

The Uncanny Valley: Phenomenological Analysis on the Unintended Consequences Caused by the Designer Fallacy of Humanoid Robots

ABSTRACT

In 1970, Japanese roboticist Masahiro Mori proposed the uncanny valley theory, hypothesising the relationship between an object's human likeness and the perceiver's emotional response. This theory has been commonly applied to humanoid robots because of our desire to make robots resemble human beings. Beyond designers' expectations, humanoid robots have unintentionally fallen into the uncanny valley. This mismatch of designers' intents and actual consequences can be referred to as the designer fallacy that was proposed by Ihde (2008). Using the phenomenological method from Sokolowski (2000) and Gallagher & Zahavi (2008), this essay explores how the designer fallacy of humanoid robots has led to the uncanny valley. Three humanoid robots examples that were designed to serve distinct purposes have been selected: *Tara the Android*, an entertaining robot pop singer; *Roxy TrueCompanion*, the first sex robot as claimed by the designer; and *Telenoid*, a comforting minimalistic human-like robot for telecommunication. By reflecting on my phenomenological experience with each example, the reasons for the designer fallacy problems on humanoid robots are investigated. The essay ends with speculation about the future of the human-robot relationship.

INTRODUCTION

Imagine one day. You have a brilliant idea that you know will change the world. So, you pour your heart into designing and creating the thing to achieve this goal. However... The public reception tells an entirely different story in the end.

In fact, it is very common for this to happen in real life, including for John Bergeron, the designer of Tara the Android. In 2001, he began creating a humanoid robot dedicated to entertainment. He had spent three years perfecting his robot Tara, dedicated to making her a pop star in the music industry. Tara first debuted in 2004 with a music video *I Feel Fantastic*. Upon watching her performances, the public found her horrifying rather than entertaining. To this day, people are still discussing uncanniness of Tara. Tara the Android, the humanoid robot that was intended to be entertaining, was embedded into popular culture because of her creepiness, which is entirely different from what the designer imagined. It must be devastating for the designer because the entire thing went off-track, and no one seems to hear from him ever since. Nevertheless, what actually went wrong? Why did the designer fail to deliver his objectives through humanoid robots? Why is this humanoid robot creepy?

This essay centres around the humanoid robots that tumble down the uncanny valley, namely robots that are creepy to perceivers, examining why the designer fallacy leads to this unintended consequence. Three humanoid robot examples from the uncanny valley, each with a unique technology/use relationship, are selected and dissected. The robot examples are Tara the Android, intended for entertainment; Roxy TrueCompanion, intended for sexual activities; and Telenoid, intended for telecommunication. With the phenomenological method from Sokolowski (2000) and Gallagher & Zahavi (2008) being the essay's framework, my phenomenological experiences toward those examples are recorded and analysed. This structure facilitates attentive

discussions by focusing on intuition and suspending my natural attitude. The goal of this essay was to find the common characteristics of the three examples, inspecting the causes of the designer fallacy of humanoid robots leading to the unintended consequences, which is falling into the uncanny valley in this case. By delving into the designer fallacy of humanoid robots and my phenomenological experiences, this essay reflects on the reasons humanoid robots fall into the uncanny valley and speculates on our possible future of human-robot interaction with the continuous development of humanoid robots.

This essay is organised into six major parts. This section highlights the importance of the topic by contemplating its background and motivation. Following this introductory section, the second section evaluates the concepts relevant to the essay's topic. The third section introduces three examples of humanoid robots with their background and designers' intents. The fourth section documents my phenomenological experiences with those robots respectively, while the fifth section investigates the reasons causing the unintended consequences with reference to the designers' intents and my experiences. The final section concludes the essay by providing a summary addressing the research question and speculating on the possible future with the continuous development of humanoid robots.

RELEVANT CONCEPTS

This section highlights the concepts relevant to the research topic: humanoid robots, the phenomenological method, the designer fallacy, and the uncanny valley.

Humanoid Robots

Humanoid robots have shapes that resemble humans (Kajita et al., 2014). The current development is trying to make humanoid robots like humans both externally and internally. The goals are that robots look not only similar to human beings but also intelligent and can behave, reason, and interact like humans (Fukuda et al., 2017).

Humanoid robots have been used in a wide range of disciplines, including entertainment (Bergeron, 2001), sex (TrueCompanion, 2019), and telecommunication (Ishiguro et al., n.d.).

