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# In the uncanny valley, transportation predicts narrative enjoyment more than empathy, but only for the tragic hero

Karl F. MacDorman

*School of Informatics and Computing, Indiana University, 535 West Michigan Street, Indianapolis, IN 46202, USA*

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ABSTRACT

The uncanny valley is a term used to describe the phenomenon that human simulations that are nearly but not quite realistic often give viewers an uneasy, eerie feeling. Given the prevalence of computer-animated human characters and a narrative framework in videogames, serious games, and health-related scenarios, it is important to examine how the uncanny valley influences narrative empathy and enjoyment. In a 2 × 2 × 2 between-groups posttest-only experiment, 738 participants took the role of a patient in a virtual consultation with a doctor; the consultation varied in the doctor's character (hero or villain), its subplot ending (happy or tragic), and its depiction (computer animated or real). The participants' posttest results showed greater emotional empathy and enjoyment in the hero condition and no significant difference in emotional empathy for the computer animation but greater narrative enjoyment and persuasion. Just endings (hero rewarded, villain punished) elicited much greater pleasure than unjust endings. In comparing computer animation with recorded video, emotional empathy was a significantly stronger predictor of narrative enjoyment than transportation only for the real hero with a tragic ending. The enjoyment and persuasiveness of the computer-animated doctor–patient consultation bodes well for the use of animation in interactive visual narratives.

## 1. Introduction

Viewers have reported a lack of empathy for 3D computer modeled characters in animated films and videogames (Misselhorn, 2009). A lack of empathy manifests emotionally as an inability to like, identify with, or relate to a character (Cohen, 2001; Raney, 2004). Instead of empathy, viewers experience cold, eerie feelings. Mori (1970/2012) termed this phenomenon *bukimi no tani,* which has been translated as the *uncanny valley*. *Uncanny* denotes the eeriness of human imposters, and *valley* denotes Mori's observation that intermediate and inconsistent levels of human realism are perceived more negatively than lower and higher levels. Some studies have corroborated this observation in robotics (Mathur & Reichling, 2016; Wang & Rochat, 2017) and others in film, where nearly realistic characters appear eerier than cartoonish or human-acted characters (Ho & MacDorman, 2017; Kätsyri, Mäkäräinen, & Takala, 2017). How do we explain this phenomenon?

I have proposed that the perceptual mismatch hypothesis explains the uncanny valley: As modelers and animators try to imbue a character with perfect human realism, its attainment varies in difficulty by feature, resulting in some features appearing more realistic than others; these mismatches in perceived human realism elicit eeriness (MacDorman, Green, Ho, & Koch, 2009). Moore (2012) showed how this effect can be represented mathematically using a Bayesian model of category perception, since elaborated in realism inconsistency theory (Chattopadhyay & MacDorman, 2016). A potential mechanism for the effect is prediction error in the brain associated with violated neural expectancies (Cheetham, Suter, & Jäncke, 2011; MacDorman & Ishiguro, 2006; Saygin, Chaminade, Ishiguro, Driver, & Frith, 2012). Experimental findings have supported the perceptual mismatch hypothesis for features including shape, texture, movement, and speech (MacDorman & Chattopadhyay, 2016; Meah & Moore, 2014; Mitchell et al., 2011; Seyama & Nagayama, 2007; Tinwell, Grimshaw, Abdel Nabi, & Williams, 2011). Other diverse explanations of the uncanny valley have been reviewed elsewhere (Kätsyri, Förger, Mäkäräinen, & Takala, 2015; Lay, Brace, Pike, & Pollick, 2016).

I focus instead on the heretofore unexamined question of how the uncanny valley affects empathy for characters in an interactive visual narrative and, as a result, narrative enjoyment. The question is important because the global videogame market is enormous ($108.9 billion in 2017 and projected to grow to $128.5 billion in 2020; McDonald, 2017), and AAA videogames tend to combine computer-animated characters and a narrative framework. This combination also appears in serious games, including health-related interventions (Lu, 2015).

Empathy denotes the viewer's ability to step into a character's life, to

*E-mail address:* kmacdorm@indiana.edu.

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infer beliefs, motivations, and intentions from the character's actions, and to experience similar feelings and bodily sensations (de Vignemont & Singer, 2006; Hoffman, 2000; Preston & de Waal, 2002). Empathy engages cognitive, emotional, and somatic processing in the brain (Blair, 2005; Decety & Moriguchi, 2007). Cognitive perspective-taking, also known as theory of mind, is the ability to imagine and reason about someone else's mental state in a real or hypothetical situation (Davis, 1983; Frith, 2001; Leslie, 1987). Emotional empathy is the ability to experience someone else's emotional state as distinct from one's own (i.e., unlike emotion contagion; Coplan, 2004; Hatfield, Cacioppo, & Rapson, 1993; Moriguchi et al., 2007; Nummenmaa, Hirvonen, Parkkola, & Hietanen, 2008). It may lead to sympathy and the desire to help. Somatic (or motor) empathy is the ability to sense, mimic, or synchronize with someone else's movements nonconsciously (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Chartrand & Bargh, 1999; Kupferberg, Huber, & Glasauer, 2011). While the uncanny valley has been observed anecdotally to inhibit emotional empathy for computer-animated characters and, in turn, narrative enjoyment, little is known of its effect on cognitive perspective-taking (MacDorman, Srinivas, & Patel, 2013; Misselhorn, 2009). The influence of the uncanny valley on emotional empathy, sympathy, and cognitive perspective-taking in visual narratives demands further investigation.

If the uncanny valley alters how emotional empathy functions, this could disrupt enjoyment of the story. What happens if the eyes of a 3D computer-animated character are perceived as dead and soulless? If the character plays the hero in the story, the hero may no longer be perceived as a hero, thus causing the story to fall apart. This disrupts the viewer's appreciation and enjoyment of the visual narrative. I propose that this disruption is asymmetrical: In visual narratives, the uncanny valley prevents a hero from functioning as a hero, but it does not prevent a villain from functioning as a villain. Villains can be—and often are meant to be—cold-hearted creeps, unworthy of empathy.[1]

How the uncanny valley disrupts emotional empathy, and its support of narrative enjoyment, is explained by affective disposition theory (Zillmann, 2006; Zillmann & Cantor, 1977). Liking a character, that is, having a positive affective disposition, causes the viewer to hope for the character's benefit and to fear its harm; disliking a character produces the opposite effect (Raney, 2004). Which characters are worthy of our affection is determined by many factors including judgments about their motives and behavior. A character is liked whose motives and behavior align with the viewer's norms of morality, worldview, and other allegiances. Antiheroes notwithstanding (Shafer & Raney, 2012), a liked character typically exhibits benevolence while a disliked character typically exhibits malevolence. Together, liked and disliked characters constitute the heroes and villains of stories. Thus, narrative enjoyment occurs when these characters get—after a period of conflict and suspense—what they justly deserve.

I propose that, by altering how emotional empathy functions for a hero, the uncanny valley creates misalignments between the potential outcomes the story would have the viewer wish for or fear and their later fulfilment or avoidance. To build and resolve conflict, a story requires our emotional commitment to characters and our desire for them to overcome obstacles to attain goals. Without these, it no longer captivates.

In our 2 × 2 × 2 between-groups experiment, each participant was presented with an interactive visual narrative (Fig. 1). The participant assumed the role of a patient in a doctor's consultation in which diabetes is offered as an explanation of high blood sugar results. The doctor

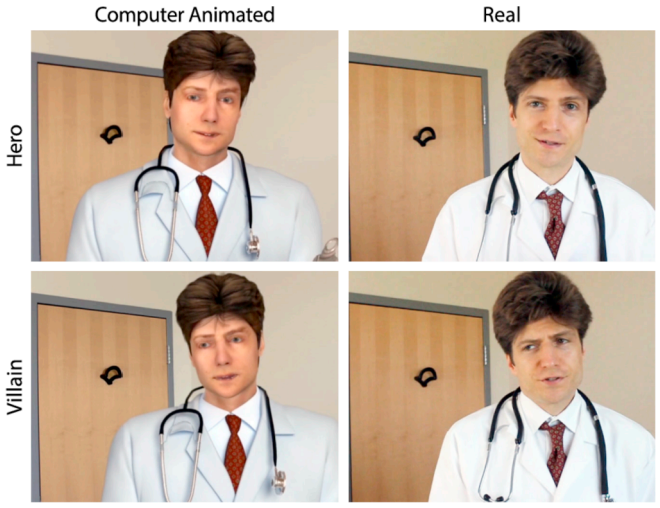


**Fig. 1.** In the role of a patient in a virtual consultation, the participant interacted with a doctor whose Character was hero or villain, subplot Ending was happy or tragic, and Depiction was computer animated or real. A 2 × 2 × 2 between-groups posttest-only experimental design was used.

was either a 3D computer model or a real human and either a benevolent hero or a malevolent villain. The narrative concluded with the doctor receiving either a fellowship in the happy ending or being sued for malpractice in the tragic ending.

