

The Disappearance of the Uncanny Valley: Future Generations May Not Feel Unease Towards Humanoid AI

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The “Uncanny Valley” theory was proposed by Masahiro Mori in 1970, suggesting that humanoids and animated figures become lifelike, which at some point becomes unsettling and provides feelings of uneasiness. While there have been many studies done on this topic, there is a significant gap in understanding how the Uncanny Valley may manifest in children and how future generations of adults might be affected by this. This research study addresses these questions through a comprehensive examination of the Uncanny Valley in adults and children. It is our prediction that children, who are introduced to rapidly growing technology, will have varying sensitivities to the Uncanny Valley compared to adults. Adults are predicted to be more sensitive to these lifelike humanoids and animations. Furthermore, we predict that the boundaries surrounding the Uncanny Valley will expand as technology continues to advance. The advancement in technology will create some kind of normalcy for future adults, changing the definition of The Uncanny Valley.

Introduction

Sophia, a humanoid robot developed by Hanson Robotics, has been designed to look and act like a human being (Hanson Robotics, 2023)¹. The robot has been programmed to mimic human expressions and emotions, and it has been given the ability to hold conversations with humans. Despite these advanced capabilities, Sophia has been known to generate feelings of uncanniness among people who interact with it (Sommer, Nielsen, Drahemi, Redshaw, Vanmanm, & Wilks, 2019)².

This is a paradigmatic case of a phenomenon called the “Uncanny Valley,” originally proposed by Mori. When people interact with robots (or other artificial beings) that appear almost human, they cause feelings of discomfort. With Sophia, for example, the noticeable imperfections in her likeness, speech, and behavior can lead to feelings of eeriness or revulsion in observers (Okanda, Taniguchi, Wang, & Itakura, & 2021)³. Perhaps surprisingly, though, uncanny valley effects appear to be different in adults and children (Brink et al, 2017)⁴.

This paper reviews and summarizes the existing psychological literature on how children and adults differentially succumb to uncanny valley effects. Not only that, but this paper also uses this information to inform the companies and organizations building these robots of the reasons as to why children are more prone to accepting these changes in technology, unlike adults. Then, I argue that, given advances in artificial intelligence, future adults will be less likely to demonstrate sensitivity toward the uncanny valley.

Significance Statement

Humanoids will become a reality in a few years and as such get introduced within our lives. The Uncanny valley explores how different generations may react to this disruptive inclusion. Insights from this research could be helpful for companies involved in creating AI based humanoids to understand acceptance of their products or likely challenges.

This research is also a step towards educating the society of the changes which are expected and the impact they can cause. When it comes to creating AI models, it is essential for the company to understand the implications these technologies can have on society. By this, these models can be modified to fit into the society better, or reduce the backlash that may arise.

By doing so, the acceptance of these AI robots will grow which in turn will better help society. AI has a lot of different aspects in which it can make our society a better place. For example, this can be seen in the aspects of self driving cars, education, restaurants, and many more. With education, there are multiple implications that can come with it, and learning about how AI functions and what it does is essential for people to understand (Willmore, 2023)⁵.

Thus, this paper focuses on the implication physiological implications of AI and allows companies to better understand why humanoid robots might be accept by one age group and not the other. In addition to that, this paper also predicts the future implications of the term “The Uncanny Valley.”

Methodology

This research paper is a review paper that makes a prediction on if the future implications of the uncanny valley will change. In order to conduct this research, precautions were taken to make sure the data provided and the results were accurate.

The main strategy with this paper was to find previously done experiments and understand the results from those experiments. By doing so, there would be enough evidence to make an indication on if the hypothesis will be supported or unsupported.

During the data collection process, I used google scholar and other trusted websites to find previously done papers in relation to The Uncanny Valley and AI. First, I started by conducting more research on The Uncanny Valley to gain a better idea of the phenomenon. Then, I searched for more previously done papers on AI and robots with children and adults. Through that, I was able to gain more of an understanding of how the uncanny valley reflected itself in adults versus children.

When it came to the criteria to determine if the data provided was valid or invalid, I focused more on the results. If multiple papers conducting similar experiments had a given result, and another paper had a different result, I would exclude that data unless there were more papers supporting that outlier. Based on that process and criteria, I made the prediction on whether the uncanny valley will be present in the future or change in meaning.