The Phenomenological Method (Sokolowski, 2000; Gallagher & Zahavi, 2008)

A four-step phenomenological method can be summarised according to Sokolowski (2000) and Gallagher & Zahavi (2008).

The first step is epoche or bracketing. Its purpose is to “suspend or bracket a certain natural attitude towards the world, thereby allowing us to focus on ways in which things appear to us” (Gallagher & Zahavi, 2008). The natural attitude refers to the everyday experience people have towards the world.

The second step is phenomenological reduction, shifting the attitude from natural to phenomenological. Phenomenological attitude reflects the natural attitude and the intentionalities that occur within it. This step aims to analyse the “correlational interdependence between specific structures of subjectivity and specific modes of appearance or givenness” (Gallagher & Zahavi, 2008).

The next step is eidetic variation, also known as imaginative variation. By changing the object's properties in our imagination, this step focuses on the crucial or invariant aspects of the collaboration.

The last step is intersubjective corroboration. After completing the phenomenological analysis in the previous step, this step is about sharing and comparing our descriptions to others.

The Designer Fallacy (Ihde, 2008)

The notion of designer fallacy was first proposed in an essay written by a philosopher named Don Ihde in 2008. He defined the term by looking at each word individually: *designer* refers to a person “design[ing] into a technology, its purposes and uses,” and *fallacy* involves “some degree of material neutrality or plasticity in the object, over which the designer has control.” In other words, designer fallacy explores the unforeseeable and unpredictable effects brought by technologies after they were employed, in which the consequences did not align with the designer's original intent.

Ihde identifies four things about the nature of technologies that need to be considered when dissecting the designer problem. The first one is the non-deterministic results produced by technological practices. For example, the phonograph, which was only intended to reproduce sounds, facilitated the development of the recording industry. The next one is the embeddedness of technologies in cultural contexts. Take the windmill as an example. This technology was used as praying devices in India, energy generation devices in Mesopotamia, and machines for pumping out the lowlands in Europe. The third one is the impact of the dance of agency on designer intent. For instance, it is difficult to identify the designer of post-it notes as a handful of parties had contributed significantly to the invention of this technology. The last one is the multiple uses or trajectories of technological development, such as gunpowder. This technology was invented in China, and there is a difference in trajectory in Europe, in which gunpowder had been developed into canons.

Ihde recognised the complexity and multistability of the inter-relations between designers, materials used to create the technologies, and the use of technologies. Thus, he evaluated the problem by looking into the two interstices: the designer/material relationship and the technology/use relationship. Under the designer/material relationship, “a process of interrogation of materiality and experimentation with it” was involved. On the other hand, the technology/use relationship focuses on the uses and how the invention of technology is put. Aeroplanes can be one example to illustrate this idea. During World War I, this technology was used militarily. Later on, aeroplanes began to be used recreationally. Users play a more crucial role in the technology/use relationship than designers because the particular use context shapes the relationship.

The Uncanny Valley (Mori et al., 2012)

Japanese roboticist Masahiro Mori formulated the uncanny valley in 1970. His theory centres on the relationship between the entity's human likeness and the perceiver's affinity for that entity. Mori hypothesised that the perceiver's affinity for a robot increases with the robot's human likeness. Then when the human likeness grows to a certain extent, the affinity drops off

dramatically, and the viewer's feeling changes to uncanniness. This dip in affinity is referred to as the uncanny valley.

Fig. 1 illustrates the relationship between affinity and human likeness of the uncanny valley with examples clarifying the concept. The leftmost example in the graph, industrial robots, describes robots with no faces or legs resembling human beings. Thus, perceivers barely have any affinity for them. People, especially children, have a heightened sense of affinity towards toy robots, which has a form of an approximate human with a face, arms, legs, and a torso. Robots tumble down into the uncanny valley when realism goes wrong. An eerie sensation arises when people realise that realistic-looking prosthetic hands are artificial because of their texture and coldness.

