in eeriness and decreases in warmth, and they are stronger in people with high sensitivity to disgusting stimuli (MacDorman & Entezari, 2015).

Another mechanism by which uncanny representations may cause aversion is as reminders of death's inevitability (MacDorman & Ishiguro, 2006). Even when presented indirectly or subliminally, such reminders evoke negative evaluation and treatment of outgroups (Arndt, Greenberg, Pyszczynski, & Solomon, 1997; Arndt, Vess, Cox, Goldenberg, & Lagle, 2009; Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989). Susceptibility to these effects may be increased by disgust sensitivity and existential anxiety (Goldenberg et al., 2001).

An alternative interpretation predicts a positive effect of uncanny responses on message processing. Uncanny representations may fail to fit into people's existing conceptual order (Douglas, 1966; MacDorman & Entezari, 2015; MacDorman, Vasudevan, et al., 2009). However, the uncertainty created by such incoherent representations could increase overall motivation to seek new information, even when it contradicts current attitudes (Hernandez & Preston, 2013; Maheswaran & Chaiken, 1991). For a credible-looking source delivering a credible message, this leads to a counterintuitive proposal: Uncanny appearance may increase compliance. A preliminary test of this claim using recorded videos of a human actor indicated that jerky motion in fact increased agreement with a recommendation—and without hindering source credibility (Patel et al., 2014). Based on these competing proposals, the following hypotheses represent predictions about the perception of the speaker (Hypotheses 1–3) and the result of the persuasive appeal (Hypotheses 4–6).

2.2 Competing Effects on Source Assessment

Hypothesis 1 addresses the direct effect of depiction on credibility:

H1. By decreasing similarity to the message recipient, a message source appears less credible as a computer animation than as a video recording.

Hypothesis 2 addresses the direct effect of motion quality on credibility:

H2. By decreasing similarity to the message recipient, a message source appears less credible when moving jerkily than when moving naturally.

Hypothesis 3 addresses the effect of eeriness on credibility, where eeriness results from pairing a human-like character with nonhuman motion. Following dual-process models of attitude formation, eeriness could increase the motivation to process persuasive messages (Chaiken, 1980; Maheswaran & Chaiken, 1991; Petty & Cacioppo, 1986). This interpretation sets up Hypothesis 3A.

H3A: Given credible arguments, a source with a human-like appearance is more credible when it is moving jerkily and less credible when it is moving fluidly.

However, through ingroup preference or disgust-related aversion, eeriness could inhibit persuasion and compliance. This alternative explanation based on self-preservation sets up Hypothesis 3B.

H3B: Given credible arguments, a source with a human-like appearance is less credible when it is moving jerkily and more credible when it is moving fluidly.

2.3 Influence of Uncanny Message Sources on Compliance

Given possible changes to source credibility, what is the impact on the source's persuasiveness? Aligning with H1 and H2 are Hypotheses 4 and 5 (H4 and H5):

H4. By decreasing similarity to the message recipient, a message source is less persuasive when computer animated than when videotaped.

H5. By decreasing similarity to the message recipient, a message source is less persuasive when moving jerkily than when moving fluidly.

If jerky motion in a computer-animated character increases elaboration, persuasive arguments may be processed more centrally. However, if the same jerky motion elicits repulsion, the computer-animated source may be less persuasive. Hypotheses 6A and 6B follow, respectively, from H3A and H3B:

H6A. A computer-animated human message source is more persuasive when moving jerkily than when moving fluidly.

H6B. A computer-animated human message source is less persuasive when moving jerkily than when moving fluidly.

3 Method

Ethical dilemmas, which present a problem with a pair of mutually exclusive decisions, stimulate critical thinking. Spurring deep consideration of a decision's consequences makes ethical dilemmas ideal for training professionals. For example, MedEthEx, a computer-based learning tool, uses cases in medical ethics to assess the critical thinking and communication skills of physicians (Fleetwood et al., 2000). Dilemmas also uncover everyday intuitions about ethical behavior, a focus of experimental philosophy.

In a given dilemma, details can shift the majority response. For example, the mere inclusion of computer-animated humans increases the proportion of consequentialist (vs. deontological) decisions (Patil, Cogoni, Zangrando, Chittaro, & Silani, 2014). A persuasive speaker can sweeten one of the choices in a dilemma, even when both arise from accepted principles.

This study adapted a previously tested hypothetical dilemma in medical ethics (MacDorman et al., 2010; Patel et al., 2014). In this dilemma, a patient reveals some information about her sexual history that could harm her

marriage and finances. Through a turn-based conversation, the patient asks her physician, played by the study participant, to withhold this information from her husband. However, the husband is also one of the physician's patients, and his health may be harmed by the withheld information. The husband has a scheduled routine examination with the physician the next day. Before this examination occurs, the physician must make several interrelated decisions about the dilemma.

3.1 Participant Characteristics and Sampling

The study's participants were current undergraduate students, age 18 or older, from the campuses of a public university system in the midwestern United States. The sample was drawn randomly from a list of students' university-sponsored email addresses. Recruitment used electronic mail containing a hyperlink to the experiment's website. The recruitment message indicated that the study was about making judgments in social situations. Participation was unpaid and voluntary, and it took place at a time and location chosen by each participant. For this experiment 45,000 undergraduate students were invited with a response rate of 0.94%. Recruitment ended after all treatment groups had at least 20 completed sessions (Simmons, Nelson, & Simonsohn, 2011).

