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Imagining New Futures: National Narratives in the Japanese Science Museum

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Abstract

The social robot is often presented as a solution to the ongoing demographic crisis and economic stagnation Japan faces, both by Japan itself and by the international community. The Japanese are viewed as inhabitants of a culturally unique affinity towards robots in both Japanese and non-Japanese media and academics, a widely circulated narrative that has tethered advanced technology to the notion of "Japanese-ness". This study argues that the Museum of Emerging Science and Innovation (the Miraikan) in Tokyo as an institution harnesses this narrative of the Japanese love of robots to legitimize a specific version of the future, which the social robot is part of. Through a combination of Lotman's cultural semiotics and the concept of sociotechnical imaginaries, the article examines what version of the future is being presented at the Miraikan by analyzing the concrete messages presented at and by the museum. As the Museum is backed by the Japanese state, academia, and industry through a variety of policies and initiatives, the narrative is presented and communicated to the Japanese public in what can be viewed as an act of autocommunication. The robots in the exhibitions at the Miraikan works as a boundary object facilitating the communication between the Museum and its visitors, positioned in the periphery of a technoscientific semiospheric foam in the bigger national semiosphere of Japan. The article shows that while the robotic figure in the museum itself has evolved from hyperrealistic androids to cute robotic companions, core traits remain fixed, as the ideologies behind them are unchanged. The robot's meaning is crystallized at the Miraikan, solidifying the narrative of the Japanese love of robots and further promoting the sociotechnical narrative at hand.

Introduction

Japan's relationship to advanced technology—especially robots—is widely discussed not only in Japan Studies but also in other parts of academia, often in stark opposition to the "Western" relationship with imagined futuristic technology. Whereas the Japanese are often portrayed in both popular culture and academic works as inhabitants of an endemic affinity towards robots and other advanced

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technological artefacts, the Anglo-American world is described as having the opposite reaction to the "Robot Revolution" (Sone, *Japanese Robot Culture* 6–9). Japan has contributed to this notion, positioning itself as a forerunner in the global race for technological dominance, and advanced technology, especially in the robot form, is inserted into the Japanese imaginary on a multitude of levels. Government reports include futuristic visions of families with robotic housekeepers, and major events such as World's Fairs and presidential visits all feature meetings with humanoid robots (Kusuda 12–13; Robertson, *Robo Sapiens Japanicus* 36–38; Sone, *Japanese Robot Culture* 73–74; Sugisaki and Ooshika). The robot as an extension of advanced technoscience plays a key role in the international and national media representations of Japan's future. For Western countries, this robotic narrative seems to be a means of establishing Japan as an "Other". This narrative is also popular among the Japanese, linking the notion of "Japanese-ness" with advanced technology and robotics.

In the present study, I argue that the National Museum of Emerging Science and Innovation (henceforth the Miraikan) in Tokyo as a national institution harnesses the narrative of a uniquely Japanese cultural affinity towards robots to legitimize a specific future where the social robot is an integral part of a utopian Japanese society without the current crises. Through a combination of Science and Technology Studies (also known as STS) and semiotics, the social robots presented in the Miraikan exhibition "Create your future" (*mirai o tsukuru*) are analyzed as an example of the Japanese government's autocommunication to the Japanese people themselves, presenting a carefully curated vision of an idealized future in co-existence with robots. In combining these two fields, especially the concepts of "sociotechnical imaginaries" and the "semiosphere", I aim to provide a new perspective in the debate on Japanese robotics in Japan Studies, as well as another non-Western case in the debate on science communication in STS and semiotics respectively.

The Miraikan poses an interesting case, as it is a highly popular museum among both the Japanese and international tourists visiting Tokyo: the museum boasts a rating of 4.1 stars out of 5 based on more than 13.000 reviews on Google reviews at the time of writing, and is featured on many lists of recommended museums in Tokyo. Furthermore, it offers a unique perspective, as the museum and its backers weave a specific narrative concerning the Japanese future and the ways in which technology, especially robots, constitute it through not just the exhibitions, but also the museum's science communication praxes and online presence. In this way, the Miraikan contributes to the creation of a "great robot nation" (*robotto taikoku*), supporting a techno-nationalist narrative with roots all the way back to the Meiji period (1868–1912). The Miraikan in this article serves as an example of how the public is introduced to grander, national narratives with a specific intent, as the museum was created by a governmental agency as part of Japan's science and technology policy.

First, the article will provide an overview of the current state of literature on Japanese robotics. Following this, I will analyze the robot exhibitions at the Mi-

raikan by using Yuri Lotman's cultural semiotic framework of the "semiosphere" as well as the STS concept of "sociotechnical imaginaries", beginning with an introduction of the Miraikan itself. In this section, I argue that the robots and their performances work as a boundary object communicating these sociotechnical imaginaries of the future of Japan. Finally, I discuss how the sociotechnical imaginary is being used in autocommunicative acts to strengthen the national semiosphere of Japan currently facing several problems by drawing on pre-existing narratives.

(Digital) Ethnography

This article combines digital ethnography with in-person observations. The data collection for the study was originally conducted using digital ethnography due to the recent pandemic. Also known as digital, virtual or remote anthropology, this field has evolved alongside digitalization through the omnipresence of the internet—but has also been criticized among researchers engaging in fieldwork, as the emergence of this methodology has challenged the notion that 'correct' ethnographical work needs to be located geographically and requires the physical presence of the ethnographer (Walton 117). This methodology, however, provides new perspectives and ways to engage with the research subject, and should not be disregarded nor delegitimized, as it also makes possible fieldwork in unsafe and uncertain times, for example during a pandemic (Postill 63–64; Walton 117). The reopening of borders around the world has made it possible again to conduct in-person fieldwork, and the two methodologies can thus complement each other, further nuancing a data set.