### 1.1. Hypotheses

*Emotional empathy will be greater for the hero than for the villain* (H1). This prediction follows from affective disposition theory: Heroes engender empathy because their words and deeds align with the viewer's morals and worldview (Raney, 2004; Zillmann & Cantor, 1977). By contrast, antiheroes engender empathy only after a justification sufficient to warrant moral disengagement (Shafer & Raney, 2012). No such justification was provided for the villain in the doctor–patient consultation, and thus empathy for the villain should be inhibited.

*Emotional empathy will be greater for the hero in the real consultation than in the computer-animated consultation* (H2A) *but no different for the villain* (H2B). Although heroes typically engender empathy, the perceptual and cognitive processes underlying the uncanny valley effect are expected to suppress empathy for the computer-animated hero. Because villains are less likely to engender empathy, these processes should have little effect on empathy for the computer-animated villain. Anecdotal evidence indicates heroes are more susceptible to the loss of empathy associated with the uncanny valley (Butler & Joschko, 2009; Freedman, 2012; Zibrek, Kokkinara, & McDonnell, 2018). Note that the computer-animated doctor used in this study had been previously rated as significantly more eerie than its human counterpart (Patel & MacDorman, 2015).

*Ending pleasure* (H3A) *and narrative enjoyment of the consultation* (H3B) *will be greater for the just endings (hero happy, villain tragic) than for the unjust endings (hero tragic, villain happy)*. H3A replicates Zillmann and Cantor's (1977, Table 1) prediction and finding that a happy ending for the hero or tragic ending for the villain elicited a positive affective response while a happy ending for the villain or tragic ending for the hero elicited a negative affective response. H3B extrapolates from this prediction to the overall enjoyment of the narrative.

*Emotional empathy will predict narrative enjoyment more strongly for the real hero than for the computer-animated hero with the happy ending* (H4A) *or with the tragic ending* (H4B). *There will be no difference for the human villain and the computer-animated villain with the happy ending* (H4C) *or with the tragic ending* (H4D). Affective disposition theory assumes that narrative enjoyment requires emotional empathy for the

[1] How realism influences eeriness depends in part on the character's personality and narrative. For example, Zibrek, Kokkinara, and McDonnell (2018) designed a 'zombie' rendering style to be perceived as eerie; however, they found it was only perceived as eerie when paired with an agreeable personality. This indicates that heroic characters are more vulnerable to the uncanny valley than villains.

**Table 1**
MANOVA of independent variables on dependent variables, effect sizes, and post-hoc tests.

| IV | DV | MANOVA (Univariate) | | | Effect Sizes and Post-Hoc Tests | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *SS* | *F* | *p* | $\eta_p^2$ | $M_{diff}$ | *SE* | *df* | *t* | $p_{tukey}$ |
| Character (Hero–Villain) | Identification | 1.22 | 6.86 | .009 | .01 | −0.08 | 0.03 | 730 | −2.69 | .007 |
| | Empathy | 12.56 | 84.82 | < .001 | .10 | 0.26 | 0.03 | 730 | 9.18 | < .001 |
| | Sympathy | 17.16 | 97.91 | < .001 | .12 | 0.30 | 0.03 | 730 | 9.84 | < .001 |
| | Cognitive P.-t. | 6.12 | 132.29 | < .001 | .15 | 0.18 | 0.02 | 730 | 11.51 | < .001 |
| | Persuasion | 34.72 | 274.38 | < .001 | .27 | 0.43 | 0.03 | 730 | 16.47 | < .001 |
| | Ending Pleasure | 1.40 | 9.56 | .002 | .01 | 0.07 | 0.03 | 730 | 2.57 | .010 |
| | Enjoyment | 1.47 | 11.19 | < .001 | .01 | 0.09 | 0.03 | 730 | 3.25 | .001 |
| Ending (Happy–Tragic) | Empathy | 0.60 | 4.04 | .045 | .01 | 0.06 | 0.03 | 730 | 2.01 | .044 |
| | Persuasion | 0.80 | 6.35 | .012 | .01 | 0.06 | 0.03 | 730 | 2.43 | .015 |
| | Ending Pleasure | 1.23 | 8.45 | .004 | .01 | 0.08 | 0.03 | 730 | 2.77 | .006 |
| | Enjoyment | 1.34 | 10.20 | .001 | .01 | 0.08 | 0.03 | 730 | 3.14 | .002 |
| Depiction (Real–Anim.) | Persuasion | 1.09 | 8.64 | .003 | .01 | 0.08 | 0.03 | 730 | 2.94 | .003 |
| | Enjoyment | 1.45 | 11.04 | < .001 | .01 | −0.09 | 0.03 | 730 | −3.33 | < .001 |
| Character × Ending (Just–Unjust) | Cognitive P.-t. | 0.23 | 4.88 | .027 | .07 | −0.04 | 0.02 | 730 | −2.23 | .026 |
| | Ending Pleasure | 20.79 | 142.27 | < .001 | .16 | 0.34 | 0.03 | 730 | 11.97 | < .001 |

*Note:* $N = 738$. Nonsignificant effects omitted.

hero but antipathy for the villain (Raney, 2004; Zillmann & Cantor, 1977). Thus, the uncanny valley is expected to alter only how empathy for the hero doctor influences enjoyment. Misselhorn (2009) proposed how the uncanny valley could interfere with empathy: Perception of a computer-animated human repeatedly activates the concept *human,* but the concept is immediately suppressed because the viewer knows the character is not human. MacDorman and Entezari (2015) proposed that the successive activation and inhibition of the concept *human* could elicit free-floating anxiety: The viewer experiences the character's perceived "suffering" but is unable to attribute it to the nonhuman imposter. (The perceived cause of the suffering could be, for example, a nonhuman feature or negative event.) Mangan (2015) and Freud (1919/2003) have also argued that the source of uncanniness may be unspecified or suppressed. Thus, the uncanny valley could diminish enjoyment by reducing empathy or increasing anxiety or other negative emotions.

## 2. Methods

A doctor's bedside manner, personal outcome, and depiction were manipulated in a web-based experiment and virtual consultation to examine whether Character (hero or villain), Ending (happy or tragic), and Realism (computer animated or real) influence Empathy, Ending Pleasure, and Enjoyment; and whether Empathy influences Enjoyment and Persuasion. Character was manipulated through the doctor's spoken words, voice and prosody, facial expressions, and body movements. Ending was manipulated through a subplot culminating in the doctor being either honored with a fellowship or sued for malpractice. Realism was manipulated by using either a recorded video of a real actor to play the doctor in a consultation room or computer-animated 3D models to simulate the same scenario.

### 2.1. Participant characteristics and sampling

The sample was comprised of randomly selected undergraduate and graduate students, age 18 or older, from a Midwestern U.S. public university system with the following demographics: 68.6% White, 6.8% Hispanic/Latino, 6.8% African American, 4.4% Asian, 3.6% two or more races, 0.1% American Indian, 0.1% Pacific Islander, 0.6% unknown, and 9.1% international. Participation was voluntary and occurred at a time and location chosen by the participant.

The study was approved by the university's Office of Research Administration (January 5, 2018, OHRP Category 7, Study No. 1712290464). Informed consent was obtained from all participants. Documentation of informed consent was waived under 45 CFR 46.117(c) or 21 CFR 56.109(c)(1). Explanation of aspects of the experiment that could have affected its outcome was delayed until after participation under 45 CFR 46.116(d). The research was performed in accordance with all relevant federal, state, and university standards, policies, and regulations on human subjects research.