3.2 Research Design

The study used a factorial between-groups experimental design. Eight treatment groups were created from three 2-level factors (see Experimental Manipulation).[1] Each participant was assigned randomly to one of the treatment groups by the website.

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1. Additional groups were used to check for the effects of pretest sensitization: The first group was the traditional pretest–treatment–posttest group; the second group had no pretest measurement; the third group had no treatment; and the fourth group had neither a pretest measurement nor a treatment (Solomon, 1949). Pretest × Treatment had no significant effect on Disclosure.

3.3 Procedure

In making a decision about the ethical dilemma, the participant was asked to use personal judgment instead of knowledge of the law. The participant took the role of a family physician treating a young married couple, Paul and Kelly Gordon. The experiment began with a telephone conversation with Kelly. The conversation went through seven exchanges. In each exchange the participant selected one of four responses to continue the call. Kelly's statements were phrased so as to follow logically from any of the preceding responses. During the call, Kelly admitted to contracting genital herpes from an extramarital affair. Kelly asked the participant as physician to withhold this information from Paul so that she can tell him herself. This request exposes a dilemma between two principles of medicine: doctor–patient confidentiality and avoidance of harm.

After the conversation with Kelly, participants made decisions related to Kelly's request (see Decisions about the Case). These decisions comprised the pretest measurements. Next, a one-minute video was presented in which Dr. Richard Clark, an expert in medical ethics from a nearby university, gave a monologue on the case.[2] The monologue was delivered in an emphatic yet professionally restrained tone. After Dr. Clark's advice, participants assessed Dr. Clark on several personality traits (see Attitudes about the Speaker). The experiment concluded with measurements of predicted covariates (see Mediating Processes and Individual Differences). Among the covariates, participants were asked to make their decisions about the case again. These comprised the posttest measurements.

3.4 Experimental Manipulation

Dr. Clark's monologue varied on three independent factors: depiction, motion quality, and advice. First, Dr. Clark was depicted either as a person, using a digitally recorded video of an actor, or as an avatar, using a computer model of the same actor (see Figure 1). The model was constructed and animated by hand using

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2. Although a real university was named, both the adviser's name and departmental affiliation were fictional.

Figure 1. *Two depictions are shown of a fictional expert to test the effect of representation on decisions about a hypothetical dilemma. Photographs and video recordings of an actor in an office (a) were modeled and animated to produce a virtual counterpart (b). The goal was to limit uncontrolled effects on credibility by aligning the two depictions on overall appearance and nonverbal behavior.*

Autodesk Maya with the recording as a reference and without the use of markers or automated tracking tools. Care was taken to match clothing, camera angle, and degree of eye contact, all of which influence credibility (Chen, Minson, Schöne, & Heinrichs, 2013; McCain, Chilberg, & Wakshlag, 1977; O'Neal & Lapitsky, 1991). In both depictions Dr. Clark wore eyeglasses and a dark business suit with a dark red tie. The actor was recorded in an office building while looking slightly downward at the camera.

Second, motion quality was manipulated by adding jerky movement using a temporal blur effect, which blends one or more preceding frames with the current one. The effect was applied to single frames separated by intervals varying between 0.33 s and 3 s. (To avoid misinterpretation of Dr. Clark's message, the audio was not manipulated.) Using Adobe After Effects, the temporal blur was applied in the same frames across all four videos. Third, Dr. Clark gave one of two possible recommendations about the case: a *go* condition advocating disclosure to the husband (i.e., rejection of the wife's request) and a *no-go* condition advocating remaining quiet (i.e., acceptance of the wife's request). Although not related to a research hypothesis, the advice manipulation was included to permit measuring acquiescence bias and regression to the mean. The go advice was reused from a previous study (Patel et al., 2014). Both the go advice and no-go advice are reproduced in Appendix A.

3.5 Dependent Variables and Covariates

Each answer was indicated by placing a mark on a visual analogue scale (i.e., a slider control with opposing anchors and no preset value). This representation permits an arbitrary level of precision, which offers stronger support for the assumption of interval-level measurement (Funke & Reips, 2012; Reips & Funke, 2008). In this study the number of points was set to 256.

3.5.1 Attitudes about the Speaker.
Participants responded to six measures about Dr. Clark, rating his appearance on three scales and rating his credibility on another three scales. Assessments of appearance were attractiveness, eeriness, and humanness, and assessments of credibility were trustworthiness, competence, and goodwill (Ho & MacDorman, 2010; McCroskey & Teven, 1999).

