

Evaluating digital avatars in VR

A systematic approach to quantify the
Uncanny Valley effect

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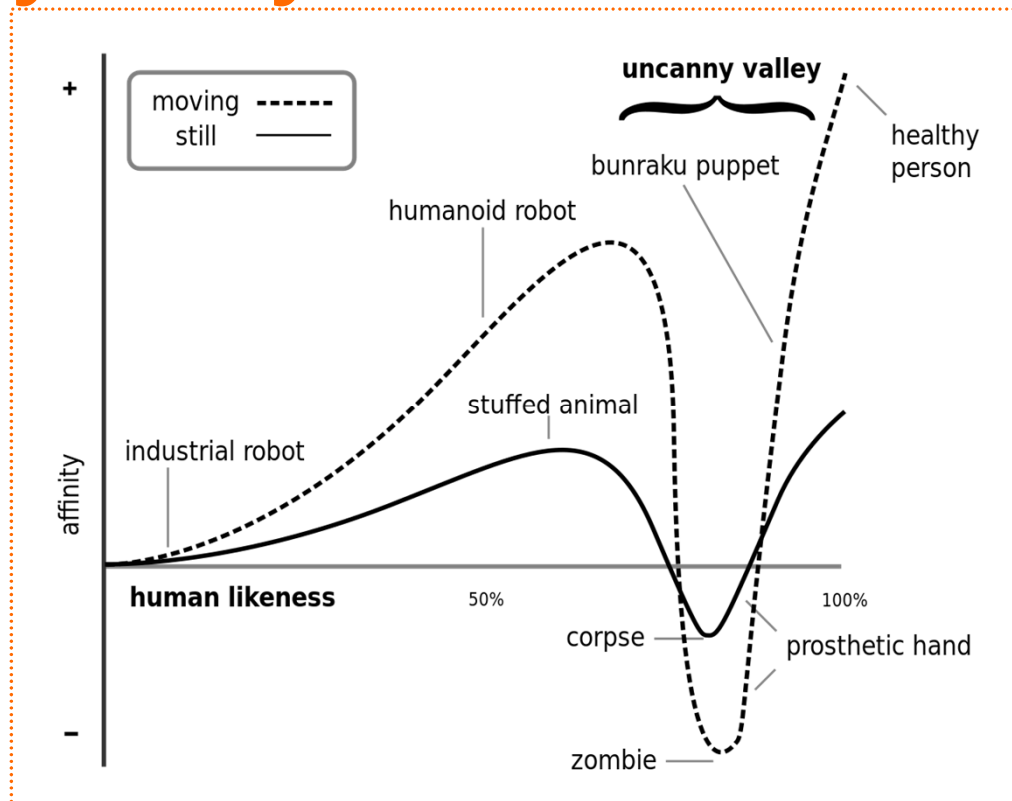
Uncanny Valley

- The **uncanny valley** (Japanese: 不気味の谷, Hepburn: bukimi no tani) effect is a hypothesized psychological and aesthetic relation between an object's degree of resemblance to a human being and the emotional response to the object.
- Used to refer to the **unpleasant** feeling that some people have when they see **robots** (= machines that can carry out actions automatically), or pictures of a **human** being created by a computer, that appear very similar to a living human.



Source: [Uncanny valley - Wikipedia](#)

Uncanny Valley



Source: [Uncanny valley - Wikipedia](#)

ABOT Database

- 251 different Anthropomorphic robots
- Many different sources
- Large survey with mTurk

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Two uncanny valleys: Re-evaluating the uncanny valley across the full spectrum of real-world human-like robots

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ABSTRACT

The uncanny valley hypothesis describes how increased human-likeness of artificial entities, inessentially, could elicit a surge of negative reactions from people. Much research has studied the uncanny valley hypothesis, but little research has sought to examine people's reactions to a broad range of human-likeness manifested in real-world robots. We focused on examining people's emotional responses to real-world, as opposed to hypothetical, robots because these robots impart real-life human-robot interactions. We measured both positive and negative emotional responses to a large collection of full-body images of robots (N = 281) with various human-like features. We found evidence for the existence of not one, but two uncanny valleys: Mori's uncanny valley emerged for high human-like robots and a second uncanny valley emerged for moderately low human-like robots. We attributed these valleys to unique combinations of perceptual mismatches between human-like features, specified by a match between surface and facial feature dimensions accompanied by a mismatch with the body-manipulative dimension. We also found that patterns of the uncanny valleys differed between positive (falar-walaan) and negative (balaan) emotional responses. Lastly, the word uncanny appeared to be an unreliable measure of the uncanny valley. Implications for robot design and the uncanny valley research are discussed.