This ethnographical material can be split in two categories: online and in-person. The first category contains sources from the online presence of the Miraikan collected from 2020 to 2021 and again in late 2023. The second category of data was collected at two different visits over a three-month period in 2023; the first visit to the Miraikan was during the renovation of the main robot exhibition in September, and the second visit was after the exhibition reopened on 20 November 2023. The data thus includes both online material and in-person observations from 2020 to 2023, reflecting different meaning-making processes mediated in different ways in the Miraikan. The ethnographical material is further supplemented by science, technology, and innovation policy. These include materials on the Innovation 25 plan from 2007, Society 5.0, and the current Moonshot programme. The ethnographical material illustrates the message presented at the museum; the archival material will show the policies and politics behind the science communication at the Miraikan.

Japanese Robotics

This section will briefly introduce the field of Japanese robotics, a broad subject that has been studied by scholars in Japan Studies and elsewhere. Studies on Japanese robotics can roughly be divided into two paradigms, all based on one

essential premise: that the Japanese people possess a uniquely Japanese cultural affinity towards robots. The first paradigm accepts this premise—the second rejects it, and instead attempts to show how this idea is constructed through a variety of different means.

Three main factors have been identified as basis of the premise that the Japanese themselves, and much of the surrounding world, believes Japan to be accepting towards robots. The first is the animism of the indigenous Shinto-religion of Japan, in which inanimate objects are infused with personality; the second is the concept of invented traditions, where relics from the past have been connected to this narrative through discourses on the uniqueness of Japan (one typical example being the wooden *karakuri ningyō* (mechanical dolls) of the Edo period); the third is a positive media representation which is quite different from the West,[1] where robots in movies often are portrayed as dangerous and cold (Sone, "Realism of the Unreal" 351–55; Šabanović 344–45).

In the first factor, the Shinto argument, special attention is often given to the animistic tendencies of the indigenous religion of Japan, where *kami*, vital forces, can infuse inanimate objects, for example a robot, with personhood. Shinto is sometimes either replaced or supported by Buddhism, as is the case in Geracis article, where he argues that "[s]acralization of the natural world and human technology in Shinto and the positive spin given to human life in Shinto and Buddhism promote the development of robotic engineering and the glorification of the humanoid robot in Japan" in juxtaposition to the West (Geraci 240). Similarly, Macdorman et al. highlights religious factors, arguing that the Abrahamic religions has a historical resistance against science and technology (Macdorman et al. 488). Jensen and Blok's article using Actor-Network Theory on Japanese robotics is another example of the Shinto argument, utilizing Allison's concept of Japanese techno-animism to unfold their study (Jensen and Blok; Allison). Several works add to the Shinto argument by using Japanese emic terms and philosophical concepts to show how this is a uniquely Japanese trait. Robertson for example uses *ba* (topos/place) and *inochi* (life) in her discussion of how the robot upholds a traditional extended nuclear family in Japan (Robertson, "Robo Sapiens Japanicus"). Other concepts include *kokoro* (mind/heart/spirit), *kansei* robotics (sensitivity, a way to say 'affective' robotics), *mono no aware* (sensitivity to things/pathos of things), and *aida* (betweenness) (Katsuno; Nakada; Šabanović 354–59).

The second factor, which Šabanović refers to as "invented traditions" inspired by Eric Hobsbawm, illustrates how robotic mythmaking takes place in Japan (Šabanović 344–45). In this argument, the wooden automated *karakuri* dolls from the Tokugawa (also known as Edo) period (1600–1867) are highlighted as proof that the Japanese always had an interest in robotics, and is used both in and outside of Japan to discuss the Japanese love of robots. The dolls were made with Dutch

[1] In these arguments the West is usually comprised of Europe, the UK, and the USA. When discussing religious factors, the Middle East have at times been included in the comparisons, as Islam is one of the Abrahamic religions.

clockwork technology imported during the Tokugawa era where Japanese borders were severely restricted and has become an often-used example of Tokugawa artisanship. This in turn has fed into what Kovacic calls the *monozukuri* discourse, where emphasis is on the "organic cultural lineage of Japan's manufacturing tradition as well as innovative excellence, social continuity, and homogeneity of products based on artisanship that is transmitted generationally." (Kovacic 275).

The third factor regarding positive media representations of robots in Japan also primarily focuses on the ways in which Japan is different from the West, where robots are evil, cold, and destructive. This argument may stem from the fact that several Japanese roboticists have highlighted the animated robot boy *Astro Boy* (*tetsuwan atomu*, iron-arm atom) as the main source of inspiration to their career in robotics (Kovacic 584; Šabanović 352–53; Richardson 120; Robertson, *Robo Sapiens Japanicus* 2). It is fair to say that Japanese media, especially manga and anime, have many heroic depictions of robots, both autonomous and with humans controlling them—*Cyborg 009* (1968), *Doraemon* (1970), *Mobile Suit Gundam* (1979), *Ghost in the Shell* (1989), and *Neon Genesis Evangelion* (1995), to name a few (Sone, *Japanese Robot Culture* 45–46).

However, in the contrasting paradigm, in which the Japanese affinity for robots is contested, these factors are criticized. In her article on the first Japanese humanoid robot, *Gakutensoku* (learning from universal rules) from 1928, Frumer rejects the Shinto argument, stating that there is no need to design humanoid machines to inspire familiarity if all objects like robots are imbued with *kami*. Furthermore, it is possible to find many instances of Japanese people being terrified of machines in pre-war Japan, showing that the notion of a Japanese love of robot is not necessarily an "essential attribute of the amorphic entity referred to as 'Japanese culture'." (Frumer 158). In a highly critical interrogation of the Shinto argument Gygi argues the idea of Shinto in these works stem from how spiritual intellectuals in Japan reconceived Shinto in the late 20th century, promoting a version where animism was central (Gygi 95). Šabanović argues that the *karakuri* dolls of the Edo period were rediscovered in the 1960s and has since been used in a form of robotic mythmaking in which robots are naturalized as Japanese (Šabanović 344). In surveying literature on the global history of humanoid robots, it becomes clear that the idea of the automated humanoid is present in many other cultures' imaginaries, from ancient China and Greece to the European automata, all created before the modern robot as a concept was introduced in 1921 in Karel Čapek's play *R.U.R. (Rossum's Universal Robots)* (Truitt 3–4; Weng et al. 830; Frumer 161; Richardson 111; Wright 335). This further destabilizes the idea that a history of robots in a nation's imaginary leads to an inherent love and acceptance of robots. To add to these arguments, there has been no quantitative study showing a significant difference in attitudes towards robots when comparing Japanese people to people in the West—see for instance Sakura's overview (1564).