3.5.2 Mediating Processes and Individual Differences.
Seven measures were presented as distractors and as measurements of potentially relevant individual differences. The first set of covariate measurements followed Dr. Clark's advice and preceded the posttest items:

- A manipulation check for participants in the experimental groups: How did Dr. Clark look? (Perceived

Form Humanness: completely nonhuman to completely human); How did Dr. Clark move? (Perceived Motion Smoothness: jerkily to smoothly); How did Dr. Clark's voice sound? (Perceived Voice Humanness: completely nonhuman to completely human; this item was included to obscure the theme of the experimental manipulations)

- An 18-item assessment of an individual's need for cognition (Cacioppo, Petty, & Feng Kao, 1984). An example is "I would prefer complex to simple problems." If someone's need for cognition is high, his or her decision about the case may depend more on the message's arguments than on the speaker's uncanniness (Petty, Cacioppo, & Schumann, 1983).

- A 25-item assessment of an individual's sensitivity to sources of disgust (Haidt, McCauley, & Rozin, 1994; Olatunji et al., 2007). An example is "It would bother me tremendously to touch a dead body." High sensitivity to disgust may predict high sensitivity to the speaker's uncanniness.

- A 13-item assessment of an individual's level of existential anxiety (Weems, Costa, Dehon, & Berman, 2004). An example is "I often think about death, and this causes me anxiety." Those with high anxiety are especially sensitive to the induction of negative moods (Larsen & Ketelaar, 1991).

The following measurements were presented after the posttest questions:

- A 5-item multiple-choice test measuring the retention of details about the scenario and message, which was assumed to indicate the relative priority of central decision-making processes (Appendix B). The items test retention objectively, which avoids the risk of self-presentation bias when using subjective measures (e.g., Schemer, Matthes, & Wirth, 2008).

- Additional self-reported demographic data: year of birth, race, education, religiosity (self-perceived affiliation and frequency of church attendance), proficiency in English communication (American Council on the Teaching of Foreign Languages, 2012), and a five-item self-assessed measures of familiarity with specific personal computing tasks and frequency of playing video games (using five-point scales; Appendix B).

- A 25-item word-completion task to measure the accessibility of death-related topics (Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994). An example is DE _ _, which could be "dead" or a word unrelated to death, such as "deer." Viewing the image of an android has been shown to increase the frequency of word completions involving death-related topics (MacDorman & Ishiguro, 2006). This task was given last to minimize suspicion of its connection to the previous items.

3.5.3 Decisions about the Case. The pretest and posttest observations shared an ad-hoc six-item index of possible decisions about the case, indicating relative favor between the two patients: Will you postpone tomorrow's appointment with Paul until Kelly is ready? If Paul has genital herpes, will you tell him that Kelly is a likely source? When you see Paul, will you tell him that you are testing him for genital herpes? When you see Paul, will you ask him about Kelly's sexual history? When you see Paul, will you tell him about his exposure to genital herpes? When you see Paul, will you tell him that Kelly has genital herpes?

4 Results

4.1 Participation

The number of participants completing the final variable measurements was 426 (64% female). Of these, 252 participants completed all four primary parts: pretest observations, treatment, posttest observations, and measurement of covariates. With these criteria each group had between 20 and 43 participants. The median completion time was 24 minutes.

4.2 Recruitment Period and Baseline Demographics

The experiment was conducted in the second half of 2013. Participants were predominantly white ($n = 346$; 81%), raised in the United States ($n = 402$; 94%), partway through their undergraduate studies

Table 1. *Descriptive Statistics for and Correlations Among Key Participant Covariates*

Variable	M (SD)	Alpha	Correlations			
			Gend	Cogn	Anxi	Disg
Gender	.64	—				
Need for Cognition	.34 (0.30)	.90	−.14*			
Existential Anxiety	−.17 (0.32)	.79	.08	−.19***		
Disgust Sensitivity	−.02 (0.32)	.88	+.33***	−.31***	+.07	
Mortality Salience	.32 (0.17)	—	−.10	−.09	.16**	.01

NOTES. Owing to dropouts and skipped items, Ns range from 326 to 450. Alpha = Cronbach's α; Correlations = Pearson's *r*; for Gender, 0 = male, 1 = female; * $p < .05$, ** $p < .01$, and *** $p < .001$, all after Bonferroni correction.

($Mdn = 3$ years of postsecondary education), and neither technically inclined nor serious gamers: computer skill $Mdn = −.38$, $IQR = [−.5, −.13]$; gaming seriousness $Mdn = −.88$, $IQR = [−1, −.38]$; both ranges $= [−1, 1]$. Participants' ages ranged from 18 to 69 years: $Mdn = 22$, $IQR = [20, 26]$.

4.3 Statistics and Data Analysis

Ranged response values were scaled to $[−1, 1]$. Test statistics were interpreted with a significance threshold of $\alpha = .05$. Tests of multivariate models used the *F* value of Pillai's trace (Field, 2013). Effect sizes for statistically significant manipulations were calculated using partial η^2 (η_p^2) and interpreted according to the following thresholds: small $= .01$, medium $= .06$, and large $= .14$ (Cohen, 1973, 1988).

Immediately after Kelly Gordon's story, participants were somewhat against disclosure, Pretest Decision $M = −.25$, $SD = .47$. Support for disclosure was greater among men than women: men $M = −.08$, $SD = .52$; women $M = −.31$, $SD = .43$; Welch's $t(191.70) = −3.96$, $p < .001$.