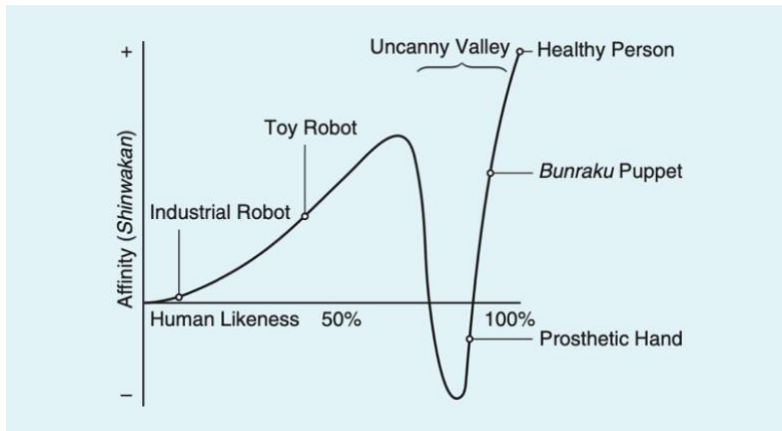


Fig.1 The uncanny valley proposed by Masahiro Mori with examples. (Mori et al., 2012)

Moreover, Mori mentioned that the entity's movement is another factor that affects the perceiver's affinity. Fig. 2 depicts the uncanny valley with the presence of movement. If the entity's velocity, acceleration, and deceleration are not similar to human movement, the slope in the uncanny valley steepens. He elaborated on this phenomenon with the robots at the Japan World Exposition, Osaka, 1970. The event exhibited a robot that could smile in a human-like fashion. However, its expression looked scary, rather than happy, when the designer slowed down the robot's speed and made it smile more slowly.

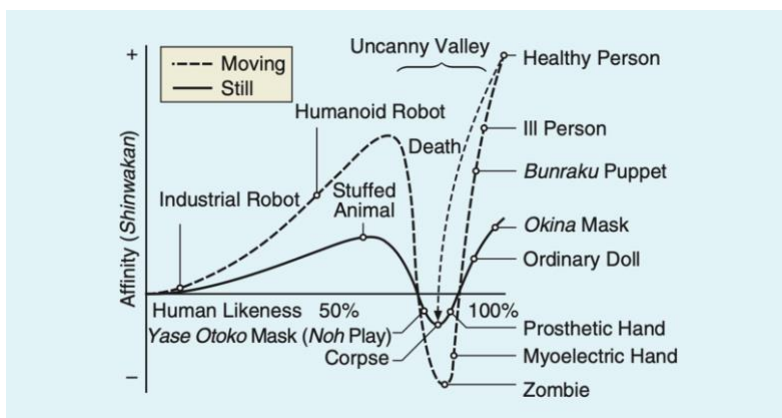


Fig.2 The uncanny valley with the presence of the entity's movement. (Mori et al., 2012)

INTRODUCING HUMANOID ROBOTS EXAMPLES AND THEIR DESIGNERS' INTENTS

This section highlights three types of humanoid robots, providing a short description for each of them regarding their backgrounds and designers' intents. Those humanoid robots were selected because they were not intended to be scary, but my natural attitude towards them is uncanniness. The humanoid robots featured below are with different technology/use relationships: *Tara the Android* was for entertainment use, *Roxxx TrueCompanion* was for sexual use, and *Telenoid* was for telecommunication use.

The Humanoid Robot for Entertainment: Tara the Android

As illustrated in Fig. 3, *Tara the Android* is a 5' 10" tall female humanoid robot built by John Bergeron (Smaller Android projects, 2006). She has a metal frame covered with synthetic rubber skin (Android music videos, 2006). According to an early description of the prototype of *Tara* in 2001 (Bergeron), this robot was "intended primarily for entertainment, not doing work". On the Android World website, the designer listed five uses of the robot, including performing in music videos, shown in Fig. 3. *Tara's* first music video, *I Feel Fantastic*, appeared on the Internet in 2004 (IMDb, 2022). Re-uploaded versions of the video can be found on YouTube (TaratheAndroidVEVO, 2022).



Fig. 3 Tara the Android. (Smaller Android projects, 2006)

Uses:

1. A display, for theme parks, trade shows, advertising.
 2. Research, for computer vision processing or AI human interaction, etc.
 3. Home use, for entertainment.
- Tara has an *ELECTRIC* personality.
- You can be in complete control of this android.
4. Security. One human operator can remote-control several androids, while remaining safely in a more secure location.
- Male and other android appearances possible.
- Provides deterrence and a friendly appearance.
5. Music videos, or live music performances (especially if modified first).

Fig. 4 Uses of Tara the Android. (Android World, 2006)

The Humanoid Robot for Sexual Activities: Roxxy TrueCompanion

According to TrueCompanion.com's blog (n.d.), *Roxxy TrueCompanion* is the first humanoid sex robot, which was manufactured by the company. In an interview with the robot's engineer-inventor Douglas Hines (asylumchannel, 2010), he mentioned that *Roxxy* was not only a sex toy, but a companion for the user, and believed developing bonds between the robot and human was also essential. His attitude probably explained the reason *Roxxy* had functionalities that are not directly related to sex, such as knowing users' names, likes and dislikes, and carrying on a

discussion (TrueCompanion.com, n.d.). In other words, the designer wanted *Roxy* to be the user's companion, and sex is more like an additional function users can use to satisfy their needs.