### 2.2. Research design

The experiment had a 2 × 2 × 2 between-groups posttest-only design (Independent Variables). Each participant was randomly assigned to one of eight treatment groups, representing either a low or high level of warmth, competence, and realism.

### 2.3. Procedure

Each participant assumed the role of a patient in a virtual consultation (Appendix A). The scenario began with the patient's blood sugar testing higher than normal and a subplot culminating in a happy or tragic ending for Dr. Richards. The doctor appeared in a video wearing a white shirt, tie, and lab coat with a stethoscope draped on his shoulders. He was standing and holding a clipboard with the patient's test results. The consultation proceeded through seven doctor–patient exchanges and a final response from the doctor. These constituted (hero or villain) Character Treatments 1–8 and (computer animated or real) Realism Treatments 1–8. The consultation ended with (happy or tragic) Ending Treatment 2, which was a whispered announcement from the nurse to the doctor and his response.

Approximately 60% of Dr. Richards' dialogue (337 of 553–561 words) was identical between the hero and villain Character Treatments. In this dialogue, Dr. Richards interpreted the patient's test results as possibly indicating diabetes and invited the patient for a retest. He also explained type 1 and type 2 diabetes and their symptoms, complications, biological mechanism, and treatments.

In each doctor–patient exchange, the participant replied to the doctor by choosing one of four text-based responses. To maintain experimental control, the doctor's statements were phrased to follow logically from any of the preceding responses. After the consultation, the participant completed posttest indices (Dependent Variables).

### 2.4. Independent variables

The independent variables were Character (hero or villain), Ending (happy or tragic), and Realism (computer animated or real). These constituted the eight treatment conditions. The video clips are available at https://doi.org/10.6084/m9.figshare.7300088.

*Character.* Approximately 40% of the doctor's dialogue reflected the doctor's bedside manner, which was either heroic or villainous. The hero treatments included expressions of caring, encouragement, praise, and confidence in the patient and treatment; offers of availability and support; and recommendations of external resources. The villain treatments included complaining about others, using disparaging and offensive language, showing a lack of availability, demeaning and discouraging the patient, cracking a joke at the patient's expense, and assuming the patient has petrifying fears and ingrained habits.

*Ending.* A happy or tragic ending subplot was set up immediately before the virtual consultation. First, the participant overheard another patient in the waiting room discussing a malpractice lawsuit and subsequently, the nurse called the patient back and mentioned that the doctor is up for an award. These events were framed more or less favorably in the happy or tragic version of Ending Treatment 1. The subplot culminated near the end of the consultation. In the happy condition, Nurse Larsson announced, "Great news, Dr. Richards! The American College of Physicians is honoring you with a Fellowship!" In the tragic condition, Nurse Larsson announced, "Bad news, Dr. Richards! Meredith Pratley decided to go ahead with the malpractice lawsuit."

*Justice.* A just ending is defined as a happy ending for the hero or an unhappy ending for the villain. An unjust ending is defined conversely.

*Depiction.* The entire virtual consultation was either real or computer animated (Realism Treatment); however, both versions used the same recording, namely, the real voice of the actor playing Dr. Richards and off-screen actress playing Nurse Larsson. The high-realism treatment used a recorded video of the actor (Fig. 1). The low-realism treatment used a computer model developed from high-resolution reference photographs of the same actor. The actor's clothing, props, and environment were all developed the same way. The computer models were animated manually using the real video as a reference. The animated Dr. Richards' lips were synchronized to the real actor's speech. The same computer model had been used in a different scenario with an earlier cohort of students and found to be significantly more eerie than the real actor (Patel & MacDorman, 2015).

### 2.5. Dependent variables

The semantic differential scales comprising the posttest indices are listed in Appendix B. The indices represent averages of interval data from visual analogue scales (Funke & Reips, 2012; Reips & Funke, 2008). Each measurement scale was represented by an adjective (or phrase) and its antonym on opposite ends of a horizontal bar. The participant placed a mark on the bar, and depending on where the mark was placed, a decimal value between −3.00 and 3.00 was recorded for the scale. Likert scales were also implemented as visual analogue scales with *Strongly Disagree* and *Strongly Agree* on opposite ends of the horizontal bar as the only labels. Index and scale order were randomized.

*Transportation.* An 11-item assessment of narrative transportation (Rodgers & Thorson, 2012) was designed to measure the intensity of absorption in the consultation.

*Identification as Patient.* An 8-item assessment of emotional identification (Cohen, 2001) was designed to measure the intensity of the experience of being the patient.

*Empathy* (emotional). A 7-item assessment of emotional empathy (Coplan, 2004; Hatfield et al., 1993; Moriguchi et al., 2007; Nummenmaa et al., 2008) was designed to measure the intensity of the experience of Dr. Richards' emotional state as distinct from the participant's own emotional state.

*Sympathy.* A 6-item assessment of sympathy—also called empathic concern (Batson, 1987; Batson et al., 1991; Davis, 1983)—was designed to measure the degree to which the participant emotionally cared about Dr. Richards' welfare.

*Cognitive Perspective-taking.* An 11-item assessment of cognitive perspective-taking—also called theory of mind (Davis, 1983; Frith, 2001; Leslie, 1987)—was designed to measure the ability to imagine and reason about Dr. Richards' cognitive state; each item had a correct or incorrect answer.

*Persuasion.* To measure persuasion, intention to adhere to Dr. Richards' treatment advice was measured using an Adherence Intention index designed for this virtual doctor–patient consultation.

*Enjoyment.* Narrative appreciation of the consultation was measured using an enjoyment index. To create it, the program evaluation index (Perry, Jenzowsky, Hester, King, & Yi, 1997) was converted from intensity scales to semantic differential scales by adding antonyms.

## 3. Results

### 3.1. Participants

Overall, 738 participants randomly assigned to eight groups, with 88–105 in each group, completed the experiment (73% female, $n = 538$).

### 3.2. Recruitment period and baseline

The experiment was conducted from January 15 to March 10, 2018. Participants ranged in age from 18 to 82 ($Mdn = 23$, $IQR = [20, 29]$) and most had grown up in the United States (88%, $n = 647$).

### 3.3. Data analysis preliminaries

Test statistics were two tailed and interpreted at a .05 significance level. Partial eta squared ($\eta_p^2$) was interpreted with small = .01, medium = .06, and large = .14 thresholds (Cohen, 1973) and Cronbach's α with acceptable = .7, good = .8, and excellent = .9 thresholds. For the path analysis of the structural models, criteria for acceptable global fit were $p > .05$ for model $\chi^2$ (cannot reject the exact fit hypothesis), RMSEA ≤ .08 (a cutoff for marginal fit; MacCallum, Browne, & Sugawara, 1996), RMSEA $\hat{\varepsilon}_L = 0$ (confidence interval includes zero); and the combination rule (CFI ≥ .95 and SRMR ≤ .08; Hu & Bentler, 1999). Factor analysis used oblimin rotation. All betas (β) were standardized. Correlations and path analysis were performed in Lavaan 0.6 and other analyses in Jamovi 0.9.

### 3.4. Index reliability

Scales were interval data. The scales of Cognitive Perspective-taking disguised a test because each scale had a correct or an incorrect answer; the index was an unweighted average of these scales. The remaining indices were averages of their respective scales weighted by their factor loadings to measure more accurately their latent concept (Appendix B). In averaging the indices, raw data, which ranged from −3.00 to 3.00, was rescaled to range from −1 to 1.