To check the salience of the visual manipulations, Depiction and Motion Quality, a two-way ANOVA with interaction was conducted on the single-item measures, Perceived Form Humanness and Perceived Motion Smoothness. Depiction had a large effect on Perceived Form Humanness: $F(1, 353) = 295.71$, $p < .001$, $\eta_p^2 = .46$. Relative to the recording, the animation was

closer to *completely nonhuman* than to *completely human*: animation $M = −.32$, $SE = .04$; recording $M = .54$, $SE = .03$. Depiction also had a large effect on Perceived Motion Smoothness: $F(1, 353) = 70.10$, $p < .001$, $\eta_p^2 = .17$. Relative to the recording, the animation was closer to *jerkily* than to *smoothly*: animation $M = −.18$, $SE = .04$; recording $M = .29$, $SE = .04$. No effect was found for Motion Quality on either item: Perceived Form Humanness, $F(1, 353) = .04$, $p = .841$; Perceived Motion Smoothness, $F(1, 353) = 1.42$, $p = .234$. Depiction × Motion Quality had a nonsignificant effect on Perceived Form Humanness: $F(1, 353) = 3.39$, $p = .067$. No effect was found for Depiction × Motion Quality on Perceived Motion Smoothness: $F(1, 353) = 1.50$, $p = .221$.

Ratings of Dr. Clark showed high internal consistency: Attractiveness $\alpha = .79$, Eeriness $\alpha = .77$, Humanness $\alpha = .93$, Competence $\alpha = .95$, Trustworthiness $\alpha = .92$, and Goodwill $\alpha = .85$. Overall, Dr. Clark was perceived as moderately credible: Competence $M = .55$, $SD = .33$; Trustworthiness $M = .44$, $SD = .38$; Goodwill $M = .18$, $SD = .30$. The internal consistency of each theoretically motivated covariate was also high (see Table 1). Gender was added as a covariate in primary analyses because of its importance in the literature (Guadagno, Blascovich, Bailenson, & McCall, 2007; MacDorman et al., 2010). Relative to men, women reported less need for cognition and greater disgust sensitivity (Table 1).

Preliminary factor analysis of the six decision items produced three factors. Only the first factor had more

than one loaded item. This factor was retained to justify the treatment of the ad-hoc scale as a single variable, named Disclosure. The factor (Cronbach's $\alpha = .77$) comprised four items: If Paul has genital herpes, will you tell him that Kelly is a likely source? When you see Paul, will you ask him about Kelly's sexual history? When you see Paul, will you tell him about his exposure to genital herpes? When you see Paul, will you tell him that Kelly has genital herpes?

To minimize Type I error inflation from multiple comparisons, MANCOVA was performed before individual analyses of variance and covariance (Cramer & Bock, 1966). The result supported the main effects of Advice and Depiction as well as the covariates of Pretest Disclosure, Recall, Disgust Sensitivity, and Gender: Advice, $F(7, 212) = 20.26$, $p < .001$; Depiction, $F(7, 212) = 30.52$, $p < .001$; Pretest Disclosure, $F(7, 212) = 29.83$, $p < .001$; Recall, $F(7, 212) = 2.23$, $p = .033$; Disgust Sensitivity, $F(7, 212) = 2.18$, $p = .037$; Gender, $F(7, 212) = 2.12$, $p = .043$. No effects were found for interactions of the independent variables, nor for the other covariates: $Fs \leq 1.17$, $ps \geq .324$.

4.3.1 Source Perception. The visual manipulations had no measurable effects on subjective reports of Dr. Clark's credibility. Depiction had a nonsignificant effect on Goodwill and no effect on Competence and Trustworthiness: Goodwill, $F(1, 350) = 3.12$, $p = .078$; Competence, $F(1, 351) = 2.66$, $p = .104$; Trustworthiness, $F(1, 347) = 1.99$, $p = .159$. Motion Quality had no effect on any of the three aspects of source credibility: $Fs \leq .96$, $ps \geq .327$. Although not relevant to the study's hypotheses, Advice had small effects on Goodwill and Trustworthiness and a nonsignificant effect on Competence: Goodwill, $F(1, 350) = 6.89$, $p = .009$, $\eta_p^2 = .02$; Trustworthiness, $F(1, 347) = 11.90$, $p < .001$, $\eta_p^2 = .03$; Competence, $F(1, 351) = 3.07$, $p = .081$. Dr. Clark's credibility on all three aspects was greater when he advocated disclosure than when he advocated remaining quiet.

The effects on perceived human realism were clearer. Depiction had small negative effects on Attractiveness and Humanness and a small positive effect on Eeriness:

Attractiveness, $F(1, 349) = 6.70$, $p = .010$, $\eta_p^2 = .02$; Humanness, $F(1, 350) = 290.94$, $p < .001$, $\eta_p^2 = .45$; Eeriness, $F(1, 346) = 11.22$, $p < .001$, $\eta_p^2 = .03$. Relative to the recording, the animation was eerier, less attractive, and less human: Eeriness recording $M = -.34$, $SE = .02$; animation $M = -.24$, $SE = .02$; Attractiveness recording $M = .07$, $SE = .02$; animation $M = .00$, $SE = .02$; Humanness recording $M = .37$, $SE = .03$; animation $M = -.43$, $SE = .03$. Neither Motion Quality nor Advice affected the three ratings of realism: Motion Quality, $Fs \leq 1.50$, $ps \geq .222$; Advice, $Fs \leq 1.16$, $ps \geq .282$. Depiction × Motion Quality had a nonsignificant effect on Attractiveness: $F(1, 349) = 3.43$, $p = .065$.