Another point to be made is the fact that Japan as a nation is culturally diverse, and that there are significant cultural differences from region to region. Assuming that the entire country is a cultural monolith and have the same attitude towards

robots is incorrect. While I will use phrases like "the Japanese semiosphere" and "Japan as a nation" in the following text, it is with the understanding that the nation of Japan that I discuss is an imagined bounded space, an understanding of a nation-state and national culture that is essential to policymaking and the establishment of a national identity. While the concept of the semiosphere in general seeks to encompass heterogeneity in a culture, the sociotechnical imaginaries I present seem to draw upon the stereotype of a culturally and ethnically homogenous Japan, however incorrect this may be. The messages in the material I analyze—policy documents and messages in a national museum—include a view of Japan as a homogenous cultural and spatial entity.

The narrative of the Japanese cultural affinity towards robots is widely circulated and resilient, perhaps owing to its long and complex history going back to the Meiji period (1868). When Japanese borders were forced open by the West, a rapid modernization and industrialization, based in Western ideals, began, founded in a technological infrastructure already created in the Tokugawa period. When World War II ended, the Japanese rebuilding helped cement the narrative—technological development was institutionally tethered to the national identity of Japan (Morris-Suzuki 161). As Morris-Suzuki notes, many scholars of Japan studies have argued that the economic success and growth of post-war Japan was based in the country's industrialization and adoption of rapid technological change, often resulting in either fear or wonder (Morris-Suzuki 1–2, 245 note 1). The 1980s saw a rise of so-called techno-orientalism in the West, which has now arguably crossed over into "wacky orientalism", where Japan is seen as a crazy country filled with robots (Wagenaar). Japanese technological development, industrialization, modernization, economic miracle, and subsequent economic issues are widely discussed themes in Japan studies (see, for example, Morris-Suzuki; Watanabe; Iida).

This contribution to the field of Japanese robotics is situated in the second paradigm in disagreeing with the notion that the Japanese people possess a unique cultural affinity towards robots. I argue that this narrative is employed by the Museum in presenting and legitimizing a specific version of the future to the visitors. The robots in the exhibitions work as a boundary object, representing this specific future—a sociotechnical imaginary—to the Japanese people in an act of autocommunication, harnessing the narrative to solve the societal crises the country is facing.

Semiotics at the Miraikan

The Miraikan is a science museum located in Odaiba, Tokyo. A popular museum, especially for families with children, the Miraikan introduces science and technology through interactive exhibits and dome theatre displays. The museum itself opened in June 2001 as a science and technology communication intiative which was part of the 1996 "Basic Plan for Science and Technology" (*kagaku gijutsu kihon keikaku*), founded in the "Basic Law for Science and Technology" (*kagaku gijutsu kihon hō*) (Nihon Kagaku Miraikan, "Enkaku"; Naikaku-fu). This "Basic Law"

was aimed at promoting technological and scientific innovation in Japan after the decline in research and development investments in Japanese companies that came as a result of the economic recession of the 1990's (Naikaku-fu). Japan needed to become a "science and technology-creating nation" (*kagaku gijutsu sōzō rikkoku*), and in 1998 part of the new Tokyo Academic Park was dedicated to the dissemination of information related to science and technology through the exhibition of the latest developments in these areas—and one of these was the Miraikan (Nihon Kagaku Miraikan, "Enkaku"). The purpose of the Miraikan can be divided into three categories: 1) the communication of technoscience to the public, 2) the education of science communicators to assist in this communication, and 3) to establish connections between academia, media, the public, government, and industry (Nihon Kagaku Miraikan, "Miraikan ni tsuite").

The Miraikan consists of three different zones or permanent exhibitions: "Explore the frontiers" (*sekai o saguru*), "Create your future" (*mirai o tsukuru*), and "Discover your Earth" (*chikyū to tsunagaru*). Centered on robotics, information technology, and innovation, the "Create your future"-zone is located on the second floor, and is the focus of this analysis. The museum guests are invited to imagine the future at the Miraikan, and on the Miraikan's conditions, surrounded by persuasive suggestions to how the Japanese future may look and how this can be achieved through technological means. The zone previously featured the exhibitions "Robots in your life" (*robotto to kurashi*) and "Android" (*andoroido*), where the former presents a version of how (Japanese) life with (Japanese) robots could look, and the latter proposes utilizing hyper-realistic androids to discuss what it means to be human (*ningen-tte nanda*) (Nihon Kagaku Miraikan, "Andoroido"; Nihon Kagaku Miraikan, "Robotto to kurashi"). These exhibitions have since closed, and new robotic exhibitions have replaced them: "Hello! Robots" (*harō! Robotto*), "Nanairo Quest – The Stories of the Future of Living with Robots" (*nanairo kuesuto – robotto to ikiru mirai no monogatari*), as well as "Park of Aging" (*oipāku*) (Nihon Kagaku Miraikan, "Nanairo Quest"; Nihon Kagaku Miraikan, "Oipāku"; Nihon Kagaku Miraikan, "Harō! Robotto").