### 3.5. Testing hypotheses 1–3

Using Pillai's trace, a three-way MANOVA found a significant effect of Character, $V = 0.33$, $F(7, 724) = 51.89$, $p < .001$; Ending, $V = 0.02$, $F(7, 724) = 2.62$, $p < .011$; Depiction, $V = 0.05$, $F(7, 724) = 5.06$, $p < .001$; and Character × Ending, $V = 0.18$, $F(7, 724) = 22.08$, $p < .001$, on the narrative-related variables: Identification as Patient, Transportation, Empathy, Sympathy, Cognitive Perspective-taking, Persuasion, Ending Pleasure, and

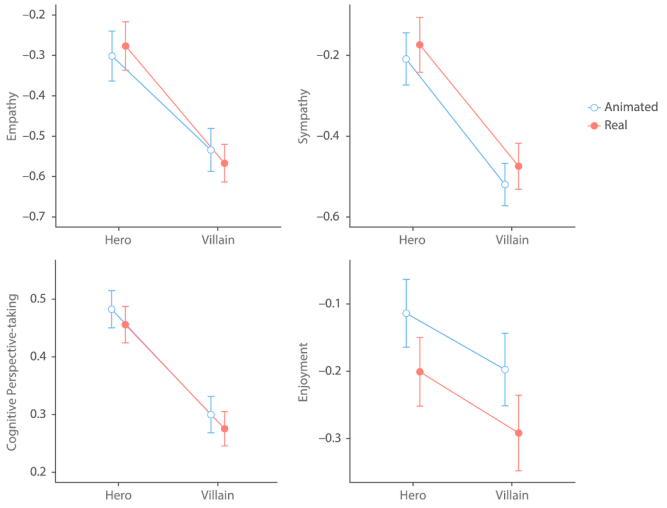


**Fig. 2.** The hero elicited significantly greater Empathy, Sympathy, Cognitive Perspective-taking, and Enjoyment than the villain. The computer-animated human elicited greater Enjoyment than the real human. Error bars indicate 95% confidence interval.

Enjoyment. The univariate tests were conducted to test the main and interaction effects of Character, Ending, and Depiction (Table 1). There were no significant effects on Transportation.

Character had a significant main effect on Cognitive Perspective-taking and Persuasion with a large effect size, on Empathy and Sympathy with a medium effect size, and on Identification, Ending Pleasure, and Enjoyment with a small effect size (Fig. 2). Post-hoc tests (Tukey's HSD) showed that the hero doctor was rated lower than the villain doctor on Identification as Patient and higher on the remaining variables with significant effects.

H1 predicted greater emotional empathy for the hero than for the villain. H1 was supported.

Ending had a significant main effect on Empathy, Persuasion, Ending Pleasure, and Enjoyment with a small effect size. The happy ending was rating higher than the tragic ending on these variables.

Depiction had a significant main effect on Persuasion and Enjoyment with a small effect size. The computer-animated consultation was more persuasive and enjoyable than the real consultation.

H2A predicted greater emotional empathy for the real hero than for the computer-animated hero. H2A was not supported. H2B predicted no difference in emotional empathy for the real villain and computer-animated villain. H2B was supported.

Character × Ending had a significant interaction effect on Cognitive Perspective-taking and Ending Pleasure. Post-hoc tests were coded using Justice. Cognitive Perspective-taking was nonsignificant. The just endings (hero happy, villain tragic) were more pleasurable than the unjust endings (hero tragic, villain happy) with a large effect size (Fig. 3).

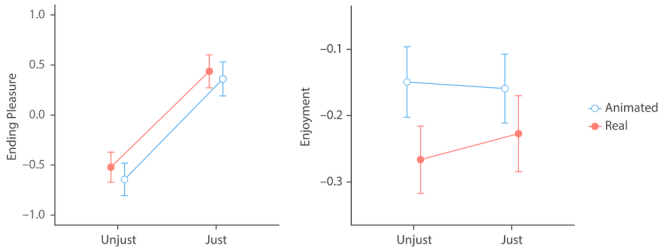


**Fig. 3.** The just ending elicited significantly greater Ending Pleasure than the unjust ending; however, Enjoyment overall was not significantly greater. Error bars indicate 95% confidence interval.

H3A predicted greater ending pleasure for the just endings. H3A was supported. H3B predicted greater narrative enjoyment for the just endings. H3B was not supported.

### 3.6. Regression models of enjoyment

Multiple linear regression was performed to predict Enjoyment from the other narrative-related variables. Predictor variables were sequentially removed in order of $p$ value, from largest to smallest, starting with Cognitive Perspective-taking, $t = 0.58$, $p = .56$, $\beta = .02$, $R^2 = .42$, and Sympathy, $t = 1.48$, $p = .14$, $\beta = .06$, $R^2 = .42$. Models were identified with four, three, two, and one predictor variables (Table 2).

### 3.7. Testing hypothesis 4

To determine whether Empathy predicts Enjoyment differently between the computer-animated and real consultations for each of the four narratives, four ANOVAs were performed comparing the regression coefficients of Model 1. This analysis was repeated for Models 2, 3, and 4 (Table 3).

The results are consistent across all four models: Only for hero tragic ending does Empathy predict Enjoyment differently ($p = .002$ to $.017$): Empathy predicts Enjoyment more strongly in the real consultation than in the computer-animated consultation. In Model 3, for example, the standardized $\beta$ for Empathy is .30 higher (computer animated: $\beta = .25$, $p < .001$, vs. real: $\beta = .55$, $p < .001$), and the standardized $\beta$ for Transportation is .19 lower (computer animated: $\beta = .48$, $p < .001$, vs. real: $\beta = .27$, $p < .001$). In Model 4, the standardized $\beta$ for Empathy is .28 higher (computer animated: $\beta = .24$, $p < .001$, vs. real: $\beta = .52$, $p < .001$), and the standardized $\beta$ for Transportation is .21 lower (computer animated: $\beta = .48$, $p < .001$, vs. real: $\beta = .27$, $p < .001$).

Hypothesis 4 predicts emotional empathy as a stronger predictor of narrative enjoyment with the real hero than with the computer-animated hero with both the happy (H4A) and tragic endings (H4B). Only H4B was supported. It further predicts no difference for the human villain and the computer-animated villain with the happy (H4C) and tragic endings (H4D). H4C and H4D were supported.

### 3.8. Structural models of enjoyment

To visualize directed dependencies among dependent variables of theoretical interest, a structural model was developed from regression Model 3, which had direct effects from Empathy, Transportation, and Ending Pleasure to Enjoyment. Direct effects were added from Transportation and Ending Pleasure to Empathy. Standardized betas for this just-identified model were calculated for the eight conditions: Character × Ending × Depiction. Empathy, Transportation, and Ending Pleasure varied across conditions (Fig. 4).

For hero happy ending, Ending Pleasure had a direct effect on Empathy with a large effect size. That is, feeling pleasure when the hero doctor is to be awarded a fellowship predicts emotional empathy. Transportation had a direct effect on Empathy with a small-to-medium effect size. Transportation had a direct effect on Enjoyment with a medium effect size. For computer animated, Empathy had a stronger direct effect on Enjoyment (.52 vs. .36), Ending Pleasure had a nonsignificant direct effect on Enjoyment, and after removing this nonsignificant direct effect, the model had excellent global fit statistics: $\chi^2_M = 0.014$, $df_M = 1$, $p = .905$, $q = 6$, RMSEA $\hat{\varepsilon} = .000$, 90% CI = [0.000, 0.110], CFI = 1.000, SRMR = .002.

For hero tragic ending, Ending Pleasure had a negative direct effect on Empathy. Feeling pleasure when the hero doctor is to be sued for malpractice predicts a lack of empathy, whereas feeling displeasure indicates empathy. As with regression Models 2–4, the effect sizes of Transportation on Enjoyment and Empathy on Enjoyment were nearly

**Table 2**
Model coefficients for Enjoyment.

| Model | *F* | *df* | $R^2$ | Predictor | *B* | *SE* | β[a] | *t* | *p* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 274.20 | 1, 736 | .27 | | | | | | < .001 |
| | | | | Intercept | 0.00 | .02 | | −0.08 | .933 |
| | | | | Empathy | 0.47 | .03 | .52 | 16.56 | < .001 |
| 2 | 240.85 | 2, 735 | .40 | | | | | | < .001 |
| | | | | Intercept | −0.01 | .02 | | −0.43 | .671 |
| | | | | Empathy | 0.36 | .03 | .40 | 13.03 | < .001 |
| | | | | Transportation | 0.62 | .05 | .37 | 12.31 | < .001 |
| 3 | 167.11 | 3, 734 | .41 | | | | | | < .001 |
| | | | | Intercept | −0.01 | .02 | | −0.65 | .513 |
| | | | | Empathy | 0.35 | .03 | .38 | 12.45 | < .001 |
| | | | | Transportation | 0.62 | .05 | .38 | 12.44 | < .001 |
| | | | | Ending Pleasure | 0.09 | .03 | .10 | 3.50 | < .001 |
| 4 | 130.27 | 4, 733 | .42 | | | | | | < .001 |
| | | | | Intercept | −0.02 | .02 | | −1.27 | .203 |
| | | | | Empathy | 0.33 | .03 | .36 | 11.73 | < .001 |
| | | | | Transportation | 0.49 | .06 | .30 | 8.08 | < .001 |
| | | | | Ending Pleasure | 0.09 | .03 | .11 | 3.73 | < .001 |
| | | | | Identification | 0.11 | .03 | .13 | 3.49 | < .001 |

*Note:* $N = 738$.
[a] Standardized.