To increase statistical power, an ANCOVA was conducted by adding Anxiety, Need for Cognition, Recall, Disgust Sensitivity, Mortality Salience, and Gender. Recall was a significant predictor of Trustworthiness and a nonsignificant predictor of Competence: Trustworthiness, $F(1, 253) = 7.44$, $p = .007$; Competence, $F(1, 252) = 3.77$, $p = .053$. Anxiety also predicted Competence: $F(1, 252) = 4.47$, $p = .036$. Gender was a nonsignificant predictor of Goodwill: $F(1, 252) = 3.64$, $p = .058$. After accounting for the covariates, the effect of Advice remained significant for both Goodwill and Trustworthiness.

Gender was a significant predictor of Attractiveness: $F(1, 253) = 4.75$, $p = .030$. Overall, Dr. Clark was slightly more attractive to men than to women: men $M = .069$, $SE = .025$; women $M = .003$, $SE = .020$. Recall was a significant predictor of Eeriness: $F(1, 253) = 6.64$, $p = .011$. Gender and Disgust Sensitivity were significant predictors of Humanness: Gender, $F(1, 253) = 5.92$, $p = .016$; Disgust Sensitivity, $F(1, 253) = 10.04$, $p = .002$. After accounting for the covariates, the effects of Depiction remained significant. Depiction × Motion Quality had small effects on Attractiveness and Humanness but no effect on Eeriness: Attractiveness, $F(1, 253) = 3.97$, $p = .047$, $\eta_p^2 = .02$; Humanness, $F(1, 253) = 4.88$, $p = .028$, $\eta_p^2 = .02$; Eeriness, $F(1, 253) = 0.50$, $p = .479$.

Hence, the predicted negative effects of Depiction and Motion Quality on source credibility (H1 and H2) were not supported. H3 was also not supported; it asserted

that jerky movement affected credibility more strongly in an animated model.

4.3.2 Decisions about the Case.

A three-factor ANOVA was conducted with all two- and three-way interactions on Disclosure: adjusted $R^2 = .26$. The main effect of Advice was significant and large: $F(1, 315) = 101.49$, $p < .001$, $\eta_p^2 = .24$. Participants advised to inform Paul more strongly supported doing so: Go $M = .15$, $SE = .04$; No-Go $M = -.44$, $SE = .04$. Additionally, the analysis indicated a nonsignificant three-way interaction: $F(1, 315) = 3.44$, $p = .064$.

To increase statistical power, the next test added Pretest Disclosure as a covariate (Braver & Braver, 1988; Van Breukelen, 2006). Adding Pretest Disclosure increased the power of the overall model: adjusted $R^2 = .64$. Pretest Disclosure was a significant predictor of Disclosure: $F(1, 247) = 238.91$, $p < .001$. After accounting for Pretest Disclosure, the effect of Advice remained large: $F(1, 247) = 238.91$, $p < .001$, $\eta_p^2 = .39$. No other main effects or interactions were observed: $Fs \leq 0.72$, $ps \geq .397$. Next, a second ANCOVA was performed by adding Anxiety, Need for Cognition, Recall, Disgust Sensitivity, Mortality Salience, and Gender. This model was only slightly more powerful: adjusted $R^2 = .65$. Both Recall and Disgust Sensitivity were significant predictors of Disclosure: Recall, $F(1, 220) = 4.02$, $p = .046$; Disgust Sensitivity, $F(1, 220) = 5.93$, $p = .016$. After accounting for all additional covariates, the positive effect of Advice remained large: $F(1, 220) = 135.80$, $p < .001$, $\eta_p^2 = .38$. No other main effects or interactions reached significance: $Fs \leq 1.16$, $ps \geq .282$.

5 Discussion and Conclusion

Human-like interfaces are becoming a powerful form of persuasive technology (Fogg, 1998, 2003), improving the efficiency of information transfer; their nonverbal gestures make messages more persuasive (Boyle, Anderson, & Newlands, 1994; Cesario & Higgins, 2008). In people, the impact of nonverbal communication has been studied extensively with respect to topics ranging from classroom learning to initial evaluations of teachers, surgeons, and politicians (Ambady et al., 2002; Ambady & Rosenthal, 1993; Cook, Duffy, & Fenn, 2013; Druckman, 2003). Increasing the overall realism of human-like interfaces increases their persuasiveness but also the likelihood of introducing perceptible mismatches in realism. Mismatched realism has been found to elicit an eerie feeling identified with the uncanny valley (MacDorman, Green, et al., 2009; Mitchell, Szerszen, et al., 2011; Seyama & Nagayama, 2007). However, the effect of mismatched realism on persuasiveness is not well understood.