Robotic Performances

The aforementioned exhibitions have different foci and present different aspects of the Japanese robot. "Robots in your life" featured a timeline of Japanese robotics, as well as three of the most famous robots: *ASIMO*, Honda's social bi-pedal robot from 2005 which has been featured heavily in promotional material for the museum; *PARO*, the seal-shaped assistive social robot created for the elder care sector to inspire positive emotional reactions; and *UNI-CUB*, a "personal mobility" robot on which you can sit and move with your weight (Nihon Kagaku Miraikan, "Robotto to kurashi"). "Android" was curated by renowned roboticist Ishiguro Hiroshi, and featured his extremely realistic-looking humanoid robots, inviting guests to "reflect upon the human existence" (*ningen to iu sonzai o kangaeru*) upon their meeting with the android adult/child combination *Otonaroid* and *Kodomoroid*, the science-

fiction like *Alter*, and *Telenoid*, the only vaguely human-like communication-robot (Nihon Kagaku Miraikan, "Andoroido"). In "Hello! Robots", visitors can interact with different types of social robots designed for companionship like *LOVOT*, *aibo, PARO*, and *Keparan* and look at the different technical parts of robotics to illustrate how these machines work (Nihon Kagaku Miraikan, "Harō! Robotto"). In "Nanairo Quest", visitors walk around with a tablet in a "city of the future" town-setting in order to experience one of three different stories about living with robots: "Friend Robot Tour" (*tomodachi robotto tsuā*), "Craftmanship Robot Tour" (*monozukuri robotto tsuā*), and "Body Robot Tour" (*karada robotto tsuā*) (Nihon Kagaku Miraikan, "Nanairo Quest"). These guides show visitors (especially children) the answers to the questions "What if a robot becomes your friend?", "What if a robot could take over your work?", "What if part of your body is augmented by a robot and gives you new abilities?" (Nihon Kagaku Miraikan, "Nanairo Quest"). Finally, in "Park of Aging", aging as a phenomenon is explored, and visitors can experience two humanoid robots, showing how technology can assist us when our bodies get older (Nihon Kagaku Miraikan, "Oipāku").

Walking through the exhibition, I especially notice the three robot-types *LOVOT*, *aibo*, and *Keparan*, as they perform various feats of automation. *LOVOT* (transcribed as *rabotto* in Japanese) is a small, cute robot designed to inspire feelings in humans—on their webpage, Groove X, the company behind *LOVOT*, writes that *LOVOT* was created to make you happy (Groove X, Inc.). The robot is shaped like two spheres placed on top of each other, covered by a soft material, with wheels to move and one small, penguin-like flipper on each side. The robot's face is in another type of material, demarcating it from the fuzzy exterior, with two big, expressive eyes and a button nose with no mouth. On its head, a "sensor horn" is placed. It is possible to dress up the robot: in the exhibition, one black robot was wearing a striped shirt and a yellow beanie; the other light brown robot a pair of denim overalls and red glasses. The two *LOVOT*s were placed on one half of a plateau, with the other half reserved for two *aibo* dogs from Sony. The *aibo* dogs were also very popular with child visitors, even though they lack the fuzziness of the *LOVOT* robots, highlighting the importance of the cuteness factor in inspiring interaction from children. The *aibo* dogs wag their robot tails or shake their heads, performing cuteness and inviting more people to treat them as dogs. The same cuteness factor is present in the design of the teddybear-like *Keparan*, slightly bigger than *LOVOT*, and completely covered in a light blue fur. *Keparan* has the Japanese katakana character *ke* stamped on its torso, enormous eyes (including eyebrows), and a tiny mouth and nose. This robot is designed as a partner robot for people to experience what it is like to have a robotic companion, and is also interactive like *aibo* and *LOVOT*. You are not allowed to touch *Keparan*, but several signs asking the robot to wink or wave are placed in front of the plateau where it sits, and when holding up the sign, the robot will perform in the ways intended. The intention behind *Keparan* is to bring about a conversation about how robots make you feel, prompting the visitors to think about their reactions in relation to such technology.

The exhibitions featuring robots are highly dependent on the performance of the robots themselves (Brødsgaard 38). The seal-robot *PARO* performed cuteness in "Robots in your life" and now in "Hello! Robots", where visitors can touch the robot through holes in a glass dome and pet it, making it interact and look at them. In these exhibitions, robots are presented as cute friends, and as the exhibit is placed directly in front of the entrance to "Nanairo Quest", visitors embark on their interactive journey through one of the storylines after first being presented with very positive interactions with robots—they are provided with a taste of the future through the robotic performances. The performance then continues when the visitors enter the imagined future of the Robot Tours in "Nanairo Quest".

These performances of cuteness can be understood through Dunstan and Hoffman's application of Ngai's framework of cute aesthetics to robotics, where the cuteness results in commodification, domestication and pacification of the cute object (Dunstan and Hoffman 28). The cute robot is not perceived as dangerous, encourages interaction, and may both be beneficial to a potential acceptance of robotic companions—but may also elicit problematic responses, as cuteness tends to create a power hierarchy (Dunstan and Hoffman 29–32). In this case, it seems that the robotic cuteness is designed to provoke interaction and empathy, especially from children. This cuteness is effective, as especially *Keparan* and *aibo* were surrounded by pre-teen children under parental supervision, all clamoring to interact with *Keparan* through signs or pet the hard, plastic exterior of the *aibo* dogs. The cute robot becomes associated with positive feelings through interaction. Even when the robots fail to perform, or perform in unintended ways, their relatability increases—in their errors, their audiences sympathize with them and encourage them to try again, as one study shows (Treusch).