**Table 3**
ANOVAs comparing regression coefficients for Depiction by Character and Ending.

| Model | Charact. | Ending | *df* | *RSS* | *SS* | *F* | *p* |
|---|---|---|---|---|---|---|---|
| 1 | Hero | Happy | 191, 2 | 13.08 | 0.33 | 2.42 | .091 |
| | **Hero** | **Tragic** | **173, 2** | **15.18** | **0.74** | **4.20** | **.017** |
| | Villain | Happy | 184, 2 | 19.94 | 0.56 | 2.57 | .079 |
| | Villain | Tragic | 174, 2 | 21.67 | 0.14 | 0.56 | .572 |
| 2 | Hero | Happy | 189, 3 | 10.63 | 0.37 | 2.19 | .091 |
| | **Hero** | **Tragic** | **171, 3** | **11.80** | **1.04** | **5.03** | **.002** |
| | Villain | Happy | 182, 3 | 16.94 | 0.45 | 1.62 | .186 |
| | Villain | Tragic | 172, 3 | 18.13 | 0.13 | 0.40 | .755 |
| 3 | Hero | Happy | 187, 4 | 10.55 | 0.35 | 1.53 | .194 |
| | **Hero** | **Tragic** | **169, 4** | **11.63** | **1.04** | **3.77** | **.006** |
| | Villain | Happy | 180, 4 | 16.70 | 0.41 | 1.12 | .350 |
| | Villain | Tragic | 170, 4 | 17.93 | 0.11 | 0.26 | .905 |
| 4 | Hero | Happy | 185, 5 | 10.26 | 0.40 | 1.46 | .207 |
| | **Hero** | **Tragic** | **167, 5** | **11.26** | **1.10** | **3.26** | **.008** |
| | Villain | Happy | 178, 5 | 15.82 | 0.36 | 0.82 | .538 |
| | Villain | Tragic | 168, 5 | 17.59 | 0.12 | 0.23 | .949 |

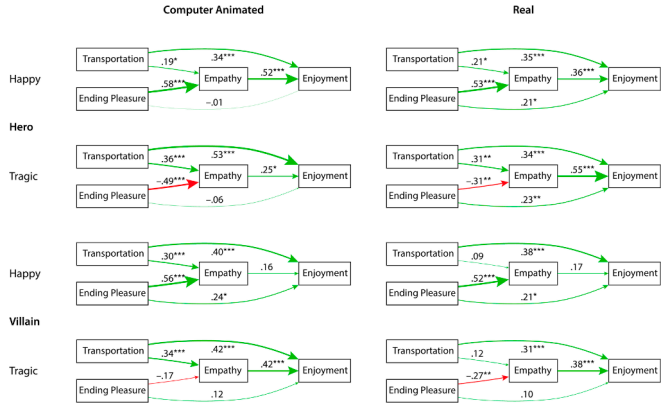


**Fig. 4.** A structural model of Enjoyment by Character, Ending, and Depiction.

reversed between the computer-animated and real consultations. For the computer-animated hero tragic ending, Transportation more strongly predicted Enjoyment than Empathy predicted Enjoyment, whereas for the real hero tragic ending, Empathy more strongly predicted Enjoyment than Transportation predicted Enjoyment. For the computer-animated consultation only, Ending Pleasure again had a nonsignificant direct effect on Enjoyment, and after removing this nonsignificant direct effect, the model had excellent global fit statistics: $\chi^2_M = 0.368$, $df_M = 1$, $p = .544$, $q = 6$, RMSEA $\hat{\varepsilon} = .000$, 90% CI = [0.000, 0.236], CFI = 1.000, SRMR = .012.

For villain happy ending, Empathy had a nonsignificant direct effect on Enjoyment for both the computer-animated and real consultation, though Ending Pleasure had a direct effect on Empathy with a large effect size. Emotional empathy did not significantly predict narrative enjoyment. Transportation had a significant direct effect on Empathy in only the computer-animated consultation. For villain happy ending, Empathy may be removed from the model with Enjoyment predicted solely by Transportation and Ending Pleasure.

For villain tragic ending, Ending Pleasure had a nonsignificant direct effect on Enjoyment. In the computer-animated consultation, Ending Pleasure also had a nonsignificant direct effect on Empathy and may be removed from the model. In the real consultation, Transportation had a nonsignificant direct effect on Empathy. After removing the two nonsignificant direct effects from the model, the model had good global fit statistics: $\chi^2_M = 2.342$, $df_M = 2$, $p = .310$, $q = 5$, RMSEA $\hat{\varepsilon} = .044$, 90% CI = [0.000, 0.219], CFI = .989, SRMR = .050.

### 3.9. Regression models of persuasion and ANOVA

A simple regression model of Persuasion was identified with two predictor variables (Table 4). The model was identified by removing predictor variables sequentially in decreasing order of *p* value. Sympathy (β = .45, $p < .001$) and Cognitive Perspective-taking (β = .39, $p < .001$) were the strongest predictors of Persuasion. To determine whether they predict Persuasion differently between the computer-animated and real consultations for each of the four narratives, four ANOVAs were performed comparing the regression coefficients of the model (Table 5). Only for hero tragic ending does the model predict Persuasion significantly differently between computer-animated and real consultations ($p = .027$). Fig. 5 depicts the regression coefficients by Character, Ending, and Depiction. For the real consultations, Cognitive Perspective-taking is a significant predictor of Persuasion only for happy endings, whereas for the computer-animated consultations, Cognitive Perspective-taking is a significant predictor of Persuasion for both happy and tragic endings.

**Table 4**
Model coefficients for Persuasion.

| Model | *F* | *df* | $R^2$ | Predictor | *B* | *SE* | β[a] | *t* | *p* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 287.27 | 2, 735 | .44 | | | | | | < .001 |
| | | | | Intercept | −0.03 | .03 | | −1.20 | .230 |
| | | | | Cognitive P.-t. | 0.71 | .05 | .39 | 13.92 | < .001 |
| | | | | Sympathy | 0.42 | .03 | .45 | 15.92 | < .001 |

*Note:* $N = 738$.
[a] Standardized.