1. Introduction

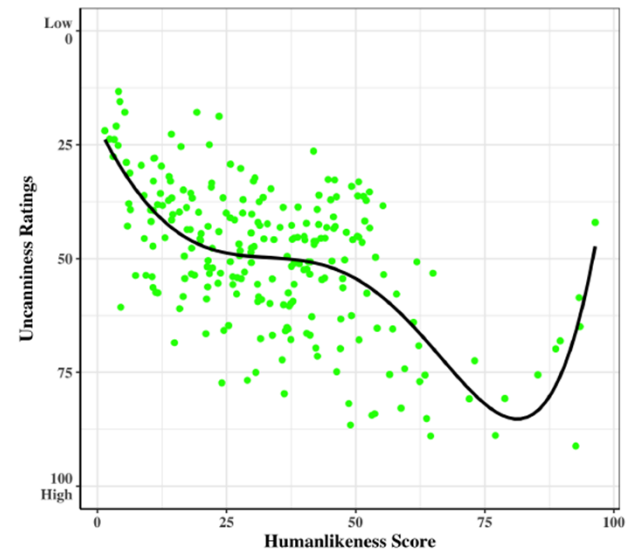
Recent advancement of robotics technologies and the proliferation of robots in societies have spurred abundant research linking human-like appearance of robots to various domains of psychology, Human-Robot Interaction (HRI), and Human-Computer Interaction (HCI), including perceptual (Marcus et al., 2016; Madhur et al., 2020; Powers & Esslinger, 2006; Rosenthal-von der Pütten & Krämer, 2014), cognitive (Gray & Wegge, 2012; Rosenthal-von der Pütten & Krämer, 2015; Zhao, Cui-mann, & Malle, 2016), and behavioral domains (Hasting, Watanabe, Silvers-Tavel, Velonaki, & Matsumoto, 2015, May; 2021; Malle et al., 2016; Rosenthal-von der Pütten et al., 2014). Amidst these interests in the influence of robot human-likeness on people's perceptions, the topic of whether the uncanny valley exists has received much attention (Diel, Wegge, & MacDermann, 2022; Fink, 2012; Ishiyama et al., 2015; Madhur et al., 2020; Mori et al., 2012; Rosenthal-von der Pütten & Krämer, 2014; Pollick, 2010; Wang et al., 2015; Zlotowski et al., 2013).

In describing the effects of robots' human-like appearance on people, the uncanny valley hypothesis (Diel, 1976; Mori et al., 2012) predicts that emotional responses to robots will be more positive as their appearance becomes increasingly human-like. But, when robots appear highly, but not perfectly human-like, people will abruptly show negative responses, described as "an eerie sensation" (Diel et al., 2012, p. 99). The uncanny valley hypothesis posits that, only after the robot's appearance becomes barely distinguishable from humans, will people's emotional responses become most positive (Fig. 1).

The original conception of the uncanny valley stemmed from attentive observation of user experience involving artificial parts or entities. In introducing the uncanny valley, Mori et al. (2012) illustrated the first-time experience of shaking hands with a prosthetic hand. Given this origin of the uncanny valley hypothesis, it would be reasonable and practical to focus research on the issue of whether the uncanny valley exists, specifically, for real-world artificial agents. Real-world robots are designed and built for use in various domains of society, including research and commercial use. Robots that exist in the wild can influence people's perception of and experience with robots, which suggests the need to identify the potential existence of the uncanny valley for improving user experience and robot design. Thus, in the current research on the uncanny valley, we aimed to focus on examining people's perceptions of robots that are present in the world.