The goal in this research was to identify the mechanisms affecting the processing of persuasive messages from computer representations that are uncannily human. Relative to a digitally recorded human speaker with high expertise, persuasiveness was predicted to change for an uncanny computer representation. Predictions were based on two competing mechanisms: (a) The animated source's decreased human realism casts it into an outgroup, decreasing persuasion (MacDorman, Coram, et al., 2010; MacDorman, Green, et al., 2009; MacDorman & Ishiguro, 2006; Mitchell, Ho, et al., 2011), or (b) the source's unusual appearance and behavior elicit greater message-relevant attention, increasing persuasion (Patel et al., 2014). To test these predictions in an ethical dilemma, this study used three 2-level factors: depiction, motion quality, and advice. Overall, the only significant treatment effect on opinion was advice, even though the animated depiction was significantly eerier than the digitally recorded version. Although the results supported a basic assumption in the study, namely, that the computer double was less human and eerier than the recording, the predicted effects on source perception (H1–H3) and decisions (H4–H6) were unsupported. Despite appearing less human, Dr. Clark was nonetheless highly persuasive. Even after accounting for gender, a second assumption that jerky motion is eerier in the animated double (MacDorman et al., 2010) was also unsupported. The pattern of results indicates overwhelming adherence to authority within the study's undergraduate student population, regardless of depiction and motion quality.

The characteristics of this study's population support several explanations for the effect of advice, namely, general acquiescence (Khan & Sutcliffe, 2014), obedience to authority (Bartneck & Hu, 2008; Milgram, 1963; Slater et al., 2006), or outward compliance with social pressure (Asch, 1956). Changes in attitude could have been merely temporary (Cialdini, Levy, Herman, Kozlowski, & Petty, 1976). Given the study's social interactivity, participants may have wanted to present a favorable self-image (Cialdini & Goldstein, 2004).

Although both the go and no-go messages were written to be comparably effective, unsystematic variation between the two messages significantly affected Dr. Clark's goodwill and trustworthiness. Relative to the no-go advice, the go advice increased both goodwill and trustworthiness. One possible source of unsystematic variation is Dr. Clark's use of personal pronouns. For example, the go advice included four second-person pronouns (i.e., *you* and *your*), whereas the no-go advice included two. Language choice has been linked with individual differences in personality (Pennebaker, Mehl, & Niederhoffer, 2003). In both messages, Dr. Clark's use of specific names and details may have conveyed a degree of personal interest in the case and led participants to consider the speaker and message jointly.

5.1 Comparison With Related Studies

This study's use of realistic human representation distinguishes it from studies of automatic social behavior toward computer agents (e.g., based on the media equation theory; Reeves & Nass, 1996). The use of a realistic animation matched with its videotaped human reference focuses the research on attributions of source credibility. In other words, by using a fixed identity, interpersonal assessments were expected to concern the represented person, not an agent acting autonomously.

This study failed to replicate the results of two previous studies using the same ethical dilemma. The first of these featured a female speaker and found gender differences in the main effect of depiction and in the interaction of depiction and motion quality (MacDorman et al., 2010). Men were less likely to comply with the animated source's request, especially when her motion was jerky.

However, the speaker in that study had low credibility owing to her admission of extramarital relationships, willingness to deceive her husband, and willingness to put him at risk of contracting a sexually transmitted infection. In addition, the computer-animated speaker was merely similar to the recorded speaker instead of being modeled directly from her appearance. Furthermore, the manipulation of motion quality was overt: Of every six video frames, the last five frames were replaced by a time-stretched copy of the first frame (MacDorman et al., 2010).

The second study using this ethical dilemma found a medium-sized positive effect of jerky motion on Dr. Clark's persuasiveness and a nonsignificant effect on attention (Patel et al., 2014). In addition to a different method of creating jerky motion (namely, repeating video frames at a fixed interval), the difference in results could have arisen from that study's additional control of apparent size: Participants were seated a short distance from a high-definition television set (Patel et al., 2014). Relative to this study, both previous studies lacked precision in measures; the studies employed scales with a range of only five to seven discrete points per item. The previous studies' manipulation of motion quality was more apparent. Taken together, these studies indicate opportunities for further research on perception of jerky character motion and its interaction with credibility.

5.2 Threats to Validity

Three possible threats to validity in this study arise from the experimental design. Two involve overreporting and misreporting of the virtual human's eeriness and lack of humanness. This study's measures were self-reported. However, subjective effects tend to be larger than other kinds of effects (Mitchell, Ho, et al., 2011; Yee, Bailenson, & Rickertsen, 2007). Even when using visual analogue scales, a general problem of validity exists with post-hoc subjective accounts of interaction (Cassell & Tartaro, 2007; Gardner & Martin, 2007; Slater & Garau, 2007).

The study's design could have introduced an order effect. To limit suspicions of the experimental manipulations, the treatment and posttreatment measurements

were separated by two sets of measurements: ratings of Dr. Clark and self-evaluations of need for cognition, existential anxiety, and disgust sensitivity. These measurements may have moderated the experimental effects by affecting the relative importance of attributes being considered (Levine, Halberstadt, & Goldstone, 1996). Such effects would be difficult to capture with a linear model, as would variations in the strength of association among covariates and reported behavior. A set of revised predictions could be tested through structural equation modeling or multiple regressions (Baron & Kenny, 1986; James, Mulaik, & Brett, 2006), though at the expense of theoretical simplicity.