**Table 5**
ANOVAs comparing regression coefficients for Depiction by Character and Ending.

| Model | Charact. | Ending | *df* | *RSS* | *SS* | *F* | *p* |
|---|---|---|---|---|---|---|---|
| 1 | Hero | Happy | 189, 3 | 12.78 | 0.39 | 1.90 | .131 |
| | **Hero** | **Tragic** | **171, 3** | **15.17** | **0.83** | **3.14** | **.027** |
| | Villain | Happy | 182, 3 | 18.05 | 0.23 | 0.77 | .510 |
| | Villain | Tragic | 172, 3 | 15.43 | 0.62 | 2.30 | .079 |

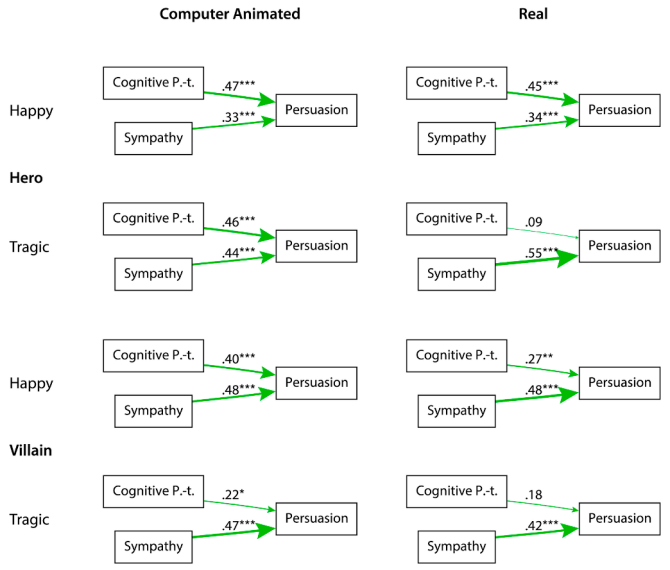


**Fig. 5.** The regression model of Persuasion by Character, Ending, and Depiction.

### 3.10. Data availability

The dataset and R script for all analyses are available at https://doi.org/10.6084/m9.figshare.7611788.

## 4. Discussion

As expected, emotional empathy, sympathy, cognitive perspective-taking, persuasion, and narrative enjoyment were greater with the heroic doctor acting as protagonist than the villainous one. Nevertheless, participants identified more strongly with being the patient when pitted against the villain, perhaps because of the added challenge and drama. Contrary to Banerjee and Greene's (2012) findings, the happy (or progressive) ending was not more transporting. Just endings—in which the hero received a fellowship or the villain was sued for malpractice—were more pleasurable than unjust endings with a large effect size. This finding aligns with affective disposition theory.

This pleasure with just endings, however, did not extend to narrative enjoyment overall. Even in Zillmann and Cantor's (1977, Table 2) original study, second and third grade students somewhat appreciated the happy ending for the villain. This may reflect the kind of simple narrative used in both studies, which either had a villain or a hero but not both. The lack of overall narrative enjoyment of the villain with tragic ending may also reflect the interactivity of the visual narrative in which the participant personally experienced being the butt of the villain's jokes and ridicule instead of viewing a third person experience it—like in a film or on television.

Contrary to expectations, the computer-animated consultation was more enjoyable and more persuasive than the real consultation, despite the computer-animated doctor having been rated as more eerie than the real one in a previous study (Patel & MacDorman, 2015). It is possible that the computer animation was simply more engaging than real life (Dai & MacDorman, 2018). Animation could also have enhanced the experience of interactivity, because participants may have thought they were interacting with an animated chatbot in real time. By contrast, the videos of the real actor were clearly prerecorded.

In comparing the regression models, only for hero tragic ending did emotional empathy predict narrative enjoyment differently, that is, more strongly in the real consultation than in the computer-animated one. For the computer-animated consultation, transportation instead predicted narrative enjoyment more strongly. Transportation has been found to be an important factor in narrative enjoyment (Green, Brock, & Kaufman, 2004; Green, Chatham, & Sestir, 2012; Johnson, 2012). If transportation tended to be heightened for computer animation in the structural model, that could be explained by the perception of interacting 'live' with an intelligent agent. It is unclear why it was prominent specifically for computer animation in the hero tragic ending condition as compared with emotional empathy.

For the structural model, ending pleasure predicted emotional empathy positively for the happy endings and negatively for the tragic endings, except for a nonsignificant direct effect for the computer-animated villain with a tragic ending. As an individual difference, it is not surprising to find those who take pleasure in happy endings and displeasure in tragic endings to be more empathetic. For the villains, regardless of ending, transportation predicted emotional empathy only for computer animation. Emotional empathy had a nonsignificant direct effect on enjoyment for the villain with happy endings, whether computer animated or real, and can be removed from the model. In other words, when villains succeed, empathy does not predict enjoyment, which is consistent with affective disposition theory (Raney, 2004; Zillmann & Cantor, 1977).

Cognitive Perspective-taking was the only index whose result may be analyzed for correctness; its Likert-like visual analogue scales disguised true-or-false questions about the doctor's mental state. Thus, higher scores on the index indicate the doctor's advice was being processed more systematically and lower scores indicate it was being processed more heuristically (Chaiken, 1980).

For the real consultations, Cognitive Perspective-taking was a significant predictor of Persuasion only for the happy endings in which the doctor receives a fellowship. It was a nonsignificant predictor in the tragic endings in which the doctor is sued for malpractice. The malpractice suit implies the doctor's advice may not be trustworthy or beneficial and may thus be discounted. Therefore, it is surprising that in all four computer-animated consultations, Cognitive-Perspective-taking was a significant predictor of Persuasion, though the difference in regression coefficients was only significant for hero tragic ending. It is

possible that the participants do not view the computer-animated doctor as an agent capable of authoring medical advice and therefore do not connect the lawsuit to the scale items concerning their intention to adhere to the doctor's medical advice.

A limitation of the study is not separating the positive contribution of animation to enjoyment and persuasion from the potentially negative contribution of the uncanny valley to these variables. A follow-up study should include computer-animated conditions at different levels of eeriness, for example, by varying realism or realism inconsistency as an independent variable.

## 5. Conclusions

The uncanny valley theory predicts that intermediate or inconsistent levels of realism in human simulations may elicit a negative affective response (Mori, 2012). This hypothesis has been supported by empirical findings (Chattopadhyay & MacDorman, 2016; Ho & MacDorman, 2017; Kätsyri, Mäkäräinen, & Takala, 2017; MacDorman et al., 2009; MacDorman & Chattopadhyay, 2016; Mathur & Reichling, 2016; Mitchell et al., 2011; Seyama & Nagayama, 2007; Wang & Rochat, 2017).

In a controlled experiment, however, the computer-animated consultation with a doctor was found to be more enjoyable than the 'real' consultation on which it was modeled, though the effect size was small. The uncanny valley may still negatively impact narrative enjoyment for a different genre, such as romance. Nevertheless, for hero tragic ending, transportation predicted enjoyment more strongly in the computer-animated consultation and emotional empathy predicted enjoyment more strongly in the real one. Perhaps in longer, more complex plots with both heroes and villains experiencing numerous windfalls and setbacks in addition to major highs and lows (Reagan, Mitchell, Kiley, Danforth, & Dodds, 2016, Appendix E, Table S2), differences in empathy for a hero experiencing misfortune could build up and affect overall narrative enjoyment.

Interacting with the heroic doctor instead of the villainous one, or seeing the doctor experiencing a happy ending instead of a tragic one, also increased narrative enjoyment with a small effect size. Participants felt the most emotional empathy for the hero; emotional empathy for the villain with a happy ending did not significantly predict enjoyment. Replicating Zillmann and Cantor (1977), just endings, in which the hero is rewarded or the villain punished, were much more pleasurable than unjust endings. However, this pleasure with the ending did not result in greater overall narrative enjoyment. Again, in a longer, more complex narrative, just or unjust events may function differently—for example, with unjust events building tension and just events resolving it.

This is the first experiment to consider how character (hero or villain), ending (happy or tragic), and human realism (computer animated or real) affect enjoyment and persuasion in light of the uncanny valley. The experiment stands out for its degree of experimental control, creating a computer animation based on video recordings of a real-life scenario. The results show increased enjoyment and persuasion for the digital double relative to a consultation filmed with a real actor. This bodes well for the use of computer animation in videogames, serious games, and other interactive media designed to increase health literacy and adherence to treatment advice. Not only is it easier to revise scenarios that use computer animation implemented, for example, on a game engine for real-time interaction, but they can also be combined with artificial intelligence to provide a human-looking interface that can answer the patient's follow-up questions.

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## Appendix A. Script

*Ending Treatment 1*

*Both:* One afternoon, you visit Dr. Richards, a primary care physician, for a routine physical examination. As instructed by the nurse, Jane Larsson, you ate nothing on the morning of your appointment.

*Happy:* In the waiting room, you overhear a patient, Meredith Pratley, tell her husband, "The lawyer says, if we sue the doctor, we both could make a ton of money."

*Tragic:* In the waiting room, two women are seated together, and you hear one of them say, "Meredith, you deserve compensation. You have a strong case."