Fig. 5 Roxy TrueCompanion (left) and her inventor Douglas Hines (right). (Independent Digital News and Media, 2010)

The Humanoid Robot for Telecommunication: Telenoid

Telenoid, depicted in Fig. 6, is a humanoid robot developed by Professor Hiroshi Ishiguro, explicitly designed for communication (Ishiguro et al., n.d.). The prefix *Tele-* denotes the terms Telephone and Teleoperation, while the Latin postfix *-oides* represents similarity, as in Humanoid (*Telenoid*, n.d.). To allow any person to transfer their presence from distant locations to *Telenoid*, it was designed to look and behave similarly to a minimalistic human (Ishiguro et al., n.d.). Moreover, the designer discarded most of the unnecessary human features unrelated to communication from *Telenoid*, making it to be identified as a person of any gender and age. His primary intent was to “[allow] people to feel as if a faraway acquaintance were close to them” with *Telenoid* (Ishiguro et al., n.d.).



Fig. 6 Telenoid. (Ishiguro et al., n.d.)

PHENOMENOLOGICAL EXPERIENCE OF HUMANOID ROBOTS

After researching the three humanoid robots, I have completed the first step of the phenomenological method, epoche or bracketing, by suspending my natural attitude towards them. This section proceeds to the next step, phenomenological reduction, which documents my phenomenological attitude towards humanoid robots.

Tara the Android

When watching *Tara's* musical performances on YouTube, her weird movements in closeup and her voices gave me a sense of eeriness.

Tara's movements are creepy to me, especially when I saw them in closeup, like the one in Fig. 7. When she was singing in the video, she only moved her mouth and had little to no head movement. At the same time, with the video being in low resolution, her movements are even less noticeable. With these unnatural movements, she reminds me of the masked killers in horror films.



Fig. 7 *Tara the Android in closeup.* (TaratheAndroidVEVO, 2022)

Tara's voice was monotone, and I found that challenging to understand what she was 'singing' in the music video. I need to search the lyrics online to recognise the words. Without those lyrics, rather than singing, I felt like she was saying magic words in a weird rhythm to cast spells on the viewers. I was creeped out by *Tara* the longer I listened.

Roxxy TrueCompanion

I watched several videos on YouTube featuring *Roxxy TrueCompanion* and looked for her information online. This humanoid robot was a nightmare to me when she moved.

I think *Roxxy* was fine in idle modes, like the one in Fig. 8. She looks lifeless and like a sex doll chilling on the sofa. Honestly, it was funny to see two grown men doing an interview in front of her while she was sitting between them.



Fig. 8 *An idle Roxxy TrueCompanion during an interview.* (asylumchannel, 2010)

However, when the designer demonstrated how *Roxy* moved, it was horrifying, to say the least. Most of the time, throughout TrueCompanionLLC's video (2018), *Roxy* had eye movement malfunctions, as illustrated in Fig. 9. Only the position for the left eye was correct. *Roxy* looked fine when covering her right-side face. However, looking at her face as a whole, she felt like a human having a normal state and in crisis simultaneously. In general, *Roxy*'s movement demonstration gave me a weird vibe.



Fig. 9 *Roxy* TrueCompanion with eye malfunctions. (TrueCompanionLLC, 2018)

Over the years, Hines had worked on improving *Roxy*. Unfortunately, the only update I could find demonstrating the changes is the one in Fig. 10. I admit this face looks much better than the one he showed in 2010, and I like it. However, without any references to *Roxy*'s appearance and movements, I do not have any further comment on this new *Roxy*.



Fig. 10 New *Roxy* TrueCompanion's face. (TrueCompanion.com, n.d.)

Telenoid

I felt uneasy upon seeing *Telenoid*'s face, form, and movements.

The discomfort first kicked in when I saw *Telenoid*'s face. I recognised all the essential features of human beings from *Telenoid*, like eyes and nose. Nonetheless, I think *Telenoid* (Fig. 11) looks more like an alien, such as the one in Fig. 12, than an actual human. The robot has more common characteristics with aliens than human beings. For example, aliens and *Telenoid* have pale skin colour and smooth skin texture, and do not have eyebrows and ears. This resemblance is terrifying to see in a humanoid robot.