5.3 Threats to Generalizability

Conducting the study through a website expediently increased the potential sample population, and it permitted measurement of the compliance effect across different environments (i.e., message destinations). However, this implementation also limits inferences about personal involvement and the motivation and ability to think about the provided arguments, all of which affect persuasion (Petty & Cacioppo, 1986; Petty, Cacioppo, & Goldman, 1981). Typically, physicians are paid salaries for making difficult decisions under time constraints and in the presence of others. Participants in this study contributed voluntarily, without a set time limit, and without being physically present in a laboratory with the experimenter. Furthermore, although the case required only minimal medical knowledge, participants were untrained in medicine. Compliance might have been reduced had the dilemma involved those with medical training or a nonmedical setting in which participants are more guarded (e.g., advertising).

A limitation made prominent by the low response rate is a potential lack of representativeness in the study's sample. Specifically, those who completed the study may have felt the greatest obligation to do so; the observed degree of compliance may simply reflect greater acquiescence generally and greater willingness to comply with authority specifically. Furthermore, online polling of undergraduate students does not ensure an accurate representation of adults from developed countries (Henrich,

Heine, & Norenzayan, 2010). The problem of representativeness may be addressed partially by sampling workers on a service like Amazon Mechanical Turk, which has greater demographic diversity (Mason & Suri, 2011). Assuming Mechanical Turk workers are reimbursed for their participation, the influence of external incentives could be evaluated. However, this approach does not account for the possibility that people willing to take online studies may be more receptive to an avatar's advice or less sensitive to the uncanny valley than other populations owing to increased exposure to computer-animated characters.

Other limits to the generalizability of the compliance effect arise from the speaker's fixed identity, the framing of the narrative itself, and the assumption of in-study behavior mapping to real-life behavior. It remains unclear what the experimental manipulations would have produced with different speakers or for different stories. The compliance effect could simply reflect participants' interpretation of the ethical dilemma as a task in a role-playing game (Williams, 2010). The limitation of Dr. Clark's fixed identity could be addressed with recordings and computer animations of several different people. The narrative limitation could be addressed with a repeated-measures design, though doing so increases the risk of attenuation from habituation. The mapping assumption could be tested in an immersive virtual environment by increasing the realism of the interactions and the immediacy of each outcome's risks and rewards.

5.4 Future Research and Applications

Future research in this area depends on improving the theoretical model so that the effects of computer-animated representation on decisions are traced more clearly. Manipulating credibility explicitly may help resolve differences between this study's results and previous findings (MacDorman et al., 2010; Patel et al., 2014). For example, Dr. Clark's credibility could be manipulated through membership in a relevant professional association (high credibility) or in an unrelated group (low credibility). In a more extreme case, Dr. Clark's recommendation could be replaced with the

uninformed advice of an unattractive and incompetent bystander.

The ability to process arguments could be manipulated explicitly by varying cognitive load through primary and secondary tasks (e.g., Martin, Hamilton, McKimmie, Terry, & Martin, 2007). For example, while attention is directed toward counting a speaker's words or specific phonemes, a realistic computer animation's eeriness can operate peripherally on the secondary task of attitude formation. Future studies could also manipulate personal involvement (Petty & Cacioppo, 1979). One way to do so is through an economic game with real money at stake.

Another potentially informative manipulation is the apparent size of the speaker (Reeves, Lang, Kim, & Tatar, 1999). Life-sized avatars perceived as occupying one's personal space may evoke heightened responses relative to avatars perceived as more distant. Additional manipulations include the length of the interaction and the degree of contingent behavior within the interaction. The effectiveness of these manipulations could influence copresence, which could be measured both during and after the interaction (Kang & Watt, 2013).

To better account for individual differences in responses to uncanny stimuli, other covariates may be explored, including authoritarianism and religiosity (Greenberg et al., 1990; MacDorman & Entezari, 2015). Other relevant individual differences concern the relative influence of central and peripheral paths to attitude formation. Heuristic thinkers may have been persuaded more easily (Petty & Wegener, 1998). However, systematic thinking could decrease altercentric behavior (Zhong, 2011). Instead of a unipolar measure, need for cognition could be tested in a bipolar way by adding intuition as an opposing anchor (Alós-Ferrer & Hügel-schäfer, 2012; Epstein, Pacini, Denes-Raj, & Heier, 1996; Pacini & Epstein, 1999). The degree of personal involvement could be measured with respect to the specific messages being presented (Zaichkowsky, 1994).

In summary, this study's results suggest that it remains easy to elicit compliance through a credible-looking speaker with high social status, even when the speaker's physical appearance is degraded, and thus rendered uncanny, by potentially uncontrolled technical prob-

lems. The source and message attributes supporting persuasiveness—logical arguments, formal attire, a terminal degree from a reputable university—seem to inoculate the speaker against the uncanny valley's negative effects on source credibility. The compliance effect may improve computer-mediated educational interactions, especially if individuals can customize agents' representations and personalities to complement their own (Isbister & Nass, 2000). The ethical use of physicians in digitally mediated healthcare delivery can effectively expand healthcare delivery services without decreasing patient compliance. Regular interaction with virtual physicians could increase adherence to medical regimens, especially in groups with low health literacy (Bickmore et al., 2010; Bickmore, Pfeifer, & Paasche-Orlow, 2009). It remains necessary to ensure these virtual healthcare providers have been given an ethically sound level of autonomy and cultural sensitivity (Luxton, 2014).