The previous "Android"-exhibition also relied heavily on the robot performances, as it was in the performance of the robots and in their mimicry of humanity that the guests engaged and reflected upon their own human experience (Brødsgaard 52). According to Ishiguro himself, humans are only able to truly 'see' themselves through the interaction with an Other, and the android can pose as this other, as the robot acts as a mirror, reflecting the human existence (Hatsusegawa). This way of approaching the robot—as a key to human self-understanding—is referred to by Ishihara as the "synthetic approach", which has been employed by Japanese roboticists from the very beginning of robot research in Japan (Ishihara 47). This description by the robots functioned as a Rosetta stone, facilitating the understanding of the exhibition to the guests (Brødsgaard 52). By encouraging the visitors to reflect upon humanity through the robots, the visitors also perform, engaging with the robots and the futuristic narratives presented.

Semiosis in the Science Museum

The robotic performances and the feelings they invoke in their audience are important to the meaning-making processes at the Miraikan. The cute robot companion conveys different meanings than the realistic humanoid does, which can greatly

influence the ways in which visitors engage with the exhibitions and understand the science communication at the Miraikan. Through semiotics—the study of signs and meaning-making—the role of robots at the Miraikan in communicating a specific vision of the future can be understood. This article uses Yuri Lotman's concept of the semiosphere to elucidate the processes at the Miraikan, focusing on the micro- and meso-level, while briefly touching upon a macro-level.

In Lotman's theory of cultural semiotics, the concept of the semiosphere is central as a holistic model of how cultures work. The semiosphere is inspired by Vernadsky's concept of the "biosphere": whereas the biosphere is both every living thing and the very condition for the continuation of life, the semiosphere is both the result of culture and necessary for the evolution of culture (Lotman 125; Tamm 8). Put simply, the concept of the semiosphere is a sort of community with "self-referential discourses and sign-systems that distinguish [it] from others" (Hartley et al. 63). These communities can be created around languages, but also other types of social networks, and are simultaneously part of a larger semiosphere (a nation, a global network) and comprised of smaller semiospheres themselves (Hartley et al. 68–69). The semiospheric model is asymmetrical, with a stable core of cultural norms and such, and an unstable periphery of dynamic activity with innovative and strange elements (Lotman 127). The boundary of the semiosphere is of analytical importance, as this periphery/boundary is where new elements are introduced to a culture or community, undergoing a translation process to make it compatible with the internal semiotics of the semiosphere. The boundary separates and unifies—it separates the semiosphere from the other semiosphere all around, while facilitating communication (Lotman 136–37, 142). Communication in Lotman's theory is dialogical, but can also happen within the semiosphere, in what Lotman called autocommunication, where a system communicates about itself to itself (Hartley et al. 79). The first is a spatial transfer of messages and the latter is a temporal transfer (Semenenko 39; Lotman 21).

The smallest unit of analysis in the semiosphere is the text, which Lotman argues all culture is made of. These texts can also be non-literary phenomena: in this case, I view the robots and their robotic performances as texts inscribed with information in the semiosphere of the Miraikan science museum. Not only are they coded to work in certain ways, itself an actual text; they also meet the three criteria for what a Lotmanian text is—to transmit existing information, to create new information, and to preserve previous information (Hartley et al. 125). Robots are a product of their creator, representing thoughts on sociality, humanity, knowledge on advanced technology, and a multitude of other inputs, determined by their creator's life and positioning in the world. The current robots at the Miraikan transmit existing information on what a cute robot companion should be; they create new information in their presentation of the future; and they preserve previous information, drawing on discourses on Japanese *kawaii* (cute) culture and the supposed Japanese love of robots. This is a slight change from the humanoid robots, who were not inscribed so much with cuteness, but instead attempts at realistically depicting an ethnically Japanese human, which

then instead communicated what a Japanese person should look like. Going back to the text metaphor, one can also view the difference in these two types of robots as difference in extra-textual relations, for example genre conventions, and materiality, as they differ in shape and technologies. Their creation of new information—the Japanese future—remains the same, however, as do their preservation of the Japanese affinity for robots.

The robots in the science museum are not a core element of the Miraikan semiosphere, but instead a boundary object facilitating a dialogue between the semiosphere of the museum and the many semiospheres of the outside world. The concept of the "boundary object", ofted accredited to Star and Griesemer, is here used in a similar way to Ostrowdun and Kim: it underscores the importance of boundaries, peripheries, and translation in Lotmanian semiotics, and at the Miraikan they straddle not only the "interface between social worlds [. . .] but also temporal worlds", in this case, the past, present, and the future (Star and Griesemer; Ostrowdun and Kim 278). The core of the Miraikan focuses on science and technology communication, technoscientific literacy, education and promotion, and research of Japanese science and technology. This is evident in the many activities of the museum published in reports, the events coordinated, and the science communicators' work in presenting and curating different types of technology.[2] The robot here serves to facilitate a message, and the museum itself and the ways in which the exhibitions are curated are important in the negotiation between the institution and the visitor in what the robots represent. In this case, the role of boundary object between the science museum and the outside is significant in negotiating how the future of Japan looks, while simultaneously preserving the idea of technological nation of Japan. In this semiosphere, every robot, exhibition, information box, art installation, and educational movie is a many-coded text, circulated in the semiosphere, some on the periphery, some closer to the core.

However, the robot as a boundary object works, as it draws upon pre-established narratives in the larger Japanese semiosphere. The notion of the Japanese love of robot is a powerful narrative, and draws upon nostalgia of a distinguished past (through the *karakuri* wooden dolls for instance) while simultaneously projecting a sustainable future where the Japanese economic and demographic crises have been solved. Simultaneously, other narratives are entwined in this. One example is Japanese exceptionalism, which has spawned an entire literary genre of *nihonjnron*[3] (theory of Japanese-ness, also sometimes translated as "discourses on Japanese uniqueness")—nationalizing human-robot interaction and crafting it as an inherently Japanese trait to accept robots on par with humans both draws on and supports Japanese exceptionalism. The previously mentioned *monozukuri* discourse is one example of Japanese exceptionalism. Replacing re-

[2] The reports are only available in Japanese, while the other activities can be found on the English version of Miraikan's webpage (Nihon Kagaku Miraikan, "Tenji katsudō hōkoku").