Fig. 11 *Telenoid* in closeup (Spectrum, 2018)



Fig. 12 Aliens (Wolchover, 2012)

Telenoid's form makes me further prove my theory of it being an alien rather than a human beings. After seeing its whole body in broad daylight, like the one in Fig. 13, Redditor OfficialKaistro's comment summarises my impression: "it looked like a seriously deformed sentient penis" (2022). Although *Telenoid* does not shape like a conventional alien in our shared belief, I think it is weird looking enough to be categorised as an alien species.



Fig. 13 *Telenoid* in broad daylight. (ISHIMURA_MJD, 2022)

When researching the information of *Telenoid*, reading its features was a chilling experience for me. In my opinion, one of the most remarkable functions of *Telenoid*, in my opinion, is its ability to breathe. According to its designer, *Telenoid* performs "spontaneous behaviours, such as breathing, are generated automatically to create the sense that the robot is alive" (Ishiguro et al., n.d.). With this knowledge and the mental image of *Telenoid* as a weirdly-shaped alien, I was scared to imagine bringing *Telenoid* close to myself. It is like being able to sense the breath of an Annabelle doll from the horror film *Annabelle*, but now the object, *Telenoid*, looks more petrifying simultaneously.

FROM DESIGNER FALLACY OF HUMANOID ROBOTS TO THE UNCANNY VALLEY

This section examines the designer fallacy of humanoid robots by comparing the designers' original intents to my phenomenological experiences as a perceiver. It also analyses the third step of the phenomenological method, eidetic variation or imaginative variation, offering insights into how the designer fallacy of humanoid robots leads to the uncanny valley.

Tara the Android

Although the designer intended to create *Tara* for entertainment, eeriness intensified when I watched her movement and singing during her performance.

For *Tara's* movements, the designer only configured her head and mouth movements, in which she can tilt and turn her head, and open and close her mouth (Bergeron, 2001). Even though *Tara* looks like a human being, her lack of non-verbal communication is a huge indicator of her inhumanity. Tinwell et al. (2011) elaborated on the importance of upper-face animation. They mentioned that displaying emotions with non-verbal signals created by eyelids and forehead

movements is pivotal to enriching communication. In most music videos, human artists have complete body movements and facial expressions when singing. Nevertheless, with *Tara* only moving her mouth in the music video, her human likeness dropped, and she tumbled down the uncanny valley.

Concerning *Tara's* audio, the designer generated the music with software simulating the analogue bass and other instruments on the computer (Android World, 2006). Probably due to the technological limitations back in the day, *Tara's* sound bizarre and inhuman. Unlike nowadays, when people can convert text-to-speech with artificial intelligence with a few clicks, it was difficult for the designer to manually simulate the words spoken by *Tara* with software, let alone make her sound like she was singing. Therefore, *Tara's* voice was so bad that it did not sound like a human or machine, sending chills down the perceivers' spine.

The analysis above suggested there is a primary reason to deviate *Tara* from her designer's intent, leading her into the uncanny valley: the dispute between her humanness, like her human-shaped body, and her inhumanness, including her limited movements and neither human-like nor machine-like audio.

Roxxy TrueCompanion

The designer aimed to make *Roxxy TrueCompanion* form relationships with and be a 'true companion' to human beings. Frankly, as a perceiver, I could not bring myself to form any kind of relationship with *Roxxy*. Despite her human-like body shape, *Roxxy* gave me a sense of creepiness when she moved.

Probably due to the videos' low resolution, *Roxxy* passed for a human when she was not moving, in my own opinion. I think her human likeness is relatively high, which would not make her fall into the uncanny valley. However, her movements broke all the illusions. When I saw her glitch up close, she did not resemble a human anymore, and her human likeness suddenly dropped to a level where the uncanny valley lies.

Roxxy was quite convincing as a human in the beginning when not moving, but later became creepy when I saw her malfunctions. I could not feel the emotions the designer wanted me to have towards *Roxxy*, and I think *Roxxy* should belong to the uncanny valley. I conclude that the reason is most likely the conflicts between my expectations and perceptions of *Roxxy*.

Telenoid

The designer attempted to design *Telenoid* as comforting to humans as possible. Unfortunately, this humanoid robot had the opposite effect on me as a perceiver since I was terrified of it. I felt uneasy upon seeing *Telenoid's* face, form, and movements.