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Avatar Database

FINAL FANTASY

FORTNITE

Fallout[®]



mixamo



Sketchfab



ARTSTATION



thws Technische Hochschule
Würzburg-Schweinfurt

Avatar Database



Source: cgtrader.com

- **Gender**
 - Male
 - Female
 - Diverse
- **Age**
 - Elderly
 - Adult
 - Child
- **Art style**
 - Realistic
 - Cartoonish
 - Low fidelity
 - Anime
- **Special features**
 - Default
 - Caricature
 - Occupation
 - Costume

Avatar Database



Source: cgtrader.com

Avatar Database



Case Study



Source: prolific.com

2 question types with one question each:
How uncanny do you think the Avatar is?
How human-like do you think the Avatar is?

8 groups with 50 avatars each and one question type

10 Prolific's Attention and Comprehension Check Policy compliant questions

A total of 60 questions per respondent

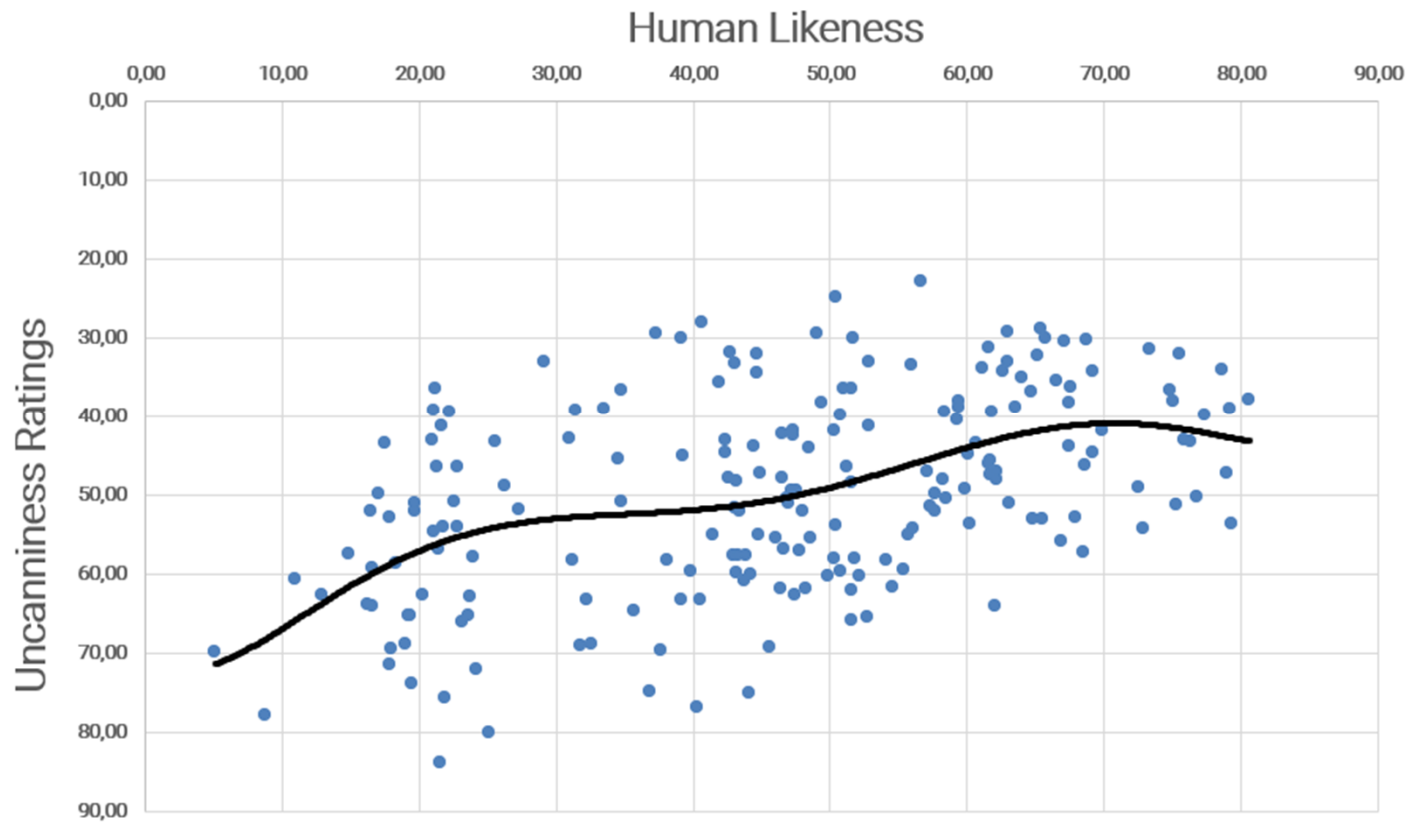
over 200 participants with an Average age of 29 years