[3] *Nihonjinron* has been analyzed and discussed in a variety of works. Classics include Befu's *Hegemony of Homogeneity* and Yoshino's *Cultural Nationalism in Contemporary Japan* (Befu; Yoshino).

alistic androids with cute companion robots connects the robots to a Japanese *kawaii* aesthetic, making them approachable and more mundane, as this aesthetic is prevalent in everyday Japanese society (Botz-Bornstein 4).[4] The future presented by the cute robots seems closer and more familiar than the ones associated with human replicas.

When semiospheres meet, a communicative act happens. The communicative act can be facilitated and guided through different means, but it is not always possible to control the outcome. The museum visitors are not passive recipients of a message—they are very much part of the negotiation of meaning (Brødsgaard 53). They do not necessarily view the robot as a part of the Japanese national identity, and previously, some visitors reported that they primarily see robots as *benri* (convenient) tools, preferring less realistic robots such as *ASIMO* instead of the android *Otonaroid*, as they are cuter and less humanlike (Tani). A hyper-realistic robot can be inconvenient as a tool, as people may feel bad about making the robot do manual labor—especially if it was designed to look exactly like a child (Tani). This can explain why Ishiguro's androids were replaced with *Keparan* and other similar cute robots. The change in robots may also indicate a shift in not only robotic trends in Japan, but also in the perceived role of the robots. Is the future filled with artificial humans—or is it filled with service robots or social robots to fulfill other functions? An often-used phrase in relation to Japanese robotics is "coexistence with robots" (*ningen to robotto no kyōsei*), and it seems the concrete meaning of "coexistence" is changing in a new meaning-making process. The Museum still features robots, however, ensuring that the technology is still an integral part of the Japanese future—the narrative of the Japanese love of robots continues to be harnessed, even though the robots themselves have undergone transitions.

That these robotic exhibitions were and are part of the "Create your future"-zone is also significant: the future that is created will, according to this narrative, feature the robots presented in the exhibitions. The future presented is nationalized through the use of Japanese robotics, as the museum is a Japanese national museum presenting Japanese robots (previously Japanese-looking androids) to the Japanese public. What is equally significant is how the newer exhibitions differ from previous ones: in "Nanairo Quest", robots are presented as part of day-to-day life in Japan to young children after they have interacted with the cute robots *Keparan, LOVOT*, and *aibo*. The "Android" exhibition was intended to show us how far robotics have come and to encourage reflection on the meaning of humanity in life, but in the new exhibitions, robots are presented as an inevitable part of our future. Furthermore, the museum no longer exhibits Ishiguro's hyper-realistic robots, who have been replaced with social robots, of which several have only one

[4] For more on *kawaii* aesthetics and Cute Studies in relation to Japan, see, for example, Ngai's previously mentioned work referenced by Dunstan and Hoffman, Botz-Bornstein work on *kawaii* and coolness, Kinsella's oft-referenced "Cuties in Japan", and Yano's book on the globalization and commodification of *kawaii* culture (Ngai; Botz-Bornstein; Kinsella; Yano). Some conflate Cute Studies with studies of *kawaii* (cute) culture and aesthetics, i.e. Ngai, while others object to this (see Dale's discussion of the differing etymologies of the two words in Dale 39).

function—to be cute and lovable.

Bubbles and Foam

Science museums as semiospheres can be characterized as discursive spaces where meaning is created through semiosis. Acknowledging that a science museum is not a "neutral transmitter of techno-scientific knowledge", but a symbolic space that "should be examined in relation to and within the broader socio-cultural environment", is crucial to understanding any science museum (Anyfandi et al. 231). In the placing of science and technology in a new, different context, a cognitive, social, and discursive series of socioepistemic transformations starts, changing said technoscience into information appropriate for this context's dominant ideology, praxes, and social order (Anyfandi et al. 231). Science museums cannot be objective, as they are shaped by ideological, political, institutional, and cultural factors—and science itself is also not objective, but steeped in culture (Evans et al. 21). In this sense, viewing the Miraikan museum as part of a bigger, national semiosphere can be fruitful for understanding the meaning-making processes.

One way of illustrating the integration of and interaction between semiospheres is through Sloterdijk's sphere framework, as Hartley et al. show (186). Analytically, the semiosphere works on several levels—the micro-level (text), meso-level (organization), and macro-level (global system), which Hartley et al. connect to Sloterdijk's sphere-terminology of "bubble" (self), "foam" (communities), and "globe" (world) (Hartley et al. 186). Hartley et al. modify the framework: "bubble" refers to "institutional (organized) semiospheres as [. . .] subsystems of the overall semiosphere" (186), "globe" to the global semiospheric system, and "foam" in-between to a structure of subsystems in dialogue with one another as a result of the centripetal forces of homogeneity and centrifugal forces of heterogeneity in the larger semiosphere (211). The multiplicity that the "foam" refers to, in which semiospheric bubbles are constantly connected in a larger semiospheric globe, paints a picture of the interconnectedness of semiospheres on different scales (Hartley et al. 211).

As an institution, Miraikan is one bubble in a "foam" of technoscientific initiatives in Japan.[5] These technoscientific initiatives are related to core values of a larger, national semiosphere, as they often are funded by governmental agencies, originating in policy by what is arguably the most powerful and unifying institution in Japanese society. At the same time, however, the Miraikan can be viewed as situated on the border of this foam, as the museum is a science communication initiative, a place where dialogues take place not just between semiospheres in Japan, but also with other, more foreign culture-systems. Other "bubbles" in the "foam" include university research labs, various robot and tech trade associations, science, technology and innovation policymakers, and actors connected to the recent governmental innovation initiative, the Moonshot program.