*Both:* After the examination, you learn from Dr. Richards that your blood sugar tested higher than normal. You undergo some further blood work and return to the waiting room. After a while, Nurse Larson calls you back into the doctor's office.

*Happy:* Walking to the office, the nurse gushes, "Dr. Richards is up for an award. Today we find out the result!"

You are greeted by Dr. Richards.

*Tragic:* Walking to the office, the nurse whispers, "Dr. Richards is up for an award. I'm sure it will go to his head!"

*Character Treatment 1*

*Villain:* [Rolling eyes peevishly and shaking head.] How'd you like our noisy waiting room? It sounds like the ghetto clinic where Dr. Mehta volunteers. And they're all here for *me*. I inherited this disaster when she took maternity leave so …

*Both:* I'm sorry you were kept waiting. From your latest blood work, your fasting blood sugar level is 203, which is higher than we'd like to see. If it tests above 126 again, we'll have to consider the possibility that you have diabetes.

*Hero:* But don't be too concerned. It's not clear you have it, and even if you do, it's very common, and we know how to treat it.

A. What is the chance I have diabetes?
B. When will you know for sure whether I have diabetes?
C. Will you retest my blood glucose level today?
D. Do my other lab results also indicate diabetes?

*Character Treatment 2*

*Hero:* Again, I wouldn't be too concerned because although …

*Both:* Your hemoglobin A1C and triglycerides are elevated. These might be signs of diabetes or a prediabetic condition. To be sure, we'll need to retest you. Come back at least 12 h after taking a meal without processed sugar. I want you to get the results fast, so I'll fit you in tomorrow …

*Villain: If* somebody cancels. Right now, I have to reserve my one open slot for a true emergency.

A. What should I know about diabetes?
B. What type of diabetes do I have?
C. Is it more likely I have type 1 or type 2 diabetes?
D. What is the difference between type 1 and type 2 diabetes?

*Character Treatment 3*

*Villain:* You should know [chuckling] it doesn't really matter what type of diabetes you have because …

*Both:* Diabetes, both type 1 and 2, involves your blood sugar being high enough to put your health at risk. This is due to a lack of insulin. In type 1 your body doesn't make any insulin, because the cells that make it in the pancreas have been killed by the immune system. In type 2 your body makes some insulin, but it's either not enough or not used well. For both types, the most common symptoms are excessive thirst and frequent urination. If it turned out you had diabetes, it's probably type 2, because of the late onset.

*Hero:* I certainly hope you have neither type, but type 2 is less severe and easier for us to treat.

A. I don't feel thirsty that often.
B. I don't urinate very frequently.
C. Do you have to feel thirsty and urinate frequently to have diabetes?
D. I only have one of those symptoms.

*Character Treatment 4*

*Villain:* [Incredulous.] If you're like most patients, you don't know how to assess your own symptoms and …

*Both:* It's possible to show *no* symptoms. A third of those with diabetes don't even know they have it. But it's important to get treated to keep the symptoms from developing and to prevent complications.

*Hero:* I'm glad to say there are many treatments today that didn't exist 20 years ago. Our understanding of the condition is constantly improving.

A. What complications are caused by diabetes?
B. What can I do to prevent complications related to diabetes?
C. How does the disease progress?
D. Do the complications of type 2 diabetes differ from type 1?

*Character Treatment 5*

*Villain:* [Checks time on watch and scoffs] Look …

*Both:* The same complications are associated with both types: heart disease; kidney disease; blindness; a shortened lifespan. However, their risk can be greatly reduced with the right treatment.

*Hero:* So, don't worry. If you have any health issues, we'll do [emphatically] *everything* we can to help you.

A. How does diabetes cause blindness?
B. Why would high blood sugar shorten my life?
C. How is a lack of insulin related to heart disease?
D. How can diabetes lead to kidney disease?

*Character Treatment 6*

*Hero:* That condition might happen, far in the future, to someone who isn't doing enough to control the disease. [Upbeat tone.] But you're asking great questions.

*Both:* [Rising tone.] How does diabetes cause that? All your organ systems have one thing in common: They rely on proteins to function. If your body doesn't make enough insulin, sugar binds to those proteins and keep them from working. This is why some people need to inject themselves with insulin.

*Villain:* Have you ever made *crème brûlée?* Take some custard—your proteins—sprinkle on sugar and caramelize it with body heat. [Chuckling] You're making *crème brûlée* out of your body.

A. Earlier you mentioned treatment options.
B. Could you tell me more about what I can do to improve my prospects?
C. Will I have to inject myself with insulin?
D. I don't feel comfortable using needles.

*Character Treatment 7*

*Villain:* [Nodding teasingly.] I bet you're terrified of needles, but in the early stages of diabetes …

*Both:* Injections aren't always necessary. Sometimes pills are enough. Getting plenty of exercise and eating a sensible diet are also key in stopping the disease from getting worse. We can discuss lifestyle changes at your next appointment …

*Villain:* [Impatiently] … because I've got a waiting room full of people. You see, the trouble is your diet and exercise habits are so ingrained they're almost impossible for you to change. So you might as well go straight to the pills or needles.

A. What's wrong with my current diet?
B. What kind of diet and exercise program do you recommend?
C. I feel I am already exercising enough.
D. Is there a type of exercise that is best for people with diabetes?

*Character Treatment 8*

*Villain:* Let's stop here. The first time you hear [pause] *diabetes,* you freeze. That's all you hear. You're thinking, "I'm going to lose a foot! I'll go blind!" So there's really no point in talking about your case now. Take this brochure. Read it before your next appointment, and you'll be able to ask better-informed questions.

*Hero:* It's important to quantify and monitor improvements in diet and exercise, because people tend to underestimate their food intake and overestimate their exercise time. Working with a nutritionist and personal trainer can help with this. You might also consider joining a patient support group. My patients have told me they have learned more in a couple of weeks at a patient support group than in six months of coming to this office, because these groups are run by people who really know what it's like to have the disease. Feel free to contact me if you have any questions or concerns. I look forward to seeing you tomorrow.

*Ending Treatment 2*

Happy:
Nurse Larsson: "Great news, Dr. Richards! The American College of Physicians is honoring you with a Fellowship."
Dr. Richards: "That *is* great news!"
Tragic:
Nurse Larsson: "Bad news, Dr. Richards! Meredith Pratley decided to go ahead with the malpractice lawsuit."
Dr. Richards: "It's unfortunate she feels that way."

## Appendix B. Indices

Table B1
Correlations among dependent variables.

| DV | Trans | Ident | Emp | Sym | Cog | Pers | End |
|---|---|---|---|---|---|---|---|
| Transportation | | | | | | | |
| Identification | .63*** | | | | | | |
| Empathy | .33*** | .34*** | | | | | |
| Sympathy | .37*** | .30*** | .75*** | | | | |
| Cognitive P.-t. | .06 | −.01 | .16*** | .22*** | | | |
| Persuasion | .17*** | .04 | .49*** | .54*** | .50*** | | |
| Ending Pleasure | .04 | .00 | .16*** | .11** | –.01 | .11** | |
| Enjoyment | .51*** | .44*** | .52*** | .46*** | .10** | .33*** | .18*** |

*Note:* $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table B2
Psychometric properties of the scale indices.

| DV | Items | *N* | *M* | *SD* | α | $\alpha_{drop}$ | Skew | Kurtosis |
|---|---|---|---|---|---|---|---|---|
| Transportation | 11 | 738 | −0.04 | 0.86 | .73 | .75 | 0.12 | 0.15 |
| Identification | 8 | 738 | −0.21 | 1.11 | .79 | .82 | 0.05 | −0.73 |
| Empathy | 7 | 738 | −1.20 | 1.21 | .87 | .88 | 0.71 | 0.04 |
| Sympathy | 6 | 738 | −1.00 | 1.34 | .89 | | 0.48 | −0.48 |
| Cognitive P.-t. | 11 | 738 | 1.14 | 0.70 | .64 | .67 | −0.01 | −0.32 |
| Persuasion | 8 | 738 | 0.34 | 1.18 | .85 | .87 | −0.19 | −0.49 |
| Ending Pleasure | 5 | 738 | 0.10 | 1.25 | .92 | | 0.01 | 0.13 |
| Enjoyment | 12 | 738 | 0.60 | 1.05 | .90 | .91 | 0.21 | −0.15 |

*Note:* $\alpha_{drop}$ is the Cronbach α excluding the item with the lowest factor loading if its removal improved reliability. *M, SD,* and α are prior to rescaling and weighted averaging.