Although virtual likenesses could promote mutually desirable behavior, they could also benefit some parties at the expense of others. The compliance effect demonstrated in this study could be exploited by the advertising industry. Despite a mixed reception, extant recordings and new virtual likenesses of deceased professionals are already being used in television commercials (Abcarian, 2006; Garfield, 2007; Hiltzik, 2014; James, 1998). Virtual likenesses could also be used to promote unethical behavior through psychological manipulation. If using realistic likenesses elicits attributions of intention and moral agency, people may be less likely to question recommendations made by autonomous virtual doubles. In effect, they are prompted to cede their own moral agency to the computing system posing as another human being (Friedman & Kahn, 1992). This could have disastrous ethical and legal consequences.

Using realistic likenesses in virtual environments also raises ethical issues involving identity management. Although the animations in this experiment were created and voiced with the actor's consent and input, such cooperation is not needed if the subject is sufficiently well known. Virtual likenesses of famous performers can be animated from existing images and without the direct involvement of the performers. Matching voices can be

added by impersonators, or the voices may be reused or synthesized from recorded speech. Furthermore, although the postmortem use of one's recorded likeness is legally protected (Madoff, 2010), autonomous virtual doubles may necessitate reinterpretation of relevant laws. A person's virtual double may be associated with ideas or behaviors that are incompatible with the original person's lifestyle. Doing so risks harming the person's image, even when done posthumously (D'Rozario & Bryant, 2013). Giving identifiable personalities to artificially intelligent agents may reveal discrepancies between perceived and actual liability for errors, especially in critical domains like healthcare. Thus, between highly influential people and their realistic virtual doubles, the prospect of bidirectional effects on credibility and liability invites further investigation.

Acknowledgments

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Appendix A: Text of Persuasive Messages

The text of Support Disclosure was reused from a previous study (Patel et al., 2014).

Support Disclosure

Hello. I'm Dr. Richard Clark, assistant professor of medical ethics at Purdue University. This case presents us with a tough dilemma. Ignoring the potential for harm to one of your patients can have serious consequences and should not be taken lightly. Sometimes the harm principle allows you to take action to protect your patients. In this case, the harm to Paul is both serious and foreseeable, and this outweighs concerns about Kelly's confidentiality. In fact, her attitude shows that she has no real intention of protecting Paul or telling him about his risk of exposure. If Paul were to contract herpes, he might take it out on Kelly, or he might take action against you for not telling him. For all these reasons, I strongly urge you to *tell Paul* about Kelly's condition.

Oppose Disclosure

Hello. I'm Dr. Richard Clark, assistant professor of medical ethics at Purdue University. This case presents us with a tough dilemma. Breaching doctor–patient privilege can have serious consequences and should not be taken lightly. If this breach were made public, other infected individuals may avoid treatment. Now, Kelly expressed a willingness to eventually tell Paul about her condition. After she's cooled down a bit, perhaps you'll be able to persuade her to do it sooner rather than later. On the other hand, if Paul's already infected with herpes, well, then the harm is already done. I'm also concerned about Kelly's safety and well-being. She's financially dependent on Paul—and frankly, we don't know how he'll react. So, for all these reasons, I strongly urge you *not to tell Paul* about Kelly's condition.

Appendix B: Ad-Hoc Assessments: Ability to Recall the Story's Details and Relevant Computer Skill and Gaming Seriousness

Ability to Recall the Story's Details

About how much time did Kelly request? (two hours; two months; two days; two weeks)

Why does Kelly want to hide her infection from Paul? (Fear of Paul attacking her new boyfriend; Fear of losing her physical possessions; Fear of Paul telling her parents; Fear of losing custody of her children)

Who asked Kelly about her sexual partners? (Paul; An ex-boyfriend; The clinic; The state's Department of Health)

What did Kelly tell the Health Department about Paul? (He is out of town. He is aware of her infection. He is in prison. He is threatening her life.)

Why is Kelly confident Paul is not the source of her infection? (Paul loves Kelly. Paul is afraid of negative rumors. Paul has old-fashioned views. Paul always uses condoms.)

Relevant Computer Skill and Gaming Seriousness

If you were performing these activities without outside help, how comfortable would you feel? (not at all, slightly, moderately, very, extremely)

Browsing the World Wide Web; Assembling a computer from parts; Designing three-dimensional models

using software like Maya, 3ds Max, and Blender; Writing in a computer programming language

How serious are you about playing these kinds of computer games? (not at all, slightly, moderately, very, extremely)

Action and adventure (including *Call of Duty* and *Grand Theft Auto*); Role playing (including *World of Warcraft* and *Final Fantasy*); Simulation (including *Gran Turismo, Madden NFL*, and *The Sims*); Strategy (including *StarCraft* and *Civilization*)