Worldwide participation, with England, Spain and Poland in the lead

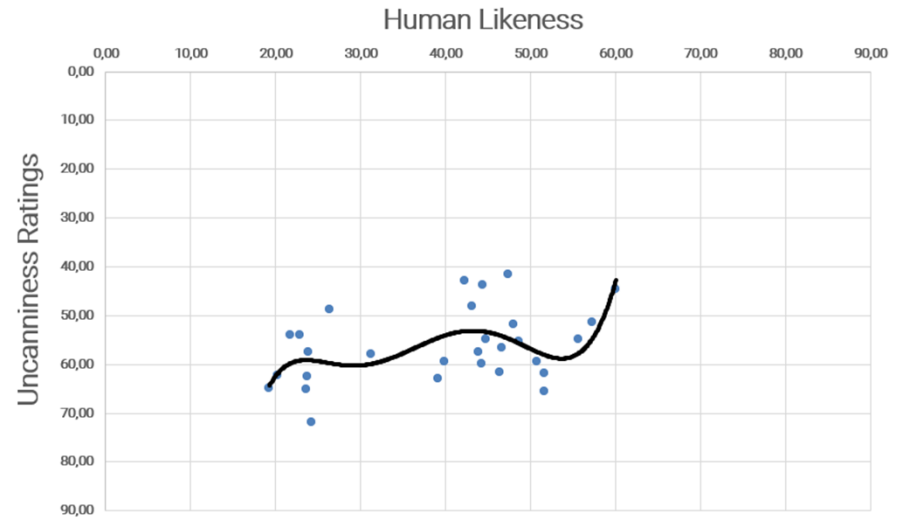
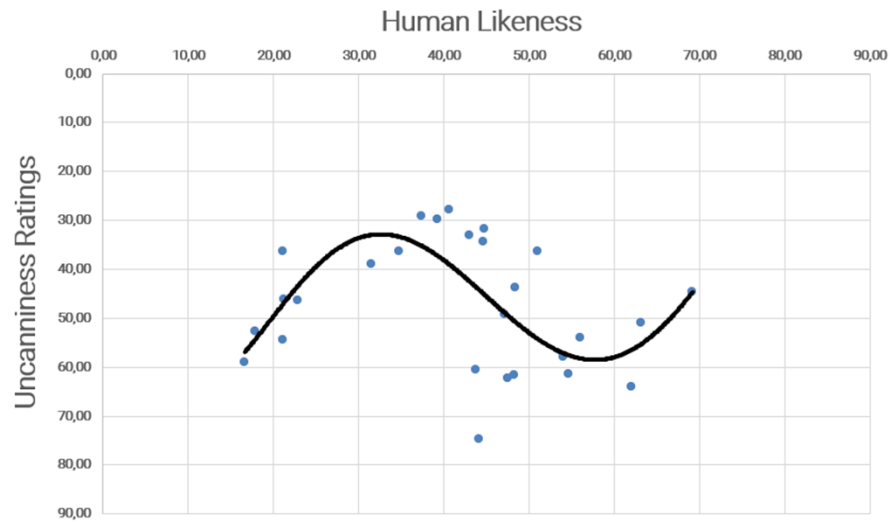
Median duration was 6 minutes

After exclusion criteria, 143 probands were paid out and we had 15 - 20 evaluations per avatar

Results



Results



Conclusion

We could observe the Uncanny Valley in certain categories of avatars but not in the whole spectrum.

We suspect it is due to the noise that occurs when the individual categories overlap.

Future

An even larger study with a planned 1000 avatars and a correspondingly large number of participants.