Table B3
Transportation
Indicate your level of agreement with the following statements about the consultation.

| No. | Item | Loading | Uniqueness |
|---|---|---|---|
| 7 | I felt like the events in the doctor's office were really taking place. | .63 | .60 |
| 6 | After the consultation ended, I wanted to know what would happen next. | .62 | .62 |
| 10 | In some small way, the consultation has changed my life. | .58 | .66 |
| 1 | I felt immersed in the conversation with the doctor. | .49 | .76 |
| 8 | When the consultation ended, I easily put it out of my mind.[R] | .49 | .76 |
| 4 | The consultation made me feel like I was entering a new reality. | .47 | .78 |
| 5 | The consultation felt intense. | .47 | .78 |
| 2 | I was more focused on my surroundings than the doctor's office.[R] | .36 | .87 |
| 11 | My mind was preoccupied with unrelated matters during the consultation.[R] | .36 | .87 |
| 3 | I never really felt involved in the doctor's consultation.[R] | .32 | .89 |
| 9 | I thought of how the consultation could have proceeded differently. | .09 | .99 |

*Note:* [R] indicates a reverse scaled item.

Table B4
Identification as Patient (Emotional)
Indicate your level of agreement with the following statements in your role as patient during the consultation.

| No. | Item | Loading | Uniqueness |
|---|---|---|---|
| 2 | I was fully absorbed in the role of patient. | .81 | .34 |
| 1 | I felt like I was really the patient. | .78 | .38 |
| 3 | I experienced the same emotions as a real patient would in that situation. | .77 | .40 |
| 7 | I could really feel what it's like to get bad results on a lab test. | .66 | .57 |
| 5 | I could not identify with being the patient in the doctor's office.[R] | .65 | .58 |
| 8 | I didn't feel sad when my blood sugar tested high.[R] | .47 | .78 |
| 6 | As patient, I felt myself guiding the direction of the conversation for a while. | .29 | .92 |
| 4 | I felt like I was still myself in my real surroundings.[R] | .12 | .99 |

Table B5
Empathy (Emotional) for Dr. Richards
Indicate your level of agreement with the following statements about Dr. Richards.

| No. | Item | Loading | Uniqueness |
|---|---|---|---|
| 3 | I can relate to Dr. Richards as a person. | .90 | .19 |
| 4 | I understand how Dr. Richards feels. | .89 | .21 |
| 5 | When Dr. Richards feels joy or disappointment, I can feel it too. | .83 | .31 |
| 2 | I can feel how Dr. Richards feels to give patients bad news. | .69 | .53 |
| 1 | I'd feel happy when Dr. Richards succeeds and sad when he fails. | .68 | .53 |
| 6 | I didn't share Dr. Richards' emotional reactions.[R] | .51 | .74 |
| 7 | I seldom experienced the same emotions as Dr. Richards.[R] | .43 | .81 |

Table B6
Sympathy for Dr. Richards (Empathetic Concern).

| No. | Item | Loading | Uniqueness |
|---|---|---|---|
| 1 | I'd worry if something bad happened to Dr. Richards. | .82 | .32 |
| 2 | I sympathized with Dr. Richards during the consultation. | .82 | .33 |
| 3 | I feel anxious and hopeful about what will to happen to Dr. Richards. | .80 | .35 |
| 6 | If someone tried to take advantage of Dr. Richards, I'd feel protective of him. | .75 | .44 |
| 4 | I don't really care how Dr. Richards feels.[R] | .71 | .49 |
| 5 | Even if Dr. Richards were treated unfairly, I wouldn't care much.[R] | .66 | .56 |

Table B7
Cognitive Perspective-Taking.

| No. | Items |
|---|---|
| 1 | Dr. Richards intended to keep me waiting.[R] |
| 2 | Dr. Richards believes I'm free of disease.[R] |
| 3 | Dr. Richards plans to retest me at his soonest convenience. |
| 4 | Dr. Richards thinks my lack of symptoms put me in the clear.[R] |
| 5 | Dr. Richards believes if a patient follows the treatment, diabetes would likely stop getting worse. |
| 6 | Dr. Richards thinks high blood sugar damages the body. |
| 7 | Dr. Richards would be surprised if I had Type 1 diabetes. |
| 8 | Dr. Richards believes his diet and exercise advice are effective if followed. |
| 9 | Dr. Richards intends to quit medicine.[R] |
| 10 | Dr. Richards plans to marry Nurse Larson.[R] |
| 11 | Dr. Richards postpones running lab tests.[R] |

Table B8
Persuasion (Adherence Intention)
Indicate your level of agreement in your role as patient during the consultation. Strongly Disagree–Strongly Agree.

| No. | Items | Loading | Uniqueness |
|---|---|---|---|
| 5 | I'd inject myself with insulin 3 min before each meal if Dr. Richards recommended it. | .78 | .40 |
| 1 | I'd return to Dr. Richards for diabetes retesting. | .75 | .44 |
| 4 | I'd double my number of meals and cut the quantity in half, if Dr. Richards said it would prevent complications. | .75 | .44 |
| 3 | I'd ignore any treatment advice from Dr. Richards.[R] | .73 | .46 |
| 8 | I'd make any lifestyle change Dr. Richards' suggests to stop the disease from progressing. | .67 | .55 |
| 2 | If I were diagnosed as prediabetic, I would consult a different doctor instead of Dr. Richards.[R] | .63 | .60 |
| 6 | I'd follow Dr. Richards' recommendation to exercise at least half an hour each day. | .62 | .62 |
| 7 | I could not rid my diet of sugar even if Dr. Richards ordered it.[R] | .23 | .95 |

Table B9
Enjoyment (Narrative Appreciation)
Describe your overall experience of the consultation?

| No. | Item | Loading | Uniqueness |
|---|---|---|---|
| 4 | Entertaining–Dull | .87 | .25 |
| 3 | Boring–Interesting[R] | .84 | .30 |
| 9 | Fun–Tiresome | .83 | .32 |
| 5 | Amusing–Tedious | .79 | .38 |
| 6 | Unimaginative–Imaginative[R] | .77 | .41 |
| 8 | Enjoyable–Unpleasant | .73 | .46 |
| 1 | Exciting–Ordinary | .70 | .51 |
| 7 | Depressing–Cheerful[R] | .54 | .71 |
| 10 | Awkward–Adept[R] | .53 | .71 |
| 2 | Suspenseful–Predictable | .51 | .74 |
| 11 | Professional–Amateurish | .43 | .81 |
| 12 | Humorous–Solemn | .41 | .83 |

Table B10
Ending Emotion
Happy: When Dr. Richards found out he was being awarded a fellowship, how did you feel?
Tragic: When Dr. Richards found out he was being sued for malpractice, how did you feel?

| No. | Item | Loading | Uniqueness |
|---|---|---|---|
| 2 | Satisfied–Disappointed | .95 | .10 |
| 1 | Happy–Sad | .91 | .18 |
| 3 | Annoyed–Pleased[R] | .83 | .31 |
| 5 | Angry–Contented[R] | .79 | .37 |
| 4 | Amazed–Discouraged | .71 | .49 |

Table B11
Character's Perceived Emotion (Manipulation Check)
Happy: When Dr. Richards found out he was being awarded a fellowship, how did you feel?
Tragic: When Dr. Richards found out he was being sued for malpractice, how did you feel?

| No. | Item | Loading | Uniqueness |
|---|---|---|---|
| 1 | Happy–Sad | .96 | .07 |
| 2 | Satisfied–Disappointed | .94 | .11 |
| 3 | Annoyed–Pleased[R] | .92 | .16 |
| 4 | Amazed–Discouraged | .83 | .32 |
| 5 | Angry–Contented[R] | .77 | .41 |

## Declarations of interest

None.

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