[5] The Miraikan can also be viewed as a bubble in a broader, global perspective, but as this article focuses on Japan, I will limit the scope.

Imaginaries in the Semiosphere

The robots at the Miraikan are both a part of a mission to communicate techno-science to the public of Japan to cement Japan's status as a "science and technology-creating nation", but they are also a boundary object between the semiosphere of the Miraikan and other, surrounding semiospheres, communicating a national narrative of a future with advanced technology and robots to the Japanese people. As Achiam shows, the contemporary science museum in a world of post-normal science serves as a space for the public to make sense of "wicked" problems, meaning highly complex issues without correct answers that require extensive qualifications (Achiam 38). The problems Japan is currently facing are indeed wicked—the demographic and economic problems do not have one simple solution, and are instead dependent on not just each other but also a vast number of other factors. According to Robertson, the demographic crisis and the societal issues stemming from it are not necessarily being viewed by the Japanese state as "political, social, economic, or historical problems—or a combination thereof—but as *biotechnological problems* requiring *biotechnological solutions*" ("Robo Sapiens Japanicus" 372, italics in original).

The acceptance of this narrative is especially important, as the acceptance of the robot would mean solving a myriad of societal issues facing Japan: "such projects linking culture, art, and new technologies are expected to give the public 'a deeper understanding and awareness of science and technology' and to improve their adoption and acceptance in society" (Šabanović 350–51). Economic and societal problems gave rise to the 2016 government plan called "Society 5.0", a joint effort response between government, academia, and industry, where innovations of the fourth industrial revolution such as IoT (internet of things), AI, big data, and robotics are presented as solutions to these issues (Holroyd 18). As such, the social acceptance of both current robots and futuristic visions of robots are crucial to the implementation of "Society 5.0" and the economic and demographic improvements promised in the plan.

The economic recession, which started in the 1990s, was further intensified and prolonged by the structural issues in the nation, of which the aging population is one example, with data from 2022 showing that 29 percent of the Japanese population is above 65 years of age (OECD; Yoshino and Taghizadeh-Hesary 2–3). Japan's population peaked in 2010 and is now declining, with one staggering estimate from 2017 predicting one third of the Japanese population will have disappeared by 2065 (Otake). According to another prognosis, the Japanese labor force will be reduced by 38.5 million people between 2005 and 2055, resulting in a productive-age population of only 51.1 percent, meaning Japan would have to import 770,000 foreign workers a year to sustain the labor force on account of the low birth rate, which seems rather unlikely given Japan's restrictive immigration policy (Shinkawa 1124). The total fertility rate of Japan has been below the replacement level of 2.1 births per woman since 1975, reaching an all-time low in 2005 at 1.26, and data from 2021 puts it at 1.3 (World Bank). In 2017, one third of public spending in Japan was invested in eldercare (Yoshino and Taghizadeh-Hesary 4).

While industrial robots have been implemented in Japan, social robots working in close contact with humans remain a futuristic ideal, not yet attainable with the current technological know-how of neither the Japanese nor the global robot community. When developed, these robots would act as a labor force-buffer and could also assist Japanese women in finding the optimal work-life balance, increasing both the labor participation rate and the fertility rate in the country while simultaneously boosting the economy. The robots are seen as a realistic solution to Japan's problems in a construction of an imagined future, like in the exhibitions at the Miraikan.

These wicked problems are destabilizing to the core of the national Japanese semiosphere, where national identity stems from. Modern (especially postwar) Japanese national identity has been closely connected to advanced technology, modernization, and economic prowess, and especially the connection to the latter has been under stress for several decades now. Furthermore, the demographic crisis means the nation quite literally is disappearing slowly from an ethnonationalist point of view. Governmental policies are necessary to rectify this trend, while reifying the national identity through technology (and other means). These are what Jasanoff and Kim refer to as "sociotechnical imaginaries" that help create a collective imaginary future where these problems have been fixed (in this case, through technological means) and simultaneously legitimizing the Japanese state.

Sociotechnical Imaginaries

Sociotechnical imaginaries as a concept stems from Science and Technology Studies (STS). They are defined by Jasanoff and Kim as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology." (Jasanoff 4). Sociotechnical imaginaries as a concept crystallize how science, technology, and nationhood co-produce one another—Kim notes how the 'right' visions of the relations between science, technology, the state, and society are embedded in and "closely intertwined with broader conceptions of national identity, history and the future" (Kim 152). Sociotechnical imaginaries are closely associated with performance—the visions of the future are performed in different ways in relation to statehood and the collective good (Jasanoff 10–11). While the concept is closely related to the master narrative, it is theorized as more dynamic and open to new elements (Jasanoff 20). Furthermore, a key tenet of the concept is the social aspect, as these imaginaries are collective and culturally particular (Jasanoff 19).

Viewing Japanese science, technology, and innovation policy initiatives as essential to the sociotechnical imaginaries in Japan is becoming more widespread (De Togni). I add to this growing corner of Japan Studies by combining sociotechnical imaginaries with semiotics, and viewing the former as an act of autocommunication in a larger semiosphere. These imaginaries are, in my view, part of a process to strengthen the center of the Japanese national semiosphere. The Miraikan is

an extension of these imaginaries, and work as a place where the imaginaries and their meanings are negotiated with the public in an act of autocommunication in the big Japanese semiosphere. I argue that the Miraikan as a national institution harness the narrative of this Japanese love of robots to legitimize and further a specific sociotechnical imaginary of a future where Japanese demographic and economic issues have been solved through technological means such as robots.