As mentioned in the section about the basic information of *Telenoid*, the designer discarded most of the unnecessary human features to make it resemble anyone. Unknown to him, this decision made *Telenoid's* face and form look like an alien to me. I could recognise the essential features of human beings from the robot, like eyes and nose, which made *Telenoid* with high human likeness. However, having those human features did not automatically make a thing look human. I felt like the designer had eliminated too many human characteristics from the robot, making

Telenoid look inhuman. Moreover, the robot's smooth texture also made it look horrifying. The designer used "a soft and pleasant skin texture" for *Telenoid* so that the users could enjoy hugging and talking to the robot (Telenoid, n.d.). As I do not have the chance to come close to any *Telenoid*, I cannot judge whether its material would make me ignore its uncanniness and enjoy my time with *Telenoid*. Nonetheless, *Telenoid*'s face made it impossible for me to have the desire to come close to it and use it.

I believe the reason the designer fallacy occurred and *Telenoid* became an uncanny-valley-robot is the clash of inhumanness and humanness. The face and form made *Telenoid* look alien, namely non-human to me, but its movements, including breathing automatically, resembled human too well. A sense of eeriness intensified when I had all those knowledge in mind.

When discussing the designer fallacy of *Telenoid*, I think it is also essential to bring up the designer's decision on the robot's child-like size. In an interview at RMIT Gallery (RMIT University, 2012), he believed that "size [was] an important factor", and a bigger *Telenoid* would scare people as they were usually afraid of giant robots and unknown objects. In my opinion, I do not agree with his belief because *Telenoid* is scary in any size. Its size only impacted how the robot is creepy. At its current size, I think *Telenoid* is an alien baby. And if *Telenoid* became larger, I would only think it is an alien adult. Another significance of this interview is that it showed that the designer had examined the eeriness of robots and tried to make *Telenoid* look less scary. Lamentably, his consideration does not prevent the robot from having the designer fallacy problem and falling into the uncanny valley.

CONCLUSIONS

Overall, with the phenomenological method according to Sokolowski (2000) and Gallagher & Zahavi (2008) as a framework, this essay examined the reasons the designer fallacy of humanoid robots leads to unintended consequences, which is tumbling down the uncanny valley in this case. After researching the three humanoid robots examples, *Tara the Android*, *Roxxy TrueCompanion*, and *Telenoid*, I recorded my phenomenological experience upon perceiving those robots. By comparing the differences between the designer's intent and my experience as a perceiver of humanoid robots, the root cause for this discrepancy was concluded, which was the clash of humanness and inhumanness between components of the humanoid robots, making their human likenesses falling in the sweet spot of the uncanny valley. This essay serves as the last step in the phenomenological method, intersubjective corroboration, as it documented my phenomenological analysis and was ready to share once it was completed.

With the ongoing trend of robotics development, roboticists work towards creating humanoid robots to be a replica of human beings, developing robots with human-like features, including the ability to draw and feel human emotions. It is possible to have a future where technology can easily produce robots with a full human likeness, freeing us from the 'threat' of the uncanny valley. This sounds like a beautiful outcome. I hate to be a Debbie Downer. However... is it?

Imagine living in a world where we can make the humanoid robot a complete replica of humans, and you walk down the street and interact with an entity that looks and acts like a human. How do you identify whether they are real human beings or humanoid robots? On the face of it,

distinguishing between humans and robots might not be necessary. However, our inability in this area implies that there are no differences between human-human and human-robot relationships. It would be a damning thing for the human fertility rate. Let us not talk about the nitty-gritty of humans and robots falling in love and marrying each other, because there is a possibility that humans and robots can produce children together in the future.

Imagine one day, people decide to raise humanoid robots as their children, instead of actual humans. Maybe they want to enjoy parenthood but do not have the time and money to raise human children, so they turn to robots as a solution. I know you think I am talking nonsense. However, similar things have been occurring, but only robot pets at this moment. In Japan, families with young children join a traditional festival named Shichi-Go-San to celebrate their growth and well-being (nippon.com, 2020). Owners of the robot pets have organised a ceremony for this festival, specifically for their pets (Yahoo!, 2022). Although those robot pets are not direct replicas of animals, this phenomenon reflects that humans tend to treat robots as the original entities they resemble, which are pets in this case.

The uncanny valley is the main obstacle stopping us from treating humanoid robots as real humans. So... Maybe the uncanny valley is protecting us? Maybe the uncanny valley is a safe place for us to stay? Maybe we should never try to escape from this valley...

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