Adult Literature

A wealth of research suggests that adults are especially prone to feeling unease towards humanoid robots (e.g., Kätsyri, Förger, Mäkäräinen, & Takala, 2015; Okanda et al., 2021)^{3,6}. These feelings can result from a variety of features—including the tonality of a robot’s voice (MacDorman & Entezari, 2015; Preseglińska; 2019)^{7,8}, smoothness of motion (MacDorman et al., 2015⁷; but see Piwek, McKay, & Pollick, 2014)², and facial composition (Burleigh, Schoenherr, & Lacroix, 2013). For example, when researchers prompted adult participants to interact with either a simple text-based chatbot or with a more complex avatar (that read its responses to the participants aloud), adults tended to feel greater negative emotions when engaging with the complex avatar. They also considered it to be a less effective communicator and more “weird” than the simple chatbot (Ciechanowski et al., 2019). This mostly takes place because adults are used to the environment around them, and these slight changes trigger the uneasiness felt towards these humanoid robots.

Though many hypotheses exist to explain why this happens (Wang et al., 2015)⁹, one main theme follows: Robots can challenge conceptual distinctions. For example, there is usually a clear distinction between something biological (e.g., cat, dog, human being), and something mechanical (e.g., TV, phone, com-

puter). Robots are mechanical, but they also can signal typically “non-mechanical” properties (e.g., being conversational, being able to walk upright, having knowledge; Gray, Gray, & Wegner, 2007; Weisman, 2022)¹⁰. One possibility is that adults tend to feel more uneasiness towards these robots because of this mismatch in biological and mechanical properties.

Just as people may struggle to conceptualize robots as either biological or mechanical, so too might they have difficulty in identifying the mental capacities of robots. People tend to consider others’ minds across two dimensions: experience and agency (Gray et al., 2007)¹⁰. “Psychological experience” consists of phenomenal mental capacities, like hunger, pain, pleasure, rage, desire, personality, consciousness, pride, embarrassment, and joy. “Psychological agency,” however, consists of capacities like self-control, morality, memory, emotion recognition, planning, and communication (Gray et al., 2007)¹⁰. For example, a biological human and humanoid robot can communicate. The majority of the time, adults are shocked by the abilities these humanoid robots have to display the same, or more, agency as humans. This shock leads to them having uneasy feelings towards these robots because of the intimidation that follows these tasks. Because of this, adults struggle to determine the difference between biological and mechanical things. While adults know that robots do not have any biological properties, they still struggle to understand the difference because of how these humanoid robots act, talk, and walk, which is similar to the way humans do.

Developmental Literature

The uncanny valley may not affect children as much as it does adults. The main reason for this is that their brains are still developing and classifying anything they see as ‘normal’ or something that belongs in this world. One study (Sommer et al., 2019)² showed how children started to believe robots have a moral understanding. While playing with a robot named Robovi, the children started to view the robot as something that had feelings and a moral understanding. When the robot was forced to go in the closet instead of playing, 53% of children said it was immoral for the robot to be forced in the closet and 73% agreed that it was unfair for the robot to skip its turn forcefully. For reference, 98% of children said it was unfair for a human to be forced into a closet or out of a turn. The majority of these children had developed a bond with the robot and started to believe that it had an actual moral understanding or feelings, potentially training their brains to believe that robots are like humans. Another experiment also showed that children are more likely to deem robots as having a moral understanding than adults (Reinecke, Wilks, & Bloom, 2021)¹¹. Children believed that a robot could feel some degree of suffering, though not as much as humans or a teddy bear. It was also shown that children believed that robots had the same amount of agency as humans,

meaning robots have the same higher-order mental capacities as humans. They believe that these robots have the same moral standings as humans. Because these robots were introduced at a young age, children did not feel as uncomfortable or uneasy as adults might. It is also important to note that the uncanny valley develops in children later in life as their brain grows more sophisticated (Brink, K. A., Gray, K., & Wellman, 2017)⁴. As children start to understand and accept their surroundings, they start to have more sophisticated brains, leading them to have perspectives on what they deem as natural or unnatural.

Change in Acceptance in the Past

While all these aspects are important to consider the acceptance of humanoid robots in the future, it is also essential to evaluate the extent of cultural differences. Through a study conducted, it was determined that Japanese Americans are more likely to be reluctant to these robots than Americans. This is essential to understand because of the cultural differences. The difference in cultures has led to these individuals gaining a different perspective on the stance of humanoid robots.

An article expresses how these changes in technology have so far affected generations. This study compared the average percentage of cell phones owned by these groups of generations; starting with Millennials, where 93% owned cell phones; Gen Xers, where 90% owned cell phones; Baby Boomers, where 68% owned cell phones; the Silent Generation, where 40% owned cell phones (Vogels, 2019)⁸. These drastic changes in numbers represent the increased use and acceptance of these growing technologies in generations. The more recent generations were more accepting and owned more phones, and the same is predicted to be the outcome with humanoid robots. Since the introduction of cell phones, the more recent generations tended to use more of these technologies which implies that the same trend can be expected with these robots. As the introduction of these robots become more common, the more recent generations are more likely to accept and use those robots compared to the older generation, who may retaliate in the beginning.