The aspects of sociotechnical imaginaries are present at different levels. At the Miraikan, the performance of the future is especially present, and the exhibitions are curated to show how the robots will contribute to the collective good of Japan in particular. The national sociotechnical imaginary is presented, performed, and circulated through the museum exhibitions, the robotic tours in "Nanairo Quest", and in the robotic performances themselves. Furthermore, the interactivity and bodily immersion in the museum facilitates a space where visitors can imagine the future through aesthetic means (Achiam 39). This experience is referred to by Achiam as a "concentrated reality"—instead of a simple message of what the future will be, the visitors "transcend time and place by imagining things "possibly being so"" (Achiam 39). The Miraikan is, in this sense, a miniature edition of the sociotechnical imaginaries in Japan. Furthermore, the museum itself is, as mentioned previously, a science communication initiative based in the Japanese concept of *shakai gijutsu* (social technology), defined as science and technology *for* society, aiming to solve societal problems (Kihara 59).

On a larger scale, the visions of the future, presented by the Japanese government through different technoscientific initiatives and policies (of which the Miraikan is just one), align with the aforementioned definition. Science, technology, and innovation, and the utopian future they are capable of producing, are viewed as desirable and attainable, and as the recent Moonshot R&D Program shows, the sociotechnical imaginaries promoted by the Japanese government are being added to and becoming more complex. At the Japanese Cabinet Office's website for the Moonshot R&D Program, nine different goals are presented, all of which seek to mitigate the challenges in Japanese society. The goals are: "Overcoming limitations of body, brain, space and time", "Ultra-early disease prediction and intervention", "Coevolution of AI and robots", "Cool Earth & Clean Earth", "Sustainable food supply and consumption", "Fault-tolerant universal quantum computer", "To Age 100 without Health Concerns", "Controlling and modifying the weather", and "Increasing peace of mind and vitality" (Cabinet Office, "Moonshot Research and Development Program"). As detailed on the English webpage, this innovation plan seeks to "create disruptive innovations from Japan", inspired by the high-risk strategies from the EU, US, and China (Cabinet Office, "About Moonshot Research and Development Program"). All of these goals, and the initiatives arising from them, are parts of the technoscientific 'foam', also including other government-funded initiatives, academic labs, and private companies, continuing the historically close collaboration between government, industry, and academia in Japanese technoscientific development (see, for example, Morris-Suzuki). It is, however, interesting to see how the government policies encourage destabilizing and innovative ele-

ments in their own projects—in a semiospheric sense, this creates a conundrum, as these innovative, strange, and destabilizing elements on the periphery are seen as a threat to the stability of the core.

This conundrum is important, as these innovative, disruptive technologies then can be viewed as something completely different. I suggest that drawing on these previously existing narratives in the creation of these sociotechnical imaginaries, in which the Japanese future is viewed as a utopian coexistence with robots in a sustainable, green nation, actually instead undermine the newness and innovativeness of the imaginary. While the technology may be new, the ideology is old—Japan is still being constructed as a space for primarily Japanese people, with Japanese technology and Japanese robots, autocommunicating this narrative to Japanese people, looking at societal challenges in a purely technical manner. The essence of Japanese robot strategy has not changed much since Innovation 25 in 2007, where the main focus was creating robots to alleviate the workload for women and raise the birth rate, while creating robots to take over undesirable jobs—the Moonshot Goal 3 report echoes many of the same sentiments (Working Group 3). The production of humanoid and/or social robots such as the ones presented in both these reports and at the Miraikan may not only serve economic interests, but also an ethnonationalist and traditionalist agenda. Many interests and ideologies converge in the creation of the social robot in Japan, as well as in how the "science and technology-creating nation" is constructed and presented to both the Japanese people and the global community.

Conclusion

The Japanese cultural affinity towards robots is a notion that enjoys great popularity both in Japan itself and in the West. This rather culturally essentialist narrative is a continuation of a discourse originating in the Meiji period, which itself has undergone some changes, tying advanced technology to the national identity of Japan after World War II. During the 1990's, the narrative was reinforced further by policies based in *shakai gijutsu*, and science and technology communication was highlighted as a way to foster innovation and stimulate the economy. During this time, the Miraikan was created to communicate science and technology to the public.

This article has contributed to the body of literature on Japanese robotics, specifically to the paradigm where the notion of a unique Japanese affinity for robots is contested, and instead is perceived as a social construct. In this article, I argue that the Miraikan as a national institution harnesses the narrative of this Japanese love of robots to legitimize and further a specific sociotechnical imaginary of a future where Japanese demographic and economic issues have been solved through technological means such as robots. Using Lotman's cultural semiotic framework and the concept of sociotechnical imaginaries from STS, I have analyzed the meaning-making processes and communicative praxes at the Miraikan, which in this article is presented as a semiospheric bubble in an ever-expanding

technoscientific foam made of policy initiatives, labs, and the robot industry, which again is part of a larger national semiosphere. The robots in the exhibitions have been analyzed as texts working as boundary objects to facilitate communication of the aforementioned sociotechnical narrative to the broader national semiosphere. The shape and intention of the robots have evolved over time—whereas the previous exhibitions aimed to showcase hyperrealistic androids to reflect upon human existence, the current robotic companions on display aim to present a future where the robot is integral to society. This communicative act is also, I argue, part of the autocommunication in this national semiosphere, currently facing destabilization of its core in the face of the demographic and economic crisis of Japan. The article has not focused on how the messages are received and negotiated by the public, instead examining the meaning-making processes of the Miraikan. At the Miraikan, the meaning of the robots is crystallized, and they are framed as an inevitable part of the Japanese future, further strengthening the narrative of Japan as a robot nation.

The sociotechnical imaginary communicated through the robots is based on a pre-existing, traditional ideology, framing future Japan as reminiscent of a glorious past of ethnic homogeneity and economic prowess, seeking to reproduce an idea of the nation of Japan through culturally essentialist narratives like the Japanese affinity for robots. Studying sociotechnical imaginaries in Japan can shed light on the ways in which Japanese society and technoscience is co-produced in the face of external and internal threats.

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