Predicted Changes to the Uncanny Valley and Results

The literature shows what the Uncanny Valley looks like in adults and children. Critically, this research predates many of the technological advances (e.g., publicly-usable large language models) present today. Given these advancements and children's exposure to these technologies, it is hypothesized that future generations will demonstrate diminished sensitivity to the Uncanny Valley. Interacting with robots on a daily basis can decrease the uneasiness a person might be feeling.

Since their invention, robots have been shown to have many useful tendencies, especially in helping with inter-ability interactions. (Artificial Intelligence, 2023) For example, robots have helped people with head and facial movement disorders practice interactions with human beings. This may ultimately change the usage and understanding of robots in the future because they will be used to support humans in overcoming complications or fears. Since these robots are being introduced to children at a young age, as they grow up they may also start to normalize these multi-use robots instead of being disgusted or uncomfortable by them, like some adults are now.

Further, robots nowadays have also been used to teach kids how to read, write, and many other things. (Robotics For Kids, 2023)¹² This may eventually lead to a more open-mindedness of robots and their interactions with people instead of the weirdness attributed to robots in today's society.

The person-robot interaction has many aspects to it. The article by Libin, A. V., & Libin, E. V. (2004)¹³ expands on the different types of relationships between humans and robots. The authors argue that people perceive and treat robots, not just as machines, but as companions or artificial partners. These artificial partners are classified into two different groups. The first is assisting robots; these robots are oriented towards industrial, military, research, medical, and service activities. The second group is classified as interactive simulation robots; they are designed for social, educational, rehabilitation, therapeutic, and entertainment purposes. The authors also present findings on the use of robotic cats by children, young and older adults, and elderly persons with dementia. Understanding the different uses of robots allows us to evaluate how and when the uncanny valley can be present. When a robot is used for assistance with dementia, the elderly person may start to view it as a person, a friend, instead of a robot, therefore, eliminating the existence of the uncanny valley in this relationship. An elderly person may be less prone to the uncanny valley because many of them have grown to need and want a companion. Having a companion, even if it's a robot, allows them to feel as though they have a friend, extending their boundaries surrounding the uncanny valley and resulting in more acceptance and less discomfort. Extending on that idea, a robotic cat being present in a child's life may change how they view robots in general. To them, the definition has been altered since they start to normalize the differences and view them as real cats instead of robotic cats. Through this, the conclusion can be made that the Uncanny Valley may have a difference in the future in how it presumes itself.

Conclusion

The uncanny valley was first introduced in 1970 by professor Masahiro Mori and is a phenomenon which is evident in humans due to the increase in humanoid robots. The increase of

humanoid robots in our society has led to individuals feeling eerie or uncomfortable with the resemblance the robots have to humans. The hypothesis of this paper was to determine if the uncanny valley definition will change in the future due to the wide acceptance present now. There have been multiple research papers and experiments conducted to determine how the phenomenon presumes itself. The experiments ranged from adults and children, both having different results.

The experiments and previous papers found on adults indicated that adults are more reluctant when it comes to accepting changes. Through different experiments, many adults had indicated that they feel uncomfortable or unease towards the robots due to their hand movements, voice, and many other aspects. Through this, it was determined that adults are more reluctant towards these robots, and prone to the uncanny valley. While this is evident in adults, the outcome is completely different for children. Through many experiments, it was determined that children feel these robots have the same physiological feelings as humans. This shows that children are more accepting of these robots and presume the uncanny valley in a minimal manner compared to adults.

Through all the data collected, it was predicted that the uncanny valley will change in the future. As the children grow up and are introduced to more humanoid robots, the definition will change and presume itself in a different manner. This prediction was mainly made by the increase in technology use. When phones were introduced, many adults were reluctant to them, but gradually the usage increased, resulting in a more accepting environment. Through this, it can be predicted that the uncanny valley will change in the future.

Limitations and Future Direction

During this research, no experiments were conducted. All the data collected was through previously conducted research and experiments. Based on that, some of the limitations can include not enough exposure to some aspects and inaccurate data from the experiment.

When it comes to the exposure to some aspects, there is always some area that has either not been researched enough or has not yet been thought of. Due to that, there could be some instances where my predictions could be proven false, but being that AI and humanoid robots are a new addition to our society, there is a lack of research surrounding some aspects of the uncanny valley. Given that, there is always a possibility that something was missed which may cause a damper in the results. When it comes to inaccuracy in data, there are always some mistakes done when conducting experiments and collecting data, which can also lead to some misconceptions in the data collected.

For the future, there are precautions that can be taken to make sure these limitations are avoided. There can be more in-depth

research that can be conducted when it comes to aspects that may have been missed or not thought of in detail yet. In order to avoid the inaccuracy in data, more of the same results indicate the accuracy in an experiment. There can be more research or finding of data that will support previous